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HW--76405

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N - REACTOR DEPARTMENT

MONTHLY REPORT

JANUARY

1963

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N-REACTOR DEPARTMENT

MONTHLY REPORT -- JANUARY 1963

Compiled by N-Reactor Department

February 7, 1963 - Richland, Washington

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GENERAL SUMMARY

N-REACTOR FUELS

Manufacturing

A total of 162 billets were extruded during January, of which 140 were outer tubes and 22 were inner tubes. Production extrusions were 133% of forecast and represent an input of 33.2 tons. The total input to date is 305.8 tons or 47.4% of first load requirements. Output for the month was 1.6% of first load. Shortage of supports continued to prevent the processing of material through the final steps of the process. First run shop yield for January was 43% for outers, 58% for inners for a combined yield of 43.5%. Yields for cumulative first load are 48% for outers, 52% for inners with a combined total of 49%.

Inner tube bonding and support procurement continue as the two major problems. Twenty-two inner tube extrusions were made during the month, of which six resulted in unbonds on the I.D.

The first autoclave rupture of a production fuel was sustained. Investigation revealed that the rupture apparently initiated at the locking clip on the inner clad of the fuel. The investigation is continuing.

Engineering

Equipment and procedures are being put into place rapidly for "on-site" fabrication of all support system components. Strip is being rolled from extruded stock by Hanford Laboratories. Proof testing of the new "arch" support is underway and charging tests at 314 Building are scheduled for mid-February. As a back up, the outer suitcase handle support design is being carried along so that if the arch design process proves inadequate, we will have something to fall back on. Specifications and bid package for normal off-site procurement of support hardware has been sent to vendors.

Design and construction of a plutonium tester was completed; achievement of demonstrated performance in prototype work could represent a substantial advancement in the testing of plutonium products. Delivery on UT-2's for National Lead Company of Ohio has been set back approximately one month due to delays in receipt of component parts.

N-REACTOR PROJECT

Production and shipment of process tube diversion valves are under way. At month's end, 708 valves were assembled, 688 had passed cold tests, 19 lots (25 valves each) had passed hot tests, and 467 valves had been shipped.

Preliminary engineering studies, prescoping, and scoping of requirements for conversion have been initiated.

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Beckman Instrument Company was visited; and as a result, a reduction in scope of the Hot Water Quality Laboratory instrumentation to approximately \$425,000 was achieved. This was \$100,000 below Beckman's preliminary estimate.

Foothill electricians walked off the job on Friday, January 25, 1963, over a dispute with the pipefitters. The dispute was settled and the electricians returned to work on Monday, January 28, 1963.

Functional tests on the standby turbine-generator were performed on January 31, 1963, and the rated output of 12,000 kilowatts was achieved.

The standby boiler facility that was started in December had to be shut down January 13 due to a number of tube leaks. The faulty tubes have been temporarily plugged and the boiler has been recertified for interim operation. The tubes will be replaced by the supplier at a later date when time permits.

RESEARCH & ENGINEERING

Advance Technology

The preliminary production capability study has been completed and publication by February 15 is planned. A resume of significant preliminary data has been transmitted to the AEC.

Process Evaluation and Control

The fourth capsule of N-Reactor core graphite samples, undergoing test irradiation, was discharged from the GETR on January 22. This is the first of the "second generation" capsules. About half of the samples have an exposure equivalent to 4 - 5 years' N operation and about half have an equivalent of about two years.

Preliminary letters of inquiry were sent to four organizations potentially capable of performing analog simulations of the N-Reactor plant.

Chemistry and Metallurgy

A test involving rusting and cleaning of the carbon steel piping is being carried out in KER Loop #1 to provide information to guide N-Reactor primary piping pre-start-up cleaning procedures. This test should be completed in February.

Eight 17-inch N inner fuel tubes with bonded and unbonded contoured end closures in KER Loop #2 reached an exposure of 775 MWD/T on January 20, 1963. This test is planned for discharge during March, 1963, at an exposure of about 1900 MWD/T.

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The fourteen N-fuel elements charged in KER Loop #4 reached an exposure of 805 MWD/T on January 20, 1963. This test is planned for a goal exposure of 2100 MWD/T with discharge about June 1, 1963.

A test to evaluate the effect of temperature, clad thickness and clad uniformity on the localized jacket splitting failure mechanism of co-extruded Zr-2 jacketed rod samples, was charged in F-Reactor on January 13, 1963. The samples had reached an average exposure of about 60 MWD/T on January 20, 1963.

PERSONNEL STATISTICS

Number of employees as of December 31, 1962	414
Number of employees as of January 31, 1963	438

	<u>Exempt</u>	<u>Nonexempt</u>	<u>Total</u>
General	3	---	3
Financial	13	7	20
N-Reactor Fuels	51	106	157
Research & Engineering	25	8	33
N-Reactor Plant	48	65	113
N-Reactor Project	<u>87</u>	<u>25</u>	<u>112</u>
TOTALS	<u>227</u>	<u>211</u>	<u>438</u>

Employment

	<u>Exempt</u>	<u>Nonexempt</u>	<u>Total</u>
Additions	12	20	32
Reductions	<u>3</u>	<u>5</u>	<u>8</u>
Net Additions	<u>9</u>	<u>15</u>	<u>24</u>

SAFETY & SECURITY

Days without a disabling injury	62
Hours worked without a lost disabling injury	135,701
Medical treatment injuries (January)	8

There was 1 security violation in the Department during January, 1963.

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SUGGESTION PLAN PARTICIPATION

Number of eligible employees	211
Number of suggestions received	26
Number of suggestions acted upon	12
Number of suggestions adopted	3
Net annual savings	\$414.00
Amount of awards	\$ 55.00
Per cent of awards to savings	13.2
Average amount of awards	\$ 18.33

PATENT SUMMARY - JANUARY 1963

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

STAFF

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

RL Dickeman

General Manager
N-Reactor Department

RL Dickeman:skd

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MANUFACTURING

Production - Coextrusion Shop

A total of 162 billets were extruded during January, of which 140 were outer tubes and 22 were inner tubes. Production extrusions were 133% of forecast and represent an input of 33.2 tons. The total input to date is 305.8 tons or 47.4% of first load requirements. Shortage of supports continued to prevent the processing of material through the final steps of the process.

The bonding of inner extrusions continues to present difficulties. Of the 22 extrusions made during the month, 20 of the billets had .040 skinned from the I.D. and 1/8 inch cut from one end and two were standard square ended billets. The two standard billets and four of the skinned I.D. billets were unbonded. At the present time the best solution appears to be a copper nose cone. On each billet which has been extruded using the copper nose cone, the bond has been good.

Production Statistics

	<u>Scheduled</u> <u>Tons</u>	<u>Actual</u> <u>Tons</u>	<u>Per Cent</u>
Shop Input - Current Month	25	33.2	132.8
First Load	645	305.8	47.4
Shop Output - Current Month	30	6.3	21.0
First Load	385	32.9	8.5
Station Throughput -	<u>Inners</u>	<u>Outers</u>	<u>Total</u>
<u>Operation</u>			
Extrusion	28	140	168
Cutup 1st	476	1924	2399
Cutup Rework	136	350	486
Chemical Milling	556	3541	4097
Braze (ends)	591	4137	4728
Heat Treat	435	1992	2427
Machining (ends)	800	3952	4752
Vacu-Blast	401	1942	2343
Welding (ends)	763	3335	4098
End Test (ends)	765	3896	4661
Clad & Bond Test	405	1720	2125
Support Weld	-0-	379	379
Autoclaves	1	674	675
To Final Inspection	1	674	675

Oxide Burner - 30 batches burned = 281.52 lbs.

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Shop Yield - First RunFirst Load to Date - January 31, 1963

	<u>Outer</u>	<u>Inner</u>	<u>Total</u>
Tons Input	<u>159.7</u>	<u>70.6</u>	<u>230.3</u>
Tons Output			
a. Ready for Support Weld	51.3	32.0	83.3
b. Final Inspection	16.6	0.4	17.0
c. Final Storage	<u>8.7</u>	<u>4.3</u>	<u>13.0</u>
Total	<u>76.6</u>	<u>36.7</u>	<u>113.3</u>
Per Cent Yield	47.8%	52.0%	49.0%

Current Month

Tons Input	<u>22.4</u>	<u>1.2</u>	<u>23.6</u>
Tons Output			
a. Ready for Support Weld	4.9	0.7	5.6
b. Final Inspection	4.7	0.0	4.7
c. Final Storage	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>
Total	<u>9.6</u>	<u>0.7</u>	<u>10.3</u>
Per Cent Yield	42.8%	58.3%	43.5%

Plant Operation

An NOT element ruptured in Autoclave No. 1. Investigation of the ruptured fuel element indicates that the rupture initiated at the locking clip. The investigation is being continued by N-Fuel Product Engineering. The autoclave is not decontaminated. A nitric acid rinse was tried but it did not prove satisfactory. More severe procedures will be used.

On January 9, 1963, the exhaust system over the press caught fire following an extrusion. The fire was contained in the exhaust and did not spread to the press or any other part of the building. The fire was caused by a buildup of oil and graphite inside the exhaust ductwork. After the fire was out, the entire exhaust system was dismantled and cleaned. Inspection holes were cut in the ductwork and a monthly inspection will be started.

A small fire occurred in the Chemical Bay at the contaminated lathe. Fire resulted from excessive chip buildup around tool holders. No damage or loss of production occurred. Stringent operating procedures have been initiated to prevent a recurrence.

The braze reject rate on NOT elements has been high during the month due to voids in the braze line. As the braze ring melts, part of the ring flows and part does not as though the ring is not homogenous. Some braze lots produce more rejects than others even though all rings are from one vendor. No trouble was encountered on the NIT elements that were brazed during the month.

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Plant Operation (Continued)

Copper sleeves (7-1/2 and 6 inch) that are cleaned and inspected at the vendor's plant are coated, after inspection, to prevent the sleeves from discoloring. The sleeves that have this treatment will not clean up using our process. After the pieces are dry, they have a gray color which can be wiped off. The vendor has been contacted to find out what material is used and how to remove it.

A malfunction of the water deionizing equipment occurred which permitted water to enter the building air system. Modifications to the control for air and water systems were initiated and a solenoid actuated valve installed in the water system. Further study is being conducted on this problem as to the desirability of additional safety features. A report will be issued after the evaluation is completed.

A drain line in the Chem Bay was found fractured. This failure appears to have been due to hot water flowing over the Poly Vinyl Chloride drain line. Temporary repairs were made and a study is currently in progress directed toward eliminating future problems of this kind. It appears at present that a number of tanks were incorrectly routed. Upon completion of a study of this problem and recommendations for correction, a separate report will be issued.

The Appropriation Requests for inner fuel autoclave baskets, materials handling equipment, and NPR fuel pallets have all been approved. Work Order and Purchase Requisitions on the Appropriation Request funds are being issued.

Three training sessions have been conducted for instrument technicians and supervision, as a part of the effort toward improved instrument service, particularly in the area of testers.

Design modification has been completed for the oxide burner and sheetmetal craft work is approximately 60 per cent complete.

Oil filter system for extrusion press hydraulic fluid was installed and put into service during the month. The system is designed to remove water and foreign material.

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N-FUELS PRODUCT ENGINEERING

Fuel Element Testing

KER Loop Testing

Loop 1 - A decontamination test is now being run in the Loop 1 out-of-reactor carbon steel piping. After this test has been completed, twelve N-inner fuels (NIE-1's) will be charged. These inner fuels will be used to test the loop and will be in the loop for approximately one operating period. When Loop 1 has been accepted for fuel testing, twelve 1.6% enriched KSE-5 fuels will be charged. The KSE-5 fuel element is designed to evaluate the swelling problems associated with the proposed single tube fuel element.

Originally it was planned to charge the "crud test" (a thermocoupled fuel) before the KSE-5 fuels. It has been decided to delay charging of the "crud test" due to deficiencies brought to light during testing of the thermocouples.

Loop 2 - The "tapered end closure" test in Loop 2 is operating satisfactorily. Present exposure is about 810 MWD/T. Goal exposure is 2000 MWD/T and should be reached about April 15, 1963. This test consists of ten NIE elements with "V" shaped end recesses and mating caps, half of which are unbonded while the other half are Be-Zirc brazed.

Loop 3 - Loop 3 is still shut down for pump repairs. When these pump repairs have been completed, fourteen prototypic N-fuel assemblies (NAE-1's) will be charged.

Loop 4 - The fourteen NAE-1 fuels charged into Loop 4 on 9/26/62 are operating satisfactorily. Current exposure is about 300 MWD/T. Goal exposure is 2100 MWD/T and should be reached about June 1, 1963.

Test Fuel Fabrication

NIE-1 Throw-away Charge

The charge of twelve 17-inch NIE-1 fuels, with shroud tubes, required for the decontamination tests in KER Loop 1 is being fabricated and expected completion date is February 8, 1963.

KSE-5 Test

Two, thirteen-element charges of KSE-5 fuel elements are complete and available for charging. No other KSE-5 geometry fuels are currently being processed.

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2% Zr-U Alloy NIN Test

Six, 2% Zr-U alloy NIN fuels are at nondestructive testing prior to support welding. Also, nineteen NIN companion fuels are at non-destructive testing. A charge consisting of six 2% Zr-U alloy NIN fuels and six companion NIN fuels was originally scheduled to study the behaviour of uranium alloyed with 2 w/o zirconium in K-East Reactor, Loop 1 or 2. Provided none of the six 2% Zr-U alloy fuels are rejected during the remainder of the processing, the entire charge should be available February 4, 1963.

NAE-1 - Prototypic Elements

A charge of fourteen NAE-1 elements is ready for charging into Loops 3 or 4, and a second charge is being prepared.

N-Charge Machine Test

One charge of 54 NAE-1 fuels with "suitcase handle" supports is complete. The 186 NOE-1 fuels required for the other charges are at support welding where "arch type" and "suitcase handle" supports are being attached. The NIE-1 fuels to complete the charge are at machining and end welding. Expected completion date for the entire ten charges is February 11, 1963.

Pilot Plant Schedule

The Pilot Plant PWR Summary is shown on the following page.

Materials Development

Uranium Development

Specifications

Two changes were made this month in the specifications for uranium metal billets for NPR fuel elements.

1. The chemical specifications have been classified "Confidential" and reissued as a separate document. No change was made in the chemical requirements. This classification was made on the basis that certain impurities were added in controlled amounts to obtain a desired result in coextrusion.
2. The location for cutting the transverse wafer for hydrogen analysis has been changed from between the "A" and "B" billets of the primary extrusion to between the rear billet and the rear end crop. This change will permit obtaining planned chemical analyses of the uranium near the bottom of the ingot without increasing the number of saw cuts during extrusion cutting.

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CONSTRUCTION PILOT PLANT WORK SCHEDULE
DATE ISSUED: January 31, 1963

Prepared by: R. K. Robinson

PWR NO.	DATE ISSUED	SPONSOR	WORK DESCRIPTION	MATERIAL REQUIRED	MATERIAL LOCATION IN PROCESS	EXPECTED PROCESSING COMPLETION DATE	SUMMARY PWR STATUS
47	9/19/62	WK Alexander	Comparison of Zirconium alloyed braze and zircaloy-2 alloyed braze	12 - NOE-24" 12 - NIE-24"	Complete 12/28/62	-----	To Be Issued
48	9/18/62	JL Guthrie	Fabricate 1.6% enriched KSE-5 fuel elements for loop testing	26 KSE-5-12"	Complete 1/9/63	-----	"
49	10/1/62	"	Fabricate U-2 W/o Zr fuel elements with NIN companion fuel elements for loop testing	6 NIN-18" (2%) 6 NIN-18"	6 NIN-Nondestructive Testing (2%) 17 NIN-Nondestructive Testing	2/4/63 "	Req. Req.
50	10/15/62	WG Hudson	Recovery of white weld beads and effect of extended autoclave cycle	6 NIE: 4 NOE	Complete 1/2/63	-----	To Be Issued
51	10/20/62	WK Alexander	Evaluate integrity of cap-clad braze below the circle braze groove	500 NOE closures 500 NIE	350 NOE-Machining 200 NIE--	4/1/63	Req.
52	10/20/62	RK Robinson	Provide fuel element assemblies for N-charge machine Test No. 22	54 NAE-24" 54 NAE-24" 24 NAE-18" 108 NAE-12" 2 NAE-24"	Complete 1/25/63 54 NAE-Support Weld 24 NAE- " 108 NAE- " Complete 1/27/63 (Fabrication)	----- 2/11/63 " " -----	Req. " " To Be Issued
53	12/26/62	RK Robinson; AP Larrick	Evaluate loop vibrations on fuel element supports under high temperature dynamic water cond.	100 NAE	Brazing	2/11/63	Req.
54	1/11/63	WG Hudson	Evaluate new end cap closure design to reduce rejects caused by crimping, reduce voids in braze, reduce depth of recessing and reduce size of braze ring	24 NIE-17"	To be extruded	4/19/63	Req.
55	1/23/63	JL Guthrie	Fabricate NIE-1 fuels, loop flow tests and heater elements	12 NIE-17"	8 NIE - Complete 5 NIE-Support Weld	----- 2/8/63	Req.
56	1/23/63	JL Guthrie	Fabricate NIE-1 fuel elements for decontamination test in Loop 1				

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Cladding Variation

A program is under way to reduce the possible effect of the highly oriented cast ingot structure on coextruded zircaloy cladding thickness variation. This program includes (1) preparation of ingots containing different amounts of silicon for grain refinement to erase the cast structure, (2) testing the effect of heat treating billets in different ways, (3) increasing the amount of uranium reduction by increasing the diameter of the cast ingot, and (4) combinations of the above.

The first group of test materials received and coextruded consisted of outer billets of the standard alloy composition that had been single beta heat treated after finish machining of the I.D. The coextrusion performance of these billets is being compared to the coextrusion results obtained from billets that were not heat treated and billets that were heat treated before final finish machining. The purpose of this test is to determine if a thin surface layer of rapidly quenched beta heat treated uranium grains is critical in achieving a smooth and uniform cladding thickness on the I.D. of the N-outer coextrusion.

Analysis of the data has not been completed, but initial examination of the results by Quality Control have indicated no major difference will be expected from this heat treating process alone. The per cent of fuel sections with inner cladding variations in excess of 0.008" are tabulated below by test and control group.

TABLE I
PER CENT OF FUEL SECTIONS WITH
CLADDING THICKNESS VARIATION IN EXCESS OF 0.008"

<u>Billets Heat Treated</u> <u>On Finished I.D.</u>	<u>Billets That Were</u> <u>Not Heat Treated</u>	<u>Billets Heat Treated</u> <u>Before Machining</u>
7.7%	9.3%	12.4%

It was interesting to note that a strong effect from billet position within the primary extrusion was noted. These data show a much poorer performance from the "A" billet which is the top of the cast ingot and the lead end of the primary extrusion. These data follow:

TABLE II
PER CENT OF FUEL SECTIONS WITH
CLADDING THICKNESS VARIATION IN EXCESS OF 0.008"

<u>Billet</u> <u>Type</u>	<u>Billets Heat</u> <u>Treated On</u> <u>Finished I.D.</u>	<u>Billets That Were</u> <u>Not Heat Treated</u>	<u>Billets Heat</u> <u>Treated Before</u> <u>Machining</u>
A	13.7%	21.7%	24.3%
B	7.1%	4.5%	3.8%
C	0 %	7.1%	11.9%

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Copper Components

One of the prospective suppliers of copper extrusion cans has recently completed a pilot lot of good cans made by extrusion. An evaluation order for 100 extruded cans has been placed, and if the product of this order is acceptable, we will then have two approved vendors and processes. The currently approved process employs welding of sheet.

Supports

Zircaloy-2 Strip

Hanford Laboratories have been rolling all the strip for on-site support fabrication and will continue to do so until commercial supplies are available. At present, approximately 100 pounds of strip has been rolled to 0.040" for outer supports, either the "arch" or the old type. None of this material has been slit as the slit width depends upon the support type. Approximately five additional pounds of this strip has been slit to 0.355" to be used for further arch support development.

The supply of 0.035" thick material for inner supports is very limited. There is no 0.045" material available for locking clips. Approximately 100 pounds of split cladding shell material is on hand at the rolling mill for reduction to strip.

Outer Supports - Arch Type

Tooling to make arch supports at Hanford has been completed and tested. A run of more than 1,000 parts was completed and is being inspected. These parts will be used in the fabrication of test pieces to check the compatibility of this type support with the N-Reactor charging machine. These tools will be installed in a new punch press in the 333 Building where support fabrication will be carried out.

Tools for making the steel shoes for the arch supports are being fabricated.

Outer Supports - Suitcase Handle Type

Hanford Laboratories are making new tools for fabrication of the "suitcase handle" outer support to be used if testing of the arch support is not satisfactory.

Tools for making the steel shoes for the suitcase handle supports are available.

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Inner Supports

Hanford Laboratories are modifying their inner support tooling to conform to the current support design. The HL tools are the only ones in existence that can make metallurgically satisfactory supports inasmuch as they are the only ones capable of hot forming. Parts formed cold suffer reduced fatigue resistance and annealing after cold forming results in excessive grain growth around the bend areas. After completion of several satisfactory lots by HL, the tools will be moved to the 333 Building where production will be carried on.

Locking Clips

Currently, there are no tools available that can produce locking clips according to the latest design. Modification of the base of the support to give proper clearance between the support and the I.D. of the outer fuel tube, for proper welding, made all present tools obsolete. Other than hand made parts, none are available, or will be, until new tools are finished.

Coextrusion Process

Extrusions

The following extrusions were made during the reporting month:

7.5 Inch Tooling

One Composite - ZT-27

ZT-27 - NOE with HL fabricated inner clad zircaloy component

One Zircaloy Billet - Z-154

Z-154 - 2-1/2" O.D. zircaloy-3 rod for end cap stock

6.0 Inch Tooling

33 Composites - X-46 Through X-60 and X-63 Through X-80

All billets were extruded in an attempt to isolate the cause, or causes, for inner tube I.D. unbonding.

Two Zircaloy Billets - Z-155 and 156

Z-155 & 156 - 1/2" x 3-3/4" zircaloy bar stock

Four Special Billets - L-4 Through L-7

L-4 and 5 - Upset thorium rod billets

L-6 and 7 - KSE-3 with thorium core

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Inner Tube - I.D. Bonding

The exact cause or causes of the I.D. bonding problem on NIE coextrusions have not yet been defined. However, development and production extrusions performed during the month have shown that bonding can be accomplished with some reliability by machine removal of 10 to 20 mils of stock from the uranium billet I.D. The reliability of I.D. stock removal will be further tested during early February with extrusion of larger quantities of material.

Development extrusions during the month also showed that use of copper nose cones during extrusion produced extrusions with good bonds. These cones affect the extrusion by (1) increasing upset extrusion pressures due to billet chilling by the cone and (2) restraining any tendency for copper weld failure due to deformation during upset. Further testing of this technique will be performed in February in an attempt to define which of the above two effects are of primary importance in promoting good bonds.

In addition to extrusion tests, extensive chemical analysis of various O.D. and I.D. surfaces is now being performed at both HAPO and NLO in an attempt to define any differences in uranium billet quality.

Chemical Processing

Cleaning Autoclaved Zircaloy

A cleaning process to remove shop dirt, fingerprints, light oils, and water stains from autoclaved fuel elements currently in final storage in the 333 Building Production Facility has been developed. Before releasing these fuels for final reactor storage, the surface contamination must be removed and the elements protected from further contamination.

Bench scale and pilot plant scale tests indicate that autoclaved zircaloy fuels may be cleaned satisfactorily by soaking 5-7 minutes in a hot aqueous solution of Alconox alkaline cleaner followed by thorough rinsing in hot process water, cold process water and hot demineralized water. Since this cleaning process would be the final chemical process prior to reactor charging, stringent requirements regarding carry-over, reactivity, composition, and corrosion attributes of the cleaner are necessary. Thus far, the Alconox process meets the necessary requirements.

A more detailed discussion of the process may be found in HW-76375 to be issued soon.

Autoclave Process

Rupture Evaluation - 333 Production Autoclave

A production NOE fuel element ruptured this month in Autoclave #1, 333 Building, after approximately nineteen hours exposure to 400°C steam at 1500 psig. Examination of the fuel and associated debris indicated that the rupture probably initiated in the fore of the fuel in the general vicinity of the two locking clips.

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The three pieces of hardware (two locking clips and one outer support) that were severed from the fuel element by the rupture were located intact and still attached to fragments of zircaloy clad.

One locking clip was located in the bore of the ruptured fuel element and at the bottom of approximately 15 inches of uranium and zircaloy debris that had filled the tube during the rupture. The other locking clip and outer support were located near the top of the debris distributed around the outside of the ruptured fuel element.

The locking clip located in the bore of the ruptured fuel element, a) contained a hole in the clad adjacent to a weld nugget, b) was attached to a spherically shaped section of inner clad, and c) was marked with a brownish-black 'burn' mark on the cladding underneath the weld nugget. Also, white stains and white oxide were observed between the locking clip and clad and at the exposed weld nugget.

The other locking clip had similar white oxide markings and also a brownish-black 'burn' mark on the cladding.

The end cap nearest the ruptured area was still attached to the fuel element through a section of the O.D. cladding. Fragments of the I.D. clad were still attached to the end cap. No metallic uranium was noted in the end cap. All fragments of zircaloy clad in and around the ruptured areas were grossly hydrided and very brittle.

Although the evidence to date suggests that the rupture occurred at or adjacent to a spot weld on one of the locking clips, the nature of the defect has not been determined. The investigation is continuing.

End Closure Development

Brazing Process

Be-Zirc Brazing Alloy Development

One of the two qualified braze alloy vendors recently submitted samples of braze rings which were made by casting directly to size. Part of these rings had been sanded to remove the mold surface and the remainder had been grit blasted only. Both groups made satisfactory closures but the grit blasted surfaces released small amounts of dross on melting which might prove undesirable. Both groups were welded and autoclaved satisfactorily. Larger numbers of such rings will need to be tested before direct casting can be approved as a production process.

Thin Braze Line Closures

Twenty-four each, outer and inner, closures were made with thin braze lines and then were welded at various amperages and rotational speeds in an attempt to optimize the welding process. Autoclave tests of some of the best welds were satisfactory. Metallographic examinations

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of welds made under various conditions showed satisfactory penetration except for the cases where very low amperages were used. It is tentatively concluded that this modification of the brazed closure should be incorporated into the production process. Some modifications of the process welding equipment may be necessary to give the operator better control of electrode positioning.

Beveled Zircaloy Closure Caps

Development work has been in process during the past two months to improve the process and operating techniques at the braze station to eliminate process yield losses due to slop-overs, non-fills, voids, etc. The most promising approach on this problem to date has been the use of zircaloy caps beveled ("V" shape) at the top to promote braze material flow during heating in place of the present crimping technique. Additional benefits which may be obtained with the use of beveled caps are (1) a reduction of chemical milled depth and (2) a reduction in the amount of braze material required.

A large scale pilot plant test is now being performed on fuels of both geometries which will be used for the charging machine test. Following completion of the charging machine test, the closures will be evaluated for quality and, based on favorable results, a production test using beveled zircaloy closure caps will be initiated.

Thermal Cycle Testing of N-Fuel Closures

Beta quenching from 730°C salt to cold water is being used as a means of inducing closure failure. This extreme treatment will cause failure eventually, but not until the uranium has become seriously distorted. It may be that this uranium distortion complicates the stress pattern to such an extent that it can no longer be assumed that the observed failure is solely the result of differential thermal expansion between the zircaloy and uranium. The failure threshold for Be-Zirc brazed closures, both outer and inner, with standard caps appears to be about 25 beta quenches. Be-Zirc brazed closures with V-bottomed caps appear to distort more rapidly and fail sooner than the standard closure. Gas pressure bonded closures show cap-core distortion after 24 cycles but have not failed.

A further test of the cap-to-core bond strength of the Be-Zirc closure was made by machining small cylindrical pins from the wall of fuel elements for beta cycling. The pins were machined so that they were zircaloy on one end and uranium on the other, bonded together with Be-Zirc. These pins were then quenched in cold water from 730°C salt. Failure was defined as the time when the uranium dropped off of the zircaloy. The first failures were at about 25 cycles, which corresponds well with the full scale tests noted above. Uranium distortion was more pronounced in this test because there was no restraining clad present. Half of the samples

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in this test were made from standard production uranium which has iron and silicon additions. The balance of the samples were made from uranium to which no additions had been made. The latter group, without iron and silicon, was found to be significantly more resistant to failure than the former.

Gas Pressure Bonded End Closures

Lot No. VII

This lot was fabricated with titanium closure rings to see if this material would completely fill the striations on the cladding surface. Four specimens were first autoclaved in 400°C steam for three days and then in 360°C water for 98 days before one of them failed. The second of these four failed between 151 and 165 days at which time the test was discontinued. The balance of the lot was autoclaved in 400°C steam for 31 days before the first failure occurred. No further failures had occurred when the test was terminated after an additional 37 days of testing.

Lot No. XI

Zirconium closure rings with semi-circular ridges on the circumferential bonding surfaces were tried in an attempt to eliminate the "pipes" which are caused by the residual cladding striations. Testing of three NOT and three NIT specimens in 400°C steam for 64 days did not produce a failure. One specimen was removed at 50 days because of heavy spalling corrosion. Corrosion of the zirconium closure rings varied from a few very small white spots in some cases to spalling over the entire closure ring surface. Exposure of three NOT and four NIT specimens in steam for three days plus 67 days in 360°C water produced one failure. Deep stringer type corrosion was found penetrating the closure rings. On the basis of these two corrosion problems, the test was discontinued and no further work with zirconium is planned.

Lot No. XV

This lot of six outer and six inner elements was prepared by the standard Be-Zr brazing process without closure welds to determine the long term effect of 360°C water and 400°C steam on the brazed joints. After 60 days exposure in both steam and water there was no evidence of visible corrosion.

Zircaloy-3

To overcome the corrosion problems with zirconium, a corrosion study is being made of zircaloy-3 coupons in steam. If satisfactory corrosion resistance is obtained, a study will be made of it as a possible closure material. The closure rings are in the process of being machined.

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Titanium-Zirconium Alloys

Coupons of 40, 45, 50, 55, 60 and 65 per cent titanium-zirconium alloys are being autoclaved in 360°C water and 400°C steam to determine if corrosion rates equivalent to those obtained at the U. S. Bureau of Mines, Albany, Oregon can be duplicated. The Bureau found that some alloys in this range exhibited a corrosion rate one-half that of zircaloy-2. If satisfactory results are obtained, then it is planned to examine this alloy as a closure ring material. Dissolving studies are being performed by Chemical Research, Hanford Laboratories.

Solid State Diffusion Summary

The end closure pressure bonding studies to date have shown that bonding between zircaloy-2 and the metals studied can be accomplished in one hour at 650°C provided two basic conditions are met. These are:

1. Surface films are removed (e.g., by cathodic etching) and the surface sees only an inert atmosphere or vacuum until it has been bonded to a mating surface.
2. There must be sufficient pressure to produce complete contact between the two surfaces to be bonded.

Item (1) will probably promote bonding between almost any two metals at temperatures lower than if this condition is not met. Item (2) is a necessary condition for any diffusion bonding. There is some evidence that bonding, per se, is not particularly pressure sensitive. Since metal flow is required to bring the mating surfaces into contact, pressure is a definite variable of the process. While any geometry can be bonded, the pressures required to produce contact between the mating faces will vary.

The nature of the joint depends on whether the two metals form inter-metallic compound layers or solid solutions. Compound layers, which tend to be brittle, can be eliminated by use of a thin layer of a third metal which will form solid solution with the other two.

Fuel Element Supports

Welding Process

The primary effort in this area during the month included a complete evaluation of the locking clip welding process. This evaluation was performed in connection with the evaluation of an autoclave rupture to determine the over-all consistency and quality of the locking clip welding process.

Results of the tests carried out showed that the welding cycle per se could not cause sufficient penetration or reduction of corrosion resistance of the fuel cladding to cause failure in the autoclave. Ranging the welding variables from one extreme to the other produced incomplete welds or splattered the molten pool, but overpenetration could not be caused. These tests do not eliminate the possibility of a welding-process-associated variable. Maloperation of the welding cycle; e.g., several weld cycles superimposed on each other, is being assessed. Sectioning of the failed weld nugget suggests a double weldment. Further testing of welding variables is being performed, and the welding process and operating procedures will be reviewed prior to further attachment of locking clips.

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Equipment Development

Projects completed during January were as follows:

The arch support dies were modified to produce parts which will meet the current design.

The arch support sizing machine was completed and debugged. Since it was built as a prototype to demonstrate the feasibility of sizing arch supports after welding, it does not have the capability of handling 18" or 21" pieces. A previously used sizing machine will be modified to handle the shorter lengths temporarily until a production machine is available.

Dies for stamping arch support steel shoes have been finished and will be tested as soon as work schedules permit.

Equipment for sizing "buggy spring" inner supports after welding has been fabricated and is being tested.

Projects in process are as follows:

1. Alternate End Closure Pilot Plant (CAF-954) - This project is in the FY '63 P.A.C. Budget and it is necessary that certain action be taken to prevent its being dropped. Specifically, the Commission has requested the two following items by the indicated dates:
 - a. Design Criteria, by February 1, 1963.
 - b. Technical Feasibility Study, by May 1, 1963.

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TESTING METHODS OPERATION**DECLASSIFIED**N-Fuel Testing

Negative results were obtained on the correlation of extrusion variables with the grain size of the billets as determined by the radial ultrasonic test (B-test). However, correlation with grain size as determined metallographically was good. Nondestructive determination of the properties of uranium may be possible and some investigations along this line will be made. Work was continued on using an eddy current test to examine the inner bore of billets for correlation with extrusion results. An improved balance circuit for greater stability and simpler balancing was designed and built. For the probe itself, two approaches are being used: a large area probe with an encircling coil and a toroid; and a small probe using crossed coils. Using these two probes, tests will be made to measure the uranium resistivity in both the longitudinal and transverse directions since orientation may be a factor in extrusion behavior.

Engineering support for the routine operation of fuel testers, location and grounding of an air duct, and corrections in the tester set-up, have resulted in improved performance of the testers. Further improvements in a light-weight outside probe using softer neoprene were not successful; however, testing will be continued on both outside and inside probes using a harder neoprene.

A start was made, in cooperation with Quality Control, in setting up special cap-clad tests on N-Fuels to determine the feasibility of more precise testing for process control purposes.

AlSi Fuel Testing

Downtime of the 313 Building testers was approximately 10% during January compared with 15% during previous month. A low performance of the UT-4 testers was more than offset by a near record high performance of the UT-2 testers. Auditing continued on reproducibility, and with the exception of the internal bond tester and the closure tester, large decreases were experienced. Some of the loss appeared to be attributed to standards and with necessary changes made, performance should return to normal.

Two-thousand C VI AlSi bonded pieces were tested for internal bond with both a Lamb wave probe and a pulse echo probe. There are no significant difference in results, except that the pulse echo method reproducibility was superior to the Lamb wave techniques.

Construction of the hot die sized fuel testing stations are estimated at 65% completion. Two nickel thickness testers, two clad thickness testers, and the oscillator-amplifier are completed. Two bond testers are substantially complete with two more bond testers yet to be wired. The dual pulse counters are currently being wired.

The two UT-2 test stations, originally scheduled for delivery to National Lead Company of Ohio on February 22, 1963, are expected to be ready for shipment by late March. The later delivery date is due to delays in receiving mechanical and electronic component parts from suppliers. The spare circuit boards have been completed and are ready for shipment.

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Irradiated Fuel Testing Facilities

Thirty-four irradiated fuel elements were tested on the UT-11 station installed at 105-C. A reproducibility test on these elements was about half complete, indicating good reproducibility with only a 6% change in total count after a four-day interval. Preliminary use of the recorder gave accurate reproduction of the unbond signals but some feed-back occurred which will be corrected.

The entire UT-10 station for N-fuel testing was put into operation for the first time at the pilot location in 189-D Building. The bond tester operated satisfactorily for internal and external testing conditions, and no further modifications are anticipated. The cap-core testing remained unproved because of transducer failures and standards difficulties. Initial tests of the core tester showed insensitivity to the standard defects, but instrument changes corrected this condition. Three transducer timing positions are used on the core tester to give complete coverage of all possible discontinuity orientations which provides a significantly improved core tester.

General

Background problems associated with the alpha contamination testers have been identified to some degree and are being corrected. Concurrently, data is being obtained on one fuel element from each autoclave. They have been running normally from 21 to 39 micrograms per outer tube. Reduction of background count will be necessary to achieve reasonable throughput rates.

Two enrichment testers are available, located in the 313 and 333 Buildings, respectively. Associated with ALSi operation are 18 different models of fuel elements all having slightly different geometry or shape. To date the enrichment has been measure successfully in all of the 15 models tested. Billet enrichment measurements in 333 Building have given characteristic count rates for each ingot, and shows that enrichment can be determined whether the fuel was clad or bare. The detection of Ruthenium continues to be of interest to Chemical Processing Department and Irradiation Processing Department and use of the tester may be considered as a possible test on incoming material.

The design and construction of the UT-13 plutonium tester was completed. Drawings of the station are nearing completion and a maintenance manual is being prepared. The ultrasonic system is capable of resolving 15 mil discontinuities to within 10 mils of the front surface. A electronic gating system capable of presenting data by sectors was developed. Other unusual developments included a Z-axis modulation circuit for repetition rate changes and a logic circuit which will prevent operation if all testing requirements are not being fulfilled. A special spiral recorder was designed and built, capable of resolving 10 mil areas

Improvements were made for the amplifier and pulser of the resin level indicator (UT-3) used by the Chemical Processing Department. Improved stability and a better signal to noise level was achieved.

A Schlieren imaging system for ultrasound is being investigated for its use as a tool for determining properties of metals and understanding ultrasonic generation and propagation. Significant increase in sensitivity of the system was achieved by a mirror arrangement which causes the light to traverse the ultrasound beam twice.

Approval was obtained for procurement of a bore camera for photographing the inside surface of N-fuels. The Purchase Requisition for bids has been processed.

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N-REACTOR FUELS OPERATION
JANUARY 1963

VISITORS

<u>Name</u>	<u>Company</u>	<u>Contact</u>	<u>Date</u>	<u>Reason</u>
H. F. Sawyer	Nuclear Metals, Inc. Concord, Mass.	C. H. Shaw	1/2- 1/4	Consult on NIE bonding problem
L. M. Levy J. F. Schiltz M. M. Cawdrey C. E. Bussert	National Lead Co., Cincinnati, Ohio	T. D. Naylor	1/8- 1/11	" "
J. L. Klein	Nuclear Metals, Inc. Concord, Mass.	L. M. Loeb	1/14- 1/17	Discuss audit of N-Reactor fuels
Everett Potter	General Electric Co., Schenectady, New York	T. B. Correy	1/23	Discuss welding of fuel elements
R. A. Graham	Wah Chang Co., Albany, Oregon	G. W. Riedeman	1/24	Technical and contractual liaison
C. A. Brown	Rem, Inc. Portland, Oregon	"	"	"
W. Kelly	Sciaky Brothers, Los Angeles, California	T. R. Groupman	1/28- 2/1	Installation of Sciaky Equipment

TRIPS

H. P. Kraemer	ALCOA - Edgewater, N. J.	M. A. Ziegler	1/7-8	Discuss caps & cans
"	JBM Tool & Die, Bryan, Ohio	Ezra Johnson	1/9	Extrusion tooling
"	Cliff Mfg., Cleveland	Albert Katz	1/10-11	Alum. caps & cans
"	Z&W Mfg., Cleveland	John Konet	1/10-11	Water mixing spoons
"	Harvey Aluminum Torrance, Calif.	Geo. Christensen	1/14-15	Zircaloy end caps Alum. caps & cans
"	Western Filter Gardena, California	Robert Gardner	1/15	Water mixing spoons
"	Airline Welding Gardena, California	H. L. Merideth	1/15	Cooper sleeves
"	R&R Tool & Die North Hollywood, Calif.	Geo. Ballentine	1/16	Aluminum stampings
"	Bridgeport Brass Riverside, California	Clarence Hoehne	1/17-18	Alum. caps & cans Zircaloy sleeves

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<u>Name</u>	<u>Company</u>	<u>Contact</u>	<u>Date</u>	<u>Reason</u>
T. D. Naylor	Bridgeport Brass Co., Ashtabula, Ohio	J.F. Puterbaugh	1/28-30	Monitor primary extrusions of NPR uranium
T. D. Naylor	National Lead Co., Cincinnati, Ohio	C.E. Bussert	1/31- 2/1	Consult on NIE bonding problem

Organization and Personnel

	<u>12/31/62</u>	<u>1/31/63</u>
<u>Exempt</u>	53	54
<u>Nonexempt</u>	104	107

Transfers

<u>Name</u>	<u>From</u>	<u>To</u>	<u>Effective Date</u>
D. C. Worlton (Exempt)	Manager - Testing Methods	HL, Physics & Instrument R & D	1-1-63
W. R. Krehbiel (Exempt)	HL, Finance & Admin.	Manager - Quality Control	1-1-63
R. B. Socky (Exempt)	HL, Physics & Instrument R & D	Manager - Testing Methods	1-28-63
L. N. Goulet (Nonexempt)	Reactivate	Quality Control	1-9-63
P. M. Loris (Nonexempt)	CPD	Support Services	1-21-63
A. S. Perkins (Nonexempt)	CE & UO	Manufacturing	1-28-63
L. V. Greer (Nonexempt)	IPD	Manufacturing	1-28-63
P. D. Sperline (Nonexempt)	Manufacturing	Handford Laboratories	1-28-63

Rotational Personnel

G. L. Wilfert	Handford Laboratories	Quality Control	1-1-63
N. W. Porter	New Hire	Testing Methods	1-1-63

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DECLASSIFIEDINVENTIONS

All Engineering personnel engaged in work that might reasonably be expected to result in inventions or discoveries advise that to the best of their knowledge and belief, no inventions or discoveries were made in the course of their work during December, 1962. Such persons further advise that for the period therein covered by this report, notebook records, if any, kept in the course of their work have been examined for possible inventions or discoveries.

SIGNIFICANT REPORTS

HW-76338, "Reprocessing of N-Fuel Rejects Through End Closure Recessing,"
W. G. Hudson, January 24, 1963 (Unclassified)

HW-76155, "Chemical Specifications for Uranium Metal Billets for NPR Fuel Elements,"
T. D. Naylor, January 10, 1963 (Confidential)

HW-76456, "Nondestructive Audit Report for January," C. J. Denton, February 5, 1963
(Unclassified)

SECURITY VIOLATIONS

There were no security violations in the N-Reactor Fuels Operation during December. Total CYTD - 0.

Manager - N-Reactor Fuels

LM Loeb:pml

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RESEARCH AND ENGINEERINGORGANIZATION AND PERSONNEL

	<u>12-31-62</u>	<u>2-1-63</u>
<u>Exempt</u>	<u>21</u>	<u>30</u>
<u>Non-Exempt</u>	<u>6</u>	<u>8</u>
TOTAL	27	38

Additions

<u>Name</u>	<u>From</u>	<u>To</u>	<u>Date</u>
A. E. Engler	CE&UO	Process Evaluation & Control	2-1-63
Joene Estabrook	HAPO General	Advance Technology	1-28-63
B. B. Lane	HL	Process Evaluation & Control	1-18-63
D. W. Leiby	GE Schenectady	Controls, Instruments & Systems Anal.	1-15-63
E. E. Leitz	IPD	Process Evaluation & Control	1-1-63
P. F. Nichols	HL	Reactor Physics	2-1-63
Joan Osborne	HL	Process Evaluation & Control	1-21-63
E. G. Pierick	CPD	Advance Technology	2-1-63
J. W. Riches	HL	Chemistry and Metallurgy	1-7-63
L. D. Smith	HL - Tech. Grad.	Process Eval. & Control - Perm.Assign.	2-1-63
J. W. Vanderbeek	HL	Process Evaluation & Control	1-1-63
G. R. Wilde	CE&UO	Process Evaluation & Control	2-1-63

Transfers Within the Section

<u>Name</u>	<u>From</u>	<u>To</u>
Betty Howard	Process Evaluation & Control	Controls, Inst. & Systems Analysis
C. F. Poor	" " "	" " "
R. H. Shoemaker	" " "	Reactor Engineering

Removals

T. W. Ambrose transferred from Chemistry and Metallurgy to IPD, 1-7-63.

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 January, 1963. Such persons further advise that for the period therein covered by this report, notebook records, if any, kept in the course of their work have been examined for possible inventions or discoveries.

SECURITY VIOLATIONS

One

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TRIPS

<u>Name</u>	<u>Company</u>	<u>Contact</u>	<u>Date</u>	<u>Reason</u>
E. E. Leitz	NS Savannah Galveston, Texas	Jim Morrissey Chief Engineer	1-9-63 thru 2-10-63	Obtain information on pressurized water reactor opera- ting experience.
R.E.Trumble	NS Savannah San Diego, Calif.	Jim Morrissey Chief Engineer	1-9-63 thru 1-15-63	" " "
K.W.Norwood	DuPont - SRP	T. C. Evans	1-22 & 1-23	Attend Mtg. of FEDC Working Committee
	GE-MSD - Philadelphia	J. H. Brown	1-23	Tech. Recruiting
	GE-KAPL - Schenectady	J. Leslie	1-24	" "
	GE-Engr. Services - NY	O. Sorensen	1-25	" "
	GE-Capacitor Dept. Hudson Falls	H. H. Marvin	1-28	Interview
J.W.Riches	DuPont - SRP	T. C. Evans	1-21 thru 1-24	Attend FED Advisory Committee Meeting

VISITORS

<u>Name</u>	<u>Company</u>	<u>Contact</u>	<u>Date</u>	<u>Reason</u>
J. L. Klein	Nuclear Metals, Inc. Concord, Mass.	J. W. Riches T. W. Evans A. C. Callen	1-14 thru 1-17	To discuss the first draft of the Fuel Audit he is conducting.

SIGNIFICANT REPORTS ISSUED

HW-76033, "N-Reactor Natural Uranium Fuel Loading," W. S. Nechodom, 12-29-62 (Secret).

HW-75577, "Functional Requirements of an N-Reactor Simulator," (to be issued) C. F. Poor, 11-12-62 (Secret).

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ADVANCE TECHNOLOGY

The preliminary production capability study, which was performed in concert with Reactor Engineering, has been completed. A resume of significant preliminary data has been forwarded to the AEC. A brief summary of this report has been completed for inclusion in the over-all HAPO study. The preliminary work should be published prior to February 15.

Preliminary work has started for preparation of 1964-65 budget plans. A technical review of all programs and preliminary planning will be conducted in February.

REACTOR ENGINEERING

The program proposal to acquire data on NPR connector and plugged fuel element flow and pressure drop characteristics in the 189-D test facility, has been studied by the Equipment Development Operation, IPD, and a detailed program is being planned. The testing program to be performed by the Thermal Hydraulics Operation of Hanford Laboratories to obtain steady-state and transient data on a mock-up of an NPR process tube and fuel configuration will be initiated next month.

PROCESS EVALUATION AND CONTROL

Nuclear Health and Safety Meetings

The philosophy and scope of operating limits and associated nuclear safety matters were discussed in meetings attended by representatives from NRD, IPD, HL and RLOO.

NPR Graphite

The fourth capsule of N-Reactor core graphite samples, undergoing test irradiation, was discharged from the GETR on January 22. This is the first of the "second generation" capsules. About half of the samples have an exposure equivalent to 4 - 5 years' N operation and about half have an equivalent of about two years. The third of the "second generation" capsule was charged into the reactor.

N-Reactor Simulation

On January 18, 1963, preliminary letters of inquiry were sent to four organizations potentially capable of performing analog simulations of the N-Reactor plant. These organizations are:

- a. Princeton Computation Center, Princeton, New Jersey

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- b. Aeronautical Systems Division, Wright Patterson Air Force Base, Dayton, Ohio.
- c. Beckman Instruments, Inc., Berkeley, California.
- d. General Electric Company, Schenectady, New York.

CHEMISTRY AND METALLURGY

Irradiation Testing in Support of N Reactor Fuel

KER-1

KER-1 is empty. A test involving rusting and cleaning of the KER-1 carbon steel piping, PT-IP-551-A, is being carried out to provide information to guide N Reactor primary piping pre-startup cleaning procedures. This test should be completed in February at which time the first fuel charge will be loaded.

KER-2

KER-2 was charged November 27, 1962, with eight 17-inch N inner fuel tubes with bonded and unbonded contoured end closures under PT-IP-536-A, Supplement A. The charge reached an exposure of 775 MWD/T on January 20, 1963, and is planned for discharge during March, 1963, at an exposure of about 1900 MWD/T.

KER-3

KER-3 is out of service for lack of pumps. A charge of fourteen N-fuel elements with a downstream flow channel temperature measuring thermocouple train is available for loading when the loop is ready.

KER-4

The fourteen N-fuel elements charged into KER-4 on September 26, 1962, reached an exposure of 805 MWD/T on January 20, 1963. This test is planned for a goal exposure of 2100 MWD/T which should be obtained about June 1, 1963.

Cladding Studies Test

A test to evaluate the effect of temperature, clad thickness, and clad uniformity on the localized jacket splitting failure mechanism of coextruded Zr-2 jacketed rod samples, PT-IP-510-A, was charged in F Reactor on January 13, 1963. The samples had reached an average exposure of about 60 MWD/T on January 20, 1963, and should reach the desired exposure of 2000 MWD/T around May 1, 1963.

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CONTROLS, INSTRUMENTS AND SYSTEMS ANALYSIS

The Controls, Instruments, and Systems Sub-section came into being during the month of January. Major activities during this period involved the interviewing of personnel and the organizing of the work of the Sub-section. In addition to the personnel listed on page C-1 of this report, we have commitments from two engineers who will be transferring from CE&UO effective April 1, 1963.

M.C. Leverett
Manager
Research and Engineering

MC Leverett:LCC:mlk

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N-REACTOR PROJECT OPERATIONRESPONSIBILITY

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

ORGANIZATION AND PERSONNEL

	<u>12/31/62</u>	<u>1/31/63</u>
<u>Exempt</u>		
Permanent	87	86
Tech Grads	0	2
<u>Non-Exempt</u>	<u>23</u>	<u>24</u>
TOTAL N-REACTOR PROJECT PERSONNEL	110	112

Transfers

<u>Name</u>	<u>From</u>	<u>To</u>	<u>Effective Date</u>
Smoot, GW (Exempt)	Pile Erection Engineering	N-Reactor Plant	1/14/63
Willmott, Berniece (Non-Exempt)	IPD	Reactor Design Analysis	1/14/63
Lemler, Patricia (Non-Exempt)	HLO	Pile Erection Engineering	1/21/63
King, JH (Tech Grad)	IPD	Reactor Design Analysis	1/1/63
Kopenen, BL (Tech Grad)	CPD	Reactor Design Analysis	1/14/63

Terminations

Merrill, Bonnie (Non-Exempt)	Reactor Design Analysis	Leave of Absence (Pregnancy)	1/11/63
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SAFETY AND SECURITY

No disabling injuries and no security violations were reported.

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.

N-REACTOR PROJECT OPERATIONTRIPS

<u>Name</u>	<u>Firm and Location</u>	<u>Date</u>	<u>Purpose</u>
Morris, WJ	Chandler-Evans Corp. West Hartford, Conn.	12-11 to 12-20-63	Diversion valve production problems
Reinig, LP	Chandler-Evans Corp. West Hartford, Conn.	12-27 to 1-11-63	Diversion valve production problems
Kratz, EM	Seattle, Wash.	1-3-63	Turbine-generators
Bainard, WD	Dow Industrial Pittsburg, California Consolidated American Hawthorne, California Beckman, Fullerton, Calif.	1-1 to 1-4-63	To obtain information on chemical cleaning and water quality
Jensen, HF	Dow Industrial Pittsburg, California Consolidated American Hawthorne, California	1-1 to 1-4-63	To obtain information on chemical cleaning
Harty, WM	Chandler-Evans Corp. West Hartford, Conn.	1-4 to 1-9-63	Diversion valve procurement problems
Mundt, WJ	Burns and Roe Hempstead, New York	1-7 to 1-10-63	To discuss remaining design and ATPs
Johnson, HG	Burns and Roe Hempstead, New York General Kinetics Corp. Bridgeport, Conn.	1-7-63 to 1-13-63	To discuss ATPs To review relief valve design
Fastabend, JH Stice, JE	Gray Tool Company Houston, Texas	1-14 to 1-15-63	Grayloc redressing problems
Bainard, WD	Atomics International Piqua, Ohio Consolidated Edison Indian Point, N. Y.	1-15 to 1-18-63	Discuss pre-startup chemical cleaning Same
Jensen, HF	Atomics International Piqua, Ohio	1-15 to 1-18-63	Discuss pre-startup chemical cleaning
Kosmata, HR	Burns and Roe Hempstead, New York	1-21 to 1-25-63	To discuss remaining design items and ATPs
Mollerus, FJ, Jr.	Burns and Roe Hempstead, New York	1-21 to 1-25-63	To discuss remaining design items and ATPs
Mundt, WJ	Burns and Roe Hempstead, New York	1-21 to 1-25-63	To discuss remaining design items and ATPs

TRIPS (Continued)

<u>Name</u>	<u>Firm and Location</u>	<u>Date</u>	<u>Purpose</u>
Pierce, LR Bernhagen, EM	Montek Salt Lake City, Utah	1-27 to 1-29-63	Control panel production problems
Reinig, LP	Chandler-Evans Corp. West Hartford, Conn.	1-27 to 2-1-63	Diversion valve production problems
Bainard, WD	Beckman Instruments Fullerton, California	1-28 to 2-1-63	To obtain information on water quality instrumentation
Johnson, VV	NS Savannah Training Cruise - Portland, Ore. to Galveston, Texas	1-5-63 to 2-10-63	Review of operating experience of NS Savannah reactor.
Resner, DR	Seminar - Material Management Institute Los Angeles, California	1-14 to 1-15-63	PERT/Time planning techniques seminar.
	Humboldt Bay Power Stn. San Jose, California	1-16-63	Direction of startup testing program.
Stice, JE	Rucker Company Oakland, California	1-15-63	Review horizontal rod fabrication.
Love, CE Walker, RC	Chicago Operations Ofc. AEC - Chicago, Illinois	1-21-63	Review pre-operational testing problems.
Love, CE Walker, RC	Hallam Nuclear Facility Hallam, Nebraska	1-22-63	Review pre-operational testing problems.
Walker, RC	Elk River Reactor Elk River, Minnesota	1-23-63	Review pre-operational testing problems.
	Piqua Nuclear Facility Piqua, Ohio	1-24-63	Review pre-operational testing problems.

VISITORS

David, HT	Bailey Meter Company Cleveland, Ohio	1-28 to 2-2-63	To discuss analog studies and 109-N instrumentation and control
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UNCLASSIFIED

HW-76405 D

SIGNIFICANT DOCUMENTS ISSUED

<u>HW Number</u>	<u>Classification</u>	<u>Author</u>	<u>Date</u>	<u>Title</u>
HW-73101	Confidential	J Muraoka	1-29-63	Consequences of an NPR Inlet Riser Rupture
HW-75135	Unclassified	JH Fastabend	12-31-62	Zr-2 to Caron Steel Expanded Joint - N-Reactor Process Tube Fitting
HW-75666	Unclassified	FJ Mollerus, Jr. CL Goss RK Robinson	1-9-63	Failure Sequence Review of the NPR Heat Dissipation Plant Control Systems
HW-76062	Secret	DL Condotta	1-2-63	Reactor Design Analysis Monthly Report - November 1962
HW-76123	Secret	DL Condotta	1-7-63	Reactor Design Analysis Monthly Report - December 1962
HW-76376	Unclassified	RK Robinson	1-29-63	Demands on H.P. Injection Pumps During Phase II - Six Loop Operation

UNCLASSIFIED

D-4

N-REACTOR PROJECTPROCESS DESIGN OPERATIONProcess Research and Development

A primary loop blowdown, through a complete rupture of an 18-inch inlet riser upstream from the check valve, was calculated for Phase I conditions. The analysis showed (with the emergency dump system operating as designed) a time separation between the release of steam and the release of fission products.

Plans have been made to perform a series of 24 blow-down tests with the RV-2 prototypical relief valve.

Calibration tests were performed to determine the limit stop setting for the inlet connector butterfly valves. To obtain an accurate low flow setting it may be necessary to have flow in the system.

The analog simulation of the pressurizer level, high-pressure injection pump system has been placed on the machine.

A final report, HW-75666, of the failure sequence analysis of the Heat Dissipation Plant control systems has been completed.

A study was made to determine the hydraulic characteristics and capacity of the secondary cooling system spill line.

The machine program for predicting emergency cooling test results has been modified for the new design of the emergency dump basin.

Conversion

A letter from the Atomic Energy Commission dated January 4, 1963, increased the authorization for preliminary engineering studies for Phase II operation and for performing topographical survey work to a total of \$61,000.

Phase II design requirements which are needed for capital cost estimating purposes were discussed at meetings on January 8, 9, and 10 between representatives of the Atomic Energy Commission, Burns and Roe, Bonneville Power Administration and General Electric.

Authorization of \$12,300 for prescoping, scoping and review of Title I and II design through March 1, 1963, was received in a letter from the Atomic Energy Commission dated January 18, 1963.

A number of preliminary studies to scope conversion requirements have been completed. Brief summaries of some of the results in these studies include:

1) Emergency Cooling System

The emergency cooling system is satisfactory for operation at Phase II six-loop conditions. The only changes required will be to modify the control instrumentation to include the sixth pump in the loss-of-pump-speed circuits.

2) Injection System

The high-pressure injection pumping system appears marginal at the design pump capacity of 1300 gpm. However, if these pumps will operate at 1400 gpm or greater, their capacity should be sufficient for the six-loop Phase II operation. Burns and Roe has indicated these pumps will provide 1400 gpm, and up to as much as 1600 gpm.

3) Confinement

The addition of a sixth loop and operation at the predicted Phase II conditions necessitates the installation of more roof vents to meet venting requirements following a maximum credible accident. Currently there are 13 installed vents and structural provisions to add three more vents. Calculations indicate 15 installed vents are required for Phase II operation and 18 or 19 vents may be required for Phase III operation. Therefore, it is proposed that during construction of a sixth loop, provisions be made to install four more vents, but that only two of these vents be initially installed.

4) Control of the Secondary Cooling System

Studies in this area indicate that reasonable control schemes can be adopted which will permit both flexibility and safety. Some problem of low load instability in the dump condensers is being found; however, corrective schemes appear to be available.

One item that must be clearly defined in the Design Criteria is whether to permit a complete export power load loss to cause a reactor scram. Unless turbine by-pass valves are provided, or pressure blow-off valves installed, it appears that such a complete export load loss will require a reactor scram. The frequency of such a load loss is small, perhaps once every two and one-half to five years.

Project CAI-816

Hot Water Quality Laboratory

Beckman Instrument Company was visited to effect a reduction in scope of the Hot Water Quality Laboratory Instrumentation to approximately \$425,000, \$100,000 below Beckman's preliminary estimate. This reduction is necessary to achieve the project goal of \$674,500 which includes installation of the above equipment plus sample lines and a roughing cooler. The Atomic Energy Commission is negotiating a CPFF contract with Beckman Instrument Company for the Hot Water Quality Laboratory Equipment.

Chemical Cleaning

Dow Industrial Service Division and Consolidated American Services, Inc. were visited to discuss consultant contracts for chemical cleaning of the secondary loop of the Heat Dissipation Plant. Consultant contracts, not to exceed \$5,000 each, are under consideration envisioning two to three week on-site studies and preparation of specific chemical cleaning proposals. The object of these consultant contracts is to obtain the best chemical cleaning procedure at the lowest possible cost.

Instrumentation

The Source Range and Intermediate Level Nuclear Monitor Systems were shipped on January 24, 1963. Some of the spare parts such as the preamplifiers and the log count rate meter are scheduled for environmental and dynamic testing on a Hanford test reactor.

The fourth Rupture Monitor Valve Rack was shipped from Western Piping and Engineering on January 30, 1963, completing the requirements for the right side and should permit an acceleration in installation efforts.

The precarious financial position of Avien could affect Avien's ability to complete delivery of the Process Tube Flow Monitor. At present, it is estimated that Avien can complete fabrication of the flow monitor by the middle of March and complete testing early in May if their efforts are not curtailed by financial problems. Avien is approximately 85 per cent complete and has the major panels fabricated and wired. Following fabrication, this order specifies required performance during a 720-hour test.

The order (\$118,063) for the Nuclear System ion chambers (30) was placed by Kaiser Engineers on January 15, 1963.

Testing of the 420-cycle flow monitor power supply was completed at Inet-Sprague.

Process Tube Diversion Valves

Production and shipment of process tube diversion valves are under way. At month's end, 708 valves were assembled, 688 had passed cold tests, 19 lots (25 valves per lot) had passed hot tests, and 467 valves had been shipped. General Electric inspection was increased to seven people to add assurance that faulty parts and faulty workmanship are not included in the valves.

During initial assembly and production testing of diversion valves, problem areas were discovered which necessitated changes to assembly procedures for achievement of satisfactory operation. These problem areas, together with corrective action which has appeared to have brought these situations under control, are:

1. Body flange leakage - the first group of valves leaked through the body seal when subjected to a cold hydrostatic pressure of 3675 psig at an incidence rate of approximately 30 per cent. Corrective action which has controlled this problem includes:
 - a. Lap seal surface.
 - b. Lubricate seal surfaces with fine powdered graphite or molybdenum disulfide.
 - c. Torque flange bolts for aligned closure.
2. Over-wedging between valve plate and seat - It was found on certain valves which had passed the cold tests that these units would fail to operate after thermal cycling. This difficulty was apparently caused by setting the travel-limit stops coincident with the position achieved by extending and retracting the piston with 300 psig air pressure. Since the valve is normally operated with a differential pressure of 50 to 100 psi, a substantial excess seating force was applied with 300 psig piston pressure. Correction of the over-wedging problem was achieved by setting the travel limit stops with the normal operating pressure. The lower seating pressure produced increased seat leakage and requirements were changed in this regard to permit leakage of 10 cc per minute at a differential pressure of 25 psi.
3. Valve shaft leakage - The initial packing procedure proved to be unsatisfactory for achievement of leakage less than 10 cc per hour. The procedure to seat each of the seven packing rings with a five-ton force was continued, but this was later followed with a ten-ton force after the seventh ring was installed. The packing gland bolts were torqued to 300 inch-pounds versus the earlier torque of 140-660 inch-pounds. This added packing force produced shaft seals which were dead tight in most cases, but the increased friction load on the shaft resulted in a galling problem.
4. Valve shaft galling - After the increased packing force was applied per item 3 above, galling was consistently observed between the packing gland and the shaft and occasionally between the shaft and the spacers. The solution which evolved included:
 - a. Increase the diameter of the spacers from .877 to .910 inch.
 - b. Taper both ends of the gland to prevent edge loading; leave one-half inch minimum bearing length.
 - c. Coat the gland bore with a dry film lubricant, Indium plus Electrofilm 66-C.
 - d. Provide axial alignment of the gland by maintaining .010 inch parallelism between the gland flange and the mating housing face.
5. Actuator cylinder leakage - It was observed after hot tests that actuator cylinders would leak air through the cover gasket or the piston rod packing. The torque on bolts involved was checked and it appeared that the gasket and packing had become heat-set. The problem was controlled by baking the assembled actuators for one hour at 600 F and retorquing the bolts.

Nozzle Caps

Kaiser Engineers' purchase order 14202 was placed with Bruce Industries, Inc. on December 18, 1962, for the cap assemblies, at a cost of \$73,390.20. The first ten cap assemblies of the order are scheduled for design testing at Hanford in the Environmental Test Facility in the 189-D Laboratory. Approval data including drawings, magnetic particle procedure and forming and heat treatment outlines are expected momentarily. Completion of the order is scheduled for May, 1963.

Design Review of Supports for Primary Piping

Electric Boat Division has submitted the results of the final computer analyses of the diversion piping system. This study showed that expansion stresses in the six-inch diversion headers are within allowable limits. Electric Boat recommended that the six-inch diversion headers be allowed to move freely in the North-South direction. Since stresses are within the allowable under the present design, and since Anchors 226, Guides 261 and all diversion headers are already field installed, it is not feasible at this late date to change the design in order to minimize stresses.

FIELD ENGINEERING OPERATIONConstruction105-N & 109-N Buildings

Foothill electricians walked off the job on Friday, January 25, 1963, over a dispute with the pipefitters. They started returning to work Monday, January 28 and were back on the job in full strength by Tuesday, January 29, 1963.

Leakage tests on all three of the Zone II exhaust fans have now been satisfactorily completed.

Approximately 3,500,000 feet of electrical cable has now been pulled by CPFF forces in the 105-N and 109-N Buildings. This represents approximately 53 per cent of the total required.

Electrical panels PC-4, PC-6 and PC-7 were received and placed in the 105-N control room on January 3, 1963. Job site inspection of these panels revealed numerous deficiencies with the result that the vendor's representative has visited the site and indicated that the vendor was responsible for a number of the noted deficiencies. No off-site inspection was performed on these panels. A field engineer visited the vendor's plant on January 28 to inspect the one remaining panel being furnished by this supplier so that any deficiencies can be corrected prior to shipment.

The installation of instrument tubing is continuing to make good progress. There have been some delays due to shortage of spare parts for the automatic welding machines and relocating the welding machines from place to place as the work progresses. Manual welding is also continuing at a good rate.

The reject rate at Tube Methods Incorporated on 3/16" stainless steel tubing is continuing at approximately 40 per cent. About 60 per cent of the tubing has now been shipped.

In addition to electrical panels PC-4, PC-6 and PC-7, the communications console and the diversion valve control panel have been installed in the 105-N control room.

The installation of the rupture monitor systems valve racks has been started in the right side rupture monitor room and the rupture monitor turrets are now being permanently installed.

117-N Building

The subcontractor is continuing with work on punch list items in this facility.

181-N River Pump House

The two diesel engine pump units have been run-in and the gear drive boxes opened and inspected.

163-183-N Buildings

Testing and correcting of deficiencies in the demineralizer plant is continuing by Bumstead-Woolford, the subcontractor.

184-N Standby Power House

The boiler was started up on December 27, 1962, and supplied heat and steam to the area until tube failures were experienced on January 13, 1963. A total of five tube failures were located and one repaired and the other four plugged off. The boiler was fired up again on January 22 after retesting and recertification, and is again supplying heat and steam to the area. Test runs on the turbine generator set started January 31, 1963, when it was operated up to 12,000 kilowatts.

Pile Erection

Installation of connectors and diversion valves in the left rear pipe space was initiated, but is progressing slowly due to the need to make repairs to the Grayloc hubs and to straighten connectors before installation. Present indications are that over 300 Grayloc hubs need to be machined and burnished before diversion valves can be installed. Tooling is being developed to perform this work, but in the meantime the Grayloc tool developed primarily for operation maintenance is being used to perform the work. Use of this tool is too time consuming for the amount of work required.

Modification of horizontal rod drive units at the 189-D Building is being delayed pending delivery of the last of the units from the vendor.

Preparations are underway to remove the temporary crane over the left rod room which will allow the installation of the Ball-X elevator. This will also allow the work to proceed on completing this system.

Aligning and babbiting of rod drive assemblies in the right rod room is continuing slowly. No substantial progress is being realized in the left rod room due to interference from instrument tubing installation.

Installation of hydraulic elevator components continues at a slow pace with interference with other activities being an increasing problem.

Primary Piping

Seven hundred and fifteen spools have now been shipped to the field from the HUICO Shop. This represents a total weight of 783.1 tons.

Based on the total number of spools needed for completion of the Primary Piping System, excluding connectors, the following figures represent the percentages of shop fabricated spools shipped to the field.

105 Building	78.8%
109 Building	71.3%
Total System	74.6%

Total spools now accepted at the HUICO Shop stands at 870 or 90.8 per cent of the total number required. (This excludes connectors).

Sixty-six connectors have been shipped to the field. This represents 6 per cent of the total number required.

Testing Program

Design prepared ATP's are currently being reviewed to extract those items of a Title III testing nature which must be performed by construction forces prior to formal operational testing. The review of seven ATP's has now been completed with appropriate notations transmitted to the Unit Supervisor responsible for Title III testing and inspection.

Of the 58 presently scheduled operational tests, seven have now been scoped by the Test Unit, four have been prepared to the comment stage, and five others are in preparation. Actual testing activities have not yet been initiated, pending completion of construction and Title III testing and inspection.

Administration

The following material has been processed during the period December 17, through January 20, 1963.

Drawing	289
Criteria	2
Specifications	4
Requisitions	63
ATP's	7
Other	<u>3</u>
Total	368

No engineering material was issued for review or comment.

Bailey Meter Material processed as of January 20, 1963 is as follows.

Released as Noted for Fabrication Drawings	105
Released for Information	135
Released for Fabrication Drawings	135
Not Released for Fabrication Drawings (B&R)	1
Approved without exceptions (GE)	<u>6</u>
Total	382

Following is the status of Subcontract KE-11252 (HUICO) data as of January 25, 1963.

Total Number Received	2794 (Included 2001 Received for Information Only)
Number Approved	742
Number Approved with Exceptions	27
Number Not Approved	22
Number Currently Being Reviewed	2
By GE & B&R - jointly	2
By B&R (109-N)	0
Number Received for Information Only - No Approval Required	2001

PROGRAM EVALUATIONDesign Status

Title I - 100 per cent complete.

Title II - 100 per cent complete.

Costs

No change was made in the Official Budget Estimate during this reporting period. The current estimate for Project CAI-816 remains at \$188,320,000 (Budget Estimate for the NPR Supporting Facility Projects is \$6,880,000, for a total of \$195,200,000).

No change has been made to the General Electric Work Authority for completion of punch list items. As reported last month, the current interim authorization totals \$160,000.

Schedules

On February 1, 1963, RL00-AEC issued Revision # 5 to the Certified Construction Schedule. This schedule shows a construction completion of March 15, 1964.

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

	<u>Scheduled</u>	<u>Actual</u>
Temporary Construction	84	83
General Area Systems	90	90
105-N Building	79	78
109-N Heat Exchanger Building	64	67
163N-183N Water Treat Facilities	99.5	100*
181-N River Water Pump House	99.6	100*
182-N High Lift Pump House	98.6	98.6
184-N Standby Power House	99.7	99.4
153-N Switchgear Building	100	100*
NPR Project (CAI-816)	77.1	77.5

* Being carried as complete with the exception of punch list items.

Manager, N-Reactor Project

JS McMahon:mef

END

**DATE
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