218135

STATE OF SOUTH CAROLINA

(Caption of Case)
Application Adjustment in the Levels of Allowable Costs and for Identification of Allowable Costs (2nd Filing and After)

BEFORE THE
PUBLIC SERVICE COMMISSION
OF SOUTH CAROLINA

COVER SHEET

DOCKET NUMBER: 2000 - 366 - A

RECEIVED 2009 JUL 27 PM 1:11 PUBLIC SERVICE COMMISSION

(Please type or print)


Submitted by: Deborah Ogilvie
Address: EnergySolutions
140 Stoneridge Drive Ste 500
Columbia, SC 29210

SC Bar Number:
Telephone: 803-758-1825
Fax: 803-256-0968
Other:
Email: dgogilvie@energysolutions.com


NOTE: The cover sheet and information contained herein neither replaces nor supplements the filing and service of pleadings or other papers as required by law. This form is required for use by the Public Service Commission of South Carolina for the purpose of docketing and must be filled out completely.

## DOCKETING INFORMATION (Check all that apply)

☐ Emergency Relief demanded in petition ☐ Request for item to be placed on Commission's Agenda expeditiously

☒ Other: Chem-Nuclear Systems Fiscal Year 2009/2010 Least Cost Operating Plan (10 copies)

| INDUSTRY (Check one) | NATURE OF ACTION (Check all that apply) | | |
|---|---|---|---|
| ☐ Electric | ☐ Affidavit | ☐ Letter | ☐ Request |
| ☐ Electric/Gas | ☐ Agreement | ☐ Memorandum | ☐ Request for Certificatio |
| ☐ Electric/Telecommunications | ☐ Answer | ☐ Motion | ☐ Request for Investigatior |
| ☐ Electric/Water | ☐ Appellate Review | ☐ Objection | ☐ Resale Agreement |
| ☐ Electric/Water/Telecom. | ☐ Application | ☐ Petition | ☐ Resale Amendment |
| ☐ Electric/Water/Sewer | ☐ Brief | ☐ Petition for Reconsideration | ☐ Reservation Letter |
| ☐ Gas | ☐ Certificate | ☐ Petition for Rulemaking | ☐ Response |
| ☐ Railroad | ☐ Comments | ☐ Petition for Rule to Show Cause | ☐ Response to Discovery |
| ☐ Sewer | ☐ Complaint | ☐ Petition to Intervene | ☐ Return to Petition |
| ☐ Telecommunications | ☐ Consent Order | ☐ Petition to Intervene Out of Time | ☐ Stipulation |
| ☐ Transportation | ☐ Discovery | ☐ Prefiled Testimony | ☐ Subpoena |
| ☐ Water | ☐ Exhibit | ☐ Promotion | ☐ Tariff |
| ☐ Water/Sewer | ☐ Expedited Consideration | ☐ Proposed Order | ☐ Other: |
| ☒ Administrative Matter | ☐ Interconnection Agreement | ☐ Protest | |
| ☐ Other: | ☐ Interconnection Amendment | ☐ Publisher's Affidavit | |
| | ☐ Late-Filed Exhibit | ☒ Report | |

ENERGYSOLUTIONS

BEDL-09-034

# FY 2009/2010
# LEAST COST OPERATING PLAN
# BARNWELL DISPOSAL FACILITY

CHEM-NUCLEAR SYSTEMS, LLC
740 OSBORN ROAD
BARNWELL, SOUTH CAROLINA 29812

# TABLE OF CONTENTS

PAGE NO.


1.0 INTRODUCTION ....4
1.1 PURPOSE ....4
1.2 SCOPE ....4
1.3 APPENDICES ....5
2.0 LEAST COST OPERATING PLAN ....6
2.1 OPERATING APPROACH ....6
2.2 LEAST COST FINANCIAL EVALUATION ....13
2.3 SUMMARY AND CONCLUSIONS ....18
2.4 SUSPENDED OPERATIONS ....19
APPENDIX A HISTORICAL BACKGROUND ....20
1.1 REGULATORY DOCUMENTS ....20
1.2 REGULATORY/POLITICAL HISTORY ....24
1.3 LICENSED DISPOSAL AREA ....28
1.4 TRENCH CONSTRUCTION ....28
1.5 WASTE FORM/PACKAGING REQUIREMENTS HISTORY ....32
APPENDIX B REGULATORY REQUIREMENTS ....38
1.1 DISPOSAL FACILITY RADIOACTIVE MATERIAL LICENSE NUMBER 097 ....38
1.2 REGULATORY REQUIREMENTS ....40
APPENDIX C FACILITY DESCRIPTION ....43
1.1 LICENSED DISPOSAL AREA ....43
1.2 DISPOSAL TRENCHES ....43
1.3 SITE SUPPORT FACILITIES ....46
1.4 ENVIRONMENTAL MONITORING FACILITIES ....50
1.5 SITE EQUIPMENT ....51
APPENDIX D DISPOSAL FACILITY OPERATIONS ....53
1.1 DISPOSAL TRENCH DESIGN AND CONSTRUCTION ....53
1.2 WASTE DISPOSAL OPERATIONS ....58
1.3 SITE MAINTENANCE ....66
1.4 RADIATION PROTECTION PROGRAM ....67
1.5 ENVIRONMENTAL MONITORING ....69
1.6 QUALITY ASSURANCE PROGRAM ....76
1.7 TRAINING AND EMERGENCY RESPONSE PROGRAM ....79
1.8 ENVIRONMENTAL HEALTH AND SAFETY ....82
1.9 PHYSICAL SECURITY ....83
1.10 COMMUNITY EDUCATION AND COMMUNICATION ....84
1.11 ORGANIZATION STRUCTURE ....85
1.12 COLLABORATIVE REVIEW ....91

# 1.0 INTRODUCTION

Chem-Nuclear Systems, LLC (CNS) operates a low-level radioactive waste (LLRW) disposal facility located approximately five miles west of the city of Barnwell, in Barnwell County, South Carolina. The disposal site comprises approximately 235 acres of property owned by the State and leased by CNS from the South Carolina Budget and Control Board (SC B&CB).

LLRW arrives at the disposal site by truck or heavy-haul transporter. Waste packages may arrive in shielded "casks" (containers of various sizes constructed of steel and lead), in shielded or unshielded vans or on flatbed trailers. Each shipment is inspected at the site and released for disposal. Disposal generally involves removing the waste package from its transportation vehicle and placing the package in a concrete disposal vault in an engineered trench. The filled vaults are covered with soils and the completed trenches are covered with a multi-layer engineered earthen cap.

## 1.1 PURPOSE

CNS submits this Least Cost Operating Plan (LCOP) to the South Carolina Public Service Commission (Commission) as required by the S.C. Code Ann. 1976 Section 48-46-40 (B)(6)(supp. 2006). This LCOP is the ninth annual update.

## 1.2 Scope

The LCOP describes the facility and its operations, significant events in the history of South Carolina's LLRW disposal site and regulatory/statutory requirements that affect disposal site operations. The LCOP provides information concerning anticipated operations over the next ten years.

## 1.3 Appendices

The Appendices to this document provide an historical background for the facility and its operation; a general description of the regulatory requirements under which the facility is operated; a description of the disposal facility; and a more detailed description of the disposal facility operations.

# 2.0 LEAST COST OPERATING PLAN

In this section, CNS describes the anticipated operating plan for the next 10 years of Barnwell Disposal Facility (BDF) operations, including anticipated operational modifications, based on past reviews of operating alternatives. Preparation of a 10-year least cost operating plan is directed by §48-46-40 (B) (6) of the 1976 SC Code of Laws (as amended). This section also provides summary financial estimates for Fiscal Years 2009/2010 to 2018/2019 along with a discussion of in-region-only operations.

## 2.1 OPERATING APPROACH

The current BDF operational requirements as described in Appendix D are not expected to change during the ten-year plan period. However, in recognition of the fact that large portions of the disposal site are essentially in a closed configuration, parts of certain fixed costs and the activities associated with those costs have been identified as "Institutional Costs" and will be paid from the Decommissioning Trust Fund as agreed in the Memorandum of Understanding (MOU) between CNS and the SC B&CB approved by the SC B&CB on June 29, 2009.

Under §48-46-40(B)(6) of the S.C. Code (as amended), CNS assumes three fundamental time periods during the remaining life of the disposal facility:

(1) An estimated thirty years of operations as an "in-region-only" disposal facility, to encompass current Atlantic Compact power plant decommissioning schedules. CNS assumes this period will end in year 2038. During the initial two years of this period, CNS will complete certain closure activities (Phase I closure) defined in the 2005 Closure Plan. The closure activities will place completed disposal trenches and most other site areas in a final closed condition.

(2) At the end of in-region operations, one year will be devoted to final site closure (Phase II closure), and five years for final post-closure observation.

(3) One hundred years of an institutional control period will follow the Phase II closure and post-closure periods, which puts the end of institutional control at year 2144.

Table 2.1-1 shows projected waste volumes for the next ten years along with actual waste volumes in past years. Starting in FY 2008/2009, although waste volume limits end, waste is being received only from Atlantic Compact States, resulting in reduced projected volumes. Waste volumes for FY 2009/2010 and beyond are based on recent dialog with Atlantic Compact utilities and the South Carolina Energy Office Staff (SCB&CB).

Slit trench shipments are separately listed in Table 2.1-1 because they require additional labor and resources to prepare and offload.

**Table 2.1-1**
**Actual and Projected Radioactive Waste Volumes Received ($ft^3$)**

| Fiscal Year | Maximum Allowed Volumes by Statute | Actual/Projected Waste Volume[1] | Number of Slit Trench Shipments |
|---|---|---|---|
| 2000/2001 | 160,000 | 125,989 | 43 |
| 2001/2002 | 80,000 | 57,763 | 11 |
| 2002/2003 | 70,000 | 65,660 | 14 |
| 2003/2004 | 60,000 | 59,515 | 23 |
| 2004/2005 | 50,000 | 43,260 | 23 |
| 2005/2006 | 45,000 | 44,988 | 18 |
| 2006/2007 | 40,000 | 37,606 | 37 |
| 2007/2008 | 35,000 | 32,901 | 75 |
| 2008/2009 | NA | 11,975 | 1 |
| 2009/2010 | NA | 10,850 | 0 |
| 2010/2011 | NA | 7,000 | 1 |
| 2011/2012 | NA | 7,000 | 0 |
| 2012/2013 | NA | 7,000 | 1 |
| 2013/2014 | NA | 7,000 | 0 |
| 2014/2015 | NA | 7,000 | 1 |
| 2015/2016 | NA | 7,000 | 0 |
| 2016/2017 | NA | 7,000 | 1 |
| 2017/2018 | NA | 7,000 | 0 |
| 2018/2019 | NA | 7,000 | 1 |

[1] Volumes through FY 2008/2009 are actual volumes.

[2] Volumes after FY 2009/2010 are estimated base load volumes only (not including large components, or decommissioning waste).

### 2.1.1 In-Region Operations

During in-region-only operations, CNS anticipates base load waste volumes at about 7,000 $ft^3$ per year with one slit trench shipment of irradiated hardware every other year. Additional waste volume may be received in some years based on the operational needs of the Atlantic Compact nuclear utilities, disposal of large components, or other special circumstances. However, personnel resources may require the additional volume to be received in any particular year to be limited to about 4,500 cubic feet. Disposal of large components and irradiated hardware may require additional resources for a short time. The base load volume projections are based on controlling annual costs and on information developed in discussion with Atlantic Compact utility generators and the South Carolina Energy Office staff.

The least cost projections provided in this plan were developed to be consistent with anticipated operational practice during the ten-year period. CNS has estimated variable and irregular costs based on waste volume projections and anticipated schedules for special projects and trench construction, while fixed costs have been re-baselined for the later low-volume (7,000 $ft^3$) years. Least cost projections also assume payment for institutional costs from the Decommissioning Trust Fund or the Extended Care Maintenance Fund as appropriate.

Revenue projections provided are dependent, in part, on type and volume of waste received in a particular year and pricing increases tied to the Producer Price Index. Some part of the projected revenue may also be determined from expected agreements with Atlantic Compact generators.

Currently, about 35 people are required to operate the disposal site and complete certain Phase I decommissioning activities. Base load labor resources will require about 32 people assigned to the disposal site.

During in-region operations, CNS has been using the Class B/C trench configuration for disposal of all waste types and classes, except for irradiated hardware, which will continue to be disposed in the slit trench, and large components, which may require special accommodation.

### 2.1.2 Decommissioning Tasks

The 2005 Closure Plan describes the plan for BDF decommissioning, including Phase 1 Decommissioning, which is currently on-going at the facility. CNS expects to complete the primary activities of Phase I Decommissioning by about the end of September 2009. Certain activities related to site performance assessment will continue beyond that date. The costs of these activities are funded through the Decommissioning Trust Fund and, as such, will not contribute to disposal site operating costs. Significant activities of Phase I closure are briefly described below with details available in the 2005 Closure Plan.

#### 2.1.2.1 Performance Objectives Verification

CNS has developed a performance objectives verification plan which defines the basis and criteria for meeting site license performance objectives. This document outlines the Phase I decommissioning activities, and serves as the overall work plan during this phase. In accordance with this work plan, CNS is preparing performance objectives verification report(s) that evaluate compliance with each of the site performance objectives.

#### 2.1.2.2 Enhanced Cap Construction

This activity involves the installation of multi-layer engineered cap on completed trenches at the facility. Between 1990 and 2007, CNS implemented six phases of enhanced cap covering a

total of 96 acres of disposal site. By the end of Phase I closure, CNS will have completed an additional three phases bringing total enhanced cap area on the BDF to 119 acres.

2.1.2.3 Closure Surface Water Management

CNS is constructing final water management features to manage storm water runoff at the BDF. Work includes retention pond construction on the southeast part of the disposal site, final grading of former facility areas and completing pond construction on the west part of the site.

2.1.2.4 Facility Decontamination and Decommissioning

During Phase I Decommissioning, CNS has decommissioned four buildings that served as support facilities for disposal operations as well as various equipment and materials retaining what will be needed for in-region operations, other parent company operations, or later use by the site custodian.

2.1.2.5 Ground Water Monitoring Plan and Well Abandonment

Based on on-going reviews of its operational environmental monitoring program, CNS anticipates adding and removing monitoring wells to enhance the program. Additional environmental studies and evaluations as required by DHEC are being performed.

2.1.2.6 Final Site Survey

During Phase I closure, following final capping of completed trenches, CNS is conducting a radiological survey program to ensure that the site surface is free of contamination and that direct gamma radiation is essentially background.

### 2.1.3 Institutional Control Period

The Institutional Control Period begins following in-region operations and its associated closure and post-closure periods. After DHEC approval, the BDF (which is leased from the State) will be transferred to the State custodial agency (SC B&CB) which will assume responsibility for the property and all buried materials. Responsibilities will include site maintenance and monitoring for which the custodial agency may retain a custodial contractor(s). Institutional control costs during the Institutional Control Period are to be paid from the Extended Care Maintenance Fund.

## 2.2 LEAST COST FINANCIAL EVALUATION

The LCOP financial evaluation is divided into two parts: (1) past years of operation including Fiscal Year 2008/2009, and (2) the next ten years of operations as an in-region-only operating site. Table 2.2-1 presents updated historical information similar to that presented in past LCOP documents

**Table 2.2-1**
**Revenue / Cost Summary**

| Fiscal Year[1] | Actual/ Projected Volume | Gross Revenue[2] (in mill $) | Costs (in mill $) | | | | Net Revenue (in mill $)[5] |
|---|---|---|---|---|---|---|---|
| | | | Allowable Operating Cost[3] | Operating Margin | Surcharges, Taxes, and Fees[4] | Total Operating Cost | |
| 2000 / 2001 | 125,989 | 69.29 | 9.41 | 2.55 | 2.94 | 14.90 | 54.39 |
| 2001 / 2002 | 57,763 | 33.19 | 9.72 | 2.64 | 2.17 | 14.53 | 18.66 |
| 2002 / 2003 | 65,660 | 37.76 | 9.68 | 2.60 | 2.11 | 14.39 | 23.37 |
| 2003 / 2004 | 59,515 | 39.16 | 9.82 | 2.63 | 2.09 | 14.54 | 24.62 |
| 2004 / 2005 | 43,260 | 29.69 | 10.85 | 2.81 | 2.35 | 16.01 | 13.68 |
| 2005 / 2006 | 44,988 | 28.96 | 10.44 | 2.80 | 2.36 | 15.60 | 13.36 |
| 2006 / 2007 | 37,606 | 36.66 | 10.10 | 2.70 | 2.36 | 15.16 | 21.50 |
| 2007 / 2008 | 32,901 | 53.50 | 11.36 | 2.96 | 2.14 | 16.44 | 37.06 |
| 2008/2009 | 11,975 | 6.03 | 3.97 | 1.04 | 0.94 | 5.95 | 0.08 |

(1) Shown are actuals for FY 2000/2001, 2001/2002, 2002/2003, 2003/2004, 2004/2005, FY 2005/2006, FY 2006/2007, FY 2007/2008 and FY 2008/2009. Actuals are based on PSC orders when available.

(2) Gross revenue is the total of all revenue for waste received for disposal. Gross revenue for FY 2007/2008 and FY 2008/2009 include adjustments consistent with the MOU between CNS and SC approved on June 29, 2009.

(3) Operating cost is the cost of disposal operations for which CNS receives 29% operating margin. Also included in this category are costs identified as allowable by the Commission upon which no 29% margin is allowed.

(4) Surcharges (for SC B&CB, Commission, etc.), taxes, and license fees related to disposal operations are allowable costs distributed from gross revenue.

(5) Net revenue to the State of South Carolina which includes money designated for Barnwell County and for South Carolina generator rebates. Interest accrued on cash flows is not included in this table.

Starting in 2007, Chem-Nuclear, the Atlantic Compact utilities, the Atlantic Compact Commission, and the SC Energy Office staff met in a series of meetings to discuss disposal site operating costs, in region operations and funding mechanisms to ensure economic viability of the Barnwell Disposal Facility as a small volume disposal site operation. These meetings and discussions resulted in agreement in 2009 on several key points: all parties agreed to a commitment to maintain the economic viability and continued operation of the Barnwell Disposal Facility; the larger in-region generators agreed to an alternative funding mechanism for allocating operating costs and disposal volume among the six utilities and 13 reactor plants in the Atlantic Compact; and the State of South Carolina agreed to disposal site operation that would yield no net revenue to the State.

An alternative rate schedule that included a quarterly access fee concept for the larger volume in-region generators was approved by the SC B&CB on June 29, 2009.Using this alternative rate schedule and waste volume information obtained through discussions with the SC Energy Office staff and the Atlantic Compact utilities, CNS prepared estimates of costs for the plan period (Table 2.2-2). The estimated costs included in this table are based on recent years' actual costs and they are consistent with orders issued by the SC Public Service Commission in prior determinations of allowable costs. These estimated costs also reflect a reduction in labor and equipment resources as appropriate for the smaller waste volume operation. Costs and revenue indicated in Table 2.2-2 do not include inflationary factors. Costs and revenue in Table 2.2-2 also do not include costs or revenue for disposal of slit trench shipments or large components. Based on a Memorandum of Understanding approved by the SC Budget and Control Board on June 29, 2009 and included in agreements with Atlantic Compact utilities, CNS anticipates operations on a "break even" basis with respect to net revenue during the plan period. During the in-region period, CNS anticipates certain allowable costs, identified as Institutional Costs up to $2.02 million (adjusted each year in accordance with the Producer Price Index), will be paid from the Decommissioning Trust Fund or Extended Care Maintenance Fund as appropriate. These institutional costs are not included in Table 2.2-2.

| Table 2.2-2<br>Anticipated Revenue / Cost Summary | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fiscal Year[1] | Actual/ Projected Volume | Gross Revenue[2] (in mill $) | Costs (in mill $) | | | | Net Revenue (in mill $)[5] |
| | | | Allowable Operating Cost[3] | Operating Margin | Surcharges, Taxes, and Fees[4] | Total Operating Cost | |
| 2009 / 2010 | 10,850 | $5.57 | $3.63 | $0.99 | $0.95 | $5.57 | 0 |
| 2010 / 2011 | 7,000 | $5.06 | $3.31 | $0.86 | $0.89 | $5.06 | 0 |
| 2011 / 2012 | 7,000 | $5.06 | $3.31 | $0.86 | $0.89 | $5.06 | 0 |
| 2012 / 2013 | 7,000 | $5.06 | $3.31 | $0.86 | $0.89 | $5.06 | 0 |
| 2013 / 2014 | 7,000 | $5.06 | $3.31 | $0.86 | $0.89 | $5.06 | 0 |
| 2014 / 2015 | 7,000 | $5.06 | $3.31 | $0.86 | $0.89 | $5.06 | 0 |
| 2015 / 2016 | 7,000 | $5.06 | $3.31 | $0.86 | $0.89 | $5.06 | 0 |
| 2016/2017 | 7,000 | $5.06 | $3.31 | $0.86 | $0.89 | $5.06 | 0 |
| 2017/2018 | 7,000 | $5.06 | $3.31 | $0.86 | $0.89 | $5.06 | 0 |
| 2018/2019 | 7,000 | $5.06 | $3.31 | $0.86 | $0.89 | $5.06 | 0 |

(1) Shown are anticipated or estimated volumes, revenue and costs for FY 2009/2010 through FY 2018/2019.
(2) Gross revenue is the estimated total of all revenue for waste received for disposal.
(3) Operating cost is the cost of disposal operations for which CNS receives 29% operating margin. Also included in this category are costs identified as allowable by the Commission upon which no 29% margin is allowed.
(4) Surcharges (for SC B&CB, Commission, etc.), taxes, and license fees related to disposal operations are allowable costs distributed from gross revenue.
(5) Net revenue to the State of South Carolina. Interest accrued on cash flows is not included in this table.

### 2.2.1 Transition Period (FY 2008/2009)

Beginning with Fiscal Year 2008/2009, CNS has been accepting waste only from the Atlantic Compact states (South Carolina, Connecticut and New Jersey). Based on recent dialog with the Atlantic Compact utility generators and the SC B&CB staff (SC Energy Office), CNS estimates the average annual regional base load waste volume at about 7,000 cubic feet with additional waste volume some years. The Atlantic Compact utility representatives indicated a commitment to the financial viability of the Barnwell Disposal site. The dialog also indicated one slit trench offload about every other year from generators in the Atlantic Compact states.

### 2.2.2 In-Region-Only Operations (FY 2009/2010 to FY 2018/2019)

During in-region operations, fixed, irregular and variable costs will remain as low as practicable. Costs are well established for operations of the disposal site and have been audited by the ORS and identified as allowable by the PSC. Some specific costs; however, may increase due to factors

outside of CNS' control. Specific actions taken to reduce in-region period costs are the following:

- Labor hours on an annual basis have decreased during in-region operations. This decrease reflects the on-going reduction in personnel staffing. It also requires increased flexibility of the remaining work force.

- Equipment leases and support required at the disposal site have been reduced.

- The quantity of variable material, supplies and disposal vaults has also been reduced as dictated by the smaller waste volume operation.

## 2.3 SUMMARY AND CONCLUSIONS

The costs of disposal site operations have been assessed based on updated operational costs, disposal rates, and waste volume projection information. The projections of waste types and volumes are based on information from dialog with the Atlantic Compact utility generators and the SC Energy Office Staff. Table 2.2-2 shows estimated operating costs versus projected revenue generated for each fiscal year of the next ten-year period. Costs for in-region disposal operations have been reduced to the extent practicable.

After the first year of in-region operations, only base load volumes and waste types are projected. Revenue will be sufficient to cover the cost of operations in the future years based on general agreement with the Atlantic Compact utility generators.

During in-region operations, certain Institutional Costs will be paid from either the Decommissioning Trust Fund or the Extended Care Maintenance Fund as appropriate. Certain portions of the disposal area have undergone closure

activities with the application of the enhanced engineered caps. These portions of the disposal site require continued maintenance and monitoring. In-region operations will take place in the remaining available areas as needed to ensure safety, ALARA, and efficient accommodation of the incoming waste. Given the consideration that portions of the site could be defined as closed, and the laws, regulations, and legal agreements allow the use of these funds during the in-region period for this purpose, this funding structure could reduce fixed costs carried by in-region operations.

## 2.4 SUSPENDED OPERATIONS

CNS has also evaluated the possibility of "suspended operations." Based on discussions with the Atlantic Compact utilities, and their commitment to support the financial viability of the BDF, CNS does not anticipate any suspended operations during the period of this plan. For FY 2009/2010, contractual agreements between Chem-Nuclear and the six Atlantic Compact utilities provide assurances that no funds from the Extended Care Maintenance Fund or any other publicly-held fund will be requested to cover operating costs.

This section provides a brief history of regulatory and legislative actions, and associated changes to the licensed disposal area, trench construction and maintenance, waste characterization and packaging.

## 1.1 REGULATORY DOCUMENTS

Three major documents govern the Barnwell site, its operation and disposition. These documents are the Lease Agreement and its amendments, South Carolina Radioactive Material License 097 (License 097) and the Decommissioning Trust Agreement of 1981.

**Lease Agreement and Amendments**: CNS entered into a 99-year lease agreement with the SC B&CB on April 21, 1971, to lease 17.2 acres of land, previously deeded to the State by CNS, for the purpose of burial of radioactive waste. Under this agreement, CNS agreed to operate in accordance with its license application, the conditions of License 097 and the requirements of the U.S. Atomic Energy Commission. The agreement also established a requirement for payments to an Extended Care Maintenance Fund for the long-term care of the site. Under §48-46-40(B)(6) of the S.C. Code (as amended), the Extended Care Maintenance Fund provides funding for long-term care as well as closure activities and post closure maintenance and monitoring after the Decommissioning Trust Fund is exhausted.

In the original agreement, CNS agreed to pay eight cents into the Extended Care Maintenance Fund for every cubic foot of waste received for burial. The Lease Agreement was amended on April 6, 1976, replacing the previous agreement and expanding the lease area to its present 235 acres. At the same time, the fund payment was increased to sixteen cents per cubic foot. The agreement included a formula for increasing the rate of payment based on the Consumer Price Index. Since 1976, the payment to the Extended Care Maintenance Fund has been set at

$2.80 per cubic foot of waste. Other conditions of the lease have remained essentially the same since inception.

As of June 30, 2009, there is $130,749,629 in the Extended Care Maintenance Fund.

**South Carolina Radioactive Material License 097**: License 097 governs operations and closure of the Barnwell site. In 1969, it was issued by the South Carolina Department of Health and Environmental Control (DHEC) authorizing receipt and storage of LLRW. Following extensive geohydrological investigations the license was amended in 1971 to authorize disposal of LLRW by shallow land burial. State and federal agency involvement and DHEC approval preceded authorization for burial.

License 097 specifies requirements by which CNS operates the disposal site. The license describes trench construction specifications, backfilling and capping requirements and required trench markings. Requirements for acceptable wastes are covered as well as specific documentation that must accompany each shipment from the generator. Waste shipments and vehicles must comply with United States Department of Transportation (DOT) regulations for transport and receipt at the site and even more stringent license conditions for acceptance, burial and vehicle release.

License 097 has been amended forty-nine times since it was issued in 1969. Amendments cover a range of changes, from modifying a single license condition to a complete rewrite consolidating several previous amendments into a single document. The amendments have resulted in positive changes and improvements to the burial site and its long-term integrity. An application to renew the license was submitted to DHEC April 27, 2000, and site activities continue with the license in timely renewal status. An additional application to renew the license was also submitted to DHEC in December 2008.

**Decommissioning Trust Agreement of 1981**: On March 24, 1981, CNS entered into a Trust Agreement with the State of South Carolina to provide monies for establishment of a Decommissioning Trust Fund. In 1981, at the time CNS entered into the Trust Agreement, CNS contributed a lump sum of approximately $1.7 million to the decommissioning fund. No additional contributions were made until April 1, 1993, when a rate of $4.11 per cubic foot of waste received for disposal at the Barnwell site was contributed to the fund. This contribution rate lasted for three months. Soon thereafter, contributions were set at $12.60 per cubic foot effective January 1, 1994, to cover costs of enhanced capping at the Barnwell site. On July 1, 1995, the contribution rate was reduced to the current $4.20 per cubic foot.

The current fund balance is $15,329,987 (as of June 30, 2009). In January 2008, the SC B&CB authorized expenditures of up to $18 million for Phase I Decommissioning activities. Phase I Decommissioning began in 2008 will generally complete during FY 2009/2010will generally take place in the latter half of 2008 and 2009. Within the general scope of the authorized Phase I Decommissioning activities, some additional detailed scope is being defined by discussions with DHEC for Radiological and Non-radiological Modeling. This additional modeling work is expected to complete during FY 2010/2011. Considering these authorized activities and at current contribution rates and projected volumes, the fund balance will provide sufficient monies to decommission and stabilize the site in accordance with the requirements of the 2005 Closure Plan. The Extended Care Maintenance Fund can be used for any remaining closure activities or post-closure observation and maintenance tasks when the Decommissioning Trust Fund is exhausted [SC Code Ann. 1976 Section 13-7-10(11) (Supp. 2006)].

On June 29, 2009, the SC B&CB approved a Memorandum of Understanding (MOU) that included recognition that large portions of the Barnwell disposal facility are permanently closed and decommissioned and agreement that the SC B&CB will, consistent with all laws, regulations and procedures, approve disbursals from the Decommissioning Trust Fund and/or the Barnwell Extended

Care Maintenance Fund to cover some of the Institutional Costs of the disposal facility and its surroundings. As described in the MOU, Institutional Costs include:

a. The costs for monitoring and custodial care of those portions of the disposal facility that have been designated as closed areas by DHEC.

b. The costs of monitoring areas adjacent to the Barnwell disposal facility property to assess compliance with regulatory standards.

c. A portion of the total costs for monitoring, security, custodial care, and other shared costs of common areas of the disposal site property, in accordance with an apportionment schedule that is consistent with any determinations by the PSC regarding allowable costs of operation.

## 1.2 REGULATORY/POLITICAL HISTORY

During the early 1970's, the Barnwell site was one of six commercially operated disposal sites. By 1979, three of the commercial sites (in Illinois, Kentucky and New York) had closed, and the Barnwell site was receiving more than three-fourths of the nation's waste.

The increased rate of waste receipt led to South Carolina establishing limits on the annual volume of waste allowed to be received at the site. The volume restriction program gradually reduced allowable volume by one-half over a two-year period (1979-1981) to 1.2 million cubic feet per year. This restriction remained in effect until statutes were amended in 2000, which established the current limits on volume.

During 1979, South Carolina developed and promulgated Regulation Number 61-83, "Transportation of Radioactive Materials Into and Through the State of South Carolina." This regulation established a permit system for waste generators shipping LLRW in the State, and a prior notification system to provide DHEC and

CNS advance notification of shipments passing through the State and arriving at the site. The system requires that shippers certify shipments have been inspected and meet the requirements of appropriate regulations and license conditions.

In 1980, the U.S. Congress passed the Low-Level Radioactive Waste Policy Act. The Act established three major policies. First, each state is responsible for the low-level waste generated within its boundaries. Second, states may form compacts (or groups of states) to facilitate managing low-level waste generated within the boundaries of the compact states, including the right to deny disposal of out-of-compact wastes at compact disposal facilities. The Act also established the policy that these compacts could not refuse waste from other states until the U.S. Congress had ratified the compact. The Southeast Compact, consisting of eight southeastern states (Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee and Virginia) was formed, with the Barnwell site designated the regional facility.

In December 1982, NRC promulgated 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Wastes," which became effective in December 1983. This regulation specifies technical requirements applicable to the different phases of a disposal facility: licensing, operations, closure, post-closure surveillance and institutional control. As a matter of Agreement State compatibility, DHEC adopted 10 CFR Part 61 – equivalent regulations.

On January 1, 1986, the Low-Level Radioactive Waste Policy Amendments Act was signed into law, making a generator's continued access to the three operating disposal sites contingent on its compact meeting specified milestones for new site development. The amended Act clarified Congress' intent to require compacts (or individual states not within a compact) to provide disposal capacity for LLRW generated within their boundaries by January 1, 1993. The legislation also defined the LLRW for which states are responsible. It mandated Federal responsibility for all waste for which states are not responsible above NRC 10 CFR Part 61 Class C limits. The amended Act also established conditions for access to operating disposal sites during the interim period, allowed the partial

rebate of surcharges to states and compacts which meet statutory milestones and established penalties for states that fail to meet the mandated site development goals. A US Supreme Court decision in 1992 struck down the penalty portion of the amended Act.

The South Carolina General Assembly (SCGA), in its 1992 session, enacted legislation to allow the Barnwell site to continue as the regional facility until December 31, 1995 subject to several conditions. One condition required states outside the Southeast Compact demonstrate progress in developing their own regional disposal sites in order to retain access to the Barnwell facility during an 18-month period (January 1993 through June 1994). After June 30, 1994, the Barnwell facility would accept only waste from Southeast Compact generators. By 1995, continued delays in building a new regional disposal site led South Carolina's governor to propose legislation to withdraw the state from the Southeast Compact.

In June of 1995, the SCGA enacted the legislation, South Carolina withdrew from the Southeast Compact, and the Barnwell facility began accepting waste from generators in all states except North Carolina and the Northwest Compact. North Carolina was restricted from site use due to its failure to develop the next disposal facility. The Northwest Compact states disposed of their LLRW at a facility in Washington. South Carolina also imposed a $235 per cubic foot tax on all waste received for disposal at the Barnwell facility. Proceeds from this tax went to the Children's Education Endowment Fund and have been used for educational scholarships and school construction.

Effective July 1, 2000, the SCGA passed legislation enabling South Carolina to join the Atlantic Compact (formerly the Northeast Compact). Provisions in the legislation limit waste volumes on a yearly basis, repeal the tax, and after June 30, 2008, restrict acceptance of waste to three states: South Carolina, Connecticut and New Jersey.

## 1.3 LICENSED DISPOSAL AREA

The initial licensed area consisted of approximately 17.2 acres purchased by CNS. In April 1971, this tract was deeded to the State of South Carolina, which leased this acreage back to CNS for disposal operations. This tract of land was part of a larger property evaluated and found suitable for use as a disposal site during the site's licensing phase (1969 to 1971). The Lease Agreement was amended in 1976, enlarging the licensed disposal area to the current 235 acres.

## 1.4 TRENCH CONSTRUCTION

The original document permitting burial at the Barnwell site was issued April 1971 as Amendment 3 to License 097. Since that time, trench design and construction practices have continuously improved, evolving in response to regulatory input, license changes and CNS technical evaluations.

### 1.4.1 1971 to 1983

As specified in Amendment 3, the first trenches were shallow earthen excavations into which waste was placed, surrounded and covered with backfill material and then capped with clay. The earliest designs included a layer of 10-mil plastic, placed on the clay cap material and below additional protective soil. Trench excavations were required to be located above the water table, a requirement that continues to the present.

In April, 1973, Amendment 5 established several new trench design requirements and standardized trench dimensions. This amendment required that a gravel-filled drain (French drain) be placed along the bottom center of each trench, and then surrounded and covered with floor sand. It also specified installation of monitoring pipes within the drain at specific intervals. At the same time, the trench cover was modified to no longer include the 10-mil plastic layer.

Amendment 12 (December 1975) established design criteria for the slit trench. The new slit trench design was like other trenches except length and width were greatly reduced providing a disposal location for higher activity waste such as irradiated reactor hardware. In regard to the standard trench, Amendment 12 moved the French drain and monitoring standpipes to the trench sidewall to reduce the possibility of pipe damage during waste placement.

Amendment 15 (July, 1977) allowed the use of larger trench dimensions, improving CNS' ability to arrange waste more efficiently, make better use of trench space and reduce personnel exposure (by using low-activity waste as shielding). This amendment also modified cover design, requiring a minimum thickness of clay and general earth cover.

### 1.4.2 1983 to 1996

At the end of 1982, NRC promulgated Regulation 10 CFR 61, which required segregation of wastes according to waste class, and, in response, DHEC issued License 097, Amendment 36 (November, 1983) to implement its requirements. Amendment 36 established three separate trench designs to facilitate waste segregation: Class A, Class B/C and slit-type trench.

Amendment 36 also established the practice of installing intrusion barriers on trenches with Class C waste. In response to this change, CNS installed intrusion barriers on existing slit trenches. The slit trench design was also changed to incorporate a keyway, a notch at the top of the trench designed to allow offload operations below grade. This below-grade arrangement provided additional shielding, thereby reducing offload crew and fenceline exposures.

In 1987, CNS improved the design of the trench floor French drain system, changing trench standpipes and screens from polyvinyl chloride (PVC) to stainless steel and the French drain gravel materials to coarse sand. The benefits were (1) steel standpipe provides greater resistance to collapse and bending during trench disposal and backfilling operations, and (2) coarse sand minimizes the infiltration of fine soils into the French drain.

Amendment 45 (January, 1990) required that CNS place polyethylene high integrity containers (HICs) containing Class B or C wastes in concrete vaults. This change was made to resolve concerns regarding the long-term stability of polyethylene HICs.

In 1991, CNS recommended and DHEC approved a change in cap configuration to reduce the size and frequency of subsidence features.

During 1993, CNS began placing slit trench wastes in concrete vaults, eliminating the need for separate concrete intrusion barriers on subsequent slit trenches.

### 1.4.3 1996 to Present

Amendment 46 (August 1995) required several substantial changes including placing all waste in concrete vaults (unless otherwise approved by DHEC) and installing enhanced multi-layer earthen cap on all future trenches.

In 2003, CNS received DHEC approval to dispose of wastes classified as Class A Stable, Class B or Class C in the same waste disposal trench and in the same disposal vault. Class A Unstable waste can be disposed in the same trench as Class A Stable, Class B or Class C, but must be placed in a separate vault.

In 2004, CNS changed trench backfill material type and installation methods to further minimize settlement and subsidence on trench covers. For backfill in the Class A and Class B/C trenches, CNS recommended and DHEC approved use of free-flowing materials as well as specific equipment for backfill material installation.

## 1.5 WASTE FORM/PACKAGING REQUIREMENTS HISTORY

Since the start of waste disposal at the site in the early 1970's, many changes have occurred affecting the acceptability of wastes, waste packaging and methods for disposal. This section describes the history of waste types received and disposal methods.

Waste types disposed in the first years of operations included utility wastes consisting of dewatered resins, absorbed liquids and Dry Active Waste (DAW). CNS also received institutional and industrial wastes in the form of biological materials, absorbed liquids, liquid scintillation vials surrounded with absorbent material (e.g., vermiculite), general laboratory trash, DAW, and source and special nuclear materials (SNM; LLRW contaminated with small amounts of plutonium and certain isotopes of uranium). These wastes were generally packaged in metal drums, wooden or metal boxes and steel liners. A considerable amount of biological waste containing mostly tritium and carbon-14 radioisotopes was packaged in paper or cardboard containers.

In April 1974, DHEC prohibited the receipt of utility-generated liquids processed in absorbent materials. These liquids had to be processed by cement solidification. The license was amended in July 1977 to broaden the list of acceptable solidification media. In May 1979, scintillation liquids were prohibited from site disposal, and institutional liquids were required to be solidified.

A change to the license in July 1981 required all ion-exchange resin and filter media bearing isotopes with half-lives greater than five years and combined activity of one microcurie per cubic centimeter, to be solidified or placed in a DHEC-approved HIC. Biological wastes were required to be double-packaged in metal containers with absorbent material and lime added to the waste and the interstitial space between containers filled with absorbent materials. These requirements continue to the present.

The operational requirements of 10 CFR Part 61 were implemented at the site during 1982. These requirements directed certain waste, based on specific radionuclides and concentrations, to be processed/packaged in a more stable form. Since most of these wastes were already packaged in HICs, the biggest effect was the requirement to segregate waste into separate trenches based on waste classification.

In 1989, NRC concluded that the current design of polyethylene HICs did not meet long-term stability requirements. A concrete vault was approved by DHEC to allow continued disposal of Class B and C waste in the polyethylene HICs.

Since 1996, CNS has buried all waste in DHEC-approved vaults. These vaults are designed to improve long-term trench stability and also provide structural stability to waste packages. With DHEC's prior approval, large components such as steam generators, pressure vessels or reactor coolant pumps are qualified for disposal using methods such as filling the shipping container with cement grout or defining the component exterior shell as comparable to a vault.

In 2003, DHEC authorized placement of different waste classifications in a single trench provided "stable" and "unstable" wastes remain segregated by vaults.

### 1.5.1 Radionuclide Reporting History

Wastes received for disposal are documented on shipment/disposal manifests. The manifest has evolved during the site's history to meet regulatory requirements and site reporting needs. During the early years of disposal, the manifest did not require specific radionuclide information. Often, only the single most abundant radionuclide or a small percentage of the nuclides were listed. During the late 1970's and early 1980's, radionuclide reporting improved as a result of regulatory reporting changes. Isotopes such as carbon-14, tritium, etc., (usually shipped by private industries and universities) were specifically listed on the manifests enabling their existence and quantities to be traced back to their origin. However, in the case of power plant generated wastes, nuclide reporting was still limited mainly to the more abundant nuclides such as easily identified gamma emitters.

In 1983, radionuclide reporting vastly improved to meet 10 CFR Part 61 waste stabilization and classification requirements. Specific waste stream samples from power plants were analyzed by independent laboratories for hard-to-identify radionuclides. Scaling factors were also developed to better estimate radionuclides in waste streams.

### 1.5.2 Waste Volume History

Table 2.5.2-1 lists the total waste volume received each year. After 2000, burial volumes are totaled over the State's fiscal year, which extends from July 1 to June 30.

| Appendix A – Table 1.5.2-1<br>Barnwell Burial Volumes | |
|---|---|
| Year | Volume (cubic feet) |
| 1971 | 50,219.34 |
| 1972 | 159,933.47 |
| 1973 | 599,886.28 |
| 1974 | 624,759.55 |
| 1975 | 643,564.44 |
| 1976 | 1,393,587.55 |
| 1977 | 1,636,425.12 |
| 1978 | 2,220,519.72 |
| 1979 | 2,238,322.13 |
| 1980 | 2,444,810.72 |
| 1981 | 1,543,278.67 |
| 1982 | 1,228,200.83 |
| 1983 | 1,240,668.21 |
| 1984 | 1,231,715.28 |
| 1985 | 1,214,422.99 |
| 1986 | 1,053,791.68 |
| 1987 | 958,275.82 |
| 1988 | 931,974.01 |
| 1989 | 1,103,299.56 |
| 1990 | 788,031.90 |
| 1991 | 789,681.85 |
| 1992 | 828,727.84 |
| 1993 | 605,443.07 |
| 1994 | 733,896.31 |
| 1995 | 484,890.82 |
| 1996 | 325,815.32 |
| 1997 | 222,269.48 |
| 1998 | 195,684.08 |
| 1999 | 166,435.79 |
| 2000 (Jan-June) | 69,197.42 |
| FY 2000/2001 | 125,988.99 |
| FY 2001/2002 | 57,763.15 |
| FY 2002/2003 | 65,660.02 |
| FY 2003/2004 | 59,515.00 |
| FY 2004/2005 | 43,260.45 |
| FY 2005/2006 | 44,988.48 |
| FY 2006/2007 | 37,606.47 |
| FY 2007/2008 | 32,900.99 |
| FY 2008/2009 | 11,974.61 |
| Total | 28,207,387.41 |

CNS operates the Barnwell site in accordance with the following regulatory requirements.

## 1.1 DISPOSAL FACILITY RADIOACTIVE MATERIAL LICENSE NUMBER 097

CNS is authorized to receive, store and dispose of radioactive material as LLRW in accordance with all conditions found in License 097. The license conditions are subdivided into the categories described below.

### 1.1.1 General Conditions

The General Conditions specify the location of the disposal facility, regulatory requirements, personnel training requirements, authorized users, record retention, site operation inspections and operating parameters.

### 1.1.2 Receipt, Acceptance and Inspection Conditions

The Receipt, Acceptance and Inspection Conditions specify shipment and disposal documentation required for receipt and disposal of low-level radioactive waste, reporting criteria, shipment inspection criteria and unusual hazard notifications.

### 1.1.3 Waste Characteristics and Waste Form Conditions

The Waste Characteristics and Waste Form Conditions specify waste classification requirements, acceptable waste forms, documentation for particular waste forms, packaging criteria for particular waste forms, package activity limits for particular waste forms and prohibited waste.

### 1.1.4 Contamination Limit Conditions

The Contamination Limit Conditions specify contamination limits for incoming shipments of radioactive waste and incoming vehicles. These conditions also specify the release criteria for vehicles.

### 1.1.5 General Packaging Conditions

The General Packaging Conditions specify the minimum requirements for disposal packages and lifting attachments.

### 1.1.6 Site Design, Construction and Maintenance Conditions

The Site Design, Construction and Maintenance Conditions specify the disposal trench design, construction, approvals and maintenance. These conditions also specify the backfilling of trenches, erosion control, trench inspection procedures, trench closure, unauthorized entry, and trench marker requirements.

### 1.1.7 Burial Operation Conditions

The Burial Operation Conditions specify methods for waste emplacement, vault design and construction, radiation and contamination controls and waste storage limits.

### 1.1.8 Environmental Surveillance Conditions

The Environmental Surveillance Conditions specify the on-site and environmental monitoring programs, surveillance reporting criteria, license transfer requirements, and site closure and stabilization plan criteria.

## 1.2 REGULATORY REQUIREMENTS

CNS operates the disposal site in accordance with all applicable state and federal regulations. The following sections identify and briefly describe each applicable regulation.

### 1.2.1 South Carolina Regulation 61-63, Radioactive Materials, Title A

Regulation 61-63 specifies the requirements for the possession, use and disposal of radioactive material. The requirements discuss general provisions, licensing, radiation protection, notices and reports and land disposal of low-level radioactive waste.

### 1.2.2 South Carolina Regulation 61-83, Transportation of Radioactive Waste Into or Within South Carolina

Regulation 61-83 specifies the requirements for the Barnwell site operator to report any shipper violations, ensure all generators and shippers have valid transportation permits and notify shippers of any special requirements for delivery to the Barnwell site.

### 1.2.3 US Nuclear Regulatory Commission, 10 CFR 71.12(b)

10 CFR 71.12(b) requires the operator of any NRC approved package (transport cask) to have an approved QA program in accordance with 10 CFR 71 Subpart H and to be registered with the NRC for each package they will operate. CNS operates in accordance with the EnergySolutions Quality Assurance Program under the NRC Approval No. 0935.

### 1.2.4 South Carolina Storm Water NPDES Permitting Regulation 61-9

Regulation 61-9 specifies that certain industrial facilities posses a National Pollution Discharge Elimination System (NPDES) permit for storm water discharge. CNS operates under a general permit in accordance with a Storm Water Pollution Prevention Plan.

### 1.2.5 Other Regulatory Requirements

CNS disposal operations must also comply, as applicable, with the following regulatory requirements:

- South Carolina State Primary Drinking Water Regulation 61-58
- South Carolina Hazardous Waste Management Regulation 61-79
- Code of Federal Regulations, Title 29, Chapter XVII – Occupational Safety and Health Administration
- South Carolina Air Pollution Control Regulations and Standards, Regulation 61-62

## 1.1 LICENSED DISPOSAL AREA

The 235 acre licensed disposal area is divided into different use categories including: completed trenches (areas used for disposal), buffer zone (areas within 100 feet of the licensed disposal area boundary) and remaining licensed area (water management, support facility and future trench areas). Table 1.1-1 summarizes current acreage in each land use with current BDF land utilization shown on the figure in Appendix A.

**Appendix C - Table 1.1-1**
**Barnwell Site Land Designations**

| Designation | Approx. Acreage |
|---|---|
| Licensed Disposal Area | 235 |
| Area Used for Disposal Since 1971* | 119 |
| Buffer Zone | 40.5 |
| Remaining Licensed Area (including future trench, water management and ancillary operation areas) | 75.5 |

* Trench surface area plus space between adjacent trenches.

## 1.2 DISPOSAL TRENCHES

Barnwell Site trench design and construction practices are governed by approved trench construction procedures and construction detail drawings. License 097 requires that changes to these documents be approved by DHEC prior to implementation.

CNS currently uses threetwo engineered trench designs: Class A, Class B/C and slit-type trench. The different trench types are primarily used to segregate waste by dose rate external to the waste packages. Stable and unstable waste segregation is achieved through use of vaults.

The most recent significant changes to trench operating practice came into effect January 1996 to comply with changes incorporated in Amendment 46 of License

097. Changes included requiring all waste to be placed in concrete disposal vaults and placing enhanced caps on all trenches.

Low dose waste is generally directed to the Class A trench, which is the largest of the three trench types at Barnwell. The trench floor is sloped to trench corner locations, and a trench drainage system is installed to facilitate monitoring of water infiltration. Waste is generally disposed of in the Class A trench in rectangular and cylindrical reinforced concrete vaults, which are stacked up to three-high on the trench floor. Voids between vaults are filled with free-flowing sandy soils (backfill). As disposal proceeds, filled vaults are covered with variable amounts of general cover soils and an initial clay cap. An enhanced cap is installed over completed sections of the trench.

With the transition to in-region operations, all waste other than slit trench waste and large components is disposed of in the Class B/C trench. is used for disposal of higher dose wastes, primarily of Class B and C (not including irradiated hardware and large sealed sources). After the transition to in-region operations, all waste other than slit trench waste and large components will be disposed of in a Class B/C trench. A French drain and sump system allows monitoring of water accumulation in the trench. Voids around disposal vaults are filled with free-flowing sandy materials, and vaults are then covered with an initial clay cap. At a later date, enhanced cap is installed over several adjacent filled trenches. The disposal vault concrete lids that are placed on all disposal vaults serve as an intrusion barrier for those vaults containing Class C waste buried within.

The slit trench is used for disposal of irradiated hardware and large-quantity sealed sources. Trenches are narrow to facilitate remote offload, shielding and rapid covering of waste. The size allows a two-high stack of slit trench concrete disposal vaults. The entire trench floor is filled with coarse drain sand and sloped to one end. Standpipes to monitor water accumulation are installed periodically along the length of trench. Disposal vaults in the slit trench are backfilled and covered with clay-rich materials. An enhanced cap identical to that used for Class

A and B/C trenches is installed above backfill materials. The concrete disposal vault lids serve as intrusion barriers, required for Class C waste.

For all trench types, CNS has developed and documented, through its procedures, backfilling methods to maximize filling of voids around vaults and to enhance long-term stability of the entire trench system.

A multi-layer enhanced cap is installed following completion of disposal in a trench or a group of adjacent trenches. The enhanced cap consists of the initial clay cap overlain by polyethylene and bentonite mat materials, a sand drain layer and general soil materials (for vegetation growth). As part of enhanced cap construction, trenches are covered with topsoil and seeded with grass. Trench standpipe, wellhead protective pads and trench corner and identification markers are installed last.

## 1.3 SITE SUPPORT FACILITIES

CNS maintains several facilities on and adjacent to the Barnwell site, some directly supporting site operations and others related to parent company business lines. Appendix C – Table 1.3-1 lists those existing facilities supporting the disposal operation, their current use and location. Disposal operations facilities are described below.

Receiving Warehouse No. 2 is the point of receipt and inspection for shipments of non-waste materials and supplies to the disposal site and other facilities in the Barnwell complex. Goods are inventoried and stored here until needed and certain routine supplies are kept and dispositioned from this location. CNS also stores selected environmental samples at a secured location in this building {{is this statement still true????}}.

Warehouse No. 3 is primarily used for storage of materials and supplies associated with parent company activities, such as ion-exchange media and waste processing equipment. However, CNS also uses the facility as a geological core storage area, in support of disposal site characterization. {{check this statement also??}}}

The Administration Building houses most of the disposal site administrative staff including Site Management, Security, Personnel, Finance and Regulatory Affairs. The main access gate is adjacent to the building and controlled by Security whose office overlooks the gate. The Administration Building is on CNS property, but the roadway and access gate are on leased state property.

Appendix C – Table 1.3-1

CNS Barnwell Ancillary Facilities

| Number | Name | Location[1] | Use[2] |
|---|---|---|---|
| 2 | Receiving Warehouse No. 2 | SP/RA | CNS/PA |
| 3 | Warehouse No. 3 | SP/RA | CNS/PA |
| 4 | Administration Building | CN | CNS/PA |
| 6 | Environmental & Dosimetry Laboratory | CN | CNS |
| 8 | Site Building | SP/RA | CNS |
| | | | |
| | | | |
| | | | |
| 14 | Cask Maintenance Building | RA | CNS/PA |
| | | | |
| | | | |
| 19 | Drilling Equipment Storage Trailer | RA | CNS |
| 20 | Instrument Calibration Shop | CN | CNS/PA |

(1) The location codes indicate facility is on State Property (SP), CNS Property (CN), disposal site restricted area (RA) or bordering restricted area fence (SP/RA).

(2) The use codes indicate if facility supports CNS disposal activities (CNS) or is shared between CNS and parent company (CNS/PA) operations.

The Barnwell Environmental and Dosimetry Laboratory (BEDL) contains facilities and equipment for radiological analysis of air, water and soil samples collected as part of the Barnwell site environmental monitoring program. The laboratory also provides company-wide radiological personnel monitoring services, such as whole body counting, bioassay and dosimetry services. The laboratory's professional technical staff performs disposal site engineering design, environmental characterization and site performance studies. Radioactive Material License 287-03 authorizes possession and use of radioactive material in the analytical laboratory.

The Site Building is the personnel access and egress point for the disposal site restricted area. Security staff controls vehicle and personnel access to the restricted area at this location. Monitoring equipment is provided for routine self-monitoring to detect personnel or vehicle contamination prior to exiting the site. The Site Building also includes site employee lockers, a break room, and an office for the DHEC on-site inspector. A smear counting system to assist with waste shipment and vehicle arrival surveys is located in this building.

The Site Building also provides office space for health physics technicians to perform radiological surveys of waste transport units entering and exiting the site and other routine radiological protection tasks. The building also houses contamination smear counting equipment and meters used for radiological surveys.

The Cask Maintenance Building (CMB) is used to prepare casks for offloading (removing rain covers, loosening lid fasteners, etc.), decreasing radiation exposure and improving efficiency and safety during offloading. Casks are also prepared here for release from the site.

The Drilling Equipment Storage Trailer contains parts and supplies in support of drilling operations and environmental sampling at the disposal site.

The Instrument Calibration Shop provides space for calibration of health physics equipment. It also houses instrument calibration sources. Radioactive Material License 287-01 authorizes possession and use of radioactive material in the calibration source area.

## 1.4 ENVIRONMENTAL MONITORING FACILITIES

CNS maintains significant facilities, instrumentation and equipment for environmental monitoring. The program infrastructure is based in the BEDL, where CNS performs radiological analyses of environmental media. Non-radiological and certain radiological analyses are performed by vendor laboratories. CNS regularly collects water, air, soil and vegetation samples from monitoring well, trench monitor pipe, air sampling and boundary station locations. The BEDL also maintains comprehensive monitoring of direct radiation along the facility's fenceline and other appropriate locations using thermoluminescent dosimeters (TLDs).

CNS maintains a network of approximately 172 groundwater monitoring wells and 166 trench standpipes designed and located to monitor for the migration of radioactive and hazardous materials. Wells are categorized by type as on-site, boundary or off-site. Wells located near trenches and within the restricted area are designated as on-site wells. Wells positioned within the restricted area and around the boundary of the disposal site are referred to as boundary wells. Wells located off restricted property are off-site wells. Monitor wells are positioned to collect groundwater upgradient as well as downgradient of the site burial area. Trench standpipes, which number one or more within most trenches, allow monitoring of water accumulation in a trench.

BEDL disposal site support also involves site characterization, groundwater and contaminant transport modeling and site performance evaluation. A full complement of equipment is maintained and routinely used to gather data for site performance evaluation as well as for routine geotechnical investigation related to qualifications for new trenches. This equipment includes a drill rig for geologic/geotechnical sample collection and monitoring well installation, a drilling equipment storage trailer (also used for environmental monitoring equipment storage) and assorted drilling support equipment such as pumps, air compressors and cement mixing apparatus.

## 1.5 SITE EQUIPMENT

In addition to equipment associated with specific facilities described above, CNS operates and maintains a variety of equipment and vehicles associated with disposal operations at the site. Equipment includes mobile cranes, earth moving and grading equipment, farm tractors and mowers, electrical generators and forklifts. Vehicles include yard tractors, stake bed trucks, light trucks and trailers.

This section presents the scope of disposal operations, describing in detail the elements required to successfully and safely operate a disposal site. In addition to basic disposal operations functions such as waste receipt and burial, site maintenance and trench construction, this section describes critical compliance functions embodied in CNS' comprehensive environmental monitoring, health and safety and radiation protection programs. These programs have enabled the disposal site to set a high standard in safety and environmental compliance. The activities described in this section form the basis for the allowable costs identified and described in Section 2.0. The work described in Appendix D represents functions and tasks developed over the years through lengthy consultation, review and concurrence from CNS regulatory oversight and CNS internal evaluations. Development of these functions and tasks has also included consideration of comments and recommendations made during audits and inspections of the disposal site operations by various organizations including regulatory entities and customers of the disposal site.

## 1.1 DISPOSAL TRENCH DESIGN AND CONSTRUCTION

### 1.1.1 Disposal Trench Qualification

CNS performs geotechnical and hydrological investigations to qualify areas prior to trench construction. Site conditions (surface drainage, access) and information from existing boreholes are evaluated as the initial phase of field investigation. Additional exploratory boreholes are drilled if available information is insufficient to characterize the geology of the proposed trench area.

Monitoring data from nearby water table wells are used to determine maximum historic water levels, which then form the basis for maximum trench depth.

CNS incorporates trench data and evaluations along with the proposed trench design drawing into a report, which is submitted to DHEC for review and approval. Construction begins after DHEC approval. During construction CNS and DHEC verify conformance to design by inspections at designated hold-points defined in the trench construction procedure.

### 1.1.2 Trench Construction

Disposal trenches are constructed in accordance with DHEC-approved procedures, appropriate trench construction detail drawings and applicable proposed trench-specific design drawing. The drawings are approved by DHEC prior to construction. The construction process is controlled through a series of documented hold points and inspections. CNS typically uses earthmoving contractors to construct Class B/C trenches and CNS personnel and equipment to construct slit trenches.

Prior to excavation, a Registered Land Surveyor (RLS) lays out the trench boundaries in accordance with the approved proposed trench drawing. The Class B/C trenches are constructed using a combination of hydraulic excavators, dump trucks, motor graders and tractor scrapers. During construction, temporary trench ramps are used to provide access to the excavation area. Slit trenches, due to their narrow and steep-walled design are excavated entirely from the top. CNS allows no personnel entry into the slit trench excavation during construction or trench operations. CNS excavates slit trenches using a hydraulic excavator and dump trucks. CNS constructs slit trenches in sections, as needed, based on waste receipt projections, thereby minimizing trench exposure to rainfall, runoff and other forms of weathering.

As excavation proceeds in all trench types, the RLS monitors elevations and sloping and establishes trench bottom elevations. Disposal trenches include systems for water collection and removal.

CNS conducts formal and informal inspections throughout the construction process and DHEC typically performs up to three formal inspections. After final trench approval, CNS prepares an as-built trench drawing and documentation package. Pertinent documents are maintained as permanent trench construction records.

### 1.1.3 Completed Trench Activities

CNS' license and procedures require several activities after completion of burial operations in a trench. These activities include (1) final grading of initial cap and installation of temporary trench identification markers, (2) health physics surveys, (3) enhanced cap construction and (4) installation of standpipe protection pads and permanent markers.

#### 1.1.3.1 Initial Clay Cap

As disposal operations progress in a trench, CNS places backfill around disposal vaults and initial clay cap above the topmost vaults in a trench. The initial cap is compacted in lifts and graded to drain surface water away from the trench. At completion of initial clay cover installation on a trench, temporary trench identification and corner markers are installed. CNS installs permanent markers during enhanced cap construction.

#### 1.1.3.2 Health Physics Surveys

Following installation of initial clay cap, the CNS Health Physics department performs a completed trench survey. This survey involves measurement of direct gamma above the initial clay cap to ensure the combination of disposal vaults, backfill and soil cover above the waste zone provide adequate shielding.

#### 1.1.3.3 Enhanced Cap Construction

As soon as practicable following completion of waste disposal and backfilling of a trench, CNS installs a multi-layer enhanced cap. DHEC approves plans and designs for the multi-layer enhanced cap, on a case-by-case basis, prior to construction. Often multiple trenches will be covered during one construction phase. Construction involves several contractors and consultants to perform the specialized construction work required for installation of engineered caps.

#### 1.1.3.4 Standpipe and Permanent Marker Installation

Following completion of enhanced capping, CNS installs protective pads around standpipes and permanent identification and corner markers.

## 1.2 WASTE DISPOSAL OPERATIONS

### 1.2.1 Receipt and Inspection of Waste

Certain prerequisites must be satisfied prior to the acceptance of any waste for disposal. Those prerequisites include:

- prior notification of waste shipments by shippers,
- review of shipment documentation upon arrival of the shipment at the disposal facility,
- inspection of the shipment for compliance with U.S. DOT regulations,

- radiological survey of the vehicle and accessible packages and
- verification of waste class and waste form.

If a discrepancy is noted during the receipt inspection of the waste shipment or its paperwork, the CNS Licensing Department is notified. The CNS Licensing Department notifies the shipper and the DHEC on-site inspector of the discrepancy. A Condition Report is generated and the shipment may not be accepted for disposal until appropriate corrective actions are taken and approval is granted.

#### 1.2.1.1 Prior Notification Process

At least 72 hours prior to releasing a shipment for delivery to the disposal site, the shipper must notify the CNS Prior Notification Plan (PNP) Department with information concerning the shipment. This information includes name of shipper, anticipated arrival date and detailed information on the waste.

CNS reviews the information and verifies that the shipper has a valid permit to transport waste into or within the state of South Carolina. The detailed waste information is entered into an electronic database (the Waste Manifest Data Management System). The shipper is issued a shipment identification number once the information is entered into the Waste Manifest Data Management System.

#### 1.2.1.2 Review of Shipping Documentation

When waste shipments arrive at the disposal site, the Licensing Department reviews the paperwork to verify compliance with U.S. DOT regulations, Barnwell Site Criteria and the 097 License. This paperwork includes:

- The Barnwell Waste Management Facility Uniform Low-Level Waste Manifest,
- S.C. DHEC Radioactive Waste Shipment Prior Notification and Manifest Form (DHEC 802 Form),
- S.C. DHEC Radioactive Waste Shipment Certification Form (DHEC 803 Form),
- Complete isotopic analysis printout or equivalent for aqueous filter media, filters and resins,
- Documentation of waste classification methods and approval required for Class "C" waste shipment,
- Written statement of any unusual hazards and/or precautions that must be taken,
- High Integrity Container Certification, and
- A DOE/NRC Form 741 for Special Nuclear Material (SNM) when required.

Data from the appropriate documents are entered into the Waste Manifest Data Management System. Calculated package volumes, activities and weights are verified with the reported values from the manifest for consistency. The waste generator and/or shipper is responsible for properly classifying the waste and documenting it on the manifest. Using the information provided in the shipping documentation, CNS calculates the waste classification. When the documentation is found to be acceptable, a "traveler" form is generated that accompanies the shipment through the remaining inspections and offload.

#### 1.2.1.3 Health Physics Receipt Inspection

Once the paperwork has been accepted, the Health Physics Department performs a visual and radiological inspection of the shipment. The visual inspection includes checking that the packages are:

- properly braced and blocked,
- properly labeled and marked,
- not damaged, and
- properly palletized, if appropriate.

The transport vehicle is also inspected to verify that it is properly placarded. Direct radiation and surface contamination surveys of the vehicle and packages are performed to verify compliance with the U.S. DOT radiological limits.

When all incoming inspections are satisfactorily completed, CNS provides the shipment paperwork to the on-site DHEC inspector for review. When the DHEC inspection is complete, CNS proceeds with the offload of the shipment.

### 1.2.2 Waste Handling and Storage

Depending on the type of shipment and waste type, the transport vehicle will be directed to either the Cask Maintenance Building (CMB) or other appropriate location within the restricted area.

#### 1.2.2.1 Cask Unloading

Casks are directed to the CMB where they are prepared for offloading and inspected. Inspections include checking the integrity of cask chains and cables, hold-down assembly, rain

cover, cask bolts and ratchets, etc. Health Physics personnel perform additional radiological surveys on the cask to assist in preparing for offloading. Offload preparations include removal of the rain cover or impact limiter, loosening ratchet binder assemblies and removal of lid hold-down bolts.

Once all inspections and offload preparations are complete, the cask is then directed to the appropriate trench for offloading. Cask shipments are directed to the appropriate trench depending on waste classification and/or container dose rates. At the appropriate trench, containers are unloaded into concrete disposal vaults.

1.2.2.2 Van Unloading

Closed vans are directed to the CMB to complete arrival radiation surveys on the top of the van. Following these surveys the van is moved to the appropriate trench. Containers are unloaded using the appropriate equipment into either the rectangular or cylindrical disposal vaults.

1.2.2.3 Container Inspections

CNS continues inspecting containers as they are unloaded and placed in the disposal vaults. The CNS Licensing Department is notified if any container is damaged, or is improperly marked or labeled.

Containers are selected according to CNS procedure or at DHEC request for verification of the absence of freestanding liquid. Liners may be placed in a test stand and punctured using hydraulic rams and special punches. Low dose drums and boxes may be placed in an appropriately controlled area

and punctured using hand tools. Liquids found are collected and measured. If the amount of measured liquid exceeds the criteria, the on-site DHEC inspector and the generator are notified and proper disposition of the container is determined.

#### 1.2.2.4 Large Component Handling

Large components such as steam generators and pressurizers are disposed of intact. Evaluations qualifying the large components as disposal vaults eliminating the need for concrete vaults are submitted to DHEC for review and approval. Because of their size and weight, large components are brought onto the specific large component trench floor with specially designed transport equipment and hardware.

### 1.2.4 Waste Disposal

Disposal containers are unloaded from vans and casks and placed inside disposal vaults. Three types of reinforced concrete vaults are normally used: slit trench, rectangular and cylindrical vaults. In some cases, oversized waste containers may require a custom-size vault that will require additional DHEC approval. The position of each vault is recorded in the Waste Manifest Data Management System. Since large components may be qualified as disposal vaults, they can be placed directly in the trench. For each large component, CNS develops a trench placement plan that is reviewed and approved by DHEC prior to acceptance of any large component for disposal. Monthly disposal volume reports are prepared and submitted to DHEC.

### 1.2.5 Disposal Trench Stabilization and Closure

When the vaults are filled and closed, CNS places free flowing backfill material in the void space between the vaults. Filling void space minimizes the potential for subsidence of the enhanced cap.

Following backfill, vaults are covered with additional soil material and clay cap. CNS installs the initial clay cap to minimize the infiltration of surface water into the trench. Grass may be planted on the initial cap to control erosion. CNS installs the final multi-layer enhanced cap after completion of waste disposal in a trench.

## 1.3 SITE MAINTENANCE

As required by License 097, CNS implements a comprehensive site inspection and maintenance program to ensure trench cap integrity and to maintain proper surface water drainage. Completed trenches are inspected monthly and after substantial rainfall. General disposal site inspections occur weekly. The inspections identify concerns such as erosion, settlement and water ponding on or around trench areas and ensure timely corrective actions.

CNS maintains records of inspections and maintenance actions. These records document disposal area performance and provide data for estimating future trench maintenance requirements.

CNS also performs operational maintenance activities. The areas around the active trenches are graded to ensure proper drainage of precipitation away from the open portions of the trenches. On-site parking areas, trench work areas and access roads to the active trenches are graded and maintained.

License 097 requires that storm water accumulation in trenches is kept away from waste. CNS manages storm water accumulated in active trenches through evaporation and percolation in available space within open trenches. CNS maintains emergency back-up storage capacity in a lined holding pond.

CNS manages surface water in accordance with the requirements of License 097 and State NPDES regulations. The primary requirements of License 097 are to eliminate run-in of surface water into open trenches, efficiently drain rainwater off of closed trench caps to minimize potential infiltration and contour trench covers to minimize erosion. These considerations are addressed in the facility's trench construction procedure and in the design of multi-layer caps, all of which are approved by DHEC before implementation. NPDES requirements are implemented through a Storm Water Pollution Prevention Plan (SWPPP). The purpose of the SWPPP is to establish measures to minimize the release of pollutants (including sediment) from the disposal site in storm water.

## 1.4 RADIATION PROTECTION PROGRAM

An integral part of the overall Health and Safety Program is the radiation protection program. This program is designed to ensure site workers, other CNS employees, visitors and members of the general public are not exposed to ionizing radiation in excess of the limits established by DHEC. CNS manages this program with the philosophy that exposures to ionizing radiation should be maintained As Low As Reasonably Achievable (ALARA). CNS maintains an ALARA subcommittee to help achieve this philosophy and draws on expertise throughout the company to provide expert reviews and advice for the radiation protection of workers. Routine and special meetings are held to discuss dose goals and engineering controls to further reduce employee exposure.

The radiation protection program controls exposures to ionizing radiation in accordance with DHEC requirements. Exposures are measured using personnel monitoring and other appropriate dosimetry. Radiation work permits are generated as a controlling device for certain work activities with potential

radiation exposure. The permits detail the personnel protective equipment required for the activity and any other special considerations needed to safely perform and control the work.

CNS controls exposure to internal sources of radiation to limits substantially below DHEC requirements. CNS uses bioassay samples and whole body radiation scans to monitor internal radiation exposures. If it is determined that an internal exposure has occurred, an internal dose assessment will be performed as part of the total effective dose equivalent record. Controlling internal exposure is done through the respiratory protection program and in accordance with criteria specified in specific radiation work permits.

A key element in the management of radiation program controls is the establishment of areas of different degrees of hazard or potential hazard. Clean areas, which are considered free of radioactive material hazard, are routinely monitored to ensure these areas remain clean, whereas restricted areas, which may pose a greater potential hazard, require additional monitoring or a higher level of control. Special control areas (such as radiation, airborne radioactivity, controlled surface contamination and radioactive material storage areas) are designated in accordance with regulations to manage radiation risk. Additional training requirements have been established for personnel entering these areas.

The radiation protection program establishes radiological controls to manage external exposure to alpha, beta and gamma radiation. These controls also are used to minimize the inhalation and ingestion of radiological materials. Through radiological dose rate and contamination surveys, the proper controls can be determined. Adequate personnel contamination monitoring is provided through these surveys and radiological airborne contamination monitoring.

To properly administer the program, radiological controls personnel must undergo rigorous training in areas such as regulatory requirements, radiation protection implementation, health physics principles and practices, proper documentation through surveys, radiation work permits, sample logs and airborne monitoring.

To ensure proper radiation monitoring, CNS personnel maintain, repair and calibrate instrumentation. The equipment is traceable to the National Institute of Standards and Technology. The program also controls the calibration and check source inventory.

## 1.5 ENVIRONMENTAL MONITORING

As required by License 097, CNS maintains both radiological and non-radiological comprehensive environmental monitoring programs for the disposal site. These programs are designed to assure that any releases of waste materials can be readily detected during operation of the site or following closure. The radiological monitoring program objectives incorporate International Commission on Radiological Protection (ICRP) guidelines.

### 1.5.1 Radiological Environmental Monitoring Program

The radiological environmental monitoring program for the disposal site is multifaceted, involving a wide range of techniques and sample points. CNS monitors the atmosphere, soil, vegetation, surface water, sediment and groundwater. In addition, instruments are carefully located to check direct radiation from the site. The sample collection schedules for the on- and off-site areas including number of each sample type, frequency of sampling and analyses performed are shown in Table 1.5.1-1. The monitoring results are submitted to DHEC on a quarterly basis in the form of two reports, the CNS Site Operational Monitoring Report and the CNS Environmental Monitoring Report. Components of the monitoring program are discussed briefly in the sections that follow.

#### Atmospheric Monitoring

CNS implements atmospheric monitoring around the perimeter of the disposal facility as well as around active disposal areas. Atmospheric monitoring is concentrated close to active disposal areas in order to

increase the likelihood of detecting any potential release soon after it occurs. A particulate filter sample is taken at the side of active trenches near the edge of the wall where the waste is being buried. This air particulate monitor is positioned downwind and moved whenever there is a shift in wind direction. Additional air sampling is performed on an as-needed basis.

Continuous air samples are taken at permanently located stations around the perimeter of the site. The disposal site's boundary stations are located uniformly around the site following ICRP guidance. Uniform spacing enables CNS to distinguish between radioactive materials potentially released by adjacent facilities and the Barnwell disposal site. This approach ensures that all sectors around the disposal site are adequately monitored. Particulates are collected by drawing air through a glass-fiber filter. The filters, which contain the captured particulates, are exchanged bi-weekly.

Soil and Vegetation

Surface soil samples are taken to detect deposition and early infiltration of radioactive material into the soil. Characteristically, tritium and other soluble species have the potential to move through the top layer of the soil rapidly. Surface soil samples provide detection of early or on-going deposition of such radionuclides. Insoluble species, which move much more slowly and are not readily distributed in soil, tend to remain near-surface. In this case, samples help demonstrate if airborne radioactive material has been deposited as a result of routine site operation. Likewise, samples of vegetation may also indicate whether radioactive materials are being deposited.

## Surface Water and Sediments

Surface water and sediments are collected at the disposal site. Particular attention is given to surface waters outside the site boundary that could be used as drinking water by the public or animals. Downgradient of the disposal site, CNS has located and monitors the location where shallow groundwater flowing under the site first emerges in surface streams. At the disposal site, shallow groundwater discharges at the headwaters of Mary's Branch. Water and sediments are monitored at this location, as well as at other nearby stream locations.

## Groundwater

The most important pathway of any environmental monitoring program for a low-level radioactive waste site is groundwater. CNS routinely monitors an extensive network of both on- and off-site wells for radioactive materials. On-site wells monitor groundwater near trench locations and at the site boundary. Off-site wells are located both up-and down-gradient from the site to as much as one mile away. Wells are strategically positioned in all directions to permit analysis of groundwater upgradient as well as downgradient of the site.

## Thermoluminescent Dosimeters

Each environmental station is equipped with a set of thermoluminescent dosimeters (TLDs) to measure external exposure from penetrating gamma radiation. TLDs are also located at intervals along the perimeter fence of the site. CNS makes extensive use of TLDs because such monitoring is relatively inexpensive and yet highly reliable for demonstrating compliance with radiological standards.

| Attachment D – Table 1.5.1-1<br>Barnwell Site Monitoring Program Sample Collection Schedule | | | | | |
|---|---|---|---|---|---|
| Sample Description | # of Loc[1] | Type | Media | Frequency | Analysis |
| **On-Site Locations:** | | | | | |
| Monitor Wells[2] | 85 | Grab | Water | Quarterly | Gross Alpha/Beta, Gamma Isotopic, Tritium, C-14[4], pH, Conductivity, Temperature |
| Observation Sumps[2] | 166 | Grab | Water | Quarterly | Gamma Isotopic & Tritium |
| External Gamma | 34 | Continuous | TLD | Quarterly | Exposure |
| **Site Boundary Locations:** | | | | | |
| Wells[2] | 20 | Grab | Water | Quarterly | Gross Alpha/Beta, Gamma Isotopic, Tritium, C-14[5], pH, Conductivity, Temperature |
| Soil | 11 | Grab | Soil | Annually | Gamma Isotopic, Tritium |
| Vegetation | 11 | Grab | Vegetation | Annually | Gamma Isotopic, Tritium |
| Atmospheric | 11 | Continuous | Particulate Filter | Bi-Weekly | Gross Alpha/Beta, Gamma Isotopic |
| External Gamma | 61 | Continuous | TLD | Quarterly | Exposure |
| **Off-Site Locations:** | | | | | |
| Potable Wells[3] | 16 | Grab | Water | Quarterly | Gross Alpha/Beta, Gamma Isotopic, Tritium, pH, Conductivity, Temperature |
| Monitor Wells[2,3] | 67 | Grab | Water | Quarterly | Gross Alpha/Beta, Gamma Isotopic, Tritium, C-14[6], pH, Conductivity, Temperature |
| Surface Water[8] | 10 | Grab | Water | Quarterly | Gross Alpha/Beta, Gamma Isotopic, Tritium, C-14[7], pH, Conductivity, Temperature |
| Soil[8, 9] | 5 | Grab | Soil | Annually | Gamma Isotopic, Tritium |
| Vegetation[8,9] | 5 | Grab | Vegetation | Annually | Gamma Isotopic, Tritium |
| Sediment[8] | 4 | Grab | Sediment | Annually | Gamma Isotopic, Tritium |
| Atmospheric[9] | 1 | Continuous | Particulate Filter | Bi-Weekly | Gross Alpha/Beta, Gamma Isotopic |
| External Gamma | 10 | Continuous | TLD | Quarterly | Exposure |

[1] As of July 1, 2008
[2] Water levels measured quarterly
[3] Selected wells sampled annually
[4] At 15 wells annually, Gross-Alpha Beta is used as a surrogate for C-14
[5] At 3 wells annually, Gross-Alpha Beta is used as a surrogate for C-14
[6] At 10 wells annually, Gross-Alpha Beta is used as a surrogate for C-14
[7] At 2 locations annually, Gross-Alpha Beta is used as a surrogate for C-14
[8] Off-Site Springs and Creeks
[9] Barnwell County Airport

### 1.5.2 Non-Radiological Monitoring Program

CNS initiated a non-radiological groundwater monitoring program in the third quarter of 1986. The program is designed to characterize and monitor non-radiological constituents in the groundwater at the disposal site. Since 1986, the monitoring program has been enhanced by optimizing the selection of monitoring wells and non-radiological parameters.

The non-radiological groundwater monitoring program consists of fifteen on-site wells, three boundary wells, nine off-site wells and two creek sample points. On a quarterly basis, eighteen of these twenty-nine sample locations are sampled and analyzed for pH, conductivity, and volatile organics. The remaining eleven wells are sampled and analyzed for pH, conductivity, and chloroform. Additionally, on an annual basis, eighteen sample points are sampled for a complete list of EPA Priority Pollutants. These priority analytes include metals, acids, base/neutrals, pesticides/PCB's, total phenols and total cyanide.

Samples are collected by CNS and provided to an independent laboratory for analysis. Upon receipt of the laboratory results, CNS performs a review of the data and forwards the results to DHEC. A summary of the sample schedule is provided in Table 1.5.2-1.

**Attachment D – Table** 1.5.2-1

Barnwell Site Non-Radiological Groundwater Sample Schedule

| Sample Description | # of Locations | Type | Media | Collection Frequency | Analysis |
|---|---|---|---|---|---|
| Wells | 16 | Grab | Groundwater | Quarterly | pH, Conductivity, Total Organic Carbon, Volatile Organics, Library Search |
| Stream | 2 | Grab | Surface water | Quarterly | pH, Conductivity, Total Organic Carbon, Volatile Organics, Library Search |
| Wells | 12 | Grab | Groundwater | Quarterly | pH, Conductivity, Total Organic Carbon, Chloroform |
| Wells | 16 | Grab | Groundwater | Annually | pH, Conductivity, Total Organic Carbon, Volatile Organics, Library Search, Acids, Base/Neutrals, Pesticides/PCB's, Cyanide, Phenols, Carbon-14 |
| Stream | 2 | Grab | Surface water | Annually | pH, Conductivity, Total Organic Carbon, Volatile Organics, Library Search, Acids, Base/Neutrals, Pesticides/PCB's, Cyanide, Phenols, Carbon-14 |
| Wells | 13 | Grab | Groundwater | Annually | pH, Conductivity, Total Organic Carbon, Volatile Organics, Library Search |

## 1.6 QUALITY ASSURANCE PROGRAM

CNS operates in accordance with a Quality Assurance (QA) Program, comprised of planned and systematic actions designed to ensure that CNS disposal and disposal-related activities are conducted in a satisfactory and compliant manner. The controls of the QA Program address disposal and disposal-related activities that are considered "Important to Safety". "Important to Safety" items and activities are those necessary to assure that radioactive waste is received, handled, packaged, stored, processed or disposed without undue risk to the health and safety of the public or the environment. The Quality Assurance Program is based on the nuclear industry standards and regulations required by our customers, the NRC and DHEC.

The QA Program is implemented through a series of procedures, instructions and drawings that are prepared, reviewed and approved by appropriately qualified personnel. Adherence to the QA Program and implementing procedures, instructions and drawings is mandatory for all CNS employees and subcontractors. Key elements of the QA Program include, but are not limited to:

- Training and qualification of personnel
- Controls for purchased materials, items and services
- Document control
- Inspections
- Audits
- Record keeping

The QA Program requires CNS personnel that perform "Important to Safety" activities to receive training on the purpose, scope and implementation of procedures and instructions. The personnel also receive training in the principles and techniques of the activity being performed. The QA Program requires that this training be documented.

An important element of the QA Program is the Safety Review Board. The Safety Review Board (SRB) is responsible for review and oversight of the conduct of CNS business where matters of safety are involved and to assure compliance with applicable regulatory requirements, procedures, policy, licenses, permits and certificates. SRB members are selected based on their experience and level of responsibility within the company. The SRB normally meets once a month and conducts additional SRB meetings as required for review and approval of new procedures. The SRB is supported by four subcommittees that report to the SRB on matters related to ALARA, Brokering, Emergency Response and Environmental Health and Safety.

The documents that are used to implement the QA Program are controlled by the Company's Document Control Center. These documents are controlled and distributed using a controlled distribution list. Procedures require that personnel remove any obsolete documents from the workplace. The Document Control system ensures that personnel have available the appropriate procedure, instruction or drawing and that it is the most current revision.

Materials, items and services purchased for the disposal site are controlled through a number of QA Program procedures. First, vendors who supply the disposal site with Important to Safety material, items and services must be evaluated and approved by Quality Assurance. Secondly, the material and items are receipt inspected by a qualified Quality Control Inspector prior to being placed in service. These actions ensure that materials, items and services comply with the applicable design, quality and regulatory requirements.

The CNS Quality Assurance/Quality Control Department is responsible for verifying compliance to the QA Program and implementing procedures. The verification activities include a series of inspections, surveillances and audits of the activities performed at the Disposal Site. Formal internal audits of all of the functional areas covered by the QA Program are conducted at least once per year. The results of these inspections, surveillances and audits are reported to senior management for evaluation and development of corrective action.

Any deficiencies identified are entered into the CNS Corrective Action Program. This Program requires that each deficiency is evaluated for cause and appropriate corrective actions are developed to fix and prevent recurrence of the deficiency. Corrective action plans are reviewed and approved by the Quality Assurance Department. Further, the Quality Assurance Department verifies effective completion of corrective actions prior to closing the issue.

The records system maintained by CNS includes the retention of those records essential to demonstrate quality and compliance to requirements. Records are prepared, reviewed, approved and maintained in accordance with established procedures and are readily retrievable. The records are retained in a secure and controlled environment.

## 1.7 TRAINING AND EMERGENCY RESPONSE PROGRAM

### 1.7.1 Training Program

CNS provides training to its employees and contract personnel to effectively and safely perform the duties of their position.

All personnel are required to complete the General Employee Training (GET). The GET is designed to provide employees and contract personnel with the fundamentals of safety, security, quality and radiation protection. The fundamental information is necessary to better understand the requirements of the individual's job, safety requirements and the various regulations under which CNS operates.

In addition to GET, individualized training is provided to each employee and contract personnel based on their job responsibilities. The individual's supervisor is responsible for identifying training requirements. The individualized training may include the following topics:

- Radiation Worker Training
- Transportation Training
- Heavy Equipment Operator Training
- Hazardous Materials Training
- Emergency Response Training

### 1.7.2 Emergency Response Program

The Emergency Response Program provides the guidelines for emergency preparedness to ensure that the:

- disposal site is operated to limit radiation exposure and the release of radioactive materials in an emergency;
- capability exists for measuring and assessing the significance of an accidental release of radioactive materials;
- capability exists for responding to nonradiological emergencies (e.g., fires and chemical spills);
- appropriate emergency equipment, procedures and training are provided;
- notifications are promptly made to appropriate state and local agencies; and
- necessary recovery actions are taken to return the disposal site to a safe condition after an emergency.

A Facility Emergency Response Team is comprised of individuals with experience and training in responding to radiological incidents, non-radiological incidents and medical emergencies. These individuals undergo initial and annual training. When requested, CNS also provides training to local fire, medical and law enforcement personnel covering radiological protection during incidents. The training includes a tour of the facility and identification of areas of special precautions.

Annual emergency response exercises are conducted to maintain readiness. The exercises are critiqued and corrective actions are taken to improve the program.

## 1.8 ENVIRONMENT, HEALTH AND SAFETY

The Environment, Health and Safety (EH&S) Program defines the environmental, health and safety requirements and designated protocols to be followed by CNS employees at the disposal site. The CNS health and safety program is established through a series of safety procedures which include the applicable requirements of the Occupational Safety and Health Administration (OSHA) regulations. The program applies to all CNS employees as well as CNS subcontractors and visitors to the site. The program provides guidance for field monitoring, sample collection and data analysis, and engineering and administrative controls. As part of this program, CNS personnel monitor and plan for chemical and biological hazards, physical hazards (such as confined spaces), vibration and noise hazards and other environmental hazards.

EH&S personnel also evaluate effectiveness of the CNS personnel protective equipment program, administer the industrial hygiene air monitoring program and provide oversight for environmental compliance in the area of hazardous and non-hazardous waste management.

The Environment, Health and Safety Subcommittee of the Safety Review Board is an integral part of the program incorporating individuals from different disciplines in evaluations of program effectiveness (including periodic inspections) throughout the facility.

## 1.9 PHYSICAL SECURITY

Since the events of September 11, 2001, various organizations, including the Department of Homeland Security, the NRC and DHEC, have increased their focus and attention on the physical security aspects of various facilities and operations throughout the country. CNS has and will continue to examine the

physical security associated with the Barnwell disposal site and enhance its security program as necessary to meet the potential threats of theft and sabotage of nuclear materials. This effort may include additional personnel resources, upgraded electronic surveillance and monitoring systems, increased physical security inspections and security awareness training for employees and contractors.

This section describes the physical security program for the Barnwell Disposal Facility. Objectives of the physical security program include, but are not limited to the following:

- Constant surveillance of access and egress points for authorized personnel
- Electronic and personnel monitoring of specific areas of concern
- Protection of facility personnel and equipment
- Response plans for emergency situations
- Unauthorized entry detection capabilities
- Unauthorized entry response plans
- Employee, visitor, and contractor positive identification
- Effective liaison with local law enforcement agencies

The Restricted and Controlled Areas of the Commercial Disposal Facility are protected by industrial style fencing and lighting. Access points to these areas are controlled by Security Personnel, and are under constant surveillance. The boundaries of these areas have been posted with the appropriate security and safety signage.

During routine security inspections of the facility, Security Department personnel ensure the objectives of the physical security program are met, that no security infractions or violations have occurred and that all security and safety monitoring equipment is in proper working order.

## 1.10 COMMUNITY EDUCATION AND COMMUNICATION

For over 37 years, CNS has maintained an "open door" policy with respect to visitors to the disposal site as well as open and active lines of communication with community leaders, residents and organizations. These lines of communication serve to support education of the public in matters related to LLRW disposal and have kept information about the disposal site and its operation accessible to the public. Continuation of an open, public LLRW disposal process, maintenance of effective lines of communication and education of the public will remain integral elements in the future successful operation of the disposal site.

## 1.11 ORGANIZATION STRUCTURE

CNS is a subsidiary of Energy*Solutions*. The mission and focus of the CNS organization is operation of the regional LLRW disposal site located in Barnwell County, SC. This section defines key elements of the CNS organizational structure, discusses direct costs associated with the CNS organization and identifies indirect costs allocated to the disposal organization from other parts of the parent company. A basic organization/function chart for CNS is provided as Attachment D – Figure 1.11-1. Functional teams are described in the following sections.

### 1.11.1 Disposal Operations Team

This team includes personnel and costs directly involved in waste handling operations and site construction/earthworks activities at the disposal site. Included in this team are the Site Operations Coordinator and the Site Construction Coordinator. Also included are Radwaste Technicians, Cask Operating Technicians, Crane Operators, Equipment Operators, Maintenance Mechanics and Waste Tracking Database staff.

1.11.2 Commission/Compact Liaison Team

This team includes personnel and costs associated with required interfaces with the SC Public Service Commission, the SC Budget and Control Board and the Atlantic Compact Commission. It also includes liaison and interaction with Atlantic Compact generators of LLRW. Activities associated with education of members of the public on matters relative to LLRW disposal and liaison with local elected officials relative to disposal site operations are also included here.

1.11.3 Disposal Administration Team

This team includes management, supervision, training support and security guards for the disposal site. It also includes finance, accounting, billing and accounts payable support for waste disposal operations.

1.11.4 CNS Regulatory Affairs and Licensing Team

This team includes costs associated with pre-approval of waste shipments through the Prior Notification Process; review of shipping paperwork to verify compliance with US DOT regulations, Barnwell Site Criteria and License 097; review and renewal of the disposal site license and disposal related permits; and document control. Included here are Licensing and Regulatory Affairs management and Barnwell licensing support.

1.11.5 Barnwell Health Physics Team

This team includes the Radiation Safety Officer for the disposal site, a Health Physics Manager and Health Physics Technicians to support waste receipt and disposal operations and instrument calibration.

### 1.11.6 Barnwell Support Services Team

This team forms a pool of costs allocated as indirect costs to Company business units with significant activities located in the Barnwell Area. This allocation is divided between Disposal and other Company business units based on approximate head counts. Included in this team are costs such as utilities, janitorial services, telefax, postage and trash pick up and county landfill charges.

### 1.11.7 Safety

This team is a pool of costs for personnel and supplies related to safety for activities in the Barnwell area. The safety and loss control manager function is included in this unit. Costs from this team are allocated to Disposal and other Company business units based on approximate head counts.

### 1.11.8 Quality Assurance/Quality Control

This team provides quality assurance program support and direct quality control support required for disposal operations.

### 1.11.9 Barnwell Environmental and Dosimetry Lab

The Barnwell Environmental and Dosimetry Lab (BEDL) primarily supports the disposal site. Labor, material and other costs are captured in this unit or charged to appropriate projects. The BEDL conducts environmental monitoring, characterization and groundwater modeling studies and engineering design for the disposal facility. Records of environmental and regulatory compliance are maintained by the BEDL in electronic databases. The BEDL also maintains dosimetry records for the disposal site, field services and other business unit personnel. The cost for dosimetry records, data processing and reports for other

units are transferred to those units through a project number. The BEDL also supports Barnwell Complex wide Information Systems. Information Systems support costs are allocated between Disposal Site and other business units.

### 1.11.10 Parent Company Indirect Costs

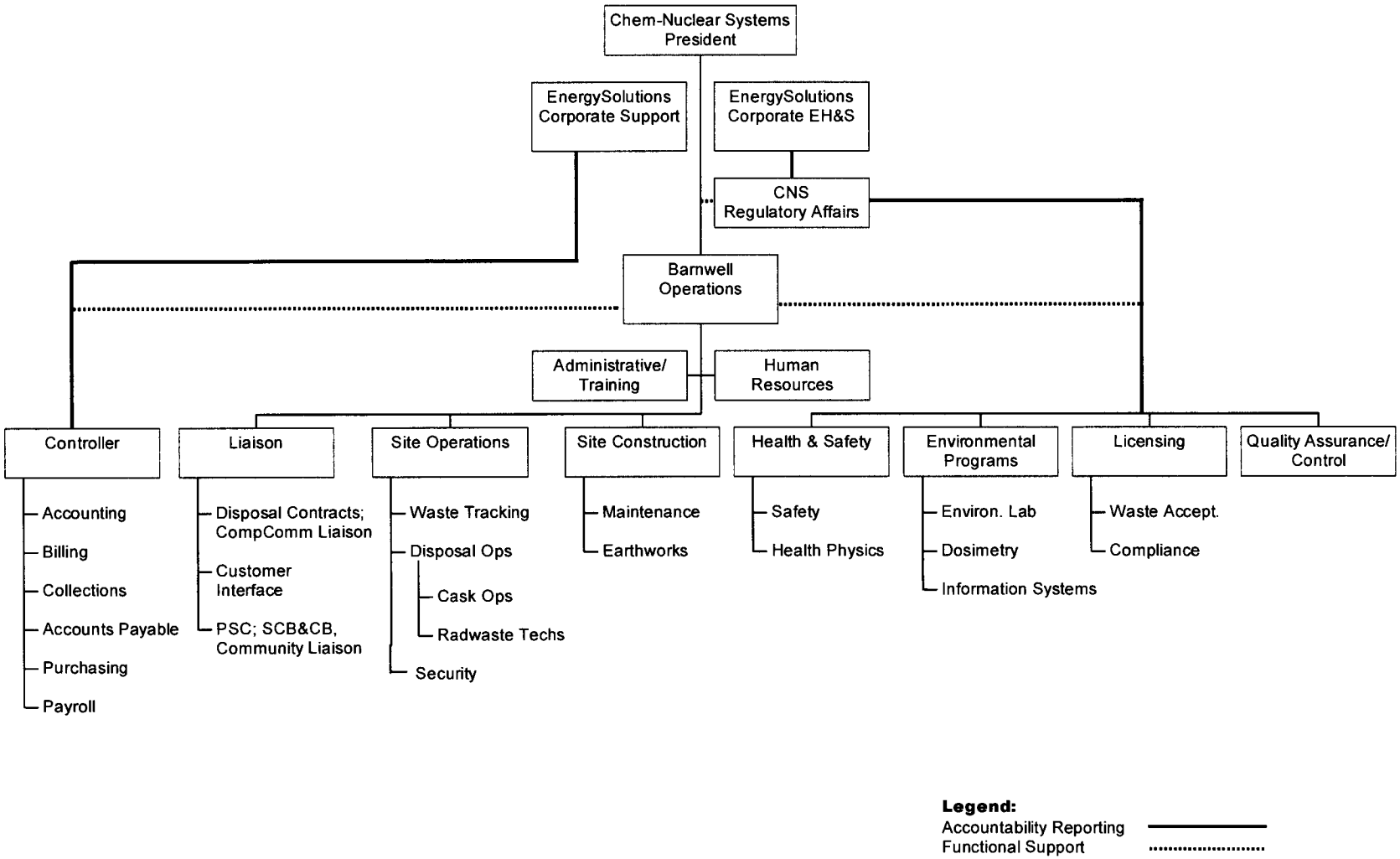
Disposal operations receives various kinds of administrative support from parent company business units. This support typically includes services such as general ledger maintenance, fixed asset depreciation accounting, purchasing and receiving warehouse support, accounts receivable collections, legal counsel support, Environmental, Health and Safety support and quality assurance oversight. Costs for these services and support are collected in appropriate "pools" and allocated to lines of business throughout the company using appropriate allocation methods.

### 1.11.11 CNS Charges to Other Units

Some personnel assigned to the CNS organizational structure may occasionally charge labor costs to other projects or business units within the parent company organization. These costs will be charged based on the employee's hourly rate plus fringe.

## Attachment D – Figure 1.11-1

## Disposal Operations Functional Organizational Chart



## 1.12 COLLABORATIVE REVIEW

In 2002, CNS retained Project Time & Cost, Inc. (PT&C) to develop an independent Operations and Efficiency Plan (O&E Plan) for the CNS Barnwell Disposal Facility. CNS provided the plan to the Commission on June 26, 2002. On April 14, 2003, the Commission issued Order No. 2003-188. This Order directed CNS to file a statement regarding a collaborative review of the O&E Plan. In response to the order, participants from the following organizations met several times:

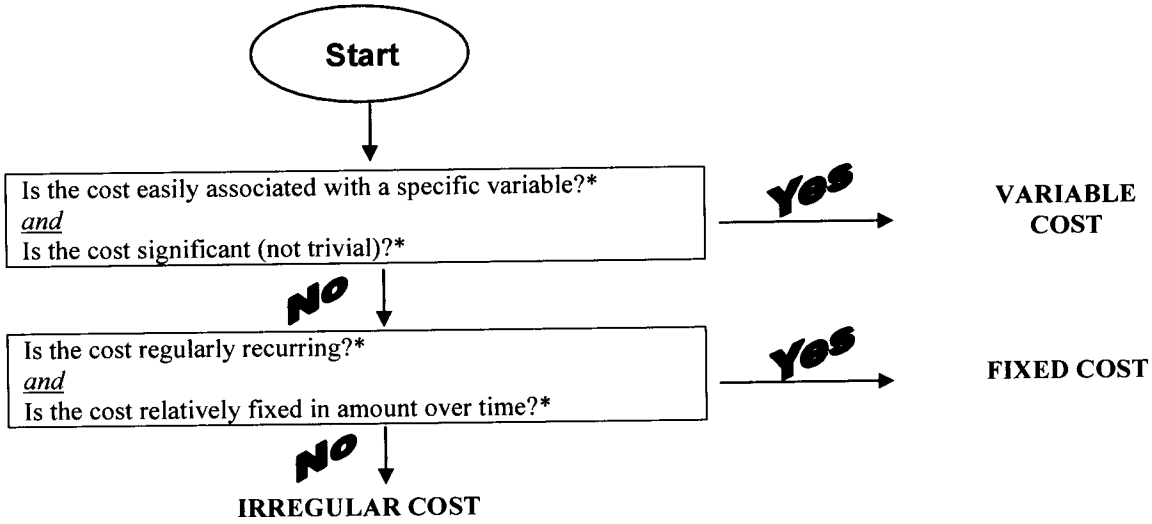
SC Public Service Commission
SC Department of Health & Environmental Control
SC Budget & Control Board
Atlantic Compact Commission
SC Consumer Advocate
Chem-Nuclear Systems

The parties, after completing a collaborative review of the O&E Plan, reached consensus that the information provided in the O&E Plan was a valid representation of disposal site operations and that the plan could be used as a baseline for establishing a method for determining allowable costs in future Commission proceedings. The parties identified three cost categories (variable costs, fixed costs and irregular costs) for operating the Barnwell disposal site. The parties also reached consensus on recommendations provided for the Commission's consideration.

### 1.12.1 Cost Categories

The O&E Plan identified seven cost types, some of which are facility-specific and some could be seen as overlapping from one category to another. Through the collaborative review discussions, the participants determined that three generic cost types represent all the work breakdown structure (WBS) elements. A working definition illustrated in Figure 5.12-1 was developed and used to classify each of the costs as variable, fixed or irregular. Fixed costs are regularly recurring and relatively constant over time. Variable costs are readily associated with a specific variable and change as the variable changes. Irregular costs occur on an intermittent basis and cannot be easily associated with a specific variable. Subsequent audits by the Office of Regulatory Staff have helped clarify placement of specific costs or cost elements in each of these cost types.

## Attachment D – Figure 1.12-1
### WORKING DEFINITIONS FOR PURPOSES OF COST CLASSIFICATION




*The two questions in each box establish qualitative tests and should be considered together. For example, if the cost is obviously and directly associated with an easily measurable variable (Box 1, Q1), then the magnitude of the cost (Q2) is less important in determining whether it is a variable cost. Similarly, if the cost is significant (Q2), then it can still be a variable cost even though its association with a measurable variable is not as obvious and direct as some others (Q1).

#### 1.12.1.1 Fixed Costs

The majority of the costs of Barnwell disposal site operations are fixed costs. Elements such as health and safety, security, licensing, environmental monitoring, training, administration, QA/QC, finance/ accounting and human resources, continue independent of the amount of waste arriving at the site. Fixed costs may change over time due to pay raises or supplier increases which are beyond control of the site operator.

#### 1.12.1.2 Variable Costs

The variable costs include certain materials and labor costs directly associated with the receipt and disposal of waste. The parties agreed that the costs identified as variable costs will likely decrease as the amount of waste received each year decreases in accordance with current statutes. The parties agreed that the methods already established by the Commission staff for determining the variable material cost rates (i.e., costs for concrete disposal vault purchases) are reasonable and appropriate and should remain in effect. As a result of the collaborative review process, the parties established variable waste dependent labor costs using information from the O&E Plan.

*Variable Material (Vault) Costs*

Variable material costs for vaults may be affected each year by such factors as the cost of each type of vault, the number of each type of vault used, the size, shape and type of waste containers received and the number of vaults used in each trench. The method established for determining variable costs rates for vaults involves examination of the volume of waste received by waste classification (Class A, Class B, Class C and slit trench volume) and the volume of each waste classification disposed of in each respective trench. The total cost for vaults used in a trench divided by the total waste volume disposed in each trench provides a variable cost rate by trench. A cumulative rate by waste classification can then be used to develop one indicator of vault costs.

*Variable Waste Dependent Labor Costs*

Variable waste dependent labor costs are included in the activities directly associated with waste acceptance, inspection and disposal. While the volume of waste in various classifications has been useful in establishing variable cost rates for the material costs associated with vaults, variable labor rates can be more appropriately developed for specific work activities based on the following independent variables related to the amount of waste received for disposal:

- number of vaults used for disposal of waste
- number/type of shipments (vans, vertical casks, horizontal/slit trench casks)
- number of waste containers received

The labor costs associated with certain activities defined in various WBS elements described in the O&E Plan are directly related to the amount of waste received as measured or indicated by one of these independent variables. The parties further agreed that the labor rates for a specific WBS activity or a group of WBS elements should be based on different independent variables.

*Other Variable Costs*

The O&E Plan describes other variable costs (such as Atlantic Compact Commission surcharges, payments to the Decommissioning Trust Fund and the Perpetual Care and Maintenance Fund). These costs are established on a per-cubic-foot basis and are included in the statutory requirements for operating the disposal site.

1.12.1.3 Irregular Costs

Through collaborative review, the parties identified some costs that tend to be irregular as defined in Section 1.12.1. Examples of ongoing irregular costs include trench construction, license renewal, large component disposal, insurance premiums and surface water management improvements. Irregular costs can be tracked and controlled separately and are easily audited by the Commission staff in their annual audit. The site operator will request reimbursement with the allowed operating margin for irregular costs in the appropriate application to the Commission.

1.12.2 Use of the Operations and Efficiency Plan

The O&E Plan provided a structure for managing, analyzing and communicating information about costs associated with operating the Barnwell disposal site. The WBS section with its hierarchical structure and cost detail provided a framework to align the Company's accounting system to collect annual costs at a level of detail to allow better analysis. The Company's accounting system has been aligned to accumulate costs in categories of fixed, variable and irregular costs consistent with agreements reached during the collaborative review and during subsequent ORS financial audits.

The Report of the Collaborative Review concludes that the method described for determining waste-dependent labor rates is a good approach.

### 1.12.3 Recommendations of the Parties

Through the collaborative review process and use of the O&E Plan, the parties identified and developed four recommendations for the Commission's consideration. These recommendations are summarized below.

The parties established that the costs identified as "fixed costs" are valid costs of operating the Barnwell disposal site. The parties recommended that the Commission allow the operating company to be reimbursed for actual dollars spent plus, where applicable, the statutory operating margin for each of these identified fixed costs.

The costs identified as "variable costs" will vary with the amount of waste, type of shipments and the number of containers received at the Barnwell disposal site. The variable costs include waste dependent labor and materials. The parties recommended that the Commission continue to use the previously accepted method of establishing material rates by waste classification for vault purchases. The parties also recommended that the Commission establish waste dependent labor rates associated with each vault, van waste shipment, cask waste shipment, slit trench waste shipment, total shipments and total containers received at the Barnwell disposal site.

The costs identified as "irregular costs" are likely to be different each year. The parties recommended that the Commission allow the operating company to be reimbursed for actual dollars spent plus, where applicable, the statutory operating margin for each of these identified irregular costs.

The parties agreed that operating efficiencies are important to cost reduction efforts and that CNS should continue efforts to improve efficiencies in all aspects of operations.

### 1.12.4 Subsequent Audit and Commission Proceedings

Subsequent to the Collaborative Review of the OEP, accounting audits conducted by the SC Office of Regulatory Staff (ORS) suggested refinement of the classification of certain specific costs as fixed or irregular.