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FUELS PREPARATION DEPARTMENT

MONTHLY REPORT

NOVEMBER

1962

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HANFORD ATOMIC PRODUCTS OPERATION

RICHLAND, WASHINGTON

GENERAL ELECTRIC

DECLASSIFIED

MASTER

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HW-75683

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FUELS PREPARATION DEPARTMENT

MONTHLY REPORT -- NOVEMBER 1962

83855

Compiled by Fuels Preparation Department

December 7, 1962 - Richland, Washington

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GENERAL SUMMARY

MANUFACTURING

Production

AlSi Process

1. Output of AlSi fuels exceeded the forecast during November.

2. Inventory of finished fuels reflected a 1.8 month supply at month's end, excluding 105 tons of dingot elements.

3. Bare core inventory at month's end reflected a 1.2 month supply, excluding 268 tons of dingot cores.

Coextrusion Process

1. An input of 23.3 tons resulted in 122 extrusions during November. Process input to date represents about 38 per cent of the first reactor load requirements.

General

1. For the third consecutive month, a new record high plant operating efficiency was achieved. November plant operating efficiency was 99.2 per cent.

2. Cost improvements in the amount of $15,279 were approved and adopted during November. Year-to-date approved cost improvements total $673,342.

3. FPD became qualified during November as a member of the G.E. Suggestion Plan 400 Club with approximately 420 adopted suggestions per thousand eligible employees.

ENGINEERING

Present Reactor Fuels

Irradiation Failures

Ten regular I&E production fuel elements failed in reactors during November. Rupture resistance of non-bumper fuels has apparently declined based on the experience of the past two months. This is the same tendency recently observed with non-bumper fuels. Evaluations are underway to define the causative factors in this trend.

Uranium Technology

Vacuum Outgassing Enriched Uranium

Vacuum outgassing enriched uranium in hollow core blank form following beta heat treating was authorized at National Lead Company of Ohio beginning November 14, 1962. This process treatment was requested to reduce surface hydrogen, which can evolve from the uranium cores during the canning operation at Hanford and contribute to fuel braze and closure porosity. National Lead Company has the capacity to vacuum outgas only 50-60 per cent of the enriched cores required for the first cycle of the E-N load.

Iron and Silicon Additions to Natural Ingots

National Lead Company began adding controlled amounts of iron and silicon to all natural ingot uranium early in November for grain size control. Initial shipments of this material will be received at Hanford about mid-December.

Eight-Inch Diameter Ingots

National Lead Company has completed an evaluation of casting and rolling eight-inch diameter ingots with favorable results. The major advantages of casting eight-inch ingots include: a ten per cent increase in throughput capacity without any equipment changes, larger diameters which aid in removal of impurities during solidification, savings of $100,000 per year in scrap reductions.

Oil Quench Ingot Program

As of November 1, about 16 tons of hollow core blank, oil quenched ingot fuel elements had been discharged at goal exposure and an additional 11 tons were undergoing irradiation. Approximately 96 additional tons of oil quenched cores are to be irradiated under the existing production test.

Projection Fuel Program

Approximately 2150 tons of bumper fuel have been charged to date in the old reactors and 1525 tons discharged at variable goal exposure. Twenty-four hundred feet of elliptical bumper rail strip was received from the vendor and is being checked out for conformance to specifications. If acceptable, this material will be used to complete testing of the prototype elliptical rail feeder and to prepare initial quantities of elliptical bumper fuel for irradiation.

As previously reported, the exposure of alloyed dingot overbore fuel elements has been decreased to 75 per cent of goal (800 MWD/T) because of the higher rupture potential of dingot material. Use of dingot overbore cores will be discontinued as soon as the existing inventory (approximately 25 tons) is exhausted.

Optimized Canning Studies

A series of tests were completed and a number of important process changes made to upgrade the quality of OIII enriched fuel elements, particularly for the second H Reactor E-N loading scheduled early in CY 1963. Since a majority of the enriched fuel ruptures experienced in the reactors have been of the "hole" and "end" types, this effort was directed primarily toward optimizing duplex bath and canning bath parameters to improve fuel braze and closure integrity.

Assembly of enriched fuel elements for the E-N load began on November 19, and has progressed satisfactorily except for incurring an abnormal AlSi slop-over, reject rate. This is largely attributed to the higher canning bath temperatures, can-sleeve vibrator frequencies, and quench pressures.

Aluminum Component Cleaning Studies

Analysis of the data from a recent test to evaluate the effects of controlling the deoxidizer (Diversey 514) solution pH on aluminum component wettability in molten AlSi was completed. The test results not only emphasize the importance of pH control, but indicate solution concentration may be reduced as much as 50 per cent, yielding an annual cost saving of approximately $15,000.

AlSi Pilot Plant Activities

During the past month, a total of 4,904 fuel elements were canned in the 306 Pilot Plant. Of these 4,391 were for reactor use and the remainder for process improvement studies. In addition, 1340 fuel elements were rewelded, 72 thermocouple assemblies were used to measure can-sleeve preheat rates, and 95 aluminum cans were subjected to wetting tests.

Alternate Process Development

Hot Press Bonding

A contract for $13,660 was agreed to with the Sylcor Division of Sylvannia Electric Products Company to produce up to 1000 CIVE fuel elements by the Sylcor Hot Press process. Receipt of the hot press fuel elements is expected at Hanford in January 1963.

Hot Die Sizing

Metallurgical examination of representative samples from a test designed to optimize conditions for producing hot die size bonded fuel elements is continuing. Conclusions reached thus far and recent fuel assembly temperature measurements are summarized as follows: 1) nickel-aluminum diffusion thickness increases with the temperature increases of the pieces at the time of sizing. The higher thickness values were produced by combinations of high temperature and long preheat times; 2) there was some indication that higher aluminum reduction ratios produced thicker nickel-aluminum diffusion on the internal surfaces; 3) bonding on the lateral surfaces near the ends can be improved by increasing the fuel assembly temperature during sizing at the ends.

Two tests designed to establish optimum process parameters for end bonding in the end bonding press were completed and are being evaluated.

Electroplating Nickel on Uranium

Testing and evaluation of fuel elements prepared by three pretreatment processes as reported last month was continued. These variations pertain to removal of the oxide sludge following electrolytic etching. A process flowsheet and descriptive material were prepared as a design basis for the nickel plating facility equipment (Project CGF-979).

AlSi Fuel Testing

Availability of the nondestructive test equipment has averaged around ninety per cent the past month. The audit system of maintaining frequent, routine checks on the tester has proven to be an effective method of early spotting and correcting of operational difficulties.

The external and internal bond tests were set to reject on both total count as well as count rate for the inspection of enriched material. This is the first time the testers have been set to reject normal production material on a total count basis. Attempts will be made to continue this mode of operation.

End bonding of 60 elements have been tested before and after attachment of self-support clips to determine if the ultrasonic welding process had any detrimental effect on the quality of the bond. The results were negative.

Extensive laboratory tests are being made to determine the criticality of test variables on the bond test data. To date, the effect of track rotational speed, pitch, water temperature, fuel element temperature, and water air content have been quite thoroughly investigated. The present effort is looking at the effect of transducer alignment and tubing. These data are being obtained in order to more precisely define test parameters important to the 313 Building test equipment. Ultimately, this information will be useful in the design of new test equipment which will be built to replace the present testers.

The hot die size fuel inspection system now under shop fabrication was modified to include two additional bond tests for the inspection of N bonding. Although these changes will delay completion, the unit is expected to be available for laboratory check-out around the first of the year.

End bonding of 145 experimental hot die size elements were successfully examined in the laboratory for process evaluation purposes. Test results are presently being checked with metallographic examination.

Irradiated Fuel Inspection

Difficulty has been experienced in making operational both the N-fuel irradiation test equipment being installed in 105 KE and the AlSi test equipment being installed in 105-C. Some testing has been accomplished with the latter equipment, however, and full operation is expected within a few days.

N-Reactor Fuels Development

Coextrusion Process

Four primary, three zircaloy, one uranium and 5 component extrusions using 11.1 inch and 7.5 inch tooling were accomplished during the month.

KER Loop Testing

Loop 1 is now purposely running empty. A decontamination test of the loop piping is scheduled and should be completed some time between December 30, 1962 and January 15, 1963. The "tapered end closure" test was charged into Loop 2 on November 27, 1962. Half the fuels for this test have unbonded end closures, while the other half have Be-Zr brazed closures. Planned goal exposure is 2000 MWD/T which should be completed by about April 15, 1963. Loop 3 is currently shut down for pump repairs and should be back in operation some time after January 1, 1963. The fourteen NAE-1 fuels in Loop 4 are operating satisfactorily. Present average tube exposure is about 420 MWD/T. Tentative goal exposure for Loop 4 is 2100 MWD/T.

Pilot Plant Fabrication

A charge of fourteen NAE-1 fuels is at the KE-Reactor ready for charging. These are backup charges for Loops 3 and 4.

Ten 17-inch NIE-1 fuels with shroud tubes are available for use as heater elements with the "crud" test.

Approximately fifty 1.6% enriched KSE-5 fuels are at heat treating in the Pilot Plant. These will be used as backup charges for Loops 1 and 2.

2% Zr-U Alloy NIN Test

This test is for the purpose of studying the behavior of uranium alloyed with 2% zirconium. Fuels for this test are at end recessing step in the 306 Pilot Plant. Completion is estimated at about January 15, 1963.

I&E Fuel

Fifty unsupported coextruded I&E fuel elements will be delivered early next week to IPD for irradiation.

Materials Development

Uranium Specifications

Agreements were reached with personnel of both the National Lead Company of Ohio and the Bridgeport Brass Company on all details of HW-67575, Revision 2, "Specifications for Uranium Metal Billets for NPR Fuel Elements." The resulting revisions to this manual were transmitted through the AEC on November 6, 1962. Only two substantial changes were made in the requirements, namely: power and time cycles were temporarily specified for control of the melting

and casting cycles; beta heat treating of the billet blanks has been discontinued because better coextrusion results have been obtained in non-heat treated billets.

The specifications of 0.030 inch maximum bow and 0.080 inch maximum wall variation for the billet blank have not been changed. However, these requirements were waived until National Lead Company and Bridgeport Brass Company developed more data to define these requirements. With the exception of this waiver, all requirements of the "Specifications For Uranium Metal Billets for NPR Fuel Elements" are considered to be in effect.

Billet Chemistry

Magnesium zirconate crucible coatings have been used for casting of ingots. It was believed that the crucible coatings would reduce particulate graphite, carbide and soluble carbon pickup in the molten metal and result in a better surface quality on the ingot.

Recent evidence at National Lead Company shows that zirconium contamination may have entered the uranium feed stream from this coating. Also, elimination of this coating on castings made to other specifications and no adverse effects on the quality of the castings has occurred. Therefore, production of up to 50 ingots with no crucible coatings used in the melting have been authorized on a test basis.

Ingot Uniformity

Plans are being made to cast solid ingots and drill the hole. However, it will take six months to a year to put this conversion in place. The ingots should then be more uniform than hollow cast ingots because of improved concentricity and because of removal of the center core of uranium which should include the shrinkage voids and many of the impurities present in the melt. A quantity of 18 test and 18 hollow control ingots has been cast at NLO to quantitatively measure these effects. This material should be available for coextrusion in January, 1963.

As a further step in demonstrating the benefits of ingot uniformity, National Lead Company has been requested to machine the O.D. of a test group of ingots and to square and chamfer the lead ends. The machined O.D. should cause the ingot to aline horizontally in the primary extrusion press. A previous test has shown that the chamfer caused the lead end of the ingot to lift on the die cone angle and center in the container just prior to upset. This substantially improved billet yield and concentricity.

Nondestructive Testing - Eleven-Inch Diameter Uranium Ingots

Initial attempts to evaluate uranium ingot coextrusion quality by nondestructive testing methods were initiated during the month. Six to eight ingots with various chemical compositions (Fe and Si content) were tested. This testing showed considerable differences exist between ingots at various Fe and Si levels and some differences between ingots with the same amounts.

NOE Sleeved Billet I.D.'s

Four NOE coextrusions were made during the month with one-half inch thick sleeves in the uranium billet I.D.'s. The primary purpose of this small experiment was to determine the significance of uranium billet alpha phase work history on coextruded inner clad thickness variation.

N-Single Tube Coextrusion

Coextrusion of the prototype N-single tube fuel element geometry was initiated during the month. The primary purpose of this work is to establish the primary areas for development in coextrusion of a single tube fuel design. Preliminary evaluation of the coextrusion performed indicates the primary fabrication problem which will exist on this basic fuel geometry will be control of inner clad thickness variation.

Billet Lubrication: Sand Blasted Copper Cans

Twenty-four inner tube copper cans and front end plates have been sand blasted with a No. 36 garnet grit to improve the lubricant retaining power of the copper cans. Examination of the extrusion data indicates that die pickup is greatly reduced using the sand blasted cans.

Chemical Processing

Horizontal Chemical Milling

Tests performed to date in the 333 Building on the new techniques of horizontal chemical milling have been successful. Masking washers and holders of improved design are now being fabricated.

Autoclave Process

Corrosion Coupons

Autoclave testing of reactor grade zircaloy-2 corrosion coupons, 1" x 1" x 0.035", with each autoclave load of production fuel elements was initiated this month. A temporary source of carefully fabricated, corrosion tested zircaloy-2 strip has been established to supply coupons for the startup of production autoclave testing. Autoclaving of "standardized" corrosion coupons will serve as a check on the etching operation and the correctness of the autoclave cycle.

End Closure Development

Brazed Closure

Vendor Qualification - Braze Rings

Five thousand each, inner and outer, braze rings have been supplied by the Brush Beryllium Company. These rings were ordered to provide Brush the

opportunity to become qualified as a second supplier of this material. Several hundred fuel elements have been brazed with this material so far and yields have been as high as with normal material.

Brazing Characteristics of NON Iron-Silicon Uranium

Metallurgical examination of brazed closures on inner fuel sections made from uranium to which no iron or silicon had been added indicated that a compound layer forms much more readily, between the braze alloy and the uranium, than when iron and silicon are present. It is believed that the presence of silicon may retard the formation of a compound layer.

Thermal-Cycle Testing of the Braze Closure

Twenty-seven samples of the N-inner piece are being thermal cycled. Each sample has had between 3 and 45 cycles through the temperature range of 20°C to 730°C to 30°C.

Based on both nondestructive and visual testing, there have been five failures. The failures are cap:core unbonds and two of them have progressed to transverse shear failures of the inner clads at the cap:core junction. One failure occurred in the interval of 4 to 9 cycles; four failures occurred in the interval of 22 to 45 cycles, but one of these showed incipient failure after only three cycles.

Fuel Element Supports

Outer Supports

As noted in previous reports, it was decided to change the design of the outer support of the N-fuel from the "suitcase handle" design to the "arch" design. The new support has about three times the impact strength of the old supports. Fully prototypic outer tube supports of the "arch" design with crimped steel shoes attached have been successfully fabricated in the pilot plant. Approximately one dozen assmblies were tested for load deflection characteristics. These ranged from 800 to 1150 pounds load at .040 to .050 inch deflection. This is classed as satisfactory.

Offsite production of the "arch" support has been delayed due primarily to classification and contracting problems; however, at the present time it seems that attachment of outer supports will be in production prior to February 1, 1963.

Inner Supports

The design modifications to the inner support (buggy spring) have been firmed up and materials have been developed by HLO, who satisfactorily produce this piece. It is planned to produce some of the highly ductile strip on-site, by HLO, and to fabricate an initial quantity of supports. At the same time, activity should permit the production process of putting inner supports on fuel elements to be in place by February 1, 1963.

Welding Process

The problem of arc burns and pickup during projection welding of the supports has finally been eliminated.

Nondestructive Testing Development

N-Fuel Test Program

It is now rather definitely established that the degree of impurity content in both billets and ingots can be reliably predicted by ultrasonic measurement. The correlation between ultrasonic pre-extrusion measurements and extrusion performance, however, is not so precise. For example, 16 per cent of the fuel elements extruded from 142 outer billets which had been selected as "good" by the ultrasonic test were rejected because of excessive clad thickness variations of the inner surface. In comparison, the extrusion of 21 billets which appeared "poor" to the same pre-extrusion test, produced roughly 38 per cent rejects for the same reason of non-uniform clad thickness.

Routine operation of the N-fuel tester has caused special problems this month. Excessive downtime resulted from attempted use of internal probes whose dimensions were not within design specifications, and from the necessity of replacing the test tank mechanisms which rotate the fuel element during testing. In order to eliminate this difficulty, simplified rollers have been designed and are now under shop fabrication. Additional effort has been devoted to development of an extremely lightweight combination eddy current-ultrasonic test probe for replacement of the bulky and occasionally troublesome probe now in use.

Hydrogen Embrittlement Detection

The possibility of detecting hydrogen embrittlement in zirconium process tubes continues to look favorable. At this point, approximately twelve samples ranging in concentrations estimated to be from 700 to 5000 ppm hydrogen have been made available for the ultrasonic test.

Testing Method for N-Reactor Primary Piping

A novel method of displaying ultrasonic defect data is being investigated. Development of the technique has been motivated by problems associated with inspection of the N-Reactor primary piping in which conventional test practices have not provided needed information relative to defect size and position. An electronic beam is scanned across the face of a cathode ray tube in direction and in time exactly corresponding to the path taken by the ultrasonic pulses as they travel through the wall of the pipe. Defect indications are fed into the electronic sweeps such that the traces are brightened at points corresponding to the point in the metal where the defect signals are generated. As the beam is directed through the weld bead, defects thus appear in their approximate geometrical position. Early laboratory evaluation of this idea with rather crude laboratory mechanical devices has been most favorable. Continued work will be aimed at refinements applicable to the inspection of installed piping.

NPR PROJECT

Engineering studies for dual-purpose operation of the NPR were reviewed at a meeting on November 1, 1962, with representatives of the Atomic Energy Commission, WPPSS, BPA, TVA, R. W. Beck and Associates, and Burns and Roe.

Five additional 190 degree cooling transient tests were run on the number 3 primary coolant pump by Byron Jackson. Casing measurement after the tests indicated no dimensional changes had occurred and Byron Jackson has given an unequivocal engineering opinion that the pumps will perform reliably in field service.

The Heat Dissipation Plant Design Concepts on Charge-Discharge, Emergency Seal Water, and Modal Station were received from Burns and Roe and approved by General Electric.

The Integrated Data and Temperature Monitor System was accepted at Information Systems Incorporated on November 28, 1962.

The calculations of pressure and flow transients caused by pipe failures in the NPR cooling system have been completed.

Establishment of the NPR Testing Program Unit as a separate functional component within the Field Engineering Operation was made effective on November 5, 1962. This Unit will provide over-all integration, planning and administration of the NPR testing and acceptance program. In this regard, preparations have been made for take-over for General Electric custody of the 108, 151, 153, 163, 181, 183, 184 Buildings and portions of the 182 Building and 1900 Area pipe systems.

Arrangements have been made for the modification of the horizontal rod drive units at the 189-D Building by Kaiser Engineers. These units are those that have failed to meet deceleration requirements at Rucker Company.

All primary loop headers have been installed in the left outlet and left inlet pipe spaces. Installation of tubing racks has now started in the outlet pipe space.

PERSONNEL STATISTICS

Number of employees as of October 31, 1962 926
Number of employees as of November 30, 1962 927

	Exempt	Nonexempt	Total
General	2	1	3
Employee Relations	1	0	1
Engineering	49	28	77
Financial	13	8	21
Manufacturing	113	494	607
N Reactor Engineering	13	2	15
N Reactor Operation	44	47	91
NPR Project	89	23	112
Total	324	603	927

Employment		November	October
Additions:	Exempt	2	147
	Nonexempt	9	86
		11	233
Reductions:	Exempt	4	1
	Nonexempt	5	4
		9	5

Additions to the FPD rolls during November included two Engineers transferred into N Reactor Operation from IPD; four new hires as replacements (two Janitors, a Stenographer, a Junior Power Operator); an Instrument Technician transferred from IPD for N Area; a replacement Secretary reactivated; a replacement Stenographer transferred from the Steno Pool; a Metal Handler addition transferred from HLO; and an excess Instrument Trainee transferred from HLO.

Reductions included a Manager transferred to HLO as a Specialist; a Consulting Engineer transferred to X-Ray Department, Milwaukee, Wisconsin; an Engineer resigned; an Engineer transferred to CPD; a Stenographer resigned; a Janitor on a Request for Transfer to IPD; a Pile Operator transferred back to IPD on request; a Chem Analyst on pregnancy leave; and a Janitor retired.

STAFF

General Manager	R. L. Dickman
Manager, Employee Relations	C. O. Steinnagel
Manager, Engineering Operation	L. M. Loeb
Manager, Financial Operation	W. S. Roe
Manager, Manufacturing Operation	W. N. Mobley
Manager, N Reactor Engineering	M. C. Leverett
Manager, N Reactor Operation	W. M. Mathis
Manager, NPR Project Operation	J. S. McMahon
Consultant, Business Effectiveness Program	J. W. Talbott

Effective December 1, 1962, the Fuels Preparation Department was eliminated with responsibilities for the New Production Reactor, including the Coextrusion Shop facilities, established as a new Level 2 component, N Reactor Department - R. L. Dickeman, General Manager. The remaining responsibilities were transferred to Irradiation Processing Department as a Level 3 component, Production Fuels Operation - W. N. Mobley, Manager.

SAFETY

Days since last disabling injury	231
Hours worked since last disabling injury	990,675

Operation	MEDICAL TREATMENT INJURIES: This Month No. of Cases	This Month Frequency Rate	Last Month No. of Cases	Last Month Frequency Rate	Year-To-Date No. of Cases	Year-To-Date Frequency Rate
Manufacturing	24	2.80	41	4.29	307	3.59
Engineering	3	2.53	3	2.39	27	1.99
Financial	0	0.00	0	0.00	0	0.00
NPR (Through Nov. 30)	3	0.94	4	1.07	7	1.01
Plant Facilities (Through Aug. 31)	—	—	—	—	162	—
Total	30	2.24	48	3.19	503	3.41

SECURITY

There was one security violation in the Department during November, which was the result of an open file. The calendar year-to-date total for FPD is eight violations.

Operation	SUGGESTION PLAN: Number Received Mo.	Number Received CYTD	Number Evaluated Mo.	Number Evaluated CYTD	Number Adopted Mo.	Number Adopted CYTD	Amount of Awards Mo.	Amount of Awards CYTD	Net Annual Savings Mo.	Net Annual Savings CYTD
General	--	--	--	--	--	--	$ --	$ --	$ --	$ --
Engineering	1	3	--	3	--	1	--	5	--	--
Financial	--	1	1	2	1	1	25	25	187	187
Manufacturing	35	298	32	281	19	134	430	3330	2160	20,051
N Reactor Eng'g.	--	--	--	--	--	--	--	--	--	--
N Reactor Operation	--	--	--	--	--	--	--	--	--	--
NPR Project	--	--	--	--	--	--	--	--	--	--
Plant Facilities	--	173	1	258	--	127	25	2730	--	14,241
Total	36	475	34	544	20	263	$480	$6090	$2347	$34,479

Operation	COST IMPROVEMENTS (EXCLUDING SUGGESTIONS): Accepted in November	Total Accepted CYTD
General	$ ---	$ ---
Engineering	---	---
Manufacturing	13,119	124,300
N Reactor Eng'g.	---	596,636
N Reactor Operation	---	---
NPR Project	---	---
Plant Facilities	---	42,414
Total	$13,119	$763,350

PATENT SUMMARY - NOVEMBER 1962

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 November. 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.

R L Dickeman

General Manager
Fuels Preparation Department

RL Dickeman:mkm

[redacted]

MANUFACTURING OPERATION

NOVEMBER, 1962

CURRENT OPERATIONS

Production

Statistics - AlSi Shop	NATURAL				ENRICHED				
Current Month's Production	C	K	Reg.	Bumper	C	K	Reg.	Bumper	Total
Acceptable Fuel Elements Produced (Tons)	2.1	209.4	154.1	131.6	9.6	19.6	0.8	31.6	558.8
As % of Forecast Production	3	313	103	123	32	68	-	35	104
Cum. % of Forecast for Current Quarter	51	178	90	97	75	92	116	66	100
As % of Past 3 Month's Average Production	7	111	157	104	56	34	-	96	97
As % of Past 12 Month's Average Production	5	87	153	137	64	39	-	102	95
% of Forecast Achieved Last Fiscal Quarter	82	123	134	98	57	64	320	134	108
% of Forecast Achieved Last 4 Fiscal Quarters	75	120	126	76	77	98	145	110	105

Operating Efficiency

Current Month (%)	99.2
Forecast (%)	95.0
Previous Month (%)	98.6

Manufacturing Yield

Current Month (%)	-	90	91	83	88	90	-	73	
Forecast (%)	90	90	90	85	90	90	90	85	
Previous Month (%)	93	91	88	86	88	90	88	89	

Bare Uranium Available for Processing (Tons)	695
Finished Products in Storage (Tons)	1082
Work in Process (Tons)	201
Special Products Finished (Pieces)	
6" Boll-Solid	78
4" Boll-I&E	1601
Uranium Utilization	96.0

[redacted]

Statistics - Coextrusion Production (1)

Forecast Process Input 25.0 Tons
Actual Process Input 23.3 Tons

	Station Throughput				Inventory of Pieces Awaiting Processing					
	Outers		Inners		Outers			Inners		
Unit Operation	Pieces Process.	Defect Rate(3)	Pieces Process.	Defect Rate(3)	24"	18"	12"	24"	18"	12"
Extrusions (2)	92	-	30	-	Awaiting cutup			Awaiting cutup		
Chemical Milling	2611	0.7	0	-	11	12	2	390	60	14
Braze	2500	10.2	0	-	0	145	110	0	0	0
Heat Treat	2593	0	0	-	0	42	0	0	0	0
Machining	2590	0	0	-	0	12	0	62	1	3
Welding	2346	4.6	213	6.6	0	201	10	0	0	0
Non-Dest. Tester	2154	18.4	345	0	75	132	12	0	0	0
Autoradiograph	1164	0	775	0	373	37	0	5	0	0
Support Weld	45	0	0	-	2749	198	61	4415	407	225
Autoclave	53	0	4	-	45	0	0	0	0	0
Final Inspection	0	0	0	-	1105	35	0	157	56	4
Process Inventory										
Production Pieces Held for Rework					183	78	12	507	155	75
Production Pieces Awaiting Evaluation					885	22	1	154	12	2
Production Pieces - Scrap					310	36	11	59	32	35
Total Process Inventory - Pieces					5736	950	219	5749	723	358
Total Process Inventory - Pounds					155,388	19,247	2924	77,956	7324	2388
Total Process Inventory - Tons				132.61						
Finished Production for November				0						
Total Finished Inventory - Tons				12.82						
Oxide Burned - pounds				284.08						

(1) Input and inventory to-date consists of enriched uranium
(2) Billets
(3) Includes pieces held for rework, pieces awaiting evaluation and scrap pieces.

Production

Plant Operation - AlSi

Output of AlSi fuels during November exceeded the forecast while a new record high plant operating efficiency of 99.2 per cent was being established. Nine canning line shifts were operated during the month for a total of 180 canning shifts.

Six-inch bumper yield is low due to the more critical inspection criteria that is being used for the enriched uranium fuel elements that will go into the E-N load. The yield is lower on both 6 and 8-inch bumpered due to an increase in mechanical and alignment problems at the rail welder. At least a portion of the trouble has been attributed to die burrs that exist on the ends of the rails.

AlSi slop problems have also contributed a lower yield in both the 6 and 8-inch fuel models. The results from a test using knurled cans indicated that knurling of cans would be effective in reducing the slop rate.

The losses due to weld pinhole problems is continuing. The most likely cause has been found to be contamination of argon shielding gas with carbon monoxide. Investigation of the pinhole problem is continuing and will include further evaluation of shielding gas purity and the effect of welding speed on pinhole formation.

Projection elements produced during November totaled 167 tons, with yields of 83.1 per cent on the 8-inch fuel and 72.9 per cent on the 6-inch. Bumper welding yields were 93 per cent on the 6-inch material and 93 per cent on the 8-inch. Production and reactor charging for November and to date are as follows:

	November 1962		To Date	
	Natural	Enriched	Natural	Enriched
FPD Produced	135	32	1826	785
IPD Charged	43	16	1667	693
Finished Inventory	159	92	159	92
Average Welding Yield	93%	93%		

A total of 78 lithium-alluminum 6-inch solid target elements were placed in storage along with 1601 4-inch pieces.

The inventory of finished fuels at month end reflects a 1.8 month supply based upon projected reactor usage and excluding 105 tons of dingot material.

Bare core inventory at month end reflects a 1.2 month supply based upon anticipated fuels process needs and excluding 268 tons of dingot cores.

Three shipments were made totaling 57 tons of natural and 21 tons of enriched scrap. In addition, a shipment containing 390 empty boxes with lids was made during the month.

The following pieces were processed through the Fuel Recovery facilities during November:

8" I&E	28,955
6" Water Mix	980
Total	29,935

There were no failures of AlSi fuels in the autoclaves during the month. Total for the year remains at two.

Plant Operation - Coextrusion

A total of 122 production extrusions were completed during November. Of which, 30 were inner tubes and 92 were outer tubes. An additional 9 special extrusions were completed for Engineering. The production extrusions represent an input of 23.3 tons and brings the total input to 246.5 tons, or roughly 38 per cent of the first load requirements.

Problems associated with the support process prevented the processing of fuels through the support welding and autoclave operations. The backlog of material ahead of these stations continues to increase.

The 30 inner extrusions were all with square ended billets and were the first production extrusions from this type material.

A total of 804 outer rework pieces was fed back into the production stream. This reduced the balance to 62 outer pieces.

Manufacturing Engineering

Design and Projects

CAF-954 High Pressure Autoclave Development Facility

A work authority authorizing $10,000 to prepare design criteria and perform Title I design on this project was issued on October 2, 1962. This work authority requires Commission approval of the design criteria before completion of Title I design.

CAF-961 Consolidated 303 Area Services Facility - Phase I

The fund authorization for this facility is still awaiting approval.

CAF-973 Steam Distribution Line Modifications - 300 Area

The project proposal has been approved and funds authorization is being delayed due to further evaluation of PRTR steam utilization.

CGF-979 Pilot Scale Plating Equipment - 300 Area

A work authorization for $5,000, covering preliminary engineering work, was received on this project.

CAF-980 Boiler Replacement for Additional Steam Generating Capacity - 384 Building - 300 Area

This project proposal has been reviewed by the AEC Project Review Board and is being returned for further study relative to gas reliability and PRTR steam utilization.

Utilities Extension - 300 Area

A project proposal has been prepared for a 300 Area utilities extension project to serve new HLO facilities at the south end of the 300 Area.

Drafting and Duplicating

Drawings Produced

New	65
Revisions	185
Small Charts	1
Large Charts	1
Miscellaneous	32

Duplicating Production

914 Copier Masters Prepared	345
914 Copier Copies	23,569
Multilith Impressions	281,431
Ozalid Copies	7,931
Number of Pages Collated	200,520
Number of Orders Processed	1,380

Services and Utilities

Statistics	November	October
Average steam generated (M lbs/hr)	70	57
Maximum steam generated (M lbs/hr)	106	88
Total steam generated (M lbs)	51,928	41,196
Coal Consumed (tons)	2,505.45	2,197.15
Evaporation rate (steam/coal)	10.36%	9.37%
Efficiency - Actual	70.5%	61.0%
Efficiency - Theoretical	74.5%	73.5%
No. of Boilers on: 1 2 1 2		
Date of change: 6 21 22		
Sanitary water from 3000 Area (M gals)	125.74	120.80
Total water from 3000 Area (Avg. rate GPM)	2,817	2,796
Peak water consumption for 24 hrs. (M gal)	4.5	4.4

PLANT CONDITIONS, INCIDENTS AND IMPROVEMENTS

AlSi Shop

The record high plant operating efficiency established in November reflects the third consecutive month in which new records have been established for operating efficiency. About half the downtime was due to equipment malfunctions, the remainder being attributed to operational problems.

Late in the month tests were started on the process for the E-N load. This work was designed to improve fuel quality through several process changes, improve reproducibility from the UT-2 test, and increase tightening of limits at inspection and test stations.

The results to date indicate an increase in AlSi slop rejects and an increase in the internal bond and UT-4 reject rates. The increase in AlSi slops is attributed to process changes and the use of cans from one vendor while the bond and UT-4 rejects are attributable to the more stringent reject limits.

The analysis of variables data from the UT-2, UE-1, and UT-4 test stations has not been completed. This study will include average quality levels and lot-to-lot variation.

The work on quality costs reporting, which is a part of the Quality Systems study, has been updated, and the program for regular quality cost summaries is being initiated. The Quality Control "paper flow" study for the 313 Building is completed.

A cost study and justification for the purchase of three convertible production data loggers has been completed. Flow charts of the present and proposed data systems are completed.

Ten samples were received for metallographic examination of the braze area. This is part of a program for evaluating the usefulness of the radiograph test. These samples were examined by a technique in which the samples were progressively ground at 10 to 20-mil intervals with the samples being examined between grindings by the Zyglo process. Four of the samples had defect areas forming a path completely through the test zone. The other six had similar defect areas; however, they extended only partially through test areas with scattered defect areas through the remainder of the sample.

A prototype heating coil has been designed and fabricated to reduce the number of reject fuel elements due to stuck sleeves. Further testing will determine economic feasibility.

Procurement of required tooling has been completed and installation on all production lathes is under way. Improved quality and reduced tooling costs are expected to result from this item of mechanization.

Justification for replacing the semi-automatic welders with automatic welders was completed. A layout was designed for installing the new automatic lathes and is shown on Drawing H-3-20745.

The first phase of the maintenance improvement program was completed, including the design of a psychologically sound questionnaire, the completion of the questionnaire by the craft personnel, and the analysis of the results.

Conversion of the semi-automatic welders from 20 to 12 RPM spindle speed was accomplished to permit processing E-N load fuels.

Ultrasonic Welding	October		November	
	Actual	Goal	Actual	Goal
Welder defective rate (total)	4.6	5.5	6.3	5.5
Welder efficiency	75%	75%	78%	80%

Mechanical and alignment problems account for 80% of the total pieces rejected smash and crack rejects account for an additional 10%, and all other causes account for the remaining 10%.

Coextrusion Shop

Continued breakage of NIT traveling mandrels was encountered during the start of the NIT run. Free mandrels were then used but there was still some loss from mandrel breakage. Work is continuing in an effort to determine the cause of the high percentage of breakage.

The new grounding method for the support welders has been installed and tested on a limited basis. At the present time the new method appears to be satisfactory and should reduce the reject rate due to arcing of the electrodes.

Two tanks in the chemical processing facilities, each having a different type of brushed or sprayed lining, show evidence of porosity of the liners or leaks as large bubbles are forming between the liner and the tank. A replacement tank is being made by using a 3/8" liner of PVC. This tank will be installed in place of one of the above tanks in an effort to find a more suitable material for containing ammonium bifluoride-nitric acid mixture.

The production billet evacuation test program was completed, the results of this program showing that the test will reliably indicate billet vacuums and that the test itself has no ill effects on the process. It was further shown that the test can be performed and results known within 30 seconds. Under these conditions, no undue interference with extrusion routine will be present. A report of the design and operation of the test has been prepared.

The Measurement Error Audit Procedure Handbook has been completed for the 333 Building and will serve as the guide for full-scale implementation of the Mercy Program. Data will be collected from the following stations for the 4th quarter: premill inspection, beta heat treat, eddy current testers, autoradiograph, and pre-irradiation measurements.

The tape readout for the PIM gauge is installed. It is estimated that approximately two weeks will be required to debug the system, collect sufficient Mercy data and have it processed, and evaluate the results.

A gauge for measureing the end squareness of billet components has been designed and is out for quotations. The gauge which will utilize the base and rollers of the regular warp gauges will allow the end squareness to be read to within 0.0005 inch.

Bids have been received and reviewed for the electronic components for the support gauge. Purchase orders have been issued and delivery is anticipated within one week. Design is complete and fabrication of the fixtures and yoke for the gauge is under way.

The high defective rate of braze voids led to an investigation of one of the variables which could cause these voids, the addition of the argon gas. The test involved the addition of the argon gas at a fixed time in cycle.

Fuel elements processed under these conditions were then compared to control elements processed under manual conditions. The test pieces had a defective rate 18 per cent less than the control pieces. No quality problems were detected during the three days of operation of the test.

A prototype crimping head for the billet assembly evacuation tube has been designed and fabricated. Further testing is required to establish production reliability.

A spare parts review was completed, and revised parts recommendations completed for the UE-2, UT-9 and the UT-8 oscillograph. Work continues on modifying and updating the UE-2 and UT-9 testers mechanical and circuit drawings.

A design has been completed, work order issued and fabrication under way to improve the alignment of the end cap braze system. Field installation is under way. Work continues in developing experimental bell jars to permit more accurate alignment and to reduce the cost of the manufacturing process. Pressure relief valves were installed on the vacuum system to eliminate breaking bell jars which resulted in releasing the bell jar clamps unevenly with 6 lb. psig of Argon in the chamber.

FPD HEALTH AND SAFETY

	November	October
Disabling Injuries	0	0
Serious Accidents	0	0
Medical Treatment Injuries	30	48

New employee orientation was conducted on October 20.

Total membership of the Program Council was changed effective November 1. The new members will serve through April 1963. Assignments made by Chairman, J. R. Carrell, include: C. R. Alton - Special Programs, G. L. Hammons - Safety Meetings and Publicity, and P. G. Rhoades - Safety Topics.

The regular quarterly safety review of Department work practices and facilities was conducted during October and November. Review teams were composed of the subsection managers responsible for audit areas and two participants for each team selected from outside the component.

Medical Treatment injury performance continues to reflect good management. A total of 30 injuries was reported during November. This is the lowest number recorded since November 1958.

FPD SUGGESTION PLAN

Fuels Preparation Department qualified for the Company's 400 Club award during November with an estimated average of 420 adopted suggestions per thousand eligible employees. This will be the fourth time FPD has won this award since the club was inaugurated five years ago.

A booklet entitled "How About the Suggestion Plan" was prepared and distributed to all employees in FPD.

Suggestion Plan Participation

	November	October
Number of eligible employees	603	596
FPD Suggestions received	36	48
Annualized rate per 1000 eligible employees	716	1047
Number of suggestions adopted	20	11
Net annual savings	$2347	$252
Amount of awards	$ 480	$ 85
Per cent of awards to savings	20.5	33.7
Average amount of awards	$ 24	$ 7.73

EMPLOYEE RELATIONS

Safety

Personnel of Manufacturing Operation sustained 24 medical treatment injuries during November.

Radiation and Beryllium Control

Eleven air samples and 58 smear samples were taken during the period from October 25, 1962, through November 25, 1962. All of the air sample results were less than 10 per cent of the limit and the smear sample results indicated continued good control.

Three radiation orientation meetings were held during the month.

The total of the exposures in excess of 100 mrads for Manufacturing Section personnel for the four-week badge period ending November 2, 1962, was 17,203 mrads compared with an average of 7,550 mrads for the previous year. During this badge period, there were 10 exposures over 300 mrads. The average number of exposures over 300 mrads per badge period for the calendar year to date is 2.8 compared to a goal of 2.

The reason for the high exposure this month has not as yet been established; however, since the increase is plant-wide, a study of film badge processing techniques is being made.

SIGNIFICANT REPORTS ISSUED

HW-75522	Uranium Quality Control Analytical Results	11-2-62	GB Hansen
HW-75480	Evaluation of Measurement Error - 3rd Qtr.	11-1-62	WF Stevenson
HW-75545	Evaluation of Measurement Error in Coextrusion Process	11-7-62	WF Stevenson

VISITS

Name	Company	Contact	Date	Reason
HA Jones	National Carbon Co. Cleveland, Ohio	MN Burkett	11-6-62	Graphite components
HA Jones	United Forge Co. Detroit, Mich.	HA Henchel	11-5-62	Copper components
DC Lehfeldt	G.E. Schenectady, N.Y.	R. T. Short	11-16-62	Cost reduction seminar

VISITORS

J Foss	Bridgeport Brass Seattle, Wash.	DW Darsow	11-7-62	Zirc and copper components
RA Graham	Wah-Chang Co. Albany, Ore.	DW Darsow	11-15-62	Zirc end caps
CA Brown	Rem-Inc. Portland, Ore.	DW Darsow	11-15-62	Zirc end caps
DM Guy, Jr.	ALCOA Seattle, Wash.	HP Kraemer	11-20-62	Caps and cans
F Arsenault	Div. of Internal Affairs AEC-Wash. D.C.	HE Berg	11-29-62	Audit
D Rose	Ray Johnston Co. Seattle, Wash.	FA Leach	11-12-62	Give instructions to instrument craftsmen
W. Hulett	RIDL Berkeley, Calif.	FA Leach	11-12-62	Give instructions to instrument craftsmen

TRAINING

A total of 358 man-hours of training was given during the period October 20, 1962 through November 20, 1962.

PATENT SUMMARY

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.

Manager - Manufacturing

WN Mobley:HFT:mfj

8" NORMAL

	JUNE	JULY	AUG	SEPT	OCT	NOV
CUR MO.	91.4	92.1	92.1	89.0	91.9	89.9
3 MO.	92.2	92.3	91.9	91.3	91.0	90.0
CY	91.2	91.3	91.5	91.3	91.3	91.1
FY	90.6	92.1	92.1	91.9	91.3	91.0

8" BUMPERS

	JUNE	JULY	AUG	SEPT	OCT	NOV
CUR MO.	83.0	83.2	83.0	82.5	85.8	83.1
3 MO.	83.7	83.1	83.1	82.8	83.8	83.8
CY	84.7	84.5	84.2	83.9	84.2	84.1
FY	85.0	83.2	83.1	82.8	83.6	83.5

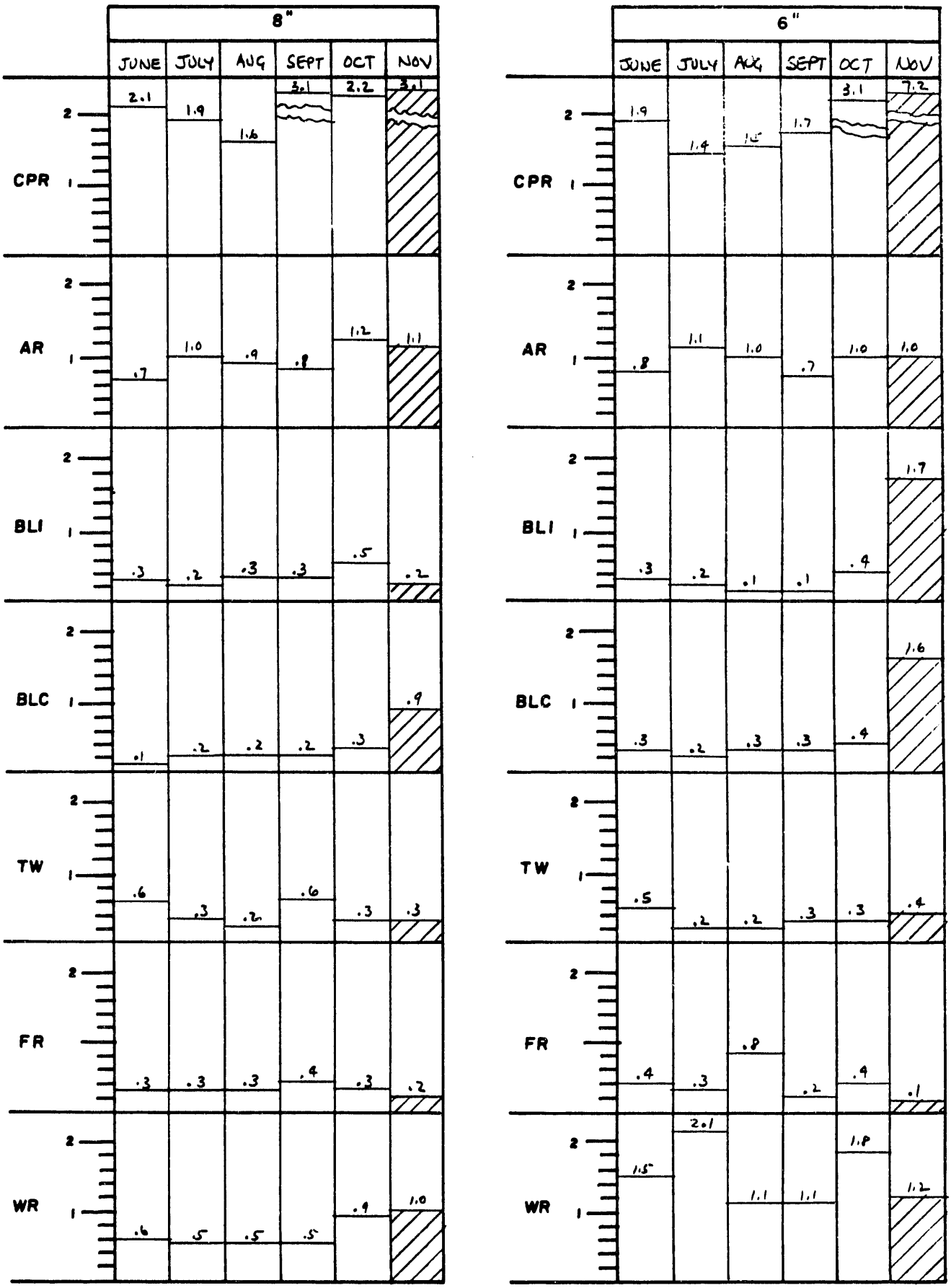
6" ENRICHED

	JUNE	JULY	AUG	SEPT	OCT	NOV
CUR MO.	89.1	88.1	90.6	91.3	89.0	89.6
3 MO	90.9	90.0	89.9	90.6	90.0	89.6
CY	91.6	91.4	91.3	91.3	90.9	90.8
FY	91.0	88.1	90.3	90.6	89.9	89.9

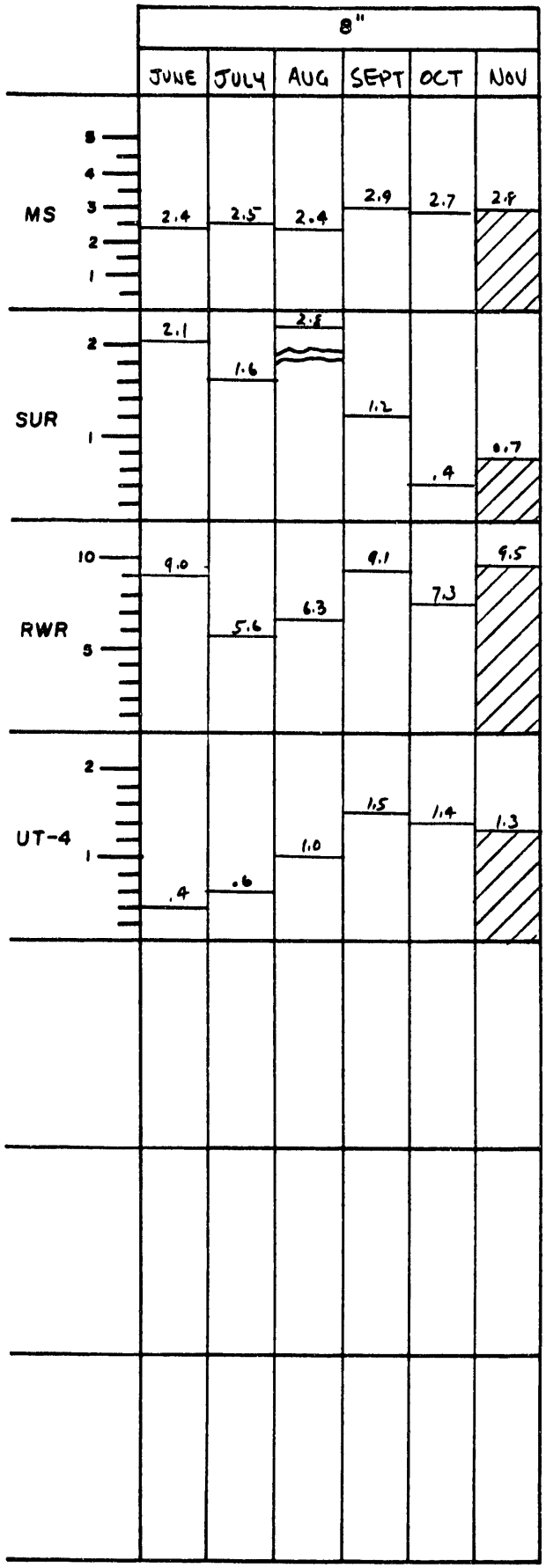
6" BUMPERS

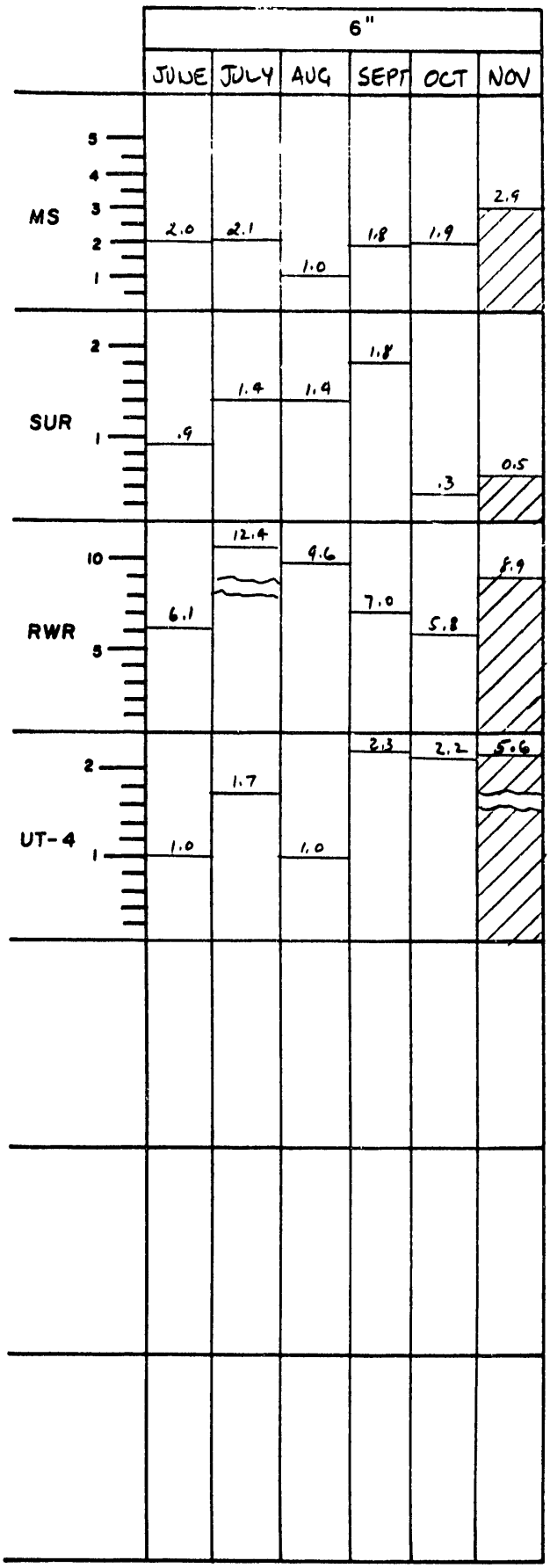
	JUNE	JULY	AUG	SEPT	OCT	NOV
	86.4	79.8	80.8	87.1	88.6	72.9
	84.0	83.4	83.4	83.0	84.0	82.9
	84.3	83.9	83.2	83.9	84.5	83.3
	84.5	79.8	80.4	83.0	84.9	82.1

Statistics, November 1962



Statistics, November 1962





ENGINEERING OPERATION

NOVEMBER, 1962

VISITORS

Name	Company	Contact	Date	Reason
PN McCreery, CE Bussert MA DeSesa	National Lead Co. of Ohio, Cincinnati, Ohio	TD Naylor	11/5-11/6	Discuss quality control, uranium products
WD Kelly	Sciaky Brothers, Los Angeles, Calif.	TR Groupman	10/29-11/6	Supervise installation of Sciaky welding equipment.
CA Graham, CA Brown	Wah Chang Corporation, Albany, Oregon	GW Riedeman	11/15-11/16	Material development.
RS Wood	E.I. duPont DeNemours & Co., Aiken, South Carolina	LT Hagie	11/6-11/7	Data processing systems.

TRIPS

TB Correy	International Institute of Welding, New York City, New York	EA Fenton, Secretary	11/20	Planning for annual meeting
TD Naylor	Bridgeport Brass Co., Ashtabula, Ohio	JF Puterbaugh	11/2[illegible]-11/27	Discuss uranium procurement
"	National Lead Co. of Ohio, Cincinnati, Ohio	PN McCreery	11/28-11/29	" "
LT Hagie	GE-Heavy Military Electronics Department, Syracuse, New York	HS Charlip	11/2	Data retrieval systems.
EA Weakley	NLO, Cincinnati, Ohio	PN McCreery	11/12-14	Uranium technology.
	duPont, Aiken, South Carolina	TC Evans	11/15	" "
	MCW, St. Charles, Mo.	NF Newmann	11/16	" "
JT Stringer	Atomic Energy Commission, Chicago, Illinois	--	11/8-11/9	Briefing session on US-UK exchange.
"	London, England	AEC London representative	11/26	Instructions and briefing.
"	Springfields, England	Dr. Rogan	11/27	Proposed agenda
"	Risley, Culcheth & Windscale, England	Dr. McIntosh	11/28-11/29	" "
"	Harwell, England	--	11/30	" "

PERSONNEL

Additions

None

Removals

R. L. Walser, Manufacturing Training Program, transferred out of AlSi Product Engineering November 19, 1962.

INVENTIONS

All Engineering personnel engaged in work that might reasonably be expected to result in inventions or discoveries advise that to the best of their knowledge and belief, no inventions or discoveries were made in the course of their work during November, 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 ISSUED

HW-67575, REV 2, 29 pages were reissued in "Specifications for Uranium Metal Billets For NPR Fuel Elements," T. D. Naylor, November, 1962 (Unclassified).

HW-69886, "Provisional Process Specifications for the Attachment of Projection Rails by Ultrasonic Spot Welding," J. T. Stringer, September 21, 1962 (Confidential).

HW-75463, "Nondestructive Tests - Engineering Audit Reports - AlSi Shop Operation - October," C. J. Denton, October 31, 1962 (Unclassified).

HW-75502, "Preliminary Billet Designs for NPR Single Tube Fuel Elements," C. H. Shaw, November 2, 1962 (Confidential).

SECURITY VIOLATIONS

There was one security violation in the Engineering Operation on November 19, 1962. Total CYTD - 2.

ADVANCE FUEL ENGINEERING

Rupture Summary

Ten regular production I&E fuel elements failed in the reactors during November.

Fuel Element Type	Tube and Reactor	Exposure (MWD/T)	Rupture Classification	Failure Date	Canning Date
Natural					
Non-Bumper	3648-KW	416	Side Hot Spot	11-11-62	6-8-62
" "	1282-C(1)	523	Unclassified	11-14-62	3-5-62
" "	1364-F	539	Side Other	11-14-62	5-10-62
" "	3867-F(2)	591	Side Other	11-22-62	7-12-62
Bumper	3266-D	786	Hole	11-2-62	2-15-62
"	2771-D	783	Hole	11-27-62	6-25-62
Enriched					
Non-Bumper	4167-F	593	Side Other	11-3-62	5-15-62
" "	1888-C(3)	605	Side Hot Spot	11-4-62	2-9-62
" "	1458-C(3)	778	Side Hot Spot	11-26-62	5-15-62
Bumper	1675-DR	950	Hole	11-13-62	6-14-62

(1) Water Mix piece failed.
(2) Failure caused by non-uniform corrosion attack.
(3) Second failure in lot.

Rupture resistance of non-bumper fuel has apparently declined based on the experience of the past two months. This is the same tendency recently observed with bumper fuel. This decreased rupture resistance may be stemming from a) reduced fuel element quality, e.g., poorer dimensional stability or bond integrity, and/or b) a more severe fuel corrosion environment in the reactors. A more accurate assessment of these factors (either individually or as they might interplay) cannot be made at this time.

ALSI PRODUCT ENGINEERING

Uranium Technology

Vacuum Outgassing Enriched Uranium

Vacuum outgassing enriched uranium in hollow core blank form following beta heat treating was authorized at National Lead (NLO) beginning November 14, 1962. This process treatment was requested to reduce surface hydrogen, which can evolve from the uranium cores during the canning operation at HAPO and contribute to fuel braze and closure porosity. Conditions specified for vacuum outgassing are as follows:

1) Temperature - 950 ± 50°F (482-538°C)
2) Time - 8 hours, minimum
3) Pressure - 0.4 mm of Hg, maximum

NLO has the capacity to vacuum outgas about 80 tons of enriched uranium per month without overtime. On this basis, only 50-60 percent of the enriched cores required for the first cycle of the E-N load can be vacuum outgassed.

Iron (Fe) and Silicon (Si) Additions to Natural Ingots

NLO began adding Fe and Si to all natural ingot uranium early in November for grain size control. Average Fe and Si content of the first 275 ingots produced under this program was 157 ppm and 97 ppm, respectively. Initial shipments of this material will be received at HAPO about mid-December.

Ingot Quality Improvements

NLO has recently investigated the use of uranium prill (shot) blasting to remove imbedded slag (MgF_2) from ingot derbies. A test on 136 Grade I (their best grade based on visual observation) enriched derbies removed between 3 and 16 pounds of material per derby, with an average removal of 7.2 pounds per derby. The present small-scale equipment cleans eight derbies in eleven minutes, and should be capable of cleaning all of the enriched derbies. Removal of the slag should significantly improve the quality of the ingots.

Eight-Inch Diameter Ingots

NLO has completed an evaluation of casting and rolling 8-inch diameter ingots with favorable results. X-ray diffraction data on cores from 8-inch diameter ingots at HAPO revealed no unusual diffraction patterns. Grain size, chemistry and inclusion tests were completed with satisfactory results at NLO. The major advantages of casting 8-inch diameter ingots are:

1) A 10% increase in throughput capacity without any equipment changes.

2) A larger diameter to height ratio which aids in removal of impurities during solidification of the ingot.

3) An annual savings of about $100,000 due to generation of less scrap.

A waiver is being issued to accept the 9 tons of 8-inch ingot material now on hand at NLO and specification changes will be made to permit the use of 8-inch diameter ingots.

Enriched Core Reactivity Testing

The number of tests required in the Hanford Test Reactor (HTR) has become excessive with the present practice of testing one core from each enriched "dry blend" ingot. Therefore, composite limits were established for testing three enriched cores per stringer to reduce the number of tests required. If the dih value falls outside of the composite limit, then the three cores are tested individually and all of the cores from an ingot whose HTR sample falls outside of the individual acceptance limit will be rejected and returned to NLO.

Oil Quench Ingot Program

As of November 1, about 16 tons of hollow core blank, oil quenched ingot fuel elements had been discharged at goal exposure and an additional 11 tons were undergoing irradiation. Approximately 95 additional tons of oil quenched cores are to be irradiated under the existing production test. Nineteen (19) tons of oil quenched cores were canned this month and 25 tons per month are scheduled for canning in December and January.

AlSi Process Development

Projection Fuel Program

Approximately 2150 tons of bumper fuel have been charged to date in the old reactors and 1525 tons discharged at variable goal exposure. Including fifteen (15) enriched bumper fuel ruptures sustained in the H reactor E-N loading, twenty (20) natural and thirty-one (31) enriched fuel ruptures have occurred in bumper fuel loadings. None of these ruptures have been of the "hot spot" type bumper fuel was designed to prevent. "Hole" and "end" failures, attributed to small end closure defects and internal corrosion of the fuel cladding, continue to be the major rupture categories. One enriched and two natural bumper fuel ruptures, experienced this period at exposures ranging from 783 to 950 MWD/T, were classified as "hole" failures.

Twenty-four hundred feet of elliptical bumper rail strip was received from the vendor and is being checked for conformance to specifications. If

acceptable, this material will be used to complete testing of the prototype elliptical rail feeder and to prepare initial quantities of elliptical bumper fuel for irradiation. Based on recent tests using sample rail strip supplied by the vendor, further adjustments and minor changes are being made to the rail feeder in order to eliminate occasional stoppages caused by the strip binding or hanging up in the feeder guides.

There were no self-supported fuel ruptures during November. About 4,100 overbore (CVIN) and 14,100 regular (CIVN and CVN) self-supported fuel elements have been discharged to date from the C reactor test facilities, incurring a total of eight ruptures. As previously reported, the exposure of alloyed dingot overbore fuel elements has been decreased to 75 percent of goal (800 MWD/T) because of the higher rupture potential of dingot material. Use of dingot overbore cores will be discontinued as soon as the existing inventory (approximately 25 tons) is exhausted. Initial shipments of alpha rolled ingot cores are being received to meet future overbore fuel requirements.

Self-support rail design studies thus far have indicated the present 50 mil thick, three-dimple, collapsible-bridge rail design is superior to a modified arch-type rail design. Attempts to improve the strength of the arch-type rail by increasing the amount of upset metal under the arch have been unsuccessful. This rail completely collapses under average static loads of 800 pounds, as compared to 1,000 pounds for the collapsible-bridge rail. Until a potentially stronger rail can be developed, the collapsible-bridge design will be used for KVN fuel production.

Because the collapsible-bridge rail tends to bow upward during ultrasonic welding, the rails may be deflected several mils under relatively light loads as a result of the clearance between the rail dimples and fuel cladding. Studies are currently being made to minimize this clearance without risking contact and possible penetration of the dimples into the fuel cladding during welding. Impact tests have confirmed that the dimples are adequately relieved to avoid penetration or damage to the fuel cladding in excess of 3 mils under loads sufficient to completely collapse the rails.

As previously reported, minimum head spacing (3-9/16 inch) of the ultrasonic welders limits the length of the KVE self-support rail to a maximum of 1-7/8 inches. A two-dimple collapsible-bridge rail and a single dimple arch rail are being evaluated for this fuel design. This work is scheduled for completion early in December. Ultimate choice between the two rail designs will depend primarily on strength and resistance to deflection loads.

Optimized Canning Studies

A series of tests were completed to upgrade the quality of OIII enriched fuel elements, particularly for the second H reactor E-N loading scheduled

early in CY 1963. Since a majority of the enriched fuel ruptures experienced in the reactors have been of the "hole" and "end" types, this effort was directed primarily toward optimizing duplex bath and canning bath parameters to improve fuel braze and closure integrity. Significant test results and process changes adopted to achieve these objectives were as follows:

1) Metallographic examination of enriched fuel elements processed under present duplex canning bath conditions revealed that the percentage of UAl_3-type scrambled compound layer formed on the cores varies over a wide range, averaging 87.0% and 78.6%, respectively, on the inner and outer surfaces. The remainder of the compound layer is laminar in structure, lower in strength, and subject to fracture and undercutting. Tests to optimize duplex bath conditions indicated the percent UAl_3 compound layer will approximate 100% if the bath temperature is increased or the silicon content in the bath is reduced. Adverse interactions of lower silicon contents on compound layer thickness and braze porosity, however, led to the adoption of higher duplex temperatures (lead layer 625 ± 5°C and AlSi layer 616 ± 5°C) for the immediate production of enriched fuel for the E-N load.

2) An investigation of OIII material and enriched can base preheating rates in the canning bath indicated the average temperature of the can bases after the standard 47 second can-sleeve preheat cycle was 558°C for both fuel models. This is appreciably below the solidus temperature of the AlSi. Preheat cycles of about 100 seconds were required to raise the can base temperature above the eutectic temperature (578°C) of the AlSi. Attempts to improve preheating rates by reducing the tolerances between the sleeve base I.D. and can base O.D. resulted only in a slight temporary increase in temperature (563°C) on a 47 second cycle. After prototypic sleeves of the closer dimensional tolerances were used several times, the average heating rate was identical to present can-sleeve designs. Use of bottomless sleeves also proved to be of no real benefit.

3) Use of a longer can-sleeve preheat cycle reduced internal braze porosity; however, external braze porosity was adversely affected by non-wetting near the can base. This confirmed early test data, which nullified the use of longer preheat cycles. Supplemental preheat of the sleeves before inserting the cans for the standard preheat and submerge cycles yielded some improvement in external braze closure, but was of no benefit to the internal closure.

4) Subsequent tests indicated that the greatest improvement that could readily be achieved in fuel braze porosity and closures would result from maintaining the canning bath temperature 2-6°C above the primary arrest temperature. On this basis, the enriched fuel for

the E-N load is being assembled at nominal temperatures of 588°C or above. Ultimately, a supplemental source will be required for can-sleeve preheat to insure optimum temperature for fuel assembly. Steps are being taken to investigate induction heating in the near future.

Fuel assembly process changes other than those mentioned above to upgrade the quality of enriched fuel proposed for the E-N load include:

a) Maximum can-sleeve vibrator frequency to minimize gas entrapment and facilitate can wetting.

b) Pressure quench fuel assemblies under full line pressure to suppress braze voids.

c) Double pass end closure welding to improve secondary weld closure.

d) More stringent control and tighter rejection standards for UE-1 bond and UT-4 closure integrity testers.

e) Weld inspection under 3X magnification to reject welds with small pinholes or other defects.

f) Increase the autoclave test cycle from 20 hours to a minimum of 40 hours for all enriched fuel lots having a weld pinhole reject rate greater than 0.5%.

Assembly of enriched fuel elements for the E-N load began on November 19, and has progressed satisfactorily except for incurring an abnormal AlSi slop-over reject rate. This is largely attributed to the higher canning bath temperatures, can-sleeve vibrator frequencies, and quench pressures.

Aluminum Component Cleaning Studies

Analysis of the data from a recent test to evaluate the effects of controlling the deoxidizer (Diversey 514) solution pH on aluminum component wettability in molten AlSi was completed. The data confirmed 1) good component wetting could be obtained using standard solution make-up (29 oz. deoxidizer/gal. of H_2O) for two solution lives if pH is controlled between 0.25 and 0.29, and 2) component wetting is not effected by changes in solution composition. Sulfuric acid was added to hold pH within the desired limits. The test results not only emphasize the importance of pH control, but indicate solution concentration may be reduced as much as 50 percent, yielding an annual cost saving of approximately $15,000. A further test is being made to investigate lower solution concentrations.

AlSi Pilot Plant Activities

During the past month, a total of 4,904 fuel elements were canned in the 306 Pilot Plant. Of these, 4,391 were for reactor use and the remainder for process

improvement studies. In addition, 1340 fuel elements were rewelded, 72 thermocouple assemblies were used to measure can-sleeve preheat rates, and 95 aluminum cans were subjected to wetting tests.

Alternate Process Development

Hot Press Bonding

A proposal to produce up to 1,000 CIVE fuel elements by the Sylcor hot press process was sent to the Sylcor Division of the Sylvania Electric Products, Inc. during April, 1962. A contract was subsequently agreed to under the provision of DDR 149 for the sum of $13,660.

Sylcor received an initial shipment of enriched uranium cores during late November and expects to complete hot pressing by late December. Receipt of the hot press fuel elements is expected at HAPO in January, 1963.

Hot Die Sizing

Metallurgical examination of representative samples from a test designed to optimize conditions for producing hot die size bonded fuel elements is continuing. Process variables under study are as follows:

Variable	Range
Preheat Temperature	650, 680, and 710°C
Preheat Time	8-1/2, 10, and 11-1/2 min.
Aluminum Reduction Ratio	27, 45, and 64%
Ram Speed	40, 65, and 90 in./min.

Conclusions reached thus far from incomplete metallurgical data and recent fuel assembly temperature measurements are summarized below:

1) Nickel-aluminum diffusion thickness increases with the temperature of the pieces at the time of sizing. All nickel-aluminum diffusion thickness data were taken on the internal and external surfaces of sections from the center of the test samples. Diffusion layers were more readily measured at this point because the central sections of the pieces remain hotter for a longer period of time, producing more diffusion. For the same reason, internal diffusion thickness was greater than external diffusion thickness. Nickel-aluminum thickness ranged from less than 0.01 to 0.15 mils. The higher thickness values were produced by combinations of high temperature and long preheat times.

2) There was some indication that higher aluminum reduction ratios produced thicker nickel-aluminum diffusion on the internal surface.

3) Nickel-uranium diffusion thickness was too thin to measure effectively with equipment on hand at magnifications up to 400X. Most of the samples had nickel-uranium diffusion layers less than 0.005 mils in thickness.

4) Bonding on the lateral surfaces near the ends can be improved by increasing the fuel assembly temperature during sizing at the ends. Fuel assembly temperatures are lower on the ends due to the rapid removal of heat by the upper and lower rams.

In order to more precisely control fuel assembly temperatures during sizing, the following equipment changes have been initiated.

1) Modifications to permit pushing the cap end of the fuel elements through the die to prevent rapid heat loss from regions prone to non-bonding.

2) Insulate rams to reduce heat loss from the ends of fuel assemblies.

3) Install a radiant energy reflector to reduce heat losses during and immediately after sizing.

4) Provide a heating coil to control die temperature during sizing.

Two tests designed to establish optimum process parameters for end bonding in the end bonding press were completed and are being evaluated. The ranges of process variables investigated were as follows:

Test I

Variable	Range
Pressing Time	5, 7, and 9 Minutes
Bonding Die Temperature	560, 600, and 640°C
Pressure	1.7, 2.1, and 2.8 tons/in.^{2}

Test II

Variable	Range
Pressing Time*	30, 105, and 180 Seconds
Bonding Die Temperature	560, 600, and 640°C
Pressure	1.7, 2.1, and 2.8 tons/in.^{2}

*Fuel assemblies were preheated to approximately 400°C in an auxiliary furnace, permitting a reduction in pressing time.

Ultrasonic bond testing of the pieces from the above tests has been completed with the following results:

1) Lowest cap and base end bond counts were obtained at the maximum temperature, time, and pressure tested for pieces pressed without auxiliary preheat (Test I).

2) Lowest cap end bond counts were obtained on pieces preheated to approximately 400°C at the maximum temperature, time, and pressure investigated (Test II).

3) Lowest base end bond counts were obtained on pieces preheated to approximately 400°C at the maximum time and pressure and lowest temperature investigated (Test II).

A cursory examination of bond strength data indicates high bond strength on the lateral surfaces at the ends and a marked reduction in bond strength on the lateral surface one inch from the ends. Bond strength data have been sent to Applied Mathematics for evaluation.

Tooling to test a second method of end bonding which uses the differential expansion method of applying pressure to the lateral surfaces at the ends is complete and being installed for debugging prior to testing.

Electroplating Nickel on Uranium

Testing and evaluation of fuel elements prepared by three pretreatment processes as reported last month was continued. These variations pertain to removal of the oxide sludge following electrolytic etching. The processes employed include:

1) Two minute spray rinse, six minute immersion in 7.5 - 8 M HNO_3 @ 40°C (control).

2) Dip rinse, 1/2 minute immersion in 8 - 10 M HNO_3 @ 65°C, 1 to 1-1/2 minute immersion in 7.5 - 8 M HNO_3 @ 40°C.

2a) Same as 2 except immersion time in 65°C nitric is 1-1/2 minutes.

3) Dip rinse, 1.5 to 1.65 minute immersion in 11 - 12 M HNO_3 @ 25°C.

3a) Dip rinse, 3.5 - 4 minute immersion in 10.4 M HNO_3 @ 25°C. The 2a and 3a processes were used for only a small portion of the over-all test.

Evaluation of the test data is incomplete; however, the following tentative conclusions have been made relative to the results:

1) The #1 process and the #3 process are superior to the #2 process with the higher median and minimum bond strengths as determined by stud-pulling. Only bond fractures at the Ni-uranium interface were considered in this evaluation.

2) The Ni-uranium bond is generally equal to or stronger than the Ni-aluminum bond. Most of the fractures occurred either at the Ni-aluminum interface or simultaneiosly at both the Ni-uranium and the Ni-aluminum interface.

3) The 600°C, 30 minute bake test, in an air atmosphere furnace, of plated unjacketed cores revealed no difference between the pretreatment processes tested.

4) Adhesion testing by mechanical removal of the plate also revealed no difference in the process treatments.

A total of 22 fuel elements out of approximately 140 were subjected to 600°C bake tests. Average quality was indicated with surface blistering generally confined to 0 to 9 points less than 1/16 inch in diameter on the internal surface. Four pieces developed an oxide blister at the base end contact point and one a single blister on the external surface. Further testing and evaluation of the various process changes (1, 2, and 3) will be carried out including metallographic examination.

A second sample of nickel plate from the present plating bath yielded a boron content of approximately 100 ppm, equivalent to an increase of about 10% in the neutron capture cross-section of the plate. It was also observed that this plate was relatively brittle. Further monitoring of the micro-constituents of both the plating bath and the plate will be carried out in an attempt to isolate the cause of these phenomena.

A process flowsheet and descriptive material were prepared as a design basis for the nickel plating facility equipment (Project CGF979).

[redacted]

COEXTRUDED PRODUCT ENGINEERING

N-Reactor Fuel Development

KER Loop Testing

Loop 1 - Loop 1 is now purposely running empty. A decontamination test of the loop piping is scheduled and should be completed sometime between December 30, 1962 and January 15, 1963. After the decontamination test is completed, the next "crud" test is scheduled for charging in Loop 1. The "crud" test is now being fabricated by HLO and should be available by month end.

Loop 2 - The "tapered end closure" test was charged into Loop 2 on November 27, 1962. The "tapered end closure" test consists of ten NIE fuels with "V" shaped end recesses and mating "V" shaped end caps. Half the fuels for this test have unbonded end closures, while the other half have Be-Zr brazed closures. Planned goal exposure is 2000 MWD/T which should be completed by about April 15, 1963.

Loop 3 - Currently, Loop 3 is shut down for pump repairs. It is anticipated that Loop 3 will be back in operation sometime after January 1, 1963.

Loop 4 - The fourteen NAE-1 fuels in Loop 4 are operating satisfactorily. Present average tube exposure is about 420 MWD/T. Tentative goal exposure for Loop 4 is 2100 MWD/T which should be reached about June 1, 1963.

Pilot Plant Fabrication

NAE-1 Test Fuels

A charge of fourteen NAE-1 fuels is on the shelf at the K-East Reactor ready for charging. These are backup charges for Loops 3 and 4.

Heater Fuels For "Crud" Test

Ten 17 inch NIE-1 fuels with shroud tubes are available for use as heater elements with the "crud" test.

KSE-5 Test

Approximately fifty 1.6% enriched KSE-5 fuels are at heat treating. These fuels are needed for backup to the "crud" test and the "tapered end closure" test, i.e., as backup charges for Loops 1 and 2. The HLO heat treating operation has just been put back into operation. It is estimated that at least one loop charge of KSE-5's will be fabricated before the end of the month.

[redacted]

2% Zr-U Alloy NIN Test

This test is for the purpose of studying the behavior of uranium alloyed with 2 W/o zirconium. Fuels for this test are at end recessing step in the 306 Building Pilot Plant. Completion is estimated at about January 15, 1963.

Fabrication of these fuels has been delayed due to hazards of chemical processing. The copper stripping operation was safely performed by masking the exposed uranium of tube ends with lead tape. The chemical milling will be performed by a process recently developed in the pilot plant. The recesses are machine milled to leave about 20-25 mills of uranium on the cladding which is removed by air oxidation at 300-400°C (1-2 hours exposure). This is followed by abrasive blasting on the recess and pre-braze etch.

I&E Fuel

Fifty unsupported coextruded I&E fuel elements will be delivered early next week to IPD for irradiation. These are fuels which were fabricated in the pilot I&E production program about 1-1½ years ago.

Other Pilot Plant Activity

A schedule of pilot plant fabrication activity is shown on the following page.

Materials Development

Uranium Specifications

Agreements were reached with personnel of both the National Lead Company of Ohio and the Bridgeport Brass Company on all details of HW-67575, Revision 2, "Specifications For Uranium Metal Billets For NPR Fuel Elements". The resulting revisions to this manual were transmitted through the AEC on November 6, 1962. Only two substantial changes were made in the requirements.

1. Power and time cycles were temporarily specified for control of the melting and casting cycles. To obtain reproducibility in ingot characteristics, direct temperature control of this operation will be necessary. However, the equipment has not been developed to do this. Priority effort on developing this equipment has been requested.

2. Beta heat treating of the billet blanks has been discontinued because better coextrusion results have been obtained in non-heat treated billets. However, test work on developing improved billets is continuing, and some modification of this heat treating process may be required in the future.

IN PROCESS DATE	PWR NO.	EXTRUSION DATE	TUBE NUMBER	WORK DESCRIPTION	TYPE AND QUANTITY REQUIRED	PROCESS LOCATION	EXPECTED COMPLETION DATE	COMMENTS
9/10/62	46			Evaluate the feasibility of using braze alloy fabricated by the pressed chip method.	(12) NIE (12) NOE	Complete		
9/10/62	47			Determine if brazing alloy made with zirconium is superior to the current material Zr-2.	(12) NOE (12) NIE	Outers complete Inners to be autoclaved	11/30/62	
9/18/62	48			Fabricate 1.6% enriched KSE-5 fuels for loop testing.	(40) KSE-5	Brazing	12/15/62	Heat treating equipment down for repairs.
10/1/62	49			Provide U-Zr alloy fuels for KER loop tests to determine the effect of irradiation on swelling. Companion elements of unalloyed uranium to be provided.	(12) U-^{2}Zr (40) NIN	End Recessing	1/1/63	

The specifications of 0.030 inch maximum bow and 0.080 inch maximum wall variation for the billet blank have not been changed. However, these requirements were waived until NLO and BBC developed more data to define these requirements. With the exception of this waiver, all requirements of the "Specifications For Uranium Metal Billets For NPR Fuel Elements" are considered to be in effect.

Billet Chemistry

Magnesium zirconate crucible coatings have been used for casting of ingots. It was believed that the crucible coatings would reduce particulate graphite, carbide and soluble carbon pickup in the molten metal and result in a better surface quality on the ingot.

Recent evidence at NLO shows that zirconium contamination may have entered the uranium feed stream from this coating. Also, they report that this coating has been eliminated on castings made to other specifications and no adverse effects on the quality of the castings has occurred. Therefore, production of up to 50 ingots with no crucible coatings used in the melting have been authorized on a test basis. If the results of this test are favorable, the specifications will be changed to remove the requirements for crucible coating.

Ingot Uniformity

The initial fabricated shape in the production of coextruded fuels is the cast uranium ingot. Any non-uniformity introduced at this step may be manifested throughout the remainder of the fuel fabrication process. Dimensional stability under irradiation, resistance to warp, and clad uniformity are examples of fuel characteristics which may be directly related to ingot uniformity.

The ingots are now hollow cast and, except for end cropping with a saw, are primary extruded from the as-cast geometry. Hollow casting results in some eccentricity of the I.D. with the O.D. and any shrinkage voids remain in the usable part of the ingot. Because of the eccentricity and roughness of the as-cast surface, the primary extrusion must be made oversize to allow about 1/8 inch of metal for machining cleanup and dimensional truing.

Plans are being made to cast solid ingots and drill the hole. However, it will take six months to a year to put this conversion in place. The ingots should then be more uniform because of improved concentricity and because of removal of the center core of uranium which should include the shrinkage voids and many of the impurities present in the melt. A quantity of 18 test and 18 hollow control ingots has been cast at NLO to quantitatively measure these effects. This material should be available for coextrusion in January, 1963.

As a further step in demonstrating the benefits of ingot uniformity, NLO has been requested to machine the O.D. of a test group of ingots and to square and chamfer the lead ends. The machined O.D. should cause the ingot to aline horizontally in the primary extrusion press. A previous test has shown that the chamfer caused the lead end of the ingot to lift on the die cone angle and center in the container just prior to upset. This substantially improved billet yield and concentricity.

Drilling and machining ingots will cause chip generation. However, no over-all increase in chip production should result if the added uniformity is used to reduce the cross section of the primary extrusion and reduce the chip generation for billet finishing.

Nondestructive Testing - 11 Inch Diameter Uranium Ingots

Initial attempts to evaluate uranium ingot coextrusion quality by non-destructive testing methods were initiated during the month. Six to eight ingots with various chemical compositions (Fe and Si content) were tested. This testing showed considerable differences exist between ingots at various Fe and Si levels and some differences between ingots with the same amounts. Based on the above, three representative ingots were selected for primary extrusion to NOE billet stock. Billets produced from this stock will be further tested to determine the correlation, if any, between the ingot test and the billet test.

Coextrusion Process

The following CPE extrusions were made during the reporting month:

11.1 Inch Tooling

Four Primary Extrusions - PU-84, 85, 86, and 87

PU-84	N-single tube billet stock
PU-85, 86, & 87	NOE billet stock

7.5 Inch Tooling

Three Zircaloy Extrusions - Z-149, 150, and 151

Z-149	3" bar stock for HLO
Z-150	2½" x 2" tube stock for HLO
Z-151	NOE end cap stock with titanium clad.

One Uranium Extrusion - U-116

U-116	4" x 2½" sleeve stock for NOE coextrusion billets

Five Composites - X-41 Through X-45

X-41,42,43,45	NOE extrusions with ½" wall I.D. sleeves
X-44	N-single tube extrusion

NOE Sleeved Billet I.D.'s

Four NOE coextrusions were made during the month with 1/2" thick sleeves in the uranium billet I.D.'s. The primary purpose of this small experiment was to determine the significance of uranium billet alpha phase work history on coextruded inner clad thickness variation.

The uranium billet materials used for the above test were (1) standard NLO production NOE billets single beta heat treated in the as-extruded blank, and (2) 1/2" thick wall sleeves with an alpha phase extrusion reduction of approximately 13x. The inner clad thickness variation for fuel lengths from all four coextrusions did not exceed 7 mils and, in fact, clad variation did not exceed 6 mils in 95% of the fuel lengths produced. In addition to an over-all reduction in clad thickness variation, the interface roughness or longitudinal wrinkling between the uranium and zircaloy was reduced by at least 80%.

N-Single Tube Coextrusion

Coextrusion of the prototype N-single tube fuel element geometry was initiated during the month. The primary purpose of this work is to establish the primary areas for development in coextrusion of a single tube fuel design.

Preliminary evaluation of the coextrusion performed indicates the primary fabrication problem which will exist on this basic fuel geometry will be control of inner clad thickness variation. Further development work will be performed in this area to define in more detail the dimensional variations which can be expected in a single tube fuel design with the present billet component fabrication processes.

Billet Lubrication: Sand Blasted Copper Cans

Twenty-four inner tube copper cans and front end plates have been sand blasted with a #36 garnet grit to improve the lubricant retaining power of the copper cans. The sand blasted cans are being alternated with standard cans during extrusion to characterize the effects of sand blasted copper can surfaces on billet assembly, die pickup, mandrel life, coextruded clad to core bond, copper removal, and warp yield. Twenty-nine extrusions of this test (Process Work Request CX-32) have been made to date.

Preliminary examination of the extrusion data indicates that die pickup is greatly reduced using the sand blasted cans. The effect of sand blasting the I.D. surface of the inner can on mandrel life will not be evaluated on this PWR as equipment problems did not allow sand blasting of the inner tube.

Chemical Processing

Horizontal Chemical Milling

Tests performed to date in the 333 Building on the new techniques of horizontal chemical milling have been successful. Masking washers and holders of improved design are now being fabricated. Additional development work planned will be performed in the pilot plant. At this point the process status is about as follows:

1. Basket design to be individual baskets almost identical to the pilot plant model with the addition of self support legs.

2. No change in the present chemical solution specifications.

3. That masking washers and holders be used according to the design presently being firmed-up in the pilot plant.

4. Introduction of this process into the production facility be accomplished by the fabrication of two milling baskets, one for inners and one for outers. The fabrication of masking washers and holders to await design optimization by Engineering.

5. Re-establish zircaloy-2 strip in the process.

Autoclave Process

Corrosion Coupons

Autoclave testing of reactor grade zircaloy-2 corrosion coupons, 1" x 1" x 0.035", with each autoclave load of production fuel elements was initiated this month. A temporary source of carefully fabricated, corrosion tested zircaloy-2 strip has been established to supply coupons for the startup of production autoclave testing. A summary of the general requirements and techniques to be used in autoclaving corrosion coupons has been issued and process specifications are being prepared.

The reasons for autoclaving "standardized" corrosion coupons, having predetermined corrosion characteristics, in the same autoclaves with production fuel elements may be stated as follows:

1. Coupons accompanying the fuel elements through the final etching process and subsequently autoclaved will serve as a check on the etching operation. For example, some of the etching variables that could be determined accurately using coupons are etch rate, fluoride pickup, hydrogen pickup, and acid staining.

2. Carefully etched coupons placed in production autoclaves, i.e., in the bottom and top of the autoclave, will serve as a check on the "correctness" of the autoclave cycle. For example, coupon weight gains are sensitive to autoclave contaminants and temperature gradients. Chemical analysis of autoclaved coupons for fluoride and hydrogen pickup would aid in assessing the autoclave cycle.

The first results from the coupon testing this month provide some interesting results. The weight gains for coupons located in the bottom of two production autoclaves were 11.5 and 5.3 mg/dm^2, while the weight gains for coupons in the upper one-half of the autoclaves were 29.5 and 26.8 mg/dm^2, respectively. The weight gain for the coupons should have been approximately 20 mg/dm^2. The weight gains for the "bottom" coupons corresponds to a three day cycle in 550-600°F water. The saturation temperature for the production autoclaves at 1500 psi is approximately 600°F, thus indicating that the bottom portion of these two autoclave loads were probably operating in the water phase. The slightly high weight gains for the "TOP" coupons are unexplained at the present.

The bottom basket of fuel elements in these two autoclaves exhibited some unusual coloration. The bottom several inches of one fuel element load has a lighter colored autoclave film. A white ring was found on some of the fuel elements in the other autoclave load about three inches up from the bottom end. The appearance of both autoclave loads suggest a water phase was present in bottom of the vessels, and the coupon results provided substantiating evidence.

Destructive analyses of the coupons for hydrogen pickup and fluoride contamination are being made.

End Closure Development

Brazed Closure

Vendor Qualification - Braze Rings

Five thousand (5,000) each, inner and outer, braze rings have been supplied by the Brush Beryllium Company. These rings were ordered to provide Brush the opportunity to become qualified as a second supplier of this material. Several hundred fuel elements have been brazed with this material so far and yields have been as high as with normal material. There are some slight differences in behavior during the brazing operation between this material and the normal material, but there is no evidence to indicate that these differences are detrimental in any way.

Brazing Characteristics of NON Iron-Silicon Uranium

Metallurgical examination of brazed closures on inner fuel sections made from uranium to which no iron or silicon had been added indicated that a compound layer forms much more readily, between the braze alloy and the uranium, than when iron and silicon is present. It is believed that the presence of silicon may retard the formation of a compound layer. This possibility will be further investigated when material with varying amounts of silicon becomes available.

Thermal-Cycle Testing of the Braze Closure

Twenty-seven samples of the N-inner piece are being thermal cycled. Each sample has had between 3 and 45 cycles through the temperature range of 20°C to 730°C to 30°C.

Based on both nondestructive and visual testing, there have been five failures. The failures are cap:core unbonds and two of them have progressed to transverse shear failures of the inner clads at the cap:core junction. One failure occurred in the interval of 4 to 9 cycles; four failures occurred in the interval of 22 to 45 cycles, but one of these showed incipient failure after only three cycles.

Three samples with initial gross unbonds between the cap and the core have been given 45 thermal cycles. There is no evidence of further increase in unbond.

The samples are incurring large dimensional changes. There is an approximate 15% elongation with general increase in I.D. and decrease in O.D. (i.e., wall thinning) and large warp after 45 cycles. These dimensional changes would be very serious if they occurred in-reactor. A study of the dimensional changes and cap:core bonding at reactor-operating temperatures should therefore be started.

The nondestructive testing done between thermal cycles has suffered a loss of resolution from the warp in the pieces. The warp causes a poor alignment between the testing crystal and the outer-most surface of the cap with an accompanying loss in return signal.

Gas Pressure Bonded End Closure

Lot VII - This lot had closure rings of titanium 0.100" thick for studying the filling of the striations on the inside of the cladding. The first specimen failed in 360°C (680°F) water at 98 days. Two NOT and one NIT have not failed after 126 days. One specimen failed in 400°C (752°F) steam after 31 days.

Lot XI - In order to try to eliminate the pipes produced by the residual cladding striations after gas pressure bonding at 10,000 PSI, 650°C (1202°F) for one hour using zirconium closure rings with smooth bonding surfaces, closure rings with semi-circular ridges circumferentially around the closure rings on the bonding surfaces were tried. Exposure of 7 NOT and 9 NIT specimens in 400°C (752°F) steam for 72 hours produced no failures. The specimens were then divided into two lots for long term autoclaving in steam and water. The lot for steam autoclaving was composed of three NOT specimens and four NIT specimens. After three days autoclaving, there was virtually no evidence of corrosion. However, after 17 days, two NOT closure rings had heavy corrosion, and after 36 days the corrosion was very heavy. An NOT closure ring was exceedingly heavily corroded after 19 days and corroded off most of the 0.100 inch extensions. The NIT specimen showed virtually none to very heavy corrosion.

Three NOT and four NIT specimens have been autoclaved in 360°C (680°F) water for 28 days. There is a very slight amount of corrosion and pitting around the bond line.

No failures have occurred in either water or steam autoclaving.

Lot XVI

This lot was prepared by the standard Be-Zr braze process without closure welds to determine the long term effect of 360°C (680°F) water and 400°C (752°F) steam on the brazed joints. Previous to shipping they were exposed to 400°C (752°F) steam autoclaving with no evidence of failure. They are undergoing long term autoclaving at Battelle Memorial Institute.

Titanium

An end closure section using a 0.100 inch thick titanium closure ring has been tested by Chemical Research for dissolvability in the Zirflex process. The amount of titanium dissolved by the time the Zr-2 cladding was removed was negligible, establishing a dissolving rate of 0.7 mil/hour. Handling of massive titanium closure rings in the dissolver by an alternate method is being considered.

A coextrusion approximately the dimensions of a NOT closure ring has been made using zircaloy-2 for the core with the inner and outer surfaces cladded with titanium. Specimens for examination have been removed and processing started.

Zironium alloys containing 6, 8, 10, and 12 per cent titanium are being prepared in the form of buttons for corrosion and bonding studies. So far no diffuser for zircaloy-2 has been found that equals titanium in the ease of preparation and the clean uniform diffusion zone produced. On the basis of this, the alloys are being prepared to see if the problems of dissolution and coating can be overcome. In the range of about 0.1 to 4 per cent titanium, zirconium alloys display a very high corrosion rate in steam (400°C-752°F) and fairly high rate in water (360°C-680°F).

Fuel Element Supports

Outer Supports

As has been mentioned in previous reports, it was decided to change the design of the outer support of the N-fuel from the "suitcase handle" design to the "arch" design. The purpose was to increase the impact strength of the outer support. While the earlier design, from KER loop tests, appeared to have adequate impact strength insofar as in-reactor performance was concerned, it was felt that the impact strength was low with regard to the possibilities of handling damage. The new support has about three times the impact strength of the old support.

Because of the production schedule requirements to have a full load completed by the last quarter of CY-1963, it will not be possible to have all pieces utilize the new design of outer support. Consequently, a decision was made to accept up to 5,000 fuel elements with the old style of outer support. These supports had already been welded on some near 2,000 pieces and are directly available for immediate production with minor modifications. For the largest batch of material, the modification consisted of sizing the supports down from .150 inches high to .125 inches.

The existing process for the attachment of the "suitcase handle" type of outer support was rechecked to assure weld quality was consistent. Specifically, using the established weld schedule, eight supports were attached to reject outer fuel. Metallographic samples were examined for any change in the bonding between the zircaloy and the uranium and for any effects on the grain structure of the uranium. These examinations proved that the weld integrity is satisfactory. Nugget depth averaged about two-thirds of the zircaloy cladding thickness.

Fully prototypic outer tube supports of the "arch" design with crimped steel shoes attached have been successfully fabricated in the pilot plant. Approximately one dozen assemblies were tested for load deflection characteristics. These ranged from 800 to 1150 pounds load at .040 to .050 inch deflection. This is classed as satisfactory.

The crimp-on shoe for the "arch" support appears to be quite satisfactory from a mechanical viewpoint. Many shoes have been fabricated by hand and no basic fabrication problems have arisen, such as wrinkling or tearing. Tooling for prototype or small production fabrication of shoes is being fabricated in Technical Shops.

Offsite production of the "arch" support has been delayed due primarily to classification and contracting problems, however, at the present time it seems that attachment of outer supports will be in production prior to February 1, 1963.

Inner Supports

The design modifications to the inner support (buggy spring) have been firmed up and materials have been developed by HLO who satisfactorily produce this piece. It is planned to produce some of the highly ductile strip on-site,by HLO, and to fabricate an initial quantity of supports. At the same time, activity off-site, utilizing the technology developed in the laboratory should permit the production process of putting inner supports on fuel elements to be in place by February 1, 1963.

Welding Process

The problem of arc burns and pickup during projection welding of the supports has finally been eliminated. A copper strip attached to a length of channel iron in the form of a saddle has been attached to the two hold-down clamps, with the previously used Vee ground blocks now being insulated. This method of grounding the fuel prevents arcing and burning of the zircaloy surface which had resulted in white oxide spots after autoclaving. This grounding process has been checked out, and fuel elements with supports attached using the new grounding technique have been autoclaved without white oxide or other visible evidence of the grounding location.

TESTING METHODS OPERATION

N Fuel Test Program

It is now rather definitely established that the degree of impurity content in both billets and ingots can be reliably predicted by ultrasonic measurement. The correlation between ultrasonic pre-extrusion measurements and extrusion performance, however, is not so precise. For example, sixteen percent of the fuel elements extruded from 142 outer billets which had been selected as "good" by the ultrasonic test were rejected because of excessive clad thickness variations of the inner surface. In comparison, the extrusion of 21 billets which appeared "poor" to the same pre-extrusion test, produced roughly thirty-eight percent rejects for the same reason of non-uniform clad thickness.

Attempts are being made to strengthen this correlation by incorporating supplemental inspections to the ultrasonic test. In addition to the usual test which measures billet attenuation in a transverse direction, new circuitry has been added to the tester which sends a beam of ultrasound once through the billets (or ingots) along a radial direction. The modified tester thus simultaneously measures attenuation along two perpendicular directions, both of which are normal to the billet longitudinal axis. Surprisingly, data obtained from these two tests are not always in agreement, suggesting that billet ultrasonic characteristics are anisotropic, even after beta heat treatment. It is hoped that the new test will provide better correlation with internal clad wrinkling since its beam travels next to the axial bore of the billet.

Routine operation of the fuel tester has caused special problems this month. Excessive downtime resulted from attempted use of internal probes whose dimensions were not within design specifications, and from the necessity of replacing the test tank mechanisms which rotate the fuel element during testing. In order to eliminate this difficulty simplified rollers have been designed and are now under shop fabrication. Additional effort has been devoted to development of an extremely lightweight combination eddy current-ultrasonic test probe for replacement of the bulky and occasionally troublesome probe now in use.

AlSi Fuel Testing

Availability of the nondestructive test equipment has averaged around ninety percent the past month. The audit system of maintaining frequent, routine checks on the tester has proven to be an effective method of early spotting and correcting of operational difficulties. Optimum standardization of the UT-2 and UT-4 testers has not yet been achieved, although much improved UT-4 performance has resulted from use of the stainless steel standards recently adopted.

The external and internal bond tests were set to reject on both total count as well as count rate for the inspection of enriched material. This is the first time the testers have been set to reject normal production material on a total count basis. Attempts will be made to continue this mode of operation.

End bonding of sixty elements have been tested before and after attachment of self support clips to determine if the ultrasonic welding process had any detrimental effect on the quality of the bond. The results were negative.

Extensive laboratory tests are being made to determine the criticality of test variables on the bond test data. To date, the effect of track rotational speed, pitch, water temperature, fuel element temperature, and water air content have been quite thoroughly investigated. The present effort is looking at the effect of transducer alignment and tuning. These data are being obtained in order to more precisely define test parameters important to the 313 Building test equipment. Ultimately, this information will be useful in the design of new test equipment which will be built to replace the present testers.

The Hot Die Size fuel inspection system now under shop fabrication was modified to include two additional bond tests for the inspection of N bonding. Although these changes will delay completion, the unit is expected to be available for laboratory check out around the first of the year.

End bonding of one hundred and forty-five experimental Hot Die Size elements were successfully examined in the laboratory for process evaluation purposes. Test results are presently being checked with metallographic examination.

Irradiated Fuel Inspection

Considerable difficulty has been experienced in making operational both the N fuel irradiation test equipment being installed in 105 KE and the AlSi test equipment being installed in 105 C Building. Some testing has been accomplished with the latter equipment, however, and full operation is expected within a few days. Many mechanical problems, while minor individually, have delayed full check out of the N fuel test equipment.

General

The possibility of detecting hydrogen embrittlement in zirconium process tubes continues to look favorable. At this point approximately twelve samples ranging in concentrations estimated to be from 700 to 5000 ppm hydrogen have been made available for the ultrasonic test. All are detected without ambiguity. Difficulty is being encountered in preparing samples of lower concentrations. Moreover, as more samples have been destructively analyzed it has been learned that the measured values often disagree vastly from the original estimates. One sample, for example, which was thought to contain 450 ppm hydrogen was revealed by destructive tests to have 100 ppm. Since this sample was not identified by the present test, this would suggest a lower limit of detection sensitivity of around 100 ppm hydrogen. Present efforts are to obtain more samples with low concentrations and to investigate the effect of wall thickness variations on test results.

A novel method of displaying ultrasonic defect data is being investigated. Development of the technique has been motivated by problems associated with inspection of the N Reactor primary piping in which conventional test practices have not provided needed information relative to defect size and position. An electronic beam is scanned across the face of a cathode ray tube in direction and in time exactly corresponding to the path taken by the ultrasonic pulses as they travel through the wall of the pipe. Defect indications are fed into the electronic sweeps such that the traces are brightened at points corresponding to the point in the metal where the defect signals are generated. As the beam is directed through the weld bead defects thus appear in their approximate geometrical position. Early laboratory evaluation of this idea with rather crude laboratory mechanical devices have been most favorable. Continued work will be aimed at refinements applicable to the inspection of installed piping.

Manager, Engineering

LM Loeb:vb

FUELS PREPARATION DEPARTMENT
FINANCIAL OPERATION

NOVEMBER, 1962

Primary effort during the month has been directed toward assuring a smooth transfer of cost accounting work to the Financial Sections of IPD and NRD as of December 1, 1962.

Detailed efforts have been directed to the many changes occasioned by the reorganization. Specifically, arrangements have been made for code changes on office equipment, vehicles, laundry, telephone and bus costs. Establishment of precodes, IME rates and standard billing rates is progressing. Records relating to the work order system are being changed. The major extent of the changes would indicate that the detailed work involved will extend well into December.

Property assigned to FPD has been segregated for transfer to NRD and IPD according to functions being assumed by each. Since the transfers are primarily a change of account and custodian codes in most instances, a machine program will be used to make the necessary code changes. Project CAF-847, New Fuel Cladding Facility, will be booked directly to the NRD accounts.

The equipment Budget Midyear Review was completed during the month. Earlier estimates of being able to release $400,000 were correct. The current estimated requirements for FPD functions for FY 1963 are $1.3 million. These funds are to be split $330,000 to NRD and the balance to IPD.

Travel cost during November increased to $17,293 with 247 days in travel status. November business included such areas as employee transfers, personnel recruiting and travel for attendance at society meetings as well as other regular business trips. Society meeting attendance encompassed meetings of the American Institute of Electrical Engineers held in Chicago, the Society for Nondestructive Testing held in New York and the Instrument Society of America also held in New York.

Work is under way to transfer appropriate travel documents to IPD, and a review of special travel budgets for courses and meetings is being made preparatory to a reallocation of funds to IPD.

Nine cost improvement proposals were received in November with estimated savings of $20,183. Five showing savings of $13,119 were accepted, two indicating savings of $3,290 were rejected and two with estimated savings of $3,774 were being evaluated at the close of the month. These proposals coupled with suggestions of $2,347 brought year-to-date activity to $797,829, 97% of the eleven-month goal and 89% of the CY 1962 goal.

Several contacts were made with and assistance given to representatives of the General Accounting Office who are studying uniform procurement of gloves throughout the AEC complex.

Systems studies involved in the transfer of certain functions to IPD were reviewed at length with the IPD procedures specialist and appropriate courses of action charted.

Department OPG's on travel and delegations of routine authority have been revised to reflect application to N-Reactor Department. A program is under way to review and revise the OPG distribution list to ensure appropriate distribution of guides commensurate with the new organization. Initial plans are for distribution of guides at the Section and Subsection level with supplemental transmittal below these levels when need is established.

L R Stengquist
Manager - Finance

J Milne:pw

NPR PROJECT OPERATION

RESPONSIBILITY

Establishment of the NPR Testing Program Unit in the Field Engineering Operation as a separate functional component was made effective on November 5, 1962. R. C. Walker was named Supervisor of this Unit.

ORGANIZATION AND PERSONNEL

	10/31/62	11/30/62
Exempt		
Permanent	86	88
Non-Exempt	21	23
TOTAL NPR PROJECT PERSONNEL	107	111

Transfers

Name	From	To	Effective Date
Walker, RC (Exempt)	N Reactor Plant	NPR Testing Program	11/5/62
Johnson, VV (Exempt)	N Reactor Plant	NPR Testing Program	11/12/62
Edwards, Sharon (Non-Exempt)	CE&UO	Drawing, Spec., & Control	11/19/62
Hoff, Vonnie (Non-Exempt)	CE&UO	NPR Testing Program	11/19/62

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.

NPR PROJECT

TRIPS

Name	Firm and Location	Date	Purpose
JH Fastabend	Gray Tool Company Houston, Texas	11-12 to 11-13-62	DDR-155 and discussion on assembly tolerance.
JH Fastabend	Microdot, Inc. Pasadena, Calif.	11-14-62	Discuss weldable strain gage techniques for coextruded joint and primary loop piping.
RA Rohrbacher	Engelhard Newark, N. J.	10-17-62	To discuss engineering problems that appeared during fabrication and testing of prototypes.
CW Ward	Parker Aircraft Co. Los Angeles, Calif.	10-18 to 10-22-62	To expedite the production of "H" Fittings.
JD McCullough	Brush Instruments Cleveland, Ohio	10-19-62	To discuss results of tests on "Metrisite" units.
RA Rohrbacher	RdF Corporation Hudson, N. H.	10-19-62	To discuss engineering problems with vendor.
JD McCullough	Panellit Div. ISI Skokie, Illinois	10-22-62	Engineering relative to Rod Flow Monitor and Zone Temperature Monitor.
CW Ward	Parker Aircraft Co. Los Angeles, Calif.	10-24 to 10-27-62	To discuss engineering and production problems with "H" Fittings.
EM Kratz	W. S. Rockwell Co. Fairfield, Conn.	10-27 to 10-30-62	Witness operational test of Rockwell butterfly valves.
WJ Mundt	Burns and Roe Hempstead, N. Y.	10-29 to 11-2-62	To discuss remaining design items.
RA Rohrbacher	Western Pipe & Eng. San Francisco, Calif.	10-29 to 11-7-62	To discuss tubing quality, stress relieving and to assist vendor with miscellaneous engineering problems.
EM Kratz	Byron Jackson Pumps Los Angeles, Calif.	11-10 to 11-12-62	Witness transient test on primary coolant pump.
WJ Mundt	Burns and Roe Hempstead, N. Y.	11-12 to 11-16-62	To discuss remaining design items.
DL Condotta	Burns and Roe Hempstead, N. Y.	11-12 and 11-16-62	Discussions on NPR design.
DL Condotta	GEL Schenectady, N. Y.	11-13-62	Meetings at GEL on ATH Contract.

TRIPS (Continued)

Name	Firm and Location	Date	Purpose
DL Condotta	General Electric Co. Schenectady, N. Y.	11-14 and 11-15-62	Attend General Electric Company Seminar on Systems Engineering
JD McCullough	Information Systems, Inc. Los Angeles, Calif.	11-15 to 11-17-62	To review equipment, fabrication and tests.
	Barton Instrument Corp. Monterey Park, Calif.	11-17-62	To review fabrication of flow transducer test facility.
JK Flickinger	General Dynamics Rochester, N. Y.	11-18 to 11-21-62	To discuss selector switch failures on the Diversion Control Panel.
LP Reinig	Chandler-Evans Hartford, Connecticut	11-20 to 11-22-62	Assist Kaiser Engineers and AEC in expediting valve delivery.
WJ Mundt	Burns and Roe Hempstead, N. Y.	11-26 to 11-30-62	To discuss remaining design items.
WJ Pickering	Large Steam Turbine Dept., General Electric Schenectady, New York and New York, N. Y.	10-29 to 11-2-62	Consultation on welding problems and presentation of technical paper.
JD Fogelquist	Tube Methods, Inc. Bridgeport, Pa.	11-12 to 11-14-62	Establish testing and inspection procedures for stainless steel tubing.
WJ Love	New York, N. Y.	11-25 to 11-28-62	Attended Winter ASME Annual Meeting as Vice Chairman, Nuclear Superheat Session and Program Chairman for 1963 Nuclear Power Conference. Also attended ANS-7 - Reactor Components Standards Subcommittee Meeting.
	Burns and Roe Hempstead, N. Y.	11-29-62	To discuss circulating water system and sixth loop piping requirements.
WJ Dowis	Washington, D.C.	11-26 to 11-30-62	Attended Atomic Industrial Forum Meeting and also discuss Advanced Reactor Study with Division of Production, AEC-Washington.

VISITORS

R Tracey	Sengco Los Angeles, California	11-15-62	Pre-award conference on nozzle caps.
M Crank	Bruce Industries Gardena, California	11-15-62	Pre-award conference on nozzle caps.

SIGNIFICANT REPORTS ISSUED

HW Number	Classification	Author	Date	Title
HW-75559	Secret	GF Bailey	11-12-62	Physics Considerations of K Reactor Channel Straightening
HW-75641 RD	Unclassified	RC Walker	11-26-62	NPR Testing Program Objectives
HW-75484	Unclassified	WJ Love	11-15-62	The Notch Sensitivity of ASTM A-212 Gr.B Steel and Pipe Welds Under Reversed Cycle Loading
HW-73012 REV1	Confidential	RK Robinson	11-28-62	Summary, NPR Thermodynamic Parameters - Phase II and III
HW-75450	Secret	GF Bailey	10-31-62	Preliminary Analysis - Modifications of Pre-K Reactors
HW-75495	Unclassified	HG Johnson	11-2-62	NPR Emergency Dump Basin System - Design Criteria
HW-75534	Secret	DL Condotta	11-7-62	Reactor Design Analysis Monthly Report - October 1962

NPR PROJECT

PROCESS DESIGN OPERATION

Process Research and Development

Design criteria for a minimum cost, limited life emergency dump system have been prepared.

The calibration data for the NPR pile gas system have been completed and are being used in the field.

The possible effects on the system of deferring the insulation on the secondary loop steam piping have been reviewed and protection against freezing recommended.

New pressure drop calculations for the NPR primary loop have been made.

The machine program for simulating an emergency dump is being changed to incorporate the redesign of the dump tank and dump piping.

A transient analysis of the NPR pressurizer injection system has been started. This study will use the 300 Area analog computer.

The calculations of pressure and flow transients caused by pipe failures in the NPR cooling system have been completed.

The capability of the moderator cooling system to cool the reactor fuel during shutdown has been calculated. These studies indicate that approximately two hours following shutdown the moderator cooling system will prevent fuel melting.

Conversion

Engineering studies for dual-purpose operation of the NPR were reviewed at a meeting on November 1, 1962, with representatives of the Atomic Energy Commission, WPPSS, BPA, TVA, R. W. Beck and Associates, and Burns and Roe.

A letter was received from the Atomic Energy Commission which, following agreement, would authorize expenditures up to $17,300 to start work on studies of dual-purpose operating conditions.

The operating parameters - temperature, pressure and flow - to be used as a basis for conversion design have been calculated.

Work has been started to develop several computer programs to analyze the operation and control of the secondary cooling systems following conversion.

Studies indicate that the flow monitor system is adequate to handle the maximum anticipated flows following conversion to six-loop operation.

Project CAI-816

Primary Coolant Pumps

Five additional 190 degree cooling transient tests were run on the number 3 primary coolant pump by Byron Jackson. Casing measurement after the tests indicated no dimensional changes had occurred and Byron Jackson has given an unequivocal engineering opinion that the pumps will perform reliably in field service.

Integrated Data and Temperature Monitor

The Integrated Data and Temperature Monitor System was accepted at Information Systems Incorporated on November 28, 1962.

Process Tube Flow Monitor Transducers

The second half of the process tube flow monitor pressure-to-electrical signal transducers has been accepted and has been received at Hanford.

Process Tube Flow Monitor Controllers

An investigation was made of the problems related to the use of the self-check functions of the Process Tube Flow Monitor in the reactor safety circuit. This resulted in a recommendation that each self-check detector (Flux-Bar Failure, High-Trip-Shorted-Diode, Low-Trip-Shorted-Diode, and Open Diode) be provided with a key-locked by-pass, and that the group be connected into the safety circuit through a 2-out-of-3 time-delay matrix. The time-delay of each relay was recommended to be adjustable between 0.5 and 5.0 minutes. An alteration to the purchase requisition was issued and approved to obtain these features.

Avien's component suppliers are failing to meet delivery commitments. Tung-Sol Electric, Incorporated, produced 18,000 thyratrons to obtain 3,000 to meet Avien's specifications for these indicators. A request was made to relax the firing-voltage tolerance from 106 plus-or-minus 2 volts to 105 plus-or-minus 3 volts. More than 4,000 indicators are required.

Delivery of transistors has permitted completion of more than 80 per cent of the approximate 4,100 amplifiers required. The 1,004 controllers exclusive of the Flux-Bars are more than 80 per cent complete.

Eighty-five drawings were submitted by Avien for approval during the month.

Horizontal Control Rod Drives

Development work and testing done on a rejected drive at the 189-D Building Laboratory has shown that it is feasible to decrease out-of-specification deceleration to an acceptable rate by modifying the cushion orifice arrangement. General Electric will provide the technical direction of job site correction of horizontal rod drives, out-of-specification on deceleration.

Process Tube Diversion Valves

Process tube diversion valve production has been resumed. All design media for the redesigned actuator have been approved including the Indium plus Electrofilm 66-C lubricant for the cylinder bore. The first production attempt to machine the Inconel X cup seals was unsuccessful. Early resolution of cup seal manufacture will be necessary in order to permit December shipments as now scheduled.

Heat Dissipation Plant Design Concepts

The Design Concepts on Charge-Discharge, Emergency Seal Water, and Modal Station were received from Burns and Roe and approved by General Electric. A rough draft of the Once-Through Cooling Design Concept was received and comments are being prepared.

Heat Dissipation Plant Hot Water Quality Laboratory

Responsibility for completion of design of the Hot Water Quality Laboratory was transferred from Burns and Roe to General Electric by letter from the Atomic Energy Commission dated November 19, 1962. This letter also requested General Electric to investigate possible cost reductions in the system. Drawings for the Hot Water Quality Laboratory were received from Burns and Roe on November 20, 1962, a letter was received from the Atomic Energy Commission permitting specification by brand name on November 27, 1962, and the specification and drawings for the Hot Water Quality Laboratory were issued "as is" for information only, on November 28, 1962.

Rockwell Butterfly Valves

A preliminary operational test was run at the Rockwell plant on the electro-hydraulic control system for one of the butterfly valves which will control steam flow to the dump condensers. Modifications will be made to the system to meet the latest design requirements before the final tests are run.

Equipment Development and Testing

The Component Test Loop was operated for 730.5 hours with an operating efficiency of 98.2 per cent. Thermal and pressure cycling was performed in accordance with MIL-F-18280A on welded and flareless "H" fittings over a thirteen day period. During the balance of this operating time, header-to-header process tube components were subjected to NPR operating conditions in the Environmental Test Facility.

Development and testing concentrated on the following design tests: Connector Evaluation; Rupture Monitor Heat Exchanger; Production Horizontal Rod Drive; High Efficiency Filter Test; Primary Loop Fittings and Valves; Production Inlet Barrier Wall Seal Plug; Control Rod Solenoid Valves; and Water Quality Monitor Pressure Reduction Valve.

FIELD ENGINEERING OPERATION

Construction

105-N & 109-N Buildings

The work on the punch list items for subcontract SC-78 is now nearing completion. This subcontract covered the general mechanical work in the 105-N Building.

Kaiser Engineers IPFF forces have started installation of the ventilation ductwork in the 105-N pipe spaces. It is estimated that this work is now approximately 30% complete.

Approximately 1,150,000 feet of electrical cable has now been pulled in the 105-N Building. There has been no progress this month on the pulling of the inter-tie cables between the 109 and 105 Buildings. This work was stopped pending the receipt of additional information from Bailey Meter.

The installation of tubing is in progress on the flow monitor system, the rod cooling and graphite cooling systems, and the rupture monitor system. Approximately 750 welds have now been satisfactorily completed and installed on the fuel rupture monitor system. Racks containing tubing for the diversion valves and rupture monitoring systems have been installed in the left outlet pipe space.

An order for about 160,000 feet of 3/16" O.D. stainless steel tubing was placed by Kaiser Engineers with Tube Methods, Inc. The inspection procedures have been approved and the vendor's eddy current testing equipment evaluated. The vendor is now in production although the initial reject rate has been rather high, approximately 37%. It is anticipated that all the tubing shipped from this vendor will be fully satisfactory and ready for installation.

All sections of the primary water graphic panel have now been installed in the 105 control room.

115-N Building

Very little progress has been made on this building by the electrical subcontractor, Ford Electric.

The mechanical and sheet metal work on the building is now essentially complete and punch lists are being prepared.

All of the filter frame guides have been installed and the steel roof panels are being placed.

181-N River Pump House

The tests on Motor #3 established that the motor still did not meet the specification requirements. The decision has finally been made to return all four electric motors to the manufacturer to be rebuilt so that they meet specification requirements. This work will be done on a single motor at a time and the first has been shipped to the vendor's plant.

182-N High Lift Pump House

Good progress has been made in this building in the past month on electrical work; however, considerable work remains. The installation of the high pressure injection water system is nearly completed.

163-183-N Building

Functional testing of the demineralization system by Bumstead-Woolford has been started.

184-N Building

The attempts to start up the boiler feed-water pumps and the air compressors for functional testing have revealed deficiencies in the electrical systems. This has required considerable trouble shooting effort with resulting delays in performing functional tests.

166-N Building

Water was found in all of the fuel and diesel oil transfer pumps. These pumps have all been removed from the building and are in the shop for a complete overhaul. The only part of the diesel oil pumps that was salvagable were the pump cases.

Pile Erection

Installation of horizontal rod assemblies is continuing with 21 drive assemblies set and aligned, and four remaining to be aligned. Arrangements have been made for Kaiser Engineers to modify, as necessary, drive units not meeting deceleration requirements in the 189D Building. General Electric Technicians will then test units.

Fifty-six trip mechanism plug assemblies have been installed on top of unit for the Ball Safety System. Further progress awaits delivery of additional modified units from J. A. Jones Company.

Development of tooling is continuing for aligning of Grayloc Hubs. Consultation with Grayloc Tool Company representatives confirms the need for close alignment, and the present repair procedure for seal surfaces.

Installation of hydraulic elevator components is continuing with the 'C' elevator hydraulic cylinder in place and superstructure mounted. Welding of hydraulic piping is complete with the exception of some repair and X-ray.

Primary Piping

Five hundred thirty-five spools have now been shipped to the field from the HUICO shop. This represents a total weight of 466 tons. All headers have been installed in the left outlet and inlet pipe spaces.

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 Bldg.	58.1%
109 Bldg.	48.0%
Total System	53.0%

(Total spools completed and accepted by General Electric at the HUICO shop now stands at 711 or 70.6 per cent of the total number required, excluding connectors).

NPR Testing Program

Establishment of the NPR Testing Program Unit as a separate functional component within the Field Engineering Operation was made effective on November 5, 1962. This unit will be staffed to provide overall integration, planning and administration of the NPR testing and acceptance program, including operational and other pre-startup testing requirements.

Initial activities have been primarily related to preparation for custody transfer of certain facilities on December 17. At this time the 108, 151, 153, 163, 166, 181, 183, 184 and such portions of the 182 and 1900 Area systems as may be directly related to insuring continuity of the testing program will be transferred from Kaiser Engineers to General Electric on a provisional acceptance basis, pending testing and punch list completion.

Activities directly related to the testing program include planning related to format and schedule for test description preparation and a more thorough definition of system boundaries. In addition, detailed test procedures are in preparation for most of the facilities which are now being considered for imminent custody transfer.

Adminstration

The following material has been processed during the period of October 22, 1962 through November 25, 1962:

Drawings	185
Criteria	0
Specifications	1
Requisitions	32
ATP's	2
Other	4
Total	224

Reviews were completed and formal comments were offered on engineering material as follows:

Drawings	1
Specifications	1
Scope	0
ATP's	1
Total	3

Bailey Meter material processed as of November 25, 1962 is as follows:

Released as Noted for Fabrication Drawings	104
Released for Information	123
Released for Fabrication Drawings	97
Not Released for Fabrication Drawings (B&R)	2
Approved without Exceptions (GE)	6
Not Approved (GE)	1
Total	333

Following is the status of Subcontract KE-11252 (HUICO) data as of November 26, 1962:

Total Number Received	2790	(Included 2001 received for Information Only)
Number Approved	733	
Number Approved with Exceptions	27	
Number Not Approved	22	
Number Currently Being Reviewed	7	
By GE & B&R jointly	7	
By B&R (109-N)	0	
Number received for Information Only - No approval required	2001	

PROGRAM EVALUATION

Design Status (*)

	Certified Schedule	Actual % Complete
Reactor Plant as of 12/1/62		
Title I		
Scope	100	100 (**)
Title II	100	100
Heat Dissipation Plant as of 12/1/62		
Title I		
Scope	100	100
Title II	100	100
Composite Design Completion as of 12/1/62 (Reactor and Heat Dissipation Combined)		
Total	100	100

Costs

HOO-AEC received the $188 million appropriated by Congress. On November 29, General Electric was issued a Work Authority increasing their authorized funds by $300,000, for a new total of $24,050,000.

On November 16, HOO-AEC submitted a revised project cost estimate to Washington totaling $188,920,000, without contingency or project startup.

Schedules

The project cost estimate submitted by HOO-AEC on November 16 was based on a revised construction schedule showing a completion of March 15, 1964. This represents a curtailed construction completion based on the deletions incorporated in the reassignment of testing activities in accordance with the Commission's directives.

(*) Title II design reported at 100 per cent complete, in accordance with letter, H. H. Schipper to J. S. McMahon, "NPR Design Schedule," 10/19/62.

(**) This percentage represents only the completion of 44 criteria and does not include updating or revising.

The construction status as of 12/1/62, based on Revision # 4 to the AEC Construction Schedule, dated April 13, 1962, is as follows:

	Scheduled	Actual
Temporary Construction	87	84.2
General Area Systems	71	75.2
105-N Building	85	68
109-N Heat Exchanger Building	87	59
163N-183N Water Treatment Facilities	99	97.4
181-N River Water Pump House	100	98.6
182-N High Lift Pump House	99	98.9
184-N Standby Power House	97	96.3
153-N Switchgear Building	93	98.3
NPR Project (CAI-816)	85	68.6

Manager, NPR Project

JS McMahon:mf

END

DATE FILMED

12 / 14 / 92