



UNITED STATES
NUCLEAR REGULATORY COMMISSION

REGION IV
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ARLINGTON, TEXAS 76011-8064

September 27, 1999

William A. Eaton, Vice President
Operations - Grand Gulf Nuclear Station
Entergy Operations, Inc.
P.O. Box 756
Port Gibson, Mississippi 39150

SUBJECT: NRC INSPECTION REPORT NO. 50-416/99-14

Dear Mr. Eaton:

This refers to the inspection conducted on August 30 through September 3, 1999, at the Grand Gulf Nuclear Station facility. The purpose of this inspection was to review your radioactive waste effluent program and engineered-safety-feature air filtration testing program. The enclosed report presents the results of this inspection.

We determined that radioactive waste effluent releases were properly controlled, monitored, and quantified. Engineered-safety-feature air filtration and adsorption units were properly tested and maintained.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be placed in the NRC Public Document Room (PDR).

Should you have any questions concerning this inspection, we will be pleased to discuss them with you.

Sincerely,

/s/

Gail M. Good
Plant Support Branch
Division of Reactor Safety

Docket No.: 50-416
License No.: NPF-29

Enclosure:
NRC Inspection Report No.
50-416/99-14

Entergy Operations, Inc.

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cc w/enclosure:

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E-Mail report to T. Frye (TJF)
 E-Mail report to D. Lange (DJL)
 E-Mail report to NRR Event Tracking System (IPAS)
 E-Mail report to Document Control Desk (DOCDESK)

bcc to DCD (IE06) - Radiological Protection Reports

bcc distrib. by RIV:

Regional Administrator

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DRS Director

Branch Chief (DRP/A)

Branch Chief (DRP/TSS)

Resident Inspector

RIV File

RITS Coordinator

Project Engineer (DRP/A)

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ENCLOSURE

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket No.: 50-416
License No.: NPF-29
Report No.: 50-416/99-14
Licensee: Entergy Operations, Inc.
Facility: Grand Gulf Nuclear Station
Location: Waterloo Road
Port Gibson, Mississippi
Dates: August 30 through September 3, 1999
Inspector: J. Blair Nicholas, Ph.D., Senior Radiation Specialist
Plant Support Branch
Approved By: Gail M. Good, Chief, Plant Support Branch
Division of Reactor Safety
Attachment: Supplemental Information

EXECUTIVE SUMMARY

Grand Gulf Nuclear Station NRC Inspection Report No. 50-416/99-14

This announced, routine inspection reviewed the implementation of the liquid and gaseous radioactive waste effluent management program; status of the effluent radiation monitors and counting room instruments; and implementation of the engineered-safety-feature filtered ventilation systems maintenance and in-place filter testing program. Training and qualifications of personnel, quality assurance oversight, and annual radiological effluent release reports were also reviewed.

Plant Support

- A good liquid and gaseous radioactive waste effluent management program was implemented. The processing, sampling, and analyses of radioactive liquid and gaseous waste effluents and the performance of waste discharges were conducted in accordance with Offsite Dose Calculation Manual requirements. Improved performance was noted in the reduction of liquid and gaseous effluent radionuclide curies released and offsite dose. Since 1996, the curie amount of radioactive liquid effluent mixed fission and activation products released decreased 79 percent. This led to an 85 percent reduction in whole body dose and a 72 percent reduction in organ dose. Since 1996, the gaseous effluent activity released decreased approximately 50 percent (Section R1.1).
- An effective maintenance and testing program was implemented for the in-place filter and laboratory charcoal testing of the engineered-safety-feature ventilation filter systems (Section R1.2).
- The chemistry counting room's analytical instrumentation was properly maintained, tested, and calibrated in accordance with station procedures (Section R2.1).
- The liquid and gaseous effluent radiation monitors were properly tested and calibrated in accordance with Offsite Dose Calculation Manual requirements (Section R2.2).
- Implementing chemistry procedures for the radioactive waste effluent program provided proper guidance to perform assigned tasks. The revision changes to the Offsite Dose Calculation Manual were appropriately implemented and did not reduce the effectiveness of the radioactive waste effluent program. The 1997 and 1998 annual radioactive effluent release reports were submitted within the time requirement specified in the Technical Specifications and Offsite Dose Calculation Manual and contained the required information (Section R3.1).

- Chemistry personnel had a very good understanding of the radioactive waste effluent program procedures, Offsite Dose Calculation Manual requirements, and dose calculation methodologies. Experienced radwaste operators performed liquid radioactive waste batch effluent releases (Section R4).
- Training and qualification programs for the chemistry technical staff and radwaste operators were properly implemented. The chemistry and operations departments maintained well trained, qualified, and experienced staffs for conducting sampling, analyses, processing, and release operations for radioactive waste effluents (Section R5).
- The licensee's radioactive waste effluent management program organization remained stable, even though the chemistry department experienced three radiochemist staffing replacements. The chemistry department staffing changes did not affect the implementation and performance of the radioactive waste effluent management program. An appropriate chemistry technical staff and radwaste operations staff were maintained (Section R6).
- The licensee's quality assurance audit program of the radioactive waste effluent program was properly implemented. The auditors assigned to perform the audit of the radioactive waste effluent program were experienced and well qualified to perform the evaluations. The biennial quality assurance audit provided management with a good perspective to assess the radioactive waste effluent management program. The contractor laboratories used to perform surveillance testing of the engineered-safety-related ventilation filter systems and the radioactive waste effluent composite samples were properly evaluated (Section R7).

Report Details

IV. Plant Support

R1 Radiological Protection and Chemistry Controls

R1.1 Implementation of the Radioactive Waste Effluent Management Programs

a. Inspection Scope (84750)

Implementation of the liquid and gaseous radioactive waste effluent management programs, as described in the Offsite Dose Calculation Manual, was reviewed.

The inspector interviewed licensee personnel and reviewed the following program areas:

- Nine batch radioactive liquid waste effluent release permits for the period July 1997 through July 1999 from the floor drain sample tanks and equipment drain sample tanks
- Selected liquid waste effluent sample analyses of continuous release samples from the standby service water basin for the period July 1997 through July 1999
- Selected gaseous waste effluent sample analyses of continuous release samples from the radwaste building ventilation exhaust, fuel handling area ventilation exhaust, containment ventilation exhaust, turbine building ventilation exhaust, offgas post treatment exhaust, and standby gas treatment exhaust for the period July 1997 through July 1999
- Dose results calculated from liquid and gaseous waste effluent releases for 1997, 1998, and the first 6 months of 1999

In addition, the inspector observed various effluent sampling and analysis activities.

b. Observations and Findings

On August 30, 1999, the inspector observed a senior radiochemist collect the monthly grab samples from the fuel handling area ventilation system and perform the required tritium and noble gas analyses. On August 31, 1999, the inspector observed a senior radiochemist collect the weekly samples from the radwaste building ventilation exhaust and fuel handling area ventilation exhaust and perform the required radiochemistry analysis for principal gamma emitting radionuclides. On September 1, 1999, the inspector observed the monthly gross alpha analysis of the air particulate filters from the four continuous ventilation exhaust release points for August 1999 and the gross alpha and tritium analyses on the composite sample of the batch liquid waste effluent releases made during August 1999.

The inspector noted that the senior radiochemists carried and referred to the proper sampling procedures while performing the sample collections. The senior radiochemists used appropriate sample handling techniques when collecting and analyzing the samples. All aspects of the airborne sample collections and analyses were performed in accordance with station procedures.

The radioactive liquid and gaseous waste effluent releases were performed in accordance with approved procedures and Offsite Dose Calculation Manual requirements. Quantities of radionuclides released in the liquid and gaseous radioactive waste effluents were within the limits specified in the Offsite Dose Calculation Manual. Offsite doses were calculated according to Offsite Dose Calculation Manual methodologies and were within regulatory limits. Required analyses of monthly and quarterly composite samples of liquid and gaseous radioactive waste effluents were performed as specified in the Offsite Dose Calculation Manual.

Radioactive liquid effluent data showed that the volume of liquid radioactive waste discharged between 1994 and 1998 continued to decrease from 7.3 million gallons in 1994 to 2.3 million gallons in 1998. This represented a decrease of approximately 69 percent for liquid radioactive waste effluent discharged. The 1999 liquid effluent waste volume released during the first 6 months continued to show a significant decrease from previous years, with a release of only 0.3 million gallons. The inspector noted that this was the result of not discharging liquid radioactive waste during the months of March and April.

From a review of data supplied by the licensee, the inspector noted that the curie amount of radioactive liquid effluent mixed fission and activation products released between 1996 and 1998 showed a declining trend from 0.38 curies released in 1996 to 0.08 curies released in 1998 (a 79 percent reduction). The curie amount of tritium released in the liquid radioactive waste effluent between 1996 and 1998 remained relatively constant (approximately 200 curies per year) but showed a significant decrease during the first 6 months of 1999 (approximately 29 curies). Even with the station's improved performance, the inspector determined that the curie amount of tritium in the liquid radioactive waste effluents released from the station remained significantly above the industry median for tritium released from boiling water reactor facilities.

The whole body and organ doses resulting from liquid effluents showed a declining trend since 1996. The whole body dose reduction between 1996 and 1998 was approximately 85 percent, and the organ dose reduction was approximately 72 percent. The 1998 whole body dose represented approximately 0.33 percent of the annual regulatory limit, and the maximum organ dose resulting from the liquid effluent releases represented approximately 0.15 percent of the annual regulatory limit.

Since 1996, the gaseous effluent data showed a decreasing trend in the curie amount of airborne fission and activation gases released from the station. From 1996 through 1998, the curie amount of airborne fission and activation radioactive gases released decreased approximately 50 percent from 93 curies to 46 curies. The 1998 gamma and

beta air doses resulting from the gaseous effluent releases represented less than 0.11 percent of the annual regulatory limit.

c. Conclusions

A good liquid and gaseous radioactive waste effluent management program was implemented. The processing, sampling, and analyses of radioactive liquid and gaseous waste effluents and the performance of waste discharges were conducted in accordance with Offsite Dose Calculation Manual requirements. Improved performance was noted in the reduction of liquid and gaseous effluent radionuclide curies released and offsite dose. Since 1996, the curie amount of radioactive liquid effluent mixed fission and activation products released decreased 79 percent. This led to an 85 percent reduction whole body dose and a 72 percent reduction in organ dose. Since 1996, the gaseous effluent activity released decreased approximately 50 percent.

R1.2 Engineered-Safety-Feature Ventilation Filter Systems

a. Inspection Scope (84750)

The inspector performed external visual inspections of the filter housings for the standby gas treatment system and control room fresh air system and interviewed the system engineer assigned to the systems.

The inspector reviewed the following records for the two engineered-safety-feature ventilation filter systems:

- Records and results of the in-place filter testing of high efficiency particulate filters and charcoal adsorbers
- Records of the laboratory test results of charcoal adsorbers

b. Observations and Findings

The inspector noted during visual inspections of the air cleaning systems that the filtration units and ventilation ducts were properly maintained. All filter housing doors were tightly closed, and the door gaskets were not leaking. The inspector noted that the material condition of the filter housings was very good. The areas surrounding the filtration units were clean and free of debris. There was adequate lighting to visually inspect the filter housings (inside and outside). No problems were identified during the ventilation filter system visual inspection.

The inspector verified that the surveillance tests provided for the required periodic functional testing of the filtration systems' components, evaluation of the high efficiency particulate air filters and activated charcoal, and in-place filter testing. The inspector reviewed the results of the last surveillance tests for each of the two safety-related air cleaning ventilation filter systems and verified that previous surveillance tests were performed at the required frequency. The inspector verified that the in-place filter testing and activated charcoal iodine removal efficiency tests were performed in

accordance with approved procedures by an offsite contractor laboratory and that the surveillance test results met Technical Requirements Manual acceptance criteria.

c. Conclusion

An effective maintenance and testing program was implemented for the in-place filter and laboratory charcoal testing of the engineered-safety-feature ventilation filter systems.

R2 Status of Radiological Protection and Chemistry Facilities and Equipment

R2.1 Chemistry Counting Room

a. Inspection Scope (84750)

The chemistry counting room's analytical instrumentation was inspected to verify that adequate calibration and quality control programs were in place.

b. Observations and Findings

The inspector verified that the chemistry counting room maintained appropriate analytical instrumentation to perform the required radiochemistry analytical measurements of the radioactive waste effluent samples. Quality control indicators were tracked and trended for the gamma spectroscopy and gross alpha counting systems. Data showed that the counting room instruments were operable, well maintained, and calibrated. Senior radiochemists assigned to the chemistry counting room were properly trained and experienced on the use of the instrumentation.

c. Conclusion

The chemistry counting room's analytical instrumentation was properly maintained, tested, and calibrated in accordance with station procedures.

R2.2 Liquid and Gaseous Effluent Radiation Monitors

a. Inspection Scope (84750)

The inspector interviewed licensee personnel and reviewed the following items:

- Effluent radiation monitor operability
- Effluent radiation monitor checks and calibrations during the period July 1997 through July 1999

b. Observations and Findings

During the inspection of the effluent radiation monitors, the inspector determined that all Offsite Dose Calculation Manual required effluent radiation monitors and flow measurement equipment were operable. The inspector verified that source checks, channel checks, channel functional tests, and calibrations were properly performed on the liquid and gaseous effluent radiation monitors. Surveillance test records documented that the effluent monitoring instrumentation was properly tested and calibrated in accordance with the requirements specified in Tables 6.3.9-1 and 6.3.10-1 of the Offsite Dose Calculation Manual.

c. Conclusion

The liquid and gaseous effluent radiation monitors were properly tested and calibrated in accordance with Offsite Dose Calculation Manual requirements.

R3 Radiological Protection and Chemistry Procedures and Documentation

R3.1 Radioactive Waste Effluent Procedures, Offsite Dose Calculation Manual, and Annual Radioactive Effluent Release Reports

a. Inspection Scope (84750)

The inspector reviewed the following items:

- Procedures for the sampling, analysis, and release of radioactive liquid and gaseous waste effluents
- Revisions to the Offsite Dose Calculation Manual involving changes to the radioactive waste effluent program
- Annual radioactive effluent release reports for 1997 and 1998

b. Observations and Findings

The inspector verified that chemistry procedures described the responsibilities for collection and analyses of liquid and gaseous radioactive effluent waste samples in accordance with Offsite Dose Calculation Manual requirements. Chemistry procedures for batch and continuous releases of liquid and gaseous radioactive waste effluents provided proper instruction for sampling, analyses, release permit generation, release limits, monitoring, and approvals. Chemistry procedures also provided proper guidance in the use of the computer software to perform pre- and post-release dose calculations in accordance with the dose calculation methodologies described in the Offsite Dose Calculation Manual. The chemistry procedures provided sufficient instruction to effectively conduct the required radioactive waste effluent program activities.

Revision 21 of the Offsite Dose Calculation Manual was issued December 15, 1997. The inspector determined that the revision changes did not negatively affect the implementation of the radioactive waste effluent management program. The revision changes were documented in the appropriate annual radioactive effluent release report as required by the Offsite Dose Calculation Manual.

The annual radioactive effluent release reports were written in the format described in NRC Regulatory Guide 1.21, Revision 1, June 1974, and contained the required information. The annual radioactive effluent release reports were issued in accordance with the time requirements stated in the Technical Specifications and Offsite Dose Calculation Manual.

c. Conclusions

Implementing chemistry procedures for the radioactive waste effluent program provided proper guidance to perform assigned tasks. The revision changes to the Offsite Dose Calculation Manual were appropriately implemented and did not reduce the effectiveness of the radioactive waste effluent program. The 1997 and 1998 annual radioactive effluent release reports were submitted within the time requirement specified in the Technical Specifications and Offsite Dose Calculation Manual and contained the required information.

R4 Staff Knowledge and Performance

a. Inspection Scope (84750)

The inspector interviewed chemistry personnel to evaluate their knowledge and performance of radioactive waste effluent activities.

b. Observations and Findings

The inspector observed chemistry personnel perform radioactive waste effluent activities and determined that they were very familiar with the radioactive waste effluent management program requirements. All chemistry personnel interviewed were knowledgeable and experienced in the liquid and gaseous radioactive waste effluent program procedures, sampling and analyses requirements, and dose calculation requirements specified in the Offsite Dose Calculation Manual. Batch and continuous radioactive liquid and gaseous waste effluent releases were properly performed during the period July 1997 through July 1999. The inspector determined that the chemistry personnel assigned to perform the effluent dose calculations were fully trained and qualified. The inspector also determined that all of the radwaste operators were properly trained, qualified, and experienced in performing liquid radioactive waste batch effluent releases.

c. Conclusions

Chemistry personnel had a very good understanding of the radioactive waste effluent program procedures, Offsite Dose Calculation Manual requirements, and dose calculation methodologies. Experienced radwaste operators performed liquid radioactive waste batch effluent releases.

R5 Staff Training and Qualification

a. Inspection Scope (84750)

The inspector interviewed licensee personnel and reviewed the following program elements:

- Training and qualification programs for radiochemists and radwaste operators
- Chemistry training program procedure
- Chemistry training lesson plans for radiological effluent activities
- Chemistry training practical factors for radiological effluent tasks
- Non-licensed operator training program procedure
- Radwaste operator training cycle lesson plans
- Training and qualification records for radiochemists and radwaste operators

b. Observations and Findings

Based on a review of training and qualification records, the inspector verified that 10 senior radiochemists were fully trained and qualified to independently perform routine radioactive waste effluent program activities, including the performance of dose calculations. The inspector noted that, in addition, there were two new radiochemists presently completing the initial qualification training. The inspector also verified that the radwaste supervisor and 11 radwaste operators were fully trained and qualified to perform radioactive waste effluent program release activities.

c. Conclusions

Training and qualification programs for the chemistry technical staff and radwaste operators were properly implemented. The chemistry and operations departments maintained well trained, qualified, and experienced staffs for conducting sampling, analyses, processing, and release operations for radioactive waste effluents.

R6 Radiological Protection and Chemistry Organization and Administration

a. Inspection Scope (84750)

The organization, staffing, and assignment of the radioactive waste effluent management program responsibilities were reviewed. Chemistry procedures were reviewed to verify that responsibilities were assigned for program management and implementation.

b. Observations and Findings

The chemistry and operations departments were responsible for implementation and control of the radioactive waste effluent management program. Three staffing changes were noted in the chemistry department since the last inspection of the radiological waste effluent program in June 1997. Since April 1998, there were three new radiochemists transferred or hired into the chemistry department. These staff changes represented 25 percent (3 of 12) of the radiochemists. The inspector determined that these staffing changes did not affect the radioactive waste effluent management program implementation and performance. Few staffing changes of radwaste operators were noted in the operations department. The qualified staffing levels of the chemistry and operations department were sufficient to perform the duties required by the radioactive waste effluent management program.

c. Conclusions

The licensee's radioactive waste effluent management program organization remained stable, even though the chemistry department experienced three radiochemist staffing replacements. The chemistry department staffing changes did not affect the implementation and performance of the radioactive waste effluent management program. An appropriate chemistry technical staff and radwaste operations staff were maintained.

R7 Quality Assurance in Radiological Protection and Chemistry Activities

a. Inspection Scope (84750)

The quality assurance program for the radioactive waste effluent program was reviewed. Specifically, the following items were reviewed:

- Qualifications of personnel who performed the quality assurance audits
- Biennial quality assurance audit of Regulatory Guide 4.15, Offsite Dose Calculation Manual, and Radiological Environmental Monitoring Program performed in August 1997
- Quality assurance audits of the contractor laboratories used to perform surveillance tests and sample analyses required by the radioactive waste effluent program and the engineered-safety-related ventilation filter systems' testing program

b. Observations and Findings

The 1997 biennial quality assurance combined audit of Regulatory Guide 4.15, Offsite Dose Calculation Manual, and the radiological environmental monitoring program was performed by qualified auditors, who had previous operational experience in performing radioactive waste effluent activities. Based on the inspector's review of the 1997

biennial audit report, the evaluation of the radioactive waste effluent program provided management with a very good perspective to assess the program. One finding (documented in Condition Report CR#GG19970911-00) and six recommendations were identified concerning the radioactive waste effluent management program. The scope and the biennial frequency of the audit met the quality assurance department audit requirements.

An audit was performed to evaluate the contractor laboratory used to analyze radioactive waste effluent composite samples. Another audit was performed to evaluate the contractor laboratory used to conduct in-place filter testing and charcoal analyses on the station's engineered-safety-related ventilation filter systems. These audits were performed by Nuclear Procurement Issues Committee audit teams led by utilities with interest in the services provided by the contractor laboratories. The inspector determined that the audits met the requirements to properly evaluate the contractors' abilities to perform respective Offsite Dose Calculation Manual and Technical Requirements Manual required analyses and surveillance activities.

c. Conclusions

The licensee's quality assurance audit program of the radioactive waste effluent program was properly implemented. The auditors assigned to perform the audit of the radioactive waste effluent program were experienced and well qualified to perform the evaluations. The biennial quality assurance audit provided management with a good perspective to assess the radioactive waste effluent management program. The contractor laboratories used to perform surveillance testing of the engineered-safety-related ventilation filter systems and the radioactive waste effluent composite samples were properly evaluated.

V. Management Meetings

X1 Exit Meeting Summary

The inspector presented the results of the inspection to members of licensee management at the conclusion of the inspection on September 3, 1999. The licensee acknowledged the findings presented. No proprietary information was identified.

ATTACHMENT

SUPPLEMENTAL INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

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J. Walton, Chemistry Training Instructor, Training
R. Wilson, Superintendent, Radiological Controls

NRC

J. Dixon-Herrity, Senior Resident Inspector
P. Alter, Resident Inspector

LIST OF INSPECTION PROCEDURES USED

IP 84750 Radioactive Waste Treatment and Effluent and Environmental Monitoring

LIST OF DOCUMENTS REVIEWED

ORGANIZATION CHARTS

Chemistry Department - August 1999

Radwaste Operations Department - August 1999

CHEMISTRY TRAINING DOCUMENTATION

Chemistry department training records

Chemistry training lesson plans and practical factors for radiological effluent activities

01-S-04-8	"Chemistry Training Program," Revision 103, April 30, 1999
GG-1-LG-CM-CR001	"Gamma Spectroscopy Analysis Using Seeker Lesson Plan," Revision 0, October 13, 1998
GG-1-LG-CM-CR002	"Radiological Effluent Tracking and Dose Assessment Lesson Plan," Revision 0, October 13, 1998
GG-1-LP-CM-CL005	"Non-ANSI Radiochemist Technical Specifications and Surveillance Procedures Lesson Plan," Revision 1, May 20, 1999
GG-1-LP-CM-CL007	"Offsite Dose Calculation Manual Lesson Plan," Revision 0, March 13, 1997
GG-1-LP-CM-CL008	"ANSI Radiochemist Technical Specifications and Surveillance Procedures Lesson Plan," Revision 0, May 20, 1998

RADWASTE OPERATIONS TRAINING DOCUMENTATION

Radwaste operations department training records

Radwaste operations lesson plans for 1998 and 1999 training cycles

QUALITY ASSURANCE DOCUMENTS

Master Audit Plan, Revision 26

Quality Assurance Audit Schedules for 1997, 1998, and 1999

Quality Program Audit

Grand Gulf Quality Programs Audit Report 12.01-97, "Regulatory Guide 4.15, Offsite Dose Calculation Manual, and Radiological Environmental Monitoring Program," performed August 11 through September 4, 1997

Vendor Audits

NUPIC Joint Quality Assurance Audit of Duke Engineering and Services Environmental Laboratory, performed March 24-26, 1998

NUPIC Joint Quality Assurance Audit of NCS Corporation, performed December 8-10, 1998

PROCEDURES

Chemistry Procedures

- 06-CH-SG17-M-0042 "Radwaste Release Dissolved Gases," Revision 101, March 12, 1999
- 06-CH-SG17-M-0043 "Radwaste Monthly Composite," Revision 104, March 8, 1999
- 06-CH-1D17-M-0003 "Building Ventilation Gaseous Tritium," Revision 102, March 4, 1999
- 06-CH-1D17-M-0005 "Building Ventilation Exhaust Gaseous Isotopic," Revision 104, March 4, 1999
- 06-CH-1D17-M-0018 "Gaseous Release Points Particulate Alpha Activity," Revision 104, March 8, 1999
- 06-CH-1D17-W-0017 "Gaseous Release Points Iodine, Tritium, and Particulates," Revision 104, March 4, 1999

MISCELLANEOUS DOCUMENTS

Selected liquid radioactive waste batch release permits

Effluent radiation monitor surveillance test records

Engineered-safety-feature ventilation filter systems surveillance test records

Annual Radioactive Effluent Release Reports - 1997 and 1998

"Offsite Dose Calculation Manual," Revision 21, December 15, 1997