PROJECT MANAGEMENT OF RADWASTE RETROFITS

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ABSTRACT

Many utilities are finding it necessary to provide additional radioactive waste processing facilities at operating or nearly completed nuclear stations in order to accommodate the ever-changing regulatory, political and socio-economic environment in which we operate. This paper describes the project approach taken at Duke Power Company to provide a comprehensive radioactive waste processing facility at Oconee Nuclear Station.

Following a historical perspective which includes a brief description of the facility scope, the philosophy and mechanics of the project team are discussed. The goal of the project team was to provide a facility which could meet the liquid and solid radioactive waste processing needs of Oconee within the restraints of a utility budget and schedule. The unique quality of the project team approach was the integral involvement of all of the necessary departments in every part of the design, construction and start-up phases. The project team thereby utilized feedback from over thirty reactor years of operational experience. It is the lack of feedback from the ever-changing operation/regulatory arena that often renders new radwaste systems obsolete prior to operation.

The remainder of the paper provides examples of the problems encountered and their resolution (eg. equipment layout, materials handling, vendor improvements and regulatory changes all required design-in-progress changes).

It has been the integration and concentration of the diverse resources of a large utility into a cross-departmental team which has allowed the timely resolution of the necessary changes. This same philosophy is being applied to the facility start-up program and to other major projects at Duke Power Company.

INTRODUCTION

Numerous utilities have been forced to perform extensive modifications to new and operating nuclear stations in order to maintain regulatory compliance and cost effective operation. No aspect of nuclear station operation has been more subject to extreme regulatory and economic upheaval than the management and disposal of radioactive wastes. The issue of radioactive waste disposal has expanded beyond the serenity of the technical arena and is now heavily influenced by the changes of government policy. Recent years, have seen an effort place responsibility upon the shoulders of state government for providing the ultimate disposition of low level radioactive waste. It was this environment, which is so unpredictable that swept the nuclear industry in the last decade like an ice age leaving numerous radwaste systems extinct.

Duke Power Company, like most utilities, saw the trend and marshalled its resources to respond. This paper is a description of the evolution process at Duke Power Company that has involved changes in method, equipment and organization. Although the story is historically specific, the application is both generic and futuristic. As the industry moves from a period of rapid growth to an era of maintenance and upgrade, utilities must develop a philosophy that produces depth and maturity in their organizations while undergoing the continuous change forced by their environment. There is a wealth of experience in the industry, but it must be appropriated.

The story of radwaste at Duke Power Company begins at Oconee Nuclear Station; however, the fundamental philosophy that has provided the basis for every decision is as old as the company itself. "Any function that is generic and critical to the utility industry can be performed better and more cost effectively by Duke Power resources." Although there have been exceptions to this throughout the years, Duke has developed a resource arsenal that encompasses design, construction, purchasing and operation.

Oconee Nuclear Station is a 3 PWR unit station with shared radwaste systems. When Oconee Unit 1 began operation Duke had already modified the original design scope to include a waste gas system, a waste evaporator and a boron recycle evaporator. By the time unit three had started up it was apparent that the liquid waste system had not provided adequate segregation by source and was, therefore, in need of greater storage and process capacity. An interim radwaste facility was designed and built to provide additional liquid process capacity, liquid storage, and waste gas storage. An urea formaldehyde system was installed in the auxiliary building about the same time. This system solidified itself and was replaced by vendor services within two years.

During the last half of the 1970's, Duke Power was faced with the following circumstances which led to the formation of a radwaste organization to monitor the situation and recommend future technical direction to management:

1. Disposal and vendor cost were inflating at a rate of 25% per year.

2. The states with burial sites were either closing them or restricting the volume of waste to be received.

3. Duke had four more nuclear units coming on-line which would add to the waste volumes being disposed of.

4. TMI had compounded negative sentiment toward nuclear power.

5. 10CFR50 Appendix I was being implemented.

6. A new regulation addressing shallow land burial was being discussed.

7. DOT was becoming more restrictive.

8. Oconee was in a position of having implemented several interim fixes to radwaste operational problems with commitments to provide more permanent solutions in the near future.

9. Oconee still had little or no segregation of its liquid waste sources which decreased effective decontamination factors and cost effectiveness of process options. Appendix I required improved decontamination factors.

10. State-of-the art PWR designs provided little or no primary to secondary leak process capacity for condensate polisher resin, etc.

11. There was no surge capacity storage for liquid or solid wastes.

The first major change approved for implementation by Duke Management was the formation of dedicated radwaste groups at each station and in the corporate offices. Numerous system modifications were performed at McGuire and Catawba nuclear stations to optimize the efficiency of the existing equipment and to supplement the installed systems with protable equipment. These stations are of a later vintage than Oconee and provide significantly more source stream segregation than was available at Oconee. It was decided that a more comprehensive solution was needed at Oconee and a nuclear station modification (NSM) was written to address the major problems.

SCOPE OF FACILITY

The original scope of the proposed facility was defined by cognizant personnel from the Design Engineering Department and Nuclear Production Department. After several iterations of preliminary design and cost estimate refinement an acceptable scope was developed and the modification was approved. The facility was to provide the following capabilities:

1. Resin Recovery System - To provide surge capacity storage, segregation, and processing of contaminated and non-contaminated wastes from the secondary side during primary-to-secondary leaks (eg., condensate polishing demineralizer resin, turbine building sump water, etc.)

2. Liquid Waste and Recycle System - To provide additional liquid waste storage/segregation and processing capability for miscellaneous wastes and recyclable wastes (eg. floor drains, primary bleed and recycle etc.)

3. Solidification System - An installed solidification system was designed to process both liquid slurries and dry product from a volume reduction system which was included to provide better disposal economics and to support Duke Power's commitment to minimize radioactive waste disposal volumes.

4. Some short-term surge capacity storage was provided for packaged waste. Also included were various auxiliary systems required to support process systems and personnel needs.

See Fig. 1 for a line diagram of the systems.

PROJECT TEAM

Having established the initial scope definition and preliminary schedule, the various departments were prepared to assign resources to begin work. The normal lines of communication associated with the NSM process were not readily applicable to a project of this magnitude which would involve the Construction Department, the Design Engineering Department, Nuclear Production Department (both general office and station personnel) and the Purchasing Department. A group independent of these departments was given the responsibility of integrating the project schedule and budget for all departments. Appropriately named Project Control, this group provided the basis for the project team approach. With their guidance a Project Agreement was developed that defined the interdepartmental organization, how the departments would interface and what the responsibilities of each department were. The document was signed by the vice-presidents of each department and superseded existing departmental policy manuals in those areas pertinent to the project.

A Facility Document was also developed that contained the information outlined in Table I. The document was intended to provide a general historical record of the facility. Both the Project Agreement and the Facility Document were updated as necessary to support the project. Administrative guidelines for making design changes prior to and following design drawing releases to Construction were added to facilitate the review process and to minimize schedule impact.

The general organization chart is shown in Fig. 2. Whenever significant technical issues arose requiring a decision that was matually agreeable to all departments, a meeting or teleconference was held between the department coordinators to present the pertinent information and represent the concerns of their respective departments. All formal correspondence was via the coordinators to ensure a consistent and documented exchange of information.

DESIGN-IN-PROGRESS REVIEW

For the sake of discussion, the project naturally had three phases. The first phase was the design-in-progress review period. This phase can be further subdivided into the various distinct design groups which had individually defined scopes of work (eg. civil, architectural, mechanical, and electrical). The second phase was the construction phase which formally ends with the last system turnover to the operating group in Nuclear Production. Since this project was on a fast track schedule, the construction phase overlapped with the design phase so that the construction work was begun immediately upon release of the design drawings. This made the design-in-progress review very critical to maintaining the schedule by minimizing the changes required after design drawing releases. The final phase of the project was the start-up phase. This phase began with the turnover of the first system by Construction and ends with the first operation of the facility with contaminated waste.

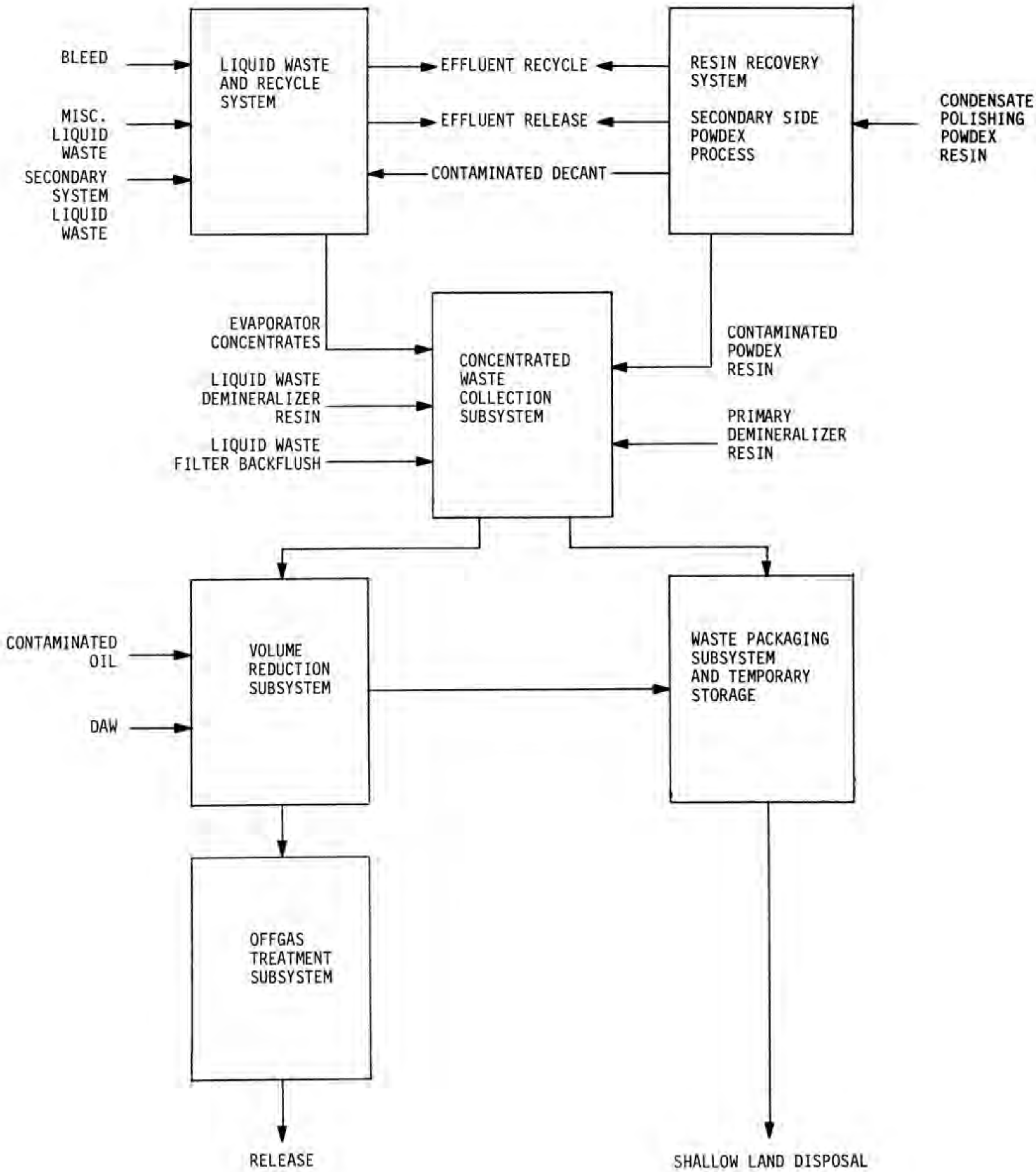

Fig. 1. Block diagram of facility scope.

TABLE I

Radwaste Facility Document Contents

1. INTRODUCTION AND GENERAL DESCRIPTION
2. CODES, STANDARDS, AND CRITERIA
3. STRUCTURES
4. MECHANICAL SYSTEMS
5. ELECTRICAL SYSTEMS
6. FACILITIES PROVIDED BY STATION
7. RADIATION PROTECTION
8. SAFETY EVALUATIONS
9. COSTS ESTIMATE, BUDGET AND SCHEDULE

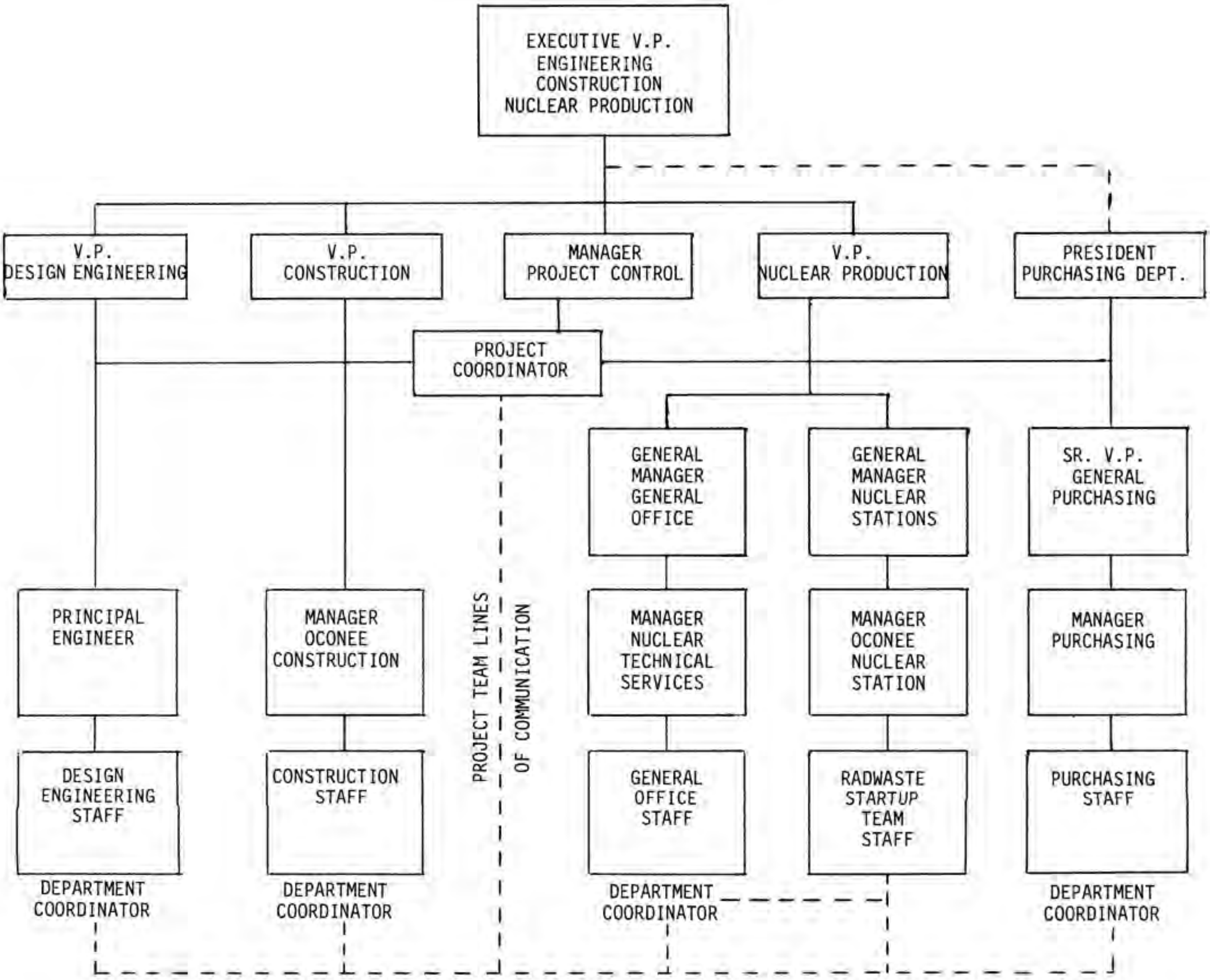

Fig. 2. Radwaste facility project team interfaces.

In order to facilitate the review process, a scale model of the facility was built based upon the latest revisions of design drawings. This model was available to all project personnel throughout the design phase and was formally reviewed at the monthly Design Review Meeting. Following the completion of the design, the model was transferred to the site for training and maintenance planning purposes by the station Start-up Team.

Having described the project team approach, the remainder of this paper describes the types of problems resolved and gives examples of design quality resulting from use of the project team approach to tap Duke's experienced resources. The greatest advantage of the project team was realized in the form of preventative review comments early in the design-in-progress review. The first stage of this process was the civil design.

Perhaps the first and most fundamental cost savings decision was the application of appropriate Q.A. standards. Based upon operating experience with radwaste building retrofits, the design was based upon Regulatory Guide 1.143, non-safety related, criteria. The provision of seismic liquid waste containment was via a 30 inch curb wall which was located to minimize the impact to materials movement within the facility. The building was also divided into a steel frame portion and a concrete portion. Non-contaminated areas were thereby built at a lower cost while adequate ALARA design was provided in the shielded areas. Adequate review by the Mechanical Design Group and the Operating Group optimized the building floor plan relative to space distribution for Operating/Maintenance access and system design parameters (eg., pump NPSH etc.). A radiation source term map was also developed to ensure adequate wall thickness, etc.

The architectural design received very specific review and comment on the scope and details of personnel areas. Operating personnel described fixtures and furniture required to meet laboratory, count room, work shop, sampling room, control room and change room needs. Where feasible, equipment was oriented to optimize personnel access and materials handling equipment (eg. monorails, job cranes, etc.) were provided early in the design before piping was laid out to ensure a functional design. This type of review continued throughout the design phase and as the mechanical and electrical designs were detailed, interferences were resolved as quickly and informally as possible through the project team interfaces. As soon as information became available from vendors and the mechanical design was finalized, maintenance platforms were provided based upon review by Operating and Maintenance personnel.

Perhaps the most critical and difficult aspect of such a retrofit facility is the design of such a interface modifications between operating systems and the facility systems. The mechanical design of these interfaces went through several iterations before all of the details were worked out. Some of the problems encountered were interfaces with safety-related piping, work located in high radiation areas, impact upon outage related work, potential violations of technical specifications, scheduling problems, and interference with operating flexibility. As a result of the meticulous effort, several long term problems with existing systems were resolved while the modifications were being performed.

A specific example of this was the primary resin storage and transfer system. Operation of this system had been a labor intensive and high radiation exposure job for years. Numerous modifications had been performed on this system and operating personnel had optimized the operation and ALARA procedures, but the fundamental problems of the piping and tank design were unresolved and not cost effective to repair. The design of the interface piping with the facility was expanded to provide an interim improvement for immediate operation and a long term solution in the facility. This type of flexibility was only possible because of the intimate working relationships of the project team.

Another important aspect of the resin transfer design was the performance of several tests to develop base-line design data for mechanical design parameters. This data was combined with previous experience to enable the transfer of resin slurries over 1000 feet to the facility resin batch tank. Equipment and materials specifications were reviewed to ensure the mechanical design was compatible with existing and future chemical addition schemes. Definition of process variables and operating controls gave the Mechanical Group a basis for chemical addition, sampling and instrumentation needs. This detail was critical to the regulatory changes that occurred during the project life. 10CFR61 and the incorporation of 10CFR50, Appendix I Technical Specifications required specific changes to the mechanical design after the design was in progress.

A detailed piping review by the Project Team minimized non-ALARA routing and provided appropriate valve operators (eg., remote, chainwheel and manual), based upon expected operating philosophy. A user-friendly computer program was developed to allow sorting of all design drawings and documents to aid in the integrated document review required on such a mechanical design. This on-going review, in conjunction with a review of the mechanical systems by an independent mechanical review team, eliminated numerous detail errors that are not usually found until the start-up phase of a project.

The final portion of the design phase was the electrical portion. Again, the advantage of having a detailed review by the Project Team personnel was realized through operational feedback concerning electrical equipment (eg., radiation monitors, instruments, etc.), and the proper location of items such as phones, lighting, speakers, fire alarm systems and electrical outlets. The operating feedback was also applied to the control panels. Since the major equipment and auxiliaries will be operated from a remote control room, the panels were designed as full mimics with consistent interfaces between systems.

CONSTRUCTION PHASE

Concurrent with the inter-disciplinary design review, a construction staff was reviewing all design documents to minimize the number of field changes required following design drawing release. During the final construction phase this made the schedule much more realistic since there were fewer surprises in the design; however, still undefined vendor information required an on-going exchange of information between departments as the details were resolved. Numerous joint inspections of field work provided swift resolution to interferences, etc. Design personnel who had been part of the project team throughout the design phase were available to Construction and the Start-up Team for consulting and field work as needed.

START-UP PHASE

As the project entered the final construction/ start-up phase there were several unresolved issues related to vendor information. A joint effort by the design personnel and Start-up Team to work with the vendors ensured the most effective resolution of these issues. The Start-up Team was comprised of station personnel from numerous disciplines who worked together through the design review phase and construction phase. Based upon their familiarity with the design they developed start-up testing, operating and maintenance procedures. They also verified as-built design and adequacy of systems at trunover. The training and chemical control programs for the facility were developed working closely with the Design Department and vendors. During the actual testing, design personnel were on-site for problem resolution on a weekly basis or more as needed.

Another aspect of the project which utilized the team members was the license for the incinerator. In this case the Nuclear Production licensing group coordinated the effort and submitted the document, but the knowledgeable groups within Design Engineering and Nuclear Production authored the technical sections.

CONCLUSION

The ultimate goal of the radwaste facility project was to resolve the problems confronting the Oconee radwaste management group in the most economically sound and long term assurable methods available at that time. The goal of the Project Team was to design and build the best possible facility within the budgetary and schedule restraints dictated by economics and company policy. The reason for developing the Project Team was to optimize the communication links between departments in the most informal method possible while documenting the decisions made and the bases for them. The bottom line for the overall approach and the professional manner in which the project was carried out is that Duke Power Company recognized the irreplaceable value of diverse in-house resources and the need to incorporate the perspective from each area of expertise.

Duke Power Company recognizes that as the nuclear industry has matured, the socio-economic environment has become more challenging and unpredictable. As the energy crisis of the 1970's demonstrated, all the energy resources available should be investigated and used in the appropriate manner. In the same way, the industry must identify, cultivate and make available all of the experience and resources we have developed.