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**HANFORD ATOMIC PRODUCTS OPERATION
RESEARCH AND DEVELOPMENT
FACILITIES AND PROGRAM**

P. F. X. DUNIGAN and R. W. BENOLIEL

AUGUST 26, 1957

HANFORD LABORATORIES

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

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HANFORD ATOMIC PRODUCTS OPERATION
RESEARCH AND DEVELOPMENT
FACILITIES AND PROGRAM

Compiled by

P. F. X. Dunigan and R. W. Benoliel

Laboratories Auxiliaries Operation

August 26, 1957

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

Work performed under Contract No. W-31-109-Eng-52 between
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RESEARCH AND DEVELOPMENT FACILITIES

SUMMARY

DISTRIBUTION BY PROGRAM (Approximate)

<u>R & D Program</u>	<u>Orig. Cost</u>	<u>Space</u>
Support of Existing Plant		
Reactor	\$ 5,130,000	58,300 sq. ft.
Metallurgy	4,845,000	82,300
Separations	11,791,000	152,045
Improved Production Reactor		
Reactor	4,944,000	56,600
Metallurgy	2,168,000	48,330
Assistance to UCRL (Whitney Proj.)	250,000	5,300
Plutonium Recycle Program	771,000	19,190
Radiological Sciences	4,970,000	88,907
	<u>\$ 34,869,000</u>	<u>510,972</u>

DISTRIBUTION BY AREAS

<u>Orig. Cost (Dollars)</u>	<u>100</u>	<u>200</u>	<u>300</u>	<u>600</u>	<u>Total</u>
Structure	4,177,000	1,704,000	12,513,000	189,000	18,583,000
Equipment	5,460,000	4,055,000	6,676,000	95,000	16,286,000
Total	<u>9,637,000</u>	<u>5,759,000</u>	<u>19,189,000</u>	<u>284,000</u>	<u>\$ 34,869,000</u>

Floor Space (Sq. Ft.)

Work Area	5,700	13,400	87,277	0	106,377
Laboratory	46,650	17,950	60,400	730	125,730
Supporting	30,050 *	5,400 *	198,780	400	234,630
Office	5,600	3,995	33,740	900	44,235
Total	<u>88,000</u>	<u>40,745</u>	<u>380,197</u>	<u>2,030</u>	<u>510,972</u>

* Supporting space in buildings not primarily R & D is omitted.

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RESEARCH AND DEVELOPMENT FACILITIES

300 Area

(Figure 1)

TEST REACTOR (305)

<u>Description:</u>	Graphite reactor with power levels up to 600 watts		
<u>Function</u>	Uranium and graphite testing and determination of reactor constants.	<u>Responsibility</u>	(FPD) J. T. Orr
<u>Statistics</u>			
<u>Use Date</u>	1944		
<u>Cost</u>	Structure	\$273,000	
	Equipment(est.)	\$850,000	
	Total		\$1,123,000
<u>Floor Space</u>	Work Area	8,100 sq. ft.	
	Supporting	3,900	
	Office	260	
	Total		12,260 sq. ft.

PHYSICAL CONSTANTS TEST REACTORS (305-B)

(Figure 2 and 3)

<u>Description:</u>	Two critical, very low power, uncooled reactors, the Physical Constants Test Reactor and Thermal Test Reactor. The PCTR has an enriched lattice surrounding a test cavity. The TTR is a small graphite reactor with a controlled, elevated temperature thermal column under construction.		
<u>Function</u>	Determination of reactor constants. Specifically: PCTR - K Infinity TTR - Danger coefficients; also source of medium intensity thermal neutrons	<u>Responsibility</u>	(HLO) H. L. Henry
<u>Statistics</u>			
<u>Use Date</u>	March, 1955		
<u>Cost</u>	Structure	\$ 98,000	
	Equipment(est.)	\$130,000	
	Total		\$ 228,000
<u>Floor Space</u>	Work Area	2,100 sq. ft.	
	Supporting	260	
	Total		2,360 sq. ft.

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METALLURGICAL SEMI-WORKS (306)

(Figure 4)

Description: Metallurgical equipment and fuel element pilot plant. Standard machine metal finishing and forming tools, heat treating, welding and metallographic equipment. For addition - p. 22.

Function Development and fabrication of experimental fuel elements   Responsibility (HLO) J. J. Cadwell
(Pilot Plant) (FPD) S. M. Gill

Statistics

<u>Use Date</u>	February, 1955	
<u>Cost</u>	Structure	\$785,000
	Equipment(est.)	\$900,000
	Total	\$1,685,000
<u>Floor Space</u>	Work Area	16,000
	Supporting	14,500
	Office	3,000
	Total	33,500 sq.ft.

METALLURGICAL ENGINEERING (314)

Description: Corrosion testing, metallurgical, and mechanical equipment, including a mock-up of a PRPR tube assembly. Converted production space.

Function Corrosion studies, mechanical development.   Responsibility (HLO) C. Groot
(HLO) R.H. Purcell

Statistics

<u>Use Date</u>	August, 1953 (as R and D Facility)	
<u>Cost</u>	Structure	\$547,000
	Equipment(est.)	\$200,000
	Total	\$ 747,000
<u>Floor Space</u>	Work Area	15,800 sq. ft.
	Supporting	1,900
	Office	460
	Total	18,160 sq.ft.

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COLD CHEMICAL SEMI-WORKS (321)

Description: Chemical processing canyon and supporting facilities. Solvent extraction apparatus as process demonstration and scale-up units. Test stands for studying process equipment.

Function Improve existing and develop new chemical processes and equipment. Responsibility (HLO) R. G. Geier

Statistics

Use Date 1944

Cost Structure \$ 839,000
Equipment(est.) \$1,536,000
Total \$2,375,000

Floor Space Work Area 11,000 sq. ft.
Supporting 6,500
Office 1,250
Total 18,750 sq. ft.

RADIOCHEMISTRY (325) ✓

(Figures 5 and 6)

Description: Forty-five laboratories with 100 radiochemical hoods, a Cobalt 60 source and many instruments such as emission and mass spectrometers. A new radiochemistry cell with four foot thick concrete walls has been approved for design.

Function Chemical process research Responsibility (HLO) W.H. Reas
Ceramic fuel element research (HLO) E.A. Evans
Analytical service and develop. (HLO) E. W. Christopherson
Coatings and corrosion research (HLO) C. Groot
Operations research (HLO) C. A. Bennett

Statistics

Use Date January, 1954

Cost Structure \$4,121,000
Equipment(est.) \$ 800,000
Total \$4,921,000

Floor Space Laboratory 20,300 sq. ft.
Supporting 91,300
Office 6,200
Total 117,800 sq. ft.

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PHYSICS AND METALLURGY (326)

(Pile Research and Development)*

(Figures 7 and 8)

<u>Description:</u>	Physics and metallurgical laboratories with such research apparatus as an electron microscope, exponential piles, an analog computer and laboratory scale metallurgical machinery.		
<u>Function</u>	Nuclear physics research	<u>Responsibility</u> (HLO) J. E. Faulkner	
	Metallurgy research	(HLO) S. H. Bush	
	Non-metallic reactor materials studies	(HLO) R. E. Nightingale	
	Fuel element coatings and corrosion research	(HLO) C. Groot	
	Non-destructive test methods development	(FPD) R. S. Paul	
<u>Statistics</u>			
<u>Use Date</u>	January, 1954		
<u>Cost</u>	Structure	\$2,388,000	
	Equipment(est.)	\$ 650,000	
	Total		\$3,038,000
<u>Floor Space</u>	Laboratory	22,300 sq. ft.	
	Supporting	26,600	
	Office	9,300	
	Total		58,200 sq. ft.

RADIOMETALLURGY (327)

(Figure 9)

<u>Description:</u>	Deep water-filled storage and viewing basin, dry storage unit, five cast iron cells and a number of lead-brick shielded installations and auxiliary facilities.		
<u>Function</u>	Remote metallurgical physical testing of irradiated material.	<u>Responsibility</u> (HLO) L. D. Turner	
<u>Statistics</u>			
<u>Use Date</u>	January, 1954		
<u>Cost</u>	Structure	\$839,000	
	Equipment(est.)	\$870,000	
	Total		\$1,709,000
<u>Floor Space</u>	Laboratory	6,200 sq. ft.	
	Supporting	14,600	
	Office	500	
	Total		21,300 sq. ft.

*Official designation.

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ENGINEERING MANAGEMENT AND TECHNICAL SHOPS (328)

(Mechanical Development Building) *

Description: Office section engineering management and Facilities Engineering. Technical Shops include electronic, machine, electrical, carpentry, paint, welding and glass shops.

<u>Function</u>	Research and development management	<u>Responsibility</u>	(HLO) F.W. Albaugh (HLO) V.R. Cooper (HLO) P.F. Gast (HLO) J.L. Boyd
	Shop assistance to engineering and scientific effort		(HLO) L.J. Lucas

<u>Statistics</u>		
<u>Use Date</u>	September, 1953	
<u>Cost</u>	Structure	\$617,000
	Equipment (est.)	\$300,000
	Total	\$917,000
<u>Floor Space</u>	Shop	17,300 sq. ft.
	Supporting	10,800
	Office	6,600
	Total	34,700 sq. ft.

BIOPHYSICS (329)

Description: Forty-five physical and radiochemical laboratories equipped with a wide range of counting apparatus including scintillation and current measuring equipment.

<u>Function</u>	Radiological physics	<u>Responsibility</u>	(HLO) W.C. Roesch
	Radiation protection instrument develop.		(HLO) R.A. Harvey
	Radioanalysis		(HLO) J.M. Nielsen
	Radiological chemical analyses		(HLO) D.L. Reid

<u>Statistics</u>		
<u>Use Date</u>	December, 1952	
<u>Cost</u>	Structure	\$1,195,000
	Equipment (est.)	\$ 57,000
	Total	\$1,252,000
<u>Floor Space</u>	Laboratory	11,600 sq. ft.
	Supporting	20,400
	Office	3,270
	Total	35,270 sq. ft.

*Official designation

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GRAPHITE SHOP (3730)

Description: Shop for machining experimental quantities of reactor graphite shapes; and an experimental shop for examining irradiated graphite.

Function Graphite machining; irradiated graphite examination. Responsibility (HLO) L. J. Lucas (HLO) R. E. Nightingale

Statistics

Use Date August, 1956
Cost Structure
Equipment (est.)
Total

\$150,000
\$ 48,000
\$198,000

Floor Space Shop
Supporting
Total

2,700 sq. ft.
420
3,120 sq. ft.

ELECTRON ACCELERATOR (3745A) ✓

Description: 2 Mev Van de Graaff electron accelerator.

Function Calibrations Responsibility (HLO) R. W. Meisinger
Primarily not R. and D. but available for special studies requiring a wide range of monoenergetic electrons.

Statistics

Use Date 1949
Cost Structure
Equipment (est.)
Total

\$45,000
\$67,000
\$112,000

Floor Space Work Area
Total

1,277
1,277 sq. ft.

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POSITIVE ION ACCELERATOR (3745B) ✓

(Figure 10)

Description: 2 Mev Van de Graaff positive ion accelerator.

<u>Function</u>	Variable energy fast neutron source for special irradiation studies.	<u>Responsibility</u> (HLO) W.C. Roesch

Statistics

<u>Use Date</u>	May, 1954	
<u>Cost</u>	Structure	\$ 56,000
	Equipment(est.)	\$118,000
	Total	<u>\$174,000</u>
<u>Floor Space</u>	Work Area	1,600 sq. ft.
	Supporting	400
	Total	<u>2,000 sq. ft.</u>

H. L. MANAGEMENT AND TECHNICAL INFORMATION (3760)

(LIBRARY AND FILES BUILDING)*

Description: H.L. management offices; Technical Information's technical library and classified files.

<u>Function</u>	Management Technical Information	<u>Responsibility</u> (HLO) H. M. Parker (HLO) C.G. Stevenson

Statistics

<u>Use Date</u>	November, 1952	
<u>Cost</u>	Structure	\$560,000
	Equipment(est.)	\$150,000
	Total	<u>\$710,000</u>
<u>Floor Space</u>	Work Area	11,400 sq. ft.
	Supporting	7,200
	Office	2,900
	Total	<u>21,500 sq. ft.</u>

*Official designation

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HOT SEMI-WORKS (201-C et al)

(Figure 11)

Description: Chemical process type building containing three process cells; several auxiliary buildings. (In standby as of July 1, 1957)

Function Semi-works demonstra-   Responsibility (HLO) R. G. Geier
tions, process improve-
ment, and prototype studies.

Statistics

Use Date

April, 1952

Cost

Structure

\$1,400,000

Equipment(est.)

\$3,325,000

Total

\$4,725,000

Floor Space

Work Area

13,400 sq. ft.

Supporting

4,800

Office

1,000

Total

19,200 sq. ft.

REDOX LABORATORY (222-S)

Description: Radiochemical laboratories with two heavy-walled 20 curie cells occupy about 20% of the laboratory space in this analytical control building.

Function Process Chemical   Responsibility (HLO) R. E. Burns
Development

Statistics

Use Date

September, 1952

Cost

Equipment (est.)

\$190,000

Total

\$190,000

Floor Space

Laboratory

2,750 sq. ft.

Office

435

Total

3,185 sq. ft.

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EARTH SCIENCES LABORATORY (222-U)

Description: Soils and radiochemical laboratories, and hydrology laboratory.

Function Soils studies for waste disposal. Responsibility (HLO) J. F. Honstead

Statistics

Use Date 1947

Cost Structure \$304,000

Equipment (est.) \$ 40,000

Total \$344,000

Floor Space Laboratory 6,000 sq. ft.

Supporting 600

Office 760

Total 7,360 sq. ft.

PLUTONIUM METALLURGY RESEARCH ANNEX (231)

Description: Laboratory space in the Isolation Building adapted for metallurgy. Including highly specialized radiometallurgical equipment.

Function Plutonium metallurgy research Responsibility (HLO) O. J. Wick

Statistics

Use Date November, 1955

Cost Equipment (included in 234-5) (est.)

Floor Space Laboratory 4,000 sq. ft.

Office 1,300

Total 5,300 sq. ft.

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PLUTONIUM METALLURGY RESEARCH LABORATORY (234-5)

<u>Description:</u>	This facility in a process building provides highly specialized shielded radiometallurgical equipment.		
<u>Function</u>	Plutonium metallurgy research.	<u>Responsibility</u> (HLO)	O. J. Wick
<u>Statistics</u>			
<u>Use Date</u>	1951		
<u>Cost</u>	Equipment (est.)	\$500,000 (incl. 231 Bldg.)	
	Total	\$500,000	
<u>Floor Space</u>	Laboratory	5,200 sq. ft.	
	Office	500	
	Total		5,700 sq. ft.

METEOROLOGY FACILITY (622 et al)

<u>Description:</u>	A 400' tower with associated buildings such as a balloon release building and a blimp hangar. Recording thermometers and wind velocity gauges at fifty foot levels of the tower telemeter readings to the office building.		
<u>Function</u>	Meteorological studies for stack gas dispersal.	<u>Responsibility</u> (HLO)	G. R. Hilst
<u>Statistics</u>			
<u>Use Date</u>	1944		
<u>Cost</u>	Structure	\$189,000	
	Equipment (est.)	\$95,000	
	Total	\$284,000	
<u>Floor Space</u>	Laboratory	730 sq. ft.	
	Supporting	400	
	Office	900	
	Total		2,030 sq. ft.

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METAL EXAMINATION FACILITY (105C)

(Figure 12)

<u>Description:</u>	Attached to a reactor building, four large water-filled concrete basins, special underwater periscopes, decannars and metallurgical tools.		
<u>Function</u>	Underwater fuel element examination and physical property measurements.	<u>Responsibility (IPD)</u>	J. M. Fouts
<u>Statistics</u>			
<u>Use Date</u>	July, 1956		
<u>Cost</u>	Structure	\$250,000	
	Equipment (est.)	\$700,000	
	Total		\$950,000
<u>Floor Space</u>	Laboratory	1,650 sq. ft.	
	Office	120	
	Total		1,770 sq. ft.

THERMAL HYDRAULICS LABORATORY (189-D)

<u>Description:</u>	Laboratories for heat transfer and fluid flow studies; pressurized mock-up process tubes and accessory apparatus.		
<u>Function</u>	Heat transfer and fluid flow studies.	<u>Reponsibility (HLO)</u>	L. H. McEwen
<u>Statistics</u>			
<u>Use Date</u>	1951		
<u>Cost</u>	Structure	\$420,000	
	Equipment (est.)	\$1,000,000	
	Total		\$1,420,000
<u>Floor Space</u>	Laboratory	10,500 sq. ft.	
	Supporting	9,300	
	Office	420	
	Total		20,220 sq. ft.

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NEUTRON SPECTROMETER (105-DR)

Description: In the DR reactor. The crystal neutron spectrometer covers a range of .01 ev to 10 ev.

Function Measure neutron cross section. Responsibility (HLO) B. R. Leonard

Statistics

<u>Use Date</u>	1950		
<u>Cost</u>	Equipment (est.)	\$100,000	
	Total		\$100,000
<u>Floor Space</u>	Laboratory	1,000 sq. ft.	
	Total		1,000 sq. ft.

KAPL-120 LOOP (105-H)

Description: Located in the H reactor, the loop operates at 2300 psi and 620 F.

Function Fuel element performance, corrosion and water chemistry evaluation. Responsibility (IPD) A. G. Blasewitz

Statistics

<u>Use Date</u>	July, 1955		
<u>Cost</u>	Equipment (est.)	\$400,000	
	Total		\$400,000
<u>Floor Space</u>	Laboratory	2,000 sq. ft.	
	Office	100	
	Total		2,100 sq. ft.

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COOLANT TESTING FACILITY (1706 KE-KER)

Description: 8 single pass tubes, 10 out-of-reactor loops, 16 steam heated mock-up tubes, and 4 in-reactor loops.

Function Evaluation of fuel elements, reactor materials and equipment. Responsibility (IPD) W. J. Gartin

Statistics

<u>Use Date</u>	May, 1955	
<u>Cost</u>	Structure	\$1,380,000
	Equipment (est.)	\$2,600,000
	Total	\$3,980,000
<u>Floor Space</u>	Laboratory	15,400 sq. ft.
	Supporting	5,800
	Office	740
	Total	21,940 sq. ft.

BIOLOGICAL LABORATORY (108-F)

(Figure 13)

Description: Headquarters for the Biology Operation; laboratories for biological and biochemical studies.

Function Animal research for permissible limits; contamination transfer from soil to plants; mechanism of biological effects of radiation. Responsibility (HLO) H. A. Kornberg

Statistics

<u>Use Date</u>	1949	
<u>Cost</u>	Structure	\$1,261,000
	Equipment (est.)	\$400,000
	Total	\$1,661,000
<u>Floor Space</u>	Laboratory	10,800 sq. ft.
	Supporting	8,500
	Office	2,300
	Total	21,600 sq. ft.

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EXPERIMENTAL ANIMAL FARM (141F et al)

Description: Animal and storage barns and auxiliary facilities for experiments with large animals.

Function I¹³¹ MPC of large animals; exposure studies on large animals for radioactive particle inhalation. Responsibility (HLO) L. K. Bustad

Statistics

<u>Use Date</u>	1949	
<u>Cost</u>	Structure	\$361,000
	Equipment (est.)	\$ 30,000
	Total	\$391,000
<u>Floor Space</u>	Work Area	5,700 sq. ft.
	Supporting	2,200
	Office	870
	Total	8,770 sq. ft.

AQUATIC BIOLOGY (146 FR)

Description: Three biology laboratories and a tank room for exposure of aquatic life to different toxic materials, including reactor effluent.

Function Evaluate toxicity of reactor effluent and absorption and toxicity of radioelements in aquatic organisms. Responsibility (HLO) R. F. Foster

Statistics

<u>Use Date</u>	September, 1952	
<u>Cost</u>	Structure	\$426,000
	Equipment (est.)	\$200,000
	Total	\$626,000
<u>Floor Space</u>	Laboratory	4,000 sq. ft.
	Supporting	4,200
	Office	800
	Total	9,000 sq. ft.

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PHARMACOLOGY (141FS, 1705F)

Description: 2 small buildings housing radio-biological laboratories.

Function Evaluate toxicity of radioactive particles in lungs of small animals. Responsibility (HLO) W. J. Bair

Statistics

Use Date 1948

Cost Structure \$80,000

Equipment (est.) \$30,000

Total \$110,000

Floor Space Laboratory 1,300 sq. ft.

Supporting 50

Office 250

Total 1,600 sq. ft.

IN-REACTOR IRRADIATION FACILITIES

Description: Approximately 62 test holes with tubes leading through reactors. Number per reactor varies from 4 in older ones to 15 in new ones.

Function Special high flux thermal neutron irradiations. Responsibility (IPD) A. G. Blasewitz

DATA PROCESSING FACILITIES (703)

Description: IBM-702 and accessory equipment.

Function Primarily accounting; scientific and engineering data processing on limited basis. Responsibility (R&UO) W. C. McGee

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MAJOR LABORATORIES WITH PRIMARY FUNCTIONS
OTHER THAN R & D OR R & D SUPPORT

<u>Name</u>	<u>Bldg. & Equipt. Cost</u>	<u>Principal Responsibility</u>
Laboratory Section - 3706	\$ 60,000	FPD (66%) HLO (34%)
Laboratory Section - Purex (202A)	\$1,256,000	CPD
Redox Laboratory - 222S	\$5,154,000 (a)	CPD (84%) HLO (13%)
Laboratory Section - 234-5	\$ 837,000 (b)	CPD
Bioassay - 747	\$ 135,000	HLO

(a) includes R & D

(b) includes R & D but not structural costs

OFF-SITE FACILITIES AT ARCO

HANFORD FACILITIES AT NATIONAL REACTOR TEST STATION

ARCO, IDAHO

MATERIALS TESTING REACTOR

(Figure 14)

Description: Accessory equipment for material in reactor tests. Test facility space limited.

Function Test reactor and other materials.

Cost \$50,000 (est.)

ENGINEERING TEST REACTOR

Description: Test loops in two test positions.

Function In-reactor testing of fuel elements.

Cost \$1,200,000 (est.)

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PROPOSED FACILITIES

PLUTONIUM RECYCLE PROGRAM REACTOR

(Figure 15)

Description: Demonstration reactor and auxiliaries, in support of PR program.

Function Demonstrate operation of plutonium recycle. Responsibility (HLO) F. W. Albaugh
Experimentation on plutonium recycle concept; recycle operation feasibility and economics.

Status Being debated in U. S. Congress.

Estimated Cost \$ 15,000,000

FUEL ELEMENT TEST REACTOR

Description: Test reactor and auxiliaries.

Function Evaluate fuel elements. Responsibility (HLO)

Status Postponed; will probably not be constructed at Hanford.

Estimated Cost \$ 17,500,000

PLUTONIUM FABRICATION PILOT PLANT

Description: Fabricate plutonium-bearing experimental fuel elements.

Function Plutonium metallurgy. Responsibility (HLO) O. J. Wick

Status \$100,000 authorized for design.

Estimated Cost \$ 4,000,000

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CRITICAL MASS LABORATORY

Description: Two reactor centers and auxiliaries.
Function Critical mass studies. Responsibility (HLO) J. E. Faulkner
Status Project Proposal in preparation.
Estimated Cost \$ 2,000,000

FUEL ELEMENT PILOT PLANT EXPANSION

Description: Additional space and new specialized metallurgical fabrication equipment.
Function Preparation and fabrication of alloys. Responsibility (HLO) F. W. Albaugh
Status Project Proposal for design being reviewed by AEC.
Estimated Cost \$ 3,600,000

GAS LOOP - 105 DR

Description: To be operated at 1250 F outlet temperature and 200 psi base pressure using nitrogen, then helium as coolant.
Function Study fuel element and structural material performance and operating characteristics of gas system. Responsibility (IPD) A. G. Blasewitz
Status Drawings complete. Start-up scheduled for January, 1959.
Estimated Cost \$900,000

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300 Area

FIGURE 2
Physical Constants Test Reactor - 305 B Building

FIGURE 4

Fuel Element Pilot Plant Canning Line - 306 Building

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FIGURE 5
High Level Solvent Extraction Facility - 325 Building

FIGURE 6
Ceramics Laboratory - 325 Building

FIGURE 7

Hot Stage Metallograph - 326 Building

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FIGURE 8

Out-of-Reactor Zirconium Gas Reaction Apparatus - 326 Building

FIGURE 9

Radiometallurgy Canyon - 327 Building

FIGURE 10
Positive Ion Accelerator - 3745 B Building

FIGURE 11

Hot Semi-Works - 201C Building

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ICS METAL EXAMINATION FACILITY

FIGURE 12

FIGURE 13

Biology Facility - 100 F Area

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FIGURE 14

MTR Pressure Loop

FIGURE 15
Plutonium Recycle Program Reactor

RESEARCH AND DEVELOPMENT BUDGET BY PROGRAM

	Prime Responsibility	FY-1957 ⁽¹⁾ \$ MM	FY-1958 \$ MM Men ⁽²⁾		FY-1959 \$ MM
Support of Existing Plant (Category I)					
Reactor	IPD	\$1. 85	\$1. 66	48	\$1. 46
Metallurgy	FPD	2. 05	1. 44	35	1. 30
Separations	CPD	<u>3. 20</u>	<u>3. 16</u>	<u>78</u>	<u>3. 27</u>
		7. 10	6. 26	161	6. 03
Improved Production Reactor (Category II)					
Reactor	IPD	1. 88	1. 80	50	2. 12
Metallurgy	IPD	<u>0. 73</u>	<u>0. 87</u>	<u>20</u>	<u>1. 20</u>
		2. 61	2. 67	70	3. 32
Assistance to UCRL	HLO	0. 79	0. 55	8	0. 58
Plutonium Recycle Program (Category III) ⁽³⁾	HLO	1. 40	3. 40	64	4. 20
Radiological Sciences Program	HLO	1. 74	1. 82	53	1. 91
Washington Designated Programs	HLO	<u>0. 23</u>	<u>0. 39</u>	<u>10</u>	<u>0. 41</u>
		\$13. 93	\$15. 09	366	\$16. 45

(1) Actual costs adjusted to FY-1958 basis by overhead factor of 1.25/1.07.

(2) Direct profession personnel.

(3) Not including Army Gas Loop (IPD - 1 man) \$710,000 including equipment for FY-1958.

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HANFORD ATOMIC PRODUCTS OPERATION COMPONENTS ENGAGED IN RESEARCH & DEVELOPMENT

SUPPORT OF EXISTING PLANT (CATEGORY I)

Reactor Program

Efforts directed toward full, safe and economic utilization of the cooling water flow capacity obtainable with completion of present major reactor plant modification projects. Major activities are

Increased Production Capacity

Hydraulics, instrumentation, operation techniques, and radio-logical engineering to support the scheduled increase of bulk outlet temperature limit from 92 C to 98 C.

Economics of use of enriched uranium and poison loadings for flattening, shield protection and isotope production.

Planning for optimum economic production of tritium in Hanford reactors.

Process Control and Safety

Reactor instrumentation and control systems to improve control of transients, power excursions and "heat cycles".

Optimization of use of accelerated safety rods and Ball 3-X systems.

Studies of feasibility of containment.

Materials

Minimization of aluminum corrosion.

Determination of incentives for replacing present 2S aluminum reactor tubes with 63S aluminum or zircaloy.

Investigation of operation with graphite temperatures in excess of 750 C at intended higher reactor power levels.

Methods of controlling reactor shield deterioration.

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Radiological Engineering

Determination of dependence of radioactivity levels in reactor effluent upon reactor process variables.

Instrumentation for increased accuracy of activity and dose measurements.

Determination of conditions under which effluent water temperature or radioactivity will limit reactor power.

Evaluation of off-site consequences of plausible reactor incidents.

Metallurgy Program (Complementary to Category II, Metallurgy Program)

Present fuel elements limited to 500 MWD/T, 50 KW/ft, tube outlet temperature of 100 C. Utilization of full capacity of the present reactors requires fuel elements to operate satisfactorily to 800 MWD/T, 85-90 KW/ft, tube outlet temperature of 130 C. Major activities are

Uranium Metallurgy

Physical metallurgy studies of uranium before and after irradiation to determine the effects of neutron flux, temperature, burnout and alloying on core integrity.

Jacket Technology

Development and application of new aluminum alloys of nickel, iron and titanium. (Strongly supported by studies of corrosion and of core-jacket interaction conducted as Category II work).

Fuel Element Design and Development

Development, demonstration of technical feasibility, and production for in-reactor testing of four to eight tube charges of modified and new types of fuel elements. Presently included are segmented, self-supported, coaxial and insulated elements.

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Fuel Element Performance Demonstration

Demonstration in production usage of internally and externally cooled (I and E) fuel elements. Large scale reactor tests of cored elements.

SEPARATIONS

Provide technological base to support chemical processing at actual and potential rates and minimum cost without sacrificing safety - includes improvement of present processing methods and establishment of processes to meet new requirements.

Product Quality

Purex two cycle operation and ion exchange for plutonium concentration.

Maintenance of plutonium and uranium product quality when recovering Np^{237} as a by-product at both Purex and Redox and when processing power fuels at Redox.

Processing compatibility for handling Hanford UO_3 product at K-25 and Paducah.

Production of plutonium metal of factor of five greater purity.

Processing Capability

Development of technology for

Economic recovery of plutonium from Purex wastes.

Purex Plant capacity of 4.0 times design level.

Additional separations capacity required if substantial additional reactor capacity is installed.

Operating Efficiency

Better understanding of effects of solids in solvent extraction and concentration systems.

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In-line instrumentation in Purex and Redox.

Minimizing contamination of surfaces and simplifying decontamination.

Understanding mechanisms of corrosion under processing conditions.

Utilization of new corrosion resistant materials, such as titanium.

Disposal of Wastes

Effects of time, temperature and radiation on stored waste.

Improved waste processing.

(See Radiological Sciences Program - Biophysics)

Recovery and Utilization of By-Products

Development of processing techniques and equipment for recovery and packaging of potentially useful fission products and trans-uranics.

New Products and Processes

Development of technology for

Separations plant additions or modifications for new types of Hanford fuel elements.

Dissolving irradiated fuel elements at a Purex Plant capacity factor of six.

New separations plant; the capital and unit operating costs to be half those for Purex.

Converting uranium product to the fluoride in a less complex process and at lower cost.

Further continuous processing steps in purification and fabrication of plutonium for improvement over batch processing steps.

Fabrication of new weapon shapes and assembly of weapons.

Reprocessing of power fuels.

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IMPROVED PRODUCTION REACTOR (CATEGORY II)

Development of technology to support design of an advanced type plutonium producer which can economically retire one or more older reactors with a payout period of not more than ten years from date of detailed design authorization. Reactor concept will incorporate recirculating cooling and production of electrical power as a by-product. Major activities and areas of investigation are

Reactor Program

Physics

Lattice constants and temperature coefficients for various massive uranium fuel types, graphite densities, and types and quantity of coolant.

Development of formulae for evaluation of lattice data.

Optimization of lattice including consideration of enrichment level and nuclear safety.

Materials

Zircaloy tubes at elevated reactor temperatures and pressures.

Zircaloy fabrication processes in cooperation with vendors.

High strength aluminum alloys as tubing material for organic cooled systems.

Thermal and radiolytic stability of candidate organic coolants.

Behavior of graphite under expected IPR conditions leading to determination of the specifications for graphite suitable up to 1000 C.

Elastomers and other materials of construction for high temperature reactors.

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Engineering

Hydraulic and heat transfer characteristics of recirculating water and organic coolant systems using candidate fuel elements in full scale electrically heated mockups.

Process designs of integrated cooling systems for high purity water, organics and heavy water as primary coolants.

Containment requirements for pressurized water and organic cooled reactors.

Development and prototype testing of safety systems.

Shielding materials of longer life than those in present reactors.

Instrumentation and Control

Improved instrumentation for

- nuclear measurements
- coolant flow and temperature
- rupture detection.

Advanced Engineering

Continuing broad assessments of present IPR program .

Identification of areas of technology with large incentives for improvement.

Evaluation of reactor concepts beyond those now under study in the IPR program.

Metallurgy Program

Prime objective - development of fuel elements capable of operating in 300 C high purity water to 1000 MWD/T with core temperature approaching 660 C.

Secondary objective - development of a fuel element suitable for suitable for similar conditions in an organic coolant.

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Irradiation of IPR candidate fuel elements in the KER high temperature recirculating coolant facilities. Includes cored, internally and externally cooled of both solid and wafer types, cluster and concentric cylinder elements, canned in aluminum and in zirconium.

Processes for fabricating candidate elements.

Fundamental studies in uranium metallurgy to support the development of candidate elements. (Complementary to Category I, Metallurgy Program)

Evaluation of

- operation of fuel elements with core temperatures over 660 C,
  - stability of metallic uranium at exposure levels of 1000 MWD/T,
  - rates of diffusion of uranium and jacket material, and
  - determination of fate and effects of fission products;
- these evaluations to consider possible alternate use of uranium oxide and scouting studies of uranium carbide, nitride and mixed systems.

ASSISTANCE TO UCRL (PROJECT WHITNEY)

Application of different fabrication techniques to formation of plutonium components for new-type weapons.

Physical metallurgy studies of plutonium.

PLUTONIUM RECYCLE PROGRAM (CATEGORY III)

Studies of the feasibility, range of application, and economics of the plutonium recycle concept in diverse thermal heterogeneous reactor systems. This is an integrated approach including all phases of the fuel cycles. Demonstration of the concepts through the design, construction, and operation of an experimental reactor and its associated plutonium fabrication and separation facilities is an essential part of the program.

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Phases of the work are

Cycle Analyses and Optimization Studies

Reactor Design Development

Reactor Experimental Operation

Reactor Engineering Development

Materials Development

Uranium Fuels Development

Plutonium Fuels Development

Separations Development

Physics and Instrument Development

RADIOLOGICAL SCIENCES PROGRAM

Biological Research

Determination of effects of radioisotopes on living things to insure the protection of humans, domestic animals and wildlife of importance. Studies derived originally from the manufacturing operations at Hanford. Extension of work beyond applicability to Hanford if further information appears likely to assist other locations, or to make a significant contribution to fundamental knowledge. Major areas of activity are

Animal Metabolism and Toxicity

Fundamental studies of the distribution and metabolism in animals, of radioactive fission products (Pu, I¹³¹, Sr⁹⁰, Cs¹³⁷ and others) and radioisotopes (P³², Zn⁶⁵ and others in reactor effluent water) as the basis for

- establishing maximum permissible concentrations;
- procedures for handling radioactive materials, particularly for plant control of emissions to the atmosphere and to the river, and
- therapeutic procedures for internal depositions.

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Aquatic Biology

Determination of coefficients of accumulation of radioactive material and of the quantities of radioisotopes which can be deposited in aquatic forms without significant effect.

Determination of changes in the abundance of important Columbia River organisms which might result from the Hanford operation.

Plant Nutrition

Mechanism of uptake of radioactive materials into plants.

Biophysics

Capacity of the lower atmosphere to disperse contaminant materials.

Disposal of liquid wastes to obtain maximum capacity for disposal sites and more permanent fixation for radioactive materials.

Technology for plutonium and fission product bio-assay work and for measurement of individual radioactive materials in reactor effluent water and stack gas streams.

Instrumentation and Dosimetry

Techniques and instruments for detection and measurement of radiation for environment and personnel monitoring.

Instrumentation required in support of plant operations and other research and development programs.

OTHER PROGRAMS

There are specialized minor programs such as the "Washington Designated Programs". It is also permissible to engage in Category IV work - support of private industry with AEC concurrence. HAPO resources are currently extended on higher priority work.

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INTEGRATION

Simultaneous operation of the different programs leads to interaction and integration in several fields. A notable example is the intermeshing of uranium fuel studies in Categories I, II, and III. (AEC-indicated designations) It is believed that this leads to a 20 - 30% increase in effectiveness of a given program.

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END

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