SAXTON NUCLEAR EXPERIMENTAL CORPORATION

Operations Report for October 1967

1. GENERAL

At the beginning of this report period the reactor was in a cold shutdown condition in continuation of the plant outage begun on September 15, 1967.

The period October 2nd through October 5th was devoted primarily to the handling of core subassemblies. Fuel subassembly #503-4-27, fuel subassembly #503-4-2, the nine thimble assembly containing flux oscillator rod #2, and the STP test loop unfueled pressure tube, were removed from reactor core positions N-5, N-3, N-2 and N-4 respectively and placed in storage. Fuel rods #783 and #784 were removed from fuel subassembly #503-4-27 and were inserted in the burnable poison test subassembly #503-4-29. The pH test subassembly #503-4-28 (Change No. 27), the burnable poison test subassembly #503-4-29 (Change No. 28), flux oscillator rod assembly #3 (Change Report No. 13), and a fueled pressure tube for the STP test loop were installed in core positions N-3, N-5, N-2 and N-4 respectively.

On October 10th maintenance work was performed on the pressurizer relief valves, V-372 and V-373. New springs were installed, the stems were checked for straightness, and the seat and disc in each valve were lapped. A service engineer for the manufacturer of the valves was present for the work.

Filling and venting of the main coolant system and pressure testing it to 500 psi was completed on October 13th. Heat-up to 500°F using the main coolant pump and the pressurizer heaters as heat sources was completed on October 15th. On October 16th, while the pressure on the main coolant system was being raised to set the popping pressure of the pressurizer relief valves, a leak developed at an instrument fitting on the pH test subassembly. A system cooldown was required to gain access to and repair the leaking fitting. Reheat of the main coolant system to 500°F using the pump and pressurizer heaters was completed on October 18th.

Pressurizer relief valves V-372 and V-373 were set and satisfactorily tested on October 18th and 19th.

2. REACTOR OPERATIONS

The reactor was maintained in a hot shutdown condition while the STP test loop was operated for 35 consecutive hours at supercritical conditions for base line data on October 20th, 21st and 22nd.

On October 23rd the reactor was made critical and was operated at a power level less than 1 MWt for a test on the STP test loop emergency condenser and for a test to determine the effect on core reactivity of heating the STP loop from 250°F to 950°F. The secondary system was started up and the reactor was loaded to 11.3 MWt on October 24th. After a flux map was made and analyzed, the reactor power level was increased to 17 MWt. Power operation at 17 MWt continued until 3:37 AM on October 25th when the reactor was manually shut down due to high hydrogen concentration in the STP test loop off-gas system and the inability to maintain vacuum in the STP loop deaerator.

The reactor remained in a hot shutdown condition until October 27th when it was made critical and loaded to 21 MWt to continue the Supercritical Technology Program. Reactor operation at 21 MWt continued until 3:35 AM on October 29th at which time the reactor was manually shutdown and the STP test loop was cooled down to investigate the cause for an excessively high ammonia concentration in the test loop.

Reactor operation at a power level of 17 MWt was resumed at 2:30 PM on October 31st. Supercritical conditions were established in the STP test loop. At 5:45 PM the reactor power level was raised to 21 MWt. Approximately one hour later the radiation monitor on the STP test loop alarmed. The reactor power level was reduced to 17 MWt. A sample of the test loop coolant was counted and the gross beta-gamma activity was determined to be 0.6 uc/cc. Reactor operation at a power level of 17 MWt and STP test loop operation at supercritical conditions were continued during the remainder of the month.

3. EXPERIMENTAL PROGRAM

The following test units were removed from the core:

Subassembly #503-4-27 - containing removable rods #711, #712, #783 & #784
Subassembly #503-4-2 - eight fixed rods
Nine Thimble Subassembly - containing flux oscillator rod #2
STP Test Loop Pressure Tube - containing a dummy assembly

Creep test fuel rods #711 and #712 were removed from subassembly #503-4-27 and were inspected with the underwater periscope. Swelling of the 23.5 mil Zircaloy-4 cladding was evident on both rods. These rods originally contained UO_2 pellets enriched to 17.4% U-235 and were internally pressurized to produce maximum operating stresses of approximately 22,000 psi in the clad. Both rods will be shipped to the Westinghouse Post Irradiation Facility for further examination

Fuel rods #783 and #784 were removed from subassembly #503-4-27, inspected with the underwater periscope, and then inserted in subassembly #503-4-29. No defects were seen on the 15 mil 304 stainless steel cladding of these rods. The rods originally contained UO_2 pellets uniformally enriched to 5.7% U-235 and were pressurized to produce maximum operating stresses of 36,000 psi in the clad.

The following test units were inserted in the core:

Subassembly #503-4-28 was inserted in core position N-3. The purpose for the addition of this subassembly is to provide instrumentation for observing the effect of pH changes on fuel center temperature and on heat transfer between instrumented fuel rods and coolant. The subassembly contains six stainless steel clad fuel rods containing UO_2 pellets and two stainless steel clad fuel rods containing UO_2 stainless steel cermet fuel. A flux thimble occupies the center position in the subassembly. Two of the rods containing pellets and the two containing cermet fuel are instrumented with thermocouples located in the fuel.

Subassembly #503-4-29 was inserted in core position N-5. Two of the nine rods in this subassembly contain burnable poison in the form of borosilicate (Pyrex) glass tubing sealed in type 304 stainless steel clad. The four corner positions and the center position of the subassembly contain dummy fuel rods that are orificed at the top and bottom end plugs. Previously irradiated fuel rods #783 and #784 occupy the remaining two positions. The purpose of this experiment is to verify the mechanical performance of a burnable poison material and rod configuration in a power reactor environment.

Flux oscillator rod subassembly #3 was inserted in core position N-2. This subassembly consists of one pressure housing thimble containing a flux or reactivity oscillator rod. The oscillator rod is larger but quite similar in design to the one previously used. Reactivity change is caused by hafnium sleeves in a movable tube moving in and out of hafnium sleeves in a stationary tube. The larger oscillator will facilitate the acquisition of data during the pH tests.

A fueled pressure tube for the STP test loop was inserted in core position N-4. The fuel assembly in the pressure tube consists of seven rods containing UO_2 pellets uniformally enriched to 21 ± 1% U-235. The fuel is clad with seamless and cold drawn Incoloy-800 with a wall thickness of 10.5 mils. The outer six rods are spiral wrapped with wire 0.05 inch O.D. at a 10 inch pitch; the center rod is not wrapped. The seven rod cluster is supported in the pressure tube by cylindrical baffles which also direct the coolant flow through the pressure tube and minimize regenerative heating between outlet and inlet coolant. The objectives of the supercritical technology program are to provide a performance demonstration of collapsed clad fuel and pressure tube design; to provide information not available from analytical method or out-of-pile experiments; and to provide a correlation between analysis of out-of-pile experiments and in-pile behavior.

During the period October 20th through October 31st the STP test loop was operated at supercritical conditions for approximately 120 hours. Over 75 hours of loop operation were with the reactor operating at power. At a reactor power level of 21 MWt the power generation in the STP loop fuel assembly was determined to be 85 kwt. Forced shutdowns of the loop were made necessary to correct a high pressure condition in the deaerator caused by a defective vacuum pump and to correct an excessively high ammonia concentration in the coolant caused by malfunction of the ammonia injection system. On October 31st approximately 3 hours after supercritical conditions were established in the test loop and with the reactor operating at 21 MWt, a higher than normal count rate was indicated on the loop radiation monitor. Coolant samples were analyzed and found to contain a maximum gross beta gamma activity of 0.6 uc/cc. Loop operation was continued through the remainder of the month.

4. OPERATIONAL TESTS

The radiation monitoring system circuits were tested on October 17th.

On October 15th a normal test of the safety injection system was conducted.

The pressurizer relief valves were successfully tested on October 18th and 19th. Valve V-372 opened at 2465 psig and reset at 2370 psig. Valve V-373 opened at 2540 psig and reset at 2400 psig.

5. MAINTENANCE

The principal items of mechanical maintenance for the month included repacking the deaerator steam pressure regulating valve V-1010; disassembling and cleaning the governor valve on boiler feed pump No. 2; processing five drums of RWDF evaporator bottoms; reinstalling the two component cooling heat exchangers that had been removed for cleaning; lapping the seating surfaces in the relief valves on the shell sides of the component cooling heat exchangers; replacing the head gasket on No. 1 cation resin tank in the make-up water treating system; repairing the gasket leak-off line on the pressurizer heater flange; replacing the cartridges in the filters in the storage well system; disassembling and repairing the hydraulic operated shear located in the storage well; cleaning the tube bundle and replacing a gasket in the heat exchanger for the storage well system; cleaning the RWDF sump; replacing the absolute filters in the control and auxiliary building exhaust air handler; lapping the seats and discs and installing new springs in pressurizer relief valves V-372 and V-373; replacing the valve in the demineralized water line used for resin addition to the demineralizers in the containment vessel; handling fuel subassemblies and preparing the reactor vessel head for operation; cleaning check valves in the vents and drain system collection headers; repacking the No. 1 plunger on the No. 1 charging pump; replacing the vanes and motor couplings in the vacuum pumps for the site air particulate monitors, RIC-8 and RIC-9; replacing the vanes in the vacuum pump for the hydrogen analyzer; and replacing a valve in the heating steam condensate return line.

The major items of electrical and instrument maintenance included remaking the cable connectors on the detectors for nuclear instrumentation source range channels A and B; repairing the calibration unit for the radiation monitoring system; repairing the paging system phone located in the make-up water treating area; repairing the vacuum pump in the alpha monitor located in the chemistry laboratory; inspecting and meggering the detector cables for all nuclear instrumentation channels; installing a 100 amp breaker in motor control center No. 1 for a welding machine; repairing the power supply for nuclear instrumentation source range channel A; replacing the air lines on a square root converter for a safety injection system flow measuring channel; stroking the purification system stop valve, HIC-23V and letdown valve, LRC-21V; measuring the response times for all reactor scrams initiated by supercritical loop parameters; replacing the battery board and a range potentiometer in a CP-3 survey meter; replacing the alarm unit in the pressurizer temperature annunciator; repairing the computer-indicator in the radiation monitoring channel RIC-4, for the component cooling system; repairing a switch in the control circuit for No. 2 sewage pump; installing a new light socket in the

filter vault in the containment vessel; replacing the meter relay in the rod drop alarm circuit for control rod No. 2; replacing the function generator in the pressurizer heater controller, PRC-2; cleaning and setting the vacuum regulating valve on RWDF gas compressor No. 1; checking and replacing vacuum tubes in the liquid scintillation counting system in the count room; replacing pneumatic relays in the secondary steam flow d/p cell and in the steam generator pressure current to air converter; and installing a new pressure regulator and gauge on the feedwater valve positioner.

6. CHEMISTRY

Main coolant system chemistry was maintained for cold shutdown conditions from the beginning of the month until October 12th. Hydrazine was added on October 12th to reduce the oxygen concentration in preparation for system heat-up. On October 23rd hydrogen was added to the system in preparation for operating the reactor at power. A summary of the analyses performed on main coolant samples taken during the month is contained in the following table:

Main Coolant System	Minimum	Maximum
pH at 25° C	5.27	6.45
Conductivity, umhos	2.42	22.1
Boron, ppm	454	1896
Chlorides, ppm	< 0.005	0.035
Lithium, ppm	< 0.01	< 0.01
Oxygen, ppm	< 0.005	0.005
Hydrogen, cc/kg H_2O at STP	8	37
Gross Beta-Gamma (15 Min. degassed) uc/cc	2.0×10^{-3}	9.10×10^{-1}
Tritium, uc/cc	9.47×10^{-3}	3.42×10^{-2}

The chloride concentration in the supercritical temperature and pressure (STP) loop was maintained at less than 0.1 ppm during the month. The gross beta-gamma (15 Min. degassed) activity the loop reached a maximum of 0.6 uc/cc on the last day of the month.

The resin in the storage well demineralizer was replaced on October 20th. The decontamination factor of the new resin as determined from a sample analyzed on October 26th was 13.8. The chloride concentration in the storage well water on October 26th was determined to be 0.020 ppm, the gross beta-gamma activity was 3.2×10^{-3} uc/cc and the boron concentration was 1926 ppm.

Four hundred and sixty grams of potassium dichromate and 180 grams of potassium hydroxide were added to the component cooling system water during the month to maintain pH and chromate requirements. The gross beta-gamma activity in the system was less than 1×10^{-6} uc/cc.

Except for a short period after startup of the secondary system on October 24th the chlorides in the steam generator were maintained below 0.290 ppm for the rest of the month. The average activity in the steam generator blowdown during the month was less than 1×10^{-3} uc/cc.

7. RADIATION AND WASTE DISPOSAL

Radiation surveying consisted of routine plant surveys, C.V. during shutdown and materials shipments. The following maximum radiation readings were taken:

Location	Radiation Reading
C&A Building	
Waste Drum (baling machine)	12 mrem/hr beta-gamma
Charging Pump (contact with chamber)	28 mrem/hr beta-gamma
Sample Room (door of sample panel)	2 mrem/hr beta-gamma
Chemical Lab Hot Sink (1" from drain)	45 mrem/hr beta-gamma
RWDF	
Evaporator (under bottom)	36 mrem/hr beta-gamma
Evaporator (contact outside upper level)	25 mrem/hr beta-gamma
Drum Storage Area (at HRA fence)	2.5 mrem/hr beta-gamma
C.V.	
Primary Compartment (general upper level)	< 1 mrem/hr beta-gamma
Primary Compartment (contact M.C. pump volute)	400 mrem/hr beta-gamma
Primary Compartment (S.G. bottom)	200 mrem/hr beta-gamma
Primary Compartment (pressurizer bottom)	100 mrem/hr beta-gamma
Primary Compartment (general lower level)	35 mrem/hr beta-gamma
Primary Compartment (Regen. HX)	210 mrem/hr beta-gamma
Primary Compartment (Non-Regen. HX)	60 mrem/hr beta-gamma
Auxiliary Equip. Compartment (S.C.H.X.)	10 mrem/hr beta-gamma
Auxiliary Equip. Compartment (D.T. top)	9 mrem/hr beta-gamma
Auxiliary Equip. Compartment (D.T. bottom)	150 mrem/hr beta-gamma
Auxiliary Equip. Compartment (general lower level)	10 mrem/hr beta-gamma
Reactor Deck (water level at grating)	20 mrem/hr beta-gamma
Reactor Deck (instrument ports)	200 mrem/hr beta-gamma
Reactor Deck (waist level)	20 mrem/hr beta-gamma
Reactor Deck (storage well railing)	18 mrem/hr beta-gamma

Contamination surveying consisted of routine plant site surveys, surveys of materials shipped, tools, equipment and C.V. during shutdown. The clean areas were within the "Clean Area" limits. The controlled area was generally within the "Clean Area" limits. The controlled area was cleaned frequently to keep and/or to return it to the "Clean Area" limits. The exclusion areas were cleaned periodically to minimize the amount of smearable contamination. The following contamination levels were observed:

Location	Contamination Reading
C&A Building	
Charging Pump Chamber	32540 d/m/smear beta-gamma
Charging Pump Chamber	10 d/m/smear alpha
Charging Room Floor	1280 d/m/smear beta-gamma

Location	Contamination Reading
C&A Building (continued)	
Sample Room Sink	175830 d/m/smear beta-gamma
Sample Room Sink	< 10 d/m/smear alpha
Sample Room Floor	1100 d/m/smear beta-gamma
Chemical Lab Hot Sink	28450 d/m/ near beta-gamma
Chemical Lab Hot Sink	< 10 d/m/smear alpha
RWDF	
Pump Room Floor	1690 d/m/smear beta-gamma
Shipping Room Floor	520 d/m/smear beta-gamma
C.V.	
Operating Deck	8910 d/m/smear beta-gamma
Operating Deck	< 10 d/m/smear alpha
Reactor Deck (head)	57000 d/m/smear beta-gamma
Reactor Deck (head)'	<10 d/m/smear alpha
Reactor Deck (grating)	38500 d/m/smear beta-gamma
Reactor Deck (grating)	<10 d/m/smear alpha
Primary Compartment (grating)	11160 d/m/smear beta-gamma
Primary Compartment (grating)	<10 d/m/smear alpha

Liquid and gaseous effluents from the SNEC site for the month of October 1967 were as follows:

Effluent Type	(Curie) Activity This Month	(Curie) Activity Year to Date	(Curie) Activity Last Twelve Months
Liquid	0.000938	0.018582	0.021323
Tritium	0.299424	5.744474	13.504956
Air, Xe	0.169180	16.695536	26.635600
Air, I-131	0.001648	0.002501	0.045505
Air, M.F.P.	0.001692	0.166955	0.266356

Twelve (12) barrels of waste were drummed for temporary storage. No drums were shipped from the site.

Radiation exposure for all SNEC personnel as measured by film badges for the month of September 1967 were a maximum of 260 mrem with an average of 32.37 mrem.

Radiation exposure for all visiting personnel as measured by film badges for the month of September 1967 were a maximum of 200 mrem with an average of 5.55 mrem.

The average radiation exposure for all personnel as measured by film badges for the month of September 1967 was 30.0 mrem.

SAXTON NUCLEAR EXPERIMENTAL CORPORATION

OPERATING STATISTICS

MONTH October YEAR 1967

NUCLEAR	UNIT	MONTH	YEAR	TO DATE
TIMES CRITICAL	NO.	2	42	537
HOURS CRITICAL	HRS.	107.81	1,063.15	19,926.10
TIMES SCRAMMED (MANUAL)	NO.	2	33	324
* TIMES SCRAMMED (INADVERTANT)	NO.	0	0	31
THERMAL POWER GENERATION	MWH	1691.72	22,869.14	362,954.01
AVERAGE BURNUP	MWD/MTU	138.09	1,866.74	12,608.53

CONTROL ROD POSITIONS AT END OF MONTH AT EQUILIBRIUM POWER OF 17 MWt

MAIN COOLANT BORON 551 PPM

RODS OUT - INCHES

NO. 1 40 NO. 2 19.5 NO. 3 40

NO. 4 40 NO. 5 40 NO. 6 40

ELECTRICAL	UNIT	MONTH	YEAR	TO DATE
GROSS GENERATION	MWH	281	4,289.00	61,764.00
STATION SERVICE	MWH	263.33	1,537.04	12,186.23
STATION SERVICE	%	93.71	35.83	19.73
AVG. PLANT EFFICIENCY - MWH(e)/MWH(t)	%	16.61	18.75	17.02
AVG. GENERATION RUNNING (85.93 HRS)	KW	3270	4,277.1	3,403.35
PLANT LOAD FACTOR - (AVG. GEN. FOR MONTH/MAX. LOAD)	%	9.63	12.95	27.96

AUXILIARY STEAM SUPPLY - NUCLEAR

STEAM SUPPLIED BY REACTOR	HRS.	85.92	1,015.72	16,505.97
RWDF EVAPORATOR OPERATION	HRS.	162.75	1,414.32	5,329.90

* REMARKS: _____

SAXTON NUCLEAR EXPERIMENTAL CORPORATION

DAILY AVERAGE POWER LEVELS FOR OCTOBER 1967