DP-MS-84-23

OPERATIONAL READINESS REVIEWS FOR RESTART OF L REACTOR

by

Robert H. Finley

E. I. du Pont de Nemours & Co.
Savannah River Plant
Aiken, South Carolina 29808-0001

For presentation at the DOE Nuclear Reactor and Facility Safety Conference
Washington, DC
February 27-29, 1984
and for publication in the Proceedings of the Conference

OPERATIONAL READINESS REVIEWS FOR RESTART OF L REACTOR

R. H. Finley

E. I. du Pont de Nemours & Co.
Savannah River Plant
Aiken, SC

ABSTRACT

The L Reactor at the Savannah River Plant is being restarted after being in a standby status since 1968. Operational Readiness Reviews (ORRs) were conducted by DOE-SR and contractor personnel concurrent with the restart activity. This paper summarizes the ORR activity.

DISCUSSION

In this presentation I will be discussing the operational readiness reviews for the restart of the L Reactor. Before I get into the details, I would like to give some background about L Reactor. Figure 1 is a photograph of the outside of the L-Reactor building. This will give you some idea of the size of the facility.

The L Reactor was initially operated in 1954 and then placed on standby from 1968 until December of 1980. While in standby status, the facility was not staffed and essentially no maintenance nor capital improvements were performed on the reactor. Some of the equipment was used as spare parts for the other reactors.

Restart activity of the reactor began in December 1980 and continues to the present (figure 2). The current status of the reactor is that it has been fueled and is essentially ready for startup, waiting on final resolution of the Environmental Impact Statement. During this period, we are conducting hydraulic tests and completing some additional capital improvements that had been scheduled for later dates.

The L Reactor (figures 3 & 4) is one of the five reactors built at Savannah River Plant during the 1950s for the production of nuclear materials for the defense programs. The SRP reactors (figure 5) are moderated and cooled by heavy water with river water cooling the primary loop through Heat Exchangers. The river water (180,000 gpm) is a once-through system with water taken from and returned to the Savannah River. The reactor operates with power levels greater than 2000 megawatts (thermal). The reactor itself is a cylindrical tank approximately 16 feet in diameter and 16 feet high. Nuclear components are arranged in the reactor in 600 4-inch tubular positions spaced in a hexagonal geometry. The reactor is designed for rapid refueling, an essential feature for isotope production.

A unique aspect of the L-Reactor restart (figure 6) is that there had been no experience in the world of restarting a reactor from standby status. For our purposes this meant that we had no organization in place to manage the effort and very little historical data for scoping or scheduling the work package. Another unique feature was that the work consisted of a mixture of repair and renovation of existing equipment combined with significant capital improvements, frequently on the same systems. Some of the equipment to be repaired was obsolete and had to be replaced because no spares could be attained for overhaul.

The restart effort cost about $190 million (figure 7). About 60% of this cost was for capital improvements to bring the reactor up to the status of the other three operating reactors at the plant. Most of the capital improvements were safety related. These improvements ranged in scope from improved seismic bracing, to improvements in the Emergency Cooling System to installing computers for process monitoring and automatic shutdown. These capital improvements had been completed in the other reactors during the time L Reactor was in standby. Repair and renovation of old existing equipment and operating expense items such as personnel training, incidental utility costs, and support staffing utilized the remaining 40% of the cost. This $190 million is very cost effective compared to an estimated 2-4 billion dollars required to build another reactor.

The organization for restarting L Reactor (figure 8) consisted of a Plant Team with a Team Manager. Reporting to him were three engineering groups, one at the Du Pont Engineering Department in Wilmington, Delaware, one for coordinating capital work on the site and a coordinating group for repair and renovation work. The team also consisted of an Operations group that performed most of the scheduling work and completed equipment tests. A separate quality verification group was also responsible to the Team Manager. In addition there were the required support personnel such as Safety Engineers, Health Protection groups, Medical, Security, etc. Much of the actual work was performed by the Du Pont construction organization at the Savannah River Plant with specialty work performed by the maintenance and technical groups at the plant.

Twelve intermediate operational readiness reviews (figure 9) have been conducted by the DOE-SR staff. These reviews were completed as various phases of the restart activity were completed, rather than waiting to just prior to startup. The details of these reviews will be discussed in the presentation following this one.

In addition to the DOE reviews, special reviews were conducted by groups formed from Plant Technical personnel to verify the reactor was ready to be fueled and will be conducted prior to nuclear startup. The pre-fueling plant review was conducted by a team of eight experienced supervisors and engineers who were not assignod to the restart effort. In this review they verified that all reactor systems necessary for safe

handling and monitoring of the fuel and that, if needed, the fuel could be discharged. The review (figure 10) examined the status of 15 essential systems and 455 checkout and operating procedures.

Several problems (figure 11) occurred during the ORR process; specifically, different administrative systems had been established for capital and for renovation work. This complicated the review process. Another problem was that the rules for documentation and the rules for revising documentation were developed concurrently with the work being performed. This resulted in some earlier work not being documented to the degree expected by the DOE ORR teams. In this regard the ORR personnel were very helpful in defining some of the administrative rules. Another problem was that contractor personnel did not anticipate the time and effort (over 100 man-weeks) required to support the ORR effort.

In closing, I would like to submit some suggestions (figure 12) for improvements in the ORR concept. First, the ORR teams should establish (as early as possible) the documentation to be reviewed and have copies of this documentation forwarded to the ORR teams as soon as it is available. This will reduce the concentration of effort required during the field review. Secondly, the contractor should adequately indoctrinate his personnel on the effort required and the need for completing ORR. Finally, the contractor and ORR teams should be encouraged to participate in open and frank dialogue on both problems and solutions.

CONCLUSION

The ORR process has proven very beneficial to the overall restart activity. Several problems were identified early by the reviews that would have been more difficult to correct when found later.

ACKNOWLEDGEMENT

The information contained in this article was developed during the course of work under Contract No. DE-AC09-76SR00001 with the U.S. Department of Energy.

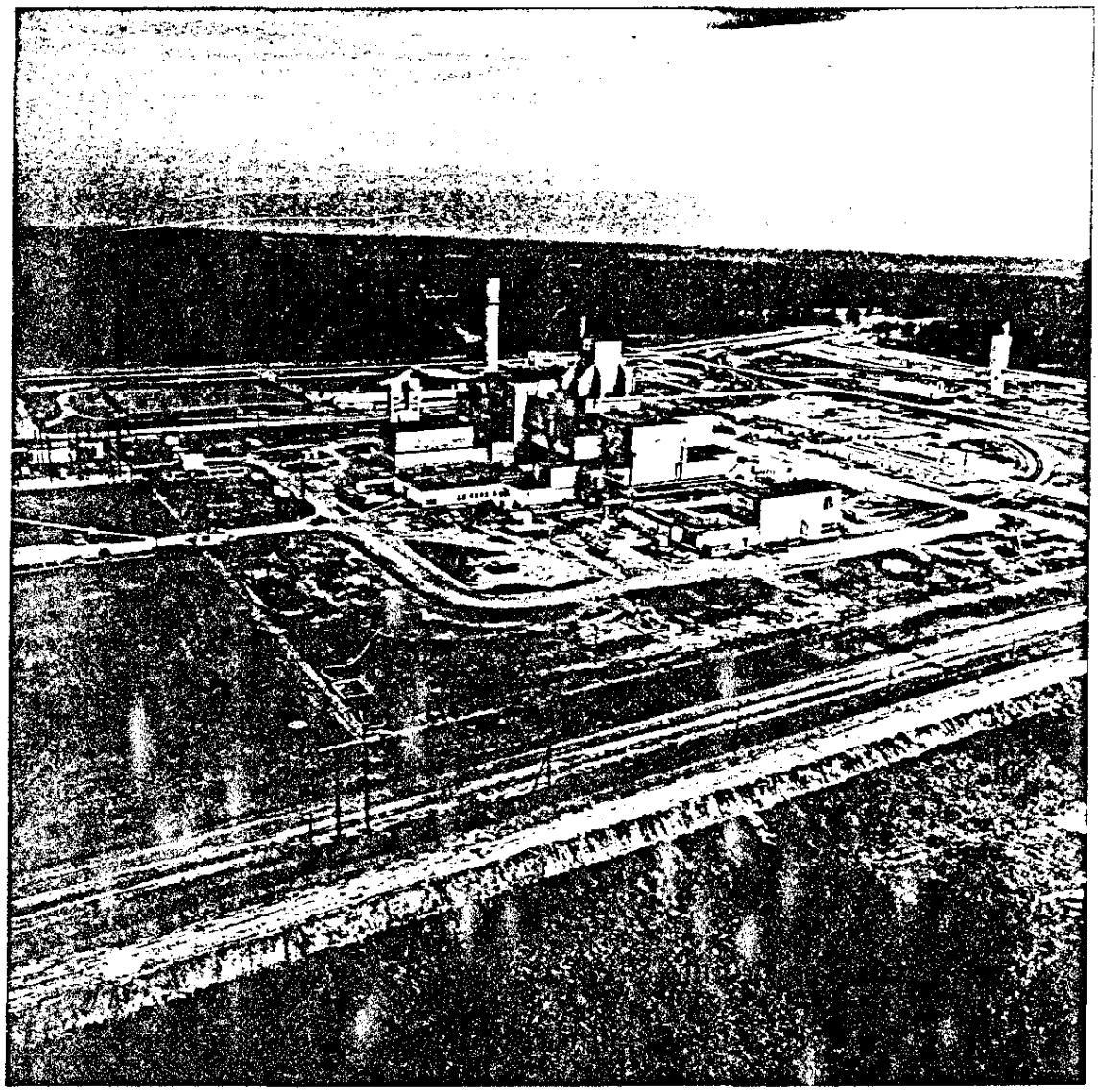

FIGURE 1

L-REACTOR HISTORY

- INITIAL STARTUP - 1954
- SHUTDOWN (PRODUCT DEMAND) - 1968
- STANDBY STATUS - 1968 - DEC. 1980
- RESTART ACTIVITY - DEC. 1980 - PRESENT

CURRENT STATUS

- FUELED, ESSENTIALLY READY TO STARTUP - WAITING ON RESOLUTION OF ENVIRONMENTAL IMPACT STATEMENT
- PERFORMING TESTS AND COMPLETING CAPITAL IMPROVEMENTS

FIGURE 2

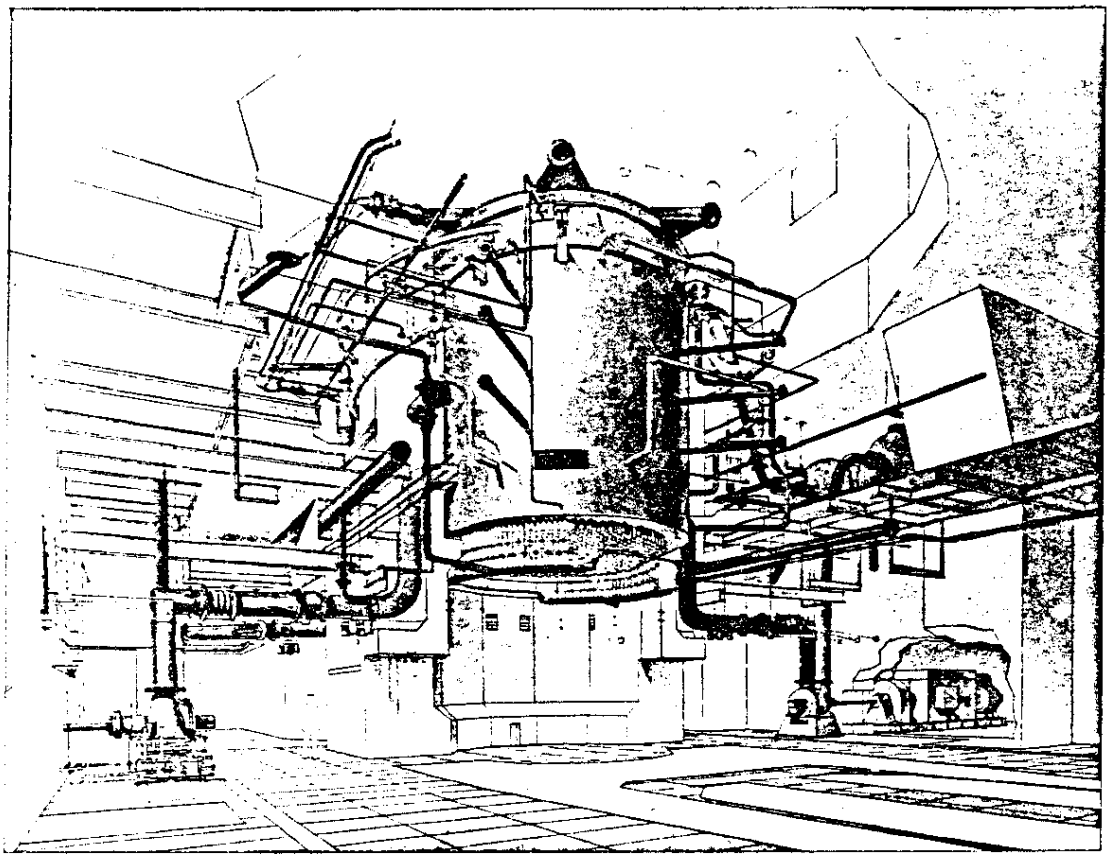

FIGURE 3

SRP REACTORS

- FIVE REACTORS BUILT AND STARTED IN EARLY 1950's FOR PRODUCING NUCLEAR MATERIALS FOR DEFENSE PROGRAMS

- CURRENT STATUS:
  - R - SHUTDOWN SINCE 1964
  - P - OPERATING
  - L - IN RESTART STATUS
  - K - OPERATING
  - C - OPERATING

FIGURE 4

SRP REACTORS

- COOLED WITH 180,000 GPM FROM SAVANNAH RIVER (ONCE-THROUGH SYSTEM)
- D_2O (HEAVY WATER) FOR PRIMARY COOLING, MODERATOR
- POWER LEVELS > 2000 MW (THERMAL)
- REACTOR ITSELF ~ 16' DIAMETER X 16' HIGH CYLINDER
- NUCLEAR COMPONENTS IN 600 4" OD TUBULAR POSITIONS ARRANGED IN A HEXAGONAL GEOMETRY
- DESIGNED FOR RAPID REFUELING

FIGURE 5

UNIQUE ASPECTS OF L-REACTOR RESTART

- NO EXPERIENCE IN RESTARTING A REACTOR FROM STANDBY STATUS
    - NO ORGANIZATION IN PLACE
    - LITTLE HISTORICAL DATA FOR SCHEDULING OR SCOPING WORK
- WORK WAS A MIXTURE OF REPAIR-RENOVATE COMBINED WITH CAPITAL IMPROVEMENTS
    - SOME EQUIPMENT OBSOLETE
    - MULTIPLE SCOPES OF WORK ON SINGLE SYSTEMS

FIGURE 6

RESTART COSTS
($190 MILLION)

60% - CAPITAL IMPROVEMENTS

- PREVIOUS IMPROVEMENTS IN P, K, AND C REACTORS
- MOST SAFETY RELATED

40% - REPAIR, RENOVATION, OPERATING

- EQUIPMENT OVERHAUL
- TESTING
- STAFFING

FIGURE 7

L-RESTART ORGANIZATION

- TEAM MANAGER
    - DESIGN LIAISON (DU PONT ENG DEPT, DELAWARE)
    - DESIGN LIAISON (SITE)
    - REPAIR & RENOVATION COORDINATOR
    - OPERATIONS/SCHEDULING
    - QUALITY VERIFICATION
    - SUPPORT PERSONNEL (SAFETY, HP, MEDICAL, SECURITY, ETC.)
- DU PONT CONSTRUCTION ORGANIZATION AT SITE
- DU PONT MAINTENANCE & TECHNICAL GROUPS AT SITE

FIGURE 8

DOE OPERATIONAL READINESS REVIEWS

- 12 INTERMEDIATE REVIEWS BY DOE-SR
  - DESIGNED TO GET A "HEAD START" BY REVIEWING AS ITEMS COMPLETED
  - COVERED ALL MAJOR REACTOR SYSTEMS

FIGURE 9

PRE-FUELING READINESS REVIEW

- EIGHT DU PONT ENGINEERS/SUPV & OVERVIEW COMMITTEE

- FIFTEEN SYSTEMS
  - SUPPLEMENTARY SAFETY
  - SAFETY & CONTROL RODS
  - FUEL DELIVERY EQUIP
  - FUELING CHARGE & DISCH EQUIP
  - FUEL DISCHARGE CONVEYOR
  - FLUX MONITORING INST
  - D_2O & H_2O EQUIP
  - PURIFICATION
  - ACID ADDITION EQUIP
  - SAFETY & CONTROL COMPUTERS
  - AUX TEMPERATURE RECORDERS
  - REACTOR LEVEL INST
  - MISCELLANEOUS ALARM PANELS
  - CONFINEMENT VENTILATION
  - EMERGENCY POWER

- 455 TEST, OPERATING, AND EMERGENCY PROCEDURES

FIGURE 10

ORR PROBLEMS

- DIFFERENT ADMIN SYSTEMS FOR CAPITAL AND RENOVATION
- DOCUMENTATION "RULES" DEVELOPED AS WORK PROGRESSED
  - SOME EARLIER WORK NOT DOCUMENTED TO DEGREE EXPECTED BY ORR TEAMS
  - ORR INPUTS HELPED DEFINE SOME RULES
- PLANT PERSONNEL DID NOT ANTICIPATE THE TIME REQUIRED TO SUPPORT THE ORR EFFORT (> 100 MAN-WEEKS)

FIGURE 11

SUGGESTIONS FOR IMPROVEMENTS

- ORR TEAMS
  - ESTABLISH, AS EARLY AS POSSIBLE, THE DOCUMENTATION TO BE REVIEWED - HAVE COPIES FORWARDED TO ORR TEAMS AS SOON AS AVAILABLE
- CONTRACTOR
  - ADEQUATELY INDOCTRINATE PERSONNEL ON DOE'S NEED TO CONDUCT ORR'S
- CONTRACTOR & ORR TEAMS
  - ENCOURAGE OPEN, FRANK DIALOG ON PROBLEMS AND SOLUTIONS

FIGURE 12