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YANKEE NUCLEAR POWER STATION

OPERATION REPORT NO. 13

For the month of

JANUARY 1962

Submitted by

YANKEE ATOMIC ELECTRIC COMPANY
Boston Massachusetts

February 19, 1962

This report covers the operation of the Yankee Atomic Electric Company plant at Rowe, Massachusetts for the month of January, 1962.

The plant operated continuously during the month and passed the one billion KWH mark in gross generation on January 12.

As reported in the December Operating Report, Core I has been expended to the extent that all control rods are fully withdrawn. A core lifetime extension program is presently in effect, based on taking advantage of the core reactivity increases associated with reductions in moderator temperature and reactor power level. The operating schedule calls for maintaining load by allowing the average main coolant temperature to drop to a predetermined value followed by a step load reduction. A corresponding increase in coolant temperature is then realized following which the new load is maintained by further T_{ave} reduction.

At the beginning of January, the station power level was approximately 140 MWe with an average coolant temperature of 512°F. For the first eleven days of the month these conditions remained essentially constant. On January 12 and 13, T_{ave} dropped approximately 7.5°F over a period of 40 hours. At this point a load reduction of 10 MWe was made accompanied by an increase in T_{ave} from 504 to 509°F. For the remainder of the month a nominal power level of 130 MWe was maintained with T_{ave} exhibiting a gradual reduction of close to 1°F/day.

Plant operation during the period was smooth in general. Intermittent periods of turbine control valve noise and vibration were still in evidence. Discussions were held with the turbine manufacturer during the month to outline a course of action for correcting the turbine problem. Losses of condenser circulating water discharge siphon were experienced on January 22, 23 and 24. Methods of correcting this condition were also investigated during January.

On January 4 a leak developed in the charging line at a point outside the vapor container. After isolating the line an alternate feed was provided. The activity of the discharged liquid was below the point of detection while contamination was less than 100 DPM/ft^2. A circumferential crack, about 1 1/2 inches in length, was discovered approximately 1/4 inch from the weld attaching the charging line to a thermal sleeve at the point of penetration into the vapor container. The defective section of the line has been removed for analysis and the charging line has been repaired and returned to service.

During January, fifteen fuel assemblies for use in Core II were delivered to the plant bringing the total of Core II fuel assembly receipts to sixty-seven. Twenty-two control rod absorber sections for possible use in Core II were also delivered to the plant in January.

Fifty-four of the sixty-seven fuel elements were transferred to the spent fuel pit and placed in storage racks. Also placed in the pit were a WL-6307 BF_3 detector and a one-curie Plutonium-Beryllium neutron source. During the flooding of the pit with demineralized water, the neutron count rate was monitored.

There were no plant outages or scrams during January.

Plant Maintenance

Following is a description of the principal maintenance activity during January:

1. A defective section of the charging line was removed and a new section of line installed. The new section was dye penetrant checked at the welds before being restored to service.

2. The clean out connections on the purification cooling and drain pumps were shortened and provided with shut-off valves. Previously, the outlet ends of the connections were capped.

3. Two sway braces were installed on the main steam line to reduce steam line vibration.

4. The upper shaft bearing on No. 1 Primary Drain Collecting Tank Pump was replaced. Considerable shaft wear was noted in the journal area. Additional maintenance will be performed on the pump during the refueling shutdown.

5. Excessive leakage from a recently installed seal on No. 3 charging pump necessitated inspection and adjustment of the seal. The operation reduced leakage to an acceptable level.

6. A rupture of the inner potting seal at the vapor container penetration of the No. 6 pressurizer heater lead occurred during the month. The break, about 1/4 inch in diameter, is believed to have been the result of a defective seal or moisture or a combination of both. Since the outer seal remained intact, leakage from the vapor container is not involved and a final repair will be deferred until the refueling period.

7. Connection of a steam sample line from nozzles in the right hand steam lead to a sampling station was completed during the month.

Besides the above, routine maintenance procedures were carried out during January. Preparations are being made for an extensive maintenance program scheduled for the refueling period.

Chemistry

As a result of a persistent solids carryover problem, a design for a new evaporator has been developed. As discussed in previous operation reports, numerous attempts have been made to correct the carryover condition associated with the electrode evaporator but with no significant results. The new design encompasses the installation of a conventional shell and tube evaporator with a cyclone separator. The existing evaporator vessel will remain in place and serve as a reservoir or storage vessel. A change request has been submitted to the A.E.C. covering this proposed modification.

Main coolant oxygen levels continued below the point of detection during January. Main coolant specific activity levels ranged from 4.2×10^{-2} to 5.6×10^{-2} µc/ml during the same period.

Secondary side steam generator specific activity measurements indicated background levels only. Iodine-131 measurements on secondary blowdown were negative. With the existing primary water Iodine-131 concentration, this method would permit detection of a primary to secondary system leak of as little as 0.003 gallons per hour.

The results of a main coolant gas analysis indicated:

	M.C. Bleed	Downstream of Low Pressure Surge Tank	Downstream of Ion Exchanger
A-41	4.0×10^{-1} µc/cc gas	2.5×10^{-2} µc/cc gas	3.1×10^{-2} µc/cc gas
Xe-135	3.5×10^{-2}	1.6×10^{-2}	2.6×10^{-2}
Kr-85M	1.8×10^{-2}	3.5×10^{-3}	4.6×10^{-3}
Xe-133	1.5×10^{-2}	1.4×10^{-2}	1.1×10^{-2}

At the beginning of January the main coolant specific activity varied between 1.4×10^{-3} µc/ml and 1.7×10^{-3} µc/ml and the I-131/I-133 atomic ratio was approximately 3.4. This represented no significant change from values reported in December but remained above corresponding levels reported in November and previous months. A period of operation during the month with no purification flow saw the I-131 concentration increase to 1.1×10^{-2} µc/ml; however, resumption of primary water purification reduced this level to 1.0×10^{-3} µc/ml. By the end of January, the I-131 activity was 4.5×10^{-4} µc/ml with an I-131/I-133 ratio of approximately 2.6.

While the increase in these values in December indicated the possibility of a minor fuel cladding defect, no new defects appear to have occurred in January.

A main coolant crud analysis made during the period of no primary coolant purification indicated:

Fe-59	7.3×10^{5} dpm/mg
Ag-110	3.2×10^{5}
Co-60	1.4×10^{6}
Co-58	2.1×10^{6}
Cr-51	1.0×10^{6}
Mn-54	4.6×10^{5}
Crud Level	0.14 ppm

No significant increase in crud level was noted while operating without purification for approximately nine days. The main coolant specific activity increased from a level of 4.2×10^{-2} μc/ml before the no-purification run to a level of approximately 5.6 μc/ml during and immediately following the run.

Reactor Plant Performance

Defining Core I end of life as that time when core excess reactivity would drop below zero at the design conditions of:

Core Power = 392 MWt
Loop Ave. Temp. = 514°F
Main Coolant Press. = 2000 psig
Equilibrium Xenon for 392 MWt

the following has been determined:

Core I Life = 8000 EFPH
MWt Hour Output = 3,136,000
Gross MWe Hour Output = 1,008,817
Net MWe Hour Output = 927,944

The following values were determined by means of in-core instrumentation measurements at a power level of 410 MWt with all control rods withdrawn to 90 inches:

F_Q (Heat Flux)	3.4
$F_{\Delta T}$ (Coolant Rise)	2.9
DNB ratio	2.9

Analysis of core reactivity during January indicated essentially a zero burnup rate during the first eleven days of the month. During this period load was maintained at a nominal 140 MWe level with the average main coolant temperature remaining in the 512 to 513°F range. It is possible to attribute this apparent gain in reactivity or indication of zero burnup to a regaining of reactivity lost during the reactor scram of December 21. As described earlier, a falling off of main coolant temperature occurred on January 12 and 13 -- the rate of temperature decrease corresponding to approximately ten times the design burnup rate. When load was reduced from 140 to 130 MWe on January 13, no reactivity gain due to the change in equilibrium Xenon conditions for the two power levels was observed. This may have been the result of a reactivity loss on load reduction or a continuation of the reactivity loss observed prior to the load reduction. During the period of 130 MWe operation (January 14-31), however, the rate of main coolant temperature decline was generally consistent with the design burnup rate. Analysis of core reactivity changes continues in an effort to resolve the apparent gains and losses of reactivity which have occurred from time to time during the past several months.

During November 1961, a physics test program for determination of core reactivity coefficients was carried out. Data for establishing the power coefficient were acquired as the plant power level was increased from 0 to 150 MWe. Loading was accomplished in 30 MWe increments with a period of stabilization of approximately two days after each power increase. The power coefficient was determined by measuring the effects of step wise power level changes in terms of moderator temperature and control rod position changes. These were, in turn, converted to reactivity changes in order to determine the power coefficient of reactivity. An average power coefficient over the range 0 - 400 MWt of $-(0.38 \pm 0.17) \times 10^{-4} \Delta\rho/$ MWt was determined and reported at that time.

An additional technique was employed by cycling load, in approximately 8 MWe steps, prior to each load increase and allowing the main coolant temperature to control with no rod motion. This method reduces the transient Xenon correction since it is conducted after allowing Xenon to reach approximate equilibrium conditions. In addition, by cycling load at various power levels, improved statistical averaging is possible.

The attached curves (page 6) indicate the value of the power coefficient as a function of reactor power level. Curve (1) represents a predicted or theoretical change in power coefficient with power level. This curve recognizes the pellet-clad gap variation induced by power level changes and inequality in the temperature coefficient of expansion between the pellet and clad materials.

Curve (2) represents a polynominal fit of the measured power coefficient as determined from the load cycling technique. The data which yielded curve (2) were corrected for the reactivity effect of variable Xenon concentration.

As indicated on the plot, both curves exhibit the same general characteristic, that is, a less negative power coefficient with increasing reactor power.

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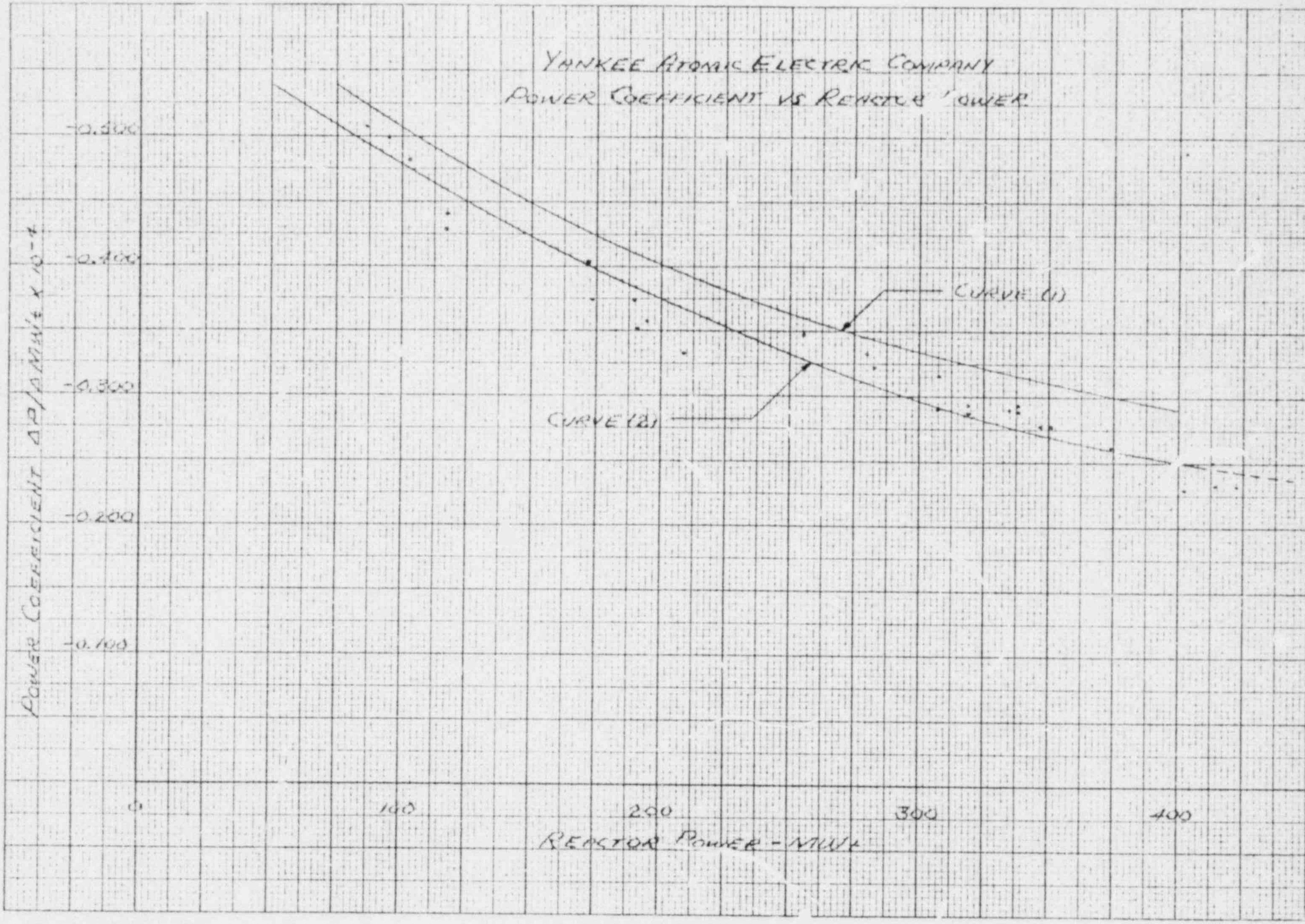


Turbine Plant Performance

Discussions were held during the month with the manufacturer covering the turbine, feedwater heaters and circulating water pumps.

As described earlier, turbine control valve noise and vibration have occurred sporadically for several months. It is expected that corrective action will be taken during the refueling outage.

The three secondary plant feedwater heaters have exhibited terminal temperature differences considerably higher than specified. As a result, the heater manufacturer has agreed to study the problem and make recommendations designed to improve heater performance. Internal inspection of the heaters is also scheduled for the refueling shutdown.

One and possibly both condenser circulating water pumps will be returned to the factory for testing. Since initial operation both pumps have operated at approximately 50 H.P. above rating. If required and if possible, the pump impellers will be modified at that time.

Also discussed was a method for reducing or eliminating vortexing at the circulating pump screen-well. The installation of either a floating raft or pump flow stabilizers is being considered.

Health and Safety

Liquid waste containing 605 μc and gaseous waste containing 0.06 μc were discharged from the plant during January.

Thirty-five drums of solid radioactive waste containing 21 millicuries were shipped from the plant for off-site disposal during the same period.

At all times the concentration of waste products discharged or shipped from the plant was well below the maximum permissible.

Following is a summary of radioactive material discharged or shipped from the plant during the year, 1961.

Liquid	7968 microcuries
Gaseous	1898 microcuries
Solid (70 concrete drums for off-site disposal)	107 millicuries

Radiation levels associated with the replacement of a section of the charging line were 5-20 mr/hr in the working area with contamination levels of 200-3,000 dpm/ft^2.

Radiation levels on contact with the removed sections of the capped tail pipes on No. 1 and No.2 purification pumps were 10 r/hr and 5 r/hr respectively.

Contamination in the cubicles as a result of the operation was 800-10,000 dpm/ft^2. The pipe sections were placed in a lead container for shipment and analysis off-site.

Following decontamination of the cubicles, a routine radiation survey indicated a contamination level of approximately 700,000 dpm/ft^2 on the floor in No. 1 purification pump cubicle. Since there appeared to be no evidence of leakage, it is believed that a radioactive particle, remaining from the tail pipe removal operation, was picked up on the smear. The decontamination procedure was repeated and levels of less than 400 dpm/ft^2 were measured.

Personnel exposure as measured by film badges for the following periods were:

	Average Exposure	Maximum Exposure
Year 1961	91 mr	760 mr
Last Quarter of 1961	33 mr	560 mr
December 1961	2.5 mr	100 mr

Continuous monitoring of off-site airborne activity during December indicated levels consistent with pre-operational values.

Changes in Operating Procedure

A new emergency instruction procedure (505 B 22:1) was issued in January. The new procedure outlines action to be taken to prevent a reactor scram resulting from spurious instrument signals caused by grounds or other faults on the station vital bus feeders.

A portion of operating instruction 504Q has been rewritten and issued. The instruction covers the vapor container atmosphere control system, the revision relating to that section pertaining to establishing and maintaining normal vapor container pressure. The revision provides for averaging eight rather than nine temperatures in the vapor container to determine the average ambient temperature of the vapor container atmosphere. The shield tank cavity temperature has been deleted from the average.

Another minor change in the instruction revises the time at which vapor container atmosphere data are recorded and comparisons of temperature and pressure changes made.

Design Changes

No changes in plant design were made during the month of January.

In Plant Training

A program of classroom instruction in basic nuclear physics is being given as part of a preliminary phase for qualifying personnel for the control room operator's position and A.E.C. reactor operator licensing.

A special training program in Health Physics has been initiated for the plant Nuclear Auxiliary Operators in conjunction with the over-all preparation for refueling.

Plant Operations

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

YANKEE ATOMIC ELECTRIC COMPANY - OPERATING SUMMARY

JANUARY 1962

ELECTRICAL		MONTH	YEAR	TO DATE
Gross Generation	KWH	99,768,400	99,768,400	1,061,115,700
Sta. Service (While Gen. Incl. Losses)	KWH	7,290,715	7,290,715	84,822,797
Net Generation	KWH	92,477,685	92,477,685	976,292,903
Station Service	%	7.31	7.31	7.99
Sta. Service (While Not Gen. Incl. Losses)	KWH	0	0	10,091,718
Ave. Gen. For Month (744 Hrs.)	KW	124,298	-	-
Ave. Gen. Running (744 hrs.)	KW	124,298	-	-

PLANT PERFORMANCE				
Net Plant Efficiency	%	30.00	30.00	-
Net Plant Heat Rate	Btu/KWH	11,377	11,377	-
Lbs. Steam/Net KWH		13.36	13.36	-
Circulating Water Inlet Temp.				
Maximum	^oF	36	-	-
Minimum	^oF	33	-	-
Plant Operating Factor	%	85.43	85.43	70.10

NUCLEAR		MONTH	CORE I	TO DATE
Times Critical		0	252	252
Hours Critical	HRS	744	10,577.01	10,577.01
Times Scrammed		0	30	30
Equivalent Reactor Hours @ 485 MWt	HRS	635.6	6,800.4	6,800.4
Average Burnup of Core	MWD/mt U	615	6,580	

Control Rod Position at Month End

Equilibrium at 127 MWe, 495°F $T_{Ave.}$

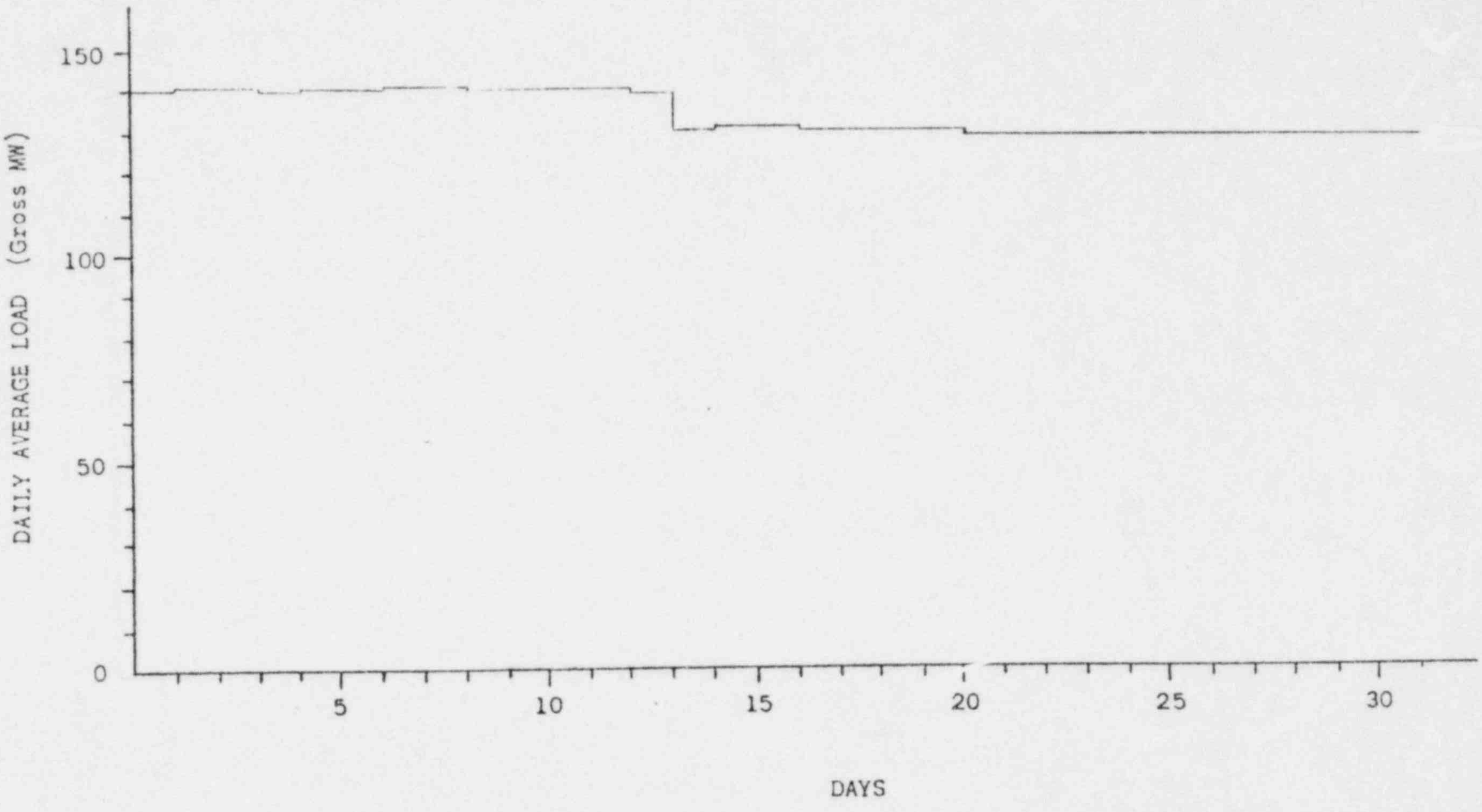
Group 1 Rods out-inches	90
Group 2	90
Group 3	90
Group 4	90
Group 5	90
Group 6	90

YANKEE ATOMIC ELECTRIC COMPANY

DAILY AVERAGE LOAD

for

JANUARY 1962



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CLASSIF.: U POST OFFICE REG. NO.:

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DESCRIPTION: (Must Be Unclassified)
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Operations Report No 13, dtd 2-19-62,
(for the month of January 1962)

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U. S. ATOMIC ENERGY COMMISSION
MAIL CONTROL FORM FORM AEC-326S (8-60)

U. S. GOVERNMENT PRINTING OFFICE: 1961 - 613958

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