**Oak Ridge Research
Reactor Quarterly Report
October, November, and
December of 1976**

S. S. Hurt, III
E. D. Lance

OAK RIDGE NATIONAL LABORATORY

OPERATED BY UNION CARBIDE CORPORATION FOR THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

27
7/8/77
256 NTLS

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

Printed in the United States of America. Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road, Springfield, Virginia 22161
Price: Printed Copy ~~\$4.00~~ Microfiche \$3.00

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the Energy Research and Development Administration/United States Nuclear Regulatory Commission, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

ORNL/TM-5965

Contract No. W-7405-eng-26

OPERATIONS DIVISION

OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT

OCTOBER, NOVEMBER, AND DECEMBER OF 1976

S. S. Hurt, III
E. D. Lance

Date Published - June 1977

NOTICE
This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research and Development Administration, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

NOTICE This document contains information of a preliminary nature. It is subject to revision or correction and therefore does not represent a final report.

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
operated by
UNION CARBIDE CORPORATION
for the
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

CONTENTS

	<u>Page</u>
Summary	1
Operations	1
Fuel Usage and Inventory	3
Shutdowns and Power Reductions	4
Instrumentation and Reactor Controls	6
Process System and Mechanical Components	6
Experiment Facilities and Core Changes	6
Distribution.	21

SUMMARY

The ORR operated at an average power level of 29.3 Mw for 20.1% of the time during October, November, and December of 1976. The time operating (%) is low due to the reduction of operating time to a level compatible with funding. Six fuel elements were declared spent (57.6% burnup) during the quarter, while no new elements were placed in service.

The reactor was shut down on seven occasions, one of which was unscheduled. Reactor downtime needed for refueling, maintenance and checks was quite low, with the reactor remaining available for operation 92.0% of the time.

Maintenance activities, both mechanical and instrument, were essentially routine in nature.

OPERATIONS

The basic operating data presented in Table 1 indicates that the ORR operation for the quarter was normal as compared with recent experience.

Details relative to cycles of operation during the quarter are given in Table 2.

Table 1. ORR Basic Operating Data
October, November, and December of 1976

	This Quarter	Last Quarter	Calendar Year 1976	Calendar Year 1975
Total energy, Mwd	554.3	1,394.7	6,638.2	9,282.5
Average power Mw/operating hr	29.3	29.8	29.7	29.8
Time operating, %	20.5*	50.9*	61.1*	85.6
Availability, %	92.0	95.5	92.0	80.9
Reactor water radio- activity $\frac{\text{c/min}}{\text{ml}}$ (av)	25,400	28,300	27,800	29,725
Pool water radio- activity, $\frac{\text{c/min}}{\text{ml}}$ (av)	570	590	588	647
Reactor water resis- tivity, ohm-cm (av)	1,676,000	1,234,000	1,159,000	902,750
Pool water resis- tivity, ohm-cm (av)	1,325,000	784,000	902,000	783,250
Fuel elements depleted	6	1	18	84
Average burnup of fuel elements depleted, %	57.6	62.4	56.9**	52.3
Shim rods depleted	0	2	8	14
Average burnup of shim rods depleted, %	0	69.0	65.1	64.2
Radioisotope samples	0	2	4	7
Research samples	1	0	7	26

*Time operating (%) low due to reduced level of funding.

**Burnup (%) greater due to lowering of the ^{235}U weight of the fuel element to ~100 gm before declaring an element depleted.

Table 2. Cycles of Operation

Cycle No.	Date Begun	Date Ended	Accumulated Energy Mwd
134	September 13, 1976	November 5, 1976	355.1*
135	November 15, 1976	December 31, 1976	306.3

*247.97 Mwd this quarter.

FUEL USAGE AND INVENTORY

Six fuel elements were declared spent during the quarter with an average burnup of 57.6 percent. Thirteen fuel elements and four shim rod elements were shipped to the Savannah River Plant for chemical separation.

Other details of fuel usage and inventory may be found in Tables 1 and 3.

Table 3. ORR Fuel Status

	This Quarter	Last Quarter	Calendar Year 1976	Calendar Year 1975
Depleted fuel elements transferred for chemical separation	13	13	71	138
Average percent burnup of fuel elements transferred	55.2	53.8	52.8	49.5
New fuel elements placed in service	0	5	58	104
New fuel elements available for use	63*	63		
Depleted shim rods transferred for chemical separation	4	4	14	18
Average percent burnup of shim rods transferred	64.4	63.0	64.2	64.5
New shims placed in service	0	2	8	14
New shim rods available for use	2	2		

*Includes four partial fuel elements.

SHUTDOWNS AND POWER REDUCTIONS

Reactor downtime (power level $<N_L$) totaled approximately 1,756 hours. A summary of the shutdowns is given in Table 4, and details of each are contained in Table 5. Table 6 offers information relative to the unscheduled shutdown.

Table 4. Summary of Shutdowns

Description of Shutdown	Number	Downtime (hr)
Scheduled		
Regular, end of cycle	2	224.900
Regular, refueling and iodine removal. Shutdown extended due to low level of funding.	1	665.200
Regular, refueling, iodine removal, and maintenance. Shutdown extended due to low level of funding.	1	296.067
Regular, completion of a run for a sample irradiation. Shutdown extended due to low level of funding.	1	322.133
Regular, completion of an experiment run. Shutdown extended due to low level of funding.	1	17.750
Special, completed a startup for benefit of the RORC. Shutdown extended due to low level of funding.	1	228.833
Subtotal	7	1,754.883
Unscheduled		
Instrument failure, reactor	1	0.633
Subtotal	1	0.633
Total	8	1,755.516

Table 5. ORR Scheduled Shutdowns, Detail

Date	Duration (hr)	End Cycle	Remarks
10-4-76	665.200	134A	The reactor was refueled and isotope (iodine, xenon) work was completed.
11-5-76	223.900	134B	The shutdown marked the end of cycle 134. Shutdown activities included: (1) routine inspection of the 24-in. reactor primary water lines in the trench at the primary pump house; (2) replacement of filter cartridges on the primary by-pass filter column; (3) cleaning of screens and basin on the reactor secondary cooling tower; (4) routine inspection and repairs of outside steam tracing lines; and (5) programmed maintenance.
11-15-76	322.133	135A	Completed 8.100 hours of operation for a sample irradiation.
12-3-76	296.067	---	The reactor was refueled and isotope (iodine, xenon) work was completed. Maintenance work included the replacement of No. 6 shim-rod operator assembly No. 9 and drive mechanism No. 6. The replacements were made because of a water leak in the seal housing.
12-16-76	17.750	135B	Completed 10.300 hours of operation for researcher work at Beam Hole No. 1.
12-17-76	228.833	---	The reactor was started up for benefit of the RORC.
12-31-76	1.000	---	The shutdown marked the end of cycle 135. All shutdown activities were scheduled for 1977.

Table 6. ORR Unscheduled Shutdowns, Details

Date	Duration (hr)	End Cycle	Remarks
12-16-76	0.633	---	Faulty action (spurious noise spike) from No. 2 Log-N period channel initiated a fast scram.

INSTRUMENTATION AND REACTOR CONTROLS

The performance of the instrumentation for the complex was quite satisfactory and only rather routine maintenance was required as indicated in Table 7. Table 8 reflects the status of the various fission and ionization chambers.

PROCESS SYSTEM AND MECHANICAL COMPONENTS

Details of maintenance or changes to the process system are given in Table 9, while Table 10 lists the maintenance on the mechanical components. Table 11 summarizes the results of efficiency tests of the various gaseous waste filters.

EXPERIMENT FACILITIES AND CORE CHANGES

Experiment facility usage is given in Table 12. The core configurations used during the quarter are shown in Figure No. 1.

ORR LATTICE LOADING

For Fuel Cycles 134A, 134B, 135A, & 135B

	1	2	3	4	5	6	7	8	9
A	Be	Be	Be	F	F	F	Be	Be	Be
B	Be	Be	F	SR	F	SR	F	Be	Be
C	Be	Be	F	F	F	F	F	F	Be
D	Be	Be	F	SR	F	SR	F	HT	Be
E	Be	Be	F	F	F	F	¹³¹ I	F	Be
F	Be	Be	F	SR	F	SR	F	SR	Be
G	Be	Be	Be	Be	Be	Be	Be	Be	Be

LATTICE COMPONENT

NUMBER

Fuel	<u>24</u>
Shim Rod (SR)	<u>6</u>
Beryllium (Be)	<u>31</u>
Experiment (E)	<u>0</u>
Iodine Sleeve (¹³¹ I)	<u>1</u>
Isotope Stringer (Iso)	<u>0</u>
Hydraulic Tube (HT)	<u>1</u>

Figure 1. ORR Lattice Configuration - October 1, 1976,
Through December 31, 1976

Table 7. Maintenance and Changes, Instrumentation and Controls

Date	Component	Trouble or Change	Reason or Maintenance
No. 1 Counting-Rate Channel			
12-13-76	No. 1 fission chamber	Chamber failure	The faulty chamber (TSM-1-52) was replaced by chamber TSM-5-67.
No. 2 Counting-Rate Channel			
			No maintenance or changes were required.
No. 1 Log-N Channel			
			No maintenance or changes were required.
No. 2 Log-N Channel			
			No maintenance or changes were required.
No. 1 Safety Channel			
			No maintenance or changes were required.
No. 2 Safety Channel			
			No maintenance or changes were required.
No. 3 Safety Channel			
			No maintenance or changes were required.

Table 7. (Continued)

Date	Component	Trouble or Change	Reason or Maintenance
		Magnet Amplifiers	
			No maintenance or changes were required.
		Nos. 1 and 2 Gamma Channel	
			No maintenance or changes were required.
		North N ¹⁶ Channel	
			No maintenance or changes were required.
		South N ¹⁶ Channel	
11-29-76	South N ¹⁶ recorder amplifier	Replacement	The faulty amplifier was replaced.
		Servo Channel	
10-4-76	Servo limit switch assembly	Checking and overhauling	The checks and maintenance were completed as follows: (1) the span time of the servo limit switches was checked in both directions (10.8 seconds on withdraw to insert and 13.8 on insert to withdraw), (2) the shim travel versus limit switch span was 1.1 inches as compared to 1.08 inches standard, (3) the worn degraded rod position indicator motor in servo limit switch assembly was replaced, and (4) the differential gear train was cleaned and oiled.

Table 7. (Continued)

Date	Component	Trouble or Change	Reason or Maintenance
		Reactor Noise Monitor	
			No maintenance or changes were required.
		Micrcmicroammeter Channel	
			No maintenance or changes were required.
		Process Instrumentation	
10-11-76	Reactor inlet water temperature recorder	Calibrated	To check calibration.

Table 8. Present Status of Ionization Chambers and Fission Chambers

Chamber Serial No.	Location	Present Service	Date Present Service Started	Previous Service	Remarks
Installed Chambers					
PCP-III-106-66-9	Position 7	No. 1 safety and No. 2 log-N	September, 1966 (safety)	None	No trouble; fabricated at ORNL. Compensated section used from February, 1969, until March, 1970, as No. 1 log-N. Used as No. 2 log-N from May 28, 1973.
CTC-2 (C-768)	Position 3	No. 3 safety	December 12, 1975	LITR-BSR	Served as LITR safety chamber from February, 1963, to July, 1965. Modified for under- water service in 1969. Installed in the BSR in April, 1970, and in August the chamber was removed to storage.
PCP-III-1-6A, SN-72-3	Position 2	No. 2 safety and No. 1 log- N	May 15, 1975	None	None.
PCP-II-106-63-4	Position 5	Servo and micromicro- ammeter	June, 1964	None	No trouble; fabricated by ORNL.
TSM-5-F67 IC-2635	Poolside	No. 1 counting rate north	December 13, 1976	None	Replaced chamber TSM- 1-52.

Table 8. (Continued)

Chamber Serial No.	Location	Present Service	Date Present Service Started	Previous Service	Remarks
CTC-5	Position 8	Chamber dis- connected	October, 1971	LITR	Used as No. 1 safety at the LITR: modified for ORR-BSR underwater ser- vice.
PCP-II-105-63-2	Poolside, south	No. 1 gamma, south	April 26, 1972	ORR	Used as No. 2 gamma, north, from April, 1964, until December, 1970.
PCP-II-105-63-3	Poolside, north	No. 2 gamma, north	August 17, 1971	ORR	Used as No. 1 gamma, south, from April, 1964, until March 1970.
TSM-4-566 IC-2634	Poolside	No. 2 count- ing rate	September 20, 1976	None	Replaced fission chamber "snake" assembly TSM- 3-F-29.
Spare Chambers					
PCP-II-105-63-1	Instrumen- tation & Controls Shop	Awaiting repair	April 26, 1972	ORR	Used as No. 1 gamma, south, from March 31, 1970, until April 26, 1972.
S27-34R-F29	ORR plug storage	Awaiting repair	April 26, 1971	ORR	Used as No. 1 counting rate from July 28, 1970, to April 26, 1971.
S3-8R-F22	ORR plug storage	Awaiting repair	April 26, 1971	ORR	Used as No. 2 counting rate from January 14, 1970, to April 26, 1971.

Table 8. (Continued)

Chamber Serial No.	Location	Present Service	Date Present Service Started	Previous Service	Remarks
TSM-1-F52	ORR plug storage	Awaiting repair	March 29, 1976 Removed from service 12/13/76	ORR	Used as No. 2 counting rate (south) from April 26, 1972, until October 24, 1972. Used as No. 1 counting rate (north) from March 29, 1976, un- til December 13, 1976.
CTC-1	Instrumen- tation & Controls Shop	Awaiting repair	October, 1976	ORR	Used as noise monitor from March, 1962, until October 1, 1971.
CTC-4 (C-769)	ORR plug storage			LITR	Used as No. 2 safety in the LITR; modified for ORR- BSR underwater service.
PCP-III-106-66-5	Instrumen- tation & Controls Shop	Awaiting repair		ORR	Used as No. 2 safety and log- N from September 27, 1968, to July 22, 1970, and from May 7, 1971, to May 20, 1971; from November, 1971, to January 24, 1973, as No. 2 safety and until May 28, 1973, as No. 2 log-N.
TSM-2-F45	I&C shop	Awaiting repair	August 8, 1975	ORR	Used as No. 1 counting rate from April 26, 1971, un- til December 5, 1972. Removed 3/30/76 to shop for repair.

Table 8. (Continued)

Chamber Serial No.	Location	Present Service	Date Present Service Started	Previous Service	Remarks
PCP-II-106-66-3	I&C Shop	Awaiting repair	May, 1974 (safety) March, 1970, (log-N). Re- moved from December 12, 1975	None	Fabricated by ORNL. Chamber failed December 12, 1975. Removed 9/2/76 to shop for repair.
TSM-3-F29	I&C Shop	Awaiting repair		ORR	Used as No. 2 counting rate from October 24, 1972 un- til September 20, 1976.

Table 9. Process Systems, Maintenance and Changes

Date	Component	Remarks
Reactor Primary Water System		
11-10-76	Reactor water lines	The 24" water line in the trench at Building 3085 was visually inspected and found to be satisfactory.
11-10-76	By-pass filters	The filter cartridges were changed.
12-21-76	Enclosure for by-pass filter columns	A new heat lamp was installed to prevent freezing of the DP cells.
Reactor Secondary Cooling System		
10-4-76	Cooling tower	Nuts and bolts in the fan cylinders were replaced.
10-6-76	Cooling tower	New conduit, electrical wire, and new outside lights were installed.
10-29-76	Cooling tower	A new safety shower was installed near the acid storage tank.
11-16-76	Cooling tower	A new blowdown line was installed on the north riser.
11-30-76	Cooling tower	The bearing on the north fan motor was noisy. The trouble was corrected after the bearing was greased.
12-14-76	Cooling tower	A faulty stepping motor and relay were replaced in the fan control timer.

Table 9. (Continued)

Date	Component	Remarks
Pool Primary Cooling System		
10-7-76	Demineralizer-anion column	The cover to the resin column was removed and reinstalled after all depleted resin was removed and new resin installed.
10-27-76	Demineralizer	The flange on valve P-23 was tightened to stop a water leak.
Emergency Cooling System		
11-8-76	Nos. 1, 2, and 3 dc units	Functional tests of equipment and alarms confirmed that the systems were in satisfactory condition.
11-30-76	No. 1 dc unit	A faulty high voltage relay was replaced.
Electrical Systems		
10-27-76	Control room instrument cabinet "B"	A faulty exhaust fan was replaced.
11-9-76	Miscellaneous breaker panels for electric meters, dc batteries, battery racks, and control room instrument cabinets	Routine end-of-cycle inspection and cleaning were performed. Dust filters for the control room instrument cabinets were changed as needed, and programmed maintenance was completed.
Emergency Electrical System		
11-8-76	Diesel generator	The routine end-of-cycle load test was performed with satisfactory results. One battery on the generator was replaced.

Table 10. Reactor Mechanical Components, Maintenance and Changes

Date	Component	Remarks
10-11-76	North hold-down arm	Hold-down arm No. 3 was replaced with No. 4 hold-down arm which was a rebuilt unit.
12-13-76	No. 6 shim-rod drive assembly	The engagement mechanism, seal housing, operator assembly, drive unit and recocking mechanism were replaced due to a leak in the seal housing.

Table 11. Status of Filters - Gaseous Waste System

Type Filter	Bank Designation	Date Installed	Date Last Tested	Type Test	Retention Efficiency %
Cell Ventilation System					
CWS	Overall*	North, 6-20-73 South, 1-12-65	9-30-76	DOP	99.997
Charcoal	Both banks	North, 9-16-74 South, 10-17-67	9-8-76	Elemental Iodine	99.93
Charcoal	Both banks	North, 9-16-74 South, 10-17-67	9-10-76	Methyl Iodide	41.37
Pressurizable Off-Gas					
CWS	North	5-5-75	9-30-76	DOP	99.920

*The CWS filters in the cell ventilation system were checked in series.

Table 11. (Continued)

Type Filter	Bank Designation	Date Installed	Date Last Tested	Type Test	Retention Efficiency %
Pressurizable Off-Gas					
Charcoal	North	2-26-73	1-28-76	Elemental Iodine	99.940
Charcoal	North	2-26-73	10-7-75	Methyl Iodide	87.970
CWS	South	10-18-67	9-30-76	DOP	99.986
Charcoal	South	8-11-75	8-13-75	Elemental Iodine	99.993
Charcoal South	South	8-11-75	10-8-75	Methyl Iodide	97.48
Basement Hood Exhaust					
CWS	South	10-4-76	10-4-76	DOP	99.997
CWS	North	10-4-76	10-4-76	DOP	99.998
Normal Off-Gas					
CWS	West	2-12-76	9-30-76	DOP	99.998
Charcoal	West	2-12-76	8-3-76	Elemental Iodine	99.94
CWS	East	6-12-75	9-30-76	DOE	99.995
Charcoal	East	7-29-75	10-27-76	Elemental Iodine	99.26
Charcoal	West	2-12-76	4-20-76	Methyl Iodide	99.93
Charcoal	East	7-29-75	4-20-76	Methyl Iodide	94.14

Table 12. Experiment Facility Usage

Facility	Access Flange	Date Installed	Date Removed	Description of Experiment	Division or Other Sponsor
D-8	V-3	3-10-67		Hydraulic tube No. 2 used for isotope production and short term irradiations	Operations
E-7	None	8-4-76		Radioisotopes (iodine & xenon)	Operations
HB-2	None	7-58	11-76	Neutron diffraction experiments	Solid State Physics
HB-3	None	11-1-58		Neutron diffraction experiments	Solid State Physics
HB-4	None	7-58	11-76	Neutron diffraction experiments	Chemistry
HB-6	None				Solid States
HN-3	None	11-59		Activation analysis	Analytical Chemistry
HN-4	None	12-15-63		Void determinations in irradiated materials	Solid State Physics
HN-4	None	12-15-63		"Fly's Eye" two-dimensional neutron detector for neutron diffraction and radiography	Instrumentation and Controls

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

INTERNAL DISTRIBUTION

1. M. A. Baker	23. L. C. Lasher
2. F. T. Binford	24. D. L. Laughlin
3. R. K. Branam	25. R. V. McCord
4. G. H. Burger	26. F. H. Neill
5. C. D. Cagle	27. T. B. Nixon
6. W. R. Casto	28. L. C. Oakes
7. G. H. Coleman	29. H. Postma
8. J. A. Conlin	30. M. E. Ramsey
9. J. A. Cox	31. J. B. Ruble
10. F. L. Culler	32. W. H. Sides
11. S. J. Ditto	33. T. M. Sims
12. W. A. Duggins	34. M. J. Skinner
13. E. D. Gupton	35. J. H. Swanks
14. T. P. Hamrick	36. J. R. Thomas
15. S. S. Hurt, III	37. W. E. Thomas
16. J. D. Jenkins	38. K. R. Thoms
17. L. P. Jernigan	39. J. R. Weir, Jr.
18. E. B. Johnson	40. K. W. West
19. O. L. Keller	41-43. Laboratory Records Department
20. E. M. King	44. Laboratory Records, ORNL R.C.
21. E. Lamb	45-46. Central Research Library
22. E. D. Lance	47. Document Reference Section

EXTERNAL DISTRIBUTION

48. K. M. Akhtar, Head, Reactor Operations Group, Pakistan Institute of Nuclear Science & Technology, Post Office Nilore, Rawalpindi, PAKISTAN
- 49-50. M. B. Biles, Director, Division of Safety, Standards, and Compliance, ERDA, Washington, D. C.
51. Eric Blomberg, AB Atomenergi, Studsvik, Nyköping, SWEDEN
52. K. J. Bobin, Centre D'Etude de Energie Nucleaire, S.C.K./C.E.N., Boeretang 200, B-2400 Mol, BELGIUM
53. Safety and Environmental Control Division, ERDA, Oak Ridge
54. C. Möller, Atomic Energy Board, Pelindaba, Private Bag X256, Pretoria, SOUTH AFRICA
55. Director, Reactor Division, ERDA, Oak Ridge
56. Kiyoshi Inoue, Hitachi Central Research Laboratory, Kokubunji, Tokyo, JAPAN
57. M. Jacquemain, Head, Technical Department ILL, Institute Max von Laue-Paul Langevin, CEDEX 156, 38 Grenoble-Gare, FRANCE
58. Masanori Kanbara, Head, Reactor Section No. 2, JMTR Division, OARAI Research Establishment, JAERI, JAPAN
59. Wilfried Krull, Gesellschaft für Kernenergieverwertung, In Schiffbau und Schiffahrt MBH., 2054 Geesthacht-Tesperhude, Reaktorstrabe-1, WEST GERMAN FEDERAL REPUBLIC
60. O. D. Oner, Head, Reactor Operation Division, Cemece Nuclear Research Center, P.K. 1. Hava Alani, Istanbul, TURKEY
61. G. Rada, Head, Reactor Department, Institute Venezolano de Investigaciones Cientificas, Apartado 1827, Caracas, VENEZUELA

EXTERNAL DISTRIBUTION (continued)

- 62. Research and Technical Support Division, ERDA, Oak Ridge
- 63. Robert J. Swanenburg de Veye, Head, Research Reactor Department,
Reactor Centrum Nederland, Westerduinweg 3-Petten (N.-H.),
THE NETHERLANDS
- 64-91. Technical Information Center, Oak Ridge
- 92. R. Wakabayashi, NAIG Research Laboratory, 250 Suehiro-Cho. Kawasaki
City, Kanagawa Prefecture, JAPAN
- 93. K. E. Wirtz, Institute of Technology, Nuclear Research Center,
Karlsruhe, WEST GERMAN FEDERAL REPUBLIC
- 94. A. C. Wood, A.A.E.C. Research Establishment, New Illawarra Rd.,
Lucas Hts., N.S.W., AUSTRALIA