HW--80111

DE93 003506

N - REACTOR DEPARTMENT

MONTHLY REPORT

DECEMBER

1963

HANFORD ATOMIC PRODUCTS OPERATION

RICHLAND, WASHINGTON

GENERAL ELECTRIC

AEC-GE RICHLAND, WASH.

This document consists of 41 Pages, Co[redacted]

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N-REACTOR DEPARTMENT

MONTHLY REPORT -- DECEMBER 1963

Compiled by N-Reactor Department

January 7, 1964 - Richland, Washington

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

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N REACTOR FUELS

Production

During December 201 billets were extruded for a total tonnage of 37.7 representing 75 per cent of forecast. For calendar year to date for 1963, 2,545 billets were extruded for a total tonnage of 471.

Production fuel assemblies transferred to finished storage totaled 29.5 tons for December exceeding monthly forecast by 47 per cent. Calendar year-to-date production at the end of December totaled 365.5 tons.

Uranium utilization for the month of December was 57 per cent for outer fuels and 77 per cent for inner with a combined total of 63 per cent. Calendar year to date over-all uranium utilization was 66 per cent for all .947 fuels.

At year end, 95 per cent of the first load requirements for .947 enriched fuel had been completed. The balance of the material required will be completed during the month of January. Deliveries to the reactor site constituted 40 per cent of the total first load fuel needs, and the balance of these requirements will be delivered as rapidly as it can be handled at the reactor site.

Plant Problems & Achievements

Major problems of process during the month of December were: (1) the dimpling of the ID clad on NOE fuels which has resulted in a 15 per cent rejection rate; (2) those fuels associated with new beveled end caps. This process was started on December 2, and the weld blow-out reject rate is high; 20 to 30 per cent of the pieces are currently being held for braze contamination. Further study of these two problems is required.

All autoclaves and associated pressure tanks were inspected internally and externally by an insurance agency pressure vessel inspector. Results of the inspection were fully satisfactory and allowed continued use of the autoclave facility.

During December document HW-79772, "Plant Capability," was issued. This report covers production capabilities and requirements of the N Reactor Fuels co-extrusion process.

Engineering Activities

A metal quality problem has occurred at NLO during December. The first 500 series billets which were produced in November were rejected due to severe pitting which became visible after machining. The process was then converted back to the 300 series metal. As a result of a shortage of re-melt scrap, the initial 300 series castings were made using 3 and 4 derbies per charge. About 50 per cent of the first 300 series ingots were below the minimum carbon specifications. A change in the charge make-up has been made, and the current castings meet the carbon specifications.

As a result of a test run of production material which varied the front and rear end defect length, the standard end defect losses have been shortened by six inches permitting better utilization of the extrusion.

Over 800 fuel elements were processed through the alpha counter to determine the extent of uranium contamination in the end cap braze of those elements designated as category 2 through examination of autoradiography films.

RESEARCH & ENGINEERING

A recent study (HW-79913) indicates that up to 304 Kg of plutonium containing 15 per cent Pu-240 could be produced by the N Reactor during FY 1966 at power levels of 4000 MW and average exposures of 2100 MWD/T. Only nominal capital expenditures for special handling equipment would be needed to support this mode of operation. By 1968, if technological progress provided for the extension of the average exposures to 3000 MWD/T at a reactor rating of 4800 MW, the annual production of plutonium containing 15 per cent Pu-240 would be 953 Kg at a unit cost of $21.55.

A study (HW-80173) was completed which evaluates the capability of the N Reactor in the production of Po-210 from irradiations of Bi-209.

A preliminary study (HW-79982) of the single tube fuel design for N Reactor was issued.

The UO_2 crud monitor fuel elements were discharged from KER Loop #1 at an exposure of 4000 MWD/T. Little evidence of film deposition was observed.

Prototype lithium-aluminum fuel elements were discharged from KER Loop #2. Analyses carried out in the Radiometallurgy facility on previously discharged fuels of this type indicate that the gas volume ratio (GVR) exposure for these fuels was about 35. This indicates that the actual rate of exposure was twice that originally predicted.

Irradiation testing of the "first load" fuel element assemblies is continuing successfully in KER Loops #3 and #4. Exposure reached by the four charges range from 1250 MWD/T to 1866 MWD/T.

A seizure of one of the inboard seals of the No. 2 Primary Pump occurred during a high velocity flush of the primary pumping. The cause of this seizure has been determined and corrective actions to prevent further seizures have been taken.

Calculations of the flow-pressure drop relationships for the entire raw water circulating system were made using design data. This confirmed earlier analyses and indicated the necessity of throttling the dump condenser flow to achieve proper pump operation and to suppress boiling in the dump condenser tubes.

Work on the monitoring system for the process tubes is proceeding on schedule, and the revised specifications for the closed circuit TV equipment is being reviewed with the AEC.

Simulation studies of the primary system pressurizer have led to the establishment of optimum controller settings and other operating criteria for the pressurizer system.

A final test of the N Reactor rupture monitor has been initiated in the KER facility. During this test, a small amount of irradiated uranium will be dissolved in the primary coolant of KER Loop #2 for the purpose of checking the sensitivity of the rupture monitor.

All special preparations for fuel loading required of Research & Engineering (i.e., training and assignment of physics test crew, equipment, other personnel and documents) were completed on schedule to permit initiation of fuel loading on December 16, 1963.

N REACTOR PROJECT

Calculations of fuel melt-down time for a hot channel on loss of coolant have been made and compared with previous calculations made for an average central tube. The results have been summarized in a separate report.

The power calculator channels have been returned to the vendor for corrective modifications which are necessary to meet the requirements of the specifications.

Corrective measures have been taken to overcome the problems of horizontal rod position indication. New drive chains have been ordered which will permit utilization of a hold-down shoe to prevent disengagement of the position indicator sprocket at scram speeds. Also, new multi-turn potentiometers have been ordered with an additional turn to reduce the risk of being overdriven.

Special inlet strainers have been developed for protection of loaded process tubes during physics testing.

Construction work and testing was completed on necessary systems to permit start of fuel loading for the physics tests on December 16, 1963.

Hydrostatic testing of the secondary and primary systems in cell 3 were successfully completed.

Damage was noted in primary loop pump #2, and all pumps have been disassembled for inspection by vendor representatives.

Nineteen (19) operational tests (or portions thereof) required as prerequisites to fuel loading were completed and approved.

Repair of steam generator unit 3B by sleeving of the tube ends is now 100 per cent complete. Cell 3 piping is now being hydro-tested and cleaned, and cell

3 is scheduled to be placed in service before mid-January. Repair work on steam generator 4A is continuing. Temporary rigging and a crane are being installed in preparation for removal of the north head from the 4A secondary vessel early in January. Completion of unit 4A repair is scheduled for August 15, 1964.

Hydrostatic testing of all 105 primary loop instrument connections was completed.

N REACTOR PLANT

Initial fuel loading began December 16, 1963, the first tube being charged at 7:18 a.m. Criticality was achieved at 11:24 p.m. on December 31, 1963, with 348 tubes charged.

The boiler developed a tube leak on December 9, 1963. Inspection revealed the leak to be due to external corrosion and similar to the leaks experienced in December, 1962. The tube was plugged off, and boiler operation resumed on December 10, 1963.

Satisfactory bid responses on bulk hydrogen were received, and Commission approval of the contract has been obtained. Supply sources for all other essential materials have been established, and materials are being delivered.

Staffing of operation and maintenance shift crews was completed with few exceptions.

PERSONNEL STATISTICS

Number of employees as of November 30, 1963	606
Number of employees as of December 31, 1963	640

	Exempt	Nonexempt	Total
General	2	2	4
Finance	15	8	23
N Reactor Fuels	57	116	173
Research & Engineering	51	9	60
N Reactor Plant	62	202	264
N Reactor Project	90	26	116
TOTAL	277	363	640

Employment

	Exempt	Nonexempt	Total
Additions	7	31	38
Reductions	1	3	4
Net Additions	6	28	34

SAFETY & SECURITY

Days without a disabling injury	396
Hours worked without a disabling injury	1 205 172
Medical treatment injuries (December)	28

There were 3 security violations in the Department during December, 1963.

SUGGESTION PLAN PARTICIPATION

	December	Year-to-Date
Number of eligible employees	363	283
Number of suggestions received	40	382
Number of suggestions acted upon	31	297
Number of suggestions adopted	12	126
Net Annual Savings	$4 317	$31 052
Amount of Awards	$ 540	$ 4 285
Per cent of awards to savings	12.5	13.8
Average Amount of Awards	$ 45.00	$ 34.00

PATENT SUMMARY - DECEMBER, 1963

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 December. 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: skd

[redacted]

N-REACTOR FUELS OPERATION
DECEMBER 1963

I. PRODUCTION STATISTICS

	Current Month	CYTD
1. Input (extrusions)		
.947% Enriched Outer	158	1436
.947% Enriched Inner	27	1014
Natural Uranium Outer	0	62
Natural Uranium Inner	16	33
Total Extrusions	201	2545
Total Tons	37.7	471
% of Forecast	75%	---
2. Output (finished production)		
Assemblies, .947% Enriched 24"	504	14,724
18"	288	2,808
12"	216	972
Natural 20"	648*	648
Outer Tubes, 1.25% Enriched 26"	88*	88
Tons .947% Enriched	16.8	352.8
Natural U	11.3	11.3
1.25% Enriched	1.4	1.4
Total Tons	29.5	365.5
% of Forecast	147	---
3. Uranium Utilization		
.947% Enriched Outer	57%	---
Inner	77	---
Over-all	63%	66%
Natural Uranium	59%	59%
1.25 Enriched	60%	60%

* Partially completed fuels provided specifically for startup testing. This material contains some reject fuel which will be removed when final testing is complete.

4. Production Comments

Commencing with this report, statistics on uranium utilization will be reported replacing former statistics of Shop Yield. This measure which is based on an analysis of input, in-process

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inventory, and output has the distinct advantage of timeliness, whereas the analysis of yield by extrusion is not available for two or three months after actual extrusion.

At year end, 95 per cent of the first load requirements for .947% enriched fuel had been completed. The balance of the material required will be completed during the month of January. Deliveries to the reactor site constituted 40 per cent of the total first load fuel needs. The balance of the requirements will be delivered as rapidly as it can be handled at the reactor site.

The forecast production schedule called for natural uranium extrusions for the entire month of December. A total of 185 outer and 135 inner billets (57 tons) had been received for this production program. Approximately 12 tons of tube assemblies were to be used in the initial startup testing of N-Reactor. This, plus an additional 15 tons of assemblies were then to be held in storage as a contingency, should the reactor testing indicate a need for the material to compensate for an excess of reactivity. The material required for testing was extruded in late November and early December and the unautoclaved assemblies delivered to N-Reactor in mid-December. The extrusion of the balance of the natural uranium was delayed and .94% enrichment substituted to provide material for additional assurance of meeting the first load requirements for regular enriched fuel. Remaining 220 natural uranium billets in storage will not be extruded at this time unless the reactor testing data indicate a definite need for the material.

II. SHOP ACTIVITIES

1. Problems and Incidents

During the last three weeks of the month the emphasis placed on expediting material for the first load resulted in material shortages at some stations and a reduction in operating efficiencies. This condition will be alleviated in January.

Dimpling of the ID clad on NOE fuels has resulted in a 15 per cent rejection rate. The fuels that show dimples at pre-mill inspection are clad and bond tested before chem milling and the pieces which show excessive clad variation are rejected at this time.

The new bevelled end caps were started at braze on December 2. The weld blowout reject rate is high and 20 to 30 per cent of the pieces are being held for braze contamination. Study of this problem is continuing.

A pilot pressure line on the press which operates at 750 psi failed. This line has failed several times in the past and several expansion loops were incorporated into the tube and a compression type fitting installed four months ago in an effort to eliminate the problem. An Engineering study is being conducted to arrive at a satisfactory solution.

On December 3, 1963, a cylinder of 1.25% enriched uranium entered the 333 Building without notification to the Shop Manager. A formal review conducted by Quality Control determined that no nuclear safety violation had occurred.

Segregation of the uranium-contaminated brazes continued with alpha counting 50 per cent complete at month end.

2. Achievements

On December 2, 1963, document HW-79772, "Plant Capability," was issued. This report covered the production capabilities and requirements of the N-Reactor Fuels coextrusion process. The report will be used as the basis for new and modified equipment requirements and the development of optimum process flow and plant layout.

Inspection of all extrusion press hydraulic piping was completed. Numerous small oil leaks were found during inspection of the pit area under the press and some pipe supports were dislocated due to vibration. All of these items were corrected.

The ultrasonic testing for cracks in autoclave main nuts and lids was completed December 13, 1963. No flaws were found. This test has been established on an 18-month routine.

All autoclaves and associated pressure tanks were inspected by an insurance agency pressure vessel inspector. All 12 autoclaves were inspected internally and two externally. Results of the inspection were fully satisfactory and allow continued use of the autoclave facility.

The first report on Quality Costs was issued which covers third quarter CY-1963. Prevention costs were 5.3 per cent of Conversion Cost, Appraisal Costs, 12.5 per cent, and Internal Failure Costs were 18 per cent. Total Quality Costs were 33.8 per cent of Conversion Cost.

Primary equipment modification and maintenance activities completed during December are as follows:

1. Cut-off saw conveyor installed to eliminate contamination problem with first run material.

2. Ultrasonic test equipment and associated services in 306 Pilot Plant relocated. Relocation of sonic welder feed and unload conveyor system completed.

3. The extrusion press container undertemperature control system has been installed and is working properly.

4. Non-skid pads were installed on the east side of the support annealing area and covers were installed on the quench tanks to prevent contaminants (aquadag, soot, etc.) from getting into the tanks.

5. An air hose was installed at the fuel element dryer in the nondestructive tester area to blow excess water out of the fuels prior to the drying and vacu-blast operations.

III. ENGINEERING ACTIVITIES

1. Materials

Evaluation of Category I Locking Clip Material. All attempts to produce a uranium contaminated or otherwise rupture-prone locking clip weld by reproducing Category I welding conditions have been unsuccessful when fuels of normal clad thickness and bond integrity were used. One weld has been made directly over a natural unbond area with no detectable disturbance of the uranium-Zircaloy interface. Welds made on thin clad fuels are currently being evaluated.

Billet Fabrication. A metal quality problem occurred at NLO during December. The first 500 series billets (produced in November) were rejected due to surface pits which became visible after machining. When pitting was detected, the process was converted back to 300 series metal. Due to a shortage of remelt scrap, the initial 300 series castings were made using three and four derbies per charge. Twenty-four of the first 47 300 series ingots were below the minimum carbon specification, with the balance in specification, but 150 to 200 ppm below normal carbon level. A change in charge make-up has been made and current castings are meeting the carbon specification. The pitting problem, although less severe, is present in all the 300 series metal.

Extrusion Bonding. Two billets, one each with one-half and one-quarter inch front end plates, were upset, stalled, and sectioned to check differences in metal flow characteristics. On both extrusions the inner copper component buckled into the core just below the ID weld. The effect was more pronounced on the one-quarter inch end plate. The one-quarter inch billet had voids on both sides of the copper spacer rings which were not found on the one-half inch billet.

Samples of good extrusion bonds have been prepared for electron micrographic examination by HL in an attempt to measure the diffusion zone established by the extrusion process.

Design of copper nose cones for normal production extrusions has been completed and will be used in the event of an unbond problem with the one-half inch end plate billet design.

Reduce End Defect Losses. During the test run of production NIT normal extrusions, the length of the front and rear end defects was varied to determine if additional material could be obtained from present production extrusions. Twenty pieces were cut from five extrusions leaving a 46-inch rear defect and 44-inch front defect. Twenty-one fuels were cut from three extrusions leaving a 36-inch rear defect and a 31 to 34-inch front defect. Twenty-one pieces were cut from 24 extrusions using a 40-inch rear defect and a 27 to 30-inch front defect. As a result of the high rate of additional acceptable fuels obtained from these test runs the standard end defect losses have been shortened by six inches.

Optimize the Braze Closure Process. During December the over-all braze reject rate and the braze contamination rate both increased substantially. These increases coincide with the introduction of the bevelled cap into production. Although an intensive investigation is under way, no cause (other than cap design) has been determined.

Outer Support Improvement. Two columns of support deflection test fuels were charged into and discharged from N-Reactor process tubes early in December. The purpose of the testing was to insure that reactor loading would be accomplished under conditions reasonably similar to those encountered during testing in the 300 Area. The tests were considered successful. It is planned that ten additional columns of fuel will be monitored after the reactor physics testing.

The carbon steel tee cross member which had been fabricated for stiffening supports was used successfully by the final assembly unit on approximately 700 non-autoclaved fuels. These fuels are to be shipped to the reactor area, used for a short time, and returned. Testing of this part has not been completed this month as had originally been planned due to conflicts with other work.

Chevron End Closure Development (Driver Tube). Two types of end caps for a bonded 90° chevron end closure were fabricated and tested on .95 enriched driver fuels. One type of cap was similar to that used in the unbonded

chevron closure except the shoulder was eliminated to give a flat sided cap. The shoulder feature, which is standard with current production cap, is necessary to give a wide braze and to center the cap in the end recess. The shoulder was eliminated with the chevron design with the expectation that the recess would adequately center the cap. In the fuels brazed this proved to be true. However, additional tests will be necessary to conclusively establish design adequacy in this respect.

Single Tube and Target Fabrication Development. Two sleeved driver tube extrusions have been processed through the nondestructive testers to evaluate clad thickness and variation. Clad variation on both extrusions was excellent with the worst fuel having an inner clad variation of nine mils and an outer clad variation of five mils. The majority of the fuels had an inner clad variation of five mils or less and an outer clad variation of three mils or less. Four 4-inch samples of extrusion X-110 were beta heat treated and dimensionally checked. Assuming .0025 inch of clad material will be lost in processing, the die size is found to be correct and the mandrel size only .006 inch oversize. A metallurgical sample was removed from the center of each of the beta heat treated tubes and the uranium-to-uranium bond examined. On all four samples, recrystallization extended across the bond line and no evidence of cracking was found. A report (HW-80198) has been issued more completely outlining the results of these extrusions.

2. Routine Process Control and Improvement

Dimple Defects. During the week of December 20, dimple rejects increased, to as much as 50 per cent. Drag marks on the ID of the fuels preceding the dimples indicated a lubrication problem. Starting December 20, billets were inspected just prior to extrusion, as extruded, and as copper stripped. At month end no conclusions as to positive causes had been established and tests are continuing.

3. Equipment and Maintenance Engineering Activities

Project CAF-954, High Pressure Bonding. The Construction Completion and Cost Closing Statement was issued by N-RD Financial on December 4, 1963. The $4,633 spent on preliminary design was charged to the Abandoned Projects Account. Project CAF-954 is now complete.

Autoclave Preheater Over-Temperature Control. Over-temperature controllers were installed in the power contactor circuits for all autoclaves as were over-temperature alarm lights. All of the preheater power control contactors were carefully examined. Their contacts were found to be in good condition.

Support and Locking Clip Welders, 306 Building. The new self-aligning electrode was installed in the support welder. Drawings for the locking clip electrode and a newly designed electrode holder are being fabricated.

4. General Equipment Support

Extrusion Press. The 75 HP pump driver motor experienced bearing over-heating trouble. Ball race was badly pitted. This may be due to shaft currents being grounded through the anti-friction bearings. If this type of failure is repeated, a set of shaft grounding brushes will be installed on each motor.

IV. NON-DESTRUCTIVE TESTING ACTIVITIES

Braze Station Operation

Work was continued on an X-ray fluorescence tester for braze layer uranium contamination with the aim of determining the extent to which the technique is capable of detecting small amounts of uranium alloyed with zirconium. An investigation of the fluorescence detection process revealed that the characteristic fluorescent peak from the uranium was being swamped by primary radiation. Adequate shielding of the detection crystal and the photo-bultiplier tube reduced the background counts and enable the fluorescent peak to be detected. The results of the tests to date indicate that an alloy concentration of 1000 ppm could be detected under optimum conditions and that a level of 5000 ppm could be discernible on a routine basis. Mechanical equipment has been designed and is being built to localize the X-ray beam collimation at the braze area to eliminate errors from fuel geometry.

Support and Clip Welding

Manual ultrasonic mapping of locking clip welds has disclosed that to obtain a positive test the clip surface must be machined smooth and even. On a small sampling, 10-15 mils of the clip surface was removed by turning in a lathe. The results of the ultrasonic test were very good and provided the desired check on possible penetrations and in addition gave information on weld size and shape and on clad unbonds in the vicinity of the clip. A memoscope was used to obtain a "map" of the weld and it has some potential for semi-automatic operation. A box of machined fuel elements will be tested manually to see how far this test should be pursued.

Alpha Surface Contamination Testers

Over 800 fuel elements were processed through the alpha counters to determine the extent of uranium contamination in the end cap braze of those elements designated as Category II by examination of autoradiograph films. Full time technical assistance has helped make the early classification possible. In addition, a second tester was modified by adding a second in-line, end cap testing head, permitting two elements at a time to be measured. As test experience has been gained, improvements in the accuracy of the testers has been undertaken. MERCY runs have indicated that the accuracy between tests in the same test head was good, but there is a bias between test heads. It is felt a large part of such bias arises from the planchets used for calibration and alloy standards are currently being fabricated.

Eight fuel elements (both ends) were neutron activated with the fission particles captured in mica. Etching and photographing of the fission tracks has been done, and density measurements are being made. The results will be used to correlate with alpha counting data to verify concentration factors.

Ultrasonic Detection of Hydriding in Zircaloy Process Tubes

Further work on the ultrasonic test confirmed previous results. Ten low temperature burst test specimens have been checked with good burst test and metallographic correlation. A 180 ppm hydride sample gave no discernible ultrasonic signals; however, a 250 ppm hydriding was ultrasonically detected. It appears the limiting resistivity is about 200 ppm. A problem with tube geometry was encountered in one tube containing localized wall thinning extending down the length of the tube. A series of samples is being checked to determine the seriousness of the problem. Circuitry can be added to subtract wall thickness changes.

N-REACTOR FUELS OPERATION
DECEMBER 1963

TRIPS

Name	Company	Contact	Date	Purpose
WR Krehbiel	Wah Chang Albany, Oregon	R. Graham S. Yih	12/2/63	Vendor Certification Plans.
	Nuclear Metals, Inc. Concord, Mass.	L. Klein W. Tuffin P. Loewenstein A. Gilman H. Sawyer	12/3 and 12/4/63	Braze ring specifications.
	G.E. Crotonville, N.Y.		12/5 and 12/6/63	Quality Control Managers' Conference

VISITORS

J. King P. E. Tade	Sciaky Brothers Chicago, Illinois Sciaky Brothers Los Angeles, Calif.	TB Correy	12/10/63	Discuss electron beam, TIG, and MIG welding.

ORGANIZATION AND PERSONNEL

	11/30/63	12/31/63
Exempt	54	57
Nonexempt	113	116
Total	167	173

Tech Grads Assigned to N-Reactor Fuels = 1

Additions

Name	From	To	Effective Date
Hoke, Sydwana (Nonexempt)		Support Services	12/30/63
Boehrs, GL (MTP)	MTP Program	Support Services	12/30/63
Emmer, RA (Nonexempt)	IPD	N-Fuels Engineering	12/9/63
Scott, WM (Exempt)	Tech Grad Program	Permanent assignment in N-Fuels Engineering	12/1/63

Additions (Continued)

Name	From	To	Effective Date
Nielsen, RL (MTP)	Educational Leave of Absence	Quality Control	12/13/63
Helgeson, WH (Nonexempt)	CPD	N-Fuels Engineering	12/2/63

INVENTIONS

All 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 December, 1963. 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.

SIGNIFICANT REPORTS

HW Number	Classification	Author	Date	Title
HW-79831	Confidential	JW Nickolaus	12/5/63	N-Fuels Engineering Programs.
HW-79927	Confidential	CH Shaw RG Curran	12/10/63	Preliminary Coextrusio Billet Design for NPR Co-Product Driver Tube Fuel Elements.
HW-78979	Confidential	TB Correy	12/10/63	Closure Welds for a Proposed Aluminum Cladding Process.
HW-80198	Confidential	RG Curran	12/30/63	Prototype Driver Tube Extrusions with Sleeved Billets.
HW-80221	Confidential	WA Hendricksen	12/31/63	Interim Report No. 1 - Status of the Fabrication Process for Target Elements for the Co-Product Assemblies.
HW-79772	Confidential	HL Sterling CJ Volmer	12/2/63	Plant Capability

[redacted]

SECURITY

There was one security violation in the N-Reactor Fuels Operation during December. Total CYTD - 10.

Manager, N-Reactor Fuels

LM Loeb:mf

RESEARCH AND ENGINEERING

1. ADVANCE TECHNOLOGY

A study (Reference 1) indicating the quantity of plutonium with high Pu-240 content that might be generated as a function of exposure in N-Reactor was completed. The study indicates that the N-Reactor at a power level of 4000 Mw and fuel exposure of 2100 MWD/T could produce up to 304 kg plutonium containing 15 per cent Pu-240 in FY-1966 with only nominal expenditures for special handling tools needed to accomplish the separation of the inner and outer tubes of selected fuel elements. If by 1968 technological progress permits extending the average exposure to 3000 MWD/T at a reactor rating of 4800 Mw, the annual production of plutonium containing 15 per cent Pu-240 would be 953 kg at a unit cost of $21.55. Further increase in the per cent of Pu-240 contained in the plutonium could be realized by separation and segregation of this material. This study has been forwarded to the AEC-RLOO.

2. REACTOR ENGINEERING

Work continued on modification of the 189-D test loop to prepare for the proposed transient testing program. Initial tests in this series will start about mid-January with priority being placed on tests to determine transient conditions within the process tube during conversion to emergency cooling incidents.

A seizure of one of the inboard seals of the No. 2 Primary Pump occurred on December 12, 1963. This seizure occurred after operation of the pump for about two hours as part of the high velocity flush of the primary piping. The cause of this seizure and corrective actions necessary to prevent further seizures have been studied by a Task Force, including members of Reactor Engineering Subsection. Actions recommended by the Task Force have included the following:

1. Disassemble, inspect and clean all pumps before further operation. (This has now been done. Pump No. 5 was also found to have suffered considerable galling and scarring in the shaft seal area. Damage to mechanical seals was found on several pumps.)

2. Thoroughly flush and clean all seal water injection lines. (This is being carried out.)

3. Install strainers and appropriate valves and instrumentation on all seal water injection lines. (A temporary installation of 600 lb. flanged strainers is being installed. Permanent

900 lb. strainers will be installed prior to low level nuclear operation.

4. Clean all lubrication oil and lubrication systems. (Procedures for this cleaning are being prepared.)

5. Provide technical bases for all future operation of the pumps and seal water system. (This is being done.)

6. Review and coordinate the shaft repair and re-installation program.

The current schedule is to have three pumps reassembled and operational by January 12 1964.

A calculation of the flow-pressure drop relationship for the entire Circulating Raw Water System was made using design data. This study showed that all major components can be adequately supplied with all system valves fully open during 4-pump operation. However, at all but the lowest river level conditions (high static head), the total head is considerably lower than what is needed for optimum river pump efficiency and would require the pumps to operate in a high flow-low head regime not covered by the manufacturer's characteristic curve. This confirms earlier studies which indicated the necessity of throttling the dump condenser flow to achieve proper pump operation and suppress boiling in the dump condenser tubes.

A report (Reference 2) has been issued to supply information pertinent to the successful completion of the vibration tests to be made on the NPR primary piping system.

The portable vibration equipment ordered by the Process Design Subsection has arrived and is in operating condition. The equipment includes a Raydata vibration analyzer and 12 Endevco accelerometers.

Equipment Laboratory and Testing, IPD, has been requested to perform Design Test 1204, "Effects of Thermal Insulation on Response Characteristics of Vibration Tests for 100-N Primary Piping System." The test equipment has been fabricated and the design test program is scheduled to start January 6, 1964.

Technical discussions were held in Los Angeles with Endevco Corp., Microdot, Inc., and Byron Jackson on December 26 through December 28. The results of these discussions are as follows:

a) A vibration measuring system was developed that will meet the operational test program requirements and also will be adequate for any future vibration monitoring program.

b) Helpful information was obtained regarding a long range vibration monitoring program for the primary pumps.

c) Recommendations are now being made for the purchase of instrumentation components necessary for the successful completion of the vibration testing program.

A meeting was held to help determine the feasibility of a long-range nondestructive test program that might determine whether any cracks or wall thinning are occurring in the high stress areas of the primary coolant piping. L. J. Chockie, Physical Testing, Hanford Laboratories, agreed to make a study of the proposal and present the results of his findings to Reactor Engineering.

Installation of strain gages has been completed and preliminary readings are being made. Some of the gages installed, however, were damaged by personnel working on the primary piping system. Fifty additional strain gages are being procurred to replace damaged gages and to add a few test locations to the strain gage program.

3. REACTOR PHYSICS

The fuel elements for the cold test of lattice parameters and spectral indices have been completed and the fuel elements for the hot test have been assembled, but not yet welded.

A preliminary study (Reference 3) of the single fuel design for N Reactor was issued.

The work to date done by Hanford Laboratories personnel on the Pu fuel study for N-Reactor has consisted of lattice cell calculations of k_{∞} for various fuel arrangements. Some fuel burn-up calculations were done, but further refinements will be necessary. Accurate burn-up data for Pu fuels is difficult to calculate due to continuous changes in the neutron flux spectrum and effective cross sections during the burn-up period. Burn-up calculations to date have assumed constant effective cross sections and constant power density. Some calculations of the change in k_{∞} with temperature have been done, but are not firm enough to be considered reliable. Some of the calculated temperature swings were very large.

The fuel geometries used in the calculations were tube-in-tube PuO_2-UO_2 oxide element, a single tube PuU metallic element with an inert flow splitter and elements consisting of PuAl drivers, either inside or outside of LiAl target elements. The least favorable case from the viewpoint of reactivity lifetime, seems to be the case in which the LiAl target is outside of the PuAl driver.

Simple cases involving fixed flux irradiation which can be checked against hand calculations have been run to provide experience with the Meleager Burn-up code. These cases involve conversion of Np^{237} to Pu^{238} and the results obtained are fairly close to hand calculated values.

A study (Reference 4) analogous to the one on the production of Pu^{238} from irradiation of Np^{237} has been completed for the production of Po^{210} from the irradiation of Bi^{209}.

Work is under way to obtain estimates of the isotopic composition of Pu and the production of Cm as a function of long-term irradiation.

The PUBO (Pu burn-up) code of R. O. Gumprecht (IPD) being used for this work solves the equations for nuclear concentrations as a function of irradiation but makes no allowances for changes in effective cross sections.

A report (Reference 5) summarizing the new work in physics which has been done during 1963 has been written.

4. CONTROLS, INSTRUMENTS AND SYSTEMS ANALYSIS

Because of the experimental nature of the process tube monitoring equipment, funding from R&D is planned. The specification for the closed circuit TV system used in the monitoring equipment has been submitted to the Atomic Energy Commission and their comments received. A meeting is scheduled with the AEC to resolve any remaining questions so that the specifications can be released for bid. The target date for delivery of the system is July 15, 1964. R&D work on the following components is continuing on schedule; ultrasonic hydride probe (by NRD Fuels Section), eddy current hydride probe (by Hanford Laboratories), push rod drive unit design, TV camera front end assembly.

Inputs for the Reactor Information File System (RIF) have been defined. The general output formats for the listing of process variables for the reactor components have been established. The numeric coding of the variables for the reactor components have been established. This is about 75% complete. Where possible the N-Planning and Scheduling Systems (NPS) is being utilized to make both systems compatible.

The following conclusions and recommendations were reached from simulation studies of the primary system pressurizer:

1. The addition of rate action to the level control system greatly diminishes pressure peaking in the pressurizer following a scram.

2. The recommended controller settings are:

   a) Proportional plus reset controller - Gain 1.0
      Reset 4.0 repeats/min.

   b) Proportional plus rate controller - Gain 1.0
      Rate Time 0.0 min.

3. To prevent draining of the pressurizer under maximum bleed conditions, the extremely low pressurizer liquid level scram setpoint should be at 8'6" above the 0'0" reference.

Burst testing of fuel rupture monitor sample chambers has been completed on three chambers after a twenty-cycle flush of decontamination chemicals. They burst at greater than 6800 psig in a longitudinal split with no welds failing. Preparation of the final report is in progress.

Operational Test Procedure T0030, Fuel Rupture Monitor System, was issued and the fabrication and installation of 72 radioactive test sources will be completed in early January.

Approval for making the final rupture monitor test at 100-KE has been obtained. During this test a small amount of irradiated bare uranium will be dissolved in the primary coolant of KER Loop 2 for the purpose of checking the sensitivity of the NPR rupture monitor.

The joint study with Chemistry and Metallurgy regarding the effects of uranium contamination of fuel elements on fuel rupture monitor system performance is continuing. Measurements have been made of the amount and location of the contamination, corrosion rates have been estimated from past performance, and preliminary calculations have been made on fission product burdens to be expected as a result of the contamination. Recommendations have been made to load contaminated elements so that their effect on sample background can be determined by the rupture monitor system. The background of samples from process tubes containing the contaminated elements can be compared with the background data from process tubes loaded with normal fuel.

5. CHEMISTRY AND METALLURGY

The UO_2 fueled crud monitors and NIE-1 heater elements were discharged from KER Loop 1 on December 22 when the crud monitor reached goal exposure (4000 MWD/T). Little evidence of crud deposition was observed. A new test was charged December 22. This consisted of two UO_2 fueled, stainless steel crud monitors with internal thermocouples and with Zr-2 sleeves over the cladding, two similar crud monitors without thermocouples and without Zr-2 sleeves and four NIE-1 heater elements.

The irradiation of the prototype lithium-aluminum target elements continued in KER Loop No. 2 until December 22. Goal exposure was a gas volume ratio (GVR) of 20 and discharge was scheduled for mid-January. Examination of the first target element test in the Radiometallurgy Laboratory has been under way. Determination of the exposure level was made by gas extraction and by Li-6 burnup analysis. The results indicated that the rate of accumulation of exposure was nearly twice that originally predicted. Accordingly, the test in KER-2 was discharged short of the calendar goal but in excess of the exposure goal. The GVR is now estimated to be about 35 rather than 18. The heater elements, standard NIE-1 elements with brazed closures, had reached an exposure of 2000 MWD/T.

Irradiation testing of first load fuel element assemblies is continuing in the KER No. 3 and No. 4 loops. The first two charges that were completed reached average exposures of 1250 and 1815 MWD/T. As of January 2, 1964 the third charge reached an exposure of 1856 MWD/T, and the fourth charge reached 1366 MWD/T.

6. PROCESS EVALUATION AND CONTROL

The following Process Change Authorizations were issued during December:

4-63 "Quality of Fill Water for Primary Loop,"
5-63 "Loading up to 48 Columns of Fuel,"
6-63 "Rod Cooling Water Time Setting,"
7-63 "Initial Fuel Loading,"
8-63 "Number of Diesel-Driven Pumps Required to be Serviceable,"
9-63 "Automatic Ball Backup Bypass,"
10-63 "Source Removal."

All special preparations for fuel loading required of the physics startup crew (i.e., equipment, personnel and documents) were completed in time to permit initiation of fuel loading on December 14, 1963.

The first fuel was charged on December 16, 1963.

The reactor achieved criticality at 11:24 p. m. December 31, 1963.

SIGNIFICANT REPORTS ISSUED

HW-79913 "The Production of Plutonium with High Pu-240 Content in N-Reactor," J. M. Bird, E. G. Pierick, J. W. Riches - December 9, 1963 Secret

HW-80028 "Technical Criteria for Co-Producer Fuel Demonstration Loading," T. W. Evans, E. G. Pierick, R. J. Shields, R. H. Shoemaker December 16, 1963 Secret

HW-79980 "Monthly Technical Report - November 1963 - Reactor Physics," P. F. Nichols and Reactor Physics Staff - December 2, 1963

HW-79982 "Preliminary Study of Single Tube Fuel Designs for NPR," E. E. Mills - December 2, 1963

HW-79983 "Alternate Uses of Higher Enrichment Material in N-Reactor - Further Studies," R. J. Shields - December 6, 1963

HW-80015 "Physics Study of Po^{210} Production Capabilities in N-Reactor," R. A. Dieterich - November 18, 1963

HW-80120 "N-Reactor Physics - 1963; A Summary," P. F. Nichols - December 26, 1963

HW-77917 PT1 Supl "Startup Test N-1, Supplement No. 1, Modification to Physics Test Procedures," W. S. Nechodom - December 14, 1963

HW-77917 PT1 Sup2 "Startup Test N-1, Supplement No. 3, Evaluation of NPR Primary Shielding," J. Greenborg, December 16, 1963

TRIPS

Name	Destination	Date	Purpose
J. A. Mitchell	Los Angeles, Calif.	12/26-28	Endevco Corp. Microdot, Inc. Byron Jackson
Milton Lewis	Andrews Field, Md. Wright-Patterson Field,O	12/5-6	Diversification
R. E. Trumble D. L. Condotta M C. Leverett	GE-THC meeting San Jose, California	12/10-11	Presentations on N-Reactor testing program.

VISITORS

None

PERSONNEL

Dr. Milton Lewis transferred to N-Reactor Department as Manager, Chemistry and Metallurgy on December 1, 1963.

Three Technical Graduates were assigned to Process Evaluation and Control.

SECURITY VIOLATIONS

None

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 December, 1963. 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.

M. C. Leverett
Manager
Research and Engineering

MCL:LCC:dd

Ref. 1: HW-79913 "The Production of Plutonium with High Pu-240 Content in N-Reactor," J. M. Bird, E. G. Pierick, J. W. Riches, December 9, 1963

Ref. 2: HW-79705 "Vibration Measurements for NPR Primary Coolant Piping - 105-N and 109-N Buildings," J. A. Mitchell, November 25, 1963

Ref. 3: HW-79982 "Preliminary Study of Single Tube Fuel Designs for NPR," E. E. Mills, December 2, 1963

Ref. 4: HW-80173 "Utilization of Pu Fuel in N-Reactor - The Study To-Date," P. F. Nichols, E. E. Mills and R. A. Dieterich, December 26, 1963

Ref. 5: HW-80120 "N-Reactor Physics - 1963: A Summary," P. F. Nichols, December 26, 196

N-REACTOR PROJECT

PROCESS DESIGN OPERATION

Process Research and Development

Calculations of fuel meltdown time for a hot channel on loss of coolant have been made. These are similar to previous calculations made for an average central tube. With a distorted rod pattern, the meltdown time was determined to be 192 seconds. For a uniform rod distribution, the time was 222 seconds. Reducing the graphite temperature by 100F had a small effect, resulting in a 10-second extension of calculated meltdown time. A report summarizing this and previous work on loss of cooling was made available to the Atomic Energy Commission.

The ACRS has shown concern over the process tube flow distribution during an emergency cooling situation. Investigations have shown that improvements in earlier calculations can be made by a more thorough instrumentation of the high temperature dump tests scheduled for early March 1964. The flow rates recorded during the dump tests could be used to calibrate the calculations of the tests and subsequently to modify the calculations of the actual dump transients. The main items of additional test equipment that would be involved are differential pressure transducers and high speed recorders which are standard items but would require special attention in procurement to meet the scheduled testing dates. Currently the matter is being reviewed by management for compatibility with overall project objectives.

Conversion

Further transient analyses have been made of the effect of a double turbine-generator tripoff. In the case of four-loop operation and 110 psia steam pressure, the transient is slightly more severe than earlier cases examined, but it does not appear to be intolerable.

Project CAI-816

Power Calculator

Three primary loop calculator channels, the power set unit, and the two totalizer chassis have been removed and returned to the vendor's plant at San Leandro, California, for necessary modifications. The other three channels will be similarly returned. The modifications, which will be at Foxboro expense, are necessary to meet the requirements of the specifications. During initial calibration of the system, it was discovered that the vendor's calculations for specific heat had been erroneously based on inlet temperature rather than average temperature. The built-in temperature standards will be replaced in all channels including the graphite loop channel. Other circuit changes will also be made to improve long-term stability of the calculator. All modifications are planned to be completed by the middle of January 1964.

Horizontal Rod Drives

A problem of the rod position indicator sprockets slipping out of timing due to chain disengagement at scram speeds has developed and has caused considerable damage to the position transducers by overdriving them. Temporarily, the sprockets are being checked after every scram and reset if necessary. As a corrective measure, new drive chains (87 out of 174 total) have been ordered. They are identical to the existing chains being replaced except the new chains are furnished with a lug-type bent link on each pitch. The projecting lug will permit utilization of a newly designed hold-down shoe which will assure positive chain-to-sprocket engagement at all times. The multi-turn potentiometers used in the rod position transducer system are also being replaced by new units. These are identical to the existing potentiometers being replaced except the new units are furnished with one more turn as an extra margin of protection against being overdriven.

Process Tube Strainers

During high flow flush of the process unit in mid-December, fine mesh wire strainers were used in the outlet nozzles to entrap debris that was suspected to be in the primary loop from earlier recirculation runs. These strainers performed very well in retaining the suspected material. However, two of the strainers failed partially and presumably released some of the material that had been entrapped. Other indications were also noted which strengthened the feeling that additional foreign material was still present in the primary loop. A task force was formed to investigate the problem and provide a positive solution for protection of loaded process tubes during physics testing. The decision was made to use the existing mesh strainers at the outlet end of empty tubes and a more sturdily designed strainer at the inlet end of loaded tubes. A stacked disc-and-spacer strainer was subsequently designed, and three prototypes with spacers of 24, 20, and 18-gage material were fabricated and subjected to service and flow testing in the NPR-PCE Loop at 189-D. The flow characteristics were found to be essentially the same among the three types. Consequently, the more finely spaced, 24-gage strainer was selected because of its ability to entrap smaller debris. The length of the strainer was established at seven inches. To accommodate the strainer in the inlet nozzle, the last upstream fuel spacer will be shortened by four inches. This modification provides a nominal clearance of 1.35 inches between the strainer and the inlet nozzle plug. It also provides assurance that the downstream O-ring of the strainer will not enter the tapered portion of the nozzle leading to the rolled area. In the event that straining of individual tubes is continued into hot testing, it has been recommended that the inlet strainer be shortened by one inch to avoid interference with the nozzle cap plug at the higher temperatures. Also, the O-rings must be replaced with halogen-free silicone rubber suitable for the higher temperature service.

Charging Equipment

One hundred seventy-two modified magazine assemblies have been received with the concentric tapered magazine end replaced with an eccentric tapered

adapter and special piston combination. The magazine loader has been installed and the operational tests have been successfully completed. Minor changes, repairs, and adjustments have been made to the installed charging machine in order to make it operate as intended. Ten of the 28 vertical rows of magazine storage wall brackets have been properly grouted to the Work Area wall face. All six magazine support assemblies have been installed on the C-elevator and are operable. The inlet barrier wall decals, which are used for aligning the charging machine with the barrier wall penetrations, have been installed. The foregoing equipment has been successfully used in preliminary fuel loading for physics tests. The length of each dummy and fuel element column is recorded as the column is loaded into the magazine. So far, the measured column lengths have not varied from the nominal length by more than one-half inch.

Maintenance Tooling

Fabrication of a special nozzle cap wrench is in progress. The wrench is designed for bench mounting and will be used for assembly and disassembly of nozzle cap nut and plug.

An improved model of the clamp-on RTD cap tightening device has been developed. The weight has been reduced from approximately 20 pounds to 7 pounds or less. A 20-ft-lb input torque to this device produces a 110-ft-lb output torque.

A face-to-face mockup with a full-length graphite channel is being installed in the 189-D Laboratory. The mockup will be used in development of tooling, equipment, and techniques for process tube replacement and front and rear face maintenance.

Equipment Development and Testing

Of the three full-size 6-inch RV-2 primary relief valves that have been functionally tested in the NPR-PCE Loop at 189-D, two failed to close completely at various times after actuation. It is believed that the primary closure spring may be inadequate. The valves are being disassembled for an engineering examination to determine the cause of the malfunction and the measures to correct it.

A quench test was performed at the 189-D Laboratory on a test assembly made up of two rolled joints and a Grayloc coupling. The purpose of the test was to determine the ability of the joint to withstand a rapid quench such as it may see during the high temperature dump test. The joint withstood the quench with no indication of leakage at its completion.

The Long-Term Test Facility of the NPR-PCE Loop was reopened after having been valved off for a three-month period to determine the effect of water stagnation on the riding feet of fuel element spacers. No indication of corrosion was detected. Plans are now being made for prolonged flow tests that will incorporate periods of stagnation in an attempt to duplicate the conditions which had previously led to gross pitting of the riding feet of fuel element spacers removed from the No. 2 nozzle-to-tube test assembly in September 1963.

FIELD ENGINEERING OPERATION

Construction

105-N Building

The principal items of construction work were completed in the 105 Building by December 15, 1963 to permit fuel loading for the physics tests to start December 16, 1963.

The Ball Safety System modifications to the hoppers and probes were completed and the system was tested and is operational.

Installation of the charging equipment was completed, tested, and the system is now operational. Miscellaneous punch list work remains in grouting the wall bearing plates for the monotube storage racks.

Numerous minor modifications have been required on the irradiated metal handling equipment. Although testing has not started, the equipment is in operational status.

Construction activities in the 105 Building have been generally limited to miscellaneous punch list work since the physics test is in progress and essentially all instrument and other systems are operational.

All of the electrical sleeve and conduit seals for Zone I have been completed and external seals for Zone I confinement are approximately 92 per cent complete. The electrical sleeve and conduit seals for Zone II are 90 per cent complete.

The shielding doors are being installed for the valve racks in the Rupture Monitor System turret rooms.

The hydrostatic testing of instrument connections to the primary loop was completed.

109-N Building

Functional testing of the Bailey Meter 109 instrument control system has made good progress during this reporting period. The pressurizer level and injection pump control systems have been essentially completed and enough testing was completed on the graphite cooling system to permit its limited use during the physics tests.

Installation of strain gages on the primary loop piping has been completed.

Approximately 45 per cent of all the 793 valves in the various process systems have been tested for remote operation.

The flushing of the primary loop, including cells 1, 2, and 5, was completed. Primary loop pump #2 failed due to damage to the seal bushing. It has been disassembled for repairs and all other pumps are being disassembled for inspection by the vendor representative for possible damage.

Hydrostatic testing of the secondary and primary systems in cell 3 was successfully completed.

Conversion

The installation of piping in the existing 109 Building in preparation for the construction of the sixth cell addition has been in progress during most of December. To date, 12 tie-ins have been completed to existing service systems.

Work has also been started on the penetrations in the west wall of the existing 109 Building for the extension of lines and facilities into the sixth cell area.

The installation of cable and conduit has been in progress and the cable and conduit installation for the motor-operated valves which will be installed in the existing 109 pipe gallery is now nearly complete.

NPR Testing Program

During the report period, scoping of all scheduled test procedures was completed. Three additional procedures were issued as approved and actual testing of the following systems was initiated:

T0014 - Graphite and Primary Shield Cooling System
T0016 - Primary Coolant System
T0018 - Charge-Discharge System
T0045 - ERWS Cont. Inst. and Flow Tests
T0048 - Area Misc. Steam Supply and Condensate System
T0059 - Physics Test

In addition, final approval of test data and results was obtained for the 19 tests (or portions thereof) which were prerequisite to initiation of fuel loading.

Over-all status of testing progress may be summarized as follows:

Total number of tests scheduled -	39
Scoped	39
Issued for Comment	36
Issued as Approved	29
Tests Started	30
Tests Completed	9

	Preparation		Performance	
	Scheduled	Actual	Scheduled*	Actual
This Month	96.5%	85.3%	56.5%	27.5%
Last Month	93.6%	79.2%	29.0%	17.3%

*Scheduled performance based on 7-23-63 target schedule.

Steam Generators

Repair of steam generator unit 3B, which is affected by stress corrosion cracking in the tubes within the tube sheet area, is now complete. The repair was accomplished by installation of Incoloy sleeves in each tube end. All sleeves were rolled in place and seal-welded on the outer end. Construction work in cell 3, which was held up during the repair of steam generator unit 3B, is now being completed and cell 3 is scheduled to be placed in service by mid-January, 1964.

Steam generator unit 4A, which is affected by extensive intergranular corrosion throughout the stainless steel tube lengths, will be repaired by the replacement of the tube bundles. Inconel tubing will be used for replacement. A mill order has been placed for the tubing material, and the first deliveries have been promised by the end of April, 1964. All tube to tube sheet welds have been cut free on the primary side, and rigging and a monorail crane are now being installed for handling of the secondary vessel head upon removal. All existing tubing will then be stripped from the interior of the secondary vessel.

After installation of the new Inconel tubes, the secondary vessel head will be re-positioned, welded in place, and stress relieved. Completion of repair of steam generator unit 4A is scheduled for August 15, 1964.

N-PLANT ENGINEERING

Plant Assistance

During the first week of December, around-the-clock electrical engineering coverage was provided by N-Plant Engineering for completion of critical operational tests needed for fuel loading and subsequent physics tests. As expected, numerous problems were encountered but none by itself was insurmountable as far as proceeding safely on schedule. Some of the more significant problems are listed in the following:

Ball 3X

Manual trip of all hoppers was achieved early in the test program, and this function continued to work satisfactorily without failure thereafter. The more troublesome circuit function for which problems had to be identified and corrected was the ball backup system which functions in the event that certain horizontal control rods make slow entry into the reactor. Correction and verification of this control function was complicated in the main by requirements for relay calibration, wiring errors, and a time requirement of approximately four hours to set up and test the function. Satisfactory performance has since been obtained.

Horizontal Control Rods

Like the Ball 3X system, manual trip rod scram action was obtained early in the program and consistent scram function was demonstrated repeatedly and consistently thereafter. A serious inconvenience to the testing program resulted from general failure of the rod position transducers. This was caused by many occurrences of the rod drive chain disengaging from the position transducer sprocket thus allowing a shift in the mechanical linkage. This shift produced a linking effect whereby the mechanical travel stops in the transducer were exceeded thus demolishing the transducer thereafter. A stop gap measure was obtained by replacing the damaged transducers and maintaining alignment between the chain and the sprocket by visual inspection and correction as required. A modification to the chain-sprocket arrangement has been successfully developed in the laboratory and plans have been made for over-all modification of the 87 rod drives including installation of new transducers in all cases.

Although scram has been consistently good, rod control has been hampered electrically by the presence of stray voltage in the control circuits and faulty operation of control valves. Mechanical problems on the control valves, although frequent, have been repaired without great distress upon occurrence. The electrical problem of stray voltages has reoccurred; and at one time, extended the program by two days while the cause was traced to malfunctioning relay contacts and contact protectors. During this same episode, equipment grounds occurred to other critical control circuits and were resolved during that period. Tests have shown that the above mentioned mechanical

and electrical problems with the rod controls can be permanently corrected by elimination or modification of the equalizing valves. Study has been initiated to effect these changes and recommendations are forthcoming.

Further inconvenience to horizontal rod operation has resulted from excessive indicator light burn out. The incidence of light failure has been sharply reduced after installation of additional resistance in the respective light circuits.

No. 1 Safety Circuit

The most notable equipment difficulty in this area consisted of two separate occurrences whereby one of the master trip circuit breakers failed to trip on demand. These instances were traced to faulty linkage between the trip solenoid and the mechanical trip mechanism. The circuit breakers are used as master trip elements in both the No. 1 safety circuit and Ball 3X system. Modifications made to all circuit breakers involved have yielded consistently reliable operation thereafter. Two additional circuit breakers have been shipped from the factory as backup, and a modification and testing program has been planned for performance on arrival of this equipment.

Another problem encountered with this system was the occurrence of grounds on the d.c. power supply arrangement. Most of the grounds occurred in equipment cases, not in the wires. In all cases, tests showed that installed ground detector action promptly identified the condition thus permitting immediate correction.

Plans have been started for completion of test and acceptance of the remaining safety circuit functions for operation. The majority of the equipment not verified for operation includes heat dissipation system trips and numerous flux monitor trips required for startup and high level reactor operation.

Maintenance Standards

Preparation of critical equipment maintenance standards is estimated to be approximately 30 per cent complete. Progress toward submittal of these standards to the Commission has been hampered by the need for engineers who have been assigned to write the standards to assist instead with plant start-up problems. Greater emphasis must be given to this program in order to meet commitments.

Equipment Development

In order to meet minimum requirements for key maintenance tools during the next six months, a financial authorization has been given to Equipment Development Operation for development of the required designs and prototypes. Using the need to have capability for removal of an irradiated process tube from the reactor as a criteria for development, all supporting tools needed for that effort will be made available. Schedules, cost, and commitments have been documented accordingly.

PROGRAM EVALUATION

Design Status

Title I - 100 per cent complete.

Title II - 100 per cent complete.

Costs

No change during this reporting period.

Schedules

On February 1, 1963, RLOO-AEC issued Revision #5 to the Certified Construction Schedule. This schedule shows a construction completion of March 15, 1964.

The construction status as of January 1, 1964, based on Revision #5 to the AEC construction schedule dated February 1, 1963, is as follows:

	Scheduled	Actual
Temporary Construction	98	99.3
General Area Systems	99	99.9
105-N Reactor Building	98	99.6
109-N Heat Exchanger Building	98	99
163N-183N Water Treat. Facilities	100	100
181-N River Water Pump House	100	100
182-N High Lift Pump House	100	100
184-N Standby Power House	100	99.9
153-N Switchgear Building	100	100
NPR Project (CAI-816)	98	99.3

Revision 5 of the integrated sequence schedule was issued on December 20, 1963 to all parties concerned. This schedule displays the major items of remaining construction, contractor testing, operational testing, calibration, and operational and physics startup steps. The schedule was extended to detail the above items through low level power demonstration.

The target goals of early fuel loading were attained on December 16, 1963, the physics testing program was initiated, and criticality was reached at 11:24 p.m. on December 31, 1963.

RESPONSIBILITY

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

ORGANIZATION AND PERSONNEL

	11-30-63	12-31-63
Exempt		
Permanent	92	89
Tech. Grads.	3	1
Nonexempt	26	26

Personnel Changes

Name	From	To	Effective Date
JW McLaughlin (exempt)	Field Eng'g.	HLO	12-1-63
FR Mattison (exempt)	Field Eng'g.	N-Reactor Plant	12-30-63
TR Riggins (exempt)	Field Eng'g.	N-Reactor Plant	12-15-63

SAFETY AND SECURITY

There were no disabling injuries or security violations reported during December.

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 & Location	Date	Purpose
EM Kratz	Corps of Engineers Portland, Oregon	12-17-63	Review experience with admiralty tubing.

VISITORS

Name	Firm & Location	Date	Purpose
E Garvey	AMF Atomics Greenwich, Conn.	12-12 thru 12-17	Check out tests on irradiated metal handling system.

SIGNIFICANT REPORTS ISSUED

Doc. No.	Classification	Author	Date	Title
HW-79978	Secret	WJ Dowis, IMA Garcia	12-13-63	Uranium Cost and Price Schedules
HW-62150RD4	Confidential	RK Robinson	12-4-63	N-Reactor System Parameters
HW-78172RD2	Unclassified	JF Nesbitt	12-21-63	Design Criteria - Special Irradiated N-Reactor Metal Handling Facilities
HW-79791	Confidential	J Muraoka DD Stepnewski	12-4-63	NPR Fuel Melting Time Following Loss of Coolant
HW-80093	Unclassified	DD Stepnewski	12-19-63	Scope of Fog Spray Tests
HW-80097RD	Unclassified	JF Nesbitt	12-21-63	Design Criteria - Irradiated Fuel Examination Facility
HW-80179	Unclassified	JH Fastabend	12-27-63	Inlet Nozzle Strainer for N-Reactor.

Manager, N-Reactor Project

JS McMahon:mbs

N REACTOR PLANT OPERATION

N PLANNING AND SCHEDULING

The collector-accumulator equipment was received late in the month. This completes the principal equipment requirements for NPS. Installation is in progress.

Satisfactory bid responses on bulk hydrogen were received. Commission approval of the contract is all that remains to be accomplished. All other essential material supplies are already set up and meeting plant needs.

The rush of activity to initiate fuel loading during the month caused procedure production to slow down to only those required for fuel loading.

Plans were made to initiate the subsection operational function as far as possible on January 6.

Effective December 23, 1963, P. J. O'Neil assumed responsibility for managing the subsection vice H. G. DeVoss.

N PROCESSING OPERATION

The boiler developed a tube leak on December 9, 1963. Inspection revealed the leak to be due to external corrosion of the 16th tube in the 9th row from the rear. This leak was similar to the leaks experienced in December 1962. The tube was plugged off and boiler operation resumed on December 10.

Resin leakage from No. 4 primary cation caused several outages during the month due to plugging of the screen at the degassifier exit before the source of leakage was isolated. The bottom plate of the resin section of the tank was pulling loose from the tank wall allowing resin to leak by. The vendor was contacted and recommended remedial action which was being taken at month end.

The primary loop hydrostatic test was successfully completed on December 12, 1963 at 2610 psig. On December 13 a high velocity flush was conducted by the primary loop with temporary screens installed in the rear of each process tube to catch debris. Some amount of debris was trapped by the screens. Prior to charging fuel into process tubes, after the flush, each tube was swabbed. No significant amounts of foreign material were collected.

Considerable testing and operation of the reactor safety and control systems were accomplished during the month, including a 3rd complete ball drop. This gave the assurance of a safe operable system before loading to critical was resumed on December 26, 1963. Rod position transducers were damaged on scrams due to the drive chain jumping the sprocket wheel which drives the transducers. A redesign of this component is in progress at month end.

Charge machine operation and monotube loading operation were initiated during the month and satisfactory operation has been experienced to date.

All shifts were fully staffed as of December 9, 1963.

Eight pile operators and one power operator journeyman began orientation training on December 16, 1963. This course will run four weeks followed by three weeks of Phase I and II training for the pile operators, after which they will be assigned to shifts.

N MAINTENANCE OPERATION

The mechanical maintenance crews were organized and assigned to shifts effective December 16, 1963. By month end these crews were staffed to nearly their assigned number of four millwrights and four pipefitters. Miscellaneous craft such as rigger, asbestos worker, painter, serviceman and welder were procured and assigned to day shift, General Service Maintenance. The maintenance crews are now organized. Experienced ex-craftsmen who were fieldmen for Project Section are to be assimilated into Maintenance wherever possible and this effort was begun late in the month.

December proved to be a period of very high output activity for Maintenance with extreme usage of overtime predominantly in the electrical-instrument craft groups. This was necessitated by need for support of tests and the simultaneous troubleshooting required to initially operate a wide range of plant equipment and systems. A full load of normal routine maintenance work was carried as well.

Acquisition of spare parts and tools from Kaiser Engineers continued. Spare parts usage was abnormally high because of equipment operational problems and failures. Action in relation to preparation of additional maintenance procedures was deferred because of the trouble-shooting work load which required the attention of all exempt personnel of the Maintenance group.

Even in view of the heavy workload, the safety climate continued good with no incidents reported other than nominal minor medical.

SIGNIFICANT REPORTS ISSUED

None

TRIPS

Name	Location	Date	Purpose
E. A. Grimm	San Jose, California	12/9-12	THC Meeting

VISITORS

Name	Firm & Location	Date	Purpose
J. A. Haaga	G. E. Co., San Jose, California	12/6 & 7	Startup Consultation

PERSONNEL

Additions	From	To	Date
M. J. Dowd	IPD	Plant Maintenance	12/2/63
D. W. Duncan	IPD	Plant Maintenance	12/2/63
J. A. Maras	IPD	Plant Maintenance	12/2/63
G. G. Murphy	IPD	Plant Maintenance	12/2/63
J. J. Phenneger	IPD	Plant Maintenance	12/2/63
D. R. Stoken	IPD	Plant Maintenance	12/2/63
R. B. Terrill	IPD	Plant Maintenance	12/2/63
E. L. Torney	IPD	Plant Maintenance	12/2/63
H. L. Welld	IPD	Plant Maintenance	12/2/63
G. F. Bambock	IPD	Plant Maintenance	12/9/63
H. L. Kellison	IPD	Plant Maintenance	12/9/63
B. F. Marshall	IPD	Plant Maintenance	12/9/63
W. C. McDermott	IPD	Plant Maintenance	12/9/63
T. R. Riggins	NR Project	Plant Maintenance	12/15/63
C. H. Amburgey	IPD	Plant Processing	12/16/63
R. N. Ervin	IPD	Plant Processing	12/16/63
L. E. Howard	IPD	Plant Processing	12/16/63
R. E. Iverson	IPD	Plant Processing	12/16/63
F. R. Hunter	IPD	Plant Processing	12/16/63
L. F. Orth	IPD	Plant Processing	12/16/63
R. E. Sadler	IPD	Plant Processing	12/16/63
L. L. Spilman	IPD	Plant Processing	12/16/63
W. H. Young	IPD	Plant Processing	12/16/63

Additions (Continued)

Name	From	To	Date
L. J. Bisson	IPD	Plant Maintenance	12/30/63
R. R. Cowin	CPD	Plant Maintenance	12/30/63
J. W. Dean, Jr.	CPD	Plant Maintenance	12/30/63
F. R. Mattison	NR Project	Plant Maintenance	12/30/63
E. O. Nylund	IPD	Plant Maintenance	12/30/63

W M Mathis
Manager - N Reactor Plant

WM Mathis:ds

END

DATE
FILMED
2/24/93