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HW--80559-4

DE93 003430

N-REACTOR DEPARTMENT

MONTHLY REPORT

APRIL

1964

[redacted]

HANFORD ATOMIC PRODUCTS OPERATION

RICHLAND, WASHINGTON

GENERAL ELECTRIC

[redacted]

HW -80559 4

This document consists of 44 Pages, Copy No. [redacted] of [redacted] Copies, Series [redacted]

Classification Cancelled And Changed To DECLASSIFIED

By Authority of CG-PR-2

R. Stein - 8-26-92

By J. Wells - 8-31-92

Verified By PM Eick 9-2-92

DECLASSIFIED

88473

N-REACTOR DEPARTMENT MONTHLY REPORT -- APRIL, 1964

Compiled by N-Reactor Department

May 7, 1964 - - Richland, Washington

Classification reviewed for declassification, left unclassified by RHK

Date 5-15-[redacted]

Work performed under Contract No. AT(45-1)-1350 between the Atomic Energy Commission and General Electric Company.

[redacted]

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TABLE OF CONTENTS

GENERAL SUMMARY

N REACTOR FUELS

Production

Uranium billets are no longer in short supply and at month end, a full two months' supply was on hand. Thirteen tons of a total of 25 tons of 1.25 enriched fuels had been received by month end.

Input production through the extrusion press exceeded forecast by 7 per cent. Two hundred and seven extrusions were made totaling 35 tons. The last 22 extrusions of inner tubes were cut into 26-inch lengths in order to expedite the production of special fuel assemblies for spike enrichment of the reactor. Finished fuel output exceeded forecast by 6 per cent with a good balance of inner and outer tubes. In-process inventory was reduced by 20 per cent during the month. At month end, the equivalent of 45 per cent of the second reactor loading had been extruded, with a total of 94 tons processed through to finished inventory.

Shop Activities

The processing of 1.25 per cent enriched fuel will create an appreciable amount of chem mill acid that must be processed through the uranium recovery operation. A number of methods are being studied to determine the best way of handling this increased load.

The sampling of each fifth extrusion to obtain grain size measurement samples has been discontinued. The deletion of this measurement results in a net savings of approximately $1000 per month. A work order was issued to Vitro Engineering for development of a scope proposal and program criteria for equipment rearrangement and development of criteria and scope for a material handling system.

Engineering

Inspection standards have been established to permit identification of different types of cladding thickness variation. These inspection standards will provide data permitting a substantial reduction in the defective rate due to cladding thickness variation. Minimum cladding thickness specifications will not be changed.

Tests on 100 inner buggy spring supports have shown that these supports annealed at 675°C prior to welding can be sized after autoclaving without cracking. A schedule for pre-annealing 5000 inner supports has been established. Experience with the beveled top end cap has indicated that gains in production quality and process yield can be obtained by increasing the braze ring OD slightly and increasing the weight by 2 grams. Preliminary testing on some 40 end closure brazes has shown excellent results.

The initial load of .050 inch thick outer supports was fabricated during April. These supports will be attached in early May and the design for testing of these supports and the forged outer support was approved and issued with initial testing to start during the week of April 22.

RESEARCH AND ENGINEERING

An evaluation of the economics of adding reactivity by using uniformly distributed spike or increased uniform enrichment indicates that under selected conditions there is little difference.

Completion of the cold and hot portions of the zero power physics testing program has confirmed the need for spike fuel of 1.25 per cent enrichment in order to complete the power ascension program. The required enrichment can be attained by charging 150 tubes with fuel consisting of 1.25 per cent enriched outer tubes and 0.947 per cent enriched inner tubes.

Shutdown margins are positive for either the rod system or ball system alone, even with the reactor fueled with sufficient 1.25 per cent enriched fuel to yield 0.5 per cent excess reactivity under equilibrium operating conditions at full power.

Quench tests on both inner and outer fuel elements at 1800° F to 150° F demonstrate that the clad has very good ductility and that there is no cause to expect release of fission products in an accidental dump followed by quenching of uncooled fuel.

N REACTOR PROJECT

Action has been taken to correct all system deficiencies noted during the hot dump test. These include increasing the response time of the low flow trip monitors, inspection of the dump basin, and design of new primary pipe spring supports.

The automatic back-pressure controllers required to establish consistent pressure drop across the primary pump seals have been installed and are operating. Pump seal leakage flow detectors have also been installed and are operating.

Installation of the water quality monitoring instrumentation is proceeding.

The DC power supply system serving the heat dissipation system in 109-N Building has been considerably improved by the installation of a new battery charger and by moving additional batteries from the 181-N and 182-N Buildings.

Contractor testing of the Bailey Meter control system for the heat dissipation plant has been completed.

The graphite cooling system was chemically cleaned April 7 and 8, 1964.

Construction has been completed on the hot water quality lab except for the tie-in of the steam line with the plant system. The facility is now in use.

Hydraulic operators have been installed on all the river pump butterfly valves.

The first concrete pour for the sixth cell addition was made April 4, 1964.

The purchase order to the inconel tubing manufacturer, Sawhill Tubular Products, called for shipment of 80,000 feet of tubing by May 1, 1964 for 4A. Approximately 32,000 feet of the total of 100,000 feet of inconel tubing required has been produced. To date, 24,000 feet of tubing has been shipped to Chattanooga, Tennessee, for bending and assembly into panels. The tube lengths furnished thus far are not suitable, unless trimmed to shorter lengths, for fabrication of more than five complete panels of tubes. Installation of the first five panels is now scheduled to start May 18, 1964, one week later than the original target schedule date.

The results of re-examination by eddy current techniques of selected tubes in the NPR steam generators has indicated that no significant changes have occurred in the condition of unit 2A or the other units during the nine-month period from July, 1963 to March, 1964.

Shortly after initial start up water was discovered collecting in the reactor gas plenum. Test data on rates of collection versus time and temperature indicate strongly that the water came from the primary shield concrete. Water is no longer being detected in the gas plenum and it is concluded that the concrete has dried out.

Water hammer apparently caused dislodgment of a concrete anchor and subsequent failure of the EJ-5 bellows expansion joint from excessive tension. Repairs are being designed, with additional supports for the anchor.

Solenoid control valves have been reworked to provide leak-tight seats; and the key emergency dump valves show satisfactory capability when seated at ambient temperatures, to open at high temperatures, and at normal pressures.

During testing some mercury wetted relay contacts failed in the safety circuits. All such contacts have been tested, the faulty ones replaced, and voltage suppressors added where they were needed.

A voltage regulator which burned out in the 120 volt AC instrument power supply is being repaired. The overload which caused the burn out has been corrected by installation of two 50 KVA transformers to split the load between phases B and C.

Two master trip devices in the safety circuit did not close and latch automatically, but tripping on demand was not impaired. Corrections are scheduled.

Operation of the rupture monitor system has revealed some difficulties with system components, including transistors, flow regulators and the differential alarm module. Close engineering attention and vendor consultation is expected to provide early resolution of these difficulties.

The Critical Equipment Maintenance Standards were completed and issued to the Commission on April 15, 1964, on schedule.

N REACTOR PLANT

The zero power hot physics testing program was completed April 4, 1964. On April 23 at 12:36 P.M. the reactor was brought to critical in initiation

of the low power level testing program. Operation at month end was at a level of 250 MW during the course of increasing the level to 400 MW for the balance of the program.

Operational test of the secondary (steam generating) loop that started last month was completed. Revisions to prevent steam-water hammering were completed during the month in four dump condensers and the surge tank.

The turbo-generator surge governor has been adjusted for satisfactory operation for normal plant requirements. Further adjustments remain to be made by plant and vendor personnel so that it can operate at its maximum rated output.

Prior to power ascension, a number of various tests remain to be completed on the circulating raw water system, heating and ventilation systems, confinement system, rupture monitor system, 184 turbine-generator and water quality sampling systems. This work, as well as the cleanup of minor exceptions to completed tests, is now in progress as plant conditions permit.

Replacement of the 15 KV cable to the four circulating raw water pumps at the 181 Building was completed during the month.

Excluding N-1 and N-2 tests, overall testing is now 90.1 per cent complete.

PERSONNEL STATISTICS

Number of employees as of March 31, 1964	635
Number of employees as of April 30, 1964	624

	Exempt	Nonexempt	Total
General	2	1	3
Finance	16	7	23
N Reactor Fuels	51	106	157
Research & Engineering	49	10	59
N Reactor Plant	65	216	281
N Reactor Project	79	22	101
TOTAL	262	362	624

Employment

	Exempt	Nonexempt	Total
Additions	2	1	3
Reductions	6	8	14
Net Reductions	4	7	11

SAFETY & SECURITY

Days without a disabling injury	517
Hours worked without a disabling injury	1 662 490
Medical treatment injuries (April)	31

There was 1 security violation in the Department during April, 1964.

SUGGESTION PLAN PARTICIPATION

	April	CY 1964 to Date
Number of eligible employees	362	365
Number of suggestions received	49	170
Annualized rate per 1000 employees	1756	1397
Number of suggestions acted upon	45	188
Number of suggestions adopted	13	77
Net annual savings	$1809	$120,102
Amount of awards	$ 305	$ 5,215
Per cent of awards to savings	16.8	4.3
Average amount of awards	$ 23.46	$ 67.72

PATENT SUMMARY - APRIL, 1964

All persons engaged in work that might reasonably be expected to result in inventions, or discoveries, advise that, to the best of their knowledge and belief, no inventions or discoveries were made in the course of their work during April. Such persons further advise that, for the period therein covered by this report, notebook records, if any, kept in the course of their work have been examined for possible inventions or discoveries.

STAFF

General Manager	R. L. Dickeman
Manager, Employee Relations	C. O. Steinnagel
Manager, Finance	J. Milne
Manager, N Reactor Fuels	L. M. Loeb
Manager, N Reactor Plant	W. M. Mathis
Manager, N Reactor Project	J. S. McMahon
Manager, Research & Engineering	M. C. Leverett

R L Dickeman

General Manager
N-Reactor Department

RL Dickeman:flb

N-REACTOR FUELS OPERATION
APRIL, 1964

I. PRODUCTION STATISTICS

	Current Month	CYTD
A. Input (extrusions)		
.947% Enriched Outer	78	418
.947% Enriched Inner	129	389
Total Extrusions	207	807
Total Tons	35.3	146
% of Forecast	107%	87%
B. Output (finished production)		
.947% Enriched Assemblies-24"	1914	4570
18"	146	1262
12"	108	252
Total Assemblies	2168	6084
Total Tons	42.4	115
% of Forecast	106%	89%

C. Month End Inventory

Finished Inventory	300 Area	100-N Area	Total
.947% Enriched Assemblies-24"	3699	30	3729
18"	828	45	873
12"	423	79	502
Total Assemblies	4950	154	5104
Total Tons	92.3	2.1	94.4
Bare Inventory			
.947% Enriched Outer	288	----	----
Inner	38	----	----
Total Billets	326	----	----
Total Tons	67.3	----	----
Natural Outer	122	----	----
Inner	105	----	----
Total Billets	227	----	----
Total Tons	41.3	----	----

	300 Area	100-N Area	Total
1.25% Enriched Outer	64	----	----
Inner	0	----	----
Total Billets	64	----	----
Total Tons	13.7	----	----

D. Uranium Utilization

	Current Month	CYTD
Outers	----	68.7
Inners	----	73.9
Total	67.4	71.4

E. Production Comments

Accelerated deliveries of uranium billets from the feed site have alleviated the short supply which has existed for the past several months. At month end, a two-month supply was on hand. Approximately 25 tons of 1.25 per-cent enriched billets, scheduled for the July test loading of co-producer fuel, had been shipped and partially received by month end.

Billet input through the extrusion press exceeded fore-cast by 7 per cent. An incident of unbond experienced with inner tubes was attributed to weld cracking of the inner copper sleeve as a result of higher than normal nickel content. A change to components of another heat eliminated the problem. In order to expedite the produc-tion of special fuel assemblies for spike enrichment of the reactor, the last 22 extrusions of inner tubes were cut into 26-inch lengths. These will be assembled later with 26-inch outer tubes of 1.25 per cent enrichment.

The output of finished fuel assemblies exceeded forecast by 6 per cent with no imbalance of inner or outer tubes. In-process inventory was reduced by 20 per cent with a normal level expected to be attained during May.

As of month end, the equivalent of 45 per cent of the second reactor loading had been extruded with a total of 94 tons processed through to finished inventory. Approximately 25 tons of processed fuel are being held in-process for rework or revaluation of the reject category. A concentrated effort is being directed toward either release or rejection of this material. It is expected that a portion of this material will be released for further production processing during May.

II. SHOP ACTIVITIES

A. Problems and Incidents

Traces of rust were discovered in one of the autoclaves on April 18. Further inspection disclosed that this material was present in all autoclave vessels. The deposits range from slight to heavy deposits. An engineering study is currently under way to determine the cause.

Studies are currently under way to determine the best method of handling the uranium recovery operation. The recovery operation in the 313 Building is not designed or staffed to handle the amounts of 1.25 per cent uranium bearing acids on a continuous basis as is now required with the sequential production of co-producer and spike enrichment assemblies this summer. The needed decision on the various alternate solutions will be made during May.

B. Achievements

Routine metallographic evaluation of samples from extrusions have been deleted. The samples will be stored, and if grain-size measurements are needed on specific extrusions, the samples will be polished and evaluated at that time. The deletion of the grain-size measurements will result in a net savings to the Section of approximately $1000 per month.

No. 3 braze station has been modified to provide better alignment and was placed back in service on April 28, 1964. The main alignment rail and induction coil were redesigned to permit more precise alignment between the fuel, the coil, and the optical pyrometer. Fabrication of the new heat treat hangers for all inner NIE fuels has been completed. These hangers are not only capable of holding 26-inch fuels, but also eliminate the requirement of welding bails on the braze rings. It is anticipated this modification will eliminate interference caused by the bails with the optical pyrometer system during braze and greatly lengthen tool life at the step cut operation.

A feasibility test was made to determine if standardization and calibration of the braze stations could be performed from the top of the braze assembly. Experience using a modified bell jar with a removable cap has been successful. Further development work will be required prior to adoption.

An automatic unloader has been installed on the cutoff saw and is operating satisfactorily. The installation

of a spray rinse to clean the tube ID's before they leave the tank was added to eliminate the carryover of saw fines which created a contamination problem.

A safety climate review was completed for all of N-Reactor Fuels Section. The review indicated that safety climate in the Section was satisfactory with no extremes indicating either a too rigid or very lax program. Final report was issued April 27, 1964.

A work order was issued to Vitro Engineering for development of a scope proposal and program criteria for equipment rearrangement as outlined in the plant capability study.

III. ENGINEERING ACTIVITIES

A. Materials

Uranium Quality: The uranium specifications for chemistry have been revised to establish a Class II category for phosphorus contamination. There are no restrictions on phosphorus contamination below the former limit of 35 ppm. Up to 10 per cent of the ingots accepted during any one month may contain phosphorus levels between 35 and 75 ppm. The main limit for phosphorus is to assure uniform dilution of the material containing phosphorus at as low a level as possible. To assure continued control of this dilution and to obviate the need for waivers for these occasional ingots, the Class II specification has been established.

Clad Thickness Variations: Inspection standards have been established which will permit identification of different types of cladding thickness variations. These standards provide for acceptance of cladding variations due to wanderlust , stria and dimples and drag marks which exceed 0.012 inch provided there is no unbond or visual rejectable surface depression. The use of these new standards will substantially reduce the defective rate of cladding thickness. The specifications for minimum clad thickness have not been changed.

Inner Support Improvement: Tests on 100 inner buggy spring supports have shown that supports annealed at 675°C prior to welding can be sized after autoclaving without cracking. Currently, the inner buggy spring support is annealed at 300°C and water quenched after autoclaving to improve the ductility prior to sizing.

After slow cooling at the end of the autoclave step, the hydrides have precipitated as platelets. These platelets are aligned radially on the compression side of the original bend. This bend is stressed in tension during support sizing and these platelets provide notches to initiate cracking. The pre-annealing of the supports reduces the tendency for the hydrides to precipitate in the preferred direction. Pre-annealing 5000 inner supports that have been annealed before welding and not annealed after autoclaving is scheduled.

B. Process

Extrusion Bonding: Eight NIE extrusions made during the week of April 6, were partially or completely unbonded on the ID. Three of these extrusions were also partially unbonded on the OD. The front ID weld of all the unbonded extrusions was fractured, and although fractured welds are not unusual on bonded extrusions, the correlation in this case appeared significant. The ID copper sleeve lot in use was somewhat questionable from past experience and impurity content (high in Ni). With the change of copper components, the bonding problem disappeared. This experience with unbonding added weight to the belief that fracture of the billet front ID copper weld during billet upset may be one of the major contributing factors in producing unbonded extrusions. Evidence in support of the above hypothesis is sufficient at least to dictate a more specific program for improving the mechanical strength of the billet copper weld joints.

Braze Ring Design: Recent experience in brazing co-product driver fuel using a beveled top end cap has indicated that considerable gains in N-outer tube product quality and process yields may be obtained by increasing the braze ring OD slightly and increasing the weight about 2 grams (12%). The change in ring dimensions eliminates the need for flow wires to promote flow with the beveled cap. The added weight of the ring increases the "hot top" effect on the closure which should reduce the number of shrinkage voids remaining in the braze line following end facing. Preliminary testing on some 40 end closure brazes has shown excellent results. A more comprehensive test design is being made to more fully evaluate potential cost savings associated with braze ring modification.

Outer Support Improvements: Fabrication of 0.050 inch thick outer supports (versus 0.040 inch thick used on all fuels to date) was initiated during the month. Attachment of these 50 per cent stronger supports to all production fuels is scheduled for May. In

addition to the deflection tests reported on in the March report, charging machine tests on these heavier supports as attached to test charges were started in the latter part of wpril. The test charges also evaluate a further support improvement represented by a forged support design. The forged design will require substantial alteration in raw material and processing so that the favored 0.050 inch support provides an interim improvement.

Process Development for Co-Product Driver Tubes: Process development for the co-product driver tubes has been completed. Based on satisfactory results, the process specification for this fuel has been proposed (see significant reports). Production of 45 reactor tube test charges is scheduled to start in May.

C. Equipment and Maintenance

Autoclave Rupture Discs Blow-down Line: New stainless steel flexible rupture discs blow-down lines were installed on all autoclaves per ECN-00066. The Monel flexible lines were replaced based on burst test results which indicated that the stainless steel flex line is safer and more satisfactory for our autoclave service than the Monel flex line.

New End Cap Welders, 306 and 333 Buildings: Appropriation requests for two end cap welders were approved during April. One welder is scheduled for production line use in the 333 Building and the other for 306 pilot plant development work on unbonded end closures. Purchasing activities for this equipment is under way.

Connect Beta Heat Treat and Fume Exhaust Fan to 300 Area Emergency Power System: The appropriation request to connect the beta heat treat equipment and fume exhaust fan to the 300 Area emergency power system has been approved. The current emergency power supply of two motor generator sets in the 333 Building is inadequate and will be excessed when the tie-in work is completed.

Chem Mill-Machine Counterbore: An appropriation request has been approved for the purchase of a double end milling machine. This equipment will be used to mechanically counter-bore the fuel element prior to chemical milling which will reduce chemical milling time by about 85 per cent. Incorporated with this milling machine is a facing chipbreaker tool which faces the end of the fuel tube after counter-boring to a pre-determined depth. Specifications and purchase requisition will be issued in the first week of May.

1.25 Spike Enrichment Modifications: Equipment modifications necessary to fabricate the 26-inch long 1.25 per cent spike enrichment fuel were initiated in April. Modification for the inner fuel will be complete by May 4, the scheduled start of production. Design for all modifications is 60 per cent complete. Major problem area is procurement of counter-bore lathe tooling for outer fuels.

N-REACTOR FUELS OPERATION
MAY, 1964

TRIPS

Name	Company	Contact	Date	Purpose
PW Hood HP Kraemer	Alaskan Copper & Brass Seattle, Wn.	B. Sells B. Benofsky K. Rosen	4/7	Appraise vendor capabilities & promote improved understanding of our quality needs.
	West. Pneumatic Tool Co. Kirkland, Wn.	A. Bounds	4/8	" "
	Wilkens & Asso. Tacoma, Wn.	J. Redding J. Lewis	4/8	" "
	Omark Industries Portland, Ore.	AC McPhail	4/9	" "
	Production Parts Manufacturing Milwaukie, Ore.	W. Freeman B. Groh	4/9	" "
	Rem, Inc. Portland, Ore.	B. Brown	4/10	" "
	Harris Ice Mach. Portland, Ore.	H. Harris	4/10	" "
DH Walker	Omark Industries Portland, Ore.	WO England AC McPhail	4/9	Check quality system
	Production Parts Milwaukie, Ore.	W Freeman B. Groh	4/9	" "
DH Walker WR Krehbiel I Glick, Jr. AC Barkoff WE Stavig	ASQC Convention Portland, Ore. " " " " " "		4/9- 4/11	American Society of Quality Control-Western Region Convention.
TB Correy	Oak Ridge Nat'l. Laboratory Oak Ridge, Tenn.	GN Slaughter JW Tacket	4/21	Discuss welding power supplies & aluminum welding.
RH Scanlon	NLO Cincinnati, O.	J Blaisdell	4/26- 5/1	Discuss uranium development programs.
	Reactive Metals Ashtabula, O.	OJ Puterbaugh	4/26- 5/1	Participate in ingot cupping tests.

VISITORS

Name	Company	Contact	Date	Purpose
R VanThuyne	IIT Chicago, Ill.	JW Nickolaus CH Shaw	4/1	Discuss extrusion, cladding.
WB DeLong	SRO Wilmington, Del.	JW Nickolaus	4/1	Discuss behavior of metallic fuels.
T. Bryant	Brush Beryllium Cleveland, O.	HP Kraemer	4/20	Braze rings.
G. Cleveland	Reactive Metals, Ashtabula, O.	HP Kraemer	4/21	Zircaloy cladding.
		RR Studer	4/21	Zircaloy components, billets for unmachin clad items.
RA Graham	Wah Chang Albany, Ore.	HP Kraemer RR Studer TD Naylor	4/30	Zircaloy support items.

ORGANIZATION AND PERSONNEL

Deletions

	From	To	Date
MF Tschauner	Quality Control	IPD-Prod. Fuels	4/13/64
MA Moore	Shop Operations	Medical Leave	3/2/64

Safety

Injury Statistics	Current Month	CYTD
Disabling Injuries	0	0
Medical Treatment Injuries	7	25

Roughly half of the nuclear safety signs have been received and are mounted.

Security

Security Violations	Current Month	CYTD
	0	2

Suggestions

No. submitted	23
No. adopted	7
Total awards	$ 230
Total savings	$1,725

Grievances

A grievance was received from an instrument technician because he felt instrument work was given to the millwrights. Management does not feel there has been a misassignment of work.

Total Personnel

Exempt	52
Nonexempt	105
	157

INVENTIONS

All persons engaged in work that might reasonably be expected to result in inventions or discoveries advise that to the best of their knowledge and belief, no inventions or discoveries were made in the course of their work during April, 1964, except as noted below. Such persons further advise that for the period therein covered by this report, notebook records, if any, kept in the course of their work have been examined for possible inventions or discoveries.

None

SIGNIFICANT REPORTS

HW Number	Classification	Author	Date	Title
HW-76155 REV2	Confidential	TD Naylor	4/2/64	Chemical Specifications for Uranium Metal Billets for NPR Fuel Elements
Undoc.	Confidential	WA Hendricksen	4/6/64	Fabrication Sched. 1.25 Driver Fuel Elements
HW-81681	Secret	LM Loeb	4/6/64	Revisions to Specifications for Uranium Metal Billets for N Fuel Elements
HW-81692	Secret	LM Loeb HP Kraemer	4/6/64	Official Production Forecast, N-Reactor Fuels Operation, April 1964-June 196
HW-81754	Secret	JW Nickolaus	4/10/64	Proposed Length Schedules for N-Fuels

HW Number	Classification	Author	Date	Title
HW-81859	Confidential	LM Loeb	4/14/64	Revised Phosphorus Specification, N-Reactor Uranium
HW-81872	Confidential	LM Loeb	4/20/64	Complete Declassification of Berylli Zircaloy Braze Ring
Undoc.	Confidential	JW Nickolaus	4/20/64	Cost Estimates--Driver Tube Prod.
HW-81936RD	Confidential	WA Hendricksen	4/22/64	Process Specification for 1.25% Enriched Co-Producer Fuel Elements
HW-81962RD	Confidential	CH Shaw	4/23/64	Review-Process Development, 1.25% Enriched Co-Product Drive Fuel
Undoc.	Confidential	JW Nickolaus	4/24/64	Fuel Length Selection-1.25 Enrichmen

Manager
N-Reactor Fuels

LM Loeb:bk

RESEARCH AND ENGINEERING

1. ADVANCED TECHNOLOGY

Spike Versus Uniform Enrichment

An evaluation of the economics of adding reactivity by using uniformly distributed spike or increased uniform enrichment indicated that the cost differences between the two alternatives were not significant when considering the addition of reactivity necessary to bring the reactor to a critical state plus 10 mk for control. Therefore, the operating mode (spike vs. uniform) of the reactor should be dictated by the ease and convenience of operation rather than the economics.

Estimate of Neptunium Production in N-Reactor

The estimated quantities of neptunium that can be produced in N-Reactor for different cases under varying fuel management cycles were published in HW-81974. These quantities are highly dependent on the reactor operating mode, fuel management cycle, and fuel design. This study indicated that for N-Reactor a co-producer mode of operation would produce more neptunium annually than the current plutonium-only operation. In general, the neptunium production per year increases as the average fuel exposure increases. For a 2100 MWD/T average exposure at a 4000 Mw power level and after eight years of recycle operation, the estimated neptunium production was as follows:

Case	Neptunium Production
Plutonium-only	23 kg/yr
Co-producer	29 kg/yr

2. REACTOR PHYSICS

N-Reactor Spike Enrichment

The completion of the cold and hot portions of the zero power physics testing program has confirmed the need for spike fuel of 1.25% enrichment in order to complete the power ascension program. The results show that the best estimate of the additional reactivity required in order to reach 4000 MW without encountering a reactivity limitation is about 1.14%. About 150 tubes of fuel in the standard N-Reactor dimensions consisting of 1.25% enrichment in the outer tube and 0.947% enrichment in the inner tube is necessary to increase the reactivity by 1.14%. This corresponds to about 38 tons of finished outer fuel elements in the 1.25% enrichment.

The individual reactivity components corresponding to the deficit of 1.14% at 4000 MW are tabulated as follows:

REACTIVITY

k_{ex}	3.4%
Net temperature effect	- .04%
Xe	-3.00%
Sm, Np	-1.0 %
Reactivity held in control rods	-0.5 %
Net reactivity deficit	1.14%

The figures given above are for fuel with slight exposure, i.e., full Sm and Np effects but negligible plutonium inventory. Reactivity increases associated with plutonium build-up from large exposures may override the more rapid burn-up of the spike columns, but the magnitude of this effect is so uncertain that no credit should be assigned in making estimates of spike requirements for the first fuel load.

The approximate number of tubes needed as a function of power level for the case considered above is as follows:

Power	Number of Tubes
4000 MW	150
3200 MW	130
2400 MW	110
1600 MW	88
1000 MW	38

Lattice Parameter and Spectral Index Experiments

Lattice parameters and spectral indices of the green-clean N-Reactor lattice at two uniform temperatures are to be inferred from activity data obtained in irradiations completed in N-Reactor this month. The two temperatures are approximately 50 F (once-through coolant in the small critical) and 470 F, obtained in the heat-up for the temperature coefficient experiments in the fully loaded reactor.

A number of radioactivants were employed in each experiment. All of

their relative activities have been determined by Hanford Laboratories personnel. The only experimental work remaining is the determination of radioactivant uniformity which is to be done in the PCTR. This work awaits the radioactive decay of activants irradiated in the April 4, 1964 hot test.

Physics Presentation to ACRS Subcommittee - April 20, 1964

The status of N-Reactor was presented to the ACRS Subcommittee on April 20, 1964. This material is summarized in HW-81989. On the basis of information presently available, the shutdown margins are positive for either the rod system or ball system alone even with the reactor fueled with sufficient 1.25% enriched fuel to yield o.5% excess reactivity under equilibrium operating conditions at full power.

The smallest margin of 1.23% results from the simultaneous assumption of the maximum graphite coefficient, minimum probable control rod strength, and a rapid startup to full power. An increase of -0.5% in margin is easily obtained by temporarily halting the power rise during a startup at 2000 or 3000 MW for several hours until -0.7% of Xe is in residence before proceeding to full power and obtaining the full positive effect of graphite heating. Other means of increasing the margin are also available if necessary, such as increasing the temperature of the emergency water or the use of splines.

3. CONTROLS, INSTRUMENTS AND SYSTEMS ANALYSIS

NPR Process Tube Monitoring

The invitation for bids for the radiation resistant TV system was sent out on April 2, 1964 with bids to be returned by May 5. Design engineering has been completed on major items of the system, with assembly drawings being made for the drive unit TV probe front end section and control console, Detailed design drafting is starting on some of the components. Orders have been placed for the major items of standard hardware. Work is continuing in the Hanford Laboratories on the development of the eddy current and ultrasonic hydride probes.

Reactor Engineering Data System

Business Systems Development Operation personnel are continuing to develop the system definition and programming of the master file.

Systems Analysis

The entire N-Reactor system has been simulated on the Hanford analog computer facility and information is being obtained in support of the

N-2 Startup Testing Program.

Information has also been obtained on the controller settings for the primary coolant flow control system.

Fuel Element Rupture Monitor System

Engineering shift coverage assistance has been given in support of the calibration and operational testing programs of the Rupture Monitor System. A Design Audit Team was assembled and recommendations were made for the procedures and operations to be followed to assure adequate rupture monitor coverage during the calibration and shakedown of the system during the N-2 Testing Program.

Co-Producer Program - Target Element Failure Detection

A study of the possible methods of detection of target element ruptures has been completed and a report (HW-81875) has been issued.

4. PROCESS EVALUATION AND CONTROL

There were 36 Process Change Authorizations issued during the month.

All contractual requirements for Startup Test N-3, Power Ascension, have been completed and transmitted to the Atomic Energy Commission.

Critical Power Procedures for N-Reactor Department have been negotiated with Electrical Utilities Operation, have received necessary managerial approval, and are being issued.

5. CHEMISTRY AND METALLURGY

Fuel Element Testing

The enriched UO_2 crud monitors and N-Inner Enriched (NIE-1) heater elements were discharged from KER Loop #1 at exposures of 4800 MWD/TU and 1400 MWD/T respectively. No excessive crud formation was indicated by the thermocouple elements or by water samples taken since decontamination of the loop in February, 1964.

Eight 12-inch KSE-5 elements (1.6% enriched uranium single tube test elements) were charged April 4. Four elements were made with standard uranium and four with a U-800 ppm Al-400 ppm Fe alloy. Maximum fuel temperatures range up to 600 C. A water channel temperature monitoring device was included at the down-stream end of the fuel charge. Goal exposure was 2500 MWD/T. In mid-April a weld in the ex-reactor piping began to leak and the loop temperature had to be reduced to an outlet temperature of 150 C (rather than 265 C). This condition persisted until the outage of April 28. This period of low temperature operation compromised the test results to an unknown degree so the test was replaced with an identical spare charge, including the water channel temperature monitor. Goal exposure is approximately 2500 MWD/T, to be reached in August of 1964.

The thorium-uranium fueled crud monitor, the four NIE-1 heater elements and the four prototype target elements were discharged from KER loop #2 during the April 4 outage at exposure levels of 1350 MWD/T, 1000 MWD/T and 8 GVR respectively. The thorium-uranium crud monitor performed satisfactorily.

Eight 12-inch KSE-5 elements were charged in KER-2 during the April 4 outage. This charge is a duplicate of that described for KER-1 above except that no water channel temperature monitor was included. This loop has operated as desired and the exposure level is now approximately 600 MWD/T. Goal exposure of 1500 MWD/T is to be reached during June 1964.

The thirteen 26-inch co-producer test elements remain under irradiation in KER loop #3. These elements are identical to the driver-target element planned for the 36-45 tube co-producer test (PT-NR-8) in N-Reactor. The exposure is currently 800 MWD/T (1200 peak). Goal exposure is 1800 MWD/T, to be reached June 30.

A thorium-uranium crud monitor element and ten N-Enriched fuel assembly heater elements were charged into KER-4 on April 4, 1964 to obtain information about crud monitor behavior in an N-Reactor sized process tube. The elements have reached an exposure of about 400 MWD/T on the crud monitor element and 300 MWD/T on the heater elements. The test is scheduled for discharge at 1000 MWD/T.

Integrity of Fuel Element Cladding After a Dump of the Primary Loop and a Delay of Emergency Cooling Water

One more outer fuel element and two more inner fuel elements which had been irradiated under N-Reactor conditions in the KER loops, were heated to 1800 F (982 C) and quenched with 150 F (65 C) water. The claddings on all three elements retained their integrity in a manner similar to the results obtained on an outer fuel element in the first test.

These last three tests were also performed in a temporary facility in the "A" cell in the Radiometallurgy Building. Using electrical induction as the heating method, a full-length coil allowed the uniform heating of a 23-inch long fuel element. Again, the heating cycle was 1) 1800 F in 230-250 seconds for an outer tube and 210-230 seconds for an inner tube with a slight arrest at 750 F (400 C), 2) the flow rate for the 150 F quench was 1.3-1.5 lb/sec. for an outer and 0.5-0.6 lb/sec. for an inner fuel element.

As before, these three elements demonstrated that the cladding has very good ductility. After the thermal cycle, all three fuel elements had blisters on the outer clads while the inner clads remained smooth. Also, the uniform strain that the clads resisted was high and was in the predicted range of 5 per cent swelling. The swelling values for the four tests are shown in the table below:

Swelling In Irradiated N Fuel Elements After Heating To 1800 F and Quenching in 150 F Water

Test No.	Piece No.	Type	Exposure (MWD/T)	Swelling (% V/V)
1	2184-1	Outer	1920	7.57
2	1201-6	Inner	1810	3.52
3	1520-4	Inner	1935	6.15
4	2680-10	Outer	1940	6.60

Each fuel element was sectioned and examined after heating. The outer clads were completely separated from the uranium cores; the uranium cores showed large macrocracks that terminated ductilely at the clads; the inner clads had only slight areas of separation from the cores. There was an apparent relation between the extent of macrocracking of the uranium cores and the blistering of the outer claddings to suggest the interdependency of these phenomena. It is suggested that the macrocracks form at the two-phase transformations of the uranium during the heating and fission gases reaching these free surfaces act like a true gas. Upon further heating and volume increase of the gas, the intermetallic compound layer fails by shear forces and the outer cladding becomes wholly separated. Being unbonded at maximum temperature, the outer clads to not return to the same O. D. as the uranium due to the differences in thermal expansion characteristics of the two materials.

This work concludes this phase of fuel element integrity and there is no apparent cause for concern from release of fission products.

SIGNIFICANT REPORTS ISSUED

HW-78445, "N-Reactor Operating Limits," April 25, 1964, Staff of Process Evaluation and Control (Confidential).

HW-80334, "N-Reactor Department Disaster Plan for 100-N Area," J. R. Bolliger, and F. Cox, Jr., April 24, 1964 (Unclassified).

HW-81729, "N-Reactor Heat Balance; Power Level Data and Calculations," K. L. Berrett, April 21, 1964 (Unclassified).

HW-81580, "Startup Test N-3, Reactor Power Ascension Program," April 30, 1964 (Confidential).

HW-82077, "Production Reactor Nuclear Safety Audit and Inspection System, N-Reactor Department," Edited by R. E. Trumble, April 30, 1964 (Unclassified).

HW-81738, "Curium Generation Rates," E. E. Mills, April 9, 1964 (Secret).

HW-81989, "Physics Presentation to ACRS Subcommittee - April 20, 1964," P. F. Nichols and W. S. Nechodom, April 24, 1964 (Confidential).

HW-81942, "Alternate Fuel Cycle for Power-Only Operation of N-Reactor," J. W. Riches, April 24, 1964 (Unclassified).

HW-81974, "Estimate of Neptunium Production in N-Reactor," E. G. Pierick, April 23, 1964 (Secret).

PERSONNEL CHANGES

R. V. Poe was granted an educational leave of absence.

TRIPS

R. E. Trumble, R. E. Hall, P. F. Nichols, and M. C. Leverett made presentations before the ACRS Subcommittee in Washington on April 20.

M. Lewis attended the Working Committee Meeting of the FEDC at Mallinckrodt Chemical Works on April 28, 29, and 30.

B. S. Kosut attended the Northwest District Council Meeting for the American Society for Testing and Materials in Spokane on April 22, where M. C. Leverett presented a paper.

SECURITY VIOLATIONS

D. H. Curtiss, open file, April 17, 1964.

INVENTIONS

All Research and Engineering personnel engaged in work that might reasonably be expected to result in inventions or discoveries advise that to the best of their knowledge and belief, no inventions or discoveries were made in the course of their work during March 1964. Such persons further advise that for the period herein covered by this report, notebook records, if any, kept in the course of their work have been examined for possible inventions or discoveries.

JW Riches

Acting for Manager
Research and Engineering

JW Riches:LCC:dd

N-REACTOR PROJECT

PROCESS DESIGN OPERATION

Low Flow Trip for Emergency Cooling

During the primary loop dump tests of March, 1964, the response of the low flow trip for emergency cooling was found to be slower than predicted. Trip settings have been defined which will provide sufficiently fast response for protection during low level power operation but will not be completely responsive for full power operation of the reactor. Corrective measures are currently being studied to obtain adequate time response for the low flow monitors.

Maximum Fuel Temperature After Coolant Loss

The maximum fuel temperature that would result in the N-Reactor following a complete loss of coolant at 10 percent power level has been calculated. These calculations assume heat transfer only to the moderator cooling system. The results of these calculations indicate that the maximum fuel temperature will not exceed the alpha-beta transition temperature of 1240 F.

Fog Spray Control

An analysis has been made of the effect of permitting the fog spray system to continue operating after a confinement incident rather than having it shut off either automatically or manually. The purpose would be to absorb the remaining sources of heat in the building and limit the rate of ventilation outflow to normal "breathing" after an incident. Damage to the building from negative pressures would be avoided by normal action of the vacuum relief valves. The only point of concern would be a potential high rate of backflow through the open exhaust filters, but calculations have indicated that this could be avoided by resetting the vacuum relief valves to open wide at a lower value of negative pressure.

Dump Basin Inspection

An inspection of the dump basin was made following the recent performance of the primary loop hot dump test. No significant damage was detected. Minor concrete cracks were found to be shrinkage cracks that were present prior to the dump. Minor leakage between the liner and concrete was suspected, and recommendations have been made for corrective action. The loss of approximately 250,000 gallons of water was analyzed and attributed to flowback through the dump line (through a V-23 valve which must have been in an intermediate position) and out the effluent system to crib.

Primary Pump Mechanical Seals

The automatic back-pressure controllers have been calibrated and put in service on the primary pump mechanical seal drain lines. Because of radical pressure variations in these lines due to primary pump speed changes, snubbers were installed in the sensing lines to the controllers. If the

snubbers do not prove adequate for all operating conditions, volume chambers may be necessary to provide additional damping. The leakage flow detectors have also been calibrated and put in service in the mechanical seal drain lines. The indicator full-scale flow is only 0.54 gph. Response will be improved by a minor piping modification.

DC System

New batteries were installed in 181-N and 182-N. The original batteries, considerably larger in size, were released to meet the increased demand in 109-N for DC power. New battery chargers were installed in 109-N with ten times the capacity of the old ones.

Process Tube Flow Monitor

Pre-startup tests were conducted on the process tube flow monitor. Actual flows through each process tube were varied, one at a time, to individually test the low flow trip and the high flow trip circuits of each controller. All controllers tripped when subjected to out-of-limit flow signals. All the trips were not properly indicated due to the thyratron problem. Thyratron replacement has reduced the thyratrons in the system not properly firing to less than sixty. Flow log sheets have been closely watched for abnormal flow data. These have been investigated to determine if the abnormalities are actual flow conditions or due to flow transducers requiring calibration. An inspection and adjustment of all valves on the transducer valve racks have been completed.

Reactor Nuclear Instrumentation

Pre-startup tests were conducted on the reactor nuclear monitoring system. All equipment was ready for the low-level startup required for operational testing. Two gamma compensated and one uncompensated chambers were installed in the intermediate range step plugs due to the fact that a connector was damaged in one of the intermediate level chambers. This chamber will be returned to GE-APED for repair.

Horizontal Rod Drives

Return end packings were replaced on five rod drive hydraulic cylinders. The packings removed have had the first teflon V-ring damaged to various degrees by extrusion. Examination of packings removed indicates that additional packings may have to be replaced, although most of the old packings seem to be functioning presently without excessive leakage. Packings have been replaced only when leakage warrants such action.

Special Studies

Additional Irradiated Metal Storage

The request for a study of additional storage basin facilities was covered on a preliminary basis. If necessary, a new storage basin facility could be located west of the present transfer area. Access to the new basin would have to be across the south side of the transfer area. A basin with the capacity to store 800 tons of metal could be provided by relocating some underground lines. A larger basin could be installed if the RDR valve pit was relocated or the proposed railroad location changed. The estimated cost of this facility is $550,000.

Filter Cooling

A preliminary scope study has been completed for providing a system which will remove heat from the filters in the 117-N filter building. This study is in response to questions raised by the ACRS as to the possible destruction of the filters by the temperatures induced from fission products following a serious incident. This study summarizes preliminary costs and presents a schedule for achieving beneficial use.

Graphite Monitoring Facility

All modification work to modify ball channel No. 60 for use as "Graphite Monitoring Facility" has been completed. Design and fabrication of a sample insertion and removal tool remains to be done before samples can be charged.

Nitrogen System

An engineering study is under way to determine whether the suggested use of high-pressure compressed air would be a practical and more reliable substitute for the existing 105-N bottled nitrogen pressure source for the actuation of the 105-N cylinder operated valves, which must function without fail during an emergency "dump" of the primary loop coolant.

FIELD ENGINEERING OPERATION

Construction

105-N Building

Work continued during the reporting period on miscellaneous punch list items as operating conditions in the 105-N Building permitted. Punch list work was completed on the reactor nuclear monitor system with the installation of the intermediate and in-core ion chambers. Installation of the cannister hoist for the metal transfer area handling equipment was also completed. Other work consisted of miscellaneous building electrical, heating and ventilation and architectural punch list items.

109-N Building

Contractor testing of the Bailey Meter control system was completed and the system turned over for operational testing.

The graphite cooling system was chemically cleaned April 7 and 8. The cleaning was accomplished as scheduled with no incident and the system was returned to service after flushing established acceptable water quality.

The installation of supports for valve operators for small size valves on the primary and secondary piping systems continued during the month. Testing of these systems showed that additional support is required to reduce pipe vibration.

The hot dump test showed that modifications are required to certain primary loop pipe supports. This work has been initiated and is being accomplished as operating conditions permit access to the pipe gallery and the cells.

Construction of the hot water quality lab has been completed except for the tie-in of the steam line with the plant steam system. The laboratory is now in use.

Miscellaneous punch list work is being accomplished on the confinement system as operating conditions permit.

General Area

The installation of the hydraulic operators for the 66" butterfly valves on the lines from the river water pumps #3 and 4 was completed and tested satisfactorily. Difficulty has been encountered in the operation of the valve for pump #1. Upon disassembly of the hydraulic operating cylinders the piston and cylinder were found to be severely scored due to a large particle of metal in the cylinder assembly. A new cylinder is being obtained from the supplier and the piston is being repaired.

Revisions to the diesel oil return lines in the 181 and 182 Buildings and the piping for the fuel oil storage tank to the 182 Building were completed. The construction of the hydrogen unloading facility for the 182 Building has been completed.

Work was initiated on the drilling of five test holes for monitoring the sub-surface water. The presence of large boulders is causing difficulty in the drilling operation.

Conversion

Excavation to permit the eight 12" tie-ins to the Condensate-1 line was completed and the drilling of wall penetrations through the south wall of the 109-N Building at the -8' 5" elevation is in progress. Footings for the sixth cell were formed and the first concrete pour for the sixth cell was made 4-16-64. Form work is continuing for the construction of the sump pits between the pipe gallery and cell 6. Installation of the cable trays from the west end of the turbine bay area to room 6 has been completed.

Steam Generators

All field work in unit 4A required to be completed before reinstallation of tubes has been completed. All tubesheet penetrations, with the exception of three holes which were previously core drilled to obtain complete tube-to-tubesheet samples, have been conditioned by wire brushing and reaming. The weld preparation on the end of the shell and on the head have been conditioned and passed magnetic particle inspection.

In response to a request by the Richland Operation Office of the Atomic Energy Commission, a program of tests has been initiated to further evaluate the cause of the intergranular corrosion found in steam generator tubing.

Production of inconel tubing for unit 4A was hampered during the first three weeks of the month by ultrasonic test equipment problems. Variations in method were adopted to accommodate the limitations of available equipment while maintaining quality standards. Production during the last week of April proceeded at a slow pace due to competition for manpower for another rush order in the plant.

Inspections were conducted on the secondary side of steam generators in operable cells; the ends of tubes from which samples had been removed for previous studies were crimped and secured in a manner to prevent damage to adjacent tubes during steam generator operation.

N-PLANT ENGINEERING

Plant Assistance

Plant Engineering support was provided in the areas of trouble shooting, repair, consultation, and performance of operational tests. Significant accomplishments in these areas follow.

Mechanical Engineering

Water in Reactor

The accumulation of water in the reactor gas plenum as measured in Drip Cell No. 6, has been followed closely since discovery shortly after initial heatup. Test data and observation of the water accumulation rate as a function of time and temperature have almost proven that the only source of water is the primary shield concrete. Calculations indicate that 3,000 gallons of water could be driven from the front and rear primary shields and to date approximately 1,900 gallons have been collected. A slower accumulation of water at a given time and temperature during recent operation indicates that the shield concrete is drying out.

Grayloc Leaks

On April 15, 1964, the diversion valve for channel 1567 was removed to investigate water leakage from the diversion leg of the Grayloc coupling. The coupling flange was found to be out of alignment, with approximately .125 inch parallelism versus .030 inch required for a good seal. Corrosion products, mostly a lead compound, were also found on the seal rings for both the normal outlet and diversion leg Grayloc seal rings. Seal surface pitting was repaired, new rings were installed, and seal closure was properly made by cold springing the misaligned flange to achieve the required alignment. Since lead containing compounds were not generally used during makeup of the seals in the construction phase, it was concluded that the corrosion which contributed to the leakage is not a general problem.

Repair of Expansion Joint EJ-5

On April 16, 1964, the EJ-5 expansion joint on the 24 inch flush line, low pressure, was found to have ruptured, presumably because of a water hammer which dislodged the adjacent concrete anchor from its attachment to the floor. The anchor failure produced excessive tension and upward thrust on the bellows expansion joint with deformation and rupture occurring at the downstream end. An engineering review has been started regarding the interlocks and a repair to the ruptured joints and anchor has been designed by Process Design. It has been scheduled to install a new bellows and anchor with additional support members by construction forces prior to May 15, 1964.

Hydrogen Facility

A review of the 184 Building hydrogen system has shown minor equipment application discrepancies. Funds have been allocated to remedy the deficiencies and engineering was initiated for delineation of corrective action.

Elevators

To increase personnel safety in the area of elevators, drawings have been essentially completed for modification of handrails, gates, sills, ladders and ladder cage for the left side of C and D elevators. Design for such improvements on the right side has been initiated.

Emergency Dump Valves

Under engineering direction, a general tune-up was given to the emergency dump valves, V3's, V4's, and V23's. Thus far, 76 out of 88 solenoid control valves have been reworked at the factory to provide leak-tight seats, and have been re-installed to minimize gas leakage. Recent functional tests of V3 and V4 valves which were closed immediately after the hot dump test performed in March, 1964, showed that the V3's operated satisfactorily and the V4's all failed to open. The outlet valves were unseated thereafter with application of gas pressure ranging between 1200 and 1400 psi. Once the V4 valves were unseated, they performed satisfactorily at the normal operating pressure of 850 psi and also at lower pressures. The seizure of all V4 valves in the closed position was most likely caused by the seating of a partially cooled plug in a hot valve body at the end of the hot dump test. All tests performed on the V3 and V4 valves before and after the above incident, where such valves were seated during room ambient temperature conditions, show satisfactory capability of the valves to open at high temperature.

Instrument and Electrical Engineering

Effective April 20, 1964, shift electrical engineering coverage was reinstated to augment testing activities. Concurrently and as backup, a shift call list was established to make available electrical engineers for assistance to the shift engineer on general control system problems outside the 105 Building, and for the heat dissipation system control problems. The arrangement provided for two engineers to be available full time by telephone for consultation or call-in to support the shift electrical engineer on duty.

Safety Circuit Relays

During recent testing activities, it was discovered that certain of the mercury wetted relay contacts, normally open, failed by remaining in the closed position. All such relays in critical circuits were tested and out of 2,718 contacts, 23 were found to be defective. The predominant cause of failures was lack of voltage surge suppression on coils which were tripped by the faulty contacts. Accordingly, surge suppressors were

added and new relays were installed where defective contacts had been noted. This deficiency in application involved less than one percent of the safety circuit; surge suppression was otherwise provided correctly during initial assembly of the panels and circuits.

Ball 3X Drop

At approximately 3:15 P.M. on April 28, 1964, the 3X balls dropped seconds after two simultaneous safety circuit trips were produced by the excessive neutron flux monitor-high level. An investigation showed that the controls functioned normally with exception of a loose connection where a signal cable joined one of the flux monitor chassis. The loose connection was repaired and, additionally, the delay period was extended from three seconds to five seconds consistent with process standards.

120 Volt AC Instrument Power Supply

On April 11, 1964, at 10:30 P.M., the inductrol regulator on Phase C of Instrument Power Supply No. 1 failed (burned out). The inductrol was removed and jumpers were installed to keep the power circuit operable although not regulated as before. The inductrol regulator has been returned to the manufacturer's plant for repair. An over-load condition on this key power supply was corrected by the installation of two 50 KVA transformers to split the load between Phases B and C.

River Water Pump Motor Controls

Corrective action has been taken to alleviate the low voltage condition which caused the river water pump motors to operate out of synchronization at times. Modification to the closing circuit of the field contractors to reduce the voltage drop by 50 percent has been completed for all pump motors.

AK-2 Circuit Breaker - Safety Circuit

Recent problems were experienced with closing and latching the 1K1 and 2K1 breakers which are the master safety circuit trip devices. The clearance of the undervoltage trip device occasionally allows the armature to hold at a position too close to the trip position and thus prevented latching of the breaker. In those instances, the breaker has been latched manually. This condition in no way impairs the tripping capability of the breakers, and the inconvenience has been planned for correction at a later date.

Instrument Systems

Power Calculator System

The power calculator system checkout has been completed under the direction of Process Design. The largest error in power calculation in the seven checks made was approximately 0.6 percent as read at the power set dial. This is well within the plus or minus two percent accuracy required. High flow operation in the primary loop created vibration that affected the

temperature elements (RTD's) in the primary coolant supply headers in the 109 Pipe Gallery. One socket in PCS-5 header developed a leak at the weld during the heatup period prior to the hot dump test and was later repaired. Modifications have been made to all such RTD assemblies in an effort to defer or eliminate the need of relocation to pipe sections where vibration is less.

Rupture Monitor System

The rupture monitor system has been placed into service for de-bugging during operating conditions. Problems thus far are mainly component, wiring, and tubing difficulties and engineering attention has been applied around the clock to remedy these problems as they arise.

Typical problems are as follows:

1. Transistor failures have occurred on the gamma energy system position identification boards. Approximately 30 transistors have been replaced during 1500 hours of operation. The vendor representative for this part of the rupture monitor was here April 27 and 28, 1964, to look into this problem. He recommended a method of trouble shooting to identify the failures and took 12 failed transistors back for analysis with a report forthcoming.

2. Pressure control problems exist with the differential pressure controller for the flow sampling panel. The problem with pressure control is due in part to incorrect control valve size. The valve vendor has been contacted for assistance.

3. Failures have been experienced with the differential alarm modules in the Gross Gamma System. Thirteen units were returned to the vendor on February 22, 1964, and 12 units April 2, 1964. Laboratory testing has been initiated at Hanford and the vendor's plant to determine the cause of the failures.

Equipment Development

CP Mercury Type Relay FG6-F-1037

Instrument and Electrical Development Operation, Irradiation Processing Department, performed laboratory analysis on four mercury relays which were the types that had failed in key electrical circuits as described above. Their findings showed that (a) when relatively high power is switched (38 volts and 3.2 amps in the test case) without arc suppression, the relay contacts may weld and stick; (b) the failure of one of the relay capsules was probably due to a manufacturing defect; (c) when relatively little current is switched, the contacts do not break down without arc suppression; and (d) the type of arc suppression device applied generally in the relay circuitry and most recently to correct those cases where arc suppression did not exist is clearly adequate to prevent the previously encountered types of failures, with the exception of manufacturing defects.

Dynamic Gas Seal - Front Nozzle

Analysis of the dynamic gas seal packing removed from channel 1648 indicates the mechanism of corrosive attack experienced on the thimble ID is that of a cathodic reaction. The packing used is a graphite impregnated asbestos containing no chlorides or nitrates but possessing some moisture. The moisture - graphite combination apparently form a cell resulting in corrosion of the bare steel of the thimble where in contact with the packing. Mica impregnated packing rings have been ordered for evaluation as a substitute seal material.

Special Reactor Tools

In the Special Reactor Tooling Development Program, fabrication of tooling prototypes designed and developed by Equipment Development Operation of the Irradiation Processing Department has continued on schedule.

Special Grayloc redressing equipment was used successfully by Plant Maintenance forces in repair of the Grayloc flanges during correction of a severe water leak at the diversion valve connections for channel 1567. To accomplish this work required draining of the primary loop. To dispense with the need for draining in the future, investigation of freezing techniques to block water flow from the vertical header prior to breaking of the Grayloc flanges was initiated. Of the methods tried, a mixture of dry ice and isopropanol appears to perform the most satisfactorily. Complete immersion of a connector spool piece in a dry ice - isopropanol solution at the 189-D Laboratory resulted in a four inch block being formed in 15 minutes. The freeze plug withheld 60 psig upstream pressure for 15 minutes before loosening sufficiently to allow leakage. Using a special can to fit the space requirements in place, freezing of a header arm at 189-D was accomplished in one hour and fifteen minutes. The effect of the freeze on the pipe, freeze temperature control and time from temperature to freeze are areas scheduled for investigation in development of the freeze technique.

Prototype tooling and equipment completed include the process tube shield plug, the outlet tube sleeve spanner wrench and the inlet nozzle/tube sleeve insertion guide. Items scheduled for immediate development completion include the header arm freezing equipment, an underwater fuel element handling device, the process tube pusher, the crate spot-facing tool, on-pile tube rolling equipment, a special Grayloc seal ring retainer device and diversion valve replacement tools.

Maintenance Standards

The 68 Instrument-Electrical and Mechanical Equipment Maintenance Standards were completed and issued to the Commission on April 15, 1964, on schedule.

RESPONSIBILITY

There was no change in responsibility since last month's report.

ORGANIZATION AND PERSONNEL

	3-31-64	4-30-64
Exempt	77	74
Nonexempt	22	21
Total	99	95
Tech. Grad.	1	1

Personnel Changes

Name	From	To	Effective Date
A Rudy (exempt)	Field Engineering	Hanford Laboratories	4-1-64
RF Smith (exempt)	Field Engineering	Irradiation Processing Department	4-16-64
JE Phillips (exempt)	Field Engineering	Terminate-ROF	4-30-64
JV Kirby (nonexempt)	Field Engineering	Leave of Absence	4-24-64

SAFETY AND SECURITY

There were no disabling injuries reported during the month; total CYTD - 0.

There were no security violations reported during the month; total CYTD - 1.

INVENTIONS OR DISCOVERIES

All persons engaged in work that might reasonably be expected to result in inventions or discoveries advise that, to the best of their knowledge and belief, no inventions or discoveries were made in the course of their work during the period covered by this report. Such persons further advise that, for the period therein covered by this report, notebook records, if any, kept in the course of their work have been examined for possible inventions or discoveries.

TRIPS

Name	Firm and Location	Date	Purpose
HD Lenkersdorfer	AMF Atomics Greenwich, Conn.	4-14 to 4-18	Review development of an on-power refueling machine for a CANDU-type reactor
DL Condotta	Atomic Energy Commission Washington, D. C.	4-18 to 4-20	Attend ACRS hearings
	Burns and Roe, Inc. Hempstead, N. Y.	4-21/22	Attend meeting on conversion
WA Richards	Engelhard, Inc. New York, N. Y.	4-20	Discuss RTD failures and repair
	Burns and Roe, Inc. Hempstead, N. Y.	4-21/22	Discuss conversion instrumentation
	Scam, Inc. Chicago, Illinois	4-23	Discuss data system
HR Kosmata	Atomic Energy Commission San Jose, California	4-21 to 23	Attend Superheat Conference
WJ Dowis	Salt Lake City, Utah	4-29 to 5-1	Present paper at IEEE Regional Meeting
EM Kratz	Burns and Roe, Inc. Hempstead, N. Y.	4-20 to 4-24	Meeting on conversion design and construction
GT Haugland	Sawhill Tubular Products Wheatland, Pennsylvania	4-9	Review inconel tubing manufacturing and inspection
	Westinghouse Pittsburgh, Pennsylvania	4-10	Discuss pump face seals
	General Electric Schenectady, N. Y.	4-13	Discuss pump face seals
	Combustion Engineering Chattanooga, Tennessee	4-14	Review inconel tube panel fabricating equipment.

VISITORS

Name	Firm & Location	Date	Purpose
D Showalter	Showalter-Judd, Inc. Seattle, Washington	4-17	Radiation monitoring instrumentation
D Knuth J Cermak	Atomic Energy Commission Division of Licensing & Regulations	4-9	Discuss hazards analyses
HS Isbin	University of Minnesota	4-10	Discuss boiling heat transfer and two-phase flow
R Rasmussen	Consultant Detroit, Michigan	4-27 4-30	Consult on boiler problems

SIGNIFICANT REPORTS ISSUED

Doc. No.	Classification	Author	Date	Title
--	Conf.-Undoc.	RK Robinson	4-8-64	Phase II Reactor Parameters vs. Active Zone Pressure Drop
HW-81779	Confidential	RK Robinson	4-14-64	Revised Phase I Operating Limits and Predicted Operating Coolant Temperatures
--	Unclassified		4-3-64	NRD PACE Budget, FY 1965 (Rev.) and FY 1966
--	Unclassified	CL Buckner	4-27-64	NPR Completion Report (Draft)

Manager, N-Reactor Project

JS McMahon:mbs

N REACTOR PLANT OPERATION

N PROCESSING OPERATION

High temperature physics measurements at zero reactor power that were in progress at the start of the month were completed. This was the final part of the zero power physics testing program.

Following completion of the zero power physics testing program preparations began immediately for the start of the low power testing program which includes operation and testing of the plant up to a reactor power level of 400 MW. These preparations included the removal of process tube temporary strainers used to clean up the reactor primary coolant system, and the completion of the detailed plant master pre-startup check list.

Events of significance during this preparatory period were as follows: Special startup nuclear instrumentation was removed from 3 ball 3X channels. Two of the channels were placed in normal service and the third channel was set up as a test facility for the irradiation of graphite samples.

The temporary strainers installed in the front of each reactor fuel channel to trap particulate matter in the primary coolant system were removed following the completion of the zero power physics tests wherein flushing under high flow conditions at elevated temperatures was achieved. No unexpected amount or type of debris was present on the strainers.

The operational test of the secondary (steam generating) loop that started last month was completed. The revisions to the dump condensers and the surge tank to prevent steam-water hammering that were in progress at the end of March were completed during the month on four dump condensers and the surge tank and appear to have solved the problem.

At the end of the zero power hot physics tests a small amount of water was collected in the reactor gas system but the quantities were insignificant when compared to the amounts previously collected. At month end after several days of reactor operation under hot conditions no further evidence of water in the gas system has been revealed. It has been definitely concluded that the water collected previously originated from within the reactor concrete biological shield.

Installation of the three intermediate range nuclear flux chambers revealed them to be less sensitive than expected.
They were, however, considered to be adequate for normal usage. One of the chambers was damaged during installation and was replaced with a temporary chamber until repair can be made.

The graphite cooling system was chemically cleaned to remove rust and scale and placed into normal operation during the month.

A special charge in one process tube was discharged at the end of the zero power testing program to retrieve the samples it contained. During this operation the temporary strainer in the front of the tube was mistakenly pushed through the tube. Because of the close fit between the strainer and the tube an examination of the front and rear portions of the tube with a borescope was made and revealed that no damage to the inner surface of the tube had occurred.

During reactor flux monitor calibrations a partial ball drop occurred when the safety circuit was broken following the completion of rod insertion. The drop which was initiated by the ball backup circuit to the rods should not have occurred since all rods were in when the safety circuit was broken. The trouble was traced to a circuit breaker in the ball backup circuit which failed to close due to faulty resistors in the rod counting circuit. Repairs were made and ball recovery was completed without incident.

On April 23 at 12:36 p.m. the reactor was brought to critical for initiation of the low power level testing program. Operation at month end was at a level of 250 MW during the course of increasing the level to 400 MW for the balance of the low level testing program.

During the operating period at month end six reactor scrams were experienced. One scram resulted in a ball 3X system trip. The cause of this trip was traced to incompletely soldered wire joints in the high level nuclear flux instruments that initiated the scram and caused the ball backup circuit to malfunction and drop the balls. Corrections were made to the instruments and ball recovery was completed without incident.

The turbo-generator surge governor is not operating properly and remains in unsatisfactory condition at month end despite tests and adjustments by vendor representatives. The machine operates satisfactorily and reliably for normal plant operating requirements but does not achieve its maximum rated output.

The relays being tested as possible replacements for the mercury wetted relays which failed in February are still under trial and are performing satisfactorily to date.

N PLANNING AND SCHEDULING

Starting April 8, a new technique for displaying the scheduled items of work for the 100-N plant was put into effect. This technique utilizes the graphic display rather than the previously used voucher cards and offers the added advantages of being more quickly observed and also shows the necessary restraints between jobs. During this reporting period, no new issues were made of the Integrated Sequence Schedule.

N MAINTENANCE OPERATION

The major Maintenance jobs during this period were:

1. Repaired the Grayloc coupling faces on 1537 process tube outlet.

2. Modified the lithium hydroxide piping in the 184 Bldg. per design change letter 394.

3. Replaced the rubber seat ring in the 66" butterfly valve at the discharge of #1 raw water pump - 181 Bldg.

4. Completed the modification of ball channel #60 to permit its use as a test channel (EMP 21).

5. Moved original batteries from 181 and 182 to 109 Bldg. and installed new batteries at 181 and 182. The battery chargers were also relocated at the 109 Bldg.

6. Replacement of the 15 KV cable to the four circulating raw water pumps at 181 Building was completed.

The support of operational tests and troubleshooting of the electrical and instrument systems absorbed the major portion of craftsmen's time. Additional effort was required to balance fans, correct valve problems, test and correct annunciators, and accomplish normal equipment preventative maintenance work.

NPR TESTING PROGRAM

During the month all operational tests which were considered to be essential prerequisites to the Low Power Testing Program (N-2) were completed and approved. Prior to power ascension testing must be completed on the Circulating Raw Water System, Heating and Ventilation Systems, Confinement System, Rupture Monitor System, 184 Turbine-Generator and Water Quality Sampling Systems. This work, as well as the cleanup of minor exceptions to completed tests, is now in progress as plant conditions permit.

Overall status of testing progress may be summarized as follows:

Total number of tests scheduled 39(1)

	This Month	Total
Scoped	--	39
Issued for Comment	--	39
Issued as Approved	(2)	38 + 1 partial
Tests Started	2	39
Tests Completed	5	28
Final Approval of Test Data & Results	13	37(3)

	Preparation		Performance(4)	
	Scheduled	Actual	Scheduled	Actual
This Month	100.0%	99.0%	97.8%	82.0%
Last Month	100.0	98.4	89.7	70.0
Net Change	--	0.6%	8.1%	12.0%

(1) Total includes N-1 and N-2 tests.
(2) N-2 Test consists of 38 steps which are being prepared and approved individually. Seventeen of these steps had been approved by month's end.
(3) Eleven of the 37 total are interim approvals for N-2.
(4) Excluding N-1 and N-2 tests, overall testing is now 90.1% complete.

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None

TRIPS

Name	Location	Date	Purpose
C. T. Hayner	Phoenix, Arizona	4/4-12	Discuss 3101 Equipment
H. A. Carlberg	Chicago, Illinois	4/13-18	Attend American Power Conference

VISITORS

J. A. Haaga	APED, San Jose	4/7-9	Consultation NPR Startup

INVENTIONS OR DISCOVERIES

All persons engaged in work that might reasonably be expected to result in inventions or discoveries advise that, to the best of their knowledge and belief, no inventions or discoveries were made in the course of their work during the period covered by this report. Such persons further advise that, for the period therein covered by this report, notebook records, if any kept in the course of their work have been examined for possible inventions or discoveries.

PERSONNEL

Additions	From	To	Date
D. W. Helton	CPD	Plant Maintenance	4/6/64
Deletions			
H. L. Kellison	Maintenance	CPD	4/6/64
D. A. LeCount	Maintenance	Temporary Assignment Complete	4/24/64

W M Mathis

Manager - N Reactor Plant

WM Mathis:ds

END

DATE FILMED

1/22/93