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**Pacific Northwest Laboratory
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DOUGLAS UNITED NUCLEAR MONTHLY REPORT

AUGUST 1970

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September 25, 1970

DOUGLAS UNITED NUCLEAR

MONTHLY REPORT

August 1970

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SUMMARY

REACTOR PLANT OPERATIONS

Production Statistics

	<u>KE</u>	<u>N</u>
Input Production - Pu (KMWD)	48.9	0
Time Operated Efficiency - %	43.2	0
Steam Availability to WPPSS - %	-	0

KE Reactor

Equilibrium power level was restricted to 3,685 MW by brittle fracture tube power limits. The reactor was shut down on August 14 for the remainder of the month because of a shortage of interruptable power.

N Reactor

The reactor remained in shutdown status during August for maintenance and project work.

FUEL FABRICATION

Production Statistics (tons)

	<u>For KE</u>	<u>For N</u>
Billets Extruded	-	-
Finished Fuel Produced	32.7	40.0

KE Fuel

The AlSi fuels operation continued on a partial line basis for the production of K5E fuel.

N Fuel

There was no input production for N fuel. The shop processed boxed pre-extruded material during the month.

TECHNICAL ACTIVITIES

A number of improvements were made on N Reactor process tube coolant temperature monitoring systems. Eighty-eight of the 128 defective All Tube Temperature Monitor channels and 49 of 61 defective Zone Temperature Monitor channels were repaired.

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Inconel actuator assemblies along with threaded gland followers and GRAFOIL packing have been installed on six V-12 valves as part of the diversion valve development program. Twenty-five other V-12 valves were also packed with GRAFOIL.

The preparation of specifications for the Nuclear Flux Monitor System has been started in support of N Reactor project activities, and the design criteria for the High Pressure Injection System have been approved by AEC-RL.

Mark IV fuel was charged into N Reactor to initiate production tests for evaluation of non-brazed end closures and the end spider inner support system. In addition, corrosion coupons were loaded into holders for evaluation of the effect of fluoride surface contamination upon corrosion rate of Zircaloy-2 fuel cladding.

Ten ball channels were successfully renovated at N Reactor to prevent the loss of poison balls into the stack through separations which had developed between the ball channel liner blocks.

Dye penetrant examination showed the tube sheet in steam generator 4A to be free of stress corrosion cracking.

The K reactor inlet supply piping system water hammer transient studies were completed and documented in DUN-7212, "Final Report of Water Hammer Transient Analysis for K Reactor Inlet Supply Piping System."

Recent vertical traverses of the KE Reactor have confirmed turnaround of the graphite in the transverse orientation.

Analyses of radioisotope deposits on metal coupons exposed in the bypass loops at N Reactor show that Fe-59 and Co-60 are the major causes of high dose rates in the reactor.

The afterheat removal tank at N Reactor plant has been restored to normal service.

The americium target elements charged in KE Reactor in May 1969 were discharged.

In-place iodine testing of the charcoal filters in two cells at N Reactor were performed. The filter efficiencies were well within limits.

GENERAL

An arbitration case relating to Material Coordinator jurisdiction, which has been dormant for two years, has been reactivated by the Union following the layoff of a Material Coordinator.

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There were no disabling injuries in August, and no radiation exposures exceeded operational control.

for *OC Schneider*
Charles D. Harrington
President

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REACTOR PLANT OPERATIONS - KEPRODUCTIONGeneral

Production (largely weapons grade Pu), power levels, efficiencies and related statistics for the KE Reactor are tabulated below.

K reactor input production and time operated efficiency (TOE) for the past six months are shown on the following chart:

Statistical Summary

Input Production - Pu (KMWD)	48.9
- U-233 (Equiv. MWD)	219.0
Power Level (MW) - Maximum	3,685
- Average	3,653
Time Operated Efficiency - %	43.2
Number of Outages	1
Number of Startup Interruptions	0
Operating Coolant Flow - 1000 gpm	201.5
Fuel Charge (Tons) - 94 Metal	27
- Natural U	215
Fuel Element Failures	0
Helium Losses - 1000 cu. ft.	80.5

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OPERATING EXPERIENCE

Reactor Loading

The front face map showing the loading in KE is reproduced on page B-5. The tonnages listed are approximate; actual fuel charge totals are tabulated above.

Power Level

The power level at KE Reactor was restricted by brittle fracture tube power limits during the month.

Reactor Outages

<u>Date Down</u>	<u>Outage Hours</u>	<u>Remarks</u>
August 14	422.6	Shortage of interruptible power.

The reactor was shut down on August 14 at the request of AEC-RL because of a shortage of interruptible power and remained down the remainder of the month. Interruptible power was made available at 12:01 a.m. on Monday, August 31. However, the reactor has remained down because of river temperature in excess of 19.5 C.

The first week of the outage was utilized for charge-discharge. The second week was utilized for maintenance and required inspections of the graphite stack. Startup preparations were completed at the end of the second week of the outage.

EQUIPMENT EXPERIENCE

Vertical and Horizontal Rods

All HCRs continue to be operable with no major binding problems. All VSRs are serviceable with an average hot drop time of ~~17.9~~ seconds.

1.79

Resistance Temperature Detectors

Eight RTDs failed during the month and were replaced.

Panellit Gauges

The flow from the front face to the Panellit manifold was checked on all Panellit lines. Twenty-nine lines were found to have low flow and were subsequently unplugged. In addition, the ermeto fittings of all Panellit lines were checked as to type of material. There were 21 fittings found to be made of galvanized metal and were replaced. The remainder of the fittings were found to be stainless steel and did not require replacement.

Panellit System Leaks

The Panellit system was pressurized to 350 pounds for leak checking because of

the Panellit leak experienced on July 27 which resulted in a reactor shutdown. Thirteen leaks were found and were repaired.

Graphite Stringer 5385

This stringer was replaced when sufficient thermocouples had failed so that the stringer was considered inoperable. Some difficulty was experienced with broken thermocouple wire during the removal of the old stringer.

Ball 3X Channels

Channels 22 and 25 failed the Equipment Maintenance Standard (EMS) six-month "Ball Hopper Inspection." This EMS requires that a small number of balls be dropped from the hopper when manually tripped and their drop verified by listening in the ball 3X tunnel. The balls did not come through channels 22 and 25. Subsequent inspection showed a blockage at the bottom of channel 22 and a blockage 15'11" from the top of channel 25. The plugging of channel 22 is below the full-in position of the rod so it is of no immediate concern because the rod and the balls can be inserted.

Channel 25 is a ball channel only with no rod. The plug at 15'11" makes the channel unserviceable. The other three ball-only channels (21, 67, and 71) were inspected and found plugged at 13'11", 11'0", and 16'3" from the top, respectively and are also unserviceable. The plugging in all four channels is due to blocks of graphite which have either moved out into the channel or fallen from a higher location. A number of loose blocks were observed in the sidewalls of the channels above the blockage. Channel 67 has been cleared of debris but remains out of use. A Process Change Authorization and EMS waiver have been issued to operate with these four nonadjacent ball hoppers out of service.

PROCESS ASSISTANCE AND CONTROL

Operational Physics

During the August 14 outage more than 1700 columns of fuel were charged-discharged. Loading changes included removal of all thorium and supporting enrichment columns from the PuAl block. The block now consists of 12 PuAl columns, 203 natural columns, and 10 enriched columns.

Approximately 120 splines and eight poison columns were necessary to satisfy total control during the unscheduled outage. One VSR is allowed out of service in each control region, and up to six HCRs are allowed out of the reactor after discharge. Four ball channels are out of service.

Some operational physics parameters of interest are shown in the following table:

Effective Central Tubes*	2,180
Flattening Efficiency** - August	.693
- 12-Month Average	.706

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Maximum Operating Time Permitting
 Scram Recovery - Hours*** 10

Average Critical Prediction Error - August (c-mk) 0
 - 12-Month Average 118

*Reactor power level divided by the average power of the ten
 most productive tubes which are representative of the reactor
 loading.

**ECT divided by the number of power generating tubes.

***The maximum operating time subsequent to a cold startup
 following which a scram recovery could be made using the
 currently approved startup procedure.

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<u>Zone</u>	<u>Tons</u>	<u>Material</u>
Central	.23	Bismuth
	228	Natural Uranium
	60	94 Metal
Buckled	82	Natural Uranium
Near and Far Fringe	54	Natural Uranium
Shield	23	94 Metal - Lithium Support
Protection	6	Natural - Lithium Support
	.6	Lithium

Loading Pattern - KE Reactor

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REACTOR PLANT OPERATIONS - NPRODUCTIONGeneral

Reactor production (largely fuel grade Pu), power level, and related statistics are tabulated below. Input production and time operated efficiency (TOE) for the past six months are shown on the following chart:

Statistical Summary

Input Production - Pu (KMWD)	.00
Electrical Generation (KWH) - WPPSS	.00
- 184-N	3.30
Power Level (MWt) - Maximum	0
- Average	0
Time Operated Efficiency - %	0
Steam Availability - %	0
Number of shutdowns - Scheduled	0
Fuel Failures	0
Fuel Charge (Tons) - 94 Metal	327.58
- 125 Metal	65.28
- Natural Uranium	.37
Total	393.23

Helium Losses (1000 cu.ft.)

0

Fuel Oil Usage (bbl.)

27,903

OPERATING EXPERIENCEReactor Loading

The reactor loading at month end is shown on the front face map that follows on page BN-6. A total of 13 fuel columns was charged during the month into previously discharged process tubes. No fuel discharge occurred during the month.

Reactor Outages

The reactor remained in scheduled shutdown status for the entire month; the outage duration was 744 hours.

EQUIPMENT EXPERIENCE**DECLASSIFIED**Primary Loop

During the report period a total of 190 V-11 valves was worked on by Construction forces. The total number of valves repaired to date is 625. A breakdown of valve repair work is as follows:

Manual operators installed only - valve not repacked	87
Valves repacked only - operators previously installed	47
Valves repacked and manual operators installed	491

Thirty-three V-12 valves were replaced during the month, making a total of 92 replaced to date during the outage. In addition, 14 Grayloc hubs were repaired, bringing the total to 34 hubs on 28 valves.

The missing V-12 flow stoppage device used in opened piping (the device is referred to as a "mouse") was found positioned in an opening in a V-12 valve; the mouse is normally placed in the opening of piping connecting to the valve rather than in the valve itself. The device was removed and placed in controlled storage.

Twenty-two primary loop valve leaks were repaired by Plant Maintenance forces, bringing the total repaired during this outage to 76.

Flow Monitor Sensing Lines

Repair of about 100 broken male venturi connectors damaged during old tubing removal was accomplished to complete the 15 tubing bundle installations made in July. The newly installed sensing lines have been hydrostatically tested and continuity checked. Final acceptance of the work had not been accomplished at month end.

Resistance Temperature Detectors

Eleven All Tube Temperature Monitor RTDs were repaired during the month, bringing the total repaired during the outage to 94. A total of 49 Zone Temperature Monitor RTDs was repaired and installed during the month.

Ball Safety System

At month end all ball safety system hoppers had been tested, accepted, and returned to service with all hoppers full and all channels empty.

Removal and replacement of the graphite liners in seven ball channels were accomplished during the month, making a total of ten renovated during the outage. Nine of the channels had known liner separations; one adjacent to a separation was also renovated.

Graphite Cooling System Heat Exchanger

The hydrostatic testing and acceptance test procedures were completed on the newly retubed and reinstalled number four unit. This heat exchanger was returned to service on August 26.

Project GCP-411 - Effluent Control Program

The final tie-in work associated with the installation of the new emergency dump tank was finished during the month. The required hydrostatic tests were satisfactorily completed. Acceptance tests were performed, including an emergency dump tank cold flow test. Exceptions to completion of the project now include the following:

1. Replacement of the emergency cooling system recirculation pump casing in 184-N.
2. Resolution of lower than anticipated effluent flow rate from the new emergency cooling system dump tank.
3. Conduct of acceptance test procedure for the diesel engine jacket cooling water system.

Foster-Wheeler Boiler Repairs

The scheduled repair work on the boiler, including installation of 408 new tubes, was completed on August 15. The boiler was returned to service on August 18, following a boil-out, prestartup flush, and a third party inspection.

Project DCE-519 - Replacement of Storage Basin Cranes

Two of the four new cranes are on-site and are being held in temporary storage pending installation. Removal of the old cranes is proceeding.

After Heat Removal Tank

Removal of the tank liner by sandblasting was completed during the month. The

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tank was cleaned and returned to service.

Demineralized Water Tank

The sunken membrane was removed from the demineralized water storage tank which was cleaned and returned to service. The pressure relief nozzles for the nitrogen gas blanket system were installed on top of the tank, and the nitrogen storage and supply tank was installed on its pad near the demineralized water tank. The nitrogen blanket installation was not complete at month end.

Circulating Raw Water Pumps

The pump wells for the 181-N circulating raw water pumps were inspected by divers, and extraneous material and debris were removed from the bottoms of the wells.

Equipment Modifications

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The following equipment modifications were completed:

MDC-N-69-20, "Emergency Evacuation Alarms", provided for additional evacuation alarms in 105-N, 184-N, and 109-N Buildings to provide better audio coverage of signals.

DC-3005, "109-N Process Cell Sump Pump Control Revision", provided for improved sump pump control to eliminate pump bearing failures.

DC-3088, "Emergency Cooling Water Master Trip Circuit Improvements", provides for replacement of mercury plunger type relays with more reliable, more easily tested mechanical machine tool relays.

EMP-349, "HCR Cooling System Improvements", provided for improving the coolant flow monitoring ability by increasing the size of the sensing line orifice plate taps and installation of new orifice plates to give more appropriate full-scale readings.

DC-3033, "PCSH-5 Modifications", provided for strengthening this solid, sliding primary coolant pipe support sufficiently to overcome the forces being exerted.

PC-3101, "Room 191 Decontamination Facility Drain Relocation", provided for elimination of a direct drain line to the Columbia River and installation of a pump and transfer line to the 1310-N storage tank for disposal of potentially contaminated chemical wastes.

DC-3107, "Removal of Two Samples from the Emergency Supply Piping in Corridor 5, 105-N Building", provided for obtaining piping samples from the emergency coolant supply line for metallurgical analysis.

DC-3110, "Primary Coolant Pump Oil Return Loop Seal Modification", provided for modification of the primary pump return oil piping to provide

a positive head for the return oil flow.

MDC-69-42, "Gas System 8-Inch Rupture Discs", provided for replacement of graphite rupture discs in the reactor gas system blower discharge lines with aluminum rupture discs.

MDC-70-41, "Modification to Scram Transient Receptacles on the Safety Circuit Panel", provided for installation of a new receptacle on the safety circuit panel to allow monitoring of the "start" time during testing of the safety circuit.

MDC-70-63, "Repair of HPRW Spool Piece, Right Outer Rod Room", provided for replacement of a failed cast iron reducing spool piece with a stainless steel piece.

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	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	
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Fuel Code	No. Tubes	Description	PT-NR No.	No. Tubes	Description
E	220	Mk-IC (94 Metal - Fringe)	94*	7	Mk-IV Demonstration
F	89	Mk-IV (94 Metal - High U-236)	113	5	Evaluation of the
G	444	Mk-IV (94 Metal - Central)			End Spider Inner
N	1	Mk-IB (Natural U)			Support System
X	231	Mk-IA & Mk-IV (125 & 94 Metal)	136	6	Mk-IV - Nonbonded
					End Closures
	985	Total		1	Graphite Sample
					Channel
	19	Total PTs		19	Total PTs
	1,004	Grand Total			

*Includes Mk-IV high U-236 content fuel and 6 tubes with Mk-IV-AA 125 Metal and Mk-IV 94 Metal.

Loading Pattern - N Reactor

FUEL FABRICATION - KE REACTOR

PRODUCTION

General

Production of AlSi-bonded fuel for KE Reactor was 102.2 percent of forecast. Eighty-six percent of the elements produced had self-supports attached.

Acceptable Fuel Elements Produced

Tons	32.7
Yields: Current Month	92.7%
FY to Date	92.7%

Month-End Inventories - Tons

Bare Uranium Cores	810*
Finished Fuel: AlSi-Bonded	1,628*
Hot-Die-Sized	14
Thoria Elements	14

*These totals include 73 tons of bare and 95 tons of finished fuel in sizes used in the smaller reactors.

OPERATING EXPERIENCE

The overall efficiency for the month is 95.6%. The distribution of downtime is not available due to limited production.

The AlSi fuels operation was continued on a partial line basis for the production of K5E fuel. Production of this fuel model is scheduled to continue until about the first of January 1971. Indications are that a potentially high rejection rate at the UT-16 tester may be avoided by machining a metal fold from the base of each can prior to its use.

EQUIPMENT EXPERIENCE

K Reactor Fuel Pallet Splintering Problem

A study of the fuel pallet splintering problem was made and recommendations for several possible solutions were submitted for evaluation. The most feasible solution appears to be to glue hardboard (tempered masonite) on the bottom side and dip the entire insert in a urethane solution. Tests will be made with an oil modified urethane thinned to different consistencies.

Automatic Probing Unit

An automatic probing unit is currently in operation in the conveyor system

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just ahead of the Bond and Penetration testers in the AlSi lines. Its purpose is to detect any obstruction in the inner coolant channel of the fuel element and thus protect delicate equipment in the testers. Its performance has been very good.

Estimates have been submitted for the cost of fabricating a similar probing unit to be installed at 105-KE Reactor. Its use would be to detect any obstruction in the inner coolant channel prior to charging the fuel into the reactor.

PROCESS ASSISTANCE AND CONTROL

K5E Can Defect

The K5E cans now being used in the AlSi process are not causing rejects for base well nonbonding. However, when the present can lot is depleted, cans reamed to remove the base well defects will be needed. A lathe has been set up, and about 1,000 cans have been reamed thus far. There were some problems with surface finish and depth of cut which have been corrected. The cans are being manually degreased before cleaning to preclude a possible fine aluminum shaving reaction with the trichlor. Reaming of the 140,000 defective cans will proceed as manpower becomes available.

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FUEL FABRICATION - N REACTOR

PRODUCTION

Input Production

Total billets extruded	0
Tons extruded	0
Percent of forecast	0

Output Production

Total finished fuel assemblies	1,581
Tons output	40.0
Percent of forecast	100.0

Uranium Utilization - % - (no input)

Month-End Inventories - Tons

Bare uranium billets	136
Finished fuel	158

OPERATING EXPERIENCE

A spike enrichment fuel run originally scheduled to start August 25 will probably be deferred until September 8 due to a delay in obtaining components and outer billets. Requirements can be met with a disrupted shop schedule, which will likely result in an overrun of forecast with a subsequent underrun.

The shop has been processing boxed pre-extruded outer fuel material following the vacation shutdown. If present schedules are met, approximately 60 percent of the boxed material will be processed in time to start the regular inner fuel run early in September.

EQUIPMENT EXPERIENCE

Minor Design Change 70-5 has been issued and approved for the installation of a new standard leak unit at billet evacuation. This new unit has been installed on the south manifold system. Its use will do much to improve the calibration of the leak detection system and will further improve the billet assembly leak detection process by providing an operable purge of the system. This in itself is necessary for precise detection of faulty (leaking) copper cladding.

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PROCESS ASSISTANCE AND CONTROL

Zircaloy Billet Plating

Thirteen Zircaloy billets were copper plated in preparation for primary extrusion to make clad components. The best plating conditions for producing a tough adherent plate at room temperature were:

Volts	1.3 - 1.4
Amperes	70 - 75

The 11-inch diameter by 22-inch long billet had a surface area of 5.3 square feet. The current density was 14 amperes per foot space.

Billets were plated to thicknesses of .013 and .003 inch. Extrusion results showed that the thinner plate produced smoother extrusion surfaces and used pressures approximately 400 tons lower than the 2900 tons required for the more heavily plated billets. Further, the thicker plating led to copper pickup in the liner.

Copper Casting Melt Composition

Analytical results from both thermal arrest and spectrochemical determinations show the silicon content of the copper preshape melt to be at or below the minimum specified value. The analyses also show an increase in iron content.

The decrease in silicon content stems from using 100% Cu-Si scrap without additions of virgin feed or silicon. Since the silicon content in a 100% scrap charge decreases as the silicon combines with oxygen and carbon and floats off as a slag, the problem can be solved by using some virgin or high silicon feed as part of the crucible charge. The increase in iron content arises from the corrosion of the iron skimming tool used in skimming off the slag from the molten silicon alloy. This problem has been corrected by the use of a skimming tool made from graphite.

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TECHNICAL ACTIVITIES

N REACTOR OPERABILITY PROGRAM

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Primary Coolant System

Primary Loop Leaks

A document (DUN-7196, Primary Loop Leakage Rate Determination Procedural and Data Update," August 7, 1970) describing the method for determining the primary loop leak rate has been issued.

V-12 Diversion Valve Development Program

Inconel actuator assemblies have been installed on six of the 78 V-12 valves repaired as of August 12. These valves are also equipped with the threaded gland follower and GRAFOIL packing. Also 25 other V-12 valves were packed with GRAFOIL. The performance of these valves is being followed closely.

In addition to the above, the actuator mountings on all V-12 valves reworked since July 20 have been modified to permit in situ replacement of inoperable valve actuator assemblies without disturbing other valve component parts.

Nuclear Flux Monitor System

Project DCE-539 authorizes modification of the N Reactor nuclear flux monitoring system to improve operational reliability and maintainability of the system. The proposed modifications include replacement of primary detectors and electronic signal conditioning equipment for the startup, intermediate and power range subsystems; provision of new detector positioners for the startup range subsystem; provision of redundant power supplies; and installation of new control room panels.

DUN has been directed to perform project management services and to prepare Title II design. Detail design was initiated on July 15 and is proceeding on schedule. Initial emphasis is being placed on preparation of design and specifications required for procurement.

High Pressure Injection System

Design criteria in support of a project proposal requesting funds for modifications of the high pressure injection system at N Reactor have been approved by AEC-RL. The project proposal has been submitted to AEC-RL for approval.

The proposed modifications will provide two separate and independent injection control systems for the primary coolant makeup and primary pump seal water and associated compressed air and electrical services.

Temperature Monitor System

Since approximately 130 resistance temperature detector (RTD) channels in the

All Tube Temperature Monitor (ATTM), and approximately 60 in the Zone Temperature Monitor (ZTM), required special handling and instrumentation to read out at the beginning of the extended summer outage, a concentrated effort has been made to effect repairs. Currently, 88 channels have been repaired in the ATTM and 49 repaired in the ZTM. The remaining channels will be repaired during subsequent reactor charge-discharge shutdowns.

FUELS PERFORMANCE PROGRAM

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Nonbrazed End Closure Evaluation

Six Mark IV fuel columns with nonbrazed end closures were charged into N Reactor during August under the authorization of PT-NR-136, "Nonbrazed End Closure Evaluation," DUN-6750, and Supplement 1 to that document. The remaining four columns authorized will be charged into N Reactor during the October outage. Goal exposures on the test columns range from 500 to 2000 MWD/T.

Evaluation of the End Spider Support System

Five columns of Mark IV fuel fitted with end spider inner fuel supports were charged into N Reactor during August under the authorization of PT-NR-113, "Evaluation of the End Spider Inner Support System," DUN-6395. Goal exposures will range from 500 to 2000 MWD/T.

Fuel Cladding Corrosion Studies

Corrosion coupons of Zircaloy-2 with various amounts of residual fluoride ion contamination have been prepared and loaded into holders for exposure in N Reactor fuel columns under authorization of PTA-NR-118. The purpose of the experiment is to evaluate the effect of fluoride surface contamination on the corrosion rate of Zircaloy fuel cladding. Residual fluoride levels were obtained using various delay times in rinsing the samples after etching. Samples include those with an as-etched condition or with either a 100 psi, 750 F, or a 1500 psi, 750 F autoclave condition following etching. Duplicate samples are being prepared for exposure in the out-of-flux bypass loops.

PLANT LIFE PROGRAM

N Ball Graphite Channel Renovation

Setup of equipment, positioning of tooling near the top of the reactor, and checking out of the debris handling system were begun on July 27. The work on all channels requiring renovation was completed, except for acceptance testing, by August 10. One additional channel was renovated on August 11, and was traversed using the new vertical traverse equipment to gather additional graphite distortion data.

Renovation of the ball channels proceeded in accordance with Method I of Design Change 3089, in which the two liner blocks above the channel separation are

removed and loosely fitting graphite sleeves and an extended flexible ball funnel are reinstalled in the channel. Forces required to pull the two liner blocks were less than anticipated and varied from simple deadweight of the blocks up to an estimated 500 pounds. Closed circuit television scans of the newly installed liners were recorded and in all cases verified close fitting joints giving a ball tight channel. All channels were checked for open condition of the ball drain pipe as the last procedure step before reinstallation of the spiral shield plug and gate mechanism.

Control of contamination at the work location kept background radiation exposure rates at a stable level.

N Moderator Distortion Measurements

Measurements made to determine the condition of N ball channels before modification as described previously are shown in Table 1, below.

TABLE 1

N BALL CHANNEL MEASUREMENTS

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<u>Channel No.</u>	<u>Separation Between Second and Third Liner Blocks</u>	<u>Condition of Second Block</u>
47	1/4"	Collar sheared cleanly at block-collar junction.
48	7/16"	Collar sheared cleanly at block-collar junction.
49	0	Collar sheared cleanly at block-collar junction.
50	1/4"	Collar sheared cleanly at block-collar junction.
51	1/8"	Collar sheared cleanly at block-collar junction.
57	3/8"	Collar sheared above the block-collar junction.
58	1-11/16"	Collar sheared cleanly at block-collar junction.
59	2-1/4"	Collar intact/block undamaged.
61	2-1/4"	Collar intact/block undamaged.
69	0	Collar intact/block undamaged.

The data are not entirely consistent with previous CCTV observations. For example, no gap was observed between liner blocks 2 and 3 in Channel 49 as reported previously. The top blocks in the channel either settled after the previous examination, or the original observation was in error. The separations in Channels 48, 58, 59, and 61, however, are obviously large enough to pass the 3/8-inch diameter balls. The second blocks in Channels 59 and 61 were not broken, but had separated to allow a two-inch gap for ball loss.

Channel 69 was modified to obtain information on the condition of channels in the rows next to the two rows which were known to be defective. There was no evidence of shearing or separation and it required only about 150 pounds force to pull the No. 2 block out of the No. 3 block socket. A traverse of the channel showed that it was bowed about one inch toward the front and 0.3 inch toward the left side of the reactor. The direction of bowing was predicted from other stack measurements, but the magnitude is less than expected.

Quarterly inspections of selected ball channels have been scheduled to gather further graphite distortion data to be used to monitor the effectiveness of the modification procedure.

In addition, process tube traverses were completed in the continuing program of N moderator surveillance. Vertical height traverses on process tube channels 2058, 2958, and 3348 fit well with previous data. Channels 2058 and 2958 have dropped 1.1 and 1.9 inches, respectively, at the center. The channel 3348 traverse shows the "longhorn" shape found previously on tube channels at the top of the reactor.

N Steam Generator Surveillance

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The primary side of the tube sheet in the manifold of steam generator 4A was dye penetrant examined for indications of stress corrosion cracking in the stainless steel overlay. The tube sheet face was found to be free of crack indications.

K Moderator Distortion Measurements

Additional vertical traverses from KE Reactor have confirmed turnaround of the KE graphite in the transverse orientation. Turnaround occurred at 3 percent contraction and 7.5×10^{21} nvt compared with turnaround at KW at 2.5 percent and 7.0×10^{21} nvt. Confirmation of turnaround was reflected by no further subsidence in the center of the Y-2 traverse hole during the past six months.

K Brittle Fracture

The K reactor inlet supply piping system water hammer studies have been completed. The results of these studies have been documented in DUN-6836, "Interim Report of Water Hammer Transient Analysis for K Reactor Inlet Supply Piping System," and DUN-7212, "Final Report of Water Hammer Transient Analysis for K Reactor Inlet Supply Piping System." The first of these documents contains a thorough description of the techniques used in the analysis and indicates that peak pressures due to 24-inch check valve closure following the postulated failure of a single riser would be below normal operating pressures. The second document describes the dual riser failure problem and indicates that the pressure transient arising from the closure of the 5-inch crossheader check valves would be far below normal operating pressures.

DECONTAMINATION PROGRAM

Recirculating Decontamination Process Development

A small recirculating loop has been installed at 105-N to determine whether

extended decontamination times (10-12 hours) can produce significantly better radioactivity removal than the one-half hour exposure obtained with the present N Reactor single-pass decontamination approach. Three tests have been completed with mixed results. Preliminary data indicate that additional activity reductions of about 50 percent may be obtainable with the extended decontamination times. Difficulties in test control and equipment operation, however, preclude any firm conclusions. Testing will be continued.

External Piping Contamination

Surface deposit samples were taken from two positions on each of four connectors in the rear pipe space at N Reactor to determine if there was a connection between radioactivity deposited on external pipe and hardware surfaces and general dose rate at the location. The dose rate of each sample was measured. Co-60 and ZrNb-95 were found to be the major isotopes present. Sample locations and measurement results are given in Table 2 (next page).

Tentative conclusions that can be drawn from the data are:

1. There is little variation in contamination on the connector piping away from the V-12 valves with location on the reactor. All connectors have low deposited activity, regardless of area dose rate.
2. Deposited activity is much greater at the V-12 valves, where primary coolant leaks can deposit radioisotopes, than at other locations on the connector.
3. No correlation between amount of deposited activity and area dose rate is evident from this small sampling. The greatest surface contamination was found at the position of lowest dose rate - 200 mR/hr.
4. A much larger sampling program would be required to confirm or refute the hypothesis that the increase in dose rates toward the bottom of the pipe space is associated with externally deposited radioactivity from primary system leaks.

Radioisotopes Analyses of Deposition Products

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Analyses of long-lived, gamma-emitting radioisotopes deposited on 30 metal alloys exposed in the bypass loops in the N Reactor graphite cooling system and primary cooling loop have been completed to identify major isotopes contributing to dose rates and to evaluate the effect of different metal surfaces on deposition parameters. The major isotopes found were Mn-54, Fe-59, Co-60, ZrNb-95, Sb-125, and CePr-144. In terms of curies/unit area, each isotope was present in significant quantities. A typical distribution range was that the smallest quantity isotope present contributed about 5 percent of the total activity, and the largest quantity isotope present contributed about 35 percent of the total activity. Generally, Fe-59 and Co-60 contributed the most to the total quantity of activity present.

Activity/unit area on the samples exposed to the Graphite Cooling System water

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TABLE 2

ACTIVITY OF REAR PIPE SPACE EXTERNAL CONTAMINATION SAMPLES

Location:	Top of Riser 3 Connector 2847	Bottom of Riser 3 Connector 1147	Top of Riser 12 Connector 3165	Bottom of Riser 12 Connector 0565
Area Dose Rate:	350 mR/hr	600 mR/hr	200 mR/hr	900 mR/hr
Sample Position On Connector:*	Near RTD	Near RTD	Near RTD	Near RTD
	V-12	V-12	V-12	V-12
Sample Activity:	150c/m	250c/m	150c/m	150c/m
	500c/m	400c/m	900c/m	300c/m

* Connector surfaces near RTD were clean and uncorroded. Surfaces near V-12 on riser connector besides V-12 B-hub Grayloc fitting were badly rusted.

was much lower than on the samples exposed to the Primary Coolant System water, except for on the carbon steel samples, where activity levels were about equivalent.

A ranking of the metals exposed to the Primary Coolant System water in terms of total activity/unit area in descending order is as follows: 400 Series Stainless Steels (0.05 to 0.4 $\mu\text{Ci}/\text{cm}^2$); Austenitic Stainless Steels (0.01 to 0.05 $\mu\text{Ci}/\text{cm}^2$); Inconel Alloys (0.004 to 0.05 $\mu\text{Ci}/\text{cm}^2$); Zircaloy-2 (0.004 to 0.03 $\mu\text{Ci}/\text{cm}^2$); and Carbon Steels (0.001 to 0.01 $\mu\text{Ci}/\text{cm}^2$).

OPERATIONAL SUPPORT PROGRAM

10-Kilogram PuAl Irradiation (PTA-150) - KE Reactor

The last of the thoria and supporting enrichment charged for flux tailoring purposes with the 220-tube PuAl block in KE Reactor was discharged in late August; the few scattered enrichment columns in the locale provide normal spiking requirements for the natural uranium loading. The reactivity and heat generation properties of the PuAl columns have now decreased to approximately those of natural uranium, and the 12 remaining PuAl columns will eventually require adjacent enrichment compensation.

Americium Irradiation (PTA-171) - KE Reactor

The americium targets charged in May 1969 in KE Reactor were discharged during the month. The targets had been spaced with column 1678 KE to provide varied exposures. Reactivity support had been provided by 94 Metal columns in 1677 KE and 1679 KE.

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Afterheat Removal Tank - N Reactor

Deterioration of the lining material in the afterheat removal tank has limited the utility of this tank for its intended service. The deterioration resulted in chemical contamination of the water in the tank and "flaking off" of the lining material which presented a potential for partial plugging of coolant system piping. During the current extended reactor outage, the removal of the lining by means of sandblasting was authorized by design change, and the work was completed. Removal of the lining is expected to permit restoration of the tank to its intended service. The lining was originally intended to prevent corrosion of the carbon steel tank by highly deoxygenated and demineralized water at approximately 160 F. Operation subsequent to dual purpose operation has created temperatures of approximately 210 F. The higher temperature of the water and the vapor blanket resulting from the higher temperature should effectively exclude oxygen entry into the tank and minimize corrosion.

Columbia River Program

Columbia River temperatures recorded at the Priest Rapids gauging station have been closely monitored during the current warm weather season. River temperatures at Priest Rapids have tended to be somewhat higher during the months of July and August than is considered normal for this time of year.

The graph on page D-9 depicts the daily average temperatures recorded at Priest Rapids since July 1 in comparison with the normal temperature curve derived from a 15-day moving average over the past eight years. The river temperatures tended to peak approximately one month earlier than in a "normal" year. The higher temperatures recorded this year are attributed to the generally warmer ambient temperatures during July and August and below average river flows during this period. The maximum instantaneous temperature recorded at Priest Rapids reached 19.5 C on July 19 and again on August 16.

NUCLEAR SAFETY ASSURANCE PROGRAM

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Technical Evaluation of 3560 KW Incident

A report, DUN-5001 PT3, "Technical Evaluation of 3560 KW Incident," July 13, 1970, (Secret), on the technical evaluation of the 3560 KW incident has been completed. The incident involved complete flow blockage to process tube 3560 KW, damage to most of the fuel elements charged, and release of some fission products. The report discusses the theoretical evaluation of the incident made initially to assist in the recovery, later refinement to this evaluation, and a comparison of the predicted fuel and tube conditions to those found by examination after removal from the reactor. The potential application of the information collected to analyses of other coolant loss accidents is also discussed. This report completes the investigation of this incident.

N Reactor Control Studies

Documentation was completed on two N Reactor control studies, DUN-7146, "Total Control Requirements - Mark IV Lattice," and DUN-7167, "Final Report of PT-NR-133, Calibration of Selected N Rods."

The bases for N Reactor high level kinetics studies progressed with improved matching of bucklings calculated by the HAMMER program for rodged lattices to experimental results. Corrections for streaming in the lattice voids and migration area values have resulted in adequate agreement to proceed with the use of the HAMMER data in conjunction with other programs for analyses of spatial effects.

N Reactor Halogen Filter Testing

Iodine test of Cells A and D charcoal filters was performed July 22 and 23. The filter efficiencies when adjusted for 100 C temperature and 100 percent humidity were Cell A - 99.3 percent, and Cell D - 97.8 percent, as compared to a required efficiency of 95 percent. Cell A contains the repacked single pass reactor canisters and Cell D contains the original N Reactor canisters with original charcoal.

N Reactor Zone 1 Confiner Leak

The Zone 1 exhaust tunnel was inspected on July 25 and defects were located in the seismic joint which are the apparent cause of the Zone 1 leak into Room 189. The seismic joint repairs were completed. The Zone 11 tunnel was

Figure 1. Columbia River Temperatures Recorded at Priest Rapids Gaging Station

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inspected and no defects were found. Zone 111 tunnel could not be inspected except in the vicinity of the 117-N Building because entry was barred by turning vanes in the tunnel.

WASTE MANAGEMENT PROGRAM

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Environmental Policy Act

In response to Immediate Action Directive No. 0510-22, all FY 1972 projects were reviewed for potential adverse effects on the human environment. All projects were found to be in harmony with the intent of the Environmental Policy Act. Administrative measures have been taken to ensure similar review of all future projects and/or changes in plant operating modes.

Smoke Density Monitors

A project authorizing installation of smoke density monitoring equipment in the exhaust stack of fossil fuel fired boilers operated by DUN has been approved by the Commission. The project authorizes installation of equipment which will assure compliance with the policy of the Federal Government concerning air pollution as stated in Title 42, Code of Federal Regulations, Part 76, "Prevention Control and Abatement of Air Pollution from Federal Government Activities: Performance Standards and Techniques of Measurement."

The regulations require that smoke emissions from fossil fuel fired facilities be limited in density and that the particulate content of such emissions be limited in size and quantity.

Detail design has been initiated by the on-site Architect-Engineer.

SPECIAL IRRADIATIONS PROGRAM

Materials Testing

The third in-reactor Corrosion Product Transport Facility test was charged, irradiated, discharged, and delivered to BNW Radiometallurgy Laboratory.

Routine Irradiations

Sixty-five quickie activation analysis capsules were irradiated in the KE Quickie Facilities for BNW, WADCO, and the University of Washington.

A (U-Pu)O fuel development capsule was irradiated in the KE Reactor Snout Facility for WADCO in support of the LMFBR Program.

Two casks containing $^{149}\text{Be}_3\text{N}_2$ and ten KCl targets were shipped to ORNL for the extraction of C-14, S-35, and Cl-36 isotopes.

TECHNICAL ACTIVITIES - FUEL FABRICATION

Extrusion Tooling Development

There has been a concern for some time in the development of extrusion tooling to attain improvements in the areas of design, product surface finishes, tool life as affected by materials and reliability relative to personnel and equipment safety. Development of a specific tool manufactured from new types of material requires extensive research to prevent failure that could cause serious equipment damage and/or personnel injury. The following advances in tool design and testing have been accomplished by engineering personnel using the 3716 Building equipment and with the above improvement areas in mind.

Extrusion dies designed with an insert of high strength, high temperature resisting materials, such as zirconia ceramic and stellite, have been tested at pressures approaching the maximum yield strength of the extrusion stem and container liner assembly. Due to the brittle condition of this type material, it is essential that the insert be encased in a generous amount of high strength hot work tool steel as a supporting member. The sudden release of force (container pressure) caused by the complete and sudden failure of the die could cause damage to equipment and related tooling, but no danger to personnel would be expected. The limited tests performed to date indicate that improved surface conditions can be attained, and tool life expectancy is ten to one hundred times that of steel dies. Dimensional control of the extruded piece is also greatly improved.

The extrusion stems used in development work to date have been manufactured from Type M-300 maraging steel. This steel is a super alloy with ultimate compressive strength of 270 ksi and high ductility in a temperature range of room temperature to 800 F. Since a complete or sudden failure of a stem manufactured from this steel is unlikely, the type of failure to be considered would be yielding or bending of this slender column. The slenderness to diameter ratio dictates a maximum usable compressive force of something less than ultimate. This usable force has been established at a maximum of 230 ksi for development purposes only. The two-inch diameter by 15-inch long stem now in service has been subjected to pressures of 220 ksi on several occasions with no apparent effect on the material; however, good control of tool temperature and near perfect stem to liner alignment is essential. The shattering failure of an extrusion stem could cause serious equipment damage and be a threat to personnel safety. Adequate shielding to protect operating personnel is mandatory when extrusion forces near the ultimate material strength of the stem are expected. A stem of even greater strength than that of the M-300 steel may be a requirement for some applications.

The steel follower block is an extension of the extrusion stem, subject to the same forces and types of failures. On some types of extrusions, the follower block is subjected to higher operating temperatures than the stem, and for this reason it must be made of a material equal to or preferably superior to that of the stem. Development of follower blocks manufactured of Type M-350 maraging steel has begun. This material appears to be equal to the M-300 type with respect to ductility and impact strength and is considerably harder and

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stronger if heat treated to the maximum hardness of Brinell hardness number 627. Since this type of maraging steel is relatively new, the reliability of a stem or follower block of this material has not been demonstrated. During the initial development period of this type follower block, the maximum compressive force exerted during extrusion will be in the safe range of 230 ksi.

Development of die cone rings and extrusion mandrels of super alloys are in the study and development stage. No actual testing has been done to date. The material chosen for this study is Carpenter Steel's pyrotool. This is a maraging type steel but much different than the M-300 or 350 steel. It was selected because of the exceptional strength at elevated temperatures and is expected to perform well in the zircaloy extrusion application.

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ADMINISTRATION - GENERALAUDITS

The FY 1970 closing was completed with the issuance of an audit report, as of July 30, and the filing of related working papers. The working papers were reviewed by AEC-RL auditors as part of their year-end audit.

Audits to be included in the FY 1971 Audit Schedule were established and the schedule was approved and issued on August 31.

PURCHASING ACTIVITIES

Requests for proposals for fabrication of Zircaloy cladding, at an estimated cost of \$1,250,000, were sent to Amax, Harvey Aluminum, Rem Metals and Wah Chang. The due date to open bids from these qualified sources is set for September 17, 1970.

EMPLOYMENT SUMMARY

DUN personnel totals and employee allocations as of July 31 and August 31 are shown in Appendix B.

UNION RELATIONS

The Company and the Union have agreed to a postponement of the reproduction work arbitration case pending further joint discussions directed toward producing a mutually acceptable basis for resolving the dispute.

A mutually acceptable Submission Agreement in the pro rata vacation arbitration case is being developed by the Company and the Union following which it will be referred to the arbitrator as the initial step in this proceeding. A date for the arbitration hearing has not been set.

An arbitration case relating to material coordinator jurisdiction which has been dormant for two years has been reactivated by the Union following layoff of a material coordinator.

SAFETY

No personnel radiation exposures exceeded operational control.

Month-end safety statistics were:

Disabling injuries - August	0
- CY to date	3
Days since last disabling injury	54
Man-hours since last disabling injury	380,016

APPENDIX APROJECT STATUS SUMMARY - REACTOR FACILITIESAUTHORIZED PROJECTS

	<u>Number & Title</u>	<u>Authorized Funds - \$</u>	<u>Percent Complete</u>		<u>Remarks</u>
			<u>Design</u>	<u>Construction</u>	
	<u>Single-Pass Reactors</u>				
	DAP-526, Deactivation of Hanford Production Reactor C	105,000	100	63	Installation of burial ground markers has been completed.
	<u>N Reactor</u>				
F-1	GCP-406, Improved Safety Platforms & Accesses - 100-N Area	300,000	100	98	Miscellaneous cleanup work in progress.
	GCP-411, Effluent Control Program - 100-N Area	1,830,000	100	95	Section II - Completed and hydrotested August 7. Backfill in progress. Section V - Piping completed August 17. Backfill in progress. ATP remains to be completed.
	DCE-519, Replacement of Bridge Crane and Hoist System with New Crane System - 105-N Storage Basin Area	465,000	100	25	Both existing old cranes have been removed from the storage basin. New NE and SE cranes are on plant. Fabrication of SW crane in progress at the vendor's plant.
	DCP-528, Fire Protection System Improvements - 100-N	40,000	5	00	Design activity suspended by AEC-RL. \$40,000 authorized of \$290,000 requested.

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Number & Title	Authorized Funds - \$	Percent Complete		Remarks
		Design	Construction	
DCE-539, Upgrade Nuclear Flux Monitoring System - N Reactor	335,000	6	0	The Project Construction Status Chart- Design has been prepared and submitted to the Commission for approval. Three engineering drawings have been issued for comment.
DAE-540, Smoke Density Monitors for DUN-Operated Facilities - 100 Areas	55,000	12	0	Detail Design has been started by Vitro/HES.

PROJECT PROPOSALS AWAITING AUTHORIZATION

Number & Title	Funds Requested	Date to AEC-RL
GCP-411, Rev. 2, Effluent Control Program - 100-N	\$2,010,000	9/23/69
DCP-525, Fire Protection Improvements - KE	225,000	5/2/69
DCP-527, Graphite Cooling & Fog Spray Improve- ments - 100-N (1)	97,000	5/9/69
DCP-528, Rev. 1, Fire Protection System Improvements - 100-N	394,000	3/31/70
DCP-529, Gravity Drainage System and Disposal Basin for 100-N Area (1)	200,000	7/9/69
DAP-530, Upgraded Electrical Services & Lighting 1100-N & 1101-N Buildings	78,000	8/12/69
DCE-532, Isolation of Process Coolant Risers - K Reactors (1)	270,000 ⁽²⁾	8/25/69

(1) To be returned to DUN by AEC-RL because of long holding periods.

(2) Additionally, this project requests the use of \$240,000 of operating funds.

<u>Number & Title</u>	<u>Funds Requested</u>	<u>Date to AEC-RL</u>
DCP-538, Heat and Ventilation System Improvements 105-N & 109-N Buildings (1)	330,000	5/18/70
DCP-542, High Pressure Injection System Improvements - N Plant	138,000	6/17/70
DCE-544, Critical Instrument Power Supplies - N Reactor	65,000	6/15/70

(1) To be returned to DUN by AEC-RL because of long holding periods.

PROJECT PROPOSAL PREPARATION

<u>Number & Title</u>	<u>Design Criteria</u>	<u>Project Proposal</u>
Export Water System Backup - 182-D (for 200 Areas)	Completed	Completed. Held by sponsor (ARHCO).
Stack Monitoring Improvements - 100-N Plant	Completed	In preparation.
DCP-527, Rev. 1, Graphite Cooling & Fog Spray Improvements - 100-N Plant	(Action deferred)	

APPENDIX BEMPLOYMENT SUMMARY
(with employee allocations)

	<u>7/31/70</u>	<u>8/31/70</u>
<u>CONTRACT PERSONNEL</u>		
<u>02 Programs</u>		
Douglas United Nuclear	1302	1273
Assisting Other Contractors	<u>13</u>	<u>17</u>
Total - 02	1315	1290
<u>Other Programs Under AEC Contract</u>		
Assisting Other Contractors and WPPSS	37	37
Special Irradiations	3	9
Other Programs - Standards	<u>1</u>	<u>4</u>
Total - Other Programs	41	50
Total Contract Personnel	<u>1356</u>	<u>1340</u>
<u>COMMERCIAL ACTIVITIES PERSONNEL</u>		
	<u>21</u>	<u>22</u>
TOTAL FORCE	1377	1362