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CONSULTANT'S FINAL REPORT
BARNWELL NUCLEAR FUEL PLANT
DECOMMISSIONING PROJECT

Prepared under
Consultant Agreement
with Allied-General Nuclear Services
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Rockwell International

Atomics International Division
Energy Systems Group

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1.0 EXECUTIVE SUMMARY

1.1 CONTRACT SCOPE

Allied-General Nuclear Services (AGNS) contracted with Rockwell International's Energy Systems Group (ESG) to provide consulting services during the decommissioning of the Barnwell Nuclear Fuel Plant (BNFP) in 1983. The author was the principal consultant and was assisted, when appropriate, by other persons in the Rockwell organization who have wide experience and expertise in decommissioning and in radiological evaluations. The credentials of the major contributors to the consultant services are shown in resumes appended to this report.

The scope of the consultancy included: (1) reviewing, early in the BNFP decommissioning project, the decommissioning plans and procedures to be employed; (2) presenting verbal critiques and a written report regarding the consultant's review of plans and procedures; (3) periodically reviewing the actual project performance; (4) providing general pertinent advice and assistance; and (5) providing a final written report summarizing the consulting work and expressing viewpoints regarding the accomplishments and plant status. The consultant services also were expanded to include a final overcheck radiological survey of the BNFP. Results and conclusions drawn from that survey are discussed in this report and presented in detail in a separate report. These services were provided, and the consultant's services are finalized with this report.

1.2 PROJECT OBJECTIVE

Planning and performance of the BNFP decommissioning project began shortly before midyear of 1983. Decommissioning was scheduled for completion by the end of December 1983. The objectives of the project evolved through discussions with the AGNS parent organizations and with the South Carolina Department of Health and Environmental Control (DHEC). The objectives,

paraphrased and generally stated, were to achieve a plant cleanup status that would: (1) justify, to the satisfaction of all parties involved, a minimal facility and plant surveillance program after plant closure, (2) achieve modification of the state license consistent with the extremely small amounts of residual radioactive material present after cleanup, (3) conduct the project in a manner that will facilitate later operation of the BNFP, and (4) conduct the project such that cleanup to regulatory agency "unrestricted use" status would be facilitated should that decision be made at a later date.

1.3 CONSULTANT'S CONCLUSIONS

Based on the reviews made of the plans, procedures, response to recommendations, and performance during the BNFP decommissioning project in conjunction with a study of the Rockwell overview survey, the consultant considers the decommissioning project to have been performed in a capable and professional manner and to have met the project objectives. The project documentation appears to be well established for future needs for records of the project.

1.4 CONSULTING ACTIVITIES

The consultant reviewed the project plans and procedures through a plant visit in July 1983 and a subsequent study of copies of the pertinent planning and procedure documents. At the conclusion of this review, verbal critiques were presented and a formal report was submitted. To summarize, the review concluded that the techniques, approaches, and detailed procedures were quite satisfactory and, in fact, somewhat conservative for the amounts and kinds of residual radioisotopes present at the plant. Natural uranium was the principal material present, with small quantities of transuranics and tracer amounts of fission products affecting only limited areas of the laboratories. The detailed procedures appeared to be consistent with proven and appropriate cleanup and control measures. Based on the reviews, recommendations were made to formalize documentation for the overall Project Plan, to initiate timely

actions for the license modification, t consider some changes in radiological evaluation approaches, and to consider environmental sampling and a final overcheck radiological survey. The AGNS responsive actions to these recommendations by the consultant were timely and considered fully responsive. Some of the suggestions to consider changes in radiological survey evaluations were not followed due to the decision not to plan for a regulatory agency status of "unrestricted use" and due to the provision for a final overview radiological survey. With the changed conditions, the response is considered appropriate.

For criteria in performing the radiological cleanup, substantial guidance regarding acceptable levels exists in the Nuclear Regulatory Commission's (NRC's) Regulatory Guide 1.86 entitled "Termination of Operating Licenses for Nuclear Reactors" and its "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material." These guidelines have not been adopted by the State of South Carolina; however, they have been widely used in nuclear facility decommissioning projects throughout the United States by both NRC and various agreement states. For this reason, the Regulatory Guide 1.86 guidelines were applied whenever practicable to the BNFP decommissioning activities. These guidelines are for achievement of an unrestricted use status. Although such status is not the current decommissioning objective, application of these guidelines is considered to represent an ALARA (as low as reasonably achievable) approach to this decommissioning and to the facilitation of later cleanup actions if required.

The facility cleanup activities are described below. In the Separations, Uranium Hexafluoride, and Waste Tank facilities, the general decommissioning approach was to clean the interior of appropriate process systems with chemical and water flushes. Piping and systems not amenable to chemical cleaning were removed as radwaste or given other cleaning (when practicable) and sealed. Accessible surfaces, such as floors, were cleaned by usual methods when residual material removal was necessary. Laboratory areas were cleaned

to the extent practicable using hand cleaning. All radioactive sources and contaminated equipment items were removed. Drain lines were flushed with acid and water. ALARA approaches were employed in cleanup of the laboratories. The glove boxes and hoods in which transuranic or tracer fission products were handled were cleaned up to the degree practicable, and some were isolated from connecting systems and sealed. Accessible surfaces outside the glove boxes were given rigorous cleaning. Because there is a small amount of high-specific-activity residual material in these sealed glove boxes and systems, the post-closure surveillance program should (and is planned to) emphasize the surveillance of these systems.

The consultant's reviews of the decommissioning progress were performed in visits to the plant during the months of August, October, November, and December 1983. In each visit, it was found that the planned procedures were being followed with few revisions, and documentation of procedures and results was being maintained. In the Alpha Laboratory, it was found that equipment removal from the glove boxes was not feasible and nominal cleaning of the glove box interiors received nominal cleaning, and the glove boxes were sealed. This change was the only major departure from the initial planning and is considered (by the consultant) to be an adequate cleanup and control approach for the near term (probably not more than 5 years). The radioactive waste management and surplus property control procedures, as they were observed, appeared to be satisfactory.

A separate report presents the details of the overview radiological survey performed by Rockwell. This survey was designed to perform both a statistical, representative sampling of the cleaned facilities and also a biased sampling of spots where residual material was most likely still to be found. More than 2500 measurements were made at various locations for alpha, beta, and gamma radiations, both removable and total. The survey covered accessible surfaces and did not include the interiors of process systems or sealed glove boxes. Most of the results showed levels below the "unrestricted use" guidelines of Regulatory Guide 1.86. The relatively few locations where residual

material exists in excess of the Guide were cleaned, and the residual material was "fixed" by painting or other means. Again, it should not be construed that the interiors of process systems and sealed glove boxes are in the same status as the accessible surfaces which were surveyed.

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2.0 INTRODUCTION

2.1 BACKGROUND*

The Barnwell Nuclear Fuel Plant of AGNS was designed and constructed to process light-water reactor fuel on a private commercial basis. Construction began in early 1971, and the present plant was essentially completed in 1976. These facilities were designed and constructed to receive and store reactor fuel; separate uranium, plutonium, and fission product components from spent fuel; convert uranyl nitrate to hexafluoride; and perform laboratory services and manage the wastes produced. The process equipment and laboratories were tested using natural uranium.

In 1977, due to a change in federal government policy, all licensing proceedings pertaining to reprocessing and recycling were terminated by NRC.† BNFP is also licensed by the State of South Carolina to possess and use radioactive materials. Beginning in 1978, the Department of Energy (DOE) and other private and government agencies variously funded research and development activities at the plant. These projects involved most of the BNFP facilities except for the Uranium Hexafluoride (UF_6) Conversion Facility. The UF_6 facility was placed on standby status. Natural uranium was the only radioactive material handled in the plant, except for the small quantities of plutonium, thorium, and neptunium and the tracer amounts of fission products used only in the laboratory areas for research and development work.

In mid 1983, the government terminated all funding for work at the plant, and the owners of AGNS made the decision to decommission the plant. The decommissioning, which was to be completed by the end of calendar year 1983,

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*Background and historical information in this report was furnished through BNFP documents and discussions with AGNS management.

†Although the BNFP operating license and other related proceedings were terminated, the NRC stated there was no reason to disturb the already issued BNFP construction permit.

was to consist of the cleanup measures necessary to justify only a minimal postclosure surveillance effort. A further objective of the decommissioning effort was also to achieve modification of the state license. An equipment salvage effort was conducted in conjunction with the cleanup of the plant. Removable items such as instruments, tools, spare parts, supplies, and equipment were made available to qualified persons and organizations. These items were subjected to close radiological control and checkout procedures.

The plant shutdown and cleanup activities began in May 1983 and were concluded in December 1983.

2.2 CONSULTING SERVICES

Rockwell International was selected to provide decommissioning consulting services to AGNS; the agreement was signed in July 1983. The scope of the consulting agreement encompassed (1) reviewing plans and procedures, (2) reporting on the review (3) periodically reviewing the progress of the project, and (4) providing a final report on the project. A subsequent modification to the agreement required for Rockwell to provide an independent overview radiological survey of the plant after cleanup was complete. That survey was begun 8 November 1983 and was completed in a subsequent survey team visit which commenced on 6 December 1983.

With the cooperation of the AGNS staff, a review was made of the plans and procedures to be followed in the BNFP decommissioning project.

A report of the review was submitted verbally to the staff on 22 July and in writing on 26 August 1983. The written report is titled "Review of Plans and Procedures for the Barnwell Nuclear Fuel Plant Decontamination Project."

The results of the independent survey were discussed with appropriate AGNS management as the data were obtained, and a final report is submitted concurrently with this report.

3.0 DISCUSSION OF CONSULTANT'S REVIEW REPORT

3.1 SCOPE AND APPROACH

The AGNS plans and procedures specific to the BNFP decommissioning project were reviewed in detail in the early visits and discussed with the appropriate management and staff members.

For orientation and perspective, key AGNS management and technical personnel conducted a tour of the facilities being decommissioned. The following facilities were visited:

- Model Building
- Fuel Receiving and Storage Facility
- Separations Facility
- Hot/Cold Laboratories
- Analytical Viewing and Operating Stations
- Uranium Hexafluoride Facility
- Instrument and Equipment Storage Facilities.

The BNFP Shutdown and Salvage Plan Summary Description of 20 July 1983 and the implementation procedures were then reviewed. The AGNS Work Instructions (formalized through the AGNS Work Request Form) reviewed were:

- General Instructions, Movable Equipment Relocation, (WI-3, 15989)
- General Instructions, Hot/Cold Laboratories (WI-3, 15985)
- Fuel Receiving and Storage Station (WI-3, 15984)
- Separations Plant, Process Vessels (WI-3, 15990)
- Separations Plant, Building Cleanup (WI-3, 15992)

- Separations Building Waste (WI-3, 16002)
- Memorandum, 14 June 1983, Waste Tank 420
- UF_6 (Project 4500300, Addenda 1-13)
- Specific Plans, Hot/Cold Laboratories (WI-3, 15985, Addenda 1-20).

Because the AGNS health physics approaches, instruments, and procedures were critical to the determination and documentation of the cleanup status, discussions were conducted with members of the Safety and Environmental Control (SEC) staff. The following pertinent procedures were also reviewed:

- Radiation/Contamination Surveys (HP-9, 2.1)
- HP Instrument Calibration Check (HP-24, 2.1)
- Counting Room Operations (HP-14, 2.3)
- Excerpt, Laboratory Instruments, Low Background Automatic Counter (6.3.2-A)
- Automatic Counting System Calibration (HP-28, 2.1).

Instrument specification sheets were reviewed for the following instruments:

- Eberline Model PAC 4S, alpha Counter
- Eberline Model E-400, Geiger Counter
- Eberline Model E-530 with HP-260 probe, beta counter
- Eberline Model RO-3, beta-gamma ion chamber.

The final Safety Analysis Report for the Separations Plant and the Facility Safety Evaluation Report for the UF_6 Plant were given a cursory review to gain a better understanding of system functions and relationships.

The onsite plans and procedures review and plant orientation were performed during 19 through 22 July 1983. Copies of the pertinent plans and procedures were furnished for subsequent review and study at the consultant's home office. This combination worked efficiently and provided a good understanding of the BNFP plans, procedures, and approaches for analysis by the consultant and Rockwell home office specialists. Comparison was made with applicable regulations, standards of the industry and profession, and with the experience and knowledge of the Rockwell staff experienced in decontamination activities.

As indicated above, the study and analysis focused on three general areas: project plans, project procedures, and project documentation. Observations, suggestions, and recommendations pertaining to these areas were presented in the consultant's report.

3.2 RECOMMENDATIONS

Several comments and recommendations were made as a result of the plans and procedures review. Six recommendations were offered and discussed in the review report:

- Consider clarification of project objectives
- Consider developing a formal project plan
- Consider timely initiation of the license amendment
- Consider changes in radiological evaluation procedures
- Consider environmental sampling and isotopic analyses
- Consider an independent party overcheck.

Each recommendation is discussed below, and the AGNS responsive action, as viewed by the consultant, is described.

4.0 RECOMMENDATIONS AND ACTION

4.1 RECOMMENDATION R-1

Recommendation: Consider development of project objectives similar to the following for the benefit of owners, regulatory agencies, project team, and future interested parties:

- Provide necessary communications to all parties concerned through:
  - a) Statement and dissemination of objectives
  - b) Formal project plan
  - c) Detailed procedures (include goals)
  - d) Project documentation (include progress and contamination status reports and closeout status report)
  - e) Interfaces with regulatory agencies
  - f) Reports to the owners
  - g) Documentation and storage of records for future interested parties
- Provide definition of categories of decontamination to be accomplished. Include general definition of what systems, structures, or equipment are included; definition of final condition of the system, structures, or equipment; and definition of acceptance criteria. Consider categories such as:
  - a) Class I--Unrestricted Use (use NRC Regulatory Guide 1.86 or site specific data as required)
  - b) Class II--Controlled Future Use
    - (1) External Accessible Surfaces or Areas
    - (2) Internal Inaccessible Surfaces or Areas

  (Use ALARA principles to establish acceptance criteria and tie directly to defined restrictions or controls to be placed on the system equipment or area.)

- Define overall plant conditions and status to be accomplished at conclusion of the project including:

  a) Licensing status (consider "Possession Only")

  b) Surveillance, maintenance, and security objectives.

Responsive Action: The definition of project objectives and the fulfillment of communication needs to "outside" parties were largely achieved through the development and issuance of the BNFP Decommissioning Plan. (The Plan is discussed under recommendation R-2.) AGNS provided this plan to its parent organization and to the South Carolina DHEC. The Plan was also discussed with these parties.

The various roles of AGNS managers in developing, reviewing, and approving the Plan provided internal consensus in goals and provided communication of objectives to the various managers. According to BNFP decommissiong project management, periodic meetings with the AGNS parent organizations kept them informed as to the status of the decommissioning project and of forecasts of postclosure conditions and probable requirements.

The decommissioning plan also provided guidance regarding project scope and defined the appropriate acceptance criteria. It was recognized that cleanup activities would be conducted to levels as low as practicable, and in cases where desired criteria were not feasible to achieve, those facilities would be adequately secured and protected against mobilization of the residual radioactive materials. (For example, in cases where glove boxes were not cleanable to unrestricted use levels, they were sealed to contain the residual material.)

Objectives in the State license modification effort as well as postclosure surveillance plans were also detailed in the BNFP Decommissioning Plan.

4.2 RECOMMENDATION R-2

Recommendation: Consider developing a formal project plan for decontamination and closure of the BNFP. Include or separately develop a brief environmenta' evaluation. The project plan should be oriented for use by the owners, the project team, regulatory agencies, and future interested parties.

Responsive Action: A draft project plan entitled "Allied-General Nuclear Services Barnwell Nuclear Fuel Plant Decommissioning Plan" was developed and submitted to the AGNS parent organizations on 31 August 1983, for approval. A subsequent addendum to the plan written in September described actions that might be required later to achieve a license modification to an unrestricted use status for the plant. The revised and approved project plan was issued 14 October 1983. Copies were provided to the regulatory agency for South Carolina, to the AGNS parent organizations, and to BNFP staff members.

The project plan was comprehensive and responsive to all the suggestions made by Rockwell concerning its contents. The plan covered project objectives, project management, the regulatory agency requirements, the facility cleanup plans and approaches, waste management, property disposition, surveillance requirements, and documentation.

4.3 RECOMMENDATION R-3

Recommendation: Initiate the license amendment application soon in order to determine if further requirements will be imposed.

Responsive Action In followup to earlier meetings with representatives of the South Carolina DHEC, a formal letter request for license amendment was submitted on 7 November 1983. The subject of the letter was "Application for Amendments, South Carolina Radioactive Materials License No. 144." The BNFP Decommissioning Plan was appended to this letter. The letter described the

actions taken in the BNFP decommissioning project to justify an amendment of the license and discussed the plan for postclosure radiological surveillance and security.

This action is considered fully responsive to the recommendation.

4.4 RECOMMENDATION R-4

Recommendation: If the intent in decontaminating external surfaces in the plant (outside the process systems) is to meet "unrestricted use" criteria, then consider making total, as well as removable, contamination measurements. This may be done on a reasonable statistical basis. Use another method than rate-meter readout for low-level contamination determinations by survey instrument--either integrating scaler or audio response. Assure calibration standards are appropriate and traceable to NBS standards.

Responsive Action: In developing the project objectives, BNFP management determined that the possibility on an early resumption of activities at the BNFP made it neither necessary nor desirable at this time to completely clean all accessible surfaces to meet both removable and fixed limits of NRC Regulatory Guide 1.86. The primary objective would be to meet the removable material criterion and also to the greatest extent practicable meet the fixed residual material criterion. This approach would minimize later radiological surveillance requirements and facilitate later possible cleanup efforts. This clarification of goals enabled maximum emphasis in the area deemed most important.

Instrument availability limitations prevented use of scaler survey instruments in the AGNS radiological surveys. With primary emphasis on meeting removable contamination criteria, this part of the recommendation became less important.

The calibration procedures and practices were reviewed by AGNS SEC staff. Memoranda SEC/143/83 of 17 August 1983 and JEC/83/145 of 19 August 1983, written by J. B. Maier to M. Hawkins, indicate the studies made regarding the applicability of sources used for instrument calibrations and checks to the range of survey applications. Discussions with the SEC staff and a review of SEC procedures for calibrations indicated to the consultant that the traceability of primary calibration sources to NBS standards was assured.

4.5 RECOMMENDATION R-5

Recommendation: Consider obtaining samples for analyses to validate environmental status and isotopic assumptions.

Responsive Action: A consulting team headed by Dr. John Palms of Emory University was contracted to provide a representative sampling of the plant environs, including isotopic information. This group previously had performed environmental sampling and studies of the BNFP environs for the plant's preoperational survey. The new data (reported separately) will provide an excellent indication of any changes since their initial studies as well as providing a current baseline of environmental and isotopic information. This action is fully responsive to the recommendation.

4.6 RECOMMENDATION R-6

Recommendation: Consider providing for an independent party overcheck of the final radiological status of the plant.

Responsive Action: The performance of an independent radiological survey of the BNFP facilities was contracted to Rockwell International in early November 1983. Members of the Rockwell Radiation and Nuclear Safety group performed overview surveys of the pertinent facilities in the periods of 8 through 18 November and 6 through 9 December 1983. Results of these surveys are briefly discussed below and are detailed in a separate report.

5.0 REVIEW OF PROCEDURES

As indicated above, the consultant was requested to review the procedures to be used in the decommissioning project. The review encompassed the techniques and approaches to be used in cleanup activities. The recommendations discussed above resulted from these reviews. In addition to the recommendations, opinions were expressed verbally and in writing in the consultant's report of 26 August 1983 regarding the probable effectiveness of the techniques and approaches to be used.

The approaches and technical content of the internal decommissioning work procedures were observed to be applicable and satisfactory to achieve objectives for plant closure with minimal postclosure surveillance requirements. It was pointed out that further efforts would be necessary if the objective was to achieve the approval of the regulatory agency for "unrestricted use." In fact, it was observed that the planned approaches were probably conservative if the only objective was to achieve a "possession only" license status.

The decommissioning of each major facility had a management team assigned with a manager reporting to the director of operations. The project management structure was observed to be efficient, responsible, and well coordinated. Facility decommissioning managers were given responsibility for procedure development, implementation, and reporting.

Regarding cleanup techniques, it was observed that the approaches taken are both efficient and effective for removing residual radioactive materials that might readily be mobilized from accessible surfaces. Flushing of tanks, systems, and piping in the Separations Facility was to be (and was) accomplished using nitric acid followed by water. This is a proven approach for removing surface residual uranium and predictably was effective. In the UF_6 plant, the decision was to remove carbon steel piping that had contained powder uranium compounds and to dispose of it as radwaste rather than to attempt to clean it.

Laboratory cleanup approaches were considered satisfactory, with the performance of postclosure radiological surveillance.* Since residual transuranic materials remain sealed in some of the glove boxes, the effectiveness of sealing methods will require periodic surveillance. The plan to lock the doors of laboratories containing glove boxes was considered a wise precaution. Other laboratory cleaning approaches were deemed to be applicable and effective.

The radiological control and evaluation procedures employed by the SEC were considered satisfactory for the objective of obtaining a license change to possession only. It was pointed out that the planned emphasis on primarily assessing removable activity by smear test would not suffice to satisfy regulatory requirements if the desired license change was to achieve unrestricted use. Suggestions were also made concerning use of different types of field survey instruments if unrestricted use was desired. Radiological control techniques and procedures were considered to be quite satisfactory for equipment, tools, supplies, and like items destined for disposition to employees and organizations outside the plant.

The plans and procedures for waste management and for property disposition were considered to be satisfactory. Plans for types and retention of the documents pertinent to the decommissioning project also were considered to be appropriate.

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*During the cleanup efforts in the laboratories with residual transuranic material in glove boxes, it was decided to change the approach somewhat. It was deemed impractical at that time to employ a vigorous effort to remove equipment in the glove boxes. Instead, the interiors were cleaned to the point considered to be practical, and the glove boxes were disconnected from all systems and all openings were sealed. This approach is considered by the consultant to be relatively satisfactory containment for a few years provided radiological surveillance is maintained.

In addition to the comments, suggestions and recommendations that were made, pertinent resource materials were furnished to the BNFP staff. These documents provided information regarding standards and guidelines for decommissioning planning, decontamination techniques, and radiological criteria.

6.0 DECOMMISSIONING ACTIVITIES

6.1 OBJECTIVES

Facilities cleanup and shutdown activities were performed and conducted toward the following objectives: (1) to achieve a condition whereby a minimal level of subsequent radiological control and security measures would be acceptable and achievable after plant closure, (2) to achieve a condition for the facility whereby the license could be modified to provide for a low-level future surveillance program, (3) to leave the Plant in a condition amenable to a future plant startup, and (4) to facilitate later efforts to place the plant in a radiological condition for unrestricted use should that goal subsequently be adopted. The project was also planned and conducted to cause minimum perturbation to the environment.

In performing the radiological cleanup substantial guidance regarding acceptable levels existed in NRC Regulatory Guide 1.86 entitled "Termination of Operating Licenses for Nuclear Reactors" and the NRC "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material." These guidelines have not been adopted by the State of South Carolina; however, they have been widely used in nuclear facility decommissioning projects throughout the United States. For this reason, the Regulatory Guide 1.86 guidelines were applied whenever practicable to the BNFP decommissioning activities. These guidelines are for the achievement of unrestricted use status. Although such status was not the current decommissioning objective, application of these guidelines represents an ALARA (as low as reasonably achievable) approach to this decommissioning and to the facilitation of later cleanup actions if required.

6.2 SCOPE

The BNFP decommissioning project was scoped to include all the areas and facilities that had been involved in the operational use of natural uranium. It also included the decommissioning of laboratory areas that had handled small amounts of transuranic radioisotopes and fission product tracers to perform research and development work. In addition, the project provided for the removal and sale of numerous items of instrumentation, equipment, tools, and supplies. None of these items came from the process cells of the Separations Facility. However, some items of process equipment proprietary to Allied Chemical Corporation were removed from the UF_6 Facility, cleaned, and shipped to Allied's Metropolis Illinois plant.

All source, special nuclear, and bulk uranium materials were packaged in approved containers and returned to DOE facilities. Process solvent was also removed and transported to the DOE's Savannah River Plant.

The support facilities at the plant had not been affected by the uranium introduced into the process systems and hence did not require radiological cleanup.

The principal facilities involved in the BNFP decommissioning project were the:

- Separations Facility
- Uranium Hexafluoride Facility (UF_6)
- Hot and Cold Laboratory Area
- Waste Tank Facility

6.3 SEPARATIONS FACILITY

The Separations Facility includes five contact maintenance cells, two remote maintenance cells, two plutonium nitrate storage cells, and associated equipment (e.g., pumps, instrumentation, and piping). Only the liquid process equipment in the Separations Facility was exposed to solutions containing uranium (natural). No TRU isotopes had been introduced in any process area. Process support equipment, such as the shear and cranes, had had no contact with uranium. The plutonium nitrate storage cells and auxiliary systems had not been in contact with uranium. Closed-loop cooling water and steam generating systems were free of uranium and this status was verified. Process piping and vessels contained solutions of natural uranium. The plant's ventilation system had had a limited uranium involvement depending on the areas serviced. Generally, residual in-cell natural uranium contamination levels were less than 1000 dpm/100 cm^2 α and 2000 dpm/100 cm^2 β,γ smearable before to the start of decommissioning. Levels in normal access areas (e.g., operating stations, piping and instrument galleries, stairwells, and hallways), were in general less than 50 dpm/100 cm^2 α and 500 dpm/100 cm^2 β,γ smearable before decommissioning.

The Fuel Receiving and Storage Station contains a cask testing and decontamination pit, two cask unloading pools, a fuel storage pool, and associated pool water cooling and treatment equipment and handling cranes. The FRSS had not been exposed to radioactive materials.

In implementing of the decommissioning plan, process solutions were removed from process tanks, systems, and piping. The feed tanks were also emptied. Process solvent was packaged for and transported to DOE Savannah River Plant. Uranyl nitrate was shipped to a vendor for conversion to UF_6 and for return to DOE.

Then, the internals of all process tanks, systems, and piping were flushed with 1 to 3 M nitric acid followed by water flushing and rinsing. In

this process, all 78 tanks as well as 110,000 ft^2 of internal process piping surfaces were completely filled, sparged, and drained, using nitric acid followed by water. The drain water was sampled to determine the concentration of uranium in the rinse. On the basis of the sample data and type of system, the nitric acid wash was repeated for 16 tanks. Samples were again taken from the final acid flush. The maximum uranium concentration was shown to be less than 98 mg of uranium per liter of solution. For all tanks, the average concentration in the flush solutions was determined to be approximately 10 mg of uranium per liter. After the second flush of the 16 tanks, the average concentration was reduced to 4 mg per liter for the final flushing of all tanks. The procedure written and followed for the process system cleaning activity is documented in AGNS Work Request WI-3-15990. Documentation was made of all the acid and water flush procedures and of the sample results.

Acid and water flush solutions were collected, concentrated, and disposed of as low-level radioactive waste. Plans provided that none of the process flush solutions be allowed to enter "cold" drains or "cold" liquid systems, nor disposed to the outside environment.

All accessible surface areas of the process building (contact cells, remote cells, galleries, stations, and areas) were cleaned to levels as low as practicable by wiping and vacuum cleaning. Radiological survey results are discussed in Section 8.0.

Cell ventilation lines were surveyed by Health Physics and closed off. Ventilation and off-gas filters were left in place.

Documentation of the decommissioning cleanup plans is found in AGNS Work Requests WI-3-15990, WI-3-15992, and WI-3-16002.

6.4 URANIUM HEXAFLUORIDE FACILITY (UF_6)

The UF_6 Facility contained equipment to convert uranyl nitrate to uranium hexafluoride. This equipment was housed in an eight-story metal frame

building. Some of the process-related equipment, such as piping, calciners, screw conveyors, baghouses, and vessels, had been in direct contact with uranium, in most cases in the form of uranium oxide powders. Auxiliary systems and areas, such as compressors, refrigeration, fluorine production, and UF_6 cylinder loading/unloading, had not been in direct contact with uranium.

The AGNS procedure for planning and accomplishing the UF_6 decommissioning is documented in AGNS Work Request 4500300, Addenda 1-28. Sampling results are shown in the work copy of this AGNS document.

The same general procedures were followed for cleanup of the UF_6 process system and building as those described in the preceding section for the Separations Facility.

Some systems in the UF_6 Facility had been in contact with natural uranium powder. Those constructed of carbon steel were not flushed with nitric acid; they were opened, vacuum cleaned, and then physically removed from the facility. Piping was discarded as low-level radioactive waste. The large waste water storage tank was removed and used as a container for radwaste disposal of cut piping sections, small pieces of equipment, etc. Some proprietary and salvagable equipment, such as conveyors, blowers, valves, etc. was transferred to Allied Corporation's Metropolis, Illinois facility.

Stainless steel equipment (e.g., the calciner, spray dryer, and accountability tank) and stainless steel piping were flushed with acid followed by water, samples were taken, and all lines and ports were sealed. Waste solutions were transported to the Separations Facility for condensation and disposal. Many of the valves and connecting piping were disposed as radwaste, and openings were blanked off.

All accessible surface areas of the facility were cleaned by wiping and vacuum cleaning to levels as low as practicable.

6.5 HOT AND COLD LABORATORY FACILITY

The Hot and Cold Laboratory Facility contains a temporary lunchroom, a change and locker room, Health Physics support offices, and several laboratories.

The Analytical Chemistry Laboratories consist of individual laboratories equipped to provide specific types of analyses or services. The laboratories include all facilities required for analyzing samples for purposes of process control, accountability and safeguards, product and raw material specifications, and process instrumentation calibration. These laboratories had been used for DOE-sponsored research and development work, support of plant cold testing, and analytical procedures development. Radioactive materials had been used in all of the laboratories. Plutonium had been used in six laboratories; thus, the hoods and glove boxes in these laboratories contained residual amounts of plutonium.

This facility also contained an Engineering Laboratory and an Alpha Laboratory. Both contained pilot-scale equipment used for process development work.

The general plan followed for decommissioning the laboratory areas was to remove all radioactive sources, contaminated equipment, and any other radioactive materials. Fixed work tables, hoods, and glove boxes were left in place. Floors, ceilings, counter tops, and the exteriors and interiors of hoods were cleaned as possible to unrestricted use limits. The administrative offices for laboratory personnel, temporary lunchroom, and Health Physics support offices were cleaned with intent to achieve unrestricted use.

Portable equipment was cleaned and placed in storage outside the laboratory area for future disposal. Equipment that could not readily be cleaned was discarded as waste. Compatible laboratory chemicals were discarded to the Separations Plant Waste Treatment Systems. Other chemicals were packaged for

disposal at an approved chemical disposal site. All cabinets and drawers were emptied and the contents removed from the laboratory for subsequent disposal. All portable equipment was removed from hoods and glove boxes.

The drain lines from hoods, non-TRU glove boxes, and sinks were flushed with nitric acid and water, and the flush solutions were treated in the Separations Facility Waste Systems.

The glove boxes and hoods that had contained TRU material were cleaned and emptied of equipment to the degree practicable and then isolated from the ventilation system and other utilities. The gloves were left in place in these glove boxes, and a gasketed cover plate was placed over the glove port. Because a very small amount of residual plutonium remains in some of the glove boxes, the postclosure surveillance program is planned to emphasize surveillance of these laboratories.

In addition to natural uranium, small quantities of plutonium, neptunium, and tracer levels of some fission products had been used in the Alpha Laboratory. Only natural uranium and thorium had been used in the Engineering Laboratory.

Three large nonstandard glove boxes in the Alpha Laboratory had been exposed to transuranics and trace amounts of fission products. The smaller of the three large glove boxes was thoroughly cleaned. The other two boxes contained large vessels and heavy equipment which was not removed. All of these boxes were isolated from connecting systems and sealed as described above.

According to plans, all drain lines and tanks in the laboratory waste system were flushed with nitric acid and water at the conclusion of the cleaning activity. No plutonium-bearing solution was allowed to come in contact with the laboratory waste system.

The documentation of plans and accomplishments for decommissioning the Hot and Cold Laboratory Facility is found in AGNS Work Request WI-3, 15985, as well as in other AGNS documents.

6.6 WASTE TANK FACILITY

There are two high-level and one intermediate-level stainless steel waste tanks in this facility. Each tank has a nominal capacity of 300,000 gal and is located inside a concrete vault lined with stainless steel.

One high-level tank and the intermediate-level waste tank had been used to collect wastes generated during the DOE-sponsored demonstration runs of the Separations Facility. Following these demonstration runs, the solutions were removed and solidified. However, a waxy film containing a small amount of uranium adhered to some of the cooling coils in the high-level waste tank, requiring further cleaning as described below. The intermediate-level waste tank was cleaned and surveyed by health physics personnel. (The second high-level tank had never been used.)

Following the foregoing cleaup activities, the intermediate-level waste tank was used to collect the nitric acid flush solutions used in cleaning the Separations Facility. The used high-level waste tank collected the water flushes which followed the acid flushing. The water flush solution provided sufficient volume to submerge the coils, and sodium hydroxide solution was added to dissolve the waxy film on them. This solution was then used to neutralize the acid in the intermediate-level tank, and the combined solutions were concentrated and disposed as radwaste at an authorized burial site.

After flushing and radiological monitoring, the waste tank vaults were closed.

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7.0 CONSULTANT'S REVIEWS OF DECOMMISSIONING

The Rockwell consultant performed reviews of the decommissioning project in visits to BNFP in August, October, November, and December of 1983. The period of review typically was 2 to 3 days and covered all the facilities. Each review consisted of visits to the facilities, an audit of actual performance versus the plans and procedures, and discussions with the managers and cognizant technical personnel regarding the procedures employed and the results obtained.

In each visit, it was found that the planned procedures were being followed, and the documentation of procedures and results was being maintained. A change in plans occurred for the Engineering Laboratory when agreement was reached with DOE that all equipment would be removed and sent to the Idaho National Engineering Laboratory. In the Alpha Laboratory, it was found that removing the equipment from the glove boxes would not be practical; therefore, nominal cleaning of the glove box interiors was accomplished and the glove boxes were sealed. Surveys were conducted by AGNS to determine removable levels of radioactive materials. Since the objectives did not include attaining an unrestricted release condition, comprehensive surveys for fixed residual materials were not deemed necessary. (The independent survey by Rockwell did not include determinations for fixed residual radioactive material.)

At the August visit, acid flushing had been completed in the separations plant for the following process systems: head end tanks, dissolvers, solvent systems, plutonium systems, co-decontamination and partitioning systems, and vessel off-gas systems. In the UF_6 plant, removal of carbon steel piping was nearly completed. The dust collector system was in the removal process, and the large waste receiving tank was ready for use as a radwaste container. In the laboratory areas, six laboratories had been cleared and cleaned, the solidification process for TRU waste had been completed, and much of the portable laboratory equipment had been removed, cleaned, and readied for disposition.

The October review found substantial further progress in the decommissioning. All bulk uranium as well as source and special nuclear material had been removed. All process systems in the separations plant had been acid and water flushed. Repeat flushing had been decided on and was in progress for 16 tanks, and some general area cleanup had been accomplished. In the UF_6 plant, all carbon steel piping involved with uranium had been removed. Work was in progress for cleaning the calciner and spray dryer systems. The dust collector had been removed and was ready for shipment to Metropolis. General cleaning had been accomplished in much of the upper floor areas. Laboratory cleanup was also found to be progressing satisfactorily. Removal of equipment from the Engineering Laboratory was in progress, and most of the laboratories had been cleaned of reagents and portable equipment. Caustic cleaning of the high-level waste tank had been accomplished with almost all the organic material deposits removed in this process. Further discussions had been accomplished with the DHEC regarding the decommissioning project and license modification.

The November review found most decommissioning work in the final phases and the planned procedures still being followed with only minor modifications.

The December review concluded the consultants review and audit of the decommissioning project. This review again covered the current decontamination status of all the facilities; in addition, it observed the progress and procedures of the Rockwell independent radiological survey and checked the status of project documentation to be placed in records retention. The final decontamination status and the independent survey are discussed in Sections 8.0 and 9.0 of this report.

The review of documentation was made by examining typical records that were to be placed in retention by the various facility decommissioning teams and by pertinent support groups. In summary, the documentation to be on file is considered excellent. The overall project plan and individual facility decommissioning plans and procedures with marked up copies showing results and

cross references are to be placed in permanent retention. Also to be placed in the permanent file are the radiological survey data sheets and the property disposition records. An audit was made of the records for several items disposed of to offsite receivers. These records were found and were considered to be quite satisfactory.

8.0 RADIOLOGICAL SURVEY RESULTS

Health physics personnel in the AGNS SEC group were responsible for all final radiological surveys for the BNFP Decommissioning Project. After area/equipment cleanup had been completed and given a preliminary check by Operations personnel, the SEC health physics technician was called on for final survey determinations. At this time, the SEC radiological survey data report was completed and the item determined either to meet acceptance criteria or to require further cleanup. Then, as appropriate, the surplus sale tag was signed, and the area was posted as clean or another condition notification was made.

For items that were to leave the plant, radiological survey procedures called for both total (instrument reading) and removable radiological determinations. For facility equipment and area surfaces that were to remain intact in the plant, the radiological determinations emphasized removable material as obtained by smear survey. The criteria applied are shown in Table 7-1 of the Allied-General Nuclear Services, Burnwell Nuclear Fuel Plant Decommissioning Plan of October 1983, and are reproduced from that in Table 1 of this report.

The AGNS final surveys of areas and equipment were documented on individual survey data sheets as the cleanup of each area or item was completed.

AGNS contracted for ESG to perform an overview and independent radiological survey of the BNFP at the completion of decommissioning activities. The first part of the survey was performed in mid-November and the second part in early December. The survey was designed to be a comprehensive statistical sampling of accessible plant surfaces and also to emphasize the areas/items that experience has shown to be most likely to show residual material. Thus, the approach was both statistical and biased toward conservatism. The total survey employed more than 500 1-m areas throughout the plant, placed to be either statistical or biased. These were outlined with paint for future identification, and instrument readings were made for α and β,γ radiations.

TABLE 1

HP RELEASE CODE CLASSIFICATION

Type of Residual Material	HP Release Code Classification	Definition	Limits[b]	
			Alpha[c]	Beta/Gamma
Smearable[a]	A	Unconditional use of items	≤100 dpm/100 cm^2	≤100 dpm/100 cm^2
	B	Restricted use of items	>100 dpm/100 cm^2	>100 dpm/100 cm^2
Fixed	1	Unconditional use of items	≤100 dpm/100 cm	≤0.1 mR/h
	2	Restricted use of items	≥100 dpm/100 cm^2	≥0.1 mR/h

[a] No covering or coating materials shall be applied to items for the purpose of reducing removable residual levels.

[b] Except as noted (see Note No. c), the limits shown shall pertain only to to natural uranium.

[c] For items removed from plutonium handling areas in the HCLA, the unconditional use limit for smearable alpha shall be ≤10 dpm/100 cm^2.

A code letter and number designating fixed and smearable classifications shall be assigned to each item.

The restrictions associated with Health Physics Release Codes shall be applied independently and the most restrictive limits shall determine the subject item's disposition. For example, items classified with a "Health Physics Release Code of 'A1'" are defined as unconditional use items. Only authorized parties, e.g., radioactive material licensees, shall be eligible to take possession of restricted use items.

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Smears were also obtained from the survey areas and counted for alpha activity. The interiors of process tanks, piping, systems, and glove boxes were not checked. The procedures employed as well as the results are described in detail in a separate report.

The first part of the survey covered areas where cleanup was complete or was nearing completion. In general, this part of the survey found most areas to be within the radiological acceptance criteria of Regulatory Guide 1.86. Some spots were found where fixed residual uranium exceeded these guidelines, and further cleanup was verbally recommended. A few cases of removable material were also found, and further cleaning was recommended. The second portion of the survey checked areas previously found and subsequently cleaned or the surface cleaned and residual material fixed by painting. The second survey portion also covered other plant areas not covered in the first portion.

The Rockwell survey procedures are consistent with those developed in a Rockwell ESG internal report, Radiological Inspection Methods for Release for Unrestricted Use, ESG N704SRR990020, November 1982, by Robert J. Tuttle. These procedures have recently been employed in final surveys for decommissioning of the Army's Frankford Arsenal and for decommissioning Rockwell's Uranium Fuels Fabrication facility. The survey results for each project were confirmed by NRC, which granted unrestricted use to both these facilities.

Sampling of the BNFP environs was accomplished near the close of the decommissioning project by a consultant group headed by Dr. John Palms. The results and observations are detailed in a separate report by Dr. Palms.

9.0 RADIOLOGICAL STATUS

In general, the BNFP Decommissioning Project is considered by this consultant to have achieved its objectives: a radiological cleanup satisfactory to justify a minimal postclosure surveillance plan and further to facilitate future activities either for plant startup or for additional cleanup to "unrestricted use." Residual uranium in accessible areas of the plant appears to be a very low amount as determined by a significant effort, and in most cases meets the acceptance guidelines of NRC's Regulatory Guide 1.86. Residual uranium in process systems also appears to be a very low amount, as determined by a significant effort to ascertain the amount left in closed process systems. By virtue of design and prefiltration, the ventilation systems for uranium processes should be assumed to contain little residual uranium and to be inaccessible after plant closure.

In the laboratory areas where transuranics and trace quantities of fission products had been handled, the cleanup, disconnect, and sealing procedures are considered to be adequate for control of material migration over the next few years. The glove boxes and ventilation systems in these areas have been placed in a static condition; however, because of the high specific activity of these nuclides, trace amounts might migrate due to small perturbations in the sealing system. Cleanup in these areas has resulted in a current "clean" environment external to the boxes (i.e., the room and box exteriors are clean). The cleanup within the boxes was performed to the degree deemed practicable, and thus it can be assumed that amounts of residual transuranics are small.

There are a few spots of fixed contamination within the process buildings and laboratories where paint has been applied to fix the residual material. In most cases, these applications are distinct and visible.

A few representative surveys of supporting facilities, such as the warehouse, indicate these areas to be clean.

Cleanup efforts for the liquid waste tanks were conducted to the degree AGNS management deemed practical, and it was indicated that access to the tanks has been sealed.

As indicated previously, a more detailed discussion of the radiological evaluation procedures and status are to be found in the separate report.

In summary, the radiological status of most areas and equipment of BNFP to which persons might have easy access (such as the normal activities of security personnel, touring visitors, or radiological surveillance personnel) is considered to be acceptable for unrestricted access and use according to Regulatory Guide 1.86 guidelines. It is appropriate to consider providing radiological monitoring escort to future personnel entries into the transuranic laboratories, particularly the Alpha Laboratory. This area should not display any problems in material migration in the short term. If migration should occur in the future, the degree probably will be small, but detectable. Future maintenance or modification of process systems should be subjected to case-by-case planning for the possible need for radiological controls.

10. DOCUMENTATION

The objectives and plans regarding project documentation were discussed with several levels of AGNS management and were considered by the consultant to be satisfactory to fulfill present and projected needs.

The overall project plan, referenced previously and appended to this report, will be in the AGNS record management system for retention. This plan documents the project scope, objectives, management, decommissioning plans, plans for equipment and waste disposition, and plans for documentation as well as other aspects of the planning for decommissioning the BNFP. This master planning document is supported by the detailed facility decommissioning plans, which are documented in individual AGNS Work Request (AWR) format.

The decommissioning AWRs typically contain detailed work instructions in sequence with provision for signoff, dating, and result entries. These entries are made and signed off by the individual performing the work or by the cognizant manager. In cases where procedure deviations were found necessary in conducting the work, these were noted or procedure addenda were written. It is the expressed intent of all the facility decommissioning managers to place these AWRs and addenda in permanent files with AGNS Record Management. The pertinent AWRs of which the consultant has knowledge are:

- General Instructions, Movable Equipment Relocation, (WI-3, 15989)
- General Instructions, Hot/Cold Laboratories (WI-3, 15985)
- Specific Plans, Hot/Cold Laboratories (WI-3, 15985 Addenda 1-20)
- Fuel Receiving and Storage Station (WI-3, 15984)
- Separations Plant, Process Vessels (WI-3, 15990)
- Separations Plant, Building Cleanup (WI-3, 15992)
- Separations Building Waste (WI-3, 16002)
- UF_6 (Project 4500300, Addenda 1-25)

Documentation concerning inventory items that were sold, donated, or transferred to offsite parties also is to be kept in record storage. Documentation regarding these items is generated and cross referenced by the participating AGNS functional groups such as Purchasing, Warehouse, and Health Physics. Equipment numbers, health physics survey data, identification of receivers, approval signatures, and the pertinent correspondence are contained in these cross-referenced records.

For project closeout, the cognizant facility decommissioning managers are preparing accomplishment and status reports regarding their phases of the decommissioning project. These reports are to become part of the project record. Other reports and correspondence that will enter the project file include: reports by this consultant, reports and data sheets for the Rockwell independent radiological survey, the report on environmental sampling by Dr. John Palms, and correspondence with the State of South Carolina on license modification.

11.0 COMPARABLE DECOMMISSIONING PROJECTS

For purposes of perspective, it may be helpful to discuss decommissioning projects for which the consultant has recent first-hand knowledge and which have some comparable characteristics. Rockwell recently performed decommissioning of two different facility complexes in which cleanup principally involved the removal of residual uranium to levels below those acceptable to the regulatory agency: (1) cleanup of the U.S. Army's Frankford Arsenal in Philadelphia and (2) cleanup of the Rockwell Advanced Test Reactor Fuel Fabrication Facility and support areas in Canoga Park (California).

The objective of the Frankford Arsenal cleanup project was to remove low levels of depleted uranium and heavy metal and explosive residues to permit release of the Arsenal complex to "unrestricted use." This complex covered 110 acres in the City of Philadelphia. Residual uranium cleanup was performed for 12 major buildings in this complex along with associated sumps and liquid disposal systems. Radium was also found in some areas and removed. This project was performed in 1980-1981, and after confirmatory surveys by NRC, the facility was released to the U.S. General Services Administration for "unrestricted use" disposition. Various portions of the complex have since been turned over t Philadelphia and to industrial users.

Frankford A covered by NRC license, and the license was terminated by the NRC eanup was shown to meet the criteria expressed as radiological cl in the NRC Regulatory Guide 1.86. The Rockwell final sur arallel to that employed by Rockwell in performing the overc surve for the BNFP decommissioning project. At Frankford, the Rockwell survey findings were confirmed by both Army and NRC overchecks.

Decommissioning of the Rockwell Advanced Test Reactor (ATR) Fuel Fabrication Facilities began in late 1982 and was completed in 1983. Decommissioning of support laboratories in a different facility is near completion at this

time. The facilities, located on Rockwell property in the Canoga Park area of Los Angeles, were used to fabricate fuel from enriched uranium. The facilities were licensed by the NRC. The State of California licenses other operations with radioactive material at the same location. The objective of the decommissioning was to clean to levels permitting "unrestricted use" as viewed by both NRC and California. The criteria adopted for cleanup were consistent with NRC Regulatory Guide 1.86 and California guidelines.

The fabrication facilities that have been cleaned consisted of equipment and areas for powder processing (included glove boxes, crushing and blending machines, melting furnaces and presses), rolling, cutting, assembly, and inspection. Decommissioning was also performed for QA and metallurgical laboratories and for ventilation and liquid drain systems.

The Rockwell final survey was parallel to that employed for the BNFP overcheck survey. The NRC overcheck for the ATR decommissioning project confirmed the cleanup was effective and met Regulatory Guide 1.86 guidelines.

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APPENDICES

A. Consultants' Resumes

B. Allied-General Nuclear Services, Barnwell Nuclear Fuel Plant, Decommissioning Plan

C. Nuclear Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors

D. Results of Separations Facility Process Tank Flush Water Sampling

E. Letter, AGNS to South Carolina Department of Health and Environmental Control, Application for Amendment – South Carolina Radioactive Materials License No. 144

APPENDIX A

CONSULTANTS' RESUMES

W. D. KITTINGER – PRINCIPAL CONSULTANT, BNFP DECOMMISSIONING PROJECT
– PROJECT MANAGER, PLANNING AND DEVELOPMENT
DECOMMISSIONING PROGRAMS, ROCKWELL ESG

EDUCATION

1950 University of Colorado; B.S., Chemical Engineering

1957-1961 University of Colorado; Business Management

1971-1973 Colorado State University; Environmental Engineering

PROFESSIONAL

Certified, American Board of Health Physics (certified 1963 by examination, recertified 1981)
Member of Health Physics Society
Member of American Nuclear Society
Member of American Society of Mechanical Engineers (Chairman ASME Decommissioning Subcommittee, Reactor Servicing Committee)
Member of American Industrial Hygiene Association

EXPERIENCE

Over 31 years' professional experience in health physics, environmental controls, safety engineering, and decontamination and decommissioning (D&D) areas. Over 20 years' experience directly related to D&D. Held supervisory and management positions for 30 years.

Since 1977, has provided management for DOE SFMP decommissioning projects and D&D projects for other clients. Specific responsibilities have include design of project approaches and technology applications; design of controls for worker and environmental radiation protection; monitoring and control of project performance from administrative, technological, and health protection aspects; project reporting and interface with regulatory agencies and customers.

Served as Program Manager for the decontamination and decommissioning of eight major nuclear facilities at the Rockwell International Santa Susana Field Laboratory, decontamination of Frankford Arsenal, decontamination of the CWTA facility at KAPL, decommissioning of the Diamond Ordnance Radiation Facility, and national decommissioning planning for the DOE. All projects were accomplished with excellent safety, environmental control, and radiation control performances as well as success with technical, cost, and schedule performance.

Served as advisor and contributor, regarding decontamination techniques and acceptance levels to the West Valley Tank Decontamination and Decommissioning Task Group (sponsored by New York State Attorney General's Office, Bureau of Environmental Protection). Also served on West Valley DEIS Review Committee by DOE and ANL.

A member of ESG's Isotopes Committee which functions within the Radiation Safety Panel to review, evaluate, approve, and monitor all work with radioactive materials at the California operations.

Previous experience was 25 years with the DOE Rocky Flats plant (near Denver) with 24 years of supervisory and management positions in the Health, Safety and Environment function. At Rocky Flats, designed and managed environmental survey and monitoring programs; managed radiation survey, evaluation, and radiological engineering functions; and managed decontamination operations for large manufacturing, chemical recovery, waste processing and R&D facilities. Managed professional health physics and technician staff of up to 125 persons. Managed radiological and environmental evaluations and controls for decontamination and restoration of 300,000 ft^2 plutonium facility following a fire incident in 1969 (a $45 million effort).

At Rocky Flats, structured and managed the total plant respiratory protection program and design and performed training programs for employees and subcontractors. For 2 years, managed the Engineering and Safety Analysis group providing safety and radiological engineering review of all construction and operations projects, fire protection engineering, performance of SARs, and a crew of area safety coordinators who provided liaison on all occupational and environmental safety matters.

PUBLICATIONS

"Lessons Learned in Decommissioning the Sodium Reactor Experiment," W. D. Kittinger, B. F. Ureda, and C. C. Conners. Proceedings of the 1982 International Decommissioning Symposium, Seattle, Washington, October 1982

"Practical Technological Benefits of SRE Decommissioning," B. F. Ureda, C. C. Conners, and W. D. Kittinger. ASME/ANS Nuclear Engineering Conference, Portland, Oregon, July 1982, Published as ASME 82-NE-21

"Atomics International's Recent Decommissioning Experience," W. D. Kittinger. Proceedings of Conference 741234, Environmental Decontamination Workshop, Oak Ridge, Tennessee, December 1979

"Nuclear Power, Waste Management and Decommissioning," R. Balent, D. G. Mason, and W. D. Kittinger. Paper for Measurement Science Conference, San Luis Obispo, California, November 1979

"Decommissioning the Sodium Reactor Experiment, A Status Report," W. D. Kittinger and G. W. Meyers. Proceedings of a Conference, Decontamination and Decommissioning of Nuclear Facilities, Sun Valley, Idaho, September 1979, Plenum Press 1980

"Experience and Techniques in Atomics International's Recent Decommissioning Programs," W. D. Kittinger, B. F. Ureda, and J. W. Carroll. Presented at 1979 Health Physics Society Annual Meeting, Philadelphia, Pennsylvania, July 1979

"Progress Report on Dismantling the Sodium Reactor Experiment," G. W. Meyers and W. D. Kittinger. Proceedings of an International Symposium, Decommissioning of Nuclear Facilities, Vienna, Austria, November 1978, IAEA publication

"Progress Report on Decommissioning the Sodium Reactor Experiment," W. D. Kittinger and G. W. Meyers, Transactions of the Winter Meeting American Nuclear Society, Washington, D.C., November 1978, published by ANS

ROBERT J. TUTTLE – CONSULTANT SUPPORT, BNFP DECOMMISSIONING PROJECT
– MANAGER, RADIATION AND NUCLEAR SAFETY, ROCKWELL ESG

EDUCATION

1957 California Institute of Technology; B.S., Physics

1957-1974 UCLA Extension; Mathematics, Physics, and Engineering

PROFESSIONAL

Professional Nuclear Engineer, State of California
Certified Health Physicist, American Board of Health Physics
Member, American Nuclear Society
Member, Health Physics Society

EXPERIENCE

Mr. Tuttle has 26 years' experience in reactor experimentation, operation and design, and radiation protection, including 9 years in management of the radiation safety and criticality prevention group. He is responsible for engineering, monitoring, and dosimetry related to personnel safety in operations with radioactive material; for the review of programs involving radioactive materials and sources of radiation; and for development and review of procedures for analyzing radioactive waste. He serves as secretary of the Rockwell ESG Management Safety Committee.

Mr. Tuttle is the radiation safety officer named on the State of California Radioactive Materials License authorizing internal review of operations with a broad range of radioactive materials. Prior to this designation, he was chairman of the Radiation Safety Review Committee.

Mr. Tuttle established the environment, safety, and health program for the Frankford Arsenal decontamination project in Phildelphia and managed it through the startup phase. He provided home office support for decontamination projects at Knolls Atomic Power Laboratory, Diamond Ordnance Radiation Facility, and the Alabama Army Ammunitions Plant. He has refined statistical methods for analysis of data and applied these to development of sampling inspection plans for effective and efficient acceptance surveys in several decontamination projects.

He has been instrumental in the development of radiological acceptance criteria applied at the Frankford Arsenal and Santa Susana projects and in reaching agreements with the agencies involved.

His prior assignments involved positions of research engineer, physicist, senior physicist, and Member of Technical Staff. Major activities included significant work in experimental reactor physics, investigating fast reactor

fuel and control materials, instrumentation and control system design, and delayed-neutron data evaluation. Mr. Tuttle has been a licensed senior reactor operator for a critical experiment facility and a research reactor.

PUBLICATIONS

Mr. Tuttle has presented papers at several national and international conferences. He has written a variety of journal articles and internal reports on reactor physics and nuclear data, nuclear safety, and radiation measurements. These publications include "Radiation Protection in Decommissioning the Sodium Reactor Experiment" presented at the American Nuclear Society Winter meeting, 1978, and "Development and Application of Sampling Inspection in a Decontamination Program" presented at the Health Physics Society Annual meeting, 1981.

CLAUDE C. CONNERS – CONSULTANT SUPPORT, BNFP DECOMMISSIONING PROJECT
- PROGRAM MANAGER, DECOMMISSIONING PROGRAMS, ROCKWELL ESG

EDUCATION

1950 University of California at Berkeley, B.S., Mechanical Engineering
1970 University of California at Los Angeles, M.S., Engineering

PROFESSIONAL

Registered Professional Engineer, Mechanical Engineering, California
Registered Professional Engineer, Nuclear Engineering, California

EXPERIENCE

Mr. Conners has 33 years' engineering experience, including 25 years in management. His experience includes design, analysis, fabrication, construction, operation, maintenance, test, and D&D of nuclear facilities.

Since 1981, he has been program manager of Decommissioning for Atomics International. In this capacity, he has technical, cost, and schedule responsibility for decommissioning projects and is accountable for the overall performance and successful completion of the projects. His specific responsibilities are to manage the projects from planning activities through dismantlement operations to completion of all tasks, including records and reports. Projects have included decommissioning of the fuel fabrication facilities in ESG's Building 001 at Canoga Park, the plutonium fuel fabrication facility (Building 055) at ESG's Santa Susana Field Laboratories (SSFL), and the Sodium Reactor Experiment (SRE), also at SSFL.

His prior assignments at AI from 1952 through 1981 included manufacturing and engineering of reactor vessels, construction of the SRE, and construction management for the Hallam Nuclear Power Facility (HNPF) near Lincoln, Nebraska. Also included were management assignments for the design of high-temperature liquid metal piping systems, development of large sodium pumps, testing of liquid metal components, analysis of high-temperature components to ASME Section III Code and nuclear standards, and design of nuclear specialty components (e.g., steam generators, pumps, and fuel handling equipment). These assignments involved direct supervision and management responsibilities ranging from construction activities through maintenance, operation, and test to highly technical design and analysis work for nuclear equipment and facilities.

DAVID L. SPEED – CONSULTANT SUPPORT AND OVERVIEW SURVEY TEAM LEADER,
BNFP DECOMMISSIONING PROJECT
– HEALTH PHYSICIST, ROCKWELL ESG

EDUCATION

Slippery Rock State College, B.S., Chemistry
University of Utah, Computer Science and Statistics

PROFESSIONAL

Health Physics Society
American Chemical Society

EXPERIENCE

Over 9 years' experience in the nuclear industry with primary experience in radiological engineering, exposure protection controls, and low-level environmental monitoring.

Radiological engineer for overview survey project, Allied General Nuclear Services Barnwell Plant.

Mr. Speed is currently responsible for direction of radiation protection procedures and surveillance in decommissioning a reactor fuel fabrication facility, including the identification of areas requiring decontamination, advising on decontamination methods, and performance of the final radiological survey. He is responsible for development of a computerized data-base management system for organizing and interpreting radiological survey data in decommissioning projects.

Two years' experience in California Radiological Health Branch, the regulatory agency in this NRC Agreement state responsible for statewide nuclear industry regulation. Project officer for California's study of preplanning for decommissioning; scoping the project, giving guidance and providing controls to the contractor. Mr. Speed also reviewed environmental monitoring programs, decontamination and decommissioning plans and procedures, and performed surveys, inspections, and investigations. Provided liaison with NRC and utility companies on power reactor matters.

Five years' health physics experience in a wide variety of Light Water Power Reactors designs with major experience at Shippingport, Beaver Valley, Peach Bottom, Salem and Fitzpatrick stations. Assisted in the Shippingport LWR to LWBR conversion.

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October 14, 1983
Revision 1

APPENDIX B

ALLIED-GENERAL NUCLEAR SERVICES
BARNWELL NUCLEAR FUEL PLANT
DECOMMISSIONING PLAN

October 1983

GLOSSARY

AEC	- Atomic Energy Commission
AGNS	- Allied-General Nuclear Services
AWR	- AGNS Work Request
BNFP	- Barnwell Nuclear Fuel Plant
CFR	- Code of Federal Regulations
CNSI	- Chem-Nuclear Systems, Inc.
DOE	- Department of Energy
FAA	- Federal Aeronautics Administration
FRSS	- Fuel Receiving and Storage Station
HCLA	- Hot and Cold Laboratory Area
HP	- Health Physics
HWP	- Hazardous Work Permit
LTRC	- Lower Three Runs Creek
LWR	- Light Water Reactor
MTU	- Metric Tons of Uranium
NRC	- Nuclear Regulatory Commission
OSC	- Operational Safety Committee
RWP	- Radiation Work Permit
R&D	- Research and Development
SCDHEC	- South Carolina Department of Health and Environmental Control
SEC	- Safety and Environmental Control
SRP	- Savannah River Plant
TBP	- Tributyl Phosphate
TRU	- Transuranic
UF_6	- Uranium Hexafluoride
WTEG	- Waste Tank Equipment Gallery

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1.0 INTRODUCTION

1.1 Purpose

This Plan has been prepared to describe fully the decommissioning of the Barnwell Nuclear Fuel Plant (BNFP), including non-radiological considerations and non-licensed facilities, in a single, comprehensive document. Therefore, the procedures and status described herein are not necessarily intended to reflect license requirements. Proposed specific license conditions will be submitted as part of the BNFP license amendment application.

1.2 General Background

The BNFP was designed and constructed, as a privately owned facility, to process light-water reactor fuel equivalent to 1500 metric tons of uranium per year. A Construction Permit was applied for on November 6, 1968 and issued (as CPCSF-4) by the Atomic Energy Commission on December 18, 1970. Construction began in early 1971 and presently existing facilities were essentially completed by mid-1976.

These facilities provide for fuel receiving and storage, separation of the uranium, plutonium and fission products in the spent fuel, conversion of uranyl nitrate solution to uranium hexafluoride (UF_6), storage of plutonium nitrate and liquid wastes and for laboratory analyses and research. As these facilities were completed, cold testing for operability was conducted using natural uranium as surrogate fuel. At no time has spent nuclear reactor fuel been present at the BNFP. During this period applications were made for other requisite Federal licenses and permits.

1.3 Reason for Shutdown

On December 23, 1977, responding to an abrupt reversal of long-standing governmental policy, the Nuclear Regulatory Commission terminated all licensing proceedings related to reprocessing and recycle of recovered products, leaving undisturbed, however, the BNFP Construction Permit. Promptly thereafter, in early 1978, recognizing the BNFP as a national asset, the Congress authorized and provided funding for research and development programs at the BNFP in support of national policy. This R&D work, which continued through July 1983, involved use of all on-site facilities other than the Uranium Hexafluoride Conversion Facility which was deactivated and placed in standby status.

In December 1982, the Congress passed a resolution which specified that "no Federal funding is provided for any activities at the Barnwell Plant beyond July 31, 1983." Proceeding on that basis, activities leading to an orderly shutdown of the BNFP by year-end 1983 were initiated in May.

There is continuing industry/utility interest in the possibility of making a proposal to the Department of Energy for future operation of

the BNFP. If such proposal is made, it may be possible to modify the ongoing shutdown program. However, in the absence of such proposal, activities leading to shutdown in December 1983 continue. These activities include implementation of this Decommissioning Plan.

2.0 BNFP DESCRIPTION AND HISTORY

2.1 Site Location and Description

The BNFP is located about 7 miles west of the City of Barnwell on a site of approximately 1706 acres of land of which approximately 200 acres have been cleared. This site is situated in a predominantly rural area in Barnwell County, South Carolina. The plant base line reference is positioned at the approximate Mercator coordinates of latitude 33°15'0" N and longitude 81°29'20" W (South Carolina State Lambert coordinates Y:516,100 and X:1,850,300).

The BNFP site is bounded on the west and south by the DOE Savannah River Plant (SRP) reservation, on the east by the Chem-Nuclear Systems, Inc. (CNSI) site, and on the north by the Barnwell County Industrial Park.

The location of the BNFP site with respect to South Carolina and Georgia is shown in Figure 2-1. The site perimeter relative to surface streams, abutting properties, industrial plants, and other items of specific interest within a five-mile radius is shown in Figure 2-2.

The BNFP site is largely forest land, with a small number of abandoned farm fields undergoing secondary succession, and several Carolina Bays. Forestation consists of loblolly pine plantings, mixed-pine forests, and mixed pine-hardwood (scrub oak) forests.

There are no natural streams on the BNFP site.

The plant site is wholly-owned private property. A right-of-way for Osborn Road, which is the principal access road to the site, has been granted to the State of South Carolina. An easement for the power transmission lines that supply the BNFP has been granted to South Carolina Electric and Gas Company. The railroad spur serving the Fuel Receiving and Storage Station (FRSS) within the site boundary is wholly AGNS-owned.

A plot plan of the BNFP plant area showing significant features is presented as Figure 2-3. A chain-link exclusion fence has been installed around the plant area.

2.2 Separations Facility

The Separations Facility was designed to process 1,500 metric tons of uranium (MTU) per year at a daily rate of 5 MTU/day. The plant was designed for processing fuel elements that prior to irradiation had a fissile material content of up to 5% U-235 or the equivalent for plutonium fuels.

The process systems in the BNFP for the recovery of special nuclear material are an adaptation of the Purex solvent extraction process, for which the technology and risks are well-defined.

The Separations Facility includes five (5) contact maintenance cells, two (2) remote maintenance cells, two (2) plutonium nitrate storage cells and associated equipment, e.g., pumps, instrumentation, and piping. Only liquid process equipment in the Separations Facility has been exposed to solutions containing uranium (natural only). No plutonium has been used in any process area. Process support equipment, such as the shear and cranes, has not had direct contact with uranium. The plutonium nitrate storage cells and auxiliary systems have not been in contact with uranium. Closed-loop cooling water and steam generating systems are clean; however, their status will be verified. The status of the Plant's ventilation systems will also receive consideration depending on areas it serviced, some of which have been exposed to natural uranium. Generally, residual in-cell natural uranium contamination levels were less than 1000 dpm/100 cm^2 α and 2000 dpm/100 cm^2 $\beta\gamma$ smearable prior to the start of decommissioning. Process piping and vessels that have contained solutions of natural uranium may have higher levels. Such levels in normal access areas, (e.g., operating stations, piping and instrument galleries, stairwells and hallways), in general are less than 50 and 500 dpm/100 cm^2 α and $\beta\gamma$ smearable, respectively.

2.3 Uranium Hexafluoride Facility

The UF_6 facility contains equipment to convert uranyl nitrate to uranium hexafluoride. This equipment is housed in an eight-story metal frame building. Some of the process-related equipment, such as piping, calciners, screw conveyors, bag houses, and vessels, has been in direct contact with uranium, in most cases in the form of uranium oxide powders. Auxiliary systems and areas, such as compressors, refrigeration, fluorine production and UF_6 cylinder loading/unloading, have not been in direct contact with uranium. Residual uranium levels in normal access areas are comparable to those that exist in the Separations Plant.

2.4 Hot and Cold Laboratory Area

The Hot and Cold Laboratory Area contains a temporary lunchroom, a change and locker room, Health Physics support offices, and laboratories.

The Analytical Chemistry Laboratories consist of individual laboratories equipped to provide specific types of analyses or services. The laboratories include all facilities required for analyzing samples for purposes of process control, accountability and safeguards, product and raw material specifications, and process instrumentation calibration.

The Analytical Chemistry Laboratories have been used for DOE-sponsored research and development work, support of plant cold testing, and analytical procedures development. Radioactive materials have been used in all of the laboratories. Plutonium has been used in six laboratories; thus, the hoods and glove boxes in these six laboratories contain residual TRU.

The Engineering and Technical Laboratories consist of an Engineering Laboratory, Alpha Laboratory, Radiochemical Laboratory, and Cold Chemical Laboratory.

The Engineering Laboratory consists of pilot-plant scale equipment, e.g., stainless steel tanks up to 500 gallons capacity (15-20 vessels), pumps, heat exchangers, instruments, three glass pulse columns, pulsers, piping, and valves. Only uranium and thorium have been used in this laboratory.

The Alpha Laboratory contains three very large glove boxes and one standard fumehood. One box (18'L x 10'H x 2.4'D) contains solvent extraction pulse columns and ancillary equipment, such as glass vessels, pumps, stainless steel tubing, and valves. A second box (approximately 25'H x 10'L x 5'D) is used for waste solution handling. This box contains a vacuum pump, stainless steel tank, glass mixing vessel, and several 26-liter polyethylene bottles for storage of waste. The third glove box is used for analytical tests. All three glove boxes and their residual plutonium.

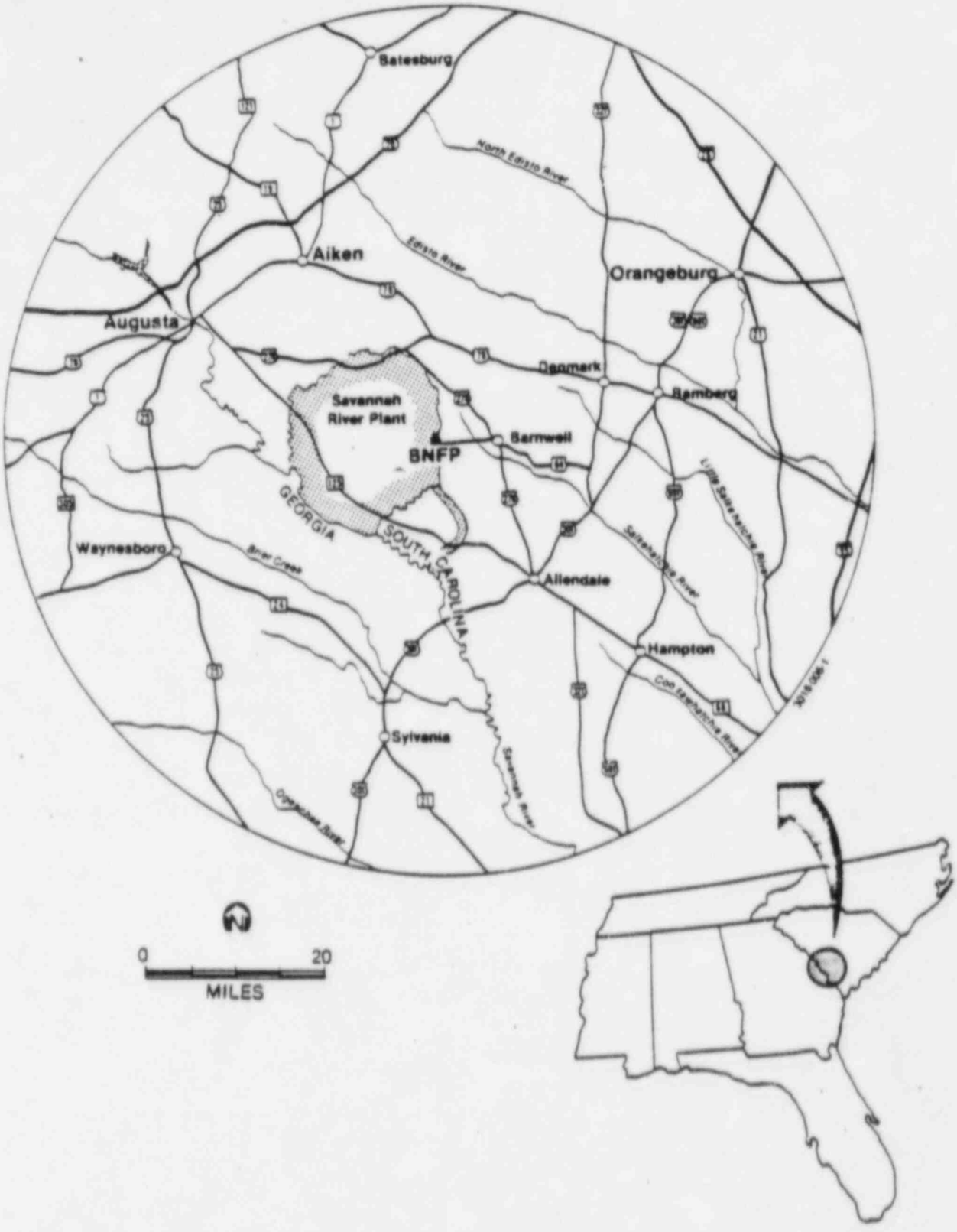
The Radiochemical and Cold Chemical Laboratories are standard chemical laboratories containing fume hoods, normal bench tops, and sinks, and are equipped with standard chemical labware. These laboratories have been used for work with natural and/or depleted uranium and by-product tracer level radionuclides. No plutonium has been used in the Radiochemical and Cold Chemical Laboratories.

2.5 Other

The Fuel Receiving and Storage Station (FRSS) contains a cask testing and decontamination pit, two (2) cask unloading pools, a fuel storage pool, and associated pool water cooling and treatment equipment and handling cranes. The FRSS has not been exposed to radioactive materials.

The Waste Tank Equipment Gallery (WTEG) houses the pumps, piping, and equipment for maintaining and sampling the three (3) underground liquid waste storage tanks. Some transfer and sampling lines have contained uranium solutions, but the general area is clean. Two of the three underground storage tanks have also contained uranium-bearing solutions.

Support facilities, such as the utility area, administration buildings, shops, and warehouses have never been exposed to radioactive materials.



BNFP SITE LOCATION

FIGURE 2-1

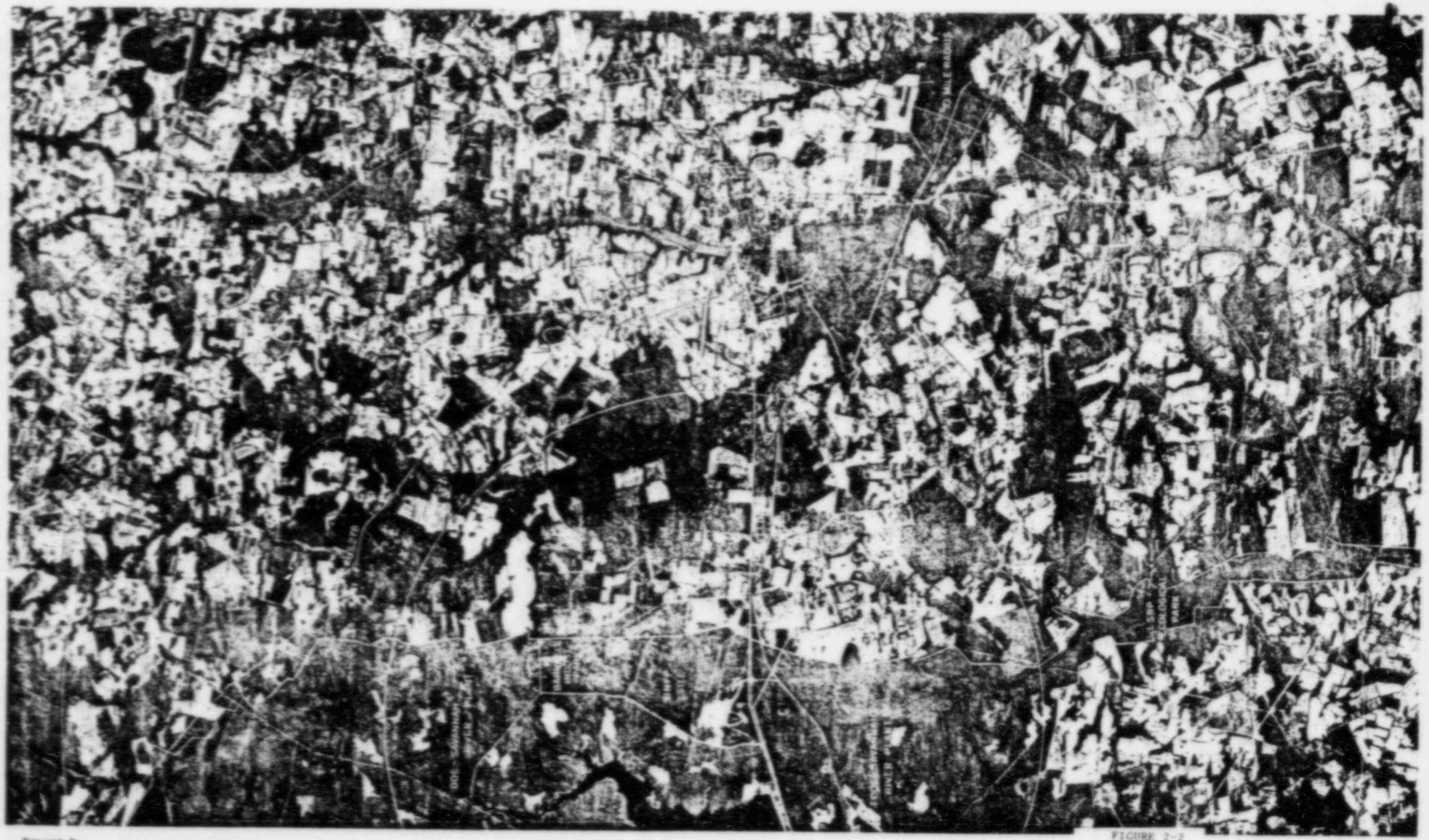


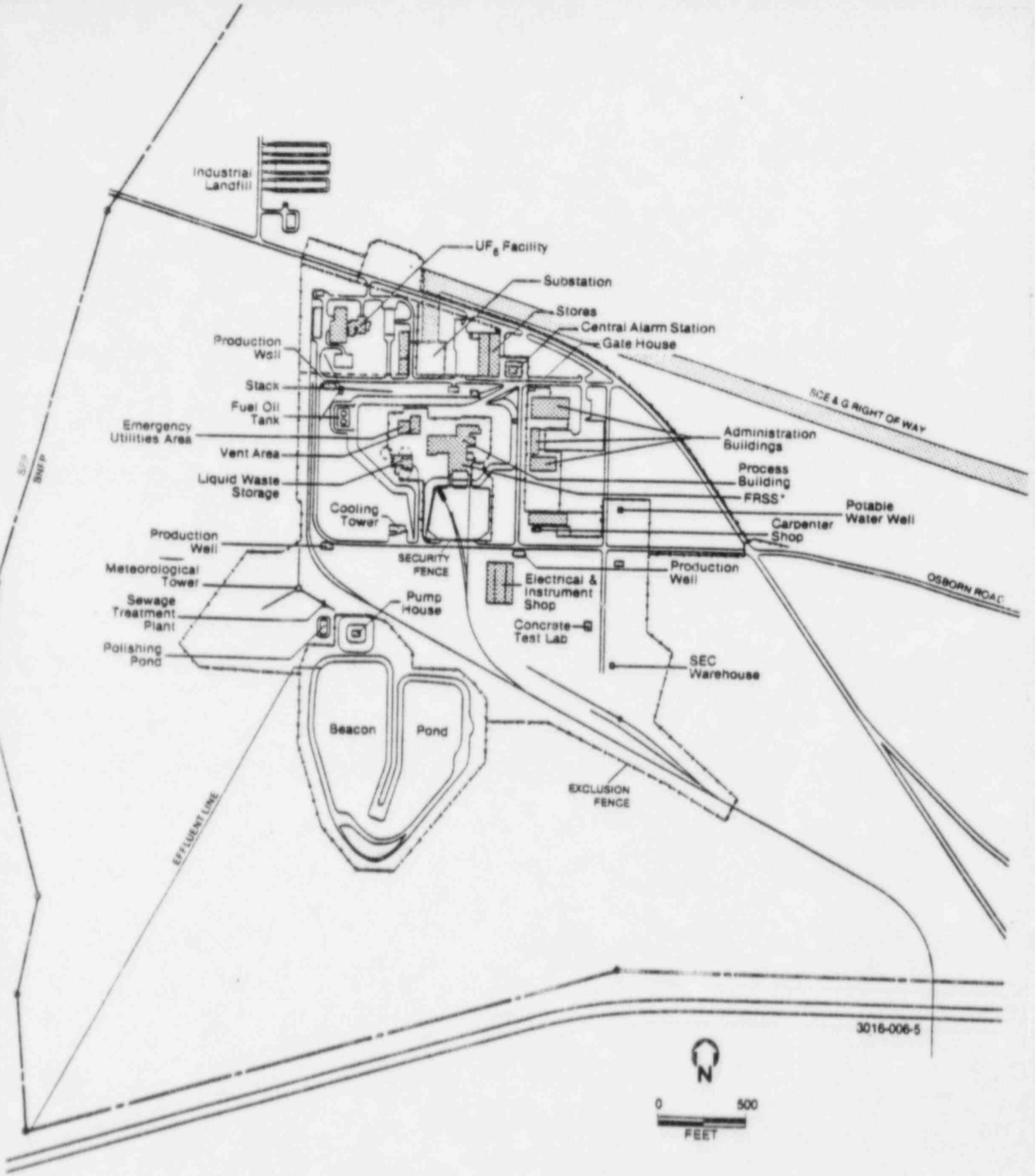
FIGURE 2-2

AERIAL PHOTOGRAPH
BNFP SITE AND SURROUNDING AREAS
BARNWELL COUNTY, SOUTH CAROLINA

NORTH

SCALE 1" = 7000'

DATE OF PHOTOGRAPHY : 10/14/1980



PLOT PLAN OF THE BARNWELL PLANT

FIGURE 2-3

3.0 DECOMMISSIONING OBJECTIVES

The objective of the BNFP Decommissioning Plan is to place the BNFP facilities and the site in such a condition that a minimal level of radiological controls and security will be required following shutdown. The Plan is consistent with preserving the option of reprocessing at the BNFP in the near term future. However, should a decision be made later that the reprocessing option no longer needs to be preserved, then the plan provides that the future level of effort necessary to place the facilities in an "unrestricted use" status also should be minimal. To accomplish the Plan's objectives, source, special nuclear, and by-product materials will be removed from the site. Low levels of residual natural uranium will remain on the interior surfaces of process piping and vessels. In addition, some residual plutonium contamination will remain on the interior surfaces of glove boxes. The TRU glove boxes will be isolated from ventilation systems and securely sealed. The exterior surfaces of equipment and structures will be cleaned to the "unrestricted use" levels set forth in NRC Regulatory Guide 1.86.

Selected equipment outside of process cells will be salvaged and sold. All waste will be disposed of in accordance with existing regulations. AGNS will submit to the SCDHEC an application to amend its existing state radioactive material license to a "possession only" license. The facilities will be closed and all access points secured. Continued surveillance will be provided as described in Section 10.0 of this plan.

4.0 REGULATORY REQUIREMENTS

Allied-General Nuclear Services (AGNS) has been licensed by the State of South Carolina to possess and use radioactive materials. The State regulations governing the use of radioactive materials are published in "Rules and Regulations for Radiation Control, Regulation No. EC-1." The shutdown and decommissioning of the BNFP will be conducted under these regulations and in conformance with existing AGNS procedures which are incorporated by reference in the State license. Although the State regulations do not specifically address decommissioning, Section RHA 2.19 states that the "Department may terminate a specific license upon request submitted by the licensee to the Department in writing." It is intended that this decommissioning plan and the supporting documentation which will be generated during the course of decommissioning will support an application to amend AGNS' current State license to be a "possession only" licensee.

A second set of applicable regulatory requirements is associated with the AGNS Construction Permit granted under 10 CFR Part 50. 10 CFR 50, paragraph 50.82 states that "a licensee must submit decommissioning plans to the NRC." However as with State Regulations, no specific guidance is provided. The NRC recently revised 10 CFR Parts 30, 40, and 70 for the purpose of establishing procedures for termination of licenses. Although these revisions address the question of acceptable levels of residual radioactive materials, no specific limits were established. Regulatory Guide 1.86, "Termination of Operating License for Nuclear Reactors," dated June 1974, included by reference in numerous NRC-issued licenses as guidelines for release of facilities for unrestricted use, will be so used during the decommissioning activities.

All other applicable State and Federal regulations governing packaging, transportation, and disposal of radioactive and hazardous materials, shutdown of sanitary waste treatment facilities, inert industrial waste landfills, etc., also will be followed.

5.0 MANAGEMENT PLAN

5.1 Management Organization

The AGNS present management organization is depicted in Figure 5-1. Dr. J. A. Buckham, President, has appointed J. H. Ellis, Director, Operations, to be Chairman of the BNFP Shutdown Steering Committee. The Committee has the responsibility for detailed planning, scheduling, and conduct of the plant shutdown and decommissioning program. Other committee members are:

J. L. Aughtman - Manager, Procurement and Material Control
J. H. Mestepey - Manager, Plant Engineering and Maintenance
J. J. Jernigan - Controller
M. Hawkins - Manager, Safety and Environmental Control

The functional decommissioning project organization is shown in Figure 5-2.

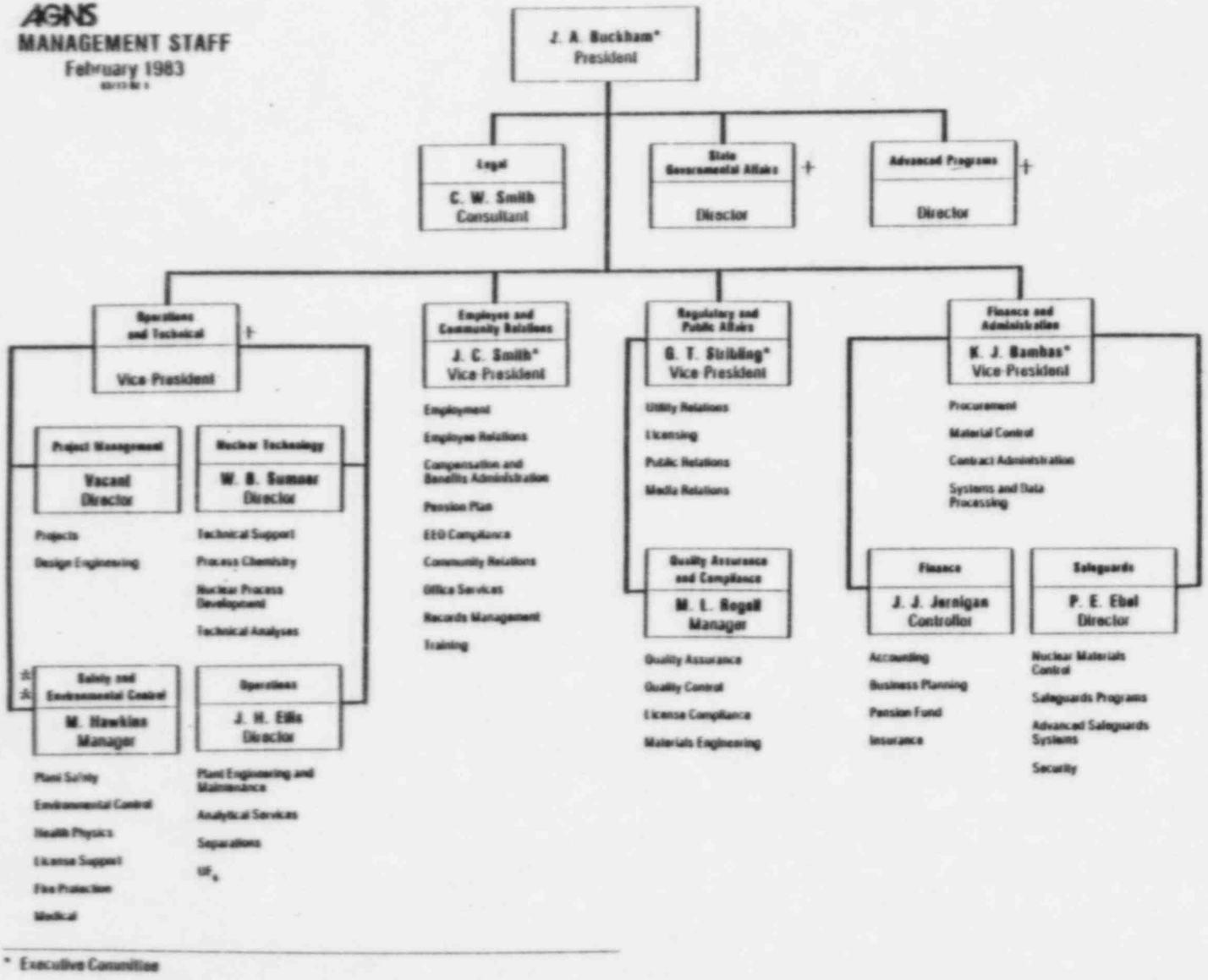
5.2 Quality Assurance and Safety

Quality assurance considerations will be in conformance with the BNFP Quality Assurance Program as set forth in AGNS Policy and Procedure Q-11. The program will be utilized to monitor and provide documented evidence of activities during the period of decommissioning.

The AGNS Operational Safety Committee (OSC) will remain functional during the decommissioning period. The OSC provides a management oversight function to assure that activities conducted at the BNFP are carried out in a manner consistent with the safety policies of AGNS and in conformance with all applicable regulations.

5.3 Consultant

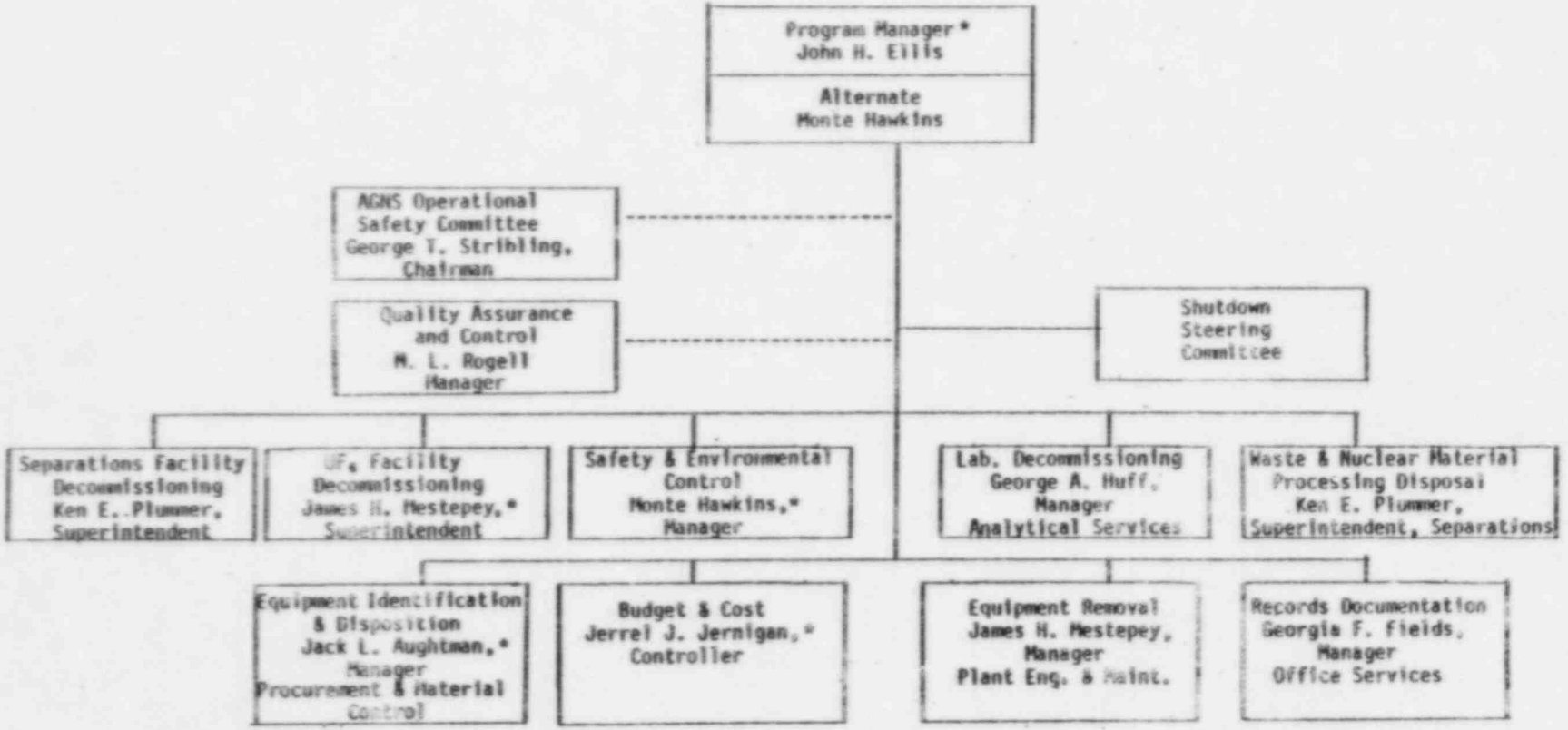
AGNS has contracted with Rockwell International of Canoga Park, California as a consultant to provide an independent review of the BNFP decommissioning program. This action was taken to provide added impartial and objective assurance that the decommissioning program is properly planned, documented and performed. Rockwell has conducted an initial review, resulting in a number of recommendations all of which have been incorporated in this decommissioning plan. Rockwell will also perform an independent radiological survey to verify the final radiological status of the facilities. This consultant is to prepare reports addressing the adequacy of the decommissioning plan and procedures, as well as perform periodic reviews during the course of decommissioning. A final report summarizing the results of the decommissioning program will be prepared. This final report will be available for review by appropriate regulatory agencies as will other supporting documentation.



**Now reports to the Director of Operations.
+As part of the shutdown plan, these employees have been terminated and the positions are now vacant.

AGNS MANAGEMENT STAFF

FIGURE 5-1



*Steering Committee Member

DECOMMISSIONING PROJECT ORGANIZATION

FIGURE 5-2

6.0 DECOMMISSIONING PLAN AND ANTICIPATED RESULTS

Existing AGNS procedures will be followed during decommissioning operations. A Hazardous Work Permit, Radiation Work Permit, AGNS Work Request and/or Work Instruction will be issued by AGNS to cover items of work in order to provide written instructions, to assure compliance with existing procedures and regulations, and to document that the work was done.

Disposal of non-TRU Radwaste, TRU waste, non-rad waste, and non-rad hazardous waste will be governed by existing AGNS procedures.

6.1 Separations Facility

6.1.1 Process Systems

Process solutions will be removed from process vessels and piping. Unused TBP and diluent will be removed from their respective feed tanks. Solvent with uranium contamination will be cleaned with sodium carbonate. Process solutions will then be packaged for off-site disposal or sale. Approximately 14.5 MTU of DOE-owned natural uranium, in the form of uranyl nitrate solution, will be shipped* to an off-site vendor for conversion to UF_6 prior to return to DOE.

In order to remove residual quantities of uranium and reduce residual internal levels in the Separations process equipment and piping, nitric acid and water flushes will be performed. Internal smear surveys will be taken from selected vessels and piping sections prior to performing an initial acid flush. Solution samples will be taken before and after "flushing" so that the effectiveness of this flushing can be determined. Additional (repeat) internal smear surveys will also be taken. Where indicated, vessels will also be flushed with sodium carbonate solutions to remove organic residues.

Data collected from this initial flush will be used to determine if an additional acid flush is required on all or part of the process. Waste generated from these acid flushes will be collected in a waste tank. Following these acid flushes, a water flush will be performed and process vessels and piping will be filled to overflow. A final dilute acid flush will then be performed to enhance clean-up and to assure passivation of the internal surfaces of the piping and vessels. All flush solutions will be collected and prepared for off-site disposal.

Records will be maintained to document the history of clean-up of major vessels and process systems (internal residual levels, type and number of flushes, etc.).

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*Shipment was completed on September 26, 1983.

It is expected that the above cleanup and flushing program will result in residual uranium levels on the interior surfaces of process piping and vessels of less than 1000 dpm/100 cm^2 smearable natural uranium alpha. The results of the flush solution samples and smear surveys of the interior surfaces of process systems will be analyzed to verify this expected result.

6.1.2 Process Building Cleanup

All areas of the process building (contact cells, remote cells, galleries, stations, and areas) will be cleaned to levels as low as practicable. Direct radiation levels in the buildings will not exceed background. Final radiological surveys will be performed.

To the extent practicable, all wood, paper, flammable liquids, and other combustibles will be removed from the process building.

Cell ventilation lines will be surveyed by Health Physics (HP), and closed off. Ventilation and off-gas filters will be left in place.

After clean-up is complete, all water will be shut off and all lines drained. All electrical service will be de-energized and the buildings secured.

6.2 Uranium Hexafluoride Facility

6.2.1 General

The same general procedures will be followed for cleanup of the UF_6 process system and building as are described for the Separations Facility.

6.2.2 Carbon Steel Piping and Equipment

Some systems in the UF_6 Facility have been in contact with natural uranium powder. Because they are constructed of carbon steel, these systems cannot be flushed with nitric acid. These systems will be identified, opened, and vacuum cleaned. They will then be physically removed from the facility. Piping will be discarded as non-TRU waste. Where practicable, equipment such as conveyors, blowers, valves, etc., will be transferred to Allied Corporation's Metropolis, Illinois Facility. These items will require HP approval prior to disposal or shipment.

6.3 Hot and Cold Laboratory Area

6.3.1 General

The laboratory area of the BNFP consists of analytical chemistry laboratories, an engineering laboratory and an alpha laboratory. The analytical chemistry laboratories are equipped with hoods, glove boxes,

work tables, and the necessary analytical chemistry equipment to perform sample analyses for process control, accountability and safeguards, product and raw material analyses. The engineering and alpha laboratories contain pilot plant scaled equipment and have been used for process development work.

The general plan for decommissioning the laboratory areas is to remove all radioactive sources, contaminated equipment and any other radioactive materials. Fixed work tables, hoods, and glove boxes will be left in place. Floors, ceiling, counter tops, and if possible, the interior of hoods will be cleaned to AGNS Zone II limits which are 50 dpm α/100 cm^2 and 500 dpm $\beta\gamma$/100 cm^2, smearable. The interior surface of the glove boxes which have not contained Pu will also be cleaned to Zone II limits.

The laboratory area also contains administrative offices for laboratory personnel, a temporary lunchroom, and Health Physics support offices. All of these areas will be cleaned to Zone II limits. It is expected that as a result of this decommissioning effort, the laboratory area, except for the interior surfaces of TRU glove boxes and hoods, will not have residual levels greater than Zone II levels on any accessible surfaces.

6.3.2 Portable Equipment and Supplies

Portable equipment will be cleaned and placed in storage outside of the laboratory area for future sale or disposal. If the equipment cannot be readily cleaned, it will be discarded as waste. Compatible laboratory chemicals will be discarded to the Separations Plant Waste Treatment Systems. Other chemicals will be packaged for disposal at an approved chemical disposal site.

All cabinets and drawers will be emptied and the contents removed from the laboratory for sale or subsequent disposal. The interior surfaces of cabinets and drawers will be cleaned to Zone II limits. All portable equipment will be removed from hoods and glove boxes.

6.3.3 Hoods and Glove Boxes

All accessible exterior surfaces of the hoods will be cleaned to Zone II limits. The interior surfaces of hoods will be cleaned to a level that is considered to be as low as practicable.

All drain lines from hoods, non-TRU glove boxes, and sinks will be flushed with nitric acid and water. The flush solutions will be treated in the Separations Facility Waste Systems. Flush solutions from TRU glove boxes will be collected and treated as TRU waste.

After cleaning, the glove boxes and hoods, which had contained TRU material, will be isolated from the ventilation system and other utilities. The gloves will be left in place in the glove boxes and a gasketed cover plate will be placed over the glove port. Since there

will be residual plutonium remaining in some of the glove boxes, a periodic surveillance program, as described in Section 10, will be performed to assure that the integrity of the boxes is maintained.

There are three large non-standard glove boxes in the alpha laboratory which have been exposed to plutonium. As much equipment as practicable will be removed from these boxes via existing bag-out ports. These boxes will be cleaned to a level that is considered to be as low as practicable, sealed and isolated as described above. As with the analytical laboratories, periodic surveillance will be performed.

6.3.4 Waste System

After clean-up of the laboratories is completed, all drain lines and tanks in the laboratory waste system will be flushed with nitric acid and water. It is expected that the interior surfaces of the pipes and vessels in this system will contain less than 1,000 dpm/100 cm^2 natural uranium alpha. No plutonium-bearing solution has ever contacted the laboratory waste system.

All waste disposal operations required as a result of laboratory decommissioning will be performed in accordance with existing AGNS procedures and applicable state and Federal regulations.

6.4 Other

6.4.1 Waste Tanks

There are two High-Level and one Intermediate-Level stainless steel waste tanks. Each tank has a nominal capacity of 300,000 gallons and is located inside a concrete vault which is lined with stainless steel.

One High-Level tank and the Intermediate-Level Waste Tank were used to collect wastes generated during the DOE-sponsored demonstration runs of the Separations Facility. These solutions have been removed and solidified. However, a waxy film containing a small amount of uranium adhered to some of the cooling coils in the High-Level Waste Tank. The Intermediate-Level Waste Tank has been cleaned, and it will be surveyed by HP. The second High-Level tank has not been used.

The Intermediate-Level Waste Tank will be used to collect the nitric acid flush solutions used in cleaning the Separations Facility. The used High-Level Waste Tank will collect the water flushes which follow the acid flush.

The water flush solution will provide sufficient volume to submerge the coils and sodium hydroxide solution will be added to dissolve the waxy film on them. This solution will then be used to neutralize the acid in the intermediate-level tank and the combined solutions will be concentrated and prepared for disposal at an authorized burial site.

The two tanks will then be flushed and final surveys will be taken. The unused High-Level Waste Tank will also be inspected and surveyed. All utilities will then be shut off, and the vaults will be closed.

6.4.2 Support Buildings

There are a number of support buildings such as warehouses, machine, vehicle maintenance, and instrument-electrical shops at the BNFP. All of these support facilities are clean. Portable equipment, flammable liquids, and to the extent practicable, combustible material will be removed for disposal or possible sale. Power will be shut down, and the buildings will be locked.

It is possible that the administration buildings will be used for records storage and will be occupied by records personnel for the immediate future. In addition, portable equipment will probably be stored in the warehouse.

7.0 DISPOSITION OF SURPLUS EQUIPMENT

A system has been established for controlling the distribution of surplus materials. All items of equipment or lots of similar items will be assigned a unique identification number. All pertinent data will be keyed to this number and maintained in a computerized data management system. The data collected will include, among other things, a description of the item, its value, location, to whom it was donated or sold, and Health Physics survey and release data.

7.1 Disposition of Equipment

Portable equipment (i.e., readily disconnected by unplugging or unbolting) is located in the Separations, Laboratory, and UF_6 facilities as well as administrative and support areas. This equipment includes such things as office furniture, laboratory instruments, welding machines, medical and safety equipment, and small tools. This equipment will be cleaned, tagged, surveyed by Health Physics, and moved to a designated holding area. Movement of this equipment will facilitate subsequent cleanup of the building.

Some of this equipment, such as safety and medical equipment, may be donated to area hospitals, schools, fire departments, and rescue squads; limited quantities of office furniture and other selected items will be sold to employees. Other selected equipment also will be sold. All equipment that is released from the site will be cleared by the Safety and Environmental Control Department (SEC) in compliance with existing AGNS procedures.

7.2 Radiological Controls

The SEC Department will determine whether an item can be released from the site on an "unconditional use" basis or whether it must be treated as a "restricted use" item. "Restricted use" items will be released only to organizations or persons authorized to receive radioactive materials, such as other licensees or the Department of Energy.

Table 7-1 describes the criteria to be used to determine the Health Physics Release Code classification for the release of material from the BNFP.

TABLE 7-1

HP RELEASE CODE CLASSIFICATION

Type of Residual Material	HP Release Code Classification	Definition	Limits (b) Alpha (c)	Limits (b) Beta/Gamma
Smearable (a)	A	unconditional use of items	$\leq$100dpm/100cm^2	$\leq$100dpm/100cm^2
	B	restricted use of items	>100dpm/100cm^2	>100dpm/100cm^2
Fixed	1	unconditional use of items	$\leq$100dpm/100cm^2	$\leq$0.1 mR/hr
	2	restricted use of items	$\geq$100dpm/100cm^2	$\geq$0.1 mR/hr

(a) No covering or coating materials shall be applied to items for the purpose of reducing removable residual levels.

(b) Except as noted (see Note No. c), the limits shown shall pertain only to natural uranium.

(c) For items removed from plutonium handling areas in the HCLA, the unconditional use limit for smearable alpha shall be $\leq$10dpm/100cm^2.

A code letter and number designating fixed and smearable classifications shall be assigned to each item.

The restrictions associated with Health Physics Release Codes shall be applied independently and the most restrictive limits shall determine the subject item's disposition. For example, items classified with a "Health Physics Release Code of 'A1'" are defined as unconditional use items. Items classified as "A2," "B1," or "B2" are defined as being restricted use items. Only authorized parties, e.g., radioactive material licensees, shall be eligible to take possession of restricted use items.

8.0 WASTE DISPOSAL

A number of types of waste will result from the shutdown and decommissioning of the BNFP. All waste disposal operations will be in compliance with applicable State and Federal regulations.

8.1 Radioactive Non-Transuranic

The waste which will be generated in this category will include such things as non-salvageable uranium-bearing equipment, including some pipes and vessels from the UF_6 Facility; "job control" waste resulting from decommissioning activities; non-salvageable laboratory glassware which may have been in contact with uranium; and solidified aqueous waste resulting from process equipment clean-up. The principal radioactive material in these wastes is natural uranium. The waste will be packaged for disposal in accordance with existing regulations. It will then be transported to a licensed commercial site for disposal.

8.2 Radioactive-Transuranic

During the performance of research and development programs for the Department of Energy, it was necessary to use limited quantities of plutonium. Because the plutonium was used in support of Department of Energy programs, it has been determined that all transuranic wastes resulting from decommissioning activities can be accepted by the Department of Energy's Savannah River Operations Office for interim storage. In addition, plutonium and other transuranic waste laboratory standards, sources, and stock material will be transferred to the Department of Energy.

8.3 Non-Radioactive

Non-radioactive wastes will include such items as paper, wood, scrap metal, plastics, and general trash resulting from cleanup. AGNS is currently licensed by the state to operate an inert industrial waste landfill on the BNFP site. Materials such as those described will be placed in that landfill. The landfill will be stabilized and shut down in accordance with state regulations. After the landfill is shut down, AGNS will obtain the services of a commercial waste contractor to accommodate the small volume of waste that will remain.

AGNS has on hand a number of chemicals used in support of laboratory operations and as stock for process solutions. These nonradioactive chemicals will be donated, sold, or disposed of as chemical waste at a licensed disposal site. Any other chemicals or hazardous nonradioactive materials will also be disposed of only at an authorized disposal site.

9.0 ENVIRONMENTAL IMPACT OF DECOMMISSIONING

The shutdown and decommissioning of the BNFP will not have a significant environmental impact beyond the socio-economic impact on employees and the community associated with loss of employment.

All flammable liquids, chemicals, radioactive, and other hazardous materials will be removed from the site for sale or for disposal at an authorized facility. Any environmental impact associated with such disposal will have been evaluated and considered during licensing activities for the disposal facilities.

The radiation exposure of personnel during decommissioning will be negligible since the principal radioactive material which must be removed from the site, natural uranium, will be handled in pipes, tanks, and similar essentially closed systems. Where it is necessary to work with plutonium, protective measures will be taken in accordance with existing AGNS procedures which have been proven effective. No exposures to the general public will result from decommissioning.

The outfall from Beacon pond will be closed off and liquid discharge into the pond and thence Lower Three Runs Creek (LTRC) will be terminated. Since the pond's discharge constitutes only a small fraction of the total flow of LTRC, cessation of discharge will have minimal, if any, impact.

An Environmental Consultant retained by AGNS has recently inspected the site to determine if erosion would be a problem should the site be abandoned. His conclusion was that the surface features of the site have stabilized and that erosion will not be a problem.

10.0 FINAL STATUS AND CONTINUED SURVEILLANCE

Upon completion of the decommissioning program, the BNFP site and facilities will be in a condition such that only minimal periodic surveillance will be required.

Except for previously discussed residual amounts, all radioactive material will have been removed from the site. All normal access areas will have been cleaned to Zone II limits and entrance may be made wearing street clothing only. Some natural uranium will be present on the internal surfaces of process pipes and vessels. However, it is anticipated that levels of residual material will be less than the limits set forth in Regulatory Guide 1.86 for "Unrestricted" use. While glove boxes which previously contained plutonium will still have residual quantities of plutonium on their interior surfaces, the external surfaces will be less than Zone II limits. Hoods, laboratory work benches, floors, ceilings, and walls in the laboratory area will also be less than Zone II limits.

The doors to laboratories and cells will be securely locked. Ventilation dampers to cells and laboratories will be closed. Glove boxes which have contained plutonium will be isolated from the ventilation system. All combustibles, flammable liquids, portable equipment, and furniture will be removed from the laboratories and process buildings. Electrical power and other utilities will be shut down. All entrance points to the process buildings will be securely locked.

Support buildings such as utility areas, training center and warehouses will be emptied of their contents. Entrances will then be locked. However, it is possible that some equipment may be stored in existing warehouses on site.

Two of three large waste tanks at the BNFP have been contained with natural uranium. These tanks will be cleaned to a level that is considered to be as low as practicable. It is expected that the residual level in these tanks will be less than the levels specified in Regulatory Guide 1.86, for "Unrestricted" use.

Although the amount of radioactive material remaining on site will be extremely small and will be present only as low-level surface residues, a periodic surveillance program will be implemented. Security inspection of the process areas will be performed quarterly. The security inspector will look for obvious damage to buildings or evidence of attempts to enter the facility. Site boundary fences will be inspected for evidence of entry and the site will be observed for erosion damage. While the meteorological tower remains in place, the FAA warning lights will be checked daily for operation.

Semi-annual radiological surveys and safety and fire protection inspections will be performed. This will consist of walk-through inspections

of the facility to detect fire or safety problems. Smear surveys will be conducted in the Separations Facility, the laboratory areas, and the UF_6 Facility. In the laboratory areas, smears will be taken around glove ports to assure that any residual material remains confined. Glove ports will be visually inspected to insure that the integrity of the box is maintained.

As a part of preparing for operation of the BNFP, an extensive radiological environmental survey was performed by a consulting team now headed by Dr. John M. Palms of Emory University in Atlanta, Georgia. Although AGNS' contractual relationship with these consultants has been terminated, a new contract will be written to provide for a final environmental survey of the BNFP. However, because only minimal levels of radioactive materials will remain at the BNFP, it is not considered necessary to perform periodic environmental surveys such as soil, air, and water sampling.

AGNS will contract with a qualified organization to perform the surveillance functions. An individual within one of the parent companies will be assigned responsibilities for assuring that the surveillance program is properly conducted.

11.0 DOCUMENTATION

All activities associated with the decommissioning of the BNFP will be performed under existing AGNS procedures. These procedures will be supplemented with written work instructions as necessary. Copies of procedures, work instructions, radiological survey data, and property disposition records will be retained as supporting documentation.

APPENDIX C

NUCLEAR REGULATORY GUIDE 1.86
TERMINATION OF OPERATING LICENSES FOR NUCLEAR REACTORS

U.S. ATOMIC ENERGY COMMISSION

June 1974

REGULATORY GUIDE

DIRECTORATE OF REGULATORY STANDARDS

REGULATORY GUIDE 1.86

TERMINATION OF OPERATING LICENSES FOR NUCLEAR REACTORS

A. INTRODUCTION

Section 50.51, "Duration of license, renewal," of 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires that each license to operate a production and utilization facility be issued for a specified duration. Upon expiration of the specified period, the license may be either renewed or terminated by the Commission. Section 50.82, "Applications for termination of licenses," specifies the requirements that must be satisfied to terminate an operating license, including the requirement that the dismantlement of the facility and disposal of the component parts not be inimical to the common defense and security or to the health and safety of the public. This guide describes methods and procedures considered acceptable by the Regulatory staff for the termination of operating licenses for nuclear reactors. The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position.

B. DISCUSSION

When a licensee decides to terminate his nuclear reactor operating license, he may, as a first step in the process, request that his operating license be amended to restrict him to possess but not operate the facility. The advantage to the licensee of converting to such a possession-only license is reduced surveillance requirements in that periodic surveillance of equipment important to the safety of reactor operation is no longer required. Once this possession-only license is issued, reactor operation is not permitted. Other activities related to cessation of operations such as unloading fuel from the reactor and placing it in storage (either onsite of offsite) may be continued.

A licensee having a possession-only license must retain, with the Part 50 license, authorization for special nuclear material (10 CFR Part 70, "Special Nuclear Material"), byproduct material (10 CFR Part 30, "Rules of General Applicability to Licensing of Byproduct Material"), and source material (10 CFR Part 40, "Licensing of Source Material"), until the fuel, radioactive components, and sources are removed from the facility. Appropriate administrative controls and facility requirements are imposed by the Part 50 license and the technical specifications to assure that proper surveillance is performed and that the reactor facility is maintained in a safe condition and not operated.

A possession-only license permits various options and procedures for decommissioning, such as mothballing, entombment, or dismantling. The requirements imposed depend on the option selected.

Section 50.82 provides that the licensee may dismantle and dispose of the component parts of a nuclear reactor in accordance with existing regulations. For research reactors and critical facilities, this has usually meant the disassembly of a reactor and its shipment offsite, sometimes to another appropriately licensed organization for further use. The site from which a reactor has been removed must be decontaminated, as necessary, and inspected by the Commission to determine whether unrestricted access can be approved. In the case of nuclear power reactors, dismantling has usually been accomplished by shipping fuel offsite, making the reactor inoperable, and disposing of some of the radioactive components.

Radioactive components may be either shipped offsite for burial at an authorized burial ground or secured

on the site. Those radioactive materials remaining on the site must be isolated from the public by physical barriers or other means to prevent public access to hazardous levels of radiation. Surveillance is necessary to assure the long term integrity of the barriers. The amount of surveillance required depends upon (1) the potential hazard to the health and safety of the public from radioactive material remaining on the site and (2) the integrity of the physical barriers. Before areas may be released for unrestricted use, they must have been decontaminated or the radioactivity must have decayed to less than prescribed limits (Table I).

The hazard associated with the retired facility is evaluated by considering the amount and type of remaining contamination, the degree of confinement of the remaining radioactive materials, the physical security provided by the confinement, the susceptibility to release of radiation as a result of natural phenomena, and the duration of required surveillance.

C. REGULATORY POSITION

1. APPLICATION FOR A LICENSE TO POSSESS BUT NOT OPERATE (POSSESSION-ONLY LICENSE)

A request to amend an operating license to a possession-only license should be made to the Director of Licensing, U.S. Atomic Energy Commission, Washington, D.C. 20545. The request should include the following information:

a. A description of the current status of the facility.

b. A description of measures that will be taken to prevent criticality or reactivity changes and to minimize releases of radioactivity from the facility.

c. Any proposed changes to the technical specifications that reflect the possession-only facility status and the necessary disassembly/retirement activities to be performed.

d. A safety analysis of both the activities to be accomplished and the proposed changes to the technical specifications.

e. An inventory of activated materials and their location in the facility.

2. ALTERNATIVES FOR REACTOR RETIREMENT

Four alternatives for retirement of nuclear reactor facilities are considered acceptable by the Regulatory staff. These are:

a. **Mothballing.** Mothballing of a nuclear reactor facility consists of putting the facility in a state of protective storage. In general, the facility may be left intact except that all fuel assemblies and the radioactive fluids and waste should be removed from the site. Adequate radiation monitoring, environmental surveillance, and appropriate security procedures should be established under a possession-only license to ensure that the health and safety of the public is not endangered.

b. **In-Place Entombment.** In-place entombment consists of sealing all the remaining highly radioactive or contaminated components (e.g., the pressure vessel and reactor internals) within a structure integral with the biological shield after having all fuel assemblies, radioactive fluids and wastes, and certain selected components shipped offsite. The structure should provide integrity over the period of time in which significant quantities (greater than Table I levels) of radioactivity remain with the material in the entombment. An appropriate and continuing surveillance program should be established under a possession-only license.

c. **Removal of Radioactive Components and Dismantling.** All fuel assemblies, radioactive fluids and waste, and other materials having activities above accepted unrestricted activity levels (Table I) should be removed from the site. The facility owner may then have unrestricted use of the site with no requirement for a license. If the facility owner so desires, the remainder of the reactor facility may be dismantled and all vestiges removed and disposed of.

d. **Conversion to a New Nuclear System or a Fossil Fuel System.** This alternative, which applies only to nuclear power plants, utilizes the existing turbine system with a new steam supply system. The original nuclear steam supply system should be separated from the electric generating system and disposed of in accordance with one of the previous three retirement alternatives.

3. SURVEILLANCE AND SECURITY FOR THE RETIREMENT ALTERNATIVES WHOSE FINAL STATUS REQUIRES A POSSESSION-ONLY LICENSE

A facility which has been licensed under a possession-only license may contain a significant amount of radioactivity in the form of activated and contaminated hardware and structural materials. Surveillance and commensurate security should be provided to assure that the public health and safety are not endangered.

a. Physical security to prevent inadvertent exposure of personnel should be provided by multiple locked barriers. The presence of these barriers should make it extremely difficult for an unauthorized person to gain access to areas where radiation or contamination levels exceed those specified in Regulatory Position C.4. To prevent inadvertent exposure, radiation areas above 5 mR/hr, such as near the activated primary system of a power plant, should be appropriately marked and should not be accessible except by cutting of welded closures or the disassembly and removal of substantial structures

and/or shielding material. Means such as a remote-readout intrusion alarm system should be provided to indicate to designated personnel when a physical barrier is penetrated. Security personnel that provide access control to the facility may be used instead of the physical barriers and the intrusion alarm systems.

b. The physical barriers to unauthorized entrance into the facility, e.g., fences, buildings, welded doors, and access openings, should be inspected at least quarterly to assure that these barriers have not deteriorated and that locks and locking apparatus are intact.

c. A facility radiation survey should be performed at least quarterly to verify that no radioactive material is escaping or being transported through the containment barriers in the facility. Sampling should be done along the most probable path by which radioactive material such as that stored in the inner containment regions could be transported to the outer regions of the facility and ultimately to the environs.

d. An environmental radiation survey should be performed at least semiannually to verify that no significant amounts of radiation have been released to the environment from the facility. Samples such as soil, vegetation, and water should be taken at locations for which statistical data has been established during reactor operations.

e. A site representative should be designated to be responsible for controlling authorized access into and movement within the facility.

f. Administrative procedures should be established for the notification and reporting of abnormal occurrences such as (1) the entrance of an unauthorized person or persons into the facility and (2) a significant change in the radiation or contamination levels in the facility or the offsite environment.

g. The following reports should be made:

(1) An annual report to the Director of Licensing, U.S. Atomic Energy Commission, Washington, D.C. 20545, describing the results of the environmental and facility radiation surveys, the status of the facility, and an evaluation of the performance of security and surveillance measures.

(2) An abnormal occurrence report to the Regulatory Operations Regional Office by telephone within 24 hours of discovery of an abnormal occurrence. The abnormal occurrence will also be reported in the annual report described in the preceding item.

h. Records or logs relative to the following items should be kept and retained until the license is terminated, after which they may be stored with other plant records:

(1) Environmental surveys,

(2) Facility radiation surveys,

(3) Inspections of the physical barriers, and

(4) Abnormal occurrences.

4. DECONTAMINATION FOR RELEASE FOR UNRESTRICTED USE

If it is desired to terminate a license and to eliminate any further surveillance requirements, the facility should be sufficiently decontaminated to prevent risk to the public health and safety. After the decontamination is satisfactorily accomplished and the site inspected by the Commission, the Commission may authorize the license to be terminated and the facility abandoned or released for unrestricted use. The licensee should perform the decontamination using the following guidelines:

a. The licensee should make a reasonable effort to eliminate residual contamination.

b. No covering should be applied to radioactive surfaces of equipment or structures by paint, plating, or other covering material until it is known that contamination levels (determined by a survey and documented) are below the limits specified in Table I. In addition, a reasonable effort should be made (and documented) to further minimize contamination prior to any such covering.

c. The radioactivity of the interior surfaces of pipes, drain lines, or ductwork should be determined by making measurements at all traps and other appropriate access points, provided contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork. Surfaces of premises, equipment, or scrap which are likely to be contaminated but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement should be assumed to be contaminated in excess of the permissable radiation limits.

d. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated in excess of the limits specified. This may include, but is not limited to, special circumstances such as the transfer of premises to another licensed organization that will continue to work with radioactive materials. Requests for such authorization should provide:

(1) Detailed, specific information describing the premises, equipment, scrap, and radioactive contaminants and the nature, extent, and degree of residual surface contamination.

(2) A detailed health and safety analysis indicating that the residual amounts of materials on surface areas, together with other considerations such as the prospective use of the premises, equipment, or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

e. Prior to release of the premises for unrestricted use, the licensee should make a comprehensive radiation survey establishing that contamination is within the limits specified in Table I. A survey report should be filed with the Director of Licensing, U.S. Atomic Energy Commission, Washington, D.C. 20545, with a copy to the Director of the Regulatory Operations Regional Office having jurisdiction. The report should be filed at least 30 days prior to the planned date of abandonment. The survey report should:

(1) Identify the premises;

(2) Show that reasonable effort has been made to reduce residual contamination to as low as practicable levels;

(3) Describe the scope of the survey and the general procedures followed; and

(4) State the finding of the survey in units specified in Table 1.

After review of the report, the Commission may inspect the facilities to confirm the survey prior to granting approval for abandonment.

5. REACTOR RETIREMENT PROCEDURES

As indicated in Regulatory Position C.2, several alternatives are acceptable for reactor facility retirement. If minor disassembly or "mothballing" is planned, this could be done by the existing operating and maintenance procedures under the license in effect. Any planned actions involving an unreviewed safety question or a change in the technical specifications should be reviewed and approved in accordance with the requirements of 10 CFR §50.59.

If major structural changes to radioactive components of the facility are planned, such as removal of the pressure vessel or major components of the primary system, a dismantlement plan including the information required by §50.82 should be submitted to the Commission. A dismantlement plan should be submitted for all the alternatives of Regulatory Position C.2 except mothballing. However, minor disassembly activities may still be performed in the absence of such a plan, provided they are permitted by existing operating and maintenance procedures. A dismantlement plan should include the following:

a. A description of the ultimate status of the facility

b. A description of the dismantling activities and the precautions to be taken.

c. A safety analysis of the dismantling activities including any effluents which may be released.

d. A safety analysis of the facility in its ultimate status.

Upon satisfactory review and approval of the dismantling plan, a dismantling order is issued by the Commission in accordance with §50.82. When dismantling is completed and the Commission has been notified by letter, the appropriate Regulatory Operations Regional Office inspects the facility and verifies completion in accordance with the dismantlement plan. If residual radiation levels do not exceed the values in Table 1, the Commission may terminate the license. If these levels are exceeded, the licensee retains the possession-only license under which the dismantling activities have been conducted or, as an alternative, may make application to the State (if an Agreement State) for a byproduct materials license.

TABLE I

ACCEPTABLE SURFACE CONTAMINATION LEVELS

NUCLIDE[a]	AVERAGE[b c]	MAXIMUM[b d]	REMOVABLE[b e]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1000 dpm/100 cm^2	3000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5000 dpm β-γ/100 cm^2	15,000 dpm β-γ/100 cm^2	1000 dpm β-γ/100 cm^2

[a]Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c]Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d]The maximum contamination level applies to an area of not more than 100 cm^2.

[e]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

APPENDIX D

RESULTS OF SEPARATIONS FACILITY PROCESS TANK FLUSH WATER SAMPLING

CONCENTRATIONS OF URANIUM IN PROCESS TANK FLUSH SOLUTIONS
(Reproduction of AGNS' Data)

PAGE	VESSEL NAME	FIRST ACID FLUSH (G/L)	WATER FLUSH SPL (G/L)	Final Acid Flu (G/L)
1	HULL RINSE	.00196	.0001	
2	DAST	.00275	.0001	
3	#1 DISS	.000382	.0001	
4	#2 DISS	.00856	.000258	
5	#3 DISS	.0117	.00158	
6	FEED SURGE	.0243	.00193	
7	DFA	.0672	.00428	
8	ACC TK	.00963	.0016	
9	#1 FAT	.0985	.000873	
10	#2 FAT	.000401	.000127	
11	CENTRIFUGE	.0172	.017	
12	HA FEED TK	.54	.000827	
13	CARB DIV TK	.0017	.000154	
*14	200 FIL PUMP TK	.0612	.04	.0283
*15	#2 SOLV FEED TK	.0404	.00207	.000642
*16	100 FIL PUMP TK	.0395	.00071	.00131
17	1P COLUMN	.0708	.0125	
18	1R COLUMN	.0282	.0225	
19	10 COLUMN	.0103	.000778	
20	2P COLUMN	.0141	.009	
*21	#1 SOL FEED TK	.021	.0031	.00422
*22	2A COLUMN	.101	.0581	.00381
*23	3A COLUMN	.0412	.0593	.00214
*24	2B COLUMN	.0446	.0613	.018
25	3PS COLUMN	.0623	.0979	
*26	3B COLUMN	.152	.0979	.00273
27	1BX ANOLYTE	.000664	.0006	
28	POG	.203	.0002	
29	PU PROD STOR (306)	.19	.0716	
30	PU PROD STOR (305)	.199	.0176	
31	PU PROD SMPL	.00709	.000316	
32	PU PROD CATCH	.00709	.000316	
33	3P CONC	.00709	.000316	
34	#2 I2 SCRUB	.186	.0162	
35	1 I2 SCRUB	.0482	.0173	
36	NO2 ABSORB	.00238	.0064	
37	DOG VAC BRAK	.00238	.0064	
38	PU REWORK	.112	.00024	
*39	1BP SURGE	.0141	.0536	.0226
40	1CU CONC	.124	.0274	
*41	1C COLUMN	.0556	.0613	.00037
42	HAW SURGE	.119	.00256	
43	PU PROD STOR (304)	.0045	.0146	

APPENDIX E

LETTER, AGNS TO SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL, APPLICATION FOR AMENDMENT – SOUTH CAROLINA RADIOACTIVE MATERIALS LICENSE NO. 144

Allied-General Nuclear Services
Post Office Box 847
Barnwell, South Carolina 29812

J. A. Buckham
President

(803) 259-1711

November 7, 1983

Mr. Heyward Shealy, Director
Bureau of Radiological Health
S. C. Department of Health
and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201

Re: Application for Amendment - South Carolina Radioactive Materials License No. 144

Dear Mr. Shealy:

Allied-General Nuclear Services (AGNS) herewith submits its application to amend SCRML No. 144 because operations at the Barnwell Nuclear Fuel Plant (BNFP) are being terminated effective December 31, 1983. For the past several months, Allied-General Nuclear Services (AGNS) has been in the process of decommissioning the BNFP in accordance with the AGNS BNFP Decommissioning Plan (the Plan) which is included as Attachment 1 to the enclosed Application for Radioactive Material License. As explained in the Plan, at no time has spent nuclear reactor fuel been present at the BNFP. During cold testing natural uranium was used as surrogate fuel. In addition to natural uranium, laboratory quantities of other radioactive materials have been used for laboratory procedures development, instrument calibrations, and pilot scale process development studies. All of these activities were conducted using materials authorized by the referenced license.

The objective of the decommissioning program is to place the BNFP facilities and the site in such a condition that only a minimal level of continued surveillance will be required. To accomplish this objective, the source, special nuclear and other radioactive materials have been removed from the site by transfer to an authorized recipient.

Transuranic (TRU) sources have been transferred to authorized licensees and to the Department of Energy Savannah River Operations Office (SR) or their contractor. TRU wastes are also being transferred to SR. These transfers are expected to be completed by December 1, 1983. Non-TRU wastes are being disposed of at Chem-Nuclear's site in Barnwell.

A radioactive materials inventory is enclosed as Attachment 4 to the License Application to show the disposition of the radioactive materials previously held by AGNS as authorized by the referenced license.

AGNS is contracting with Chem-Nuclear Systems, Inc. of Barnwell, South Carolina to perform the radiological and security surveillance program described in the Plan.

In addition to the information submitted herewith, we will provide you with additional supporting documents as they become available. These documents and their estimated submittal dates are as follows:

Document	Estimated Submittal Date
1. Final Environmental Survey	12/8/83
2. Rockwell Decommissioning Consultant's Final Reports, including Independent Facility Radiological Survey Report	12/15/83
3. AGNS Final Facility Radiological Survey Report	12/15/83

It is our objective to complete all decommissioning activities by December 31, 1983. Therefore, your expeditious review and approval of our enclosed license amendment application will be greatly appreciated. Mr. Monte Hawkins of my staff will continue to work with you in your reviews until decommissioning activities are complete.

Sincerely,

J. A. Buckham
President

JAB:jr

Attachments