

ANL-6077

ANL-6077

ARGONNE NATIONAL LABORATORY

ARGONNE LOW POWER REACTOR  
OPERATING INSTRUCTIONS MANUAL

Edited by

Eberhard E. Hamer

MANUSCRIPT

ARGONNE NATIONAL LABORATORY  
9700 South Cass Avenue  
Argonne, Illinois

ARGONNE LOW POWER REACTOR  
OPERATING INSTRUCTIONS MANUAL

Edited by  
Eberhard E. Hamer  
June, 1961

Reactor Engineering Division

Authors

N. R. Grant	W. J. Kann
E. E. Hamer	W. C. Lipinski
H. H. Hocker	G. C. Milak
G. L. Jorgensen	D. H. Shaftner
A. Smaardyk	

Contributors

J. D. Cerchione	R. W. Thiel	W. R. Wallis
Idaho Division		

Operated by the University of Chicago

under

Contract W-31-109-eng-38

**PREFACE**

In August, 1958, a draft copy of the Operating Instructions for the Argonne Low Power Reactor (ALPR) was submitted to the United States Atomic Energy Commission. The instructions were approved with the stipulation that certain additional information was to be incorporated, and this requirement was met prior to plant operation.

The prefaced document is one of three that together comprise Argonne's operating instructions for the ALPR. The other two documents are:

1. Standard Operating Procedures for Operation of the Argonne Low Power Reactor (ALPR), ANL-6082, June, 1961.
2. Argonne Low Power Reactor Health Physics Manual, ANL-6016, August, 1959.

The documents include the contents of the preliminary instructions draft, modified to reflect the experience of plant operation up to February 5, 1959, the date of transfer of the facility to Combustion Engineering, Inc., as operating contractor. For convenience of presentation some material has been presented in more than one of the reports. Also, additional material has been included.

This document supplies detailed procedures for operation of plant equipment and plant systems, and instructions for special non-routine operations. The section on "Normal Plant Shutdown" in the preliminary report has been transferred to ANL-6082. In part, the section on "Reactor Startup" appears in ANL-6082; the material retained in the present report is in the section titled "Nuclear Instrumentation and Reactor Control," which includes also a description of the automatic control system of the reactor. Three sections have been

1. "Procedure Manual Heat Storage and Dissipation Recorder" (Section IX);
2. "Procedures for Loading or Unloading of Core Components" (Section IXVIII), based partly upon plant operation and partly upon assembly-loading experiments performed in a full-scale simulation of a core quadrant in a reactor vessel;
3. "Control-System Calibrations," constituting recommended procedures extrapolated from experience with zero-power reactor physics measurements, and including outlines of proposed mixing and water-sampling procedures.

Plant controls referred to and identified by nameplate are underlined in the text.

**INDEX BY SYSTEM**

	Page
I. <b>INDEX OF PLANT COMPONENTS AND SYSTEMS</b>	11
II. <b>NUCLEAR INSTRUMENTATION AND REACTOR CONTROL</b>	12
III. <b>STEAM BYPASS CONTROL SYSTEM</b>	15
IV. <b>FEEDWATER CONTROL SYSTEM</b>	17
V. <b>MAJOR ELECTRICAL AUXILIARIES</b>	18
VI. <b>MAIN CONDENSER AND AIR COOLING SYSTEM</b>	19
VII. <b>COOLING WATER SYSTEMS (CONDENSATE)</b>	20
VIII. <b>MISCELLANEOUS DRAINS AND VAPOR LEAKOFF SYSTEM</b>	21
IX. <b>CONTROL ROD DRIVE COOLING SYSTEM</b>	22
X. <b>REACTOR WATER PURIFICATION SYSTEM</b>	23
XI. <b>SOLUBLE-POISON (BORIC ACID) INJECTION SYSTEM</b>	24
XII. <b>REACTOR SHIELD COOLING SYSTEM</b>	25
XIII. <b>REACTOR VENTILATION SYSTEM</b>	26
XIV. <b>PLANT MAKEUP WATER DEMINERALIZER AND STORAGE SYSTEM</b>	27
XV. <b>CONTROL ROD DRIVES</b>	28
XVI. <b>REACTOR FEEDWATER PUMPS</b>	29
XVII. <b>AIR EJECTORS</b>	30
XVIII. <b>TURBINE GENERATOR UNIT</b>	31
XIX. <b>TURBINE GLAND SEAL SYSTEM</b>	32
XX. <b>TURBINE LUBRICATING OIL SYSTEM</b>	33
XXI. <b>SIMULATED SPACE HEATING SYSTEM</b>	34
XXII. <b>SIMULATED ELECTRICAL LOAD SYSTEM</b>	35
XXIII. <b>REACTOR TOP SHIELD ASSEMBLY AND DISASSEMBLY PROCEDURE</b>	36
XXIV. <b>FUEL ASSEMBLY STORAGE COOLING SYSTEM</b>	37

	98
	106
	114
VII. WASTE CONDENSER AND AIR COOLING SYSTEM	132
VIII. COOLING WATER SYSTEMS (CONDENSATE)	144
IX. MISCELLANEOUS DRAINS AND VAPOR LEAKOFF SYSTEM	154
X. CONTROL ROD DRIVE COOLING SYSTEM	160
XI. REACTOR WATER PURIFICATION SYSTEM	163
XII. SOLUBLE-POISON (BORIC ACID) INJECTION SYSTEM	175
XIII. REACTOR SHIELD COOLING SYSTEM	182
XIV. REACTOR VENTILATION SYSTEM	189
XV. PLANT MAKEUP WATER DEMINERALIZER AND STORAGE SYSTEM	194
XVI. CONTROL ROD DRIVES	200
XVII. REACTOR FEEDWATER PUMPS	210
XVIII. AIR EJECTORS	221
XIX. TURBINE GENERATOR UNIT	229
XX. TURBINE GLAND SEAL SYSTEM	252
XXI. TURBINE LUBRICATING OIL SYSTEM	258
XXII. CONDENSING STEAM HEATING SYSTEM	262
XXIII. CONDENSING STEAM HEATING SYSTEM	262

	Page
XIV. PRESSURE VESSEL HEAD REPAIR AND INSTALLATION PROCEDURE	287
XVI. BUILDING CRANE AND HOISTS	293
XVII. BUILDING HEATING AND VENTILATION	297
XVIII. PROCEDURES FOR LOADING OR UNLOADING OF CORE COMPONENTS	301
XXIX. CONTROL-SYSTEM CALIBRATIONS	304
REFERENCES	306

**Section I**

1	<b>Schematic of Argonne Low Power Reactor (ALPR) Plant</b>	<b>07</b>
2	<b>Argonne Low Power Reactor Site</b>	<b>08</b>
3	<b>Reactor Installation, Vertical Section</b>	<b>09</b>
4	<b>Plan View of Control Room</b>	<b>12</b>
5	<b>Operating Floor Plan</b>	<b>13</b>
6	<b>Fan Floor Plan</b>	<b>14</b>
7	<b>Fan Floor Personnel Air Lock</b>	<b>15</b>
8	<b>Master Flow Diagram</b>	<b>16</b>
9	<b>Valve Designations and Description</b>	<b>17</b>
10	<b>Steam Systems and Space Heating Flow Diagram (with Legend)</b>	<b>18</b>
11	<b>Feedwater, Cooling Water (Condensate), Air Ejectors, Condenser, Rod Drive Cooling and Drains System Flow Diagram</b>	<b>19</b>
12	<b>Shield Cooling, Make-up Water and Boron Injection Flow Diagram</b>	<b>20</b>
13	<b>Reactor Water Purification System Flow Diagram</b>	<b>21</b>
14	<b>Miscellaneous Drains and Vapor Leak-Off Flow Diagram</b>	<b>22</b>
15	<b>Safety Valve Discharge and Vents Flow Diagram</b>	<b>23</b>
16	<b>Plant Ventilation Flow Diagram</b>	<b>24</b>
17	<b>Main Distribution Panel</b>	<b>25</b>
18	<b>Lighting and Power Distribution Panel Support Facilities</b>	<b>26</b>
19	<b>Generator Control Panel</b>	<b>27</b>
20	<b>Plant Auxiliaries Motor Control Panel</b>	<b>28</b>
21	<b>Lighting Panel (Motor Control Center)</b>	<b>29</b>
22	<b>Emergency Power Supply Panel</b>	<b>30</b>
23	<b>Hot Water Motor Control Panel</b>	<b>31</b>



	High Voltage Supply Panel	72
25	Process Instrumentation Panel	73
26	Reactor Control Panel	74
27	Reactor Panel Annunciator (Reactor Shutdown)	75
28	Process Instrumentation Panel	76
29	Process Panel Annunciator	77
30	Process Panel Temperature Selector	78
31	Local Instruments Panels Nos. 1, 2, and 3	79
32	Reactor Water Purification System Panel	80
33	Single Line Power Diagram	81
	<u>Section II</u>	
34	Nuclear Instrument Block Diagram	92
35	Power Levels Corresponding to Operating Ranges of Instrumentation Channels I to VI	93
36	Control Rod Drive Schematic Diagram	94
37	Channels I and II Setpoint/Indicator Panels Schematic Diagram	95
38	Shutdown Annunciator Circuit Diagram	96
39	Shutdown Interlock Circuit Diagram	97
40	Automatic Rod Drive Control Circuit	98
	<u>Section III</u>	
41	Bypass Valve No. 1 Control Circuit Schematic	104
42	Bypass Valve No. 2 Control Circuit Schematic	105
	<u>Section IV</u>	
43	Feedwater Valve Control Wiring Diagram	112
44	Feedwater Valve Bridge Circuit Wiring Diagram	113
	<u>Section V</u>	
45	Steam Header Panel and Tie Circuit Schematic Diagram	114

	<b>Emergency Motor Supply Schematic Diagram</b>	<b>131</b>
	<b>Section VI</b>	
48	Motor Control Panel Fuses and Ground Control Diagrams	139
49	Condenser Air Control Block Diagram	140
50	Condenser Air Circulating Damper Bridge Circuits Wiring Diagram	141
51	Condenser Air Circulating Damper Control Wiring Diagram	142
52	Condenser Air Circulating Fan Speed Control Wiring Diagram	143
	<b>Section VII</b>	
53	Motor Control Panel Pumps Wiring Diagram	153
	<b>Section XV</b>	
54	Control Rod Drive	206
55	Transmission and Position Indicator	207
56	Control Rod Drive (5) and Top Shielding	208
57	Control Rod Drive (9) and Top Shielding	209
	<b>Section XVI</b>	
58	Feedwater Pump Cutaway Section	219
59	Feedwater Pump Characteristic Curve	220
	<b>Section XVII</b>	
60	Air Ejectors, After-Condensers, and gland Steam Pre-Cooler	228
	<b>Section XVIII</b>	
61	Turbine-Generator Unit	246
62	Longitudinal Section through Multi-Stage Steam Turbine	247
63	Section Through Governor Control Mechanism, Emergency Trip Assembly, and Oil Pump	248
64	Generator Control Schematic Wiring Diagram	249
65	Generator Exciter Schematic Wiring Diagram	250
	<b>Section XIX</b>	
	Generator Capability Curve	

	<u>Turbine Generator Gland Seal and Lock-Off System</u>	265
	<u>Section XI</u>	
68	Turbine Lubricating Oil System Diagram	266
69	Section Through Low Oil Pressure Trip on Turbine	267
70	Turbine Standby Oil Pump Schematic Wiring Diagram	268
	<u>Section XXII</u>	
71	Simulated Electrical Load Diagram	277
	<u>Section XXIII</u>	
72	Removable Top Shield Plate Arrangement	281
	<u>Section XXIV</u>	
73	Fuel Assembly Storage Well	285
74	Evaporation from Fuel Storage Well (1/3 of Average Reactor Core Operated at 3-Mwt to Equilibrium Fission Product Heating)	286
	<u>Section XXV</u>	
75	Pressure Vessel Head Bolting	292
	<u>Section XXVI</u>	
76	Building Bridge Crane	296
	<u>Section XXVIII</u>	
77	Operations Organizational Chart for Loading or Unloading of Core Components	322
78	Reactor Shutdown Temperatures	324
79	Temporary Nuclear Instrumentation	324
80	Reference 40-Fuel-Assembly Core Loading for 3-Mwt Operation	325
81	Core Plan, Section	326
82	Core, Vertical Section	327
83	Source Assembly	328
84	Fuel Assembly	329
85	Control Rod	330
86	Fuel Assembly Transfer System	331

<u>Number</u>	<u>Title</u>	<u>Page</u>
87	Fuel Assembly Coffin	332
88	Fuel Assembly Gripper Mechanism	333