YANKEE NUCLEAR POWER STATION

OPERATION REPORT NO. 138

For the Month of

June 1972

Submitted by

YANKEE ATOMIC ELECTRIC COMPANY

Westboro Massachusetts

July 21, 1972

4041

This report covers the operation of the Yankee Atomic Electric Company at Rowe, Massachusetts for the month of June, 1972.

During the period plant load varied between 158.2 MWe and 156.8 MWe as the circulating water temperature fluctuated between 44°F and 49°F.

During the period June 8-11 the plant was placed in a scheduled, hot standby condition for the purpose of effecting repairs to the turbine generator No. 5 bearing hydrogen seal; and the performance of scheduled control rod drop time testing. The turbine generator was phased on line at 1653 hours on June 11. The reactor power level was increased to 498 MWt at 1000 hours on June 12; this level being maintained through the end of the report period.

The first, Core X vapor container air leakage surveillance period continued through the report period with normal leakage noted.

Plant Abnormal Occurrences

Abnormal Occurrence No. 72-7, "Inadvertent Radioactive Gas Release From Waste Liquid Evaporator".

Operation of the evaporator was initiated at 1240 hours on June 1 for processing of Class 2 (oxygenated) liquid. Venting of off-gases (non-radioactive) during Class 2 liquid processing is to the primary vent stack. At 1930 hours the Auxiliary Operator secured processing of the Class 2 liquid and commenced processing of Class 1 liquid.

Procedural valving during the change from Class 2 to Class 1 liquids re-routes the off gases (hydrogenated and radioactive) to the low pressure cover gas system. A misvalving occurred during the transition permitting the Class 1 liquid off gases to be vented to the environs via the primary vent stack. This condition existed until 0845 hours on June 2 when the evaporator was secured.

A total of 75.8 uc of Xe^{133} was released at a point of discharge concentration of 2.24×10^{-10} uc/cc.

Plant Load Reductions

June 1 (1403-1810): Plant load reduction to 60 MWe to allow repacking of the No. 3 boiler feed pump.

Plant Shutdowns

Shutdown No. 122-10-72: 6/8/72, commenced plant shutdown for repair of generator hydrogen leakage. Total outage time: 66 hours, 33 minutes.

Plant Maintenance

The following is a list of pertinent plant maintenance items performed by the plant staff during the month of June, 1972.

1. The motor for the No. 2 boiler feed pump was repaired and returned to service.
2. The No. 3 boiler feed pump inboard shaft sleeve was replaced.
3. The No. 1 and No. 3 charging pumps were repacked.
4. A leaking tube in the No. 1 auxiliary boiler was replaced.

Instrumentation and Control

The following is a list of pertinent instrumentation and control maintenance items performed by the plant staff during the month of June, 1972.

1. The pump for the vapor container air particulate monitor system was replaced.
2. The turbine generator hydrogen vent control valve was repaired.

Reactor Plant Performance

Measurements with the incore instrumentation were performed under the following plant conditions:

495.2 MWt; 510.3°F Tave; Control Rod Group A @ 78°, B, C and D @ 87°"; 1527 ppm boron; equilibrium xenon.

The results of these measurements were:

	Stainless Steel Clad Assembly	Zircaloy Clad Assembly
F_Q^N	1.93	2.11
$F_{\Delta H}^N$	1.34	1.55
Maximum Outlet °F	560.5	570.2

Secondary Plant Performance

Feedwater heater terminal differences were as follows:

No. 1 = 3.5°F No. 2 = 7.3°F No. 3 = 5.8°F

The condenser performance was as follows:

154.4 MWe; 1.29" Hg B.P.; 488 MWt; 49.6°F C.W. in; TTD = 18.6°F; cleanliness factor = 92.5%.

Chemistry

The main coolant boron concentration was reduced from 1584 ppm to 1497 ppm to compensate for normal core depletion.

The main coolant pH averaged 5.10 during the period.

The main coolant beta-gamma specific activity and crud level averaged 9.99×10^{-2} uc/ml and 0.03 ppm respectively.

The main coolant tritium concentration averaged 1.33 uc/ml during the report period.

The iodine-131 specific activity averaged 9.28×10^{-5} uc/cc and the iodine 131/133 atomic ratio averaged 2.01.

A crud sample for the month collected on June 14 had the following radiochemical analyses: dpm/mg crud

Cr-51	Mn-54	Fe-59	Co-58
4.05×10^{6}	2.90×10^{5}	3.19×10^{5}	2.77×10^{6}
Co-60	**Ag-110M**	**Zr-95**	**Sb-124**
1.03×10^{6}	2.90×10^{4}	6.16×10^{5}	1.64×10^{5}

A main coolant gas sample, collected on June 30, had the following radiochemical analyses: uc/cc gas

Xe-133	Xe-135	Ar-41
8.18×10^{-1}	5.79×10^{-2}	1.32

Health and Safety

Four shipments totalling 231 drums of low level waste containing 612.9 mc were made during the period.

Waste disposal liquid releases totalled 73,489 gallons containing 0.070 mc of gross beta-gamma activity and 89.44 curies of tritium. Gaseous releases during the period totalled 1.191 curies of gross beta-gamma activity. Secondary plant water discharged totalled 387,347 gallons containing 0.077 mc of gross beta-gamma activity and 0.250 curies of tritium.

Radiation exposure doses for Yankee plant personnel as measured by film badge, for the month of June, 1972 were as follows:

Average accumulated exposure dose: 48 mrem

Maximum accumulated exposure dose: 230 mrem

Operations

Attached is a summary of plant operating statistics and a plot of daily average load for the month of June, 1972.

YANKEE ATOMIC ELECTRIC COMPANY - OPERATING SUMMARY

June 1972

ELECTRICAL		MONTH	YEAR	TO DATE
Gross Generation	KWH	102,000,100	289,349,100	13,305,225,000
Sta. Service (While Gen. Incl. Losses)	KWH	6,521,442	19,215,807	860,285,421
Net Output	KWH	95,478,658	270,133,293	12,444,939,579
Station Service	%	6.39	6.64	6.47
Sta. Service (While Not Gen. Incl. Losses)	KWH	380,471	5,161,336	38,265,728
Ave. Gen. For Month (720)	KW	141,666.8	- -	- -
Ave. Gen. Running (653.45)	KW	156.094.7	- -	- -

PLANT PERFORMANCE				
Net Plant Efficiency	%	29.65	28.74	28.49
Net Plant Heat Rate	BTu/KWH	11,510.12	11,874.57	11,978.76
Plant Capacity Factor	%	74.54	35.88	75.14
Factor Plant Availability	%	98.93	49.98	83.79

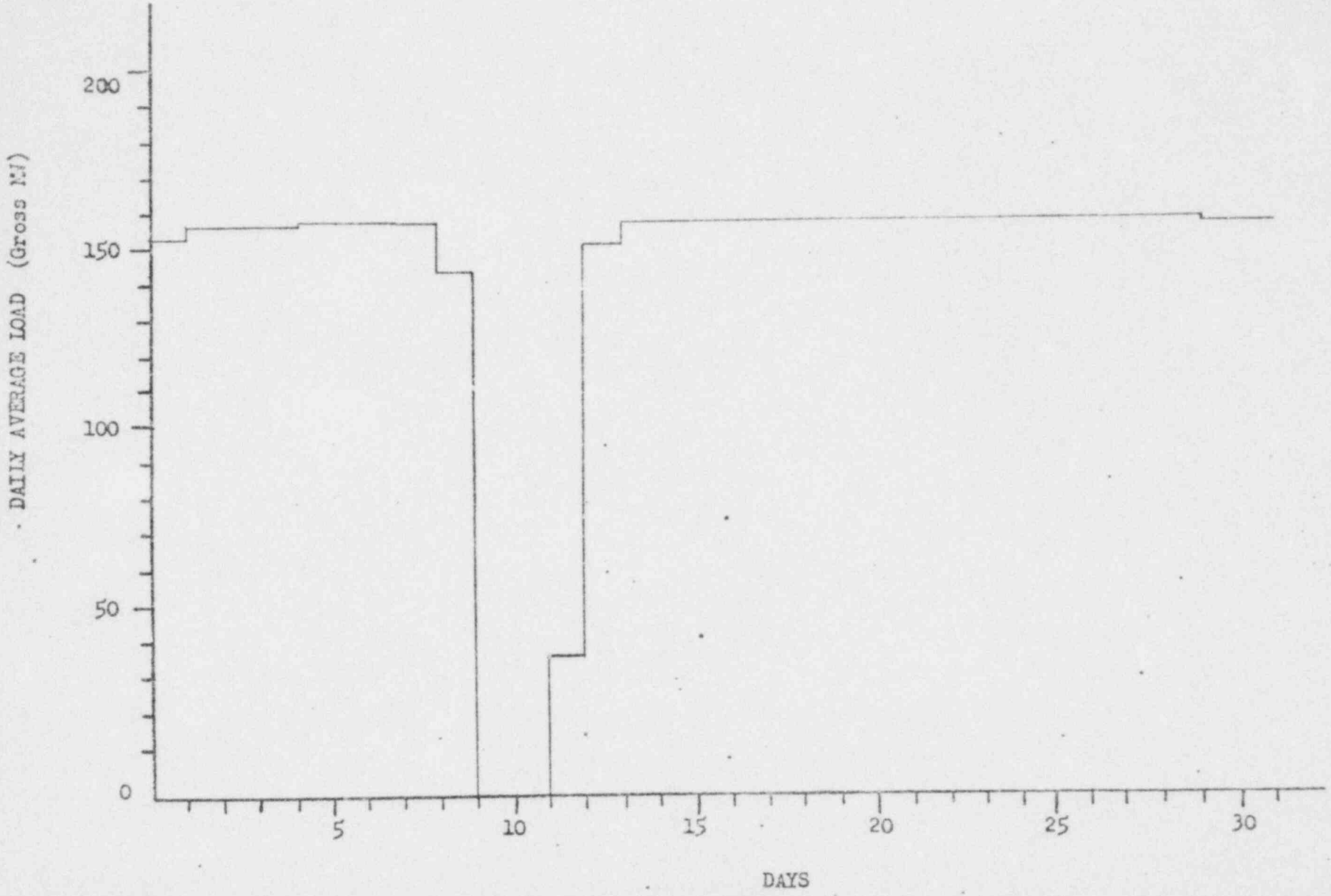
NUCLEAR		MONTH	CORE X	TOTAL
Hours Critical	HRS	691.38	1,097.23	86,582.22
Times Scrammed		0	6	67
Burnup				
Core Average	MWD/MTU	687.98	955.18	- -
Region Average	MWD/MTU			
A (INNER)		586.00	812.91	19,168.41
B (MIDDLE)		708.06	982.99	10,952.66
C (OUTER-ZIRCALOY)		677.68	941.13	941.13

YANKEE ATOMIC ELEC[illegible] COMPANY

DAILY AVERAGE LOAD

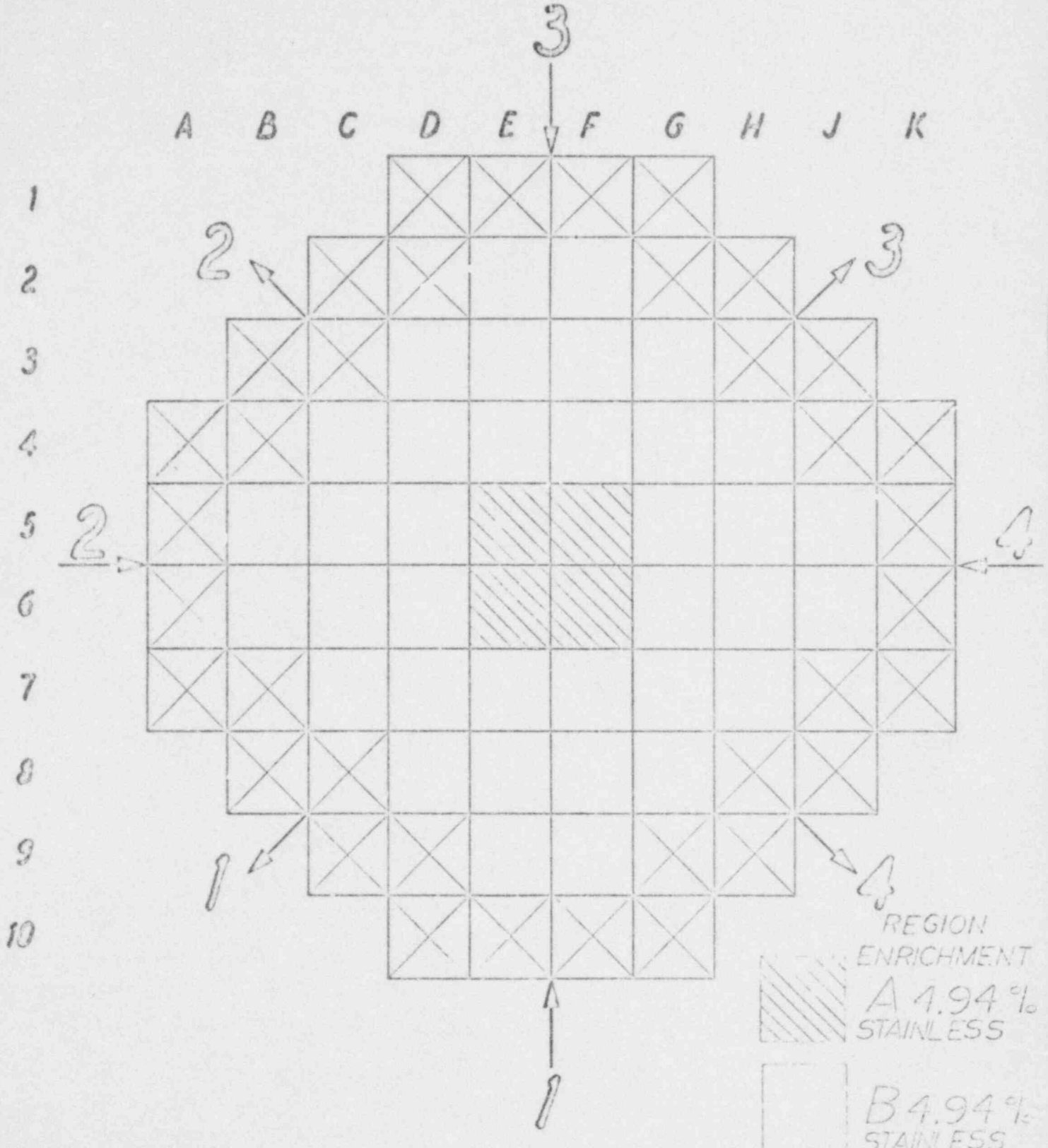
for

JUNE 1972



FUEL ASSEMBLY LAY-OUT

CORE X



This report covers the operation of the Yankee Atomic Electric Company at Rowe, Massachusetts for the month of May, 1972.

At the beginning of the period the plant was continuing its Core IX-X refueling and maintenance outage. Vapor container integrity was set, and on May 8 after establishing a main coolant temperature of 290°F using all four main coolant pumps, the four loops were isolated for hydrostatic testing of the system. The main coolant pressure was increased to 2485 psig with satisfactory results; following test completion the temperature and pressure were reduced to 200°F and 300 psig, respectively.

Plant heatup and the physics testing program were commenced on May 11. On May 12 the reactor core was brought critical. The reactor physics testing program was terminated on May 16 at 2130 hours.

Steam line warmup commenced on May 18 at 1400 hours, and turbine rolling was initiated following establishment of vacuum in the main condenser. The turbine was phased on line at 2218 hours, May 18 and loaded to 30 MWe by 2330 hours. The reactor power level was increased to 450 MWt at 0130 hours on May 19. On May 24 a scheduled hot standby shutdown commenced for repairs to the turbine generator No. 5 bearing hydrogen seal. During the shutdown scheduled control rod drop time tests were performed. The turbine generator was phased on line at 0433 hours on May 27. The reactor power level was increased to approximately 498 MWt at 2310 hours on that date; this level being maintained through the end of the report period.

The Core IX-X refueling and maintenance outage time was approximately 96.6 days.

On May 19, the initial Core X air charge to the vapor container was completed. Leakage of air from the vapor container during the balance of the report period was normal.

Plant Abnormal Occurrences

Abnormal Occurrence No. 72-5, "High Temperature in the Valve Stem Leakoff Header".

During Core X startup physics testing on May 14, 1972 a high temperature was noted in the vapor container valve stem leak off header. Proper corrective action was taken consisting of closing the header trip valve; and reducing the main coolant pressure by operation of the motor operated pressurizer spray valve. When the main coolant pressure reached 1850 psig, the reactor was scrammed, manually, from a zero power critical condition.

The stem leak off on the continuous spray valve HC-V-205 was found to be blowing through. The valve was backseated and the leak off was plugged. No adverse effects on the plant were noted. On May 18 the reactor was brought critical and the turbine generator was phased to the high line at 2218 hours that date.

Abnormal Occurrence No. 72-6, "Failure of Control Rod No. 13 to Withdraw".

On May 17, 1972 during preparations for control rod drop testing, control rod No. 13 would not withdraw from a fully inserted position in the core. Increasing the voltage to the lift coil slightly, resulted in normal withdrawal of the control rod.

After the lift coil voltage was restored to normal the rod was withdrawn to 90" and dropped five times. No reoccurrence of the withdrawal problem occurred.

Abnormal Occurrence No. 72-8, "Failure of Control Rod No. 18 to Drop Within the Time Assumed For the Accident Analysis".

On May 13, 1972, during Core X startup physics testing, control rod No. 18 failed to drop from the fully withdrawn position. The cause of the occurrence is unknown.

The rod was exercised into and out of the core to verify movement capability. Drop tests were repeated at various elevations with inconsistent results.

The accident analysis was reviewed assuming a second stuck control rod. A change to the facility license establishing a reduced maximum power level with a more stringent control rod restriction was approved by the USAEC.

Plant Load Reductions

May 22 (1925-2000): Plant load reduction to 146 MWe due to generator hydrogen leakage.

May 23 (1330-2200): Plant load reduction to 138 MWe due to generator hydrogen leakage.

May 31 (1325-1333): Plant load reduction to 152 MWe due to an electrical storm.

Plant Shutdowns

Subsequent to the return to power from the Core IX-X refueling and maintenance outage there was one scheduled shutdown.

Shutdown No. 121-10-72: 5/24/72, commenced plant shutdown for repair of generator hydrogen leakage. Total outage time: 39 hours, 8 minutes.

Design Changes

Control Rod Replacement

Prior to the placement of the reactor vessel head each control rod was withdrawn about six and one half feet to ensure they were properly coupled to the drive shafts. Difficulty was experienced in withdrawing two of the

Measurements with the incore instrumentation were performed under the following plant conditions:

494 MWt; 513.2°F Tave; Control Rod Group A at 78", B, C and D at 87"; 1603 ppm boron; equilibrium Xenon.

The results of these measurements were:

	Stainless Steel Clad Assembly	Zircaloy Clad Assembly
F_Q^N	2.00	2.24
$F_{\Delta H}^N$	1.37	1.63
Minimum DNBR	3.98	3.88
Maximum Outlet °F	560	570

Core X Startup Physics Test Program

The startup physics test program was commenced with an unadjusted pH main coolant reactor chemistry on May 11 at 1530 hours and was terminated May 16 at 2130 hours.

Hot and cold rod drops were timed using a recording oscillograph. As a result of hot rod drops, rod 18 was observed to drop with erratic results. Rod 18 is in Group D which is a shutdown group. A proposed change was subsequently submitted to the USAEC to operate the plant in a derated condition with a more stringent rod restriction curve. The basis for this change was to re-analyze the accidents assuming two control rods stuck out of the core on reactor scram. The remaining rods were within specification. The hot rod drops were repeated a minimum of two times. The results demonstrated good repeatability of drop times for all rods except rod No. 18.

The following values were measured during the test program:

Rod Worths

	Cold	Hot
Group A	-	0.93
Group B	2.72	2.48

Maximum Worth Rod (Ejected)

With Groups A and B in: Rod No. 7 = 0.73% ΔK/K

Maximum Worth Rod (Dropped)

With All Rods Out: Rod No. 11 = 0.34% ΔK/K

Minimum as measured temperature coefficients:

(250°F, 2110 ppm boron) $\Delta\rho/\Delta T = -0.4 \times 10^{-4}$ ΔK/K

(530°F, 2365 ppm boron) $\Delta\rho/\Delta T = -0.84 \times 10^{-4}$ ΔK/K

Inconel clad AgInCd-Zircaloy unitized control rod assemblies. They were replaced with two spare Hafnium-Zircaloy unitized control rod-follower assemblies.

Plant Maintenance

The following is a list of pertinent plant maintenance items performed by the plant staff during the month of May, 1972.

1. The pressurizer spray valve HC-V-205 was repacked.

2. The seat for CH-MOV-524 was removed, machined, reinserted and tack welded in place.

3. Lantern rings and a seal water supply was added to each bearing of the low pressure safety injection pumps to reduce standby leakage.

4. Pipe hanger readings were taken during hot and cold plant conditions.

5. The gasket on the No. 1 feedwater heater manway was replaced.

6. A loose main steam line pipe hanger was repaired.

7. The motor for No. 2 boiler feed pump was removed and sent off site for repairs.

8. The high pressure vent valves on No. 3 and No. 4 main coolant flow transmitters were repaired.

Instrumentation and Control

The following is a list of pertinent instrumentation and control maintenance items performed by the plant staff during the month of May, 1972.

1. The flow meter for the primary water supply was repaired.

2. The steam heat regulator valve for the boric acid mix tank was repaired.

3. The following instrument channels were calibrated:

   a. No. 3 feedwater flow transmitter.
   b. The four steam generator low level trip channels.
   c. The eight main coolant narrow range temperature channels.

Reactor Plant Performance

Following completion of the low power physics test the reactor was brought critical and loaded to 498 MWt and a detailed power distribution evaluation was performed. Preliminary results indicated that the power distribution is more even than anticipated.

Temperature Defect (250°F-530°F, 2110 ppm boron)

$\Delta \rho$ = 1.9% ΔK/K

All Rods Out Boron Concentration (530°F, 2000 psig)

C_B = 2385 ppm

Boron Worth (530°F,2050 ppm boron)

= 193 ppm/% ΔK/K

Power and Xenon Defect (Hot Zero Power to Hot Equilibrium 498 MWt)

= 797 ppm boron

Secondary Plant Performance

Feedwater heater terminal differences were as follows:

No. 1 = 3.4°F No. 2 = 7.5°F No. 3 = 6.1°F

Chemistry

The main coolant boron concentration averaged 2635 ppm until May 12 when the concentration was reduced for physics testing; and averaged 2109 ppm until reactor startup on May 18. During the balance of the report period the boron concentration averaged 1737 ppm.

The main coolant pH averaged 4.79 prior to, and 5.05 following reactor startup.

The main coolant gross beta-gamma activity averaged 5.1×10^{-3} uc/ml before startup and 9.78×10^{-2} uc/ml during the balance of the period.

The main coolant crud concentrations varied widely from a low of 0.06 ppm to a high of 7.76 ppm.

The main coolant tritium concentration before and after reactor startup averaged 1.63×10^{-2} uc/ml and 1.07 uc/ml, respectively.

A representative crud sample for the month, collected on May 25, had the following radiochemical analyses: dpm/mg crud

Cr-51	Mn-54	Fe-59	Co-58
1.57×10^6	3.84×10^5	8.27×10^4	1.58×10^6
Co-60	$Ag\text{-}110M_4$	Zr-95	Sb-124
8.53×10^5	2.75×10^4	2.52×10^5	3.64×10^4

A main coolant gas sample collected on May 22 had the following radiochemical analyses: uc/cc gas

Xe-133	Xe-135	Ar-41
8.09×10^{-2}	1.00×10^{-1}	6.77×10^{-1}

Health and Safety

One shipment of 55 drums of low level waste containing 177.6 mc was made during the period.

Waste disposal liquid releases totalled 57,451 gallons containing 0.026 mc of gross beta-gamma activity and 20.53 curies of tritium. Gaseous releases during the period totalled 0.437 curies of gross beta-gamma activity. Secondary plant water discharged totalled 291,379 gallons containing 0.083 mc of gross beta-gamma activity and 0.094 curies of tritium. In addition to the above releases, 0.642 curies of tritium as a vapor was discharged to the environs via the primary vent stack.

Radiation exposure doses for Yankee plant personnel and NEPSCo personnel, as measured by film badge for the month of May, 1972 were as follows:

Yankee Plant Personnel:

Average accumulated exposure dose:	305 mrem
Maximum accumulated exposure dose:	1530 mrem

NEPSCo Personnel:

Average accumulated exposure dose:	554 mrem
Maximum accumulated exposure dose:	920 mrem

Operations

Attached is a summary of plant operating statistics and a plot of daily average load for the month of May, 1972.

The following Operating Instructions and Emergency Instructions were revised and reissued during the month of May, 1972.

Operating Instructions

504A1	Primary Plant Startup from Cold Condition
504A2	Startup From Hot Standby Condition Shutdown to Hot Standby Condition Changing Reactor Load
504C2	Reactor and Primary Plant Cooldown
504R1	120 Volt A.C. Vital Bus System

Emergency Instructions

505B1	Emergency Shutdown from Power
505B10	Total Loss of Main Coolant
505B22	Isolation of Vital Bus Feeder Troubles
505B23	Control Rod Drop
505C2	Major Rupture of the Main Steam Line

YANKEE ATOMIC ELECTRIC COMPANY - OPERATING SUMMARY

MAY 1972

ELECTRICAL		MONTH	YEAR	TO DATE
Gross Generation	KWH	39,660,900	187,349,000	13,203,224,900
Sta. Service (While Gen. Incl. Losses)	KWH	2,608,181	12,694,365	853,763,979
Net Output	KWH	37,052,719	174,654,635	12,349,460,921
Station Service	%	6.58	6.78	6.47
Sta. Service (While Not Gen. Incl. Losses)	KWH	2,441,604	4,780,865	37,885,257
Ave. Gen. For Month (744)	KW	53,307.7	-	-
Ave. Gen. Running (262.53)	KW	151,071.9	-	-

PLANT PERFORMANCE				
Net Plant Efficiency	%	29.60	28.26	28.48
Net Plant Heat Rate	BTu/KWH	11,529.56	12,076.26	11,982.97
Plant Capacity Factor	%	28.04	28.24	75.15
Reactor Plant Availability	%	40.46	40.32	83.68

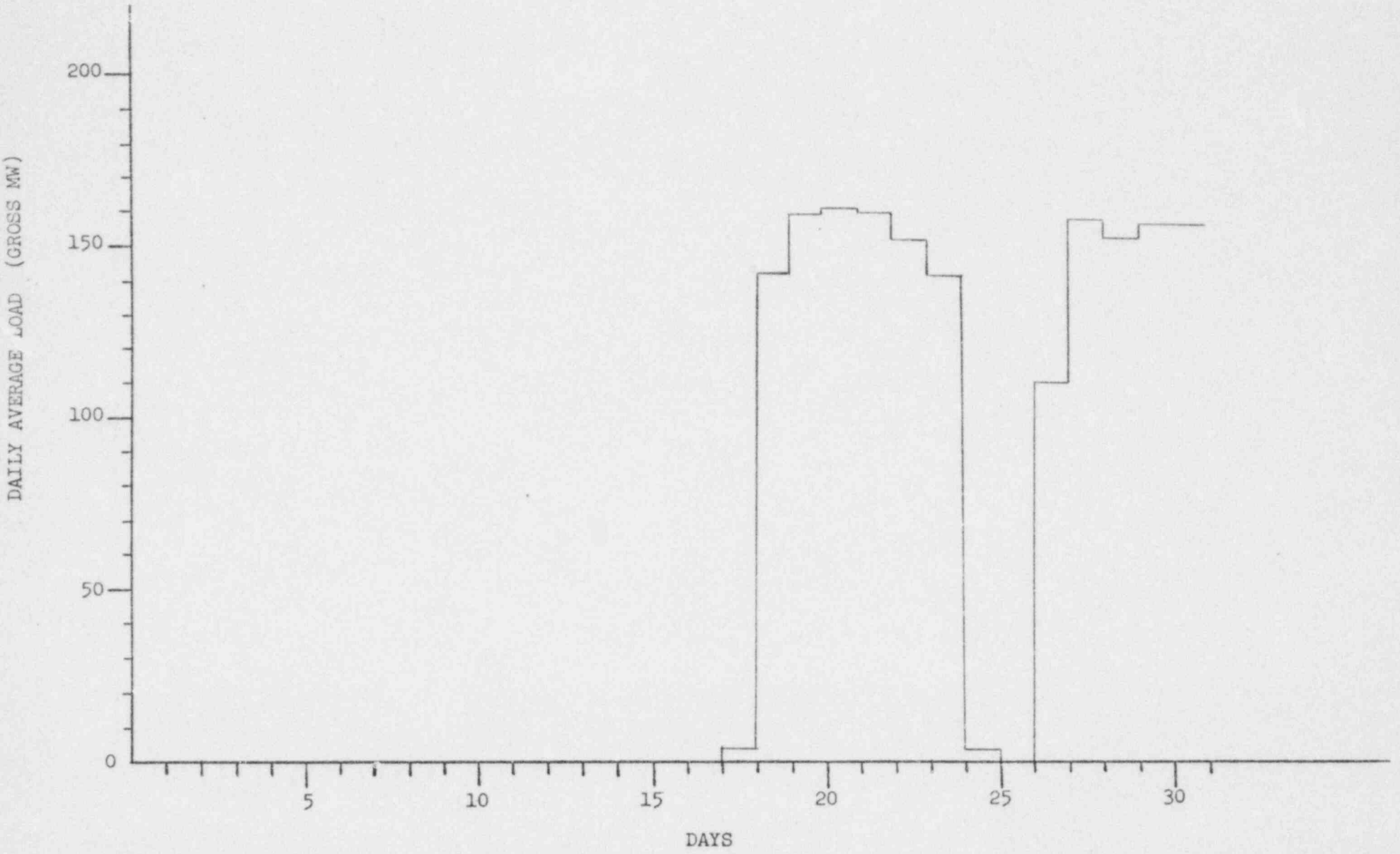
NUCLEAR		MONTH	CORE X	TOTAL
Hours Critical	HRS	405.85	405.85	85,890.84
Times Scrammed		1	6	67
Burnup				
Core Average	MWD/MTU	267.38	267.38	
Region Average	MWD/MTU			
A (INNER)		226.91	226.91	18,582.41
B (MIDDLE)		274.93	274.93	10,244.60
C (OUTER-ZIRCALOY)		263.45	263.45	263.45

YANKEE ATOMIC ELECTRIC COMPANY

DAILY AVERAGE LOAD

FOR

MAY 1972



FUEL ASSEMBLY LAY-OUT

CORE X