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HW--36573

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RICKLAND, WASHINGTON HANFORD ATOMIC PRODUCTS OPERATION

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By Authority of RLD-CG-4

May 6, 1955

WA Snyder 5-7-91
PM Eick 10-20-92
JK Will 10-21-92

U.S. Atomic Energy Commission
Hanford Operations Office
Richland, Washington

Attention: Mr. D.G. Sturges, Chief
Operations Division

Gentlemen:

SUBJECT: SAFETY EXPERIENCE - REACTOR AND CRITICAL FACILITIES

- References: 1. OC:DGS, Letter from D.G. Sturges to A.B. Greninger, 4-13-55, "Safety Experience - Reactors and Critical Facilities".
2. RD:ILB:EAL, Memorandum from W.K. Davis, 2-23-55, "Safety Experience - Reactors and Critical Facilities".

As requested in reference (1), we are transmitting certain operation and safety data including items 1 through 9 of reference (2).

With regard to the enclosed information, the following should be noted:

- (1) Item 4 of Reference (2) - We have listed the designed power of each reactor with a notation only that the reactor is now operating above designed power.
- (2) Item 6 of Reference (2) - In listing "operating hours", we have included all time except for maintenance; therefore, our tabulation includes time in which power was being produced, time in charging fuel, and time in discharging fuel. If information is desired for operating time in terms of power producing time only, such information can be supplied upon request.

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-2-

May 6, 1955

Reference (2) requests power information for one of the newer reactors. We have included such information for both the C Reactor and the H Reactor. The C Reactor is the newer and its design permits a higher neutron flux. However, because of this characteristic, it has been extensively used for production tests where a high flux is necessary and this use has contributed to reactor down-time. More importantly, the C Reactor has been utilized in the manufacture of low concentration plutonium. Because of these factors the non-operating time is abnormally high and it may be that the information we have included for the H Reactor will be more useful.

We have broken maintenance time into periods of 7 days or more and into periods of less than 7 days for the D Reactor (old reactor) and the H Reactor. This proportion should be representative for the other units. This information is included because it is believed that, with respect to radiation hazards, short maintenance periods are comparable or more dangerous to personnel than are operating periods.

- (3) Item 8 of Reference (2) - This item requested a report of accidents involving over exposure as defined in A.E.C. Manual Section 0502, paragraph 031a-1(e). We could not find a paragraph in this Section of the A.E.C. Manual on Safety and Fire Protection Reports and Investigations which is designated in this manner. Therefore, we have interpreted this reference to mean Section 0502-031a-1(a-5) of the February 1, 1955 revised edition of the Manual.

Two incidents have occurred which are pertinent to this item. One of these occurred at the DR Pile and a separate report is included covering this incident. The other was at the P-11 facility. All information for this incident has been included on the sheets pertinent to P-11.

- (4) Item 9 of Reference (2) - In item 9 we did not give consideration to damage resulting from process tube water leaks and from fuel element ruptures that occurred as a result of normal operation or because of special tests. We have had no incidents through 1954 which are pertinent to that section.

We hope to complete the information requested for items 10 and 11, together with the miscellaneous information outlined above, by June 10, 1955.

Very truly yours,

Manager, Pile Technology
ENGINEERING DEPARTMENT

OH Greager:JFM:mbs

U. S. ATOMIC ENERGY COMMISSION

SAFETY EXPERIENCE - REACTORS AND CRITICAL FACILITIES
to December 31, 1954

1. Designation of reactor or facility - 105 B 2. Location - Hanford, Wn. Startup Date - 9-26-44
3. Type (critical, research, production, power) - Production 4. Design power (kw heat) - 250,000 (1)
5. Brief description of reactor or facility and associated control and safety equipment -

Reactor is a cube of graphite containing 2004 process tubes. About 7.5' of shielding surrounds the graphite. Control of the reaction is maintained by the insertion of nine neutron absorbing control rods. Appropriate instruments measure reactor neutron flux and the flow of water to all process tubes. Should flow decrease appreciably or neutron flux increase beyond a set point, the reaction is stopped by safety rods that fall by gravity and by the automatic insertion of the control rods. A significant electric power failure will also screw the pile. Small neutron absorbing balls drop automatically in the event of rapid loss of water pressure. These balls may be tripped manually in the event of earthquake or severe shock.

6. Time operated (approximate): 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954

Operating hours (critical, approaching critical, and adjusting fuel - (3)

Maintenance (2) -

2280	8300	1848	0	4416	8335	8630	8500	8450	7870	8410
460	0	0	0	0	425	130	260	310	890	350

7. Average No. of persons - operators, research staff, and others - in reactor building during operations (include visitors if pertinent) -

45	35	35	30	25	25	20	20	20	20
----	----	----	----	----	----	----	----	----	----

- (1) Currently operating above design level.
- (2) In the opinion of those familiar with the operation, short maintenance periods are fully as dangerous as operating periods from the point of view of radioactive dangers to operating personnel and that long maintenance periods are not significantly less dangerous.
- (3) On a yearly basis, 300 actual operating days per year is quite accurate for all reactors. The difference between this 82.2 per cent operating efficiency and the figures shown opposite operating hours is due primarily to charge-discharge of fuel and the time spent in removing ruptured fuel elements.

HW-36573

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HW-36573

U. S. ATOMIC ENERGY COMMISSION

SAFETY EXPERIENCE - REACTORS AND CRITICAL FACILITIES
to December 31, 1954

1. Designation of reactor or facility - 105 C 2. Location - Hanford, Wn. Startup Date - 11-18-52
3. Type (critical, research, production, power) - Production 4. Design power (kw heat) 600,000 (1)
5. Brief description of reactor or facility and associated control and safety equipment -

Reactor is a cube of graphite containing 2004 process tubes. About 7.5' of shielding surrounds the graphite. Control of the reaction is maintained by the insertion of fifteen neutron absorbing control rods. Appropriate instruments measure reactor neutron flux and the flow of water to all process tubes. Should flow decrease appreciably or neutron flux increase beyond a set point, the reaction is stopped by safety rods that fall by gravity and by the automatic insertion of the control rods. A significant electric power failure will also scram the pile. Small neutron absorbing balls drop automatically in the event of rapid loss of water pressure. These balls may be tripped manually in the event of earthquake or severe shock.

5. Time operated (approximate) 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954

24350 277680 334957

Hi Days -

Operating hours (critical, approaching critical, and adjusting fuel) - (3)

1000 8670 8655

Maintenance-(2)

32 90 105

7. Average No. of persons - operators, research staff, and others - in reactor building during operations (include visitors if pertinent) -

30 25 20

(1) Currently operating above design level.

(2) In the opinion of those familiar with the operation, short maintenance periods are fully as dangerous as operating periods from the point of view of radioactive dangers to operating personnel and that long maintenance periods are not significantly less dangerous.

(3) On a yearly basis, 300 actual operating days per year is quite accurate for all reactors. The difference between this 82.2 per cent operating efficiency and the figures shown opposite operating hours is due primarily to charge-discharge of fuel and the time spent in removing ruptured fuel elements.

U. S. ATOMIC ENERGY COMMISSION

SAFETY EXPERIENCE - REACTORS AND CRITICAL FACILITIES
to December 31, 1954

1. Designation of reactor or facility - 105 D 2. Location - Hanford, Wn. Startup Date - 9-17-44
3. Type (critical, research, production, power) - Production 4. Design power (kw heat) 250,000 (1)
5. Brief description of reactor or facility and associated control and safety equipment -

Reactor is a cube of graphite containing 2004 process tubes. About 7.5' of shielding surrounds the graphite. Control of the reaction is maintained by the insertion of nine neutron absorbing control rods. Appropriate instruments measure reactor neutron flux and the flow of water to all process tubes. Should flow decrease appreciably or neutron flux increase beyond a set point, the reaction is stopped by safety rods that fall by gravity and by the automatic insertion of the control rods. A significant electric power failure will also scram the pile. Small neutron absorbing balls drop automatically in the event of rapid loss of water pressure. These balls may be tripped manually in the event of earthquake or severe shock.

6. Time operated (approximate):	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Operating hours (critical, approaching critical, and adjusting fuel) - (3)	--	2328	8633	8425	8465	8255	8445	8080	8520	8500	7881	8319
Maintenance, periods of 7 days or more	--	0	0	0	0	0	0	435	0	0	553	174
Maintenance, periods of less than 7 days duration (2)--		0	127	335	295	505	315	245	240	260	326	267
Average number of persons in reactor bldg. during operation.		40	35	35	30	30	25	25	20	20	20	20
(1) Currently operating above design level.												

- (2) In the opinion of those familiar with the operation, short maintenance periods are fully as dangerous as operating periods from the point of view of radioactive dangers to operating personnel and that long maintenance periods are not significantly less dangerous.
- (3) On a yearly basis, 300 actual operating days per year is quite accurate for all reactors. The difference between this 82.2 per cent operating efficiency and the figure shown opposite operating hours is due primarily to charge-discharge of fuel and the time spent in removing ruptured fuel elements.

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- 6 -

U. S. ATOMIC ENERGY COMMISSION

SAFETY EXPERIENCE - REACTORS AND CRITICAL FACILITIES

To December 31, 1954

1. Designation of reactor or facility - 105 DR 2. Location - Hanford, Wn. Startup Date - 10-3-50
3. Type (critical, research, production, power) - Production 4. Design power (kw heat) 250,000 (1)
5. Brief description of reactor or facility and associated control and safety equipment -

Reactor is a cube of graphite containing 2004 process tubes. About 7.5' of shielding surrounds the graphite. Control of the reaction is maintained by the insertion of nine neutron absorbing control rods. Appropriate instruments measure reactor neutron flux and the flow of water to all process tubes. Should flow decrease appreciably or neutron flux increase beyond a set point, the reaction is stopped by safety rods that fall by gravity and by the automatic insertion of the control rods. A significant electric power failure will also scram the pile. Small neutron absorbing balls drop automatically in the event of rapid loss of water pressure. These balls may be tripped manually in the event of earthquake or severe shock.

6. Time operated (approximate):	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Operating hours (critical, approaching critical, and adjusting fuel) - (3)					--	--	--	2135	8685	3670	7750	8650
Maintenance (2)					--	--	--	0	75	90	1010	110

7. Average No. of persons - operators, research staff, and others - in reactor building during operation (include visitors if pertinent) -
(1) Currently operating above design level.												
(2) In the opinion of those familiar with the operation, short maintenance periods are fully as dangerous as operating periods from the point of view of radioactive dangers to operating personnel and that long maintenance periods are not significantly less dangerous.	--	--	--	--	--	--	--	25	20	20	20	20
- (3) On a yearly basis, 300 actual operating days per year is quite accurate for all reactors. The difference between this 82.2 per cent operating efficiency and the figures shown opposite operating hours is due primarily to charge-discharge of fuel and the time spent in removing ruptured fuel elements.

ITEM 8

105-DR

Radiation Incidents as per AEC Manual	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Section 0502-031a-												
1-(a-5)												
On Site	0	0	0	0	0	0	0	0	0	0	1	0
Incidents of Overexposure											1	
Incidents of Contamination											0	
No. People Involved											6	
Lost time (hours)											-	
Amount Property Damage or Cost of Decontamination											-	
Off-Site	0	0	0	0	0	0	0	0	0	0	0	0
Incidents of Overexposure												
Incidents of Contamination												
No. People Involved												
Lost time (hours)												
Amount Property Damage or Cost of Decontamination												

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.

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SAFETY EXPERIENCE - REACTORS AND CRITICAL FACILITIESDescription of Lost-Time Accident Involving Radiation Exposure1953 - Case I⁽¹⁾

1. Designation of reactor or facility - 105-DR
2. Date of Accident - May 11, 1953
3. Description of accident - Three irradiated solid aluminum pieces were washed out of the front face end of a process tube on the 105-DR reactor. Two nearby employees, thinking that these aluminum pieces were "cold" pieces that they were in the process of charging, each picked up one of the irradiated pieces. One of these employees handed his aluminum piece to another employee who was to "charge" it before it was realized that these pieces were probably irradiated.
4. Extent of personal injury, time lost, and property damage (indicating location of damaged property with respect to reactor, and whether persons injured were employees or not) - Eleven people were nearby at the time of the incident though it is believed that only six of them received exposure in excess of the permissible limit. Of these six, only three (those who had handled pieces) were believed to have received significant over-exposure. Each was estimated to have received a hand dose of 100 r. The beta hand dose was estimated to range for the three employees from a possible minimum of 30 rad to a maximum of 330 rad. The maximum "whole body" dose was estimated to about 3.5 rad including 2 r.

All individuals involved were General Electric employees.

5. Remedial measures taken - More adequate communications were established between the charge face and discharge face of the reactor to prevent one group from opening a tube while the other end of the tube was still under high water pressure.

More adequate pre-job planning measures were inaugurated. Note: It was not realized prior to the incident that light weight (aluminum) pieces were upstream from the main charge. Also it was not known that the comparatively low water pressure that was on the tube could wash out such aluminum pieces under the conditions planned.

(1) Radiological Sciences Department Investigation, Radiation Incident, Class II, No. 30.

U. S. ATOMIC ENERGY COMMISSIONSAFETY EXPERIENCE - REACTORS AND CRITICAL FACILITIES
to December 31, 1974

1. Designation of reactor or facility - 105 F 2. Location - Hanford, Wn. Startup Date - 2-25-45
3. Type (critical, research, production, power) - Production 4. Design power (kw heat) 250,000 (1)
5. Brief description of reactor or facility and associated control and safety equipment -

Reactor is a cube of graphite containing 2004 process tubes. About 7.5' of shielding surrounds the graphite. Control of the reaction is maintained by the insertion of nine neutron absorbing control rods. Appropriate instruments measure reactor neutron flux and the flow of water to all process tubes. Should flow decrease appreciably or neutron flux increase beyond a set point, the reaction is stopped by safety rods that fall by gravity and by the automatic insertion of the control rods. A significant electric power failure will also scram the pile. Small neutron absorbing balls drop automatically in the event of rapid loss of water pressure. These balls may be tripped manually in the event of earthquake or severe shock.

5. Time operated (approximate):	<u>1943</u>	<u>1944</u>	<u>1945</u>	<u>1946</u>	<u>1947</u>	<u>1948</u>	<u>1949</u>	<u>1950</u>	<u>1951</u>	<u>1952</u>	<u>1953</u>	<u>1954</u>
Operating hours (critical, approaching critical, and adjusting fuel) - (3)	--	--	7385	8610	8085	7635	8680	8400	8520	7550	8570	8505
Maintenance (2)	--	--	55	150	675	1125	60	360	240	1210	190	255
Average No. of persons - operators, research staff, and others - in reactor building during operations (includes visitors if pertinent) --	--	--	40	35	30	30	25	25	20	20	20	20

(1) Currently operating above design level.

(2) In the opinion of those familiar with the operation, short maintenance periods are fully as dangerous as operating periods from the point of view of radioactive dangers to operating personnel and that long maintenance periods are not significantly less dangerous.

(3) On a yearly basis, 300 actual operating days per year is quite accurate for all reactors. The difference between this 82.2 per cent operating efficiency and the figures shown opposite operating hours is due primarily to charge-discharge of fuel and the time spent in removing ruptured fuel elements.

SAFETY EXPERIENCE - REACTORS AND CRITICAL FACILITIES
to December 31, 1954

- Reactor is a cube of graphite containing 2004 process tubes. About 7.5' of shielding surrounds the graphite. Control of the reaction is maintained by the insertion of fifteen neutron absorbing control rods. Appropriate instruments measure reactor neutron flux and the flow of water to all process tubes. Should flow decrease appreciably or neutron flux increase beyond a set point, the reaction is stopped by safety rods that fall by gravity and by the automatic insertion of the control rods. A significant electric power failure will also scavenge the pile. Small neutron absorbing balls drop automatically in the event of rapid loss of water pressure. These balls may be tripped manually in the event of earthquake or severe shock.

6. <u>Time operated (approximate):</u>	<u>1943</u>	<u>1944</u>	<u>1945</u>	<u>1946</u>	<u>1947</u>	<u>1948</u>	<u>1949</u>	<u>1950</u>	<u>1951</u>	<u>1952</u>	<u>1953</u>	<u>1954</u>
<u>MM Days -</u>						--	16,706	126,187	160,837	189,767	209,448	263,885

W. D. D.

Operating hours (critical, approaching critical, and adjusting fuel) - (3)

**Maintenance, Periods of 7 days
or more -**

Maintenance, Periods of less than 7 days duration (2) -

7. average no. of persons - operators
research staff, and others - in
reactor building during operations
(include visitors if pertinent) -

- (1) Currently operating above design level.
- (2) In the opinion of those familiar with the operation, short maintenance periods are fully as dangerous as operating periods from the point of view of radioactive dangers to operating personnel and that long maintenance periods are not significantly less dangerous.
- (3) On a yearly basis, 300 actual operating days per year is quite accurate for all reactors. The difference between this 82.2 per cent operating efficiency and the figures shown opposite operating hours is due primarily to charge-discharge of fuel and the time spent in removing irradiated fuel elements.

U. S. ATOMIC ENERGY COMMISSION

SAFETY EXPERIENCE - REACTORS AND CRITICAL FACILITIES
to December 31, 1954

1. Designation of reactor or facility - P-11 2. Location - Hanford, Wn. Date - April '50 - Nov. '51

3. Type (critical, research, production, power) - Critical 4. Design power (kw heat)

5. Brief description of reactor or facility and associated control and safety equipment -

Facility to determine critical parameters for plutonium nitrate solutions in water tamped cylinders and bare and water tamped spheres. TYPES OF EXPERIMENT: (1) Cylinders were of adjustable height, fuel added until critical. (2) Spheres made critical when partially filled, then fuel diluted, process repeated until full sphere just critical. CONTROL: (1) Tamped: Control rod or cup located in tamper. (2) Bare: Internal control rod. SAFETY: Cylinders had external cadmium sheath, spheres internal cadmium tube, both released by deactivation of magnetic clutch. Safety circuits could be actuated by any of several counters. A secondary scram circuit for tamped experiments released tamper water. GEOGRAPHICAL SAFETY: Reactor building separated by 175 feet from control building.

6. Time operated (approximate): 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954

kw hours -	--	--
Operating hours (critical, approaching critical, and adjusting fuel) -	190	160

NOTE: These numbers are very approximate. They do not include time spent in adjusting the concentration or acidity of the plutonium nitrate solutions.

7. Average no. of persons - operators, research staff, and others - in reactor building during operations (include visitors if pertinent) -

None. Average no. of persons in control building and patrol shack during operations: 6

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1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954

8. Accidents involving over-exposure of persons or radioactive contamination of property as defined in AEC Manual Section 0205, Par. 031a-1(e):*
- Involving on-site over-exposure or contamination:
- Number -
- Persons involved -
- Lost time (hours) -
- Amount of property damage -

1
6
0

contamination of reactor
building

On 11-16-51, a prompt critical condition was reached in a partially filled spherical reactor, because of too rapid withdrawal of the safety tube. Total energy release was about 3,000 kw. The reaction stopped itself through expansion of the fuel before safety circuits were actuated. Duration of reaction less than 1/2 second. Exposure of personnel less than 400 mrem. Physical damage confined to contamination of reactor building as the result of pressure buildup in reactor and connected piping and tubing. Reactor would have been back in operation after three weeks of clean-up by P-11 personnel except for non-nuclear accident. (See 9)

9. Other accidents involving property damage - in excess of \$5,000 per accident -

In the course of clean-up operations (See 8), concentrated nitric acid was used for decontamination of steel surfaces. Rags impregnated with acid were the probable cause of a fire which was detected on 12-4-51 after reactor building had been locked up for the night. Damage from fire about \$25,000. Contamination of building so severe that experimental program (about 99% completed) was discontinued. Actual financial loss estimated at \$7,170 (on basis of 99 per cent completion).

10. Number of startups -

93 109

11. Number of scrams

Because of the experimental nature of the project, no record of scrams was kept. In general, no serious attempt was made to avoid scrams.

Each described on attachment to this form.

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