DOE-FIU SCIENCE & TECHNOLOGY WORKFORCE DEVELOPMENT PROGRAM

STUDENT SUMMER INTERNSHIP TECHNICAL REPORT

June 21, 2010 to August 27, 2010

Preparation of the 11th Annual Meeting Working Party on D&D

Principal Investigators:

Ramón A. Colón Mendoza (DOE Fellow)
Florida International University

Andrew Szilagyi, Office Director
Department of Energy Headquarters
Office of Deactivation and Decommissioning

Acknowledgements:
George Cava
Alton Harris
Doug Tonkay

Florida International University Collaborator and Program Director:

Leonel Lagos, Ph.D., PMP®

Prepared for:

U.S. Department of Energy
Office of Environmental Management
Under Grant No. DE-FG01-05EW07033

ABSTRACT

The Department of Energy's Office of Environmental Management has invested in scientific research and technology development. This funding peaked at $410 million back in 1995 but was only $20 million in 2010 before the ARRA stimulus package. To enhance the cleanup effort, the National Research Council of National Academies performed a study requested by the Office of Environmental Management and congress to identify the principal science and technology gaps and research and development needs. The study was performed in the Waste Processing Office, the Groundwater and Soil Remediation Office, and the Deactivation and Decommissioning Office. The findings from this study were:

- Deactivation and decommissioning work relies on manual labor for facility characterization, equipment removal and dismantlement.
- Personal protective equipment tends to be heavy and hot and limits movement of workers.
- Removing contamination from building walls, other surfaces, and equipment can be slow and ineffective.

Since funding keeps decreasing and the number of facilities transferred to the Department of Energy keeps increasing, collaborating with international organizations like the Co-operative Programme on Decommissioning and meetings like the Working Party on Decommissioning and Dismantlement in this research and development areas will be beneficial for all countries involved. Even though most deactivation and decommissioning projects are unique in nature and the transportation and waste acceptance criteria differ depending on country and policy, there are areas, like research and development (R&D) efforts, that could be developed with collaboration between countries.

TABLE OF CONTENTS

ABSTRACT iii

TABLE OF CONTENTS iv

LIST OF FIGURES v

LIST OF TABLES v

1. INTRODUCTION 1

- 1.1 Department of Energy's Office of Environmental Management 1
- 1.2 Office of Deactivation and Decommissioning and Facility Engineering 1
- 1.3 WPDD Background 1
  - 1.3.1 Organization for Economic Co-operation & Development 1
  - 1.3.2 Nuclear Energy Agency 2
  - 1.3.3 Co-operative Programme on Decommissioning 3
  - 1.3.4 Working Party on Decommissioning & Dismantling 3

2. EXECUTIVE SUMMARY 4

3. PROJECT DESCRIPTIONS 5

- 3.1 Logistics of the 11th WPDD Annual Meeting 5
- 3.2 WPDD's Research and Development Need Task 5
- 3.3 WPDD's Large Component Dismantlement Task 6

4. RESULTS 7

- 4.1 WPDD's Research and Development Needs Task 7
- 4.2 WPDD's Large Component Dismantlement Task 7
  - 4.2.1 Flowchart Introduction 8
  - 4.2.2 Low Level Waste 10
  - 4.2.3 Transuranic Waste 13
  - 4.2.4 High Level Waste 15

6. REFERENCES 17

APPENDIX A. WPDD Task Group on R&D and Innovation Needs for Decommissioning and Associated R&D Needs 18

APPENDIX B. Disposal Process Flowchart 23

LIST OF FIGURES

Figure 1: Department of Energy seal. 1
Figure 2: Organization for Economic Co-operation and Development emblem. 2
Figure 3: Nuclear Energy Agency emblem. 2
Figure 4: Flowchart legend. 8
Figure 5: Characterization of disposal process 9
Figure 6: Low level waste disposal flowchart, part 1. 10
Figure 7: Low level waste disposal flowchart, part 2. 11
Figure 8: Low level waste disposal flowchart, part 3. 12
Figure 9: Transuranic waste disposal flowchart, part 1. 14
Figure 10: Transuranic waste disposal flowchart, part 2. 15
Figure 11: High level waste disposal flowchart. 15
Figure 12: Disposal process flowchart. 23

LIST OF TABLES

Table 1: Description of Flowchart Diagrams 8

1. INTRODUCTION

1.1 Department of Energy's Office of Environmental Management

The Department of Energy's (DOE) mission is to advance the national, economic, and energy security of the United States; to promote scientific and technological innovation in support of that mission; and to ensure the environmental cleanup of the national nuclear weapons complex [2]. Within DOE, the Office of Environmental Management (EM) focuses on dealing with the environmental legacy of the Cold War. In 1989, EM was created to be responsible for environmental restoration, waste management, technology development, and facility transition and management [3]. A very essential element of this office is the Office of Deactivation and Decommissioning and Facility Engineering.

Figure 1: Department of Energy seal.

1.2 Office of Deactivation and Decommissioning and Facility Engineering

The purpose of the Office of Deactivation and Decommissioning and Facility Engineering is to reduce project technical risk and uncertainty through technology development and deployment, thus enabling the implementation of safe, cost-effective, efficient and timely deactivation and decommissioning (D&D) of facilities and their contents [4].

In addition to the office's continuous effort to fulfill its purpose, in November 2009, DOE re-joined the Co-operative Programme on Decommissioning (CPD). This collaboration allows DOE to exchange scientific and technical information concerning nuclear installation decommissioning projects with other countries [5]. The Working Party on Decommissioning and Dismantlement (WPDD) assemble annual meetings where countries like Belgium, France, Italy, Japan, Spain, Sweden, Switzerland, United Kingdom and United States meet to contribute information related to D&D projects. DOE's involvement is not recent; DOE was a founding member of the CPD when it was establish in 1985 and a leading participant until 2002. With DOE re-joining the CPD, the 11th WPDD meeting will take place in Washington, D.C., on November 2010. The Nuclear Regulatory Commission (NRC) and DOE will host the meeting.

1.3 WPDD Background

1.3.1 Organization for Economic Co-operation & Development

The Organization for Economic Co-operation & Development (OECD) is a forum where the different governments work together to address the economic, social and environmental challenges of globalization. The organization provides a setting where these governments can compare policy experiences, seek answers to common problems, identify good practice and work to co-ordinate domestic and international policies [5].

Figure 2: Organization for Economic Co-operation and Development emblem.

The 33 participating countries are:

- Australia
- Austria
- Belgium
- Canada
- Chile
- Czech Republic
- Denmark
- Finland
- France
- Germany
- Greece
- Hungary
- Iceland
- Ireland
- Israel
- Italy
- Japan
- Korea
- Luxembourg
- Mexico
- Netherlands
- New Zealand
- Norway
- Poland
- Portugal
- Slovak Republic
- Slovenia
- Spain
- Sweden
- Switzerland
- Turkey
- United Kingdom
- United States

1.3.2 Nuclear Energy Agency

Within the OECD, the Nuclear Energy Agency (NEA) assists the participating countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally friendly and economic use of nuclear energy for peaceful purposes [6]. The NEA also provides authoritative assessments and forges common understandings on key issues, as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.

Figure 3: Nuclear Energy Agency emblem.

NEA's areas of competence include:

- Safety and Regulation of Nuclear Activities
- Radioactive Waste Management
- Radiological Protection
- Nuclear Science
- Economic and Technical Analyses of the Nuclear Fuel Cycle
- Nuclear Law and Liability
- Public Information

The NEA was established on February 1, 1958, and since then the number of countries joining the NEA has increased [5]. Today, the 28 participating countries are:

- Australia
- Austria
- Belgium
- Canada
- Czech Republic
- Denmark
- Finland
- France
- Germany
- Greece
- Hungary
- Iceland
- Ireland
- Italy
- Japan
- Korea
- Luxembourg
- Mexico
- Netherlands
- Norway
- Portugal
- Slovak Republic
- Spain
- Sweden
- Switzerland
- Turkey
- United Kingdom
- United States

1.3.3 Co-operative Programme on Decommissioning

The Co-operative Programme on Decommissioning (CPD) was initiated in 1985 by the NEA to exchange scientific and technical information concerning nuclear installation decommissioning projects. This includes participating countries actively executing or planning the decommissioning of nuclear facilities. The CPD is linked to the Radioactive Waste Management Committee (RWMC), which in the year 2000, created the Working Party on Management of Materials from Decommissioning and Dismantling [5].

1.3.4 Working Party on Decommissioning & Dismantling

The Working Party on Management of Materials from Decommissioning and Dismantling was created after recognizing that the decommissioning portion of a project was intimately related to the waste management portion of a project [5]. With the Office of D&D as DOE's representative in the CPD and WPDD, the office was responsible for the logistics of the WPDD meeting, the R&D needs compilation portion of the WPDD paper, and the development of the breakdown procedure for the disposal of large components without been segmented within DOE regulations. The 17 participating countries are:

- Belgium
- Canada
- Czech Republic
- Finland
- France
- Germany
- Hungary
- Italy
- Japan
- Korea
- Netherlands
- Norway
- Slovak Republic
- Spain
- Sweden
- United Kingdom
- United States

2. EXECUTIVE SUMMARY

This internship has been supported by the DOE-FIU Science & Technology Workforce Initiative, an innovative program developed by the US Department of Energy's Environmental Management (DOE-EM) and Florida International University's Applied Research Center (FIU-ARC). During the summer of 2010, DOE-FIU Fellow (Ramón A. Colón Mendoza) spent 10 weeks doing a summer internship at the Office of Deactivation & Decommissioning and Facility Engineering (EM-44) at DOE Headquarters, located in Germantown, MD under the supervision and guidance of Mr. Andrew Szilagyi, the office director. This internship was organized by FIU-ARC and EM's Office of Human Capital (EM-41). The intern's project was initiated on June 21, 2010, and continued through August 27, 2010, with the objective of assisting the EM-44 office with the Working Party on Decommissioning and Dismantlement (WPDD) Meeting. The WPDD assemble annual meetings where countries like Belgium, France, Italy, Japan, Spain, Sweden, Switzerland, United Kingdom and United States meet to contribute information related to D&D projects. In November 2010, the 11th WPDD meeting will take place in Washington, D.C., and the Nuclear Regulatory Commission (NRC) and DOE will host the meeting. The DOE Fellow's contributions to the organization of the WPDD consisted of keeping track of important deadlines, revising the "WPDD task group on R&D and Innovation Needs for Decommissioning and Associated R&D Needs" document, developing a flowchart for waste disposal and performing research on large components waste and available large containers.

3. PROJECT DESCRIPTIONS

For the past ten years, the WPDD annual meeting has taken place in a European province. In 2009, during the 10th WPDD annual meeting, the CPD concluded that it will be best to bring the meeting to the western hemisphere for two reasons. First, it will emphasize that the WPDD meeting is an international meeting. Second, it will open doors for countries like Canada and Mexico to increase their participation.

DOE and the NRC were chosen to host the 11th WPDD meeting after choosing Washington, D.C., as the meeting location. Both agencies collaborated in the logistics of the meeting. DOE's tasks were to:

– Organize the logistics of the meeting
– The research and development needs task
– The large component dismantlement task

3.1 Logistics of the 11th WPDD Annual Meeting

The 11th WPDD Annual Meeting will take place on November 16-18, 2010, in Washington, D.C. The day before, November 15, 2010, is designated for the task group to meet and complete their report to submit to the WPDD meeting. The CPD members representing the participating countries will arrive at Washington, D.C., at their own expense, through the Ronald Regan National Airport. With average temperatures in the month of November ranging between 40^0F and 57^0F [7], DOE selected the L'Enfant Plaza Hotel in Washington, D.C., as the hosting location for the WPDD meeting due to its convenient location. The hotel has an underground metro station beneath the hotel plaza, which directly connects with the Ronald Regan National Airport through the Yellow line. After the meeting, the CDP members will fly to the Augusta Airport in Georgia to attend a tour of the facilities at the Savannah River Site in South Carolina, concluding the meeting.

3.2 WPDD's Research and Development Need Task

The WPDD committee established a task group for "Research and Development (R&D) Needs for Decommissioning" in 2010. The objective of this task group is to provide a forum where R&D issues could be discussed among interested specialists and the outcomes reported. It is important to mention that this task group is not responsible for the development of the technology; they are responsible for determining in which D&D areas efforts should be invested. For the 11th WPDD meeting, the task group's goal is to develop a report that defines where future development work should be focused. This focus includes the following: to undertake an analysis of R&D needs for decommissioning and to assign broad priorities to these; and to define relevant R&D projects that might be undertaken in a collaborative or jointly-funded basis. The task group subdivided the tasks of the group into five themes:

– Characterization and survey prior to dismantling (Theme No. 1)
– Technologies for segmentation and dismantling (Theme No. 2)
– Technologies for decontamination and remediation (Theme No. 3)
– Materials and waste management (Theme No. 4)

– Site characterization and environmental monitoring (Theme No. 5)

The participating countries' representative filled out a form informing their country's R&D needs for each of the five themes. DOE is in charge of compiling and interpreting the R&D needs of all the participating countries for theme 3 (technologies for decontamination and remediation).

3.3 WPDD's Large Component Dismantlement Task

The WPDD committee also established a task group for "Large Components". The objective of the task group is to identify alternatives and processes to dispose of large components without segmentation. The Large Components Task Group is currently developing a guidance report that will provide a basis for the different involved parties (regulators, decommissioning managers and waste management organizations) to reach agreement on the most relevant management options for the management of large components [8].

4. RESULTS

4.1 WPDD's Research and Development Needs Task

The task group requested the representative of the participating countries to take some time to state the country's current R&D and the challenges they encounter. George Cava, a general engineer at the Office of Deactivation and Decommissioning, gathered the R&D needs from all the participating countries and formulated nine basic challenges found in common among the countries. The nine issues were:

- Issue #1 - New physical processes and chemical processes
- Issue #2 - Surface treatment and removal of contamination; surface polishing
- Issue #3 - Heels and residues (e.g., from process fuels/fuel cycle reprocessing)
- Issue #4 - Concrete remediation
- Issue #5 - Optimizing the use of robotics
- Issue #6 - Bulk soil remediation (including bio remediation)
- Issue #7 - Fixing contamination in soil (to avoid contaminating groundwater), including the use of engineered barriers
- Issue #8 - Decontamination of large components (steam generators, pressure vessels and internals)
- Issue #9 - Methods for decontaminating high volumes of water or chemicals contaminated to low levels

A report, which can be found in Appendix A, was created to identify the current R&D that is being done by the participating countries, as well as suggested R&D, and the areas where countries can join efforts to develop R&D. This report will become a section of the R&D consolidated report that will be presented to the WPDD, with the remaining themes of the R&D task group.

The DOE Fellow's contribution to this task group was to validate the "WPDD Task Group on R&D and Innovation Needs for Decommissioning and Associated R&D Needs" document by making sure that the original input data was correctly interpreted into the document. In addition, the DOE Fellow revised the document to ensure that all data are in its corresponding section of the document.

4.2 WPDD's Large Component Dismantlement Task

The main difficulty in developing a common guidance report for different countries is that different countries have different regulations. The DOE Fellow's contribution to this task group had two phases. The first phase was to develop a basic and easy to follow method to explain to other countries the process of determining how to dispose of waste from a DOE D&D facility. The method used to explain the process is a flowchart created using the SmartDrawVP software. The second phase included defining a range of dimensions of a large component and determining the factors that would determine whether a large component has to be size-reduced within the DOE D&D facility. Due to the detail and time invested in waste disposal processes, the second phase of this task will be completed after the internship and reported directly to the Office of Deactivation and Decommissioning.

4.2.1 Flowchart Introduction

The flowchart follows an easy to follow pattern of shapes and arrows. In Figure 4, an illustration of the shapes used in the flowchart state their purpose and in Table 1, a brief description of the same can be found.

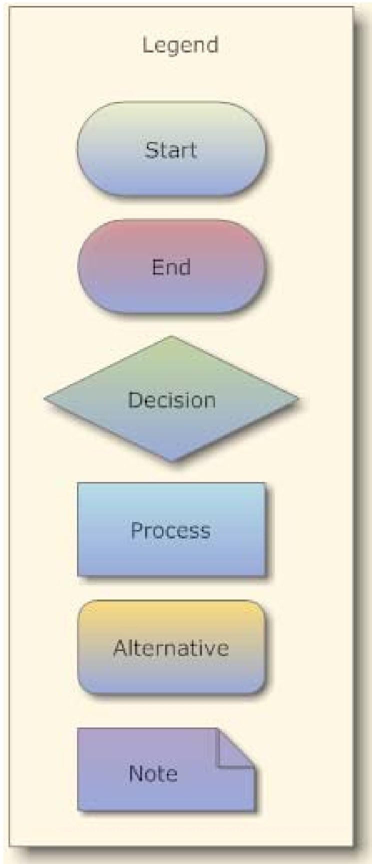


Figure 4: Flowchart legend.

Table 1: Description of Flowchart Diagrams

Shape	Color	Purpose
Circle	Gray	Starting Point
Circle	Red	Ending Point
Rhombus	Green	Decision Should be Made
Rectangle	Blue	A Process Need to be Performed
Rounded Rectangles	Orange	One of the Alternatives Available
Rectangle with Bended Corner	Purple	A Relevant Note

The beginning steps are identical for large or regular components (Figure 5). The starting point of this flowchart assumes that it has already been determined the component has been categorized as waste. The first step is to make sure that all components are handled safely, that ALARA is followed, that any security concerns are managed, and that the dismantlement cost or any other cost is constantly reviewed. After this, the process knowledge and acceptable knowledge should be reviewed; this will help in the following step which is characterization with non-destructive assay. At this point, the project manager is presented with the first three alternatives which will determine the path to follow. If the waste is characterize as:

- Low level waste (LLW) proceed to section 4.2.2 and follow Figure 6
- Transuranic waste (TRU) proceed to section 4.2.3 and follow Figure 9
- High level waste (HLW) proceed to section 4.2.4 and follow Figure 11

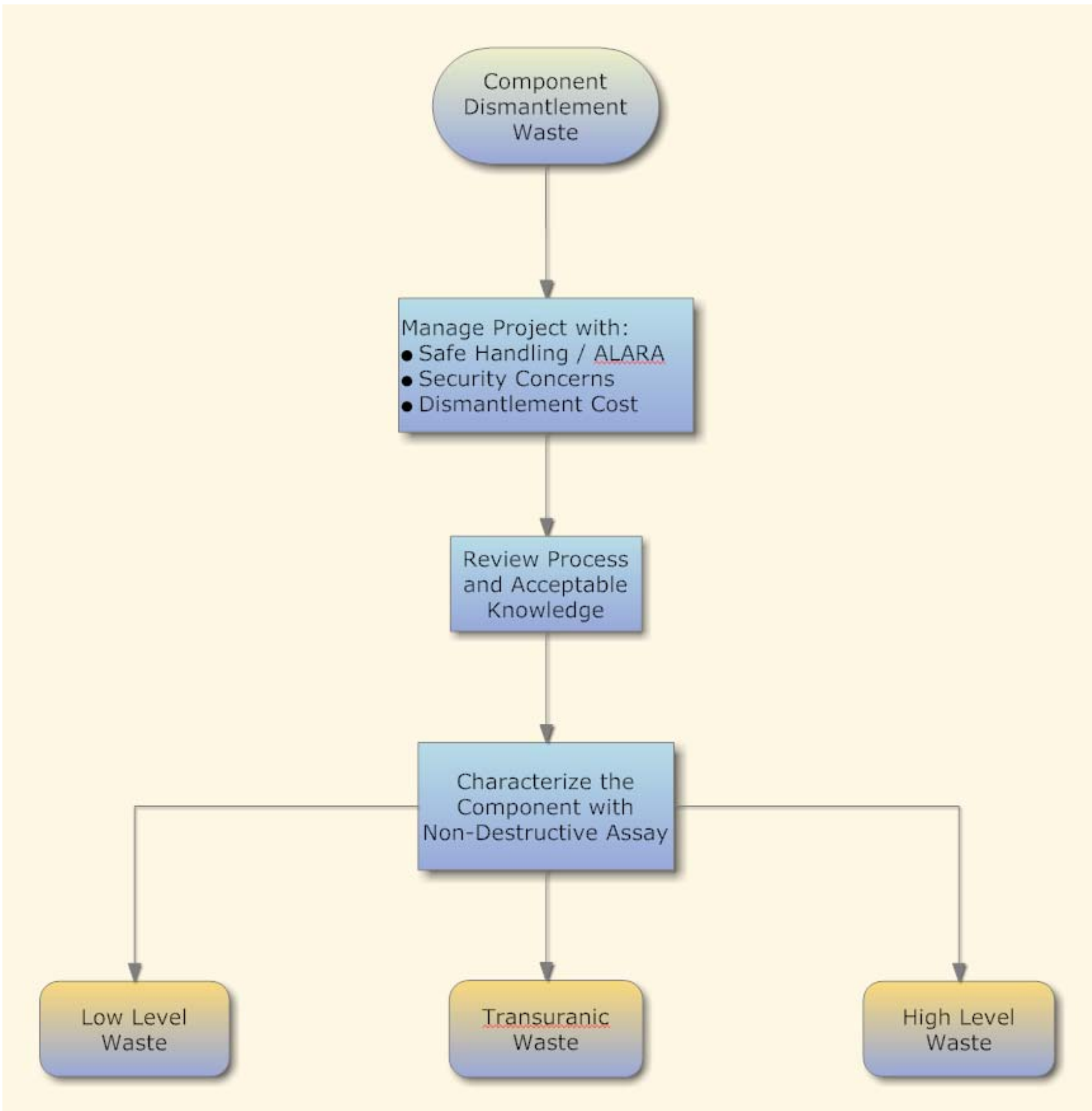


Figure 5: Characterization of disposal process

4.2.2 Low Level Waste

In low level waste, the first decision is to determine if the component is LLW Class A. For a component that came from a DOE facility, this step is a redundant test, since, as noted in Figure 6, DOE only works with Class A. Classes B and C are used by the commercial field. This is important to clarify because not all of the countries participating in the WPDD are government agencies. The next question is whether or not the waste was generated within a CERCLA project. If the waste is generated within a CERCLA project, a cost/benefit analysis (CBA) is performed to determine if it is best to use an onsite CERCLA cell for disposal or on offsite disposal facility. Note that the CBA will only be performed if the waste will arrive at the CERCLA cell outside of the 40 hour work shift paid by DOE. For example, if the waste needs to arrive on a Saturday, the project manager will have to cover the costs. Follow the flowchart in Figure 7 for waste disposal at an onsite CERCLA cell. If the waste was not generated within a CERCLA project, a CBA is performed to determine the best disposal site between a RCRA site or a commercial disposal site (Figure 8).

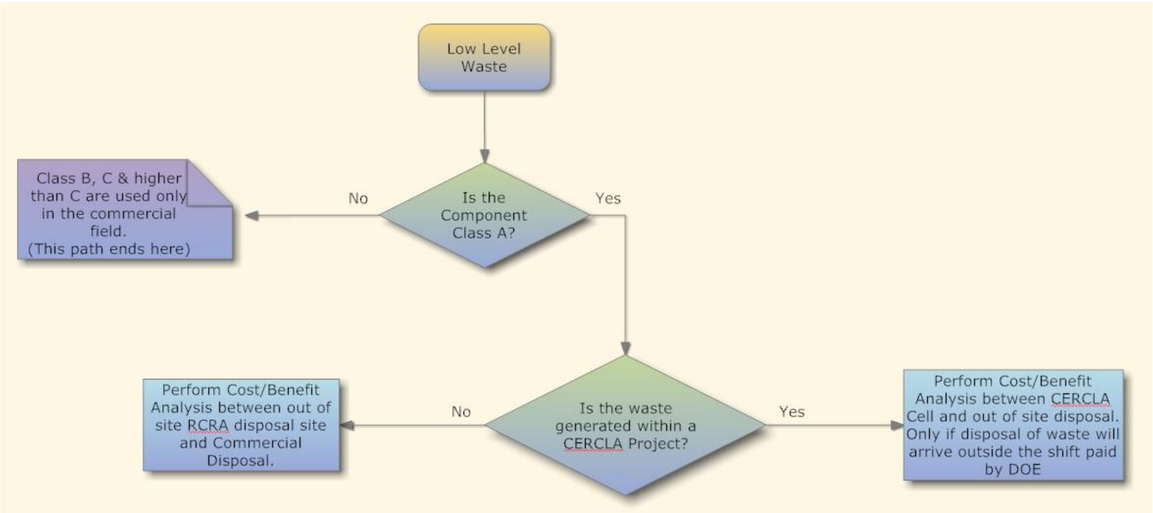


Figure 6: Low level waste disposal flowchart, part 1.

Looking at Figure 7, if there isn't an onsite CERCLA cell, follow Figure 8 after performing a CBA to determine the best disposal site between a RCRA site and a commercial disposal site. If there is an onsite CERCLA cell, determine if the waste meets the waste acceptance criteria (WAC). If it does, continue to the next step which is determining if the waste and package can meet the site's transportation requirements; if so, ship to the designated site for disposal. If the waste doesn't meet the WAC, decontaminate to reduce radiation levels and re-examine if the waste meets the WAC. If in the re-examination the WAC is met, proceed to determining if the waste and package meet the site's transportation requirements. If on the re-examination the WAC is not met, perform a CBA between size reducing the component or offsite disposal. If size reduction is the best option, size reduce and re-examine to determine if it meets the WAC. If the best choice is to dispose of the component offsite, then perform a CBA to determine the best disposal site between a RCRA site and a commercial disposal site (Figure 8). If the site's transportation requirements are not met, size reduce to decrease payload and repeat the flowchart loop.

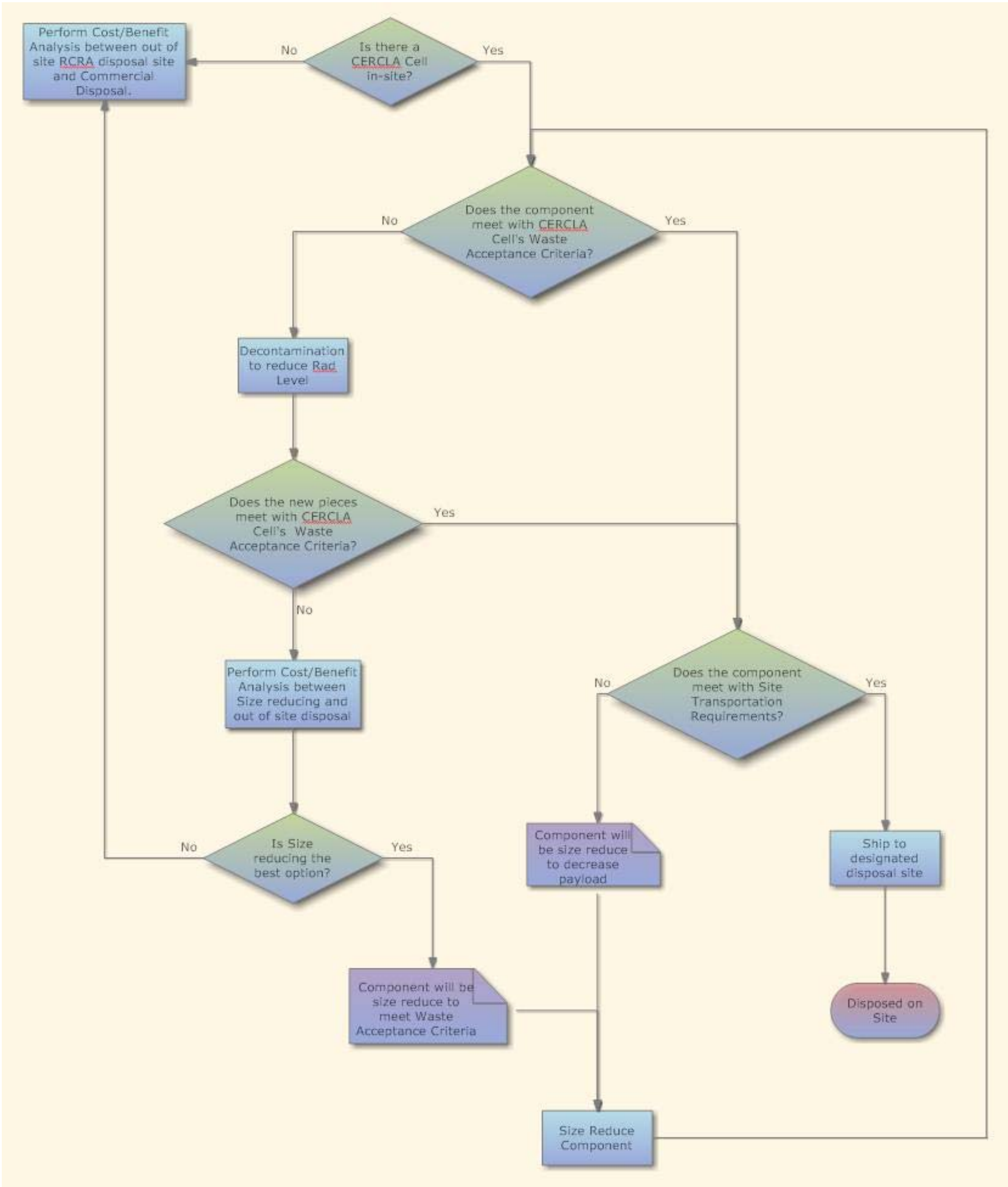


Figure 7: Low level waste disposal flowchart, part 2.

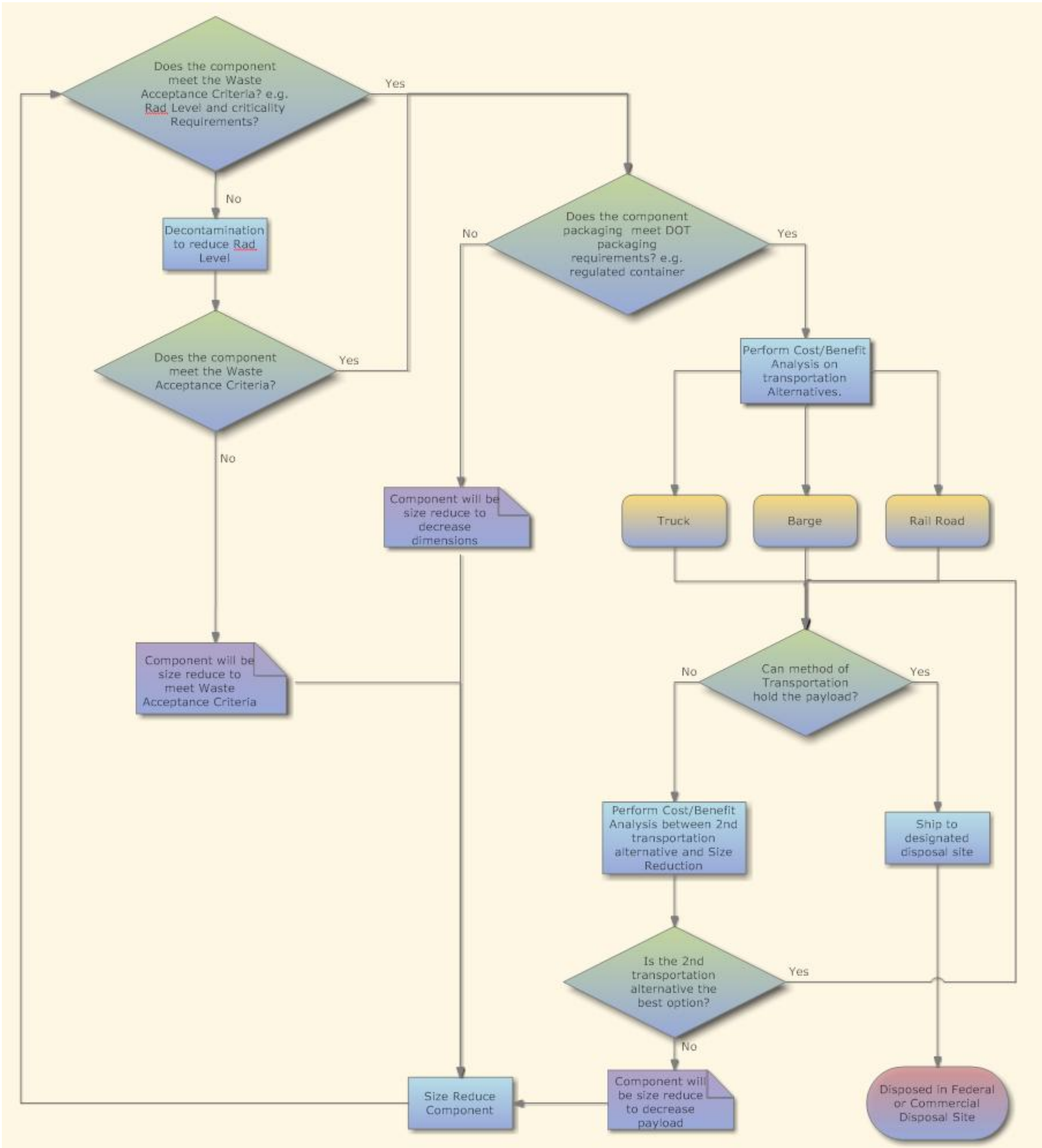


Figure 8: Low level waste disposal flowchart, part 3.

Looking at Figure 8, after performing the CBA between the RCRA and commercial disposal site, determine if the waste meets the WAC for the best disposal site choice. If it meets the WAC, determine if the waste fits in a DOT regulated package. If it does, perform a CBA on the transportation alternatives between truck, barge, or rail. The number of alternatives will depend on the disposal site chosen. Once a type of transportation is chosen, determine if the method selected can hold the payload. If it does, ship the waste to the designated disposal site for disposal. If the WAC is not met, decontaminate and re-examine. If the WAC is met after the decontamination, proceed to determine if it fits in a DOT regulated package. If it doesn't meet the WAC, then size reduce and re-examine against the WAC. If it doesn't fit in a regulated DOT package, size reduce to separate volumes. If the type of transportation chosen doesn't hold the payload, perform a CBA between the second alternative and size reducing. If the second transportation alternative is the best option, ship to the designated site for disposal. If not, size reduce and re-examine.

4.2.3 Transuranic Waste

Looking at Figure 9, the first step for TRU waste is to confirm that the waste matches the transuranic waste definition. To be considered TRU waste, it needs to have an atomic number greater than 92, be an alpha emitter with half-lives greater than 20 years and TRU radionuclide concentrations greater than 100 nCi/g of waste. Next, examine the waste to see if the waste meets the WAC. If so, make sure the waste came from defense waste. If it does, determine if it is classified and if it is, perform a CBA to determine the best option between sanitation and disposal of the waste as a classified waste. Then, proceed to measuring the dose of the package. If it is not classified, go directly to measuring the dose of the package. After measuring the dose, proceed to the flowchart in Figure 10. If the WAC is not met, treat the waste to meet the WAC. If the WAC cannot be attained, there is no disposal site and the waste will have to be managed by the operating site. In such cases, perform a CBA to determine which is the best D&D action and execute it. The same process should be followed if the waste meets the WAC but is not defense waste.

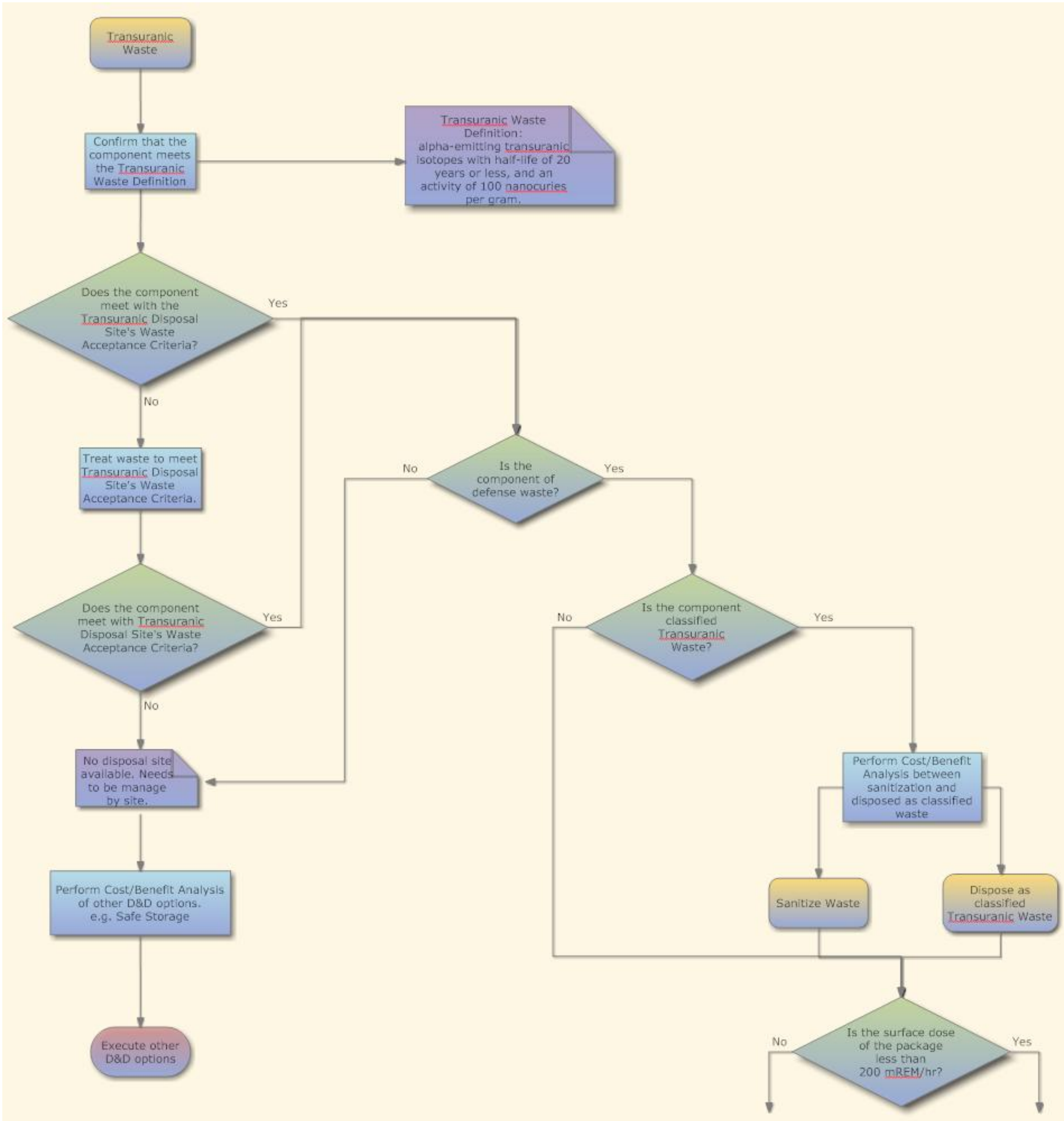


Figure 9: Transuranic waste disposal flowchart, part 1.

Looking at Figure 10, once the dose of the package is measured, if it is less than 200 mREM/hr, the waste is considered *contact handled waste*; if it is higher, it is consider *remote handled waste*. With contact handled waste, determine if it fits in a TRUPACT III, which is the largest package for contact handled TRU waste. If it does, determine if a truck can hold the payload and if so, ship to the disposal site for disposal. With remote handled waste, determine if it fits in a 55 gallon container. If it does, determine if a truck can hold the payload and if so, ship to disposal site for disposal. If the waste does not fit in their respective assigned package or a truck cannot hold the payload, it needs to be size reduced. Once size reduced, repeat the process flow as shown in Figure 10.

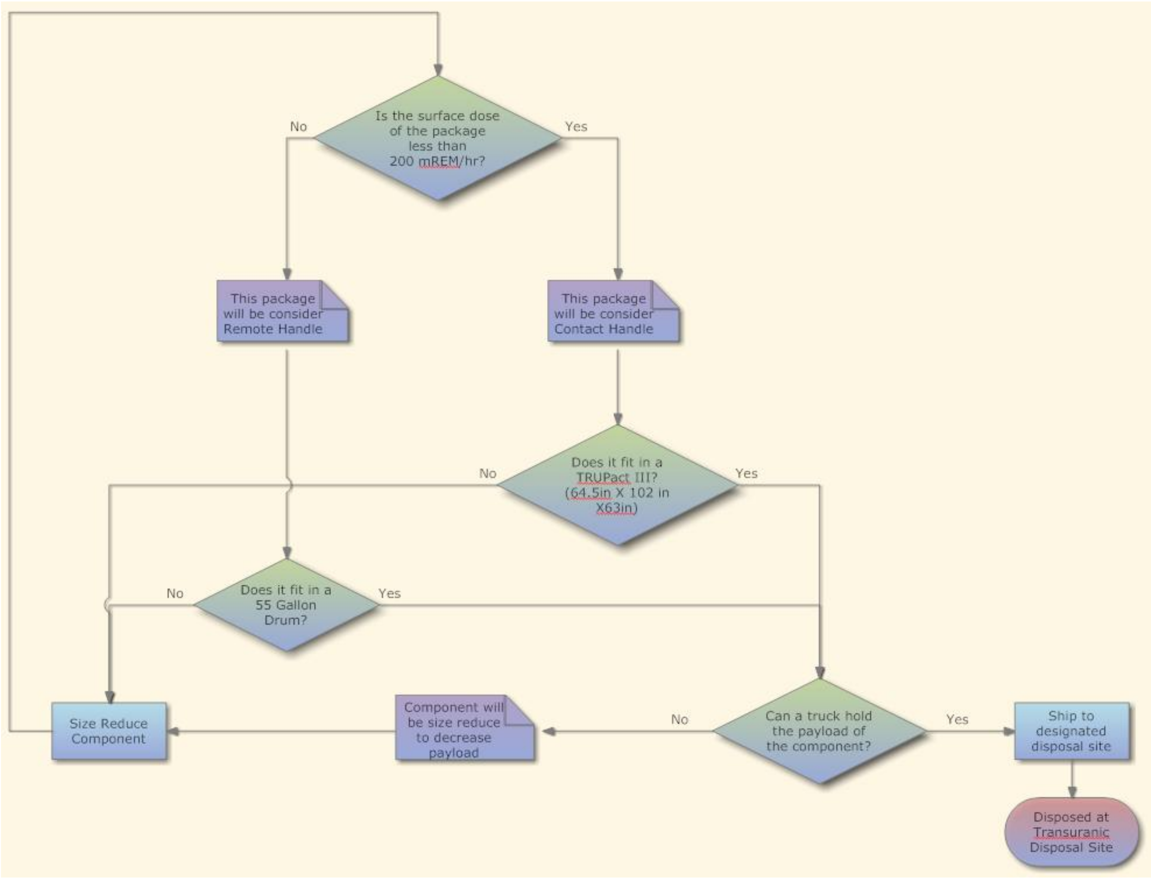


Figure 10: Transuranic waste disposal flowchart, part 2.

4.2.4 High Level Waste

In the United States, congress has to approve the opening of a high level waste disposal site. Since such approval has not been made, there is no disposal site available and the site has to manage their HLW. The project manager will have to perform a CBA to determine the best D&D action and execute it (Figure 11).

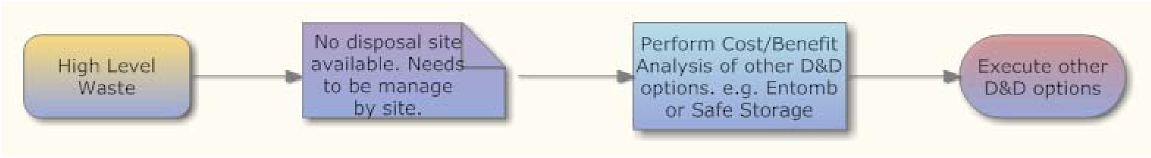


Figure 11: High level waste disposal flowchart.

5. CONCLUSION

The role of the Office of Deactivation and Decommissioning and Facility Engineering at DOE Headquarters is to reduce project technical risk and uncertainty through technology development and deployment, thus enabling the implementation of safe, cost-effective, efficient and timely D&D of facilities and their contents. Their vision and mission is reinforced by collaboration of other participating countries in the WPDD annual meeting. The expectations of the 11th WPDD meeting are to have several parties benefit from the valuable and useful information exchange that will reduce project technical risk and uncertainty in D&D projects and save time simultaneously due to the mutual collaboration.

6. REFERENCES

[1] The National Academies Press. Advice on the Department of Energy's Cleanup Technology Roadmap Gaps and Bridges. Washington, DC: National Academies, 2009. Print.

[2] "Department of Energy - About DOE." Department of Energy - Homepage. Department of Energy. Web. 16 Sept. 2010. <http://www.energy.gov/about/index.htm>.

[3] "DOE Environmental Management (EM) History." History - EM. Department of Energy, 30 July 2010. Web. 16 Sept. 2010. <http://www.em.doe.gov/Pages/History.aspx>.

[4] “DOE Enviromental Management (EM) – D&D Excess Facility Life Cycle Overview” Retrived in July 3rd, 2009 from <http://www.em.doe.gov/DandD/TierFlowChart.aspx>.

[5] The NEA Co-operative Programme on Decommissioning - A Decade of Progress. Nuclear Energy Agency, Organisation for Economic Co-operation & Development, 2006. NEA No. 6185. 30 June 2010. Web. <http://www.nea.fr/rwm/reports/2006/nea6185-decommissioning.pdf>.

[6] "About Us - NEA." OECD Nuclear Energy Agency. Organisation for Economic Co-operation and Development, 14 Jan. 2010. Web. 16 Sept. 2010. <http://www.nea.fr/nea/>.

[7] "Average Weather for Washington, DC - Temperature and Precipitation." National and Local Weather Forecast, Hurricane, Radar and Report. Weather Channel. Web. 16 Sept. 2010. <http://www.weather.com/weather/wxclimatology/monthly/graph/USDC0001?from=dayDetails_bottomnav_undeclared>.

[8] "Working Party on Decommissioning and Dismantling (WPDD)." OECD Nuclear Energy Agency. Organization for Economic Co-operation and Development, 31 May 2010. Web. 16 Sept. 2010. <http://www.nea.fr/rwm/wpdd.html>.

APPENDIX A. WPDD Task Group on R&D and Innovation Needs for Decommissioning and Associated R&D Needs

WPDD Task Group on R&D and Innovation Needs for Decommissioning and Associated R&D Needs

1. Theme Summary

Theme Number 3 focused on the issues surrounding the decontamination of components, remediation of soils and limiting the spread of contamination in groundwater. Nine issues were formulated to assess the rudimentary challenges encountered during the facility decommissioning process. The issues addressed by this working group were:

- Issue #1 New Physical Processes and Chemical Processes
- Issue #2 Surface treatment and removal of contamination; surface polishing
- Issue #3 Heels and residues (e.g. from process fuels/fuel cycle reprocessing)
- Issue #4 Concrete remediation
- Issue #5 Optimizing the use of robotics
- Issue #6 Bulk soil remediation (including bio remediation)
- Issue #7 Fixing contamination in soil (to avoid contaminating groundwater), including the use of engineered barriers
- Issue #8 Decontamination of large components (steam generators; pressure vessels and internals)
- Issue #9 Methods for decontaminating high volumes of water or chemical contaminated to low levels

2. Challenges

A summary of the decontamination and soil/groundwater contamination challenges encountered by the respondents are:

Issue #1: New Physical Processes and Chemical Processes

- Decontamination of concrete
- Removing transuranic surface contamination
- High cost to develop new technologies
- Graphite Processing

Issue #2: Surface treatment and removal of contamination; surface polishing

- Develop a laser process for surface decontamination
- Tritium decontamination of heavy water systems
- High Cost to decontaminate large volumes of waste

Issue #3: Heels and residues (e.g. from process fuels/fuel cycle reprocessing)

- Chemical treatment of heels produce large quantities of liquid waste
- High dose rates are encountered
- Requires aggressive processes which can damage components.

- Reprocessing of Spent Fuel and Vitrification HLW
- Liquids left in fuel cycle vessels.
- Fixing or removing hold/up deposits in piping and equipment.

Issue #4: Concrete remediation

- Reuse of concrete in non-nuclear applications
- High cost to remotely decontaminate large quantities of concrete wastes
- Controlling dust and debris during concrete removal
- Maintaining the structure of deeply irradiated concrete
- Technology require large area of space to operate

Issue #5: Optimizing the use of robotics

- High cost of deploying robotics could be offset by developing multi-tool and flexible robots
- Robotics are used depending on the situation in High Rad Areas

Issue #6: Bulk soil remediation (including bio remediation)

- Treating large volumes of soils
- Storage of large volumes of contaminated soils
- Reusing contaminated soils

Issue #7: Fixing contamination in soil (to avoid contaminating groundwater), including the use of engineered barriers

- High Cost of controlling the spread of soil contamination to groundwater
- Immobilization can be a temporary solution

Issue #8: Decontamination of large components (steam generators; pressure vessels and internals)

- Decontaminate components before dismantlement

Issue #9: Methods for decontaminating high volumes of water or chemical contaminated to low levels

- The associated cost of treatment and the volumes of secondary waste produced
- Post-operative clean outs effluents and groundwater
- The limitation to organic liquids

3. Current R&D

Presently, the R&D activities that are now on-going to meet these challenges are:

Issue #1: New Physical Processes and Chemical Processes

- Use gels and foams to treat secondary waste (France)
- R&D activities to treat passivated sodium waste (U.S.)
- Ice pigging of pipes (U.K)

Issue #2: Surface treatment and removal of contamination; surface polishing

- Use of gels (Japan and U.S)
- Washing, wiping and pressure washing techniques for metal surfaces (Spain)
- Cleaning laser process (France)

Issue #3: Heels and residues (e.g. from process fuels/fuel cycle reprocessing)

- No R&D Activities in progress

Issue #4: Concrete remediation

- Wiping & scabbing (Spain)
- Diamond wire cutting (Spain)
- Nitrogen Blasting (U.K)
- Using Gels (U.S)
- Laser Cutting (UK)

Issue #5: Optimizing the use of robotics

- No R&D Activities in progress

Issue #6: Bulk soil remediation (including bio remediation)

- Soil Washing and Thermal/Chemical/Biological treatment of soils (U.S)

Issue #7: Fixing contamination in soil (to avoid contaminating groundwater), including the use of engineered barriers

- Use of Groundwater monitoring wells (U.S.)
- Thermal fixation, passive/reactive barriers, grout walls and engineered wetlands (U.S)
- Adaptation with foam reducing liquid waste (France)

Issue #8: Decontamination of large components (steam generators; pressure vessels and internals)

- Full System Decontamination Method (Spain)

Issue #9: Methods for decontaminating high volumes of water or chemical contaminated to low levels

- Stabilization, containment, physical& chemical treatments, pump & treat (U.S.)

4. Suggested R&D

Issue #1: New Physical Processes and Chemical Processes

- Abrasive blasting to decontaminate machine, concrete and metal surfaces (Belgium)
- Use lasers to decontaminate concrete (Italy)
- NDA funded Graphite Behavior project (U.K)

Issue #2: Surface treatment and removal of contamination; surface polishing

- Drying process using vacuuming or supplying dry air (Japan)

Issue #3: Heels and residues (e.g. from process fuels/fuel cycle reprocessing)

- NDA funded projects include Removal of Heels & Residuals and Novel Applications of Magnox Dissolution Technology Projects (U.K)

Issue #4: Concrete remediation

- No recommended R&D activities to be investigated
- NDA funded Electromechanical blanket for decontaminating concrete project (U.K)

Issue #5: Optimizing the use of robotics

- NDA funded Robotic Decommissioning Techniques and 3-D integrated gamma –ray and vision system projects (U.K)
- Develop flexible robots with the possibility to mount different tools (Spain)

Issue #6: Bulk soil remediation (including bio remediation)

- Biogeochemical Application in Nuclear Decommissioning and Waste Disposal study (U.K)

Issue #7: Fixing contamination in soil (to avoid contaminating groundwater), including the use of engineered barriers

- NDA funded Immobilization of radionuclide viva in situ incorporation into stable mineral phase study (U.K)

Issue #8: Decontamination of large components (steam generators; pressure vessels and internals)

- No recommended R&D activities to be investigated

Issue #9: Methods for decontaminating high volumes of water or chemical contaminated to low levels

- NDA funded Modular/Mobile Effluent and Retrieval Studies study (U.K)

5. Suggested Areas of Collaboration

Although the respondents' Research and Development (R&D) requirements and priority of consequences to the nine issues vary significantly, there was a general and common agreement regarding the problematic challenge of disposing contaminated concrete generated waste during facility decommissioning. Therefore, the group may benefit by sharing R&D solutions to address similar issues such as concrete disposal or robotic technology.

Specifically, Issue #1 and Issue #4 address the application of new physical and chemical processes to remediate concrete. The concrete decontamination strategies that are identified as being effective include:

- Laser Cleaning
- Scabbling
- Nitrogen Blasting
- Gel Coating
- Crushing & Disposal using volumetric criteria

Additionally, utilizing robotic technology is identified as a preferred method to perform work in high radiation or contaminated areas. Particularly, Issue #5 categories the limiting factors which prevent optimizing the use of robotics are attributed to:

- The high cost associated with both robotic technology
- The development of specialized tools limits their use

APPENDIX B. Disposal Process Flowchart

Note: This page will be a large print out folded to fit the 8” x 11” report size.

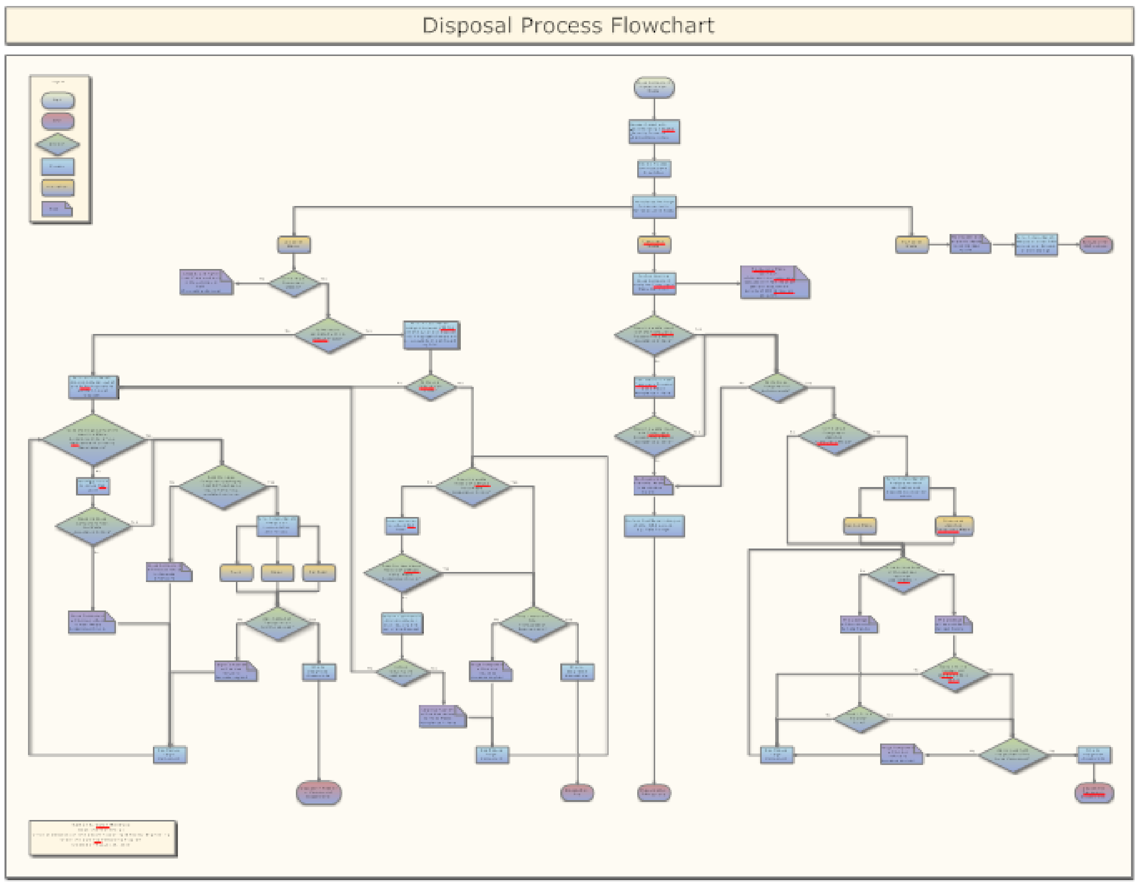
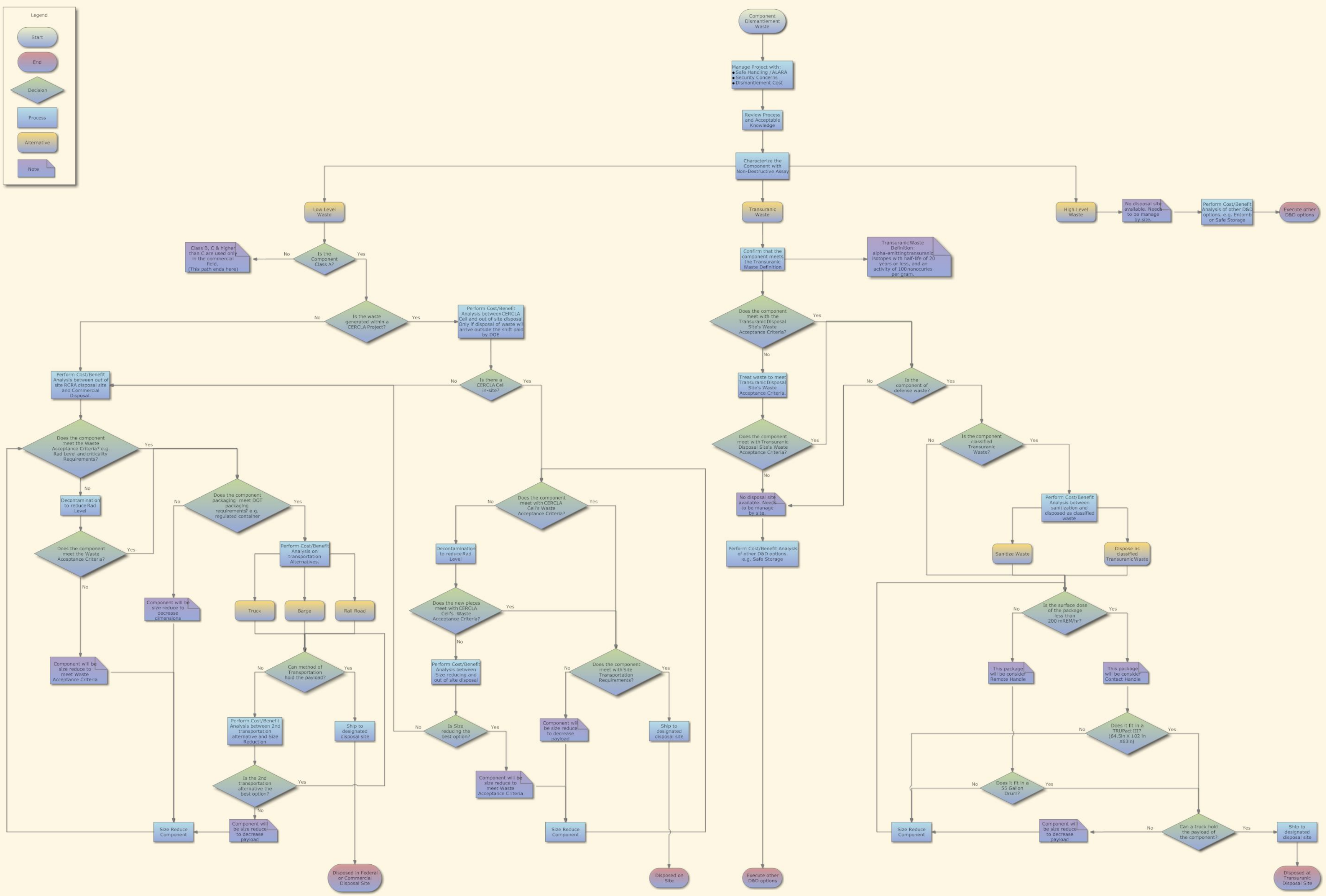


Figure 12: Disposal process flowchart.

Disposal Process Flowchart



Ramón A. Colón Mendoza
Department of Energy
Office of Deactivation and Decommissioning & Facility Engineering
Under the DOE-FIU Fellowship Program
Created on August 26, 2010