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N-REACTOR DEPARTMENT

MONTHLY REPORT

MARCH

1964

HANFORD ATOMIC PRODUCTS OPERATION

RICHLAND, WASHINGTON

GENERAL ELECTRIC

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N-REACTOR DEPARTMENT

MONTHLY REPORT -- MARCH, 1964

Compiled by N-Reactor Department

April 7, 1964 - Richland, Washington

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GENERAL SUMMARY

N REACTOR FUELS

Production

The tight billet supply problem which existed at the beginning of the month was partially alleviated by accelerated deliveries from feed site. At month end, a three-week supply was on hand compared to a one-week supply at the beginning of the month.

Total input production for the month of March consisted exclusively of .947 enriched outer billets of which 236 were extruded, representing 50.5 tons at 97 per cent forecast. The outer extrusion problems of the past several months were significantly reduced; and at month end, production flow was approaching a normal rate.

Finished fuel output at the beginning of the month was considerably below forecast, due to normal processing time of the outer tubes between extrusion and final assembly. This time delay resulted in total output being 27 per cent below forecast. However, at month end, the imbalance between outer and inner fuels was essentially eliminated.

Uranium utilization during March was 70.7 with calendar year to date at 72.6. Three hundred and eighty-five tons, representing 20,075 assemblies, had been shipped to the reactor site by month end.

Shop Activities

An engineering test fuel of reject quality ruptured during autoclaving on March 21. This fuel element was being autoclaved in conjunction with charging tests.

Agreements have been reached with Research and Engineering for the discontinuance of reactivity testing which will provide a savings of approximately $10,000 per year. In addition, the amount of pre-irradiation measurements taken on routine production has been reduced from 10 per cent to 3 per cent of the routine production stream resulting in a net savings of an additional $20,000.

Engineering

The billet quality and yield problems associated with low temperature casting of uranium ingots have been resolved. Currently, the billet delivery rate and receiving inspection at HAPO are essentially back to normal. The scope of braze improvement work was broadened during March. This includes a thorough investigation and characterization of the brazing process and product with a primary goal of reducing all braze-associated reject rates.

Approximately 200 outer tube extrusions made during February and March under closely controlled processing conditions were used to evaluate the dimpling reject rate. This study produced only one significant result in that no

dimpling occurred on billets lubricated with a new test lubricant. Extrusions made with this lubricant also achieved lower internal clad variation than those extrusions made with the present lubricant.

RESEARCH & ENGINEERING

A research and development program was proposed to more assuredly define the ultimate capability of graphite-moderated reactors when coupled with an electrical generating plant and a sea water desalination plant.[1] Current estimates indicate that a reasonable target for this program would be an 8300 MW(t) nuclear plant capable of producing 1570 MW(e) at 2.4 mils/kwh and 620 million gallons per day of pure water at a cost of less than $.24 per 1000 gallons. The original cost of the reactor plant would be about $280 million.

A study has been made of the reactivity effects of replacing present Zircaloy-2 supports of the tube-in-tube NPR fuel with iron supports. Results indicate that the use of iron fuel supports increases the required enrichment by an increment of about +0.010% above that required with Zircaloy-2 supports.

Hot physics under start-up test N-1 has been completed, and the data are being evaluated.

The four N-inner enriched fuel element "heaters" (NIE-1) in KER Loop #1 have reached an exposure of 1400 MWD/T. These elements have closures consisting only of TIG welds (i.e., no braze) and utilize tapered end caps with a 90° angle. The enriched UO_2 thermocouple elements, also in this loop, have reached an exposure of about 4800 MWD/T. This test is scheduled for discharge about April 1.

Irradiation of four NIE-1 heater elements with unbonded end closures, four co-producer target elements (9-inch), and a thorium-uranium crud monitor element continued in KER Loop #2. The test is scheduled for discharge about April 1.

Thirteen 26-inch co-producer test elements were charged into KER Loop #3 during February. These consist of 17-½ lb/ft driver tube (1.25% enriched uranium) and an Al-0.6% Li (65% enriched) target rod. Current exposure is 550 MWD/T for the fuel and a Gas Volume Ratio (GVR) of 2.8 for the target. This test is scheduled for discharge about July 1.

The program to evaluate fuel element performance during a dump of the primary loop and a delay in the receipt of emergency cooling water continued on schedule. An outer fuel element which had been irradiated to 1920 MWD/T, was heated to 1800 F and quenched by 150 F water at a flow rate of 1.4 lbs/sec. The Zircaloy cladding remained intact although blistering occurred on the outer clad. Work is currently under way to determine the cause of blistering and to perform the same thermal cycle on an irradiated inner fuel element.

(1-HW-81403, "Nuclear Reactor for De-salting Sea Water," by W. J. Dowis and J. W. Riches.

The output needs for the N Reactor Data System have been defined.[2] The estimated demand is approximately 285 routine and 250 non-routine reports per year.

The Hanford Laboratories Analog Computer facility is in full operation and is being used for the study of N Reactor Systems. A review of the control system for the primary coolant temperature control and the secondary coolant pressure system has been completed. This review indicates these systems to be well engineered with no apparent design deficiencies.

N REACTOR PROJECT

The conditions leading to the loss of the KER loop pressurizer vessel have been investigated and compared with similar, though more remote, possibilities that could exist with the N Reactor pressurizer. Corrective measures will be taken.

An updated version of the confinement system instrumentation criteria was issued for final scope approval under Project CAI-816. It conforms to the current design of the confinement control system.

Pipe movement readings were obtained during hot flow testing of the primary loop and are being evaluated in a computer program. Minor damage to the 109-N pipe supports was observed following the primary loop hot dump test, and corrective measures are being developed.

Calculations based on recent data have been completed to give assurance that the six-loop Phase II steam generation requirements can be met at design power level.

The pipe gallery sixth cell tie-ins for the primary loop piping were completed as scheduled March 4 through March 17, 1964.

Contractor testing of remote-operated valves, not included in the Bailey Meter work in the 109-N Building, was completed during the month.

All exception items on the graphite cooling system, including the repair of the four heat exchangers, have been completed.

All exception items on the fuel rupture monitor system have been completed.

Steam generator unit 4A tubing affected by extensive intergranular corrosion has been removed, and the unit is now being readied for installation of new inconel tubing. All required inconel hollows have been produced; ten per cent of the 100,000 feet of required replacement tubing has been drawn to size and is now being inspected. Installation of the new tubing is scheduled to begin the first part of May, 1964, with completion of repairs scheduled for August 15, 1964.

(2-HW-81080, "N Reactor Engineering Data System Output Reporting," by C. F. Poor.

Modifications have been made to eight of the ten existing steam generators to improve the venting of air from the primary manifold during filling of the cell primary piping.

During initial reactor heat up, an estimated 350-400 gallons of water were collected in the pile exhaust gas plenum. While the first evidence indicated that the water could have resulted from a process tube leak, subsequent tests have shown that the most likely source is the shield concrete. A procedure is in force that will confirm the source of water accumulated in the reactor during high temperature operation.

Difficulties associated with the emergency dump system controls have resulted from excessive nitrogen gas leaks and problems with speed control valve settings. Of the 88 control valves involved, 68 have been repaired at the factory to provide leak tight seats with the remainder scheduled for rework. Tests show that elimination of the speed control valves is a practical method for reducing erratic operation of inlet V3 and outlet V4 valves. Further tests have been planned to assure the required system reliability.

The membrane for the after-heat removal tanks was found to have several tears, one of which was 40 feet long. The membrane has been repaired and reinstalled. In order to prevent further tears from occurring, floats have been attached to the top of the membrane to prevent it from sinking in the event that new leaks develop. Without the floats, the membrane would be allowed to sink and become entangled with the protective gratings at the bottom of the tank.

In order to provide more reliable control room annunciator power for N-2 physics tests, the power feed was relocated to distribution panel DR where dual feed and automatic transfer is available.

The specially developed tools for process tube removal performed satisfactorily during removal of the #1648 process tube assembly. Development of tooling to permit removal of irradiation process tube assemblies is continuing on schedule.

N REACTOR PLANT

Full reactor zero power hot physics testing was continued throughout the month. Final high temperature physics measurements were in progress at month end.

Operational testing of the primary coolant system was nearly completed at the end of the report period.

Testing was initiated or continued on many supporting systems with significant activity on the secondary coolant system, confinement system, stand-by boiler, high-pressure injection system, graphite cooling system, annunciator system, and rupture monitor system.

Modifications to increase the operating reliability of the control rods and safety circuits were completed during the month.

The mercury wetted relays in the rod control circuit, which failed in February, are presently backed up by a replacement relay on a trial installation. The trial period continued throughout the month without incident.

A leak caused by failure at a tack weld in a water wall tube of the stand-by boiler resulted in a short outage for repair on March 13.

Process tube #1648 was removed from service on March 17, to permit the tube channel to be used for graphite sample irradiations.

The first charge-discharge of reactor fuel took place without incident during the month when fuel in 36 tubes was replaced with fuel having slight surface imperfections but suitable for short-term irradiation in preparation for the charging of special test fuel later in the year.

Replacement of all remaining installed 15 KV electrical distribution cable was initiated following in-service failure of the power supply to #3 raw water pump.

Total NPR testing program is 70% complete.

PERSONNEL STATISTICS

Number of employees as of February 29, 1964.	640
Number of employees as of March 31, 1964.	635

	Exempt	Nonexempt	Total
General	2	1	3
Finance	15	8	23
N Reactor Fuels	51	108	159
Research & Engineering	49	10	59
N Reactor Plant	64	219	283
N Reactor Project	85	23	108
TOTAL	266	369	635

Employment

	Exempt	Nonexempt	Total
Additions	2	15	17
Reductions	10	12	22
Net Additions	- 8	3	- 5

SAFETY & SECURITY

Days without a disabling injury	487
Hours worked without a disabling injury	1 547 240
Medical treatment injuries (March)	31

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

SUGGESTION PLAN PARTICIPATION

	March	CY 1964 to Date
Number of eligible employees	369	366
Number of suggestions received	53	121
Number of suggestions acted upon	56	143
Number of suggestions adopted	29	64
Net annual savings	$9 663	$118 293
Amount of awards	$1 225	$ 4 910
Per cent of awards to savings	12.7	4.2
Average amount of awards	42.24	76.72

PATENT SUMMARY - MARCH, 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 March. 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

N-REACTOR FUELS OPERATION
MARCH, 1964

I. PRODUCTION STATISTICS

		Current Month	CYTD
1. Input (extrusions)			
.947% Enriched Outer		236	340
.947% Enriched Inner		0	260
Total Extrusions		236	600
Total Tons		50.5	134
% of Forecast		97	82
2. Output (finished production)			
.947% Enriched Assemblies	24"	1108	2656
	18"	432	1116
	12"	0	144
Total Assemblies		1540	3916
Total Tons		29.2	72.4
% Of Forecast		73	81

3. Month End Inventory

Finished Inventory		300 Area	100-N Area	Total
.947% Enriched Assemblies	24"	1143	672	1815
	18"	684	43	727
	12"	325	79	404
Total Assemblies		2152	794	2946
Total Tons		37.0	15.2	52.2
Bare Inventory				
.947% Enriched Outer		129	----	----
Inner		62	----	----
Total Billets		191	----	----
Total Tons		36.5	----	----
Natural Outer		122	----	----
Inner		105	----	----
Total Billets		227	----	----
Total Tons		41.3	----	----

	300 Area	100-N Area	Total
1.25% Enriched Outer	28	---	---
Inner	0	---	---
Total Billets	28	---	---
Total Tons	5.7	---	---

4. Shipments to Reactor (total first load to date)

.947% Enriched Assemblies	24"	16,159
	18"	3,132
	12"	784
Total Assemblies		20,075
Total Tons		385.1

5. Uranium Utilization

	Current Month	CYTD
Outers	---	71.2
Inners	---	75.3
Total	70.7	72.6

6. Production Comments

The tight billet supply problem which existed at the beginning of the month was partially alleviated by accelerated deliveries from the feedsite. At month end, a three week supply was on hand compared to a one week supply at the beginning of the month. Rejects for poor billet quality at billet assembly have dropped significantly.

All extrusions during March consisted of outer billets in order to the correct the significant imbalance of inner tubes remaining in-process from the January production run. The exclusive production of the heavier outer tubes increased the uranium in-process by 10 per cent. The outer extrusion problems of the past several months were significantly reduced and by month end, production flow through the shop was approaching a normal rate with the imbalance of inners essentially corrected.

The output of finished fuel assemblies at the beginning of the month was considerably below the forecasted production rate due to the normal processing time of the outer tubes between extrusion and final assembly. This time delay resulted in total output being 27 per cent below forecast. However, the production flow was approaching normal rate by month end.

During March, 676 assemblies previously used for reactor startup were sorted, cleaned, repacked and shipped to the reactor site at mid-month. These special fuels, of somewhat lesser quality than regular production fuels, will be used to replace 36 charges of high quality .947 fuel now in the reactor. The special fuels will be discharged later this year at relatively low exposure to permit charging of the 1.25 per cent co-producer fuel elements. The high quality fuel currently being discharged will be recharged for high exposure at a later date.

A skeleton swing shift consisting of four operators, one coverage man, and an instrument technician was started March 9, 1964.

II. SHOP ACTIVITIES

1. Problems and Incidents

An engineering test fuel of reject quality ruptured during autoclaving on March 21. This fuel element was being autoclaved with 50 mil supports in conjunction with charging tests. About one-fifth of the element was destroyed. The remainder of the vessel was loaded with similar fuels.

On March 6, a sulphuric acid line in a trench near the tank farm ruptured as the operator was opening a valve. The PVC nipple adjacent to the valve broke, allowing the acid to spray the immediate area around the pipe. The operator was not injured and repairs have been made to the support brackets holding the pipe which were severely corroded.

Difficulty was experienced in maintaining adequate demineralized water supplies. It was discovered that the replacement filters installed during the recent overhaul were the wrong filters for this type of equipment. The spare parts number has been corrected and the proper filters set up in spare parts.

2. Achievements

Agreement was reached with Research and Engineering, NRD, that the reactivity data routinely being taken on N-Fuels showed a high degree of consistency over the first load. It was agreed that since the magnitude of the production variation indicated by the data was well below anything that would need to be monitored routinely, reactivity testing could be discontinued. Reactivity testing will be discontinued with a savings to the Section of approximately $10,000 per year.

Agreement was also reached with Research and Engineering on a reduction in the amount of pre-irradiation measurements taken on routine production from 10 per cent to 3 per cent of the routine production stream. This reduction will result in a net savings to the Section of $20,000.

A new one shift throughput record for the preweld etch operation was established on March 18. Three hundred and twenty outer fuels were processed on a standard eight-hour shift without relief. The previous high was 298 fuels set on September 18, 1963.

New flexible lines have been installed on all autoclaves. The new lines are made of stainless steel instead of

Monel and are of welded construction instead of being brazed. This modification has eliminated a safety hazard in the autoclave area.

A document entitled, "Proposed Vendor Certification System for N-Fuels" was issued on March 17, which outlines three steps in vendor certification; vendor approval, vendor rating, and vendor certification. Specific details of the vendor approval program were issued on March 20 in a letter entitled "Approved Vendor Program."

A management decision was made to remove the existing emergency power equipment in the 333 Building and connect two of the four exhaust fans to the 300 Area emergency power system. The removal of this equipment will result in an initial savings of $5,000 plus normal maintenance and repair costs on existing motor-generator sets.

III. ENGINEERING ACTIVITIES

1. Materials

Uranium Quality: The billet quality and yield problems associated with low temperature casting of uranium ingots between November, 1963, and January, 1964, have been solved. The billet delivery rates and receiving inspection results at HAPO are normal. Shop yields at NLO are between 80 and 90 per cent for raw billet to good billet, somewhat higher than previous to the low temperature incident. New casting cycles have been adopted based on charge composition and these cycles have been checked using immersion thermocouples in the production plant furnaces. All ingots are being cast solid and drilled prior to heat treating.

Billet finishing operations and metallographic analyses have been completed on the primary extrusions from four 13 inch OD by 6-1/2 inch ID ingots that were extruded to NOT billets using a tipped mandrel technique at Bridgeport Brass Company, Ashtabula, Ohio. Metallographic results show that in addition to the expected increase in grain refinement near the ID, a general improvement in grain refinement was obtained through the full cross section of the primary extrusion. This improvement has been attributed to the more effective beta quench resulting from the thinner wall section of the primary ingot and the large ID that provides increased surface for heat transfer to the quench media. An additional 16 ingots will be cast and extruded.

Uranium Specifications: The uranium specifications are being critically reviewed at both HAPO and the feedsites in an effort to relate quality needs to the process capability of the feedsites for billet fabrication. The objective of the program is to establish billet acceptance limits that encompass the output of the producer's process whenever that process is in as good a state of control as is reasonable to expect and whenever the extremes of this distribution are acceptable input for N-fuel coextrusions. Additional gains from developing specifications limits of this type are the control of the central tendency of the distribution, i.e., greater uniformity, reduction of the number of waivers and associated paperwork when the product being waived is really no different from that normally produced, and reduced billet cost. The approach selected is to use a two-limit system where the material between the first and second limit represents the fringe of the normal distribution. These billets will be identified as Class II to enable observation of fabrication performance.

The new specification limit for billet length has been developed using the above approach. This specification will permit the receipt of 10 per cent of the billet 1/8-inch short in length. NLO reports that about 5-10 per cent of the billets machined for Hanford are up to 1/8-inch short or have small defects on end surfaces that can be removed by machining another 1/8 inch from the end of the billet. Economic studies have shown that only a slight cost increase will occur at HAPO from occasional loss of 6 inches of coextruded fuel elements from a billet as compared to the significant cost that would be encountered from remelting and replacing raw billets sections that are only 1/8-inch short. The number of short billets to be accepted during any one month is limited to 10 per cent of the total billets shipped in that geometry. This limit should encompass essentially all of the short billets being made at the present time and should act as a deterrent to any tendency to lessen length control at the feedsite.

2. Process

Braze Closure Process: The scope of braze improvement work was broadened considerably during the month. This program can best be described now as a thorough investigation and characterization of the brazing process and product with a primary goal of reducing all braze-associated reject rates. Developments during the month are as follows:

a. Forty-eight outer fuel ends were brazed to study braze metal flow, braze core bonding, brazing cycle

time effects, uranium surface oxidation effects on bonding, and induction field flux variation effects. These fuels have been welded and are now being autoradiographed for evaluation of uranium contamination in the closure weld.

b. Equipment was designed and fabricated for destructive evaluation of braze core bond shear and tensile strengths.

c. A process work request was initiated to compare the performance of flat and beveled end caps on braze-associated reject rates.

Outer Support Improvement: To further evaluate preliminary test results on the .050 inch supports which indicated a 50 per cent improvement in deflection strength, a number of minor dimensional variations were made on the supports in an attempt to further improve deflection strength. In general, the test results indicated approximately the same deflection strength regardless of minor dimensional changes. It was concluded, therefore, that the optimum level of improvement in deflection strength with the modified outer support (.050 vs. .040 inch thick) will be 50 per cent. Final testing of the support is now being performed in the interest of placing this support into production during April.

Process Development for Co-Product Driver Tubes: Brazing of driver fuels on production equipment in the 333 Building was initiated during the month. The only equipment modifications were those required to accomodate the extra length of the driver fuel. (Chamber extension and coil height.)

Driver fuel tooling designs were furnished to the Materials Operation for purchasing. Twelve zircaloy billets were extruded to driver billet inner zircaloy component stock. Final machining of these components will be performed by offsite vendor(s). Coextrusion billets have been designed and components are being fabricated to provide thick-thin driver fuel clad standards for the nondestructive testers.

The driver fuel support design (basically the same as the outer fuel support) deflection strength is approximately 50 per cent stronger than the present outer support design.

The wall thickness variation typical of all driver extrusions to date is 34 mils based on three sigma limits. This amount of variation creates some problems at end closure recessing, brazing, step cutting, and welding. Warp of the front fuel element

from each extrusion has consistently been significantly greater than the remainder of the extrusion. The exact cause for this difference is not known at this time.

Outer Tube Inner Clad Dimpling Defects: Approximately 200 outer tube extrusions were made during February and March under closely controlled processing conditions. These extrusions were used to evaluate the dimpling reject rate versus high and low billet temperature, present lubricant, a new test lubricant, inner copper component vendors, and inner zircaloy component vendors. The only significant result obtained from these extrusions was that no dimpling occurred on billets lubricated with the new test lubricant. Extrusions made with this lubricant also exhibited a lower internal clad variation than those extrusions made with the present lubricant.

A revision to the Quality Control Standards has been initiated to allow the use of the new lubricant. Production extrusion of outer fuels has been converted 100 per cent to this lubricant.

Autoclave White Oxide Reject Recovery: A number of test fuels with white oxide on the end closure welds and/or cladding were recovered during the month by abrasive blast removal of the autoclave oxide followed by etching and reautoclaving.

White weld rejects were recovered by preferential blasting and etching of the welds with the remaining fuel surfaces protected by masking. All fuel surfaces exhibited acceptable black oxide after reautoclaving.

Inner fuels with white oxide or cracked buggy spring supports were recovered by cutting the support body from the weld tab, blasting, welding new supports to the old support tabs, etching, and reautoclaving. The new supports were formed such that the inner portion of the weld tab was bent down to rest on the clad, while the outer end of the weld tab was welded to the old support tabs. This permitted standard height buggy springs to be used. Fuels recovered by the above process had acceptable oxide films after reautoclaving. The above special forming of the buggy spring support tabs should allow replacement of cracked supports without the requirement of an additional autoclave cycle.

A process description is being prepared for Research and Engineering evaluation.

3. Nuclear Safety

A complete set of Nuclear Safety Specifications for existing products for the 333 Building has been approved and issued. Conformance to these specifications is being audited by Quality Control.

Nuclear Safety Specifications are being prepared for the Pilot Plant using limits that are inherently safe for handling all materials enriched up to 1.95 per cent uranium.

A preliminary nuclear safety review was made of the 333 Building for processing 1.95 per cent driver tube fuel elements. Adequate specifications will be written to enable safe processing of this material in the production plant.

4. Equipment & Maintenance Engineering

In order to reduce the variables inherent in the braze equipment, several design improvements are being made. Fabrication of carriage guide assembly and indexing fixtures was completed on March 19. Detail drawings were issued for the scheduling of installation work. Additional fuel element retaining flanges are being procured for all braze stations. These flanges will improve alignment of the fuel piece during brazing.

Considerable design analyses and prototype effort have been required to obtain designs of locking clip and shoeing tools which function properly. Two pair of the new locking clip pliers are being tested at final inspection and appear satisfactory. Four pair of shoeing tools were fabricated and are being tested. The shoeing tools crimp the shoes adequately to meet the process specifications without tape shimming.

K. H. Huppert Company, Chicago, Illinois, was awarded the purchase order for the new preheat furnace. Delivery was promised 40 days after receipt of order which should be in the latter part of April or first part of May.

The appropriation request for capital funds was approved for the production end cap welder but has not yet been approved for the Pilot Plant end cap welder. Specifications for the welding machine and controls are being prepared, and are 60 per cent complete. The week of April 13, 1964, is the target for issuing the purchase requisition for the machine and controls. The requisition for the power supply and miscellaneous welding controls has been issued.

N-REACTOR FUELS OPERATION
MARCH, 1964

TRIPS

Name	Company	Contact	Date	Purpose
JW Nickolaus	Wah Chang Albany, Ore.	RA Graham	3/4-5	Zr-2 strip order
RR Studer	Wah Chang Albany, Ore.	RA Graham	3/4-5	Zr-2 strip order
TD Naylor RR Studer	Wah Chang Albany Ore.	RA Graham	3/23/25	Zr-2 strip order
	Rem, Inc. Portland	CA Brown	3/25	Strip fabrication
WR Krehbiel	NLO Fernald, O	P. McCreery	3/4-5	Uranium quality discussions
	Large Jet Eng. Department Cincinnati	JM Scanlon	3/6	Quality management.
	U. of Wyoming		3/9/	Recruiting.
RG Curran	NMI Boston, Mass.	HF Sawyer P Loewenstein	3/24-26	Extrusion technology
	Acheson Colloids Port Huron Mich.	G. Rzeppa	3/27	Extrusion lubricants
	Superior Graphite Chicago, Ill.	R. Steibeck P. Carney	3/30	Extrusion lubricants
	Thompson-Ramo-Wooldrige Co. Cleveland, O.	R. Haverstraw	3/31	Extrusion lubricants
DE Blahnik P Conrad	Precision Engr. Seattle, Wn.	JJ Morris	3/23	Vacu-blast equipment problems.
	Boeing Co. Seattle, Wn.	J Pake		
LH Steves DW Darsow	NMI Concord, Mass	P Loewenstein	3/23	Braze rings
	Brush Beryllium Cleveland, O.	H. Piper	3/24	Braze rings
LM Loeb	GE Mfg. Services New York, NY	OF Sorenson	3/17	Engr'g. Reg.
	SRP Augusta, Ga.	J Croach	3/18-19	Attend FEDC Meet.
	NLO, Cinnati	J Noyes	3/20	

TRIPS

Name	Company	Contact	Date	Purpose
LH Steves DW Darsow	Winslow Mfg.	M Price	3/24	Tooling
	Reactive Metals Nile, Ohio	J. Powers	3/25	Zircaloy
	Brush Beryllium Elmore, O.	E. Wukle	3/26	Braze rings
	JBM Tool & Die Bryan, Ohio	E. Johnson	3/27	Tooling

VISITORS

Name	Company	Contact	Date	Purpose
PE Tade	Sciaky Bros. Chicago, Ill.	TB Correy	3/25	Consult on welding equipment.
W. Kelly	Sciaky Bros. Chicago, Ill.	TB Correy	3/23-27	Service welding equipment.
JJ Morris	Precision Engr. Seattle, Wn.	P Conrad	3/18	Vacu-blast equipment problems.

ORGANIZATION AND PERSONNEL

Additions	From	To	Date
RJ Kasko	NRD-Plant Maint.	Shop Operations	3/2
RG Lauer (TG)	NRD-R&E	N-Fuels Engr.	3/1

Deletions				
RL Brown	Testing Methods		Hanford Labs.	3/1
RG Chafin	"	"	" "	"
ZL Elliott	"	"	" "	"
SJ Foreman	"	"	" "	"
CL Frederick	"	"	" "	"
DO Hunter	"	"	" "	"
CN Jackson	"	"	" "	"
RB Jacob	"	"	" "	"
SJ Ostrum	"	"	" "	"
EF Perrizo	"	"	" "	"
FD Skalicky	"	"	" "	"
RB Socky	"	"	" "	"
GL Waldkoetter	"	"	" "	"

Deletions	From	TO	Date
CE Bigelow	Shop Operations	NRD-Plant Maint.	3/2
EW Enos	Quality Control	HU&PO	3/2
MS Wynia	Support Services	Leave of Absence	3/13

Moves and Change of Status

CD Benson	Elec. Trainee	Elec. Journeyman	3/2
JR Merriman	Pipefitter Trainee	Pipefitter Journeyman	3/30
RW Gilmore	Testing Methods	N-Fuels Engr.	3/1

The following Chemical Workers returned from temporary loan in IPD, Production Fuels:

CS Babcock	3/9	CB Maberry	3/9	MF Tschauner	3/9
AW Davis	3/9	RR Musselman	3/9	SB Varvel	3/9
HL Jackson	3/9	MR McColley	3/9	DC Wyatt	3/9

Safety

Injury Statistics	CM	CYTD
Disabling injuries	0	0
Medical treatment injuries	7	17

An order was placed for 120 nuclear safety signs. These are required for compliance with the new Nuclear Safety Specifications.

Security	CM	CYTD
Violations	0	2

Suggestions

No. submitted	19
No. adopted	16
Total Awards	$ 980.00
Total Savings	8,943.00

Employee Relations

Grievances: The electricians submitted a grievance because in their opinion, engineers were performing work which should be done by electricians. The answer, which contended the engineers were doing initial exploratory work on prototype equipment, was unsatisfactory.

Service Awards: RD Dudley; 10 years. WA Hendricksen; 5 years.

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 January, 1964, except as noted below. Such persons further advise that for the period therein covered by this rpeort, 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-79292	Confidential	SG Forbes	2/6	Locking Clip Weld Evaluation, Cat. III
HW-80313	Confidential	N-Fuels Engr.	2/20	Nuclear Safety Specs. for N-Reactor Fuels
HW-80545	Confidential	SG Forbes, CL Frederick RR Studer	2/28	Evaluation of Locking Clip Welds
HW-81060	Secret	JW Nickolaus	3/2/	Manufacturing Cost Comparison, Tube-Tube vs. Single Tube Design
HW-81318	Unclassified	RG Curran	3/20	Alignment Reference Measurements for 2750 Ton Extrusion Press

Manager, N-Reactor Fuels

LM Loeb:bk

RESEARCH AND ENGINEERING

1. ADVANCE TECHNOLOGY

A research and development program was proposed to more assuredly define the ultimate capability of graphite moderated reactors when coupled with an electrical generating plant and a sea water distillation plant (1). This would be accomplished through a program of limited scope to obtain a more precise definition of design characteristics, optimum sizes, crucial technological areas and the broad field of dual product economics and marketing and the resulting impact on design optimization. Current estimates indicate that a reasonable target for this program would be an 8300 Mw(t) nuclear plant capable of producing 1570 Mw(e) at 2.4 mils/kwh and 620 million gallons per day of pure water at a cost of less than 24¢ per 1000 gallons. The original cost of the reactor plant would be about $280 million.

The N-Reactor Department Research and Development Budget for FY-1966 and Revision of Budget for FY-1965 (AEC Schedule 189)(2) was compiled, edited and reviewed with personnel of the RLOO-AEC. The budget is divided in three categories in support of research and development in (1) reactor materials, processes and equipment, (2) fuel element development, and (3) co-product demonstration.

2. REACTOR PHYSICS

Survey studies in support of the co-product program have continued during the month. The dimensions of the fuel element, enrichment, target concentration and tube power have been varied in order to provide a base for the selection of the most favorable fuel element from an economic point of view. It appears that the operational reactivity swings for all normal and abnormal conditions except target loss can be controlled by the present control system, but detailed calculations of control strength will be required for the fuel element design selected.

A review of results obtained during the physics startup tests continued and a discussion of several parameters is given below.

The void anisotropy in the graphite stack of N-Reactor induces differences in the directional migration areas. These differences have been inferred from buckling and reactivity experiments obtained in the cold physics tests in the small critical assembly. The differences are statistically significant as shown in Table I.

TABLE I

DIRECTIONAL MIGRATION AREAS

Direction	Migration Area	Number of Measurements
horizontal	536 ± 10 cm^2	1
vertical	502 ± 4	2
axial	711 ± 70	1

The total migration area is a buckling-weighted sum of the directional values and is therefore shape dependent. Using the values in Table I for the small critical assembly, the total migration area is found to be 535 ± 8 cm^2. For the fully loaded reactor the total migration area is found to be 564 ± 20 cm^2. These quoted uncertainties are standard deviations based upon least squares errors in determining the bucklings, but do not include the contributions from the random uncertainties in the reactivity measurements which are not available at this writing.

The buckling of the core region covered by fully inserted control rods has been inferred from data obtained during the startup test. The experiment used to obtain this information is the one in which the reactor was made critical by the removal of successive control rods at one end of the reactor. The end region is then serving as a neutron source for the subcritical fully rodded region. By the application of the method used for analyses of exponential pile experiments, a value for γ can be obtained by fitting the function $e^{-\gamma z}$ to the flux traverse through the rodded region toward the other end of the reactor. The buckling for the rodded region is then obtained by subtracting γ^2 from the known values of the buckling in the other two directions (x and y). The result of this analysis is nominally $B^2 = -75 \mu b$ for this region.

A study has been made of the reactivity effects of replacing with iron supports the present Zr-2 supports of the tube-in-tube NPR fuel. The FLEX computer code was used to determine the enrichment required to provide a given value of k_{eff} for the following sets of conditions: (1) the regular tube-in-tube fuel with Zr-2 supports, and (2) the regular tube-in-tube fuel with iron fuel supports. The results indicate that the iron fuel supports increase the required enrichment by an increment of $\Delta E \approx +0.010\%$ above that required with the Zr-2 fuel supports.

More detailed studies of the hazards involved with hot startups have been made in order to establish Technical Bases and Standards for efficient startup control. The initial nuclear conditions were 30 mk subcriticality and a reactivity ramp of 1 mk/sec. The time delay between attainment of a trip power level and the opening of the master (1K1 or 2K1) breaker which initiates rod insertion was varied to determine the maximum acceptable delay which would still prevent bulk coolant boiling. Ball insertion studies were made assuming the rods failed to scram after opening of the master breaker.

The rod scram case results show that bulk boiling would be prevented if the delay time were not greater than 0.8 sec. However, some boiling in the center channel of the fuel element would probably be experienced if the time delay exceeds 0.6 seconds.

For ball scram cases, the total time delay between attainment of the trip power level and release of the balls can be broken down into the time delay between attainment of the trip power level and opening of the master (1K1 or 2K1) breaker and the time delay for the ball backup circuit to determine that the rods have not scrammed and thus release the balls. For these studies the time delay in the ball backup circuit remained fixed at 1.5 sec. The results of the studies showed that a time delay as small as 0.2 sec. for opening of the master breaker, i.e. a total time delay of 1.7 sec., would result in bulk coolant boiling.

The initial conditions assume that the system pressure has been allowed to drop after the scram from which the recovery is being attempted. Thus, the startup is being attempted with high inlet temperature water and reduced system pressure and there is little safety margin from the boiling standpoint to accommodate an excursion. However, if the equilibrium pressure is maintained after scram, possibly by reducing primary-secondary heat transfer, then for ball cases a total delay time as large as 2.1 sec. would still prevent bulk boiling or boiling in the center channel of the fuel element. As previously noted, the information is being used to establish the Technical Bases for startup control

3. REACTOR ENGINEERING

A second revision of HW-80393, "Interim Limits for Primary Pump Operation," has been published to take advantage of the experience gained during primary cooling system tests.

A proposal has been prepared for design, fabrication, testing and installation of thermocouple "trains" in N-Reactor process tubes. As planned, the thermocouples will be arranged to measure temperature at the outlets of the three coolant channels in the fuel column and the bulk outlet temperature in selected process tubes. These measurements will be employed to establish maximum operating limits for tube outlet temperature that will be required to prevent bulk (saturated-nucleate) boiling in any of the three coolant channels. A previous analysis has shown that the enthalpy rise in the center channel may exceed bulk enthalpy rise by as much as 16 per cent (3). Accurate knowledge of this imbalance in enthalpy can be gained only through in-reactor measurements.

4. PROCESS EVALUATION AND CONTROL

There were four PCA's issued during the month(Process Change Authorizations).

The process standards for Startup Test N-2 have been rearranged so that 32 standards instead of 35 will be sufficient. Of these 16 have been approved, 15 have been issued for comment or for approval, and one (Total Control) awaits results from the hot physics testing portion of Startup Test N-1.

Hot physics testing under Startup Test N-1 was completed. The data are currently being evaluated.

5. CONTROLS, INSTRUMENTS AND SYSTEMS ANALYSIS

Specifications for the TV system are still being processed by AEC Purchasing prior to release for bid. Quotations have been received on recording and instrumentation equipment and are being reviewed prior to selection and placing of orders. Detailed design of the camera front end section is proceeding. Work is also proceeding on the design of the drive unit and the control console.

Development efforts are being directed toward the design and development of a combined eddy current and ultrasonic hydride probe.

The output needs from the N-Reactor Engineering Data System are summarized in report HW-81088, "N-Reactor Engineering Data System, Output Reporting." The estimated demand on the data system is approximately 285 routine and 250 nonroutine reports per year.

The analog computing facility in the Hanford Laboratories has been placed into full operation and studies are being made on the operation of the primary coolant loop and the secondary coolant system. Information is being obtained to determine control settings for the various control systems.

Field assistance is being given on the calibration of the gamma energy monitoring equipment. Assistance is also being given Process Design in selecting a method of modification of the fuel element monitoring system to accommodate the removal of process tube #1648. The effect of part-loading of co-producer fuel elements upon the operation of the fuel element rupture monitoring system is also being evaluated.

A study has been initiated to evaluate possible methods of detection of co-producer target element ruptures. An economic evaluation of several possible detection methods is under way.

A review has been made of the control systems for the primary coolant temperature control system and secondary coolant pressure systems. This indicated the control system is well-engineered with no apparent design weaknesses. Areas have been found, however, in which some modifications of the circuitry have been suggested to improve the fail-safe features and the reliability through redundancy aspects of the system.

A study has been started to evaluate a proposed scope design for monitoring the total activity burden contained in the effluent from the venting system resulting from the worst conceivable nuclear accident.

6. CHEMISTRY AND METALLURGY

The four N-inner enriched fuel (NIE-1) heater elements in KER Loop #1 have reached an exposure of approximately 1400 MWD/T. These elements have closures consisting only of simple TIG welds (i.e. no braze). The tapered end cap design was used on these elements with a 90° included angle. This test is scheduled for discharge about April 1.

No excessive crud formation has been indicated by the two UO_2 thermocouple elements also in the loop or by water samples since the decontamination of KER-1 in February 1964. The enriched UO_2 thermocouple elements have reached an exposure of about 4,800 MWD/Tu.

The test charge in KER Loop #2 also contains 4 NIE-1 heater elements with tapered end caps and unbonded closures. The current exposure is 1000 MWD/T. In addition, four 9-inch prototype target elements are included in the charge. Three of the target cores are Al-3.2% Li and the fourth is Al-8% Li. This is the first test of two-phase Al-Li alloys at the high temperatures of a pressurized water cooled reactor. The current exposure is estimated to be a gas volume ratio of 8. The thorium-uranium crud monitor element is also in KER-2 and has functioned without difficulty. The current exposure is 1350 MWD/T. This test is scheduled for discharge about April 1.

Thirteen 26-inch co-producer test elements were charged into KER Loop #3 during February. These elements consist of a 17-1/2 lb/ft driver tube (1.25% enriched uranium) and an Al-0.6% Li (65% enriched) target rod. This element is essentially identical to that which will be used in the 36-tube co-producer demonstration test (PT-NR-8) scheduled for N-Reactor later this year. The current exposure is 550 MWD/T (800 max.) for the fuel. The target alloy has reached a GVR of 2.8 (4 max.).

Equipment necessary to induction heat either an inner or an outer fuel element and quench the fuel element under simulated flow of emergency raw water has been assembled. The induction coil covers the full length of the element and a quartz tube serves both as a support for the element and as a pipe to carry the quench water.

The system has been calibrated on non-irradiated fuel elements and power settings determined so that the elements reach 1800 F (982 C) in 230-250 seconds (outer) and 210-230 seconds (inner) after reaching an initial temperature of 750 F (400 C). Cooling water at 150 F (65 C) is introduced at 1.3 - 1.5 lb/sec (outer) and 0.5 - 0.6 lb/sec (inner) flow rate.

An outer fuel element that had been irradiated to 1920 MWD/T was heated to 1800 F and quenched by 150 F water at a flow rate of 1.4 lb/sec. The Zircaloy cladding remained intact. The outer clad incurred severe localized deformation at many locations where blisters formed; inner clad remained relatively smooth.

Work is currently under way to determine the cause of the blistering of the outer clad of this outer fuel element and to perform the same thermal cycle on an irradiated inner fuel element.

SIGNIFICANT REPORTS ISSUED

HW-81403, "Nuclear Reactors for Desalting Sea Water," W. J. Dowis and J. W. Riches

HW-80908, "N-Reactor Department Research and Development Budget for FY-1966 and Revision of Budget for FY-1965," Staff - N-Reactor Department

HW-80948, "Expected Irradiated Fuel Composition First Load Type," R. J. Shields

HW-80937, "Fission Product Formation in Fuel Elements," R. J. Shields

HW-81375, "Technical Data for Use in Hazards Analysis of Production Test NR-8" R. J. Shields

HW-80393 Rev 2, "Interim Limits for Primary Pump Operation," R. H. Shoemaker

HW-68900, "Technical Bases for NPR Process Standards: Basis 4.1.3: Primary Pumps - Function and Description" R. H. Shoemaker

Test Program Proposal - "NPR Process Tube Enthalpy Imbalance," P. Riggle

HW-80727, "Secondary System Process Piping," L. D. Smith

HW-81317, "Primary Pump Reliability," E. E. Leitz

HW-81342, "Summary - N-Reactor Cold Physics Test Results," W. S. Nechodom

PERSONNEL CHANGES

No change in the total number of personnel.

TRIPS

M. C. Leverett, R. E. Trumble, W. S. Nechodom and Milton Lewis made presentations to the ACRS and Division of Licensing and Regulation of the AEC on March 16 and 17 in Washington.

SECURITY VIOLATIONS

W. S. Nechodom, open file, March 9, 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.

M. C. Leverett
Manager
Research and Engineering

MC Leverett:LCC:dd

References

1. HW-81403, "Nuclear Reactors for Deslating Sea Water," J. W. Riches and W. J. Dowis

2. HW-80908, "N-Reactor Department Research and Development Budget for FY-1966 and Revision of Budget for FY-1965," March 25, 1964

3. HW-62150 RD 4 "N-Reactor System Parameters," R. K. Robinson, December 4, 1963

N-REACTOR PROJECT SECTION

PROCESS DESIGN OPERATION

Project CAI-816

Pressurizer Vessel Protection

The conditions leading to the loss of the pressurizer vessel in the KER loop have been investigated and compared with those that could exist in connection with the N-Reactor pressurizer. Although a number of protective devices were used in the KER pressurizer system, the heaters were turned on while the pressurizer was empty and the condition went undetected for several hours. By that time the pressurizer had reached temperatures that produced cracking and deformation of the vessel, rendering it unsuitable for future use. A similar possibility, though more remote, was found to exist with the N-Reactor pressurizer. To protect against this possibility, surface temperature detectors have been recommended to be installed to actuate an alarm upon excessively high wall temperature and permit corrective action to be taken before damage is caused.

Circulating Raw Water System

As part of a design review of the circulating raw water system, a high differential pressure trip has been recommended to be installed in series with the low differential pressure trip across each of the circulating raw water pumps. The purpose of the added trip function is to insure that a loss of pump flow is detected for all foreseeable circumstances, such as a pump being shut down with its discharge valve open or a pump operating with its discharge valve closed. The loss of pump flow in such cases would not actuate a low differential pressure trip, and scram protection would not be provided.

Primary Pump Lube Oil Bypass

An equipment modification procedure has been issued to install a valved bypass line around the 5 psi U-type confinement trap in each of the primary pump lube oil return lines. Apparently due to entrained air in the oil, trouble was experienced with foaming and flow retardation of the oil in the U-trap, causing the oil to back up and overflow through the equipment vents. Now with the bypass line around the U-trap, the flow of oil from the turbines in Zone I back to the supply reservoir in Zone IV will be unrestricted during normal operation. During a confinement incident, the bypass line will be valved closed and the U-trap will provide the necessary seal. Closure of the bypass line will be manual at first, but later will be converted to automatic operation.

Dump Condensers and Condensate Surge Tank

During testing of the secondary cooling system, trouble was experienced because the steam admission lines were located below the water level in the dump condensers and caused hammering. The condition was corrected by providing an additional steam admission line to permit steam to enter the

top of each dump condenser. Somewhat similarly, it was found that the steam admission line to the condensate surge tank was located about two feet below the top of the tank. Upon a high level condition, the cold water in the surge tank would rise to the level of the steam admission line and cause hammering and loss of surge tank pressure control. The condition was corrected by relocating the steam admission line to the top of the surge tank.

Fuel Rupture Monitor

Final functional testing of the gamma energy monitor was successfully performed on the installed system with the vendor's representative in attendance. A portion of this testing was originally to have been done at the vendor's plant but was postponed to avoid delaying the installation schedule. A number of difficulties were encountered that were either overcome during the testing or identified for correction later. An oscillation problem was evidenced in a majority of the preamplifiers and was corrected by inserting an additional resistance in series with each preamplifier input. Another problem was caused by an undesirable effect of the time-constant shorting switches on the output of the spectrometers. The opening of these shorting switches caused momentarily unequal spectrometer outputs which intermittently resulted in spurious alarm signals. The introduction of a larger resistor in each time-constant circuit corrected the problem.

Zone Temperature Monitor

The process tube zone temperature monitor has accumulated over 4,000 operating hours. This represents approximately one-half million controller hours. During this period no component failures occurred.

Power Calculator

The power calculator equipment has been returned from the vendor and reinstalled. Preliminary checks indicate that the system will meet or exceed specifications.

Boiling Point System

All channels of boiling point instrumentation have been calibrated and functionally tested. Over a pressure range of 300 to 1,600 psia and a temperature range of 100 to 600F, all channels now calculate boiling point with an accuracy of plus-or-minus 2.5F.

Confinement System Criteria

An updated version of the confinement system instrumentation criteria was issued for final scope approval under Project CAI-816. It conforms to the current design of the confinement control system as now being installed. Multiple timers and a building pressure signal are used, in addition to the primary loop pressure signal, for closure of the confinement system steam vent valves. The system also provides for automatic venting of the building atmosphere through the ventilation exhaust filters when conditions are within predetermined limits. In the event that building pressure rises again to exceed the capacity of the filters, the ventilation exhaust valves are automatically reclosed.

105-N Building Pressure Capabilities

In order to re-establish the maximum internal pressure that the 105-N Zone I building structure can safely withstand during an emergency, the original design calculations of General Electric and the final report of Holmes and Narver, Inc. were recently reviewed. The results indicate that the original design pressure of 5 psig is still a desirable upper limit to minimize cracking of the concrete, but that 6.2 psig may be approached if some cracking is permissible. The maximum pressure possible is about 7.3 psig. At that point, a large amount of steel reinforcement would be stressed to its yield point; severe cracking would be experienced throughout the structure; minor buckling would occur in truss members; and tension ties would begin to fail between the roof and walls.

Primary Piping Supports

Readings of pipe movements and strain were obtained during hot flow testing of the primary loop in which temperatures of 250F and 390F were reached. Strain data obtained during these tests are being evaluated in a computer program. Rotations of the mixing headers during heatup and pipe movements in general were about as assumed in design. After cooldown some of the cell piping did not return to its original position, but was apparently restrained by friction at various supports. During the primary loop cold dump test some of the gallery piping was observed to move substantially. It is possible that a combination of shocks due to valve operation, water hammer, or change in the rate of flow could have overcome the frictional resistance at supports and allowed the piping to move rapidly to another position.

During the primary loop hot dump test of March 27, 1964, a rapid cooldown and depressurization of the primary loop (from 450F and 1450psig) was experienced in a simulated emergency transition from circulating to once-through coolant flow conditions. During the time of the dump, pipe movements were discernible but were not considered excessive for the circumstances. However, immediately after the dump, severe water and steam hammer occurred. Subsequent inspection of pipe supports revealed no damage in 105-N but some damage in the 109-N pipe gallery, where: 1) brackets were pulled from the south wall at PCSH-10 and 19; 2) the last roller on the dump line seized during cooldown and bent the support beam; and 3) at least twelve wall plates were pulled from the south wall in amounts up to 3/8". These wall plates are intended to resist lateral movement of the major support structure for the primary piping runs between the gallery mixing headers and the cells.

Considering that the primary loop had previously been heated to 390F and cooled down with no observed damage to the above wall plates or brackets, it is possible that they could have also withstood a rapid cooldown from 450F. However, it is believed that the severe water and steam hammer precipitated by introducing injection water at the primary pumps could have been responsible for the damage described above. The wall plates are now being monitored for any additional movements that may be produced during future heating and cooling cycles of the primary loop. It is possible that the frictional resistance between pipe supports and bearing plates

is greater than assumed in the design. A solution to this problem will be made when more information is developed. Meanwhile, corrective action is being taken with respect to the trunnion supports bearing on the wall brackets at PCSH-10, 19, and 28 (Cells 1, 3, and 4). These are to be changed to spring supports, as was recently done for the corresponding trunnion supports on the PCR lines.

Conversion

Based on recent data relative to transient pressure surges, instrument errors, boiling allowance, and a 16 per cent channeling factor in fuel element design, an analysis has been made which gives assurance that the six-loop Phase II steam generation requirements can be met at design power level. The operating and trip pressure setpoints to accomplish this are included in the document that was prepared as part of the above analysis.

Special Studies

Elevator Hazards

A recent hazards study of the W, C, and D elevators has indicated the desirability of installing a redundant leveling system and separate shut-off valves to protect against equipment malfunctions. A budget reason sheet is being prepared to earmark FY-65 funds for the desired modifications.

Multiproduct Operation

The economic incentives, technical criteria, and plant modifications for processing multiproduct fuel through N-Reactor and the additional requirements of chemical separation have been set forth in a formal budget study report. The basic technology to support such a program appears to be reasonably well established at this time.

FIELD ENGINEERING OPERATION

Construction

105-N Building

Installation of the ion chambers for the sub-critical portion of the nuclear monitoring system has been completed. The remaining work on this system consists of installation of the twenty-five in-core ion chambers to be placed in selected graphite cooling tubes and three intermediate level chambers located in the top of the reactor.

Five guide tubes for the traveling wire flux monitor system were installed in the reactor.

All exception items on the fuel rupture monitor system have been completed.

109-N Building

Contractor testing has continued on the Bailey Meter steam generator and secondary loop pressure control systems.

Contractor testing of other remote operated valves, not included in the Bailey Meter package, was completed during the month, except for valves in cell 4.

All exception items on the graphite cooling system, including repair of the heat exchangers, have been completed.

Installation of the confinement instrumentation system is in progress. Currently the nitrogen backup cylinders on the steam vent bag closures are being installed.

All construction punch list work on the secondary piping system has been completed, exclusive of cell 4 and a few miscellaneous valve operator supports on small valves.

The hot water quality laboratory is about 85 per cent complete. Work is continuing on final tubing connections and electrical tie-ins. Testing of the facility will progress as rapidly as construction completion permits.

181-N Building

The changing of the valve operators for the 66" butterfly valves from electric to hydraulic operation has been completed on the discharge lines for pumps 1 and 2. These units are in service and work is in progress on the valves for lines to pumps 3 and 4.

184-N Building

At the recommendation of the supplier, the turbine drive for the generator, located in this facility, was partially dis-assembled for examination of the steam controls as minor steam leakage was evident. The diaphragm ledge seal was readjusted and a faulty three-way air valve controlling steam leak-off was repaired. The unit was reassembled and satisfactorily tested to 16,300 KW.

Conversion

The pipe gallery sixth cell tie-ins for the primary loop piping were accomplished during a scheduled system outage March 4, through March 17, 1964. Other work of miscellaneous vents and drains was completed during the month. Installation of electrical conduit and wire has been completed to sixth cell tie-in valves and valve checkout is in progress. The tie-in valve for future extension of the 18" water to water header was also installed during the month.

Steam Generators

All panels of stainless steel tubing have been removed from steam generator 4A; approximately 50 per cent of the tube stubs protruding from the manifold have also been removed. Tube support brackets are being modified for installation of replacement panels of inconel tubes. The first shipment of inconel tubing from Sawhill Tubular Products to Chattanooga for bending and assembly into panels is scheduled for the week of April 6, 1964. Tube bending equipment and nondestructive test equipment has been set up in the Combustion Engineering plant in Chattanooga preparatory to receipt of tubing. The first panels of inconel tubing are scheduled to arrive at Hanford during the first week of May, 1964.

Repairs of minor damage (caused by strainer basket failures) to tube ends and the primary manifold dome in steam generator units 1A and 1B have been completed. At the same time, the primary manifold venting arrangement was modified in eight steam generators; the remaining two units in cell 4 will be modified near the completion of unit 4A repairs.

N PLANT ENGINEERING

Plant Assistance

Engineering assistance was provided to N Plant Operation for trouble shooting, repair, consultation and performance of operational tests.

Mechanical Engineering

Water In Reactor

During the first heat-up of N-Reactor on March 1, 2, and 3, an estimated 350-400 gallons of water was collected in Drip Leg No. 6 - pile exhaust gas plenum. Immediate analysis of this water revealed traces of ammonia indicating a possibility of process tube assembly leakage. A hydrostatic test performed on all left side process tubes did not reveal a leak. Later laboratory tests of shield concrete samples however, revealed 2.3 percent moisture and ammonia traces present. This information plus finding that the front and rear primary shield vent valves were closed during the heat-up period indicate the water collected was driven from the primary shield concrete into the reactor, condensed on the cooled thermal shields and drained from the bottom of the reactor into the exhaust gas plenum. It is estimated that as much as 3000 gallons of water will eventually be driven from the front and rear primary shields. Since cool-down of the reactor was necessary before all desired sampling and testing could be performed to confirm the water source, a temporary sampling procedure was issued for the next heat-up period.

The "Hot-Dump Test" period from March 25 through March 29, 1964 provided the first opportunity for use of the temporary sampling procedure. During this period approximately 930 gallons of water was collected. Through taps installed in the primary shield vent pipes, out-gas samples were obtained during heat-up and a pressure increase measured when the vent valves were closed thus giving further indication that the water source is the shield concrete. Analysis of the collected water samples compared favorably with previous analysis of water collected as well as with the results obtained in the laboratory analysis of water obtained from shield concrete specimens. The procedure in force has specified testing and surveillance for confirmation of the water source.

Emergency Dump Valves

During the emergency dump system test on March 27, 1964, two of the outlet V4 valves failed to open on AUTOMATIC, but did function on MANUAL control from the Control Room. One of the inlet V3 valves failed to open on AUTOMATIC, but opened on MANUAL from the Control Room. Both of the 16 inch V23 dump valves functioned properly.

Prior to the dump tests, excessive leakage occurred on the nitrogen gas system used to operate the emergency raw water valves. Most of the leakage was caused by lack of leak tight seats in the control valves. Of the 88 solenoid control valves involved, 68 have been repaired at the factory. Re-installation has been made on all V4's, six of the V3's, V19, V6 and one V28 valve. The remainder have been scheduled for change-out as soon as replacements can be reworked by the vendor.

Membrane - Afterheat Removal Tank

The subject membrane whose purpose is to prevent air contact with the process water was found to be ripped approximately 40 by 25 feet on March 12, 1964. The membrane has been repaired, thirty special lifting patches have been attached, and it has been re-installed. Styrafoam floats have been attached to the top of the membrane to prevent it from sinking in the event that leaks develop later. Previous damage has been attributed in part to entanglement of the sunken membrane with protective gratings located in the bottom of the tank.

Study has been initiated by Process Design for alternate solutions to the problem.

Electrical Engineering

Engineering time was spent in around-the-clock coverage during the period February 27, 1964 through March 3, 1964 to trouble-shoot and supervise repair of systems during N-1 Cold Physics Test period. Significant items corrected during this and subsequent periods were:

Ball Recovery System - Trouble-shooting on the ball recovery system revealed a grounded wire at the front metering hopper and faulty valve on the rear of the metering hopper. These problems were corrected.

Primary Drive Turbine Main Lube Pumps - The investigation of the trip of number one main oil lube pump which caused a ball drop, has shown the drive motors to be rated at 25 amps and draw approximately 26 amps under load conditions. Data obtained on the service factor ratings of the motors indicate the motors were fabricated to withstand a 15 per cent overload. The overload settings for all trip elements have been adjusted to 115 per cent as per the manufacturer's recommendations as an immediate solution to the trip out problem.

Pony Motor Trip Setting

The protective relays which control starting of the pony motors was found to require a change in setting. A ball drop caused by an emergency cooling water trip was found to be caused by the speed trip settings for the circuits of the pony motors. These trip settings were readjusted on all pony motors and the trip-out points for both the pony motors and the emergency cooling water tested satisfactorily thereafter.

480 Volt Substation Number Two

During power switching, it was found to be impossible to reclose the incoming line breaker, 480 volt substation number two. The trouble was determined to be due to a broken racking mechanism on the breaker. After the mechanism was repaired, the breaker was restored to service.

Circulating Raw Water River Pumps

Failure of circulating raw water pump motor number two to synchronize was determined to be due to low voltage at the 153 Building battery "B." Measurements of the voltage at the motor field contactor showed a 13 volt drop between the 153 Building battery and the field contactor which was sufficient to prevent pull-in of the contactor to energize the field with the battery voltage at 120 volts. Work has been initiated to correct the excessive voltage drop and in the meantime the battery voltage has been raised to approximately 130 volts to compensate for the drop.

Annunciator System

During performance of OTP T0024 while Bus "B" was being tested, the annunciator in the control room lost all power with the exception of cabinets 1, 2, and 3 in room 6. Investigation showed the power feed to these annunciators from a distribution panel fed from Bus "B" does not have automatic transfer on power loss and the DC supplies furnished with the annunciator equipment failed to operate properly. To assure annunciator power during N-2 test phases, the power feed to the annunciators was relocated to distribution panel DR which has dual feed and automatic transfer.

Instrument Systems

Engineering time was spent in support of calibration and trouble shooting on instrument systems primarily as follows:

Bailey Meter Instrumentation

Engineering coverage was supplied to Plant Processing in support of OTP T0017 through the use of Kaiser Engineers technical personnel retained by Plant Engineering. In addition, diagrams have been prepared of the interlocks for the operating mode sequences of the modal control system to assist in the operational checkout.

Rod Flow Monitor System

Operating problems encountered in resetting the safety circuit relays in the rod flow trip modules were investigated and corrected. It was found that excess voltage drop occurred in small wire jumpers in the vendor's panel wiring at the rod flow panels. Larger feeder jumpers were installed which reduced the voltage drop and corrected the situation.

Plant Modifications - Instrument and Electrical

To date there are approximately 25 plant modifications on backlog; the majority of these items have been assigned to engineers for study and establishment of priorities. The significant modifications among these are as follows:

Horizontal Rod and Safety Circuit Audit Modifications - EMP 15

Extensive wiring revisions have been completed on schedule to the rod control and safety circuits for achievement of greater reliability as recommended by the audit committee. The installation has been tested and the modification is complete with the exception of as-built drawings.

Temporary Addition Relays - Rod Out Control - EMP 14

To prevent inadvertent rod withdrawal experienced during earlier tests, certain mercury wetted relays have been backed up with the addition of six relays in the rod-out circuits. Equipment modification procedure number 14 which delineated the changes was completed and the circuits were retested following the installation.

Instrument Power Supply 1 and 2 - 105 Building

Phase C of these power supplies became overloaded as more of the Bailey Meter system was energized. The overload has been temporarily overcome by load shifting. For a permanent correction, two 208 to 120 volt step-down transformers of 50 KVA power rating have been ordered to balance the loads on the supply transformers. These transformers have been scheduled for N-Area receipt by April 6, 1964. An Equipment Modification Procedure is being prepared for their installation.

V-6 Valve Controls - EMP 18

The modifications (Equipment Modification Procedure 18), to the control circuit for the diversion system blocking valve V-6 to allow proper valve timing, have been physically completed. Testing of the installation has been scheduled.

Safety Circuit Modifications

An Equipment Modification Procedure has been initiated to accomplish three changes in the safety circuit. These three changes are as follows:

1. A failed rod in the OFF position is now to be counted for all backup purposes; also, a rod in the OFF position will be retained in the rod cooling water low flow trip circuit.

2. The emergency cooling water signal in the rod scram circuit will now be in use at all power levels.

3. A ball drain valve interlock from the rod scram circuit will be used now instead of the ball drain valve permissive switch.

Equipment Development

The necessary tools were provided through the Special Reactor Tooling Development Program for removal of the process tube from channel 1648 on March 17, 1964. This removal was accomplished to provide a Graphite Test Channel longitudinally through the reactor. Direction of craft in the work and in the use of the special tools was provided. Areas for improvement of the tooling were demonstrated. The process tube was scratched during removal but is readily salvagable for reuse in the reactor.

Inspection of the various pieces of hardware removed from channel 1648 revealed corrosive attack to the thimble in the area of the dynamic gas seal packing. This area of the thimble was found quite badly pitted. The individual packing rings were found to be hard and rust colored on their O.D. where they were in contact with the thimble and in their original condition on their I.D. Investigation of the packing was initiated to determine the mechanism of corrosive attack and corrective measures that could be employed if determined necessary.

In the Special Reactor Tooling Development Program, fabrication of special reactor tool prototypes designed and developed by Equipment Development Operation of Irradiation Processing Department has progressed on schedule. The tools necessary for support of the non-irradiated tube removal were made available as needed. Prototypes requiring modification as determined during the tube removal include the protective liners for thermal shield, the outlet nozzle carriage assembly, and the drive for the internal tubing cutters. Prototype equipment completed during this reporting period include the tube expander double thrust collar, cap plug redressing tool and a special 1-1/2 inch Grayloc burnishing tool. Items in the process of

development include the process tube pusher, a process tube shield plug, a crate spot facing tool, an inlet nozzle/tube sleeve guide mechanism, on-pile tube rolling equipment and a special Grayloc seal ring retainer device.

Results received on the test for halogens in the high temperature anti-sieze compound under evaluation in the NPR-PCE loop indicate the compound to be undesirable for use where it could conceivably enter the process water stream. Chloride concentrations to 130 ppm and fluoride presence up to 100 ppm are more than allowed in a system containing 300 series stainless and zircaloy tubing. Evaluation of other high temperature anti-sieze compounds has been planned at the Advanced Technology Laboratory, Schenectady, New York.

The process tube of the full tube mockup in the NPR-PCE loop was replaced with a new tube (HT-256) to provide a non-marred I.D. surface for fuel/spacer flow tests. The Environmental Test Facility's new insulation cover was completed following the addition of six (6) diversion valves to the flow stream. The facility was operated at 1800 psi, 550 F for fourteen days since the valve additions were made. The NPR-PCE loop was used to perform testing of a permanent injection water strainer for the N-Reactor primary pumps. Flow/pressure drop characteristics were obtained for the strainer as was performance under various plugged conditions. The results verified adequate strainer design for the application.

Testing of four conventional relays and five mercury type relays (four of them of the type used in the horizontal rod control circuitry) under maximum load conditions is continuing. So far these have accumulated over 30,000 operations with no failures.

Maintenance Standards

Approved	Issued for Approval	To Be Issued
34	29	6

The total number of Critical Equipment Maintenance Standards required for submittal to the Atomic Energy Commission is 69.

PROGRAM EVALUATION

Design Status

Title I - 100 per cent complete.

Title II - 100 per cent complete.

Costs

We are establishing a closing notice to be issued on April 15, 1964 with all essential items to be set up on an accrual basis.

Schedules

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

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

	Scheduled	Actual
Temporary Construction	100	100
General Area Systems	100	100
105-N Reactor Building	100	100
109-N Heat Exchanger Building	100	100
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	100
153-N Switchgear Building	100	100
NPR Project (CAI-816)	100	100

AEC issued a physical completion notice on March 19, 1964 showing that the job was physically complete as of March 15, 1964.

Revision 10 of the integrated sequence schedule was issued on March 17, 1964 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 cold dump test was completed on March 21, 1964, and the hot dump test was completed on March 27, 1964.

RESPONSIBILITY

The responsibilities of the NPR Testing Program Unit were transferred to the N-Reactor Plant Operation on March 1, 1964.

ORGANIZATION AND PERSONNEL

	2-29-64	3-31-64
Exempt	86	77
Nonexempt	24	22
Total	110	99
Tech. Grad.	1	1

Personnel Changes

Name	From	To	Effective Date
RC Walker (exempt)	Field Engineering	N-Reactor Plant Oper.	3-1-64
GR Hosack (exempt)	Field Engineering	N-Reactor Plant Oper.	3-1-64
D Marinos (exempt)	Field Engineering	N-Reactor Plant Oper.	3-1-64
DR Resner (exempt)	Field Engineering	N-Reactor Plant Oper.	3-1-64
LL Grant (nonexempt)	Field Engineering	N-Reactor Plant Oper.	3-1-64
PO Lemler (nonexempt)	Field Engineering	IFD	3-23-64
SC Edwards (nonexempt)	Drawing, Spec. & Material Control	Research & Engineering	3-23-64
WE Kendall (exempt)	Field Engineering	N-Reactor Plant Oper.	3-2-64
EG Edwards (nonexempt)	Research & Eng'g.	N-Plant Engineering	3-23-64
JGC Diehl (exempt)	Field Engineering	Termination-ROF	3-31-64

Name	From	To	Eff. Date
FC Fisher (exempt)	Field Engineering	Terminate-ROF	3-31-64
WJ Pickering (exempt)	Field Engineering	Terminate-ROF	3-31-64
WL Goss (exempt)	Field Engineering	Terminate-ROF	3-31-64
RS Rodman (nonexempt)	CE&UO	N-Reactor Project	3-30-64

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
None			

VISITORS

Name	Firm and Location	Date	Purpose
T Sthulfire R Austin	Foxboro Company San Leandro, California	3-3-64/ 3-17	Installation and checkout of power calculator system
M Wittry	General Electric - APED San Jose, California	2-25/ 3-4	Initial checkout and system functional testing of the gamma energy monitor
WJ Larson	Wallace & Tiernan Seattle, Washington	3-25	To discuss servicing of water quality monitoring instruments
RW Awalt RP Connor	Beckman Instruments Fullerton, California	3-26	To discuss startup of water quality monitoring instrument.

SIGNIFICANT REPORTS ISSUED

Doc. No.	Classification	Author	Date	Title
None	Unclassified	FJ Mollerus, Jr.	3-3-64	Budget Study Report, Second Standby Boiler Facility, N-Reactor Plant
None	Unclassified	GF Bailey	3-6-64	Budget Study Report, Polonium Production Facility, N-Reactor Plant
None	Unclassified	DD Stepnewski	3-6-64	Budget Study Report, Radioactive Waste Management, N-Reactor Plant
HW-79240	Confidential	J Muraoka	3-20-64	NPR Outlet Riser Pressure Requirements
HW-81200	Secret	JF Nesbitt	3-9-64	Budget Study, Multiproduct Equipment for 100-N and CPD Plants.
HW-81403	Unclassified	WJ Dowis JW Riches	3-26-64	Nuclear Reactors for Desalting Sea Water.

Manager, N-Reactor Project

JS McMahon:mbs

N REACTOR PLANT OPERATION

N PROCESSING OPERATION

Full reactor zero power hot physics testing was continued throughout the month in conjunction with primary coolant system operational tests. The final high temperature physics measurements were in progress at month end.

The primary loop emergency cooling system tests under cold conditions were successfully completed on March 21, 1964.

The primary loop emergency cooling system tests under hot conditions were successfully completed on March 27, 1964.

Final primary loop testing under hot pressurized conditions was in progress at month end in conjunction with zero power hot physics tests. Also during this period was system cleanup by high temperature, high flow, and high feed and bleed rates to establish primary loop water quality for subsequent operations. During this period temporary strainers were in place in each process tube to trap any residual particulate matter remaining in the primary coolant system.

A ball system trip occurred on March 2 during initial hot physics tests when loss of a vacuum on a primary loop pump drive turbine caused the pump to shut down. The loss of a single pump during this phase of testing would trip the ball system. When hot physics testing was resumed on March 25 four pumps were in operation and a two pump loss was required to trip the ball system.

Initial testing of the secondary (steam generating) loop began during the month using steam supplied by the standby boiler. Steaming rates of up to 100,000 pounds per hour were attempted. These initial trials pointed up the need for more system control instrument adjustments and revealed a source of steam-water hammering in the dump condensers and the surge tank. The system was inactive at month end while modifications were being made to eliminate the steam-water hammer problems. These modifications consist of connecting the top of the dome of each dump condenser to the steam supply line above the condenser to enable the dome, which is above the normal steam entry to the condenser, to drain normally during the transition from water operation to steaming. Prior to this modification water became trapped in the dome and the steam-water hammer developed. The surge tank presented a similar problem. The steam supply to the tank entered the side of the tank instead of the top. Rerouting the steam supply into the top of the tank dome was in progress at month end.

During initial heating of the primary loop for hot physics tests water collection rates in the reactor gas system rose and at a maximum reached 60 gallons per hour. Chemical analysis of the water indicated that it was water of hydration from the concrete biological shields but the detection of ammonia indicated that it might have been from the primary coolant loop. Hydrostatic tests of all reactor shield and rod cooling systems revealed no leaks and half of the reactor process tubes were hydrostatically tested without evidence of a leak. Laboratory tests of concrete samples showed that ammonia could be present. This fact plus the observation that the water showed up only during reactor heat up pointed strongly to the shields as the source of water. At month end during the hot physics tests further tests and observations were in progress to resolve the source of the water.

Control rod circuit and safety circuit modifications were completed during the month to increase the operating reliability of these circuits. These modifications were recommended after observation of the operation of these circuits during initial testing programs. Following completion of the modifications a comprehensive functional test of the rod systems was conducted. The mercury wetted relays which failed in February are presently backed up by a replacement relay on a trial installation. This trial period continued throughout the month without incident.

One tube leak occurred in the standby boiler during the month. This leak was caused by a failure at a tack weld in a water wall tube and resulted in short outage for repair, March 13. Subsequent to this outage a series of performance tests were completed from 20 per cent to 100 per cent of load for gathering data to set the controls for automatic operation following the steam drum modifications completed in February.

The primary loop was shut down from March 4 to March 17 to permit major tie-ins for the 6th steam generator cell to be completed prior to the start of nuclear operation.

Process tube 1648 was removed from service on March 17 to permit the tube channel to be used for graphite sample irradiations.

Accidental flooding of the auxiliary cell and some of the corridors in 109 Building to a maximum depth of 12 - 18 inches occurred on March 18 during the removal of a blank in the line from the raw water supply to the graphite cooling system. The single valve in this line is remotely operated and was later found to be wired up incorrectly. When the flange at the blank was loosened some water leakage was observed and during attempts to stop this leakage so the work could proceed the valve was opened long enough to cause the flooding. No damage or significant delays resulted.

The first charge-discharge of reactor fuel took place without incident during the month when 36 tubes of fuel were replaced with fuel having slight surface imperfections but suitable for short term irradiation in preparation for the charging of special test fuel later in the year. The discharged fuel was inspected and stored for subsequent full term irradiation.

The turbo-generator turbine was removed from service on March 19 at the vendor's request for inspection and adjustment to steam regulating valves and to look for the source of internal steam leakage. Significant steam leakage into the machine was found to be through the diaphragm, diaphragm shaft seal, and gland seal steam drain valve. Repairs were effected and the machine was returned to service on March 19.

N MAINTENANCE OPERATION

Major out of the ordinary maintenance jobs during this period involved:

1. Initiation of replacement for all remaining installed 15 KV electrical distribution cable following in-service failure of power supply to No. 3 Raw Water (River) Pump - the third of four pump circuits to fail.

2. The removal and offsite repair of the Afterheat Removal Tank membrane following in-service failure (60' rip).

3. The repair of leaking seal joints in the demineralization cation No. 2 and cation regenerative tanks.

4. The on reactor work for removal of process tube and the fitting of channel 1648 for research purposes.

5. Under vendor direction the tear down, reassembly and correction of closed valve steam flows within the turbine of the 15,625 KW turbo-generator set.

In addition to the above, programs were continued to correct problems with confinement doors, annunciators and valves and valve actuators in the 105 and 109 buildings. Support of operational tests and system troubleshooting absorbed major portions of instrument and electrical maintenance manpower.

N TESTING OPERATION

Operational testing of the Primary Coolant System was nearly completed at the end of the report period. This included heatup and pressurization tests, with four primary pumps in operation and

two emergency dump tests, from 150° F to 440° F. In addition, testing was initiated or continued on many supporting systems with significant activity on the Secondary Coolant System, Confinement System, Standby Boiler, High Pressure Injection System, Graphite Cooling System, Annunciator System, and Rupture Monitor System.

Overall status of testing progress may be summarized as follows:

Total number of tests scheduled 39	This Month	Total
Scoped	--	39
Issued for Comment	--	39
Issued as Approved	2 + 1 partial	38 + 1 partial
Tests Started	2	37
Tests Completed	8	23
Final Approval of Test Data and Results	7	14

	Preparation		Performance*	
	Scheduled	Actual	Scheduled	Actual
This Month	100.0%	98.4%	89.7%	70.0%
Last Month	99.9%	96.7%	63.8%	51.4%
Net Change	0.1%	1.7%	25.9%	18.6%

*Based on N-2 Test as 15% of total performance.

N PLANNING AND SCHEDULING

During this reporting period one issue of the integrated sequence schedule was issued, Revision 10 dated March 17, 1964. In addition to this, five summary sheets have been issued outlining to interested parties the major items on the critical path.

SIGNIFICANT REPORTS ISSUED

None

TRIPS

Name	Location	Date	Purpose
E. A. Grimm	Bethesda, Maryland	3/14-17	Make presentations on N Reactor before ACRS and Division of Licensing and Regulation.

VISITORS

None

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
R. C. Walker	Project Section	Testing Operation	3/1/64
G. R. Hosack	Project Section	Testing Operation	3/1/64
D. Marinos	Project Section	Testing Operation	3/1/64
D. R. Resner	Project Section	Testing Operation	3/1/64
C. E. Bigelow	N Reactor Fuels	Plant Maintenance	3/2/64
Lynn Grant	Project Section	Testing Operation	3/2/64
J. L. Hutchinson	IPD	Plant Processing	3/2/64
W. E. Kendall	Project Section	Plant Maintenance	3/2/64
Deletions			
R. J. Kasko	Plant Maintenance	N Reactor Fuels	3/2/64
Sheryl Ritchie	Planning & Scheduling	CPD	3/9/64

W M Mathis

Manager - N Reactor Plant

WM Mathis:ds

DATE
FILMED
01/20/93