YANKEE NUCLEAR POWER STATION

OPERATION REPORT NO. 104

For the Month of

August 1969

Submitted by

YANKEE ATOMIC ELECTRIC COMPANY

Boston Massachusetts

September 23, 1969

This report covers the operation of the Yankee Atomic Electric Company plant at Rowe, Massachusetts, for the month of August, 1969.

On August 2 at 0615 hours the generator was separated from the high line for the Core VII - VIII refueling and maintenance shutdown. Plant load at time of shutdown was 106 MWe. The total electric generation for Core VII was 1,796,576,600 KWh. During the Core VII period, reactor availability and the plant capacity factor including stretchout operation but exclusive of refueling shutdown time were 96.97% and 84.24%, respectively.

At the beginning of the report period the plant was operating under stretchout conditions, and systems were being prepared for the Core VII - VIII refueling outage. Ammonia feed to the main coolant system had been secured, and residual ammonia removed by mixed bed (H^+, OH^-) purification to a negligible concentration.

A 31,700 gallon continuous dilution of the main coolant was performed on August 1 and 2 to reduce the system tritium inventory. Tritium concentrations before and after the dilution were 3.03×10^{-1} uc/ml and 8.64×10^{-2} uc/ml, respectively.

Routine vibration testing of the four main coolant pumps was performed at the onset of the outage. No abnormal conditions were detected.

A turbine oil pressure, simulated overspeed trip test, and an actual turbine overspeed trip test were performed following separation from the high line. Both tests were successful.

Steam line safety valves for steam generators No's. 1, 2 and 3 were tested on August 2. Five of the nine valves operated at the set pressures. Four valves required slight adjustment.

Following plant shutdown, the main coolant was borated and system cooldown was initiated. The plant cooldown was completed on August 3.

A vapor container Class A overpressure test was performed during the period commencing August 3 at 1551 hours, and continuing through August 5, at 2330 hours.

The integrity of the vapor container was broken on August 6 at 0015 hours, permitting entry for work preparatory to removal of the reactor vessel head. The vapor container purge was commenced at this time and continued throughout the report period. The International Atomic Energy Agency seals were removed from the missile shield, and the shield was removed.

Test operation of the fuel chute transfer carriage was satisfactory, and filling of the spent fuel pit with demineralized water was commenced on August 9.

Removal of reactor head studs was commenced on August 8, and was completed August 10.

On August 11, the reactor vessel head was removed and the shield tank cavity was flooded to a depth of approximately 2' above the cavity floor; this water level to be maintained during replacement of the four retaining rivets on

the South thermocouple spire. An unacceptable leak rate from the shield tank cavity developed which necessitated draining the cavity to locate and repair the leak. Components which had been removed from in-core were reinstalled and the reactor vessel head was put back in place. The point of major leakage was found to be the outer gasket for the inner moat ring which had rolled during installation and became pinched when the ring was tightened down. On August 13, the reactor vessel head was removed for the second time, and the shield tank cavity was refilled to a depth of approximately two feet.

Following repairs to the South thermocouple spire, the water level in the shield tank cavity was raised to normal refueling depth. During the filling of the cavity, a capacity test was performed of the safety injection pumps; pumps functioned satisfactorily. The clarity of the water in the shield tank cavity was exceptionally good throughout the balance of the period. This excellence of clarity is attributed to the modified purification system, which was installed prior to the Core VI - VII refueling period, and which was described in Operation Report No. 88.

On August 13, the unloading of core components commenced. Transfer of fuel was started August 15, and temporarily terminated on August 18 due to damage done to the refueling equipment on that date (See Abnormal Occurrence No. 69-5, this report). Refueling operations were reinitiated on August 28 and completed on August 31. Thirty six spent fuel assemblies were removed from the core, including the four zircaloy clad qualification assemblies. Thirty six new stainless steel clad fuel assemblies were inserted in the core. The four zircaloy clad qualification assemblies were not recycled.

Representatives of the International Atomic Energy Agency were on-site during the major portion of the report period.

Plant Abnormal Occurrences

Abnormal Occurrence No. 69-4 "Exposure of an Individual to Radiation in Excess of USAEC Title 10 - Code of Federal Regulations Applicable Limit".

On August 14, 1969, repair of the primary to secondary leak in No. 4 steam generator was initiated. Radiation surveys of the work area indicated dose rates of 5 to 6 r/hr inside the water boxes.

The cause of the subject exposure was the lack of proper Health Physics coverage. The nature of the work involved entries into a confined space; the duration of each to be strictly timed so as to permit good account of accumulated radiation exposure. The dose accountability was to be maintained by a check of the individual's dosimeter by the Health Physics man, after each timed entry. In this instance the individual made three entries into the area with no dosimeter check until after the third entry. After the third entry the individual's dosimeter (0-1000 mr) was checked and found to be off scale. The maximum total time spent in the high radiation area was 17 minutes. The individual's beta-gamma dose recording film was sent by carrier for immediate processing. The radiation exposure dose reported was 2.500 REM. This 2.500 REM dose coupled with a previous dose of 0.560 REM received in this quarter, totalled 3.060 REM.

The maximum time spent in the work area where the measured radiation dose rate was 100 mr/minute was 17 minutes. Using these figures, the calculated dose is 47% lower than the reported dose, based on the individual's film badge. It is also of interest to note that controlled exposure films consistently indicate doses which are 30% - 40% higher than the actual dose applied. We are actively investigating these discrepancies since this problem imposes a severe penalty on our overall operation.

Abnormal Occurrence No. 69-5 "Damage to Refueling Equipment and Spent Fuel Assembly B-276".

Core VII - VIII refueling was in progress on August 18, 1969. Operations personnel were preparing to send spent fuel assembly B-276 to the spent fuel pit from the vapor container. At 0750 hours the assembly was positioned against the upender backstop and the carriage was raised. As the carriage reached the vertical position, the fuel assembly was seen to deflect. The operators then noticed that the stainless steel assembly retainer band on the carriage had crushed against the fuel assembly lower nozzle.

It was determined that the crane operator had positioned the spent fuel assembly too low. Operating procedures stipulate a band clearance elevation of 22.50 feet with visual observations to confirm band clearance. Due to an error in reading the elevation indicator, the fuel assembly was positioned at 21.50 feet which did not give the required band clearance. In addition, visual observations were not made to detect the discrepancy.

The plant staff was notified of the accident. The Chemistry and Health Physics Departments took samples of the shield tank cavity water and the vapor container atmosphere. No traces of fission products were detected, indicating that fuel tube rupture had not occurred.

The damaged fuel assembly was given a thorough inspection through a periscope. No signs of tube failure were noted. Damage to the lower nozzle assembly consisted of deformation of the nozzle with some distortion to two fingers.

Following inspection, the damaged assembly was stored in the guide tube rack fuel position.

It was determined that removal of the band would be required to allow carriage movement through the transfer chute; therefore, the band was cut from the carriage with an underwater saw. Following the band removal, the upender was actuated to a vertical position for inspection. It was determined that extensive repairs would be required to allow the continued use of this equipment. It was decided to complete the refueling using an alternate mode of operation. A single spent fuel assembly cask was used to transfer the remaining spent fuel between the vapor container and the spent fuel pit.

Plant Load Reductions

There were no plant load reductions during the period prior to the reactor shutdown on August 2.

Plant Shutdowns

Shutdown No. 10-7-9 : August 2, 1969. Scheduled Core VII - VIII refueling shutdown.

Core VII - VIII Major Work Items

1. On August 3, at 1551 hours, a vapor container Class A overpressure test was started. The air charge to the vapor container was secured at 0745 hours, August 3, with the pressure at 22 psig. The Class A test surveillance period continued until 1500 hours, August 5. During the surveillance period, leakage checks were performed at the vapor container electrical and mechanical penetrations using sonic and soap bubble techniques. One minor leak was detected at an electrical penetration. Preliminary results of the overpressure test indicated a leak rate of less than five pounds per hour, corresponding to 0.054% per day of the confined volume of air at 22 psig. Depressurization of the vapor container was commenced at 1520 hours, August 5 and was completed at 2330 hours the same day.

2. The moisture separators were opened August 4, preparatory to replacement of the three turning vane elbows and two deflector rings in the inlet piping. Work was still in progress at the end of the period.

3. On August 11, the seal welds were cut on the diaphragms for the No. 4 steam generator primary side manways. The diaphragms were removed and three leaking tubes were identified for plugging. Difficulties in sealing the tube ends prolonged this job until August 22 when successful welds were accomplished. Work area radiation levels in both the inlet and outlet water boxes were 5 - 6 r/hr.

4. On August 22 the primary side manway diaphragms were removed from the No. 1 steam generator for a tube leak inspection. One leaking tube was found, plugged and seal welded. Difficulties were encountered as in the No. 4 steam generator and it was not until August 26, that sound welds were obtained. Work area radiation levels in the inlet and outlet water boxes were 17 - 18 r/hr and 10 - 12 r/hr, respectively.

5. The high pressure turbine was dismantled for inspection. All blades were in a satisfactory condition. The spindle was sand blasted and checked for cracks. No cracks were found. Inspection of the seal rings in the inner cylinder nozzle chambers for the four control valves showed extensive erosion in the ring bearing surface of the nozzle chambers which apparently resulted from faulty ring installation during a previous outage. All four control valves were removed to facilitate replacement of their respective inner cylinder nozzle chambers. This work is currently in progress. The gland steam seals were found to be in satisfactory condition. Inspection of the No. 1 feedwater heater extraction pipe showed the single 12" line to be in good condition. The No. 2 feedwater heater extraction piping showed extensive erosion in the 18" line at the point of confluence of the two 12" lines. Replacement of this section of pipe was in progress at the end of this report period.

6. New modified springs were installed in the pressurizer safety valves under supervision of a vendor representative. The valves were then adjusted, leak tested and reinstalled.

7. New wear parts, fabricated of chromalloy, were installed in the main coolant bleed line vari-orifice valve. A new replacement 20 gpm orifice was also installed.

8. The four anti-rotation rivets in the South incore thermocouple spire were replaced. Work area radiation levels after shielding was installed, were 150 - 250 mr/hr.

9. The No. 4 steam generator 6" safety valve was dismantled for inspection. The retainer pin for the bottom adjusting ring was found to be bent; this accounting for the failure of the valve to reseat after its test blow June 10, 1969. The retainer pin being bent, permitted the adjusting ring to rotate upward. When the valve disc descended, it seated on the adjusting ring, rather than on the valve seat. New retainer pins of an improved design were installed for both the top and bottom adjusting rings in this valve. In addition, the valve seat was lapped and a new disc was installed. At this time the corresponding retainer pins in each of the 6" safety valves for steam generators No's. 1, 2, and 3 were replaced.

10. The defective back-up plug seal, for the North incore instrumentation reactor head penetration, was replaced. This seal replacement was effected as an operational repair of the leak experienced at this penetration during April, 1969 and which was described in the Operation Report No. 88.

Design Changes

1. The pressurizer manway studs were modified to accomodate stud heaters.

2. The No. 4 steam generator blowdown suction line was extended from just inside the generator shell to near center of the tube sheet, in an attempt to eliminate the problem of chemical hideout in this area.

3. The ventilation ports in the coil stack housings were enlarged to provide greater cooling capacity.

Inspections

The following is a list of major inspections performed during the period.

1. Epoxy repairs which were made in October, 1966 to the No. 1 and No. 2 circulating water pump inlet bells were inspected, using a diver, and underwater television. The visual inspection and wax impressions of the repaired areas showed essentially no visible defects.

2. Four Core VII zircaloy qualification fuel assemblies and nine Core VII stainless steel fuel assemblies were inspected. No mechanical abnormalities were detected. A light film of crud was noted on all inspected fuel assemblies.

3. Five control rods were inspected; only minimum wear was found in the guide block area. One of the rods inspected was No. 17 which has a history of operational problems, described previously in Core VII Operation Reports. Inspection of control rod No. 17 revealed a scratch on the South side of the East vane. The scratch did not penetrate the inconel cladding. Inspection of the lower core support plate and fuel assemblies adjacent to control rod No. 17 indicated no wear, scratches, or foreign objects. It was determined that rod No. 17 was not defective and it will be recycled in Core VIII.

4. Four shim rods were inspected. No significant wear was detected.

5. The West source vane was inspected and found to be in good condition.

6. No abnormal conditions were detected during inspection of the thermal shield seam clamps and secondary core support assemblies.

7. Selected nozzles of the lower core support plate were inspected. No abnormal conditions were noted.

8. The top nozzles of fuel assemblies in the Northeast quadrant of the core were inspected. No significant wear was observed.

9. The welds of each of the four main coolant loops' safety injection line 5" transition sections were dye penetrant tested, as were the welds of the charging line transition section in loop No. 4. In addition the welds of the transition section of the safety injection line in loop No. 2 were radiographed. Results of the dye penetrant test and of the radiograph inspection showed no abnormal conditions in any of the welds.

10. Both water boxes of the main condenser were inspected. All tubes in both boxes were cleaned with rubber plugs.

11. An inspection of control rod pressure housings No's. 7, 17, and 21 was performed as a check on trueness. No abnormal conditions were noted.

12. A visual inspection was made of the dome area of the pressurizer vessel. No abnormal conditions were detected.

13. The secondary side of steam generators No. 2 and No. 4 were inspected. No abnormal conditions were detected.

Plant Maintenance

The following is a list of pertinent plant maintenance items performed, additional to the major work items, during the month of August, 1969.

1. During the hot leak check in the vapor container following reactor shutdown, a noise was detected in the check valve in No. 2 main coolant loop. Upon inspection, the disc hinge bushing and block assemblies exhibited wear. New bushing and block assemblies were installed and the valve was reassembled. Although the corresponding check valves in loops 1, 3, and 4 had not exhibited abnormal noise conditions during the same hot leak check period, the No. 4 check valve was arbitrarily chosen for inspection as representative of the remaining three such valves. The No. 4 check v' was found to be in good condition; no repairs were made. Upon opening the No. 2 check valve, radiation levels were 800 mr/hr in the vicinity of the studs, 2 - 3 r/hr inside the valve body, and 2.5 r/hr at 2" from the clapper, removed. Shielding reduced these levels to 100 mr/hr at the studs and 1.25 r/hr inside the valve body. Radiation levels inside the No. 4 check valve were comparable.

2. An improved walkway and guard rail were installed on the No. 1 manipulator crane.

3. A new impeller was installed on the No. 2 pump for the gravity drain tank.

4. A tube leak test was performed on No. 3 feedwater heater. Three tubes were plugged.

5. The existing coils, in the stack for control rod No. 5 position indication, were 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 August, 1969.

1. New neutron counters were installed in thimbles No's. 2, 4, 5 and 7.

2. All primary plant instrumentation channels and feedwater system controls were recalibrated.

3. The vapor container trip valves were tested at simulated high vapor container pressure. All valves operated normally.

4. Repairs were made to the turbine thrust bearing thermocouples.

Chemistry

Following reactor shutdown on August 2, the main coolant was borated to a concentration of 2012 ppm. The No. 4 main coolant loop, which was in an isolated condition due to primary to secondary leakage, was borated to a concentration of 2740 ppm before being valved into the system. Concurrently, the in-service mixed bed demineralizer was saturated with boron. Prior to fuel handling the boron concentration in the main coolant was increased, and averaged 2893 ppm in the shield tank cavity water through the end of the period.

The main coolant gross beta-gamma specific activity decreased from 4.79×10^{-2} uc/ml just prior to reactor shutdown, to 6.46×10^{-4} uc/ml at the end of the period. The crud level averaged 0.06 ppm during the period.

At the beginning of the period the Iodine - 131 specific activity was 2.1×10^{-5} uc/ml and the Iodine 131/133 atomic ratio was 0.43. At the end of the period the iodine values had decreased to below detectable concentrations.

The main coolant pH averaged 4.70 during the period.

A crud sample collected from the shutdown cooling system on August 20 and corrected to the date of shutdown, had the following radiochemical analyses: dpm/mg crud

Cr-51	Mn-54	Fe-59
1.62×10^6	8.80×10^5	1.11×10^6
Co-58	Co-60	Ag-110M
2.44×10^6	1.01×10^6	7.46×10^5

Health and Safety

Three shipments of radioactive waste were made during the period, totalling 211 drums containing a total activity of 755.6 mc.

Waste disposal liquid releases totalled 119,120 gallons containing 0.124 mc of gross beta-gamma activity and 45.42 curies of tritium. Gaseous releases during the period totalled 23.8 mc of gross beta-gamma activity and 0.90 curies of tritium. Secondary plant water discharged, totalled 54,337 gallons containing 0.45 mc of gross beta-gamma activity and 2.84 curies of tritium.

In addition to the above releases, 1.33 curies of tritium as a vapor, was discharged to the environment through the primary vent stack.

At the time of reactor shutdown, the airborne tritium concentration in the vapor container was 4.5×10^{-6} uc/cc. Ten hours of purging reduced this concentration to 3.6×10^{-7} uc/cc. Following the vapor container Class A overpressure test, the purge fan was restarted and run continuously, maintaining an average tritium concentration of 9×10^{-8} uc/cc during the balance of the period.

Samples of the vapor container atmosphere were collected during removal of the reactor vessel head. No gaseous radionuclides were detected in these samples.

Radiation levels in the shield tank cavity following reactor shutdown were 35 - 50 mr/hr on the reactor head catwalk, 500 - 1000 mr/hr on contact with the lower section of the reactor head ventilation annulus, with the upper section removed, 100 - 400 mr/hr at the reactor head stud annulus, and 70 - 140 mr/hr general area midway between the reactor head and the shield tank cavity walls. The addition of 20 shield tubes over the control rod pressure housings reduced

all work area radiation levels by a factor varying from two to ten.

Radiation exposure doses for Yankee personnel and N.E.P.S.Co. personnel as measured by film badge, for the month of August, 1969 were:

Yankee Plant Personnel:

Average accumulated exposure dose:	749 mrem
Maximum accumulated exposure dose:	2330 mrem

N.E.P.S.Co. Personnel:

Average accumulated exposure dose:	758 mrem
Maximum accumulated exposure dose:	2370 mrem*

* See A.O. 69-4, this report.

Operations

Attached is a summary of plant operating statistics and a plot of daily average load for the month of August, 1969. Also attached is a graphic display of the Core VIII configuration.

YANKEE ATOMIC ELECTRIC COMPANY - OPERATING SUMMARY

August 1969

ELECTRICAL		MONTH	YEAR	TO DATE
Gross Generation	KWH	3,232,200	787,259,400	9,791,021,200
Sta. Service (While Gen. Incl. Losses)	KWH	256,046	49,958,612	644,552,871
Net Output	KWH	2,976,154	737,300,788	9,146,468,329
Station Service	%	7.92	6.35	6.58
Sta. Service (While Not Gen. Incl. Losses)	KWH	608,027	1,431,792	27,715,442
Ave. Gen. For Month (744 hr.)	KW	4,344.35	- -	- -
Ave. Gen. Running (30.25 hr.)	KW	106,850	- -	- -

PLANT PERFORMANCE				
Net Plant Efficiency	%	26.33	28.49	28.38
Net Plant Heat Rate	BTu/KWH	12,961	11,979	12,025
Plant Capacity Factor	%	2.53	73.98	74.53
Reactor Plant Availability	%	4.87	84.81	83.98

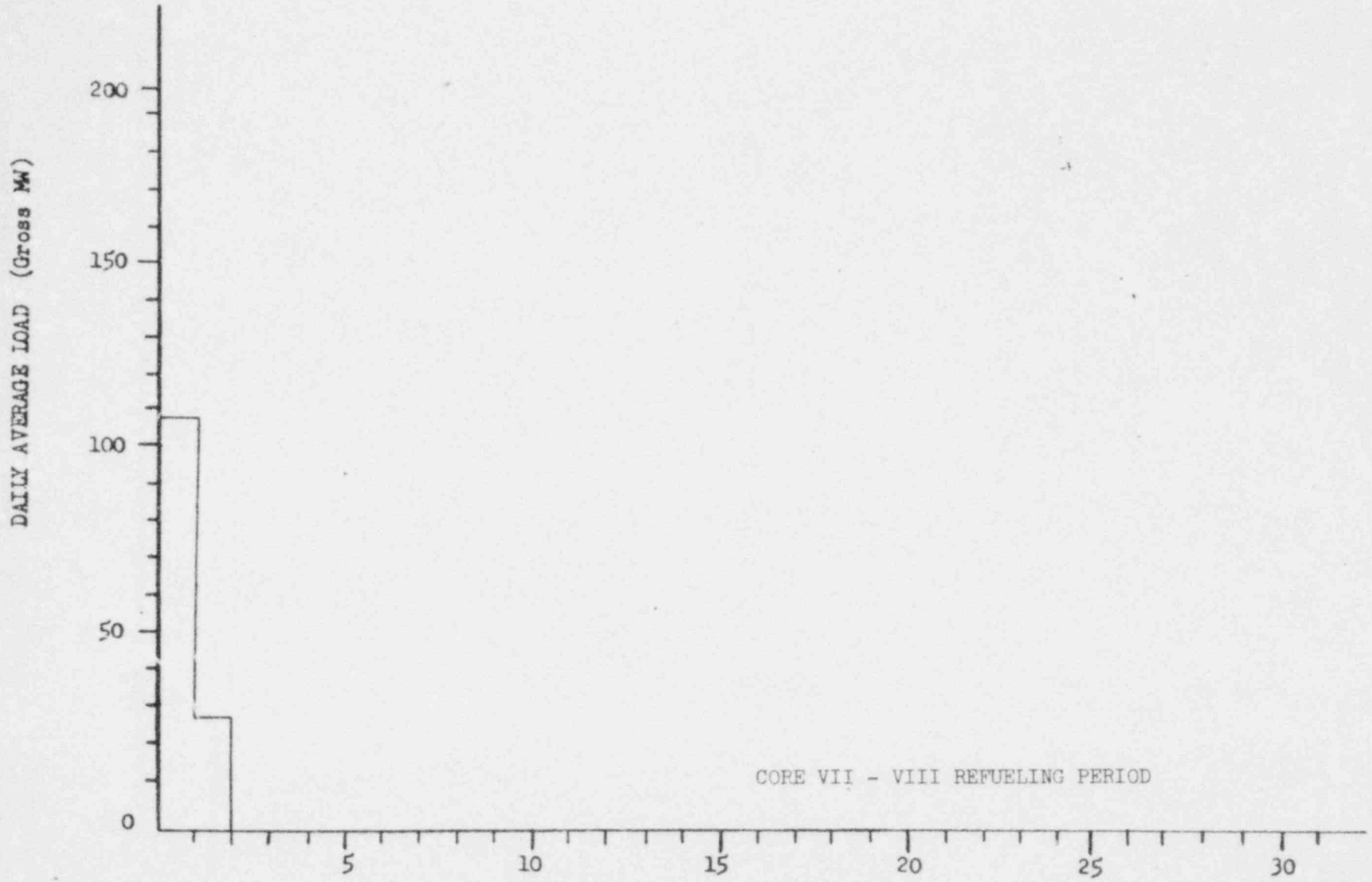
NUCLEAR		MONTH	CORE VII	TOTAL
Hours Critical	HRS	36.25	10,712.36	65,819.78
Times Scrammed		0	3	58
Burnup				
Core Average	MWD/MTU	22.79	11,963.33	- -
Region Average	MWD/MTU			
A (INNER)		24.78	12,588.68	30,442.96
B (MIDDLE)		25.68	13,945.76	23,933.19
C (OUTER)		19.40	9,650.11	9,650.11
D (ZIRCALOY)		22.00	12,036.06	12,036.06

YANKEE ATOMIC ELECTRIC COMPANY

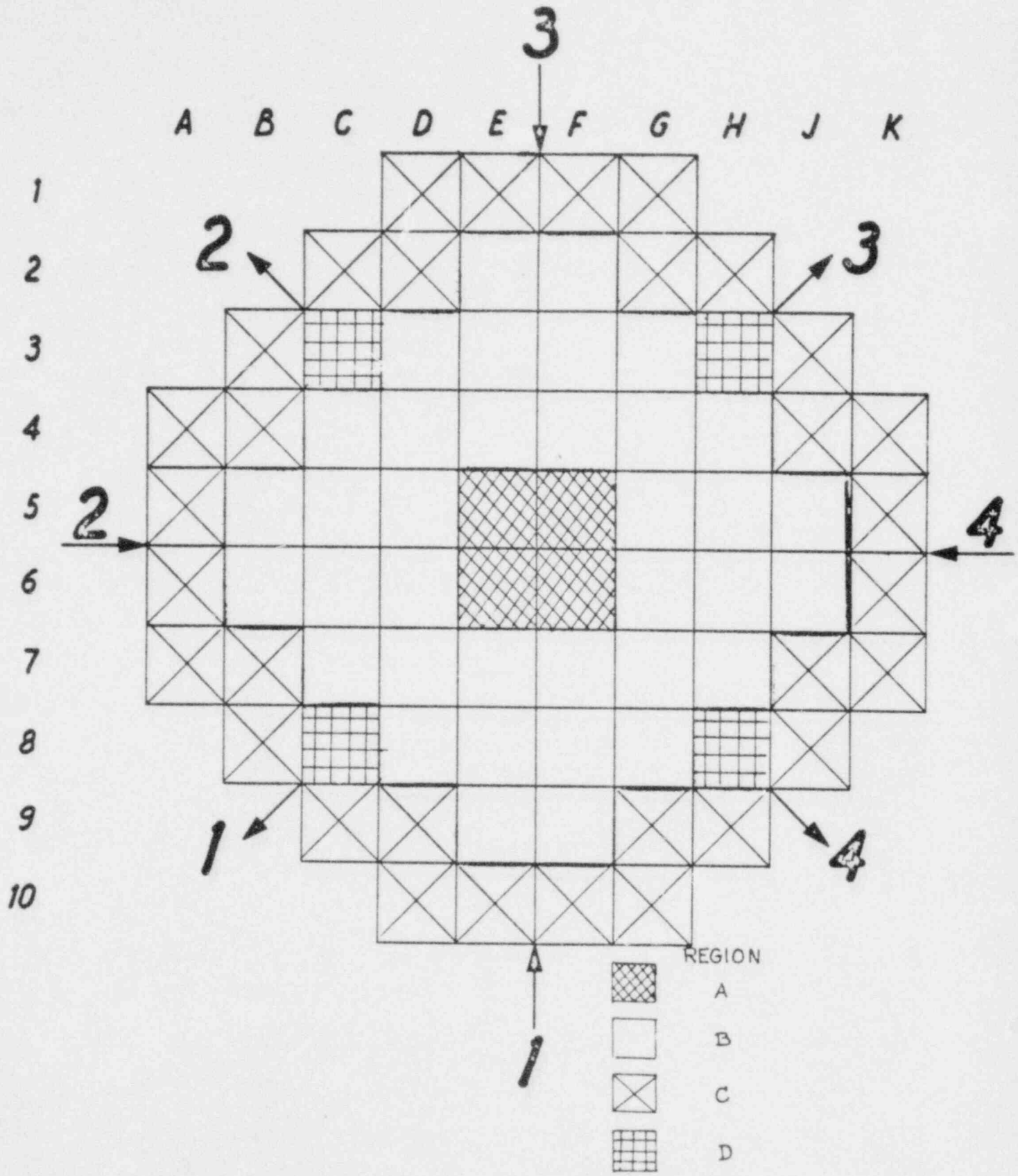
DAILY AVERAGE LOAD

for

August 1969

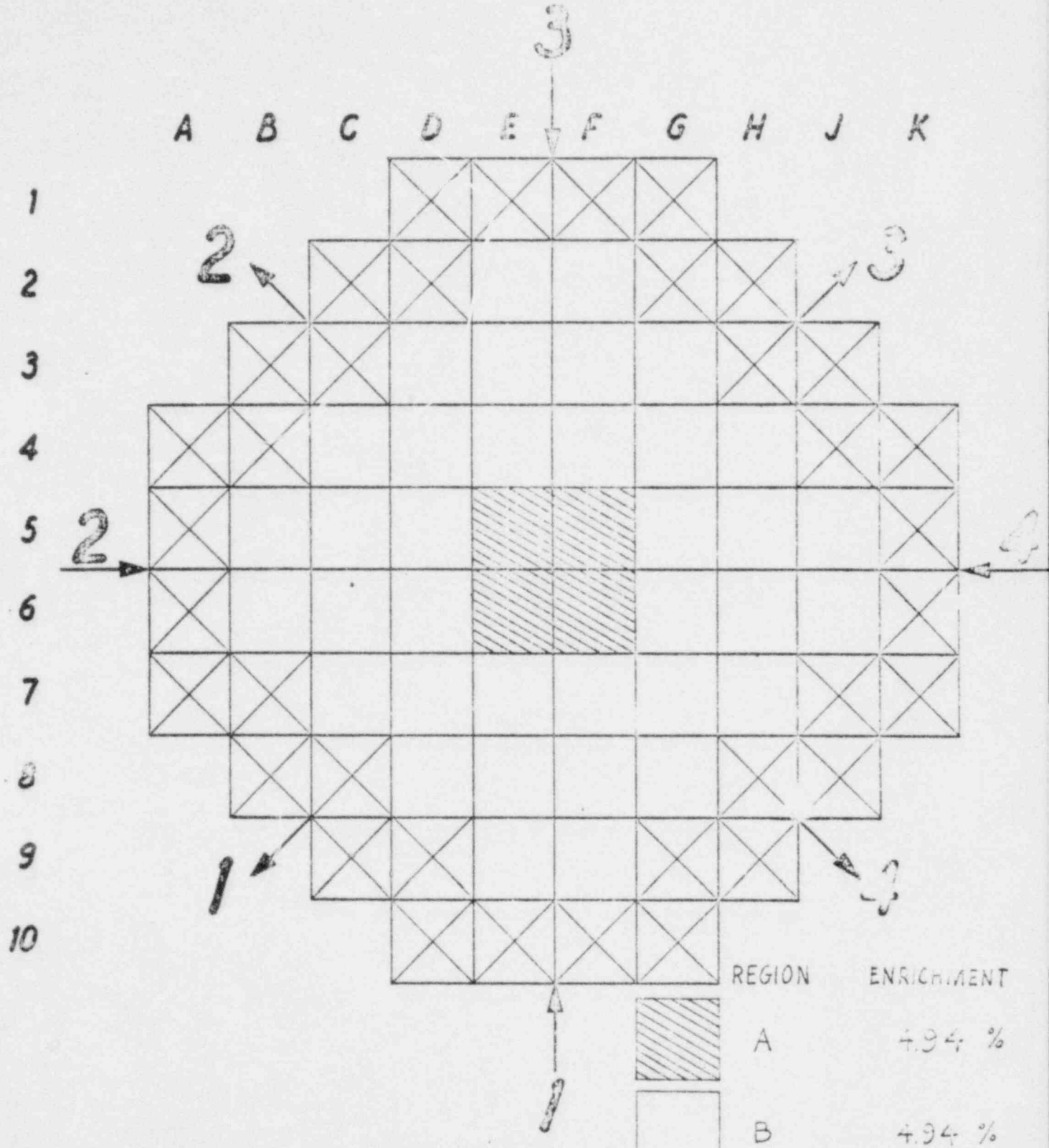


YANKEE - ROWE
CORE VII



FORM RE-8

CORE VIII



REGION	ENRICHMENT
A	4.94 %
B	4.94 %
C	4.94 %

FORM RE-8