DOCKET NO. 50-29

File Copy
(FORMAL)


YANKEE NUCLEAR POWER STATION

OPERATION REPORT NO. 64

For the month of

APRIL 1966


Submitted by

YANKEE ATOMIC ELECTRIC COMPANY
Boston Massachusetts

May 23, 1966

8011260 223

This report covers the operation of the Yankee Atomic Electric Company plant at Rowe, Massachusetts, for the month of April, 1966. At the start of the period the plant was base loaded at 185 MWe. A plant shutdown was scheduled for April 6 to repair the leaking pressurizer safety valve. (Operation Report #63 March, 1966). An increase in the leakage rate advanced the shutdown and the plant was taken off the line at 2148 hours on April 4. Primary plant cooldown began at that time and was completed by 1500 hours on April 5.

The high set pressurizer safety valve was dismantled and examined with a representative of the manufacturer present. The disc was slightly cut and was replaced. The low set safety valve was also dismantled and examined. The Stellite seat was badly cut as well as some cutting of the disc. The entire valve was removed and taken to the machine shop. The Stellite face of the seat was ground down to remove the cut and refaced. A new disc was installed and lapped in. The valve was re-assembled in the shop and leak tested using a dead-weight tester before the valve was re-installed on the pressurizer.

While repairs were proceeding on the safety valves, a vapor container inspection was made. Indications of leakage around the bolted and gasketed flange of the loop one check valve were noted. The loop was drained and the valve cover removed. The bearing blocks, bushings and pivot pin were badly worn. The bearing blocks were loose in their slots and motion had caused the wear. The motion of the blocks against the valve cover had caused the gasket to leak. Repair was made by installing a complete new disc assembly and welding the new bearing blocks to the valve body. In addition, a stop block was attached, by capscrews and tack welding, to the underside of the cover to prevent the bearing blocks from escaping in the event the welds failed and wear began again. The pumps in each loop were run individually and a sonic inspection of each check valve was made by the manufacturer, with no additional abnormalities noted.

Upon completion of the repair, the loop was filled borated water. Due to an air pocket that forms, within the "u" tubes of the steam generator, it is impossible to completely fill an isolated loop. After the loop was vented and filled as much as possible it was pressurized to 250 lbs. to allow operation of the main coolant pump. The loop was cut into the main coolant system and the pump operated to drive the air out of the loop. The displaced air collected under the vessel head, which in turn was vented via a hose and vent line to the inlet of the Primary Auxiliary Building exhaust fan, which discharges through the Primary Vent Stack.

About 5 hours after the completion of this operation, water was noted on the floor of the fan room. Further checking indicated that the water was contaminated. An analysis of the water showed that it contained 2300 ppm boron, and a specific activity of 2.26 $\mu$c/ml. Smears of the dried areas indicated that contamination levels were between $10^5$ and $10^6$ dpm/ft$^2$, predominately $Co^{58}$ and $Mn^{54}$. It was estimated that a total of 25 gallons had been spilled.

It was theorized that the 250 psi air vented from the vessel head attained a high enough velocity to carry entrapped water to the fan, although during previous ventings the 1¼" drain on the vent line had been adequate to prevent this. The water passed through the fan and leaked out of the ductwork onto the floor. A radiation survey of the vent line and ductwork indicated radiation levels of 10 to 70 mr/hr on horizontal runs and 10 to 25 mr/hr on vertical runs, on contact.

The fan room was posted as a contaminated area and decontamination work began which reduced contamination levels of the floor areas to less than 100 dpm/$ft^2$.

The vent line will be modified before it is used again for this purpose to prevent a recurance of this incident.

To correct completely the spurious "pips" that were appearing on the power range channels, the compensated and the uncompensated ion chambers in thimble 7 were replaced during the shutdown. (Operations Report #63 March 1966). These detectors correspond to channel 5 and channel 6 respectively. Also, at this time, a new $BF_3$ detector was installed in thimble 6 and will serve as a spare.

The bleed line motor operated sample valve, SA-MOV-513, which has been inoperative since its installation at the last refueling, was made fully operative by repacking the stem with a different type of material.

Primary plant repairs were completed at 2100 hours on April 7, and heat-up commenced. The reactor was critical at 1014 hours on April 8 and heat-up completed and the generator phased at 1520 hours. The load was raised, with pauses for boron dilution, to 160 MWe and held until 1445 hours on April 9, when the load was increased to 170 MWe. At 1950 hours on April 10, the load was raised to 185 MWe and remained essentially at that level for the remainder of the period.

Following the plant heatup, an inspection was made within the vapor container to check the repaired equipment. All pressurizer safety valve welds and safety valve leakage, and loop 1 main coolant check valve repairs, were inspected with no adverse or abnormal condition being noted. Minor valve stem packing adjustments were made on several smaller manual valves.

The spent fuel shipment scheduled for last month and delayed by a rail strike, was made on April 4. The empty fuel cask was returned to the plant and another shipment of 10 spent fuel assemblies was made on April 22. This latter shipment is the sixth in the series and makes a total of 60 spent fuel assemblies sent directly to NFS for reprocessing.

Control rod pressure housing No. 21, which was removed from the reactor vessel head at the last refueling, (Operation Report #58, Oct. 1965) has been destructively tested. This housing was chosen because it indicated slight internal wear when ultrasonically tested at the shutdown and because its location in an outer row of pressure housings made removal relatively easy. The housing was shipped to Westinghouse for the actual testing. The test program consisted of a hydro-static test and a vertical sectioning of the housing to expose the internal surface for overall examination, chemical analysis of deposits and metallographic examination.

The results reported to us indicated the housing did not deform when subjected to a hydrostatic test pressure of 6000 psi.

The internal surface exhibited minor signs of wear consistant with 3/8" control rod shaft steps. The depth of these marks was so slight that it could not be measured and is considered to be insignificant.

Metallographic samples prepared from transverse sections exhibited a microstructure typical of stainless steel with an average grain diameter of from 0.05 to 0.10 mm. No evidence of carbide precipitation was found. The overall results of the inspection were very favorable.

In the past, difficulty has been experienced in latching drive shafts to control rods following refueling. The drive shaft is hollow and has a rod running its full length which locks the latching fingers at the bottom. During the refueling operation, the universal handling tool grasps the upper end of a drive shaft and simultaneously pulls the internal rod to release the fingers at the bottom.

Modifications have been made to the universal handling tool and to the drive shafts, but the problem has persisted. Present thinking is that with a possible stack up of tolerences in a drive shaft, the universal handling tool was unable to withdraw the rod far enough to fully release the latch fingers.

The tool has been dismantled again this month with modifications having been made that allow an increase of ¼" in the pulling of a drive shaft button to 1-15/16". It is now hoped that this modification will prevent delays in future refuelings caused by these drive shafts.

The monthly control rod exercise was performed on April 27, with no abnormal operation being noted. Voltage readings on the primary position indicators indicated that all rods returned to their starting points.

Plant Shutdowns

Shutdown No. 82-5-3 4-4-66 An 89 hour 32 minute forced shutdown to repair leaking pressurizer safety valves.

Plant Maintenance

The following is a list of major items performed by the plant maintenance staff during the month of April, 1966.

Items performed during the shutdown include:

1. Repair of pressurizer safety valves.

2. Repair of main check valve in #1 loop.

3. Repacked various primary plant valves including: the bleed line motor operated sample valve (SA-MOV-513), the pressurizer drain and capillary vent valved and various angle stem valves.

4. Cleaned the tubes of the main condenser.

5. Lubricated the three boiler feed, three condensate, two heater drain and two circulating water pumps.

6. Inspected and lubricated the vital bus inverter.

7. Plugged 5 leaking tubes in No. 2 feedwater heater.

8. Replaced manway gaskets on the right moisture separator.

Items performed during operation include:

1. Inspected the No. 2 instrument air compressor and installed new valves installed new heater elements in the air dryer and cleaned the after-filter.

2. Repaired some bolt heaters used in tensioning the studs in the main coolant check valve.

3. Inspected the group 4 pressurizer heater air circuit breaker.

4. Made dimensional checks of the fuel handling system universal handling tool.

5. Inspected the fire protection system hose houses and hoses and replaced some hoses.

6. A broken valve spring was replaced in No. [illegible] charging pump.

7. A leaking flange on No. 3 boiler feed pump discharge was tightened and reinsulated.

Chemistry

On April 4 the main coolant system was borated to 1493 ppm for the cold shutdown. After plant shutdown the system crud level increased from 0.12 ppm to 2.5 ppm. The oxygen concentration increased from less than 50 ppb to 380 ppb during the shutdown. After plant heatup the oxygen levels were reduced below the level of detection and remained below detection throughout the remainder of the period. During plant heatup, the coolant crud concentration, as measured from a bleed line sample, increased to 112 ppm the value decreased to 0.23 ppm after plant heatup. After return to power, the main coolant boron concentration was reduced to 380 ppm.

The pressurizer capillary vent system flow rates were measured at 54 lbs/hr and 44 lbs/hr for the right and left vents, respectively. These measurements were made April 11, following this, the vents were closed to measure any gas buildup with time in the steam phase of the pressurizer.

Analyses of two separate main coolant gas samples, taken early and late in the period was as follows:

| | | |
|---|---|---|
| A-41 | $6.3 \times 10^{-1}$ μc/cc gas | $6.6 \times 10^{-1}$ μc/cc gas |
| Xe 135 | $1.5 \times 10^{-2}$ μc/cc gas | $1.7 \times 10^{-2}$ μc/cc gas |
| Xe 133 | $1.8 \times 10^{-3}$ μc/cc gas | $6.2 \times 10^{-3}$ μc/cc gas |

Analyses of samples of the main coolant for tritium concentration have varied from 1.15 μc/ml to 1.5 μc/ml.

Main coolant iodine -131 specific activity was $1.3 \times 10^{-5}$ µc/ml and the I-131/I-133 atomic ratio was 0.69. Following the control rod exercise, the I-131 specific activity was $1.91 \times 10^{-5}$ µc/ml and the I-131/I-133 atomic ratio was 0.63. This data indicates that core V is continuing to operate with no detectable fuel defects with the burnup on the fuel in the inner region almost 20,000 MWD/MTU.

The waste gas surge drum was sampled and the specific activity of Xe-133 was $1.55 \times 10^{-5}$ µc/ml. The sample had the following gas concentrations:

$O_2$ - 0.05%

$N_2$ - 47.2%

$H_2$ - balance

Reactor Plant Performance

One 3 wire flux wire run was made under the following conditions with the following results:

596 MWT 527°F Tavg 375 ppm boron

rod groups BDC @ 88 1/8" group A @ 89 2/8

Fq = 2.4

$F\Delta h$ = 2.0

Min q" DNBR = 3.3

Max. fuel outlet temp = 591.5°F

Control rod absorber section A75, a hafnium section removed at the last refueling, was examined in an attempt to determine the feasability of its reuse. The section was examined in the spent fuel pit where it is stored. It was inverted, placed in the fuel elevator, and raised to within a few feet of the surface of the water to examine the surfaces which mate with the control rod follower. Small amounts of wear were noted and attempts at wear measurement will be made before a final decision is rendered.

Turbine Plant Performance

As a result of terminal difference data obtained on the feedwater heaters, #2 feedwater heater was opened during the shutdown. Five tubes were found leaking and were plugged.

Measurements of feedwater heater terminal difference since the #2 heater tube plugging are as follows:

| | |
|---|---|
| #1 | 6.0 |
| #2 | 15.0 |
| #3 | 11.2 |

Taking advantage of the plant shutdown, the condenser tubes were cleaned, although it was not imperitive to do so at this time. Data taken since the tube cleaning indicate a 5°F decrease in the terminal temperature difference of the main condenser.

Instrumentation and Control

The following is a list of the major items performed during the month of April.

1. Repaired and recalibrated #2 and #4 main coolant pump bearing thermocouple and inspected those in #1 and #3 pumps.

2. Replaced the two, valve position-turbine speed, pressure switches.

3. Recalibrated nuclear instrumentation channels 1, 2, 3, and 4.

4. Replaced the detectors for channels 5 and 6 in thimble 7.

5. Replaced the spare $BF_3$ detector in thimble 6 with a new detector.

6. Installed two thermocouples on the outer moat ring of the neutron shield tank (one on inner edge, one on outer edge).

7. Dead-weight tested the pressurizer safety valve.

8. Relocated the vapor container upper hemisphere temperature detector to a position directly above the missile shield.

9. Recalibrated the main coolant temperature, stop valve interlock, bistables on the wide range temperature channels.

10. Recalibrated the charging pump discharge pressure transmitter and indicators.

11. Checked the operation of the pneumatic, pressurizer pressure system.

12. Recalibrated the main coolant system narrow range temperature channels.

13. Recalibrated the pressurizer temperature system.

14. Readjusted the loop seal level alarms in the waste gas system.

Health and Safety

During the month of April, two shipments consisting of a total of 109 drums of radioactive waste were made. The total calculated activity of these shipments was 1146 millicuries.

Two spent fuel shipments, numbers 5 and 6 in the series, were made to the reprocessing facility during April. Both shipments consisted of 10 spent fuel assemblies. The total calculated activity of shipment #5 was 0.89 megacuries and of shipment #6, 0.62 megacuries. The external readings for both shipments were similar and were as follows: Gamma radiation levels on contact with the loaded cask were 3.5 mr/hr maximum with 0.8-1.0 mr/hr generally. Gamma levels at one meter were less than 0.1 mr/hr. No neutron radiation or alpha contamination was detectable. Contamination levels on the cask were less than $1 \times 10^{-6}$ curies/100 $cm^2$, beta-gamma.

Liquid waste disposal releases totaling 100,276 gallons containing a gross beta-gamma activity of 93 µc and 287.78 curies of tritium, were discharged during the month of April. Gaseous waste released contained a total gross beta-gamma activity of 144 mc and an additional 4.54 curies of tritium. All of the tritium in the gaseous release was due to a vapor container purge with all the discharge via the primary vent stack.

In addition to the above liquid releases, 236,970 gallons of water containing 1.36 curies of tritium, were discharged from the secondary plant. The gross beta-gamma activity of this water was less the 10 µc.

A radiation survey was made in the vapor container shortly after shutdown. A similar survey was made last August after the shutdown for the core IV-V refueling. The major difference between the shutdowns is the fact that prior to the August shutdown, the plant was operating with ammonia in the main coolant to control pH. The following readings are given for comparison:

| Pressurizer Cubical (all contact) | April 5, 1966 | August 11, 1965 |
|---|---|---|
| General area | 5-10 mr/hr | 300-400 mr/hr |
| Spray line | 8-18 mr/hr | 2-5 r/hr |
| Heater bundles | 30-150 mr/hr | 100-700 mr/hr |
| Level dp cell | 13-15 mr/hr | 10 r/hr |

| Main Coolant #2 Loop (contact) | April 5, 1966 | August 11, 1965 |
|---|---|---|
| General area | 15-80 mr/hr | 65-150 mr/hr |
| Base steam generator | 125 | 220 |
| By-pass valve | 85 | 200 |
| By-pass piping | 180 | 470 |
| Hot leg piping | 240 | 150 |
| Hot leg valve | 80 | 150 |
| Chem. injection valve | 200 | 620 |
| Cold leg piping | 150 | 180 |
| Cold leg valve | 40 | 310 |

Personnel exposure for Yankee plant personnel as measured by film badge for the month of April 1966 were:

| | |
|---|---|
| Average for all station personnel | 131 mrem |
| Maximum individual exposure | 640 mrem |

Attached is a summary of plant operating statistics and a plot of Daily Average Load for the month of April 1966.

# YANKEE ATOMIC ELECTRIC COMPANY -- OPERATING SUMMARY

APRIL 1966

## ELECTRICAL

| | | MONTH | YEAR | TO DATE |
|---|---|---|---|---|
| Gross Generation | KWH | 114,952,100 | 514,082,700 | 5,504,923,600 |
| Sta. Service (While Gen. Incl. Losses) | KWH | 6,838,735 | 30,483,605 | 376,896,099 |
| Net Generation | KWH | 108,113,365 | 483,599,095 | 5,128,027,501 |
| Station Service | % | 5.95 | 5.93 | 6.85 |
| Sta. Service (While Not Gen. Incl. Losses) | KWH | 196,159 | 216,250 | 22,457,828 |
| Ave. Gen. For Month (719 Hrs) | KW | 159,878 | -- | -- |
| Ave. Gen. Running (629.47 Hrs) | KW | 182,617 | -- | -- |

## PLANT PERFORMANCE

| | | | | |
|---|---|---|---|---|
| Net Plant Efficiency | % | 29.15 | 29.21 | 28.51 |
| Net Plant Heat Rate | Btu/KWH | 11,708 | 11,683 | 11,970 |
| Lbs. Steam/Net KWH | | 14.02 | 13.96 | -- |
| Circulating Water Inlet Temp. | | | | |
| Maximum | °F | 42 | 42 | -- |
| Minimum | °F | 33 | 32 | -- |
| Plant Operating Factor | % | 85.98 | 95.84 | 70.00 |
| Reactor Plant Availability | % | 88.26 | 96.99 | 81.51 |

## NUCLEAR

| | | MONTH | CORE V | TO DATE |
|---|---|---|---|---|
| Times Critical | | 1 | 16 | 373 |
| Hours Critical | HRS | 634.60 | 4,016.10 | 39,977.06 |
| Times Scrammed | | 0 | 1 | 50 |
| Equivalent Reactor Hours @ 600 MWt | HRS | 618.20 | 3,841.68 | 30,000.72 |
| Average Burnup of Core | MWD/MTu * | | | |

Control Rod Position at Month End
Equilibrium at 598.5 MWT

| | |
|---|---|
| Group A Rods out-inches | 86 5/8 |
| Group B | 88 1/8 |
| Group C | 88 1/8 |
| Group D | 86 1/8 |

| *REGION | MONTH | TOTAL BURNUP |
|---|---|---|
| A (INNER) | 742.35 | 19,965.18 |
| B (MIDDLE) | 839.11 | 11,986.94 |
| C (OUTER) | 641.08 | 3,989.92 |
| ZIRCALOY TEST ASSEMBLIES | 1,057.77 | 6,619.00 |

Boron 300 ppm

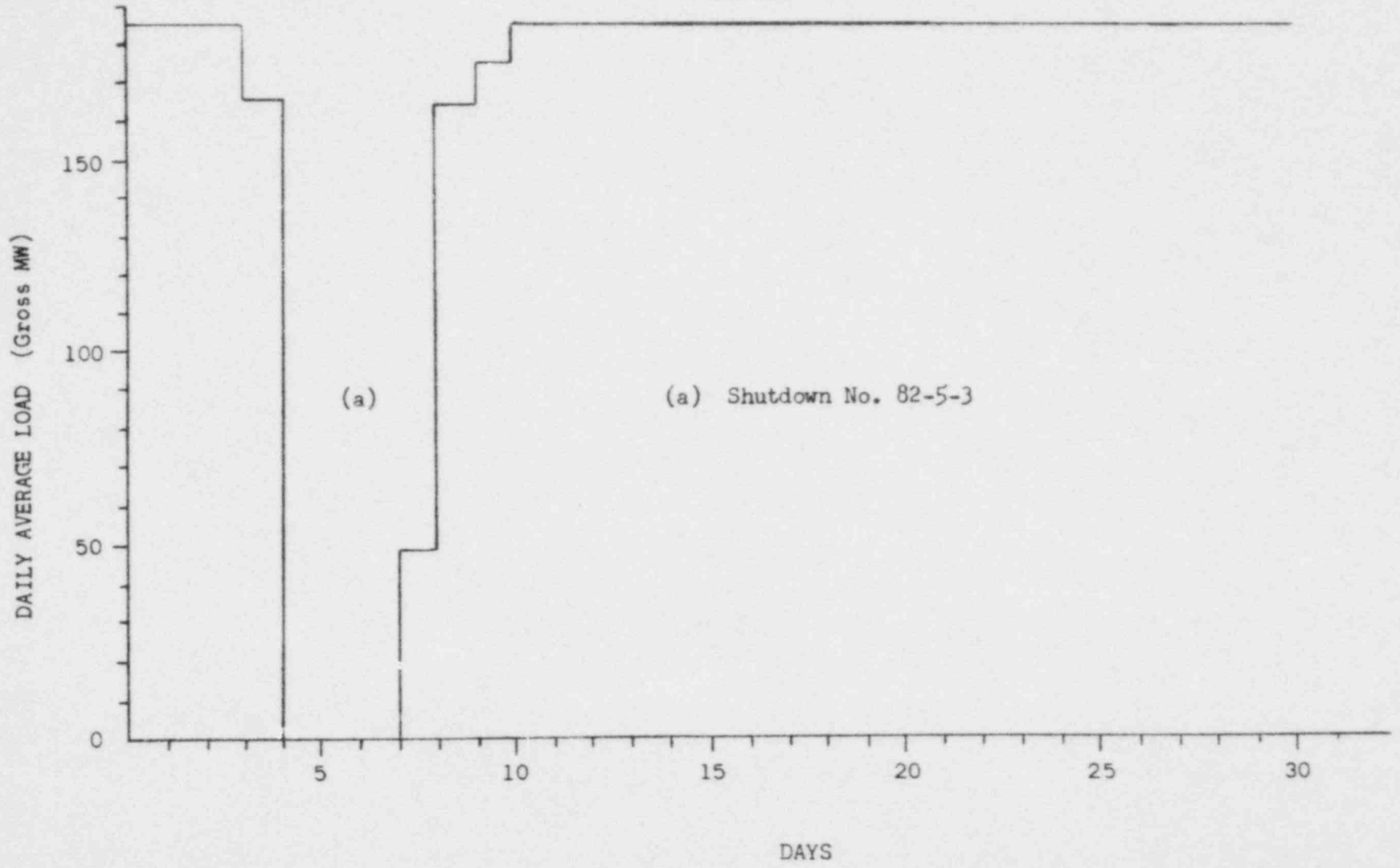
Ammonia 0

YANKEE ATOMIC ELECTRIC COMPANY

DAILY AVERAGE LOAD

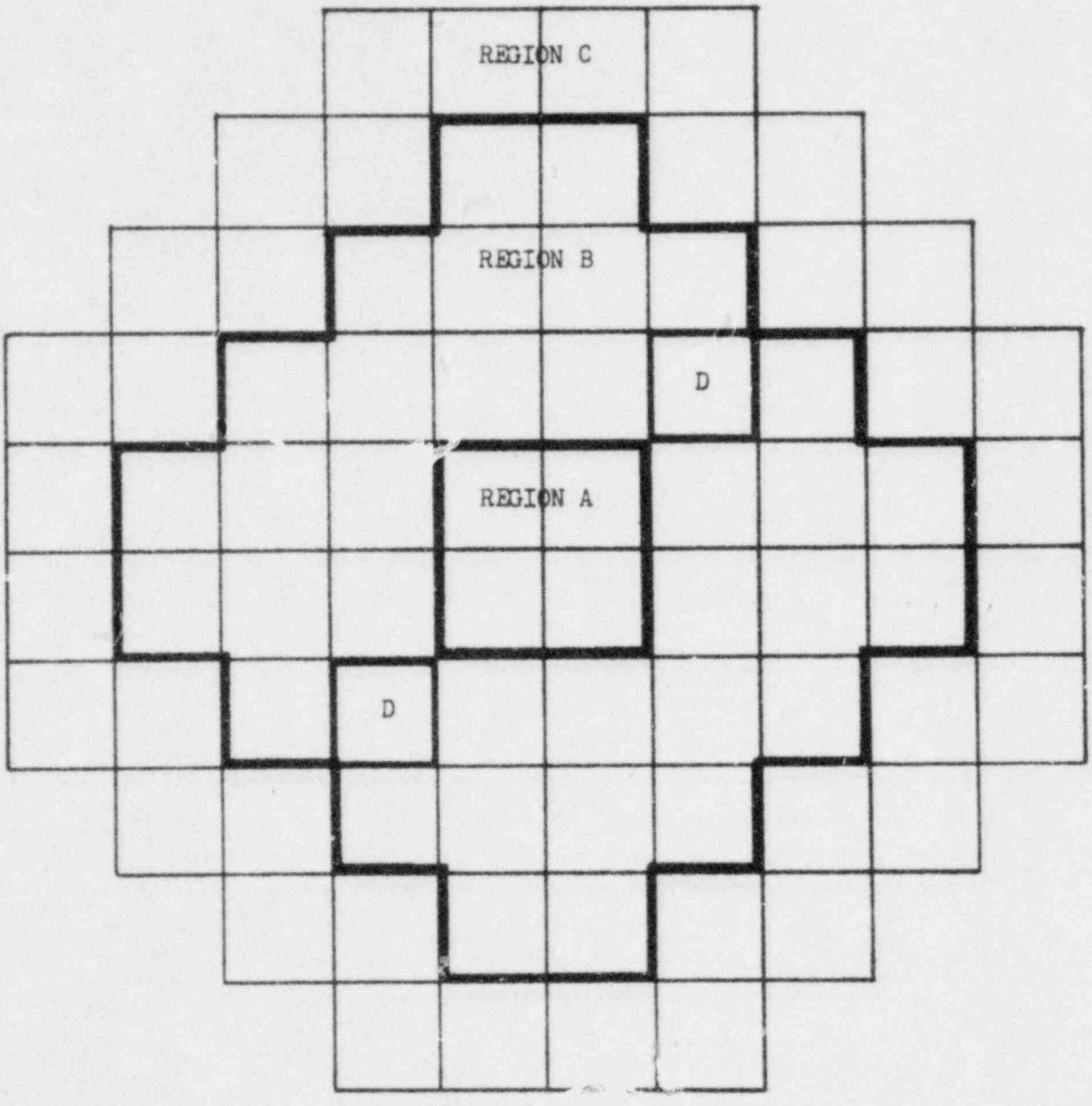
for

APRIL 1966




(a) Shutdown No. 82-5-3

CORE V REGION LOCATIONS




D - ZIRCALOY TEST ASSEMBLIES