1. INTRODUCTION

1.1 General Information

This information is submitted to supercede the original application [1.1] and amendments for license R-62 as follows:

Application for Construction Permit

Date: February 5, 1959

Amendments: April 1, 1959
July 2, 1959
November 20, 1959
December 14, 1959

Reactor Vendor: Advanced Technology Laboratories (a division of American-Standard)

Applicant: Virginia Polytechnic Institute & State University (VPI & SU)
Blacksburg, Virginia 24061

VPI&SU is the state, land-grant university with main campus and reactor facility at Blacksburg, Montgomery County, Virginia.

Principal Officers: President - Dr. W. M. Lavery, U.S. Citizen
Vice President for Administration - Dr. A. H. Krebs, U.S. Citizen
Vice President for Finance - Mr. M. E. Ridenour, U.S. Citizen
Addresses - (All) Blacksburg, Virginia 24061

Class of License: Class 104(C) Training and Research Reactor
Present License: R-62
Period of License: 10 years

Financial Qualifications: The university financial qualifications are unchanged from 1969 when License R-62 was renewed.

Technical Qualifications: The VPI&SU reactor facility now has operated safely for twenty years and has logged approximately 4000 startups during this period.

Schedule for Proposed Alterations: Modification to permit 500 KW operation will begin immediately after authorization and should be completed in approximately sixty days.

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1.2 Description of the Nuclear Process to be Performed

The VPI&SU Nuclear Reactor is a class 104C facility utilized for research and teaching activities of the university. No basic change in the nuclear processes performed at the facility are proposed and the general operating procedures as stated in the "Technical Specifications" are unchanged from the original application (Feb. 5, 1959) and amendments (Apr. 1, July 2, Nov. 20 and Dec. 14, 1959). License R-62, received in December, 1959 has been amended as follows:

Amendment No.1, Dec. 7, 1965, Increase in Power Level from 100 kw to 500 kw

1.3 Description of the Facility

The VPI&SU Nuclear Reactor is an Argonaut reactor [1.2] designed, built and installed by Advanced Technology Laboratories, a Division of American-Standard and designated by them as the "UTR-10 reactor." The reactor is a 100 KW, H_2O moderated, heterogeneous reactor with graphite internal and external reflectors. Similar reactors are located at five other universities in the U.S. and also at several universities and research institutes around the world. A plan view of the reactor is shown in Fig. 1.1. The performance characteristics of the reactor are described in reference 1.3.

The reactor core consists of a graphite parallelepiped in which are embedded two aluminum tanks containing the fuel. The internal graphite reflector is about 18 inches wide. Inside the aluminum tanks are twelve fuel elements each of which contains 12 fuel plates. The fuel plates are composed of U-Al alloy and are clad with aluminum. The maximum thermal neutron flux is approximately 10^{12} neutrons cm^{-2} sec^{-1}.

The reactor operated since December 1959 under license R-62 at power levels up to the maximum of 10 KW. In 1969 the license was amended to allow operation at power levels up to 100 KW. Performance of the system has been essentially as predicted by the manufacturer and, wherever possible, experimental verification of the design characteristics of the system has been carried out. The reactor is described in the "Technical Specifications," Parts 3.0 through 6.0, and detailed drawings of the system and components are found in "Hazard Analysis - UTR-10," submitted as part of the original Application for Construction Permit, Feb. 5, 1959.

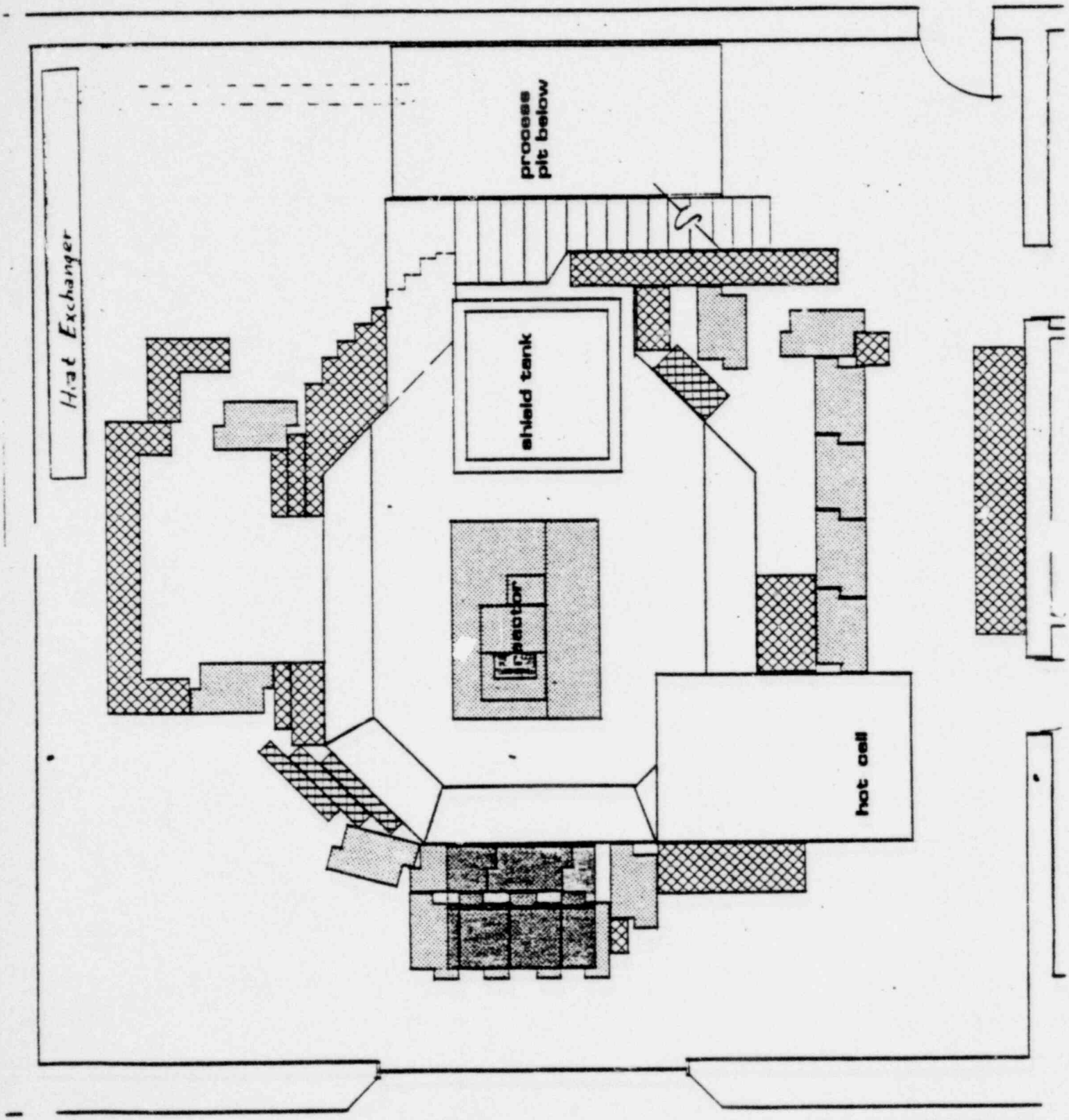


Fig. 1.1 Plan View of the Reactor

The location of the reactor facility in the Physics Building is unchanged and the teaching, laboratory and research activities in the remainder of the Physics Building have not changed significantly.

The facility change proposed in this document is to increase the maximum power level from 100 KW to 500 KW. Modifications required to carry out the facility change are:

1. Enlarge cooling lines from core tanks to process pit.
2. Extend range of present instrumentation.
3. Add additional shielding to outside of concrete shield.
4. Install new secondary coolant system.
5. Install new A-41 control system.

A detailed description of each particular modification is included in this document. (Chapter 2)

1.4 Administration of the Facility

The professional staff at the reactor as of August 30, 1979 is given in Table 1.1. Part-time student help consists of reactor operator trainees and laboratory helpers.

Table 1.1

Nuclear Reactor Staff

Position	Name	Full-Time Equivalent
Laboratory Director	T. F. Parkinson	0.5
Deputy Director	A. K. Furr	*
Reactor Supervisor	R. T. Stone	1.0
Senior Reactor Operator	A. P. Curtner	1.0
Laboratory Supervisor/Senior Reactor Operator	H. G. Knight	1.0
Radiation Safety Officer	R. T. Mogle	*
Clerk-Typist	F. B. Leighton	0.5

* Not budgeted to the Nuclear Reactor Laboratory

Administration of reactor operations is subject to the review of the Reactor Safety Subcommittee, the Radioisotope Subcommittee, and the Radiation Safety Committee. The personnel assigned to these groups as of Sept. 30, 1979 is listed in Tables 1.2, 1.3, and 1.4. A block diagram of the VPI & SU line organization is shown in Fig. 1.2. This administrative structure complies with the guidelines of Reference 1.4.

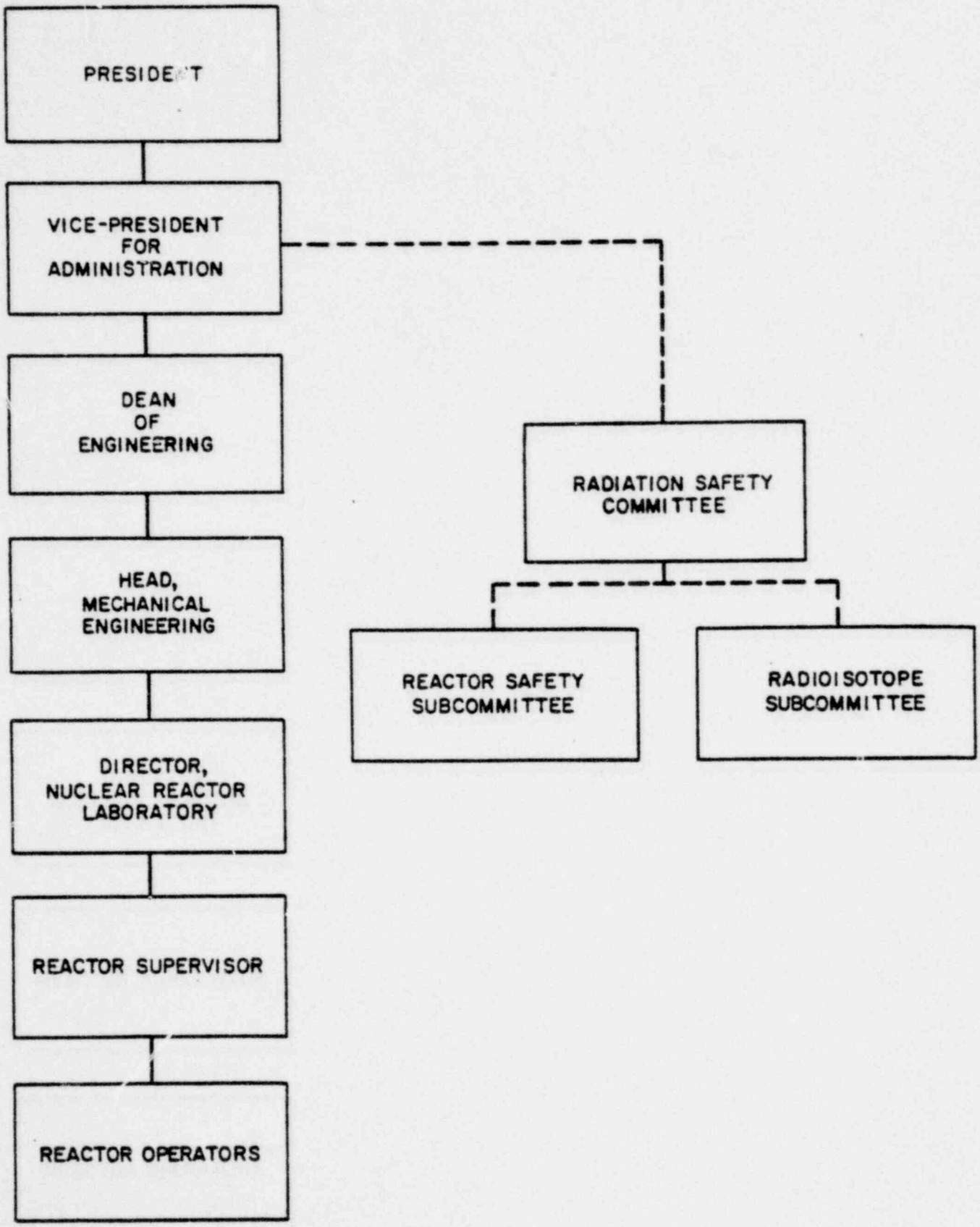


Fig. 1.2 Administrative Organization for Reactor Control and Safety

Table 1.2

Reactor Safety Subcommittee

Dr. Robert H. Miller, (Chairman), Assoc Prof., Electrical Engineering
Dr. Ronald J. Onega, Assoc. Prof., Nuclear Engineering
Dr. Clifford Randall, Prof., Civil Engineering
Dr. Bryce Shriver, Director, Nuclear Reactor Laboratory, Univ. of Virginia
Mr. Robert D. Mogle, Reactor Radiation Safety Officer (ex-officio)
Dr. Thomas F. Parkinson, Director Nuclear Reactor Laboratory (ex-officio)
Mr. Alan P. Curtner, (Secretary), Reactor Supervisor (ex-officio)

Table 1.3

Radioisotope Subcommittee

Dr. A. Keith Furr (Chairman), Prof., Nuclear Engineering and Director, Office of Health and Safety Regulatory Programs
Dr. R. C. Bates, Assoc. Prof., Microbiology, Biology Dept.
Dr. T. L. Bibb, Assoc. Prof., Col. of Vet. Medicine
Dr. J. R. Craig, Prof., Geol. Science
Mr. C. D. Goldsmith, Asst. Purchasing Agent, Purchasing Dept.
Mr. S. L. Meyers (Secretary), Radiation Safety Officer
Dr. B. Storrie, Asst. Professor, Biochem. & Nutrition
Dr. G. G. Schurig, Assistant Prof., Veterinary Medicine

Table 1.4

Radiation Safety Committee

Dr. Roger A. Teekell (Chairman), Assoc. Dean, Graduate School, and Professor of Poultry Science
Dr. James R. Craig, Prof., Geological Science
Dr. Richard F. Desjardins, M.D., Staff Physician
Dr. A Keith Furr, Prof. of Nuclear Engineering and Director, Office of Health and Safety Regulatory Programs
Mr. Sylvester L. Meyers, Radiation Safety Officer
Dr. Thomas F. Parkinson, Prof. of Nuclear Engineering and Director, Nuclear Reactor Laboratory
Dr. C. E. Polan, Professor, Dairy Science
Mr. J. L. Shotts, Director of Purchasing
Mr. R. D. Mogle, (Secretary), Reactor Radiation Safety Officer
Dr. Gerald P. Beck (Consultant), Director, Nuclear Reactor Laboratory, University of Illinois-Champaign, Urbana
Dr. H. L. Wood, Prof., Mechanical Engineering
Mr. A. P. Curtner, Nuclear Reactor Supervisor, Mechanical Engineering
Mr. John W. Cure, III (Consultant), Staff Health Physicist, Babcock and Wilcox Co., Lynchburg, Virginia

Utilization of the reactor has increased substantially over the past 10 years. Table 1.5 summarizes the operating time and energy generated for the period 1971-1979. In spite of its 20-year operating history, the reactor has a high availability and is one of the best utilized of any university reactor of its class.

Table 1.5

Operating History of the VPI&SU Reactor

Year*	Hours Operated	Energy Generated (KWH)
1971- 72	450	45,514
1972- 73	1000	93,680
1973- 74	1100	73,497
1974- 75	1100	95,346
1975- 76	1400	127,736
1976- 77	1156.4	110,091
1977- 78	1310.8	114,313
1978- 79	1022.5	87,918

*For Fiscal Years, i.e. July 1 through June 30

Plans to increase the maximum power of the reactor to 500 KW have been underway for several years. A study of the "design basis accident" for the higher power operation has been completed. [1.5] This study confirmed the inherent safety of the Argonaut reactor design even under the high unlikely postulated accident.

A proposed schedule for accomplishing the increase in maximum power to 500 KW is shown in Figure 1.3.

1.5 Power Upgrade of the Scottish Universities Research Reactor

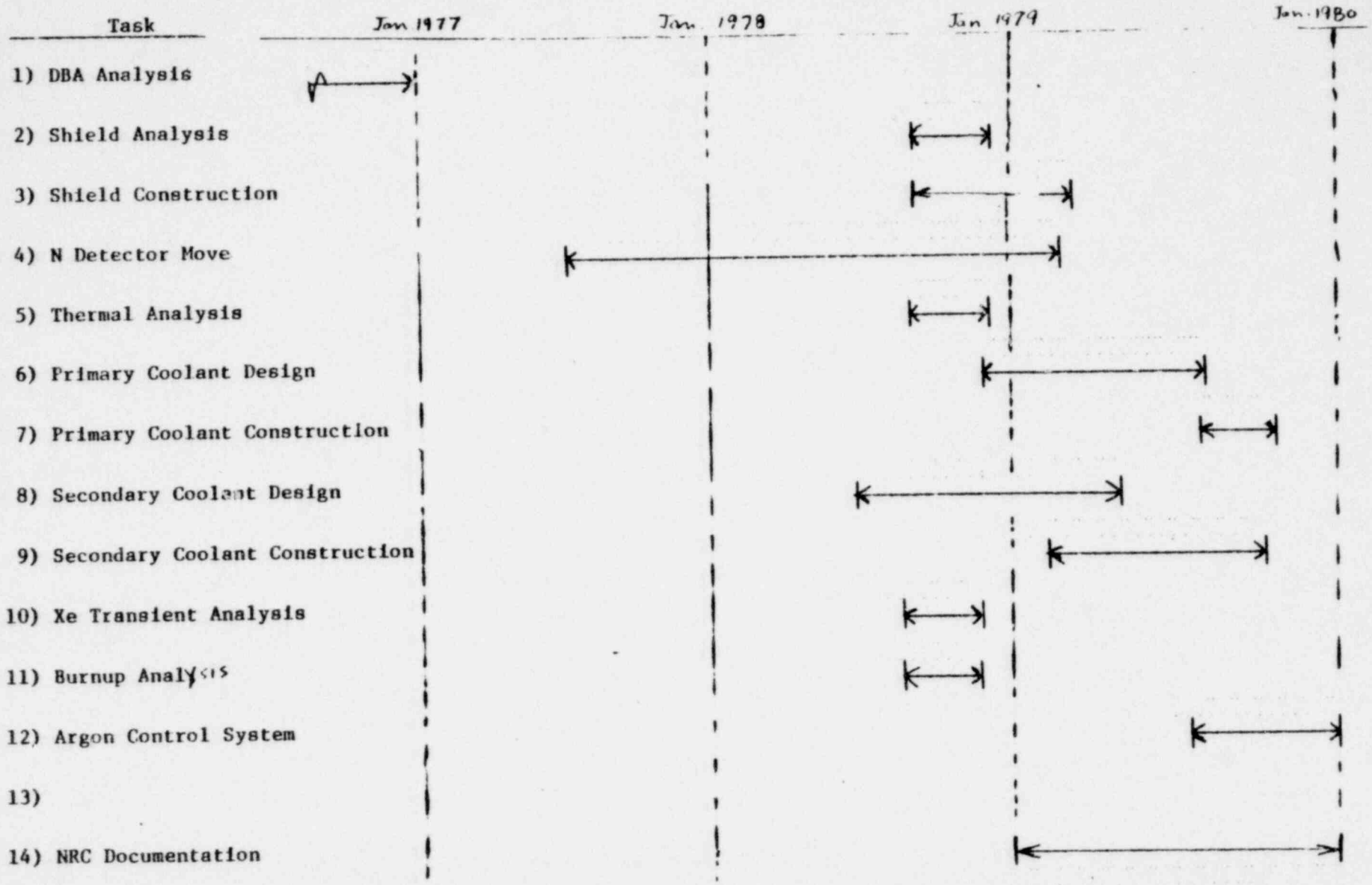
The Scottish Universities Research Reactor (SURR) is an Argonaut reactor located in East Kilbride near Glasgow, Scotland [1.6]. This reactor was designed by American Standard and is virtually identical to the VPI & SU Research Reactor. One minor difference between the two reactors is that the original SURR fuel elements contain 13 plates while the VPI & SU fuel elements contain 12 plates. The SURR was initially licensed to operate at 100 kw maximum power.

In 1969 studies were undertaken to raise the maximum operating power to 300 kw. An extensive analysis of the thermal hydraulics indicated that higher power operation was feasible and the necessary system modifications were implemented. Since the end of 1970 the SURR has been operating routinely at 300 kw. A description of the analytical and experimental programs supporting 300 kw operation is given in reference 1.7.

Because of the close similarity between the SURR and the VPI & SU reactor, the experience and excellent documentation of the former is particularly valuable in upgrading the VPI & SU reactor to 500 kw maximum power.

Plans are underway to upgrade the power of the UCLA Argonaut reactor to 500 kw. [1.8].

Fig. 1.3 Schedule for Power Upgrade Program



1.6 References

1.1 Construction ermit Application for Amendment to VPI Reactor License R-62

1.2 Lennox, D.N., et al., "The Argonaut Reactor: A Generalized Reactor Facility for Nuclear Technology Training and Research," Proc. 2nd Conf. on PUAC, 10, 265 (1958).

1.3 Stam, E., "Performance Characteristics of the VPI Training and Research Reactor (UTR-10), "M.S. Thesis, VPI&SU, 1961.

1.4 Proposed American National Standard, ANS 15.18, "Standard for Administrative Controls for Research Reactors," Jan. 1978 (Draft)

1.5 Tuley, K. D., "Power Excursion Safety Analysis of the VPI&SU Reactor 500 KW Model," M.S. Thesis, VPI&SU, 1976.

1.6 Izatt, J. A. and J. Scobie, " Characteristics of the UTR-100 Reactor", J. of Brit Nuc. Eng. Soc. 6, No. 4, Oct. 1967

1.7 Riley, J. A. and J. A. Izatt, "Upgrading Power of the Scottish Universities Research Reactor",
- Part 1. Analysis of Reactor Cooling System, SRRC 24/68
- Part 2. Proposed Scheme for Increasing Reactor Power to 300 kw Thermal, SRRC 28/68
- Part 3. Commissioning and Post Commissioning Report, SRRC/44/72, April 1972

1.8 Howard, George E. and C. D. Smith, "Operation of the UCLA Argonaut Reactor at 0.5 MW", Trans. ANS, Dec. 1969.