NRC FORM 195 (2-76)

U.S. NUCLEAR REGULATORY COMMISSION

NRC DISTRIBUTION FOR PART 50 DOCKET MATERIAL

DOCKET NUMBER 50-269

FILE NUMBER

TO: B.C. RUSCHE

FROM: DUKE PWR CO. CHARLOTTE, N.C. W.O.PARKER,JR.

DATE OF DOCUMENT 3/30/77

DATE RECEIVED 4/5/77

X LETTER ☒ NOTORIZED
X ORIGINAL X UNCLASSIFIED
☐ COPY

PROP

INPUT FORM

NUMBER OF COPIES RECEIVED 3 SIGNED

DESCRIPTION

LTR. NOTARIZED 3/30/77...TRANS THE FOLLOWING.......

ACKNOWLEDGED

ENCLOSURE

PROPOSED CHAGES TO TECH. SPECS ASSURING OPERATION OF THE CYCLE 4 CORE WITHIN APPLICABEE FUEL DESIGN AND PERFORMANCE CRITERIA ...W/ REPLACEMENT PAGES. AND. RELOAD REPORT...

(40 ENCLOSURES RECEIVED)

(2 P & 1/2 INCH THICK)

566 ORPT

PLANT NAME: OCONEE # 1

SAB

DO NOT REMOVE

FOR ACTION/INFORMATION

SAFETY		ENVIRO	
ASSIGNED AD:		ASSIGNED AD:	
/ BRANCH CHIEF:	Schwencer (5)	BRANCH CHIEF:	
/ PROJECT MANAGER:	Zech	PROJECT MANAGER:	
/ LIC. ASST. :	Sheppard	LIC. ASST. :	

INTERNAL DISTRIBUTION

/ REG FILE	SYSTEMS SAFETY	PLANT SYSTEMS	SITE SAFETY & ENVIRO ANALYSIS
/ NRC PDR	HEINEMAN	TEDESCO	DENTON & MULLER
/ I & E (2)	SCHROEDER	BENAROYA	
/ OELD		LAINAS	
/ GOSSICK & STAFF	ENGINEERING	IPPOLITO	ENVIRO TECH.
MIPC	MACARRY	KIRKWOOD	ERNST
CASE	BOSNAK		BALLARD
HANAUER	SIHWEIL	OPERATING REACTORS	YOUNGBLOOD
HARLESS	PAWLICKI	STELLO	
			SITE TECH.
PROJECT MANAGEMENT	REACTOR SAFETY	OPERATING TECH.	GAMMILL
BOYD	ROSS	/ EISENHUT	STEPP
P. COLLINS	NOVAK	/ SHAO	HULMAN
HOUSTON	ROSZTOCZY	/ BAER	
PETERSON	CHECK	/ BUTLER	SITE ANALYSIS
MELTZ		/ GRIMES	VOLLMER
HELTEMES	AT & I		BUNCH
SKOVHOLT	SALTZMAN		/ J. COLLINS
	RUTBERG		KREGER

EXTERNAL DISTRIBUTION

/ LPDR: Walhalla, SC	NAT. LAB:	BROOKHAVEN NAT. LAB.	CONTROL NUMBER
/ TIC:	REG V.IE	ULRIKSON (ORNL)	770970415
/ NSIC:	LA PDR		
ASLB:	CONSULTANTS:		
/ ACRS 16 CYS ~~HOLDING~~/SENT AS CAT B			

DUKE POWER COMPANY
POWER BUILDING
422 SOUTH CHURCH STREET, CHARLOTTE, N. C. 28242

WILLIAM O. PARKER, JR.
VICE PRESIDENT
STEAM PRODUCTION

March 30, 1977

TELEPHONE: AREA 704
373-4083

Mr. Benard C. Rusche, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Re: Oconee Unit 1
Docket No. 50-269

Dear Mr. Rusche:

Pursuant to 10CFR50, §50.90, please find attached proposed changes to the Oconee Nuclear Station Technical Specifications. The purpose of these revisions is to assure operation of the Oconee Unit 1, Cycle 4 core within applicable fuel design and performance criteria. The proposed changes are shown in Attachment 1 as replacement pages for the Oconee Nuclear Station Technical Specifications:

2.1 SAFETY LIMITS, REACTOR CORE
2.3 LIMITING SAFETY SYSTEM SETTINGS, PROTECTIVE INSTRUMENTATION
3.5.2 Control Rod Group and Power Distribution Limit

Also attached is Babcock & Wilcox Report BAW-1447, "Oconee Unit 1, Cycle 4 Reload Report." This report includes a summary of Cycle 4 operating parameters and contains the safety analyses supporting the operation of Oconee 1, Cycle 4 core at rated power in accordance with the Technical Specifications provided.

Very truly yours,

William O. Parker, Jr.

William O. Parker, Jr.

MST:ge

Attachments

7709070415

WILLIAM O. PARKER, JR., being duly sworn, states that he is Vice President of Duke Power Company; that he is authorized on the part of said Company to sign and file with the Nuclear Regulatory Commission this request for amendment of the Oconee Nuclear Station Facility Operating Licenses DPR-38, DPR-47, and DPR-55; and that all statements and matters set forth therein are true and correct to the best of his knowledge.

William O. Parker

William O. Parker, Jr., Vice President

Subscribed and sworn to before me this 30th day of March, 1977.

Vivian B. Rakkins

Notary Public

My Commission Expires:
My Commission Expires February 15, 1982

2 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

2.1 SAFETY LIMITS, REACTOR CORE

Applicability

Applies to reactor thermal power, reactor power imbalance, reactor coolant system pressure, coolant temperature, and coolant flow during power operation of the plant.

Objective

To maintain the integrity of the fuel cladding.

Specification

The combination of the reactor system pressure and coolant temperature shall not exceed the safety limit as defined by the locus of points established in Figure 2.1-1A-Unit 1. If the actual pressure/temperature point is below
2.1-1B-Unit 2
2.1-1C-Unit 3
and to the right of the line, the safety limit is exceeded.

The combination of reactor thermal power and reactor power imbalance (power in the top half of the core minus the power in the bottom half of the core expressed as a percentage of the rated power) shall not exceed the safety limit as defined by the locus of points (solid line) for the specified flow set forth in Figure 2.1-2A-Unit 1. If the actual reactor-thermal-power/power
2.1-2B-Unit 2
2.1-2C-Unit 3
imbalance point is above the line for the specified flow, the safety limit is exceeded.

Bases - Unit 1

The safety limits presented for Oconee Unit 1 have been generated using BAW-2 critical heat flux (CHF) correlation[1]. The reactor coolant system flow rate utilized is 106.5 percent of the design flow (131.32×10^6 lbs/hr) based on four-pump operation.[2]

To maintain the integrity of the fuel cladding and to prevent fission product release, it is necessary to prevent overheating of the cladding under normal operating conditions. This is accomplished by operating within the nucleate boiling regime of heat transfer, wherein the heat transfer coefficient is large enough so that the clad surface temperature is only slightly greater than the coolant temperature. The upper boundary of the nucleate boiling regime is termed "departure from nucleate boiling" (DNB). At this point, there is a sharp reduction of the heat transfer coefficient, which would result in high cladding temperatures and the possibility of cladding failure. Although DNB is not an observable parameter during reactor operation, the observable parameters of neutron power, reactor coolant flow, temperature, and pressure

can be related to DNB through the use of the BAW-2 correlation (1). The BAW-2 correlation has been developed to predict DNB and the location of DNB for axially uniform and non-uniform heat flux distributions. The local DNB ratio (DNBR), defined as the ratio of the heat flux that would cause DNB at a particular core location to the actual heat flux, is indicative of the margin to DNB. The minimum value of the DNBR, during steady-state operation, normal operational transients, and anticipated transients is limited to 1.30. A DNBR of 1.30 corresponds to a 95 percent probability at a 95 percent confidence level that DNB will not occur; this is considered a conservative margin to DNB for all operating conditions. The difference between the actual core outlet pressure and the indicated reactor coolant system pressure has been considered in determining the core protection safety limits. The difference in these two pressures is nominally 45 psi; however, only a 30 psi drop was assumed in reducing the pressure trip setponts to correspond to the elevated location where the pressure is actually measured.

The curve presented in Figure 2.1-1A represents the conditions at which a minimum DNBR of 1.30 is predicted for the maximum possible thermal power (112 percent) when four reactor coolant pumps are operating (minimum reactor coolant flow is 106.5 percent of 131.3×10^6 lbs/hr.). This curve is based on the combination of nuclear power peaking factors, with potential effects of fuel densification and rod bowing, which result in a more conservative DNBR than any other shape that exists during normal operation.

The curves of Figure 2.1-2A are based on the more restrictive of two thermal limits and include the effects of potential fuel densification and rod bowing:

1. The 1.30 DNBR limit produced by the combination of the radial peak, axial peak and position of the axial peak that yields no less than a 1.30 DNBR.

2. The combination of radial and axial peak that causes central fuel melting at the hot spot. The limit is 20.15 kw/ft for Unit 1.

Power peaking is not a directly observable quantity and therefore limits have been established on the bases of the reactor power imbalance produced by the power peaking.

The specified flow rates for Curves 1, 2, 3 and 4 of Figure 2.1-2A correspond to the expected minimum flow rates with four pumps, three pumps, one pump in each loop and two pumps in one loop, respectively.

The curve of Figure 2.1-1A is the most restrictive of all possible reactor coolant pump-maximum thermal power combinations shown in Figure 2.1-3A.

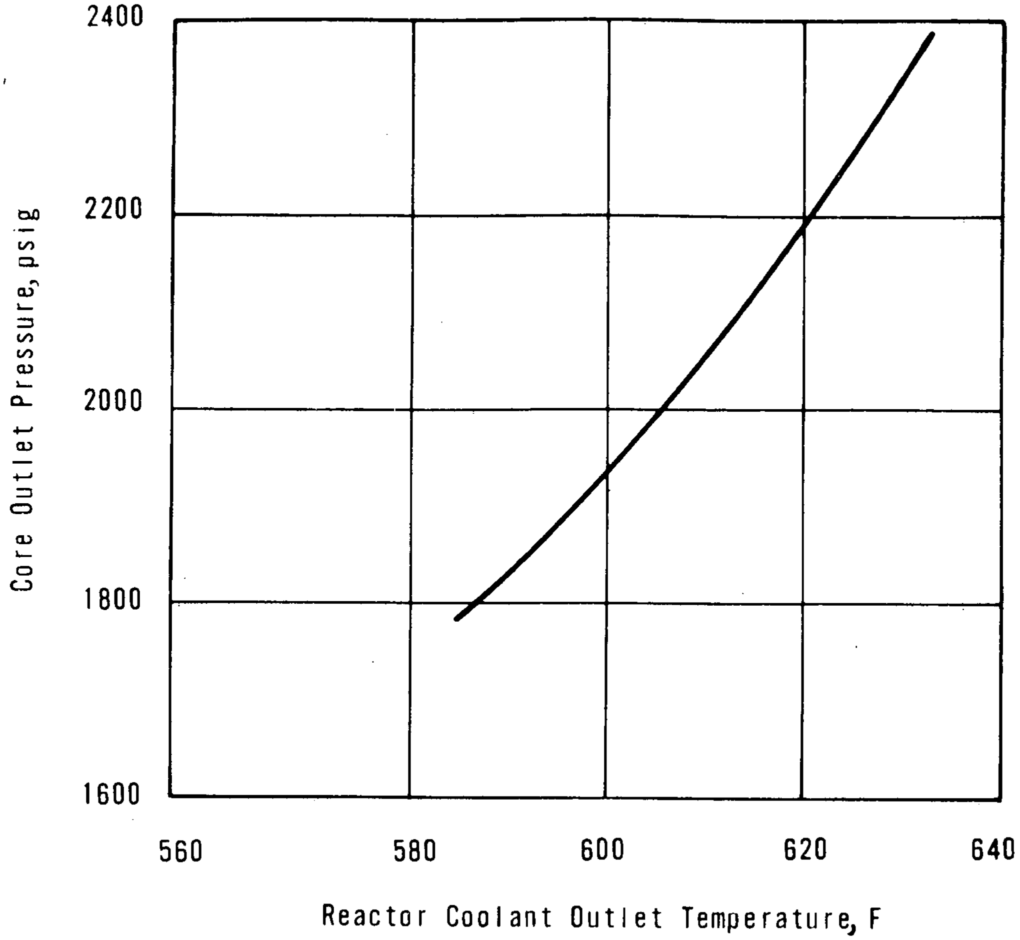
The maximum thermal power for three-pump operation is 85.3 percent due to a power level trip produced by the flux-flow ratio 74.7 percent flow x 1.055 = 78.8 percent power plus the maximum calibration and instrument error. The maximum thermal power for other coolant pump conditions are produced in a similar manner.

For Figure 2.1-3A, a pressure-temperature point above and to the left of the curve would result in a DNBR greater than 1.30.

References

(1) Correlation of Critical Heat Flux in a Bundle Cooled by Pressurized Water, BAW-10000, March, 1970.

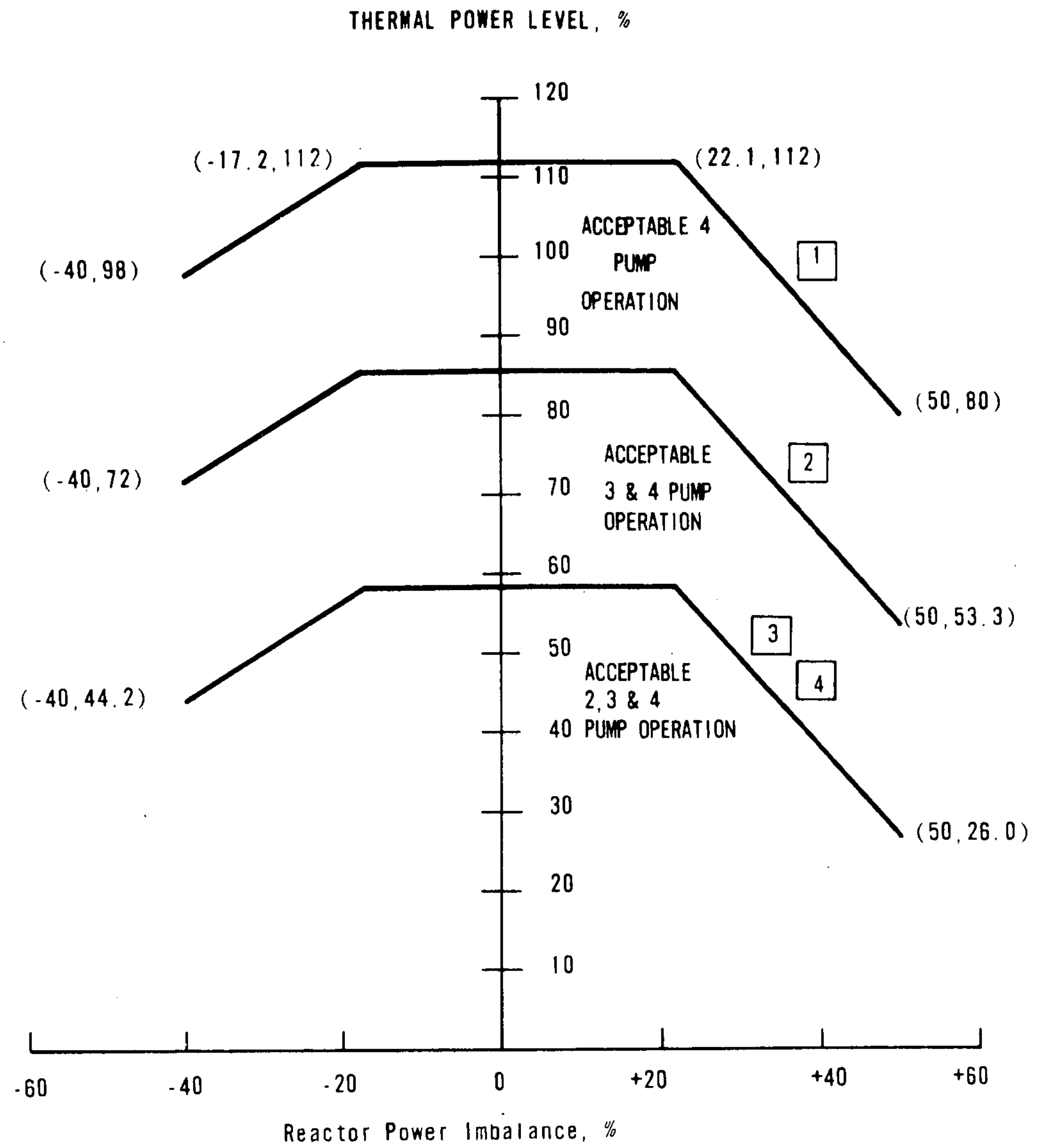
(2) Oconee 1, Cycle 4 - Reload Report - BAW-1447, March, 1977.



CORE PROTECTION SAFETY LIMITS, UNIT 1

OCONEE NUCLEAR STATION

Figure 2.1-1A

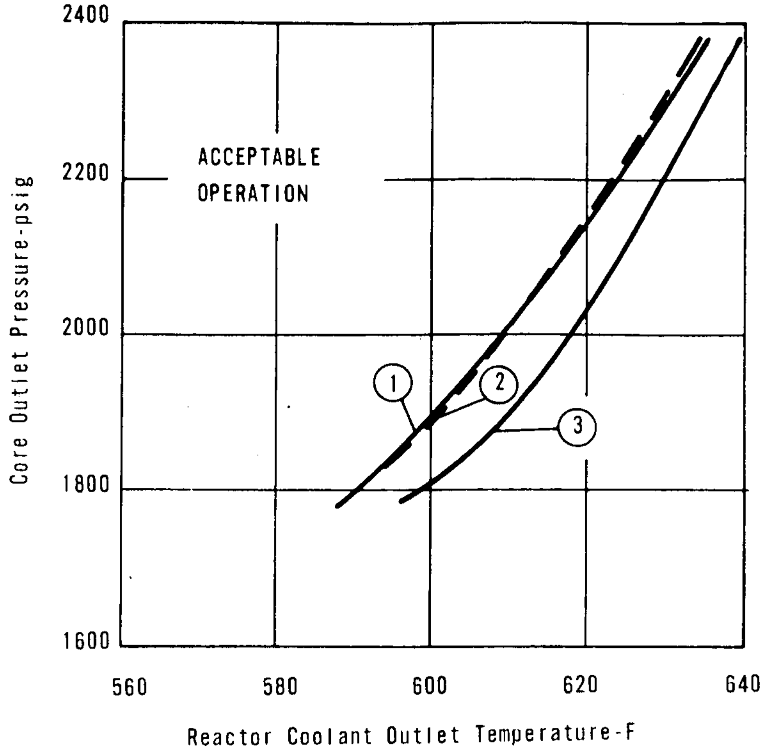


CURVE	REACTOR COOLANT FLOW (GPM)
1	374880
2	280035
3	183690
4	204310

CORE PROTECTION SAFETY
LIMITS, UNIT 1

OCONEE NUCLEAR STATION

Figure 2.1-2A



CURVE	REACTOR COOLANT FLOW (GPM)	POWER	PUMPS OPERATING	(TYPE OF LIMIT)
1	374880 (100%)*	112%	4	(DNBR)
2	280035 (74.7%)	86.7%	3	(DNBR)
3	183690 (49.0%)	59.0%	2	(QUALITY)

* 106.5% OF FIRST CORE DESIGN FLOW

CORE PROTECTION SAFETY
LIMITS, UNIT 1

OCONEE NUCLEAR STATION
Figure 2.1-3A

During normal plant operation with all reactor coolant pumps operating, reactor trip is initiated when the reactor power level reaches 105.5% of rated power. Adding to this the possible variation in trip setpoints due to calibration and instrument errors, the maximum actual power at which a trip would be actuated could be 112%, which is more conservative than the value used in the safety analysis. (4)

<u>Overpower Trip Based on Flow and Imbalance</u>

The power level trip set point produced by the reactor coolant system flow is based on a power-to-flow ratio which has been established to accommodate the most severe thermal transient considered in the design, the loss-of-coolant flow accident from high power. Analysis has demonstrated that the specified power-to-flow ratio is adequate to prevent a DNBR of less than 1.3 should a low flow condition exist due to any electrical malfunction.

The power level trip set point produced by the power-to-flow ratio provides both high power level and low flow protection in the event the reactor power level increases or the reactor coolant flow rate decreases. The power level trip set point produced by the power-to-flow ratio provides overpower DNB protection for all modes of pump operation. For every flow rate there is a maximum permissible power level, and for every power level there is a minimum permissible low flow rate. Typical power level and low flow rate combinations for the pump situtations of Table 2.3-1A are as follows:

1. Trip would occur when four reactor coolant pumps are operating if power is 105.5% and reactor flow rate is 100%, or flow rate is 94.8% and power level is 100%.

2. Trip would occur when three reactor coolant pumps are operating if power is 78.8% and reactor flow rate is 74.7% or flow rate is 71.1% and power level is 75%.

3. Trip would occur when two reactor coolant pumps are operating in a single loop if power is 51.7% and the operating loop flow rate is 54.5% or flow rate is 48.5% and power level is 46%.

4. Trip would occur when one reactor coolant pump is operating in each loop (total of two pumps operating) if the power is 51.7% and reactor flow rate is 49.0% or flow rate is 46.4% and the power level is 49%.

   The flux-to-flow ratios account for the maximum calibration and instrument errors and the maximum variation from the average value of the RC flow signal in such a manner that the reactor protective system receives a conservative indication of the RC flow.

For safety calculations the maximum calibration and instrumentation errors for the power level trip were used.

The power-imbalance boundaries are established in order to prevent reactor thermal limits from being exceeded. These thermal limits are either power peaking kw/ft limits or DNBR limits. The reactor power imbalance (power in the top half of core minus power in the bottom half of core) reduces the power level trip produced by the power-to-flow ratio such that the boundaries of Figure 2.3-2A - Unit 1 are produced. The power-to-flow ratio reduces the power
2.3-2B - Unit 2
2.3-2C - Unit 3

level trip and associated reactor power/reactor power-imbalance boundaries by 1.055%-Unit 1 for a 1% flow reduction.
1.07%-Unit 2
1.07%-Unit 3
For Unit 1, the power-to-flow reduction ratio is 0.949, and for Units 2 and 3, the power-to-flow reduction factor is 0.961 during single loop operation.

Pump Monitors

The pump monitors prevent the minimum core DNBR from decreasing below 1.3 by tripping the reactor due to the loss of reactor coolant pump(s). The circuitry monitoring pump operational status provides redundant trip protection for DNB by tripping the reactor on a signal diverse from that of the power-to-flow ratio. The pump monitors also restrict the power level for the number of pumps in operation.

Reactor Coolant System Pressure

During a startup accident from low power or a slow rod withdrawal from high power, the system high pressure set point is reached before the nuclear overpower trip set point. The trip setting limit shown in Figure 2.3-1A - Unit 1
2.3-1B - Unit 2
2.3-1C - Unit 3
for high reactor coolant system pressure (2355 psig) has been established to maintain the system pressure below the safety limit (2750 psig) for any design transient. (1)

The low pressure (1800) psig and variable low pressure ($11.14\ T_{out}-4706$) trip
(1800) psig ($10.79\ T_{out}-4539$)
(1800) psig ($10.79\ T_{out}-4539$)
setpoints shown in Figure 2.3-1A have been established to maintain the DNB
2.3-1B
2.3-1C
ratio greater than or equal to 1.3 for those design accidents that result in a pressure reduction. (2,3)

Due to the calibration and instrumentation errors the safety analysis used a variable low reactor coolant system pressure trip value of ($11.14\ T_{out}-4746$)
($10.79\ T_{out}-4579$)
($10.79\ T_{out}-4579$)

Coolant Outlet Temperature

The high reactor coolant outlet temperature trip setting limit (619 F) shown in Figure 2.3-1A has been established to prevent excessive core coolant
2.3-1B
2.3-1C
temperatures in the operating range. Due to calibration and instrumentation errors, the safety analysis used a trip set point of 620^{o}F.

Reactor Building Pressure

The high reactor building pressure trip setting limit (4 psig) provides positive assurance that a reactor trip will occur in the unlikely event of a loss-of-coolant accident, even in the absence of a low reactor coolant system pressure trip.

Shutdown Bypass

In order to provide for control rod drive tests, zero power physics testing, and startup procedures, there is provision for bypassing certain segments of the reactor protection system. The reactor protection system segments which can be bypassed are shown in Table 2.3-1A. Two conditions are imposed when
2.3-1B
2.3-1C
the bypass is used:

1. By administrative control the nuclear overpower trip set point must be reduced to a value $\leq$ 5.0% of rated power during reactor shutdown.
2. A high reactor coolant system pressure trip setpoint of 1720 psig is automatically imposed.

The purpose of the 1720 psig high pressure trip set point is to prevent normal operation with part of the reactor protection system bypassed. This high pressure trip set point is lower than the normal low pressure trip set point so that the reactor must be tripped before the bypass is initiated. The over power trip set point of $\leq$ 5.0% prevents any significant reactor power from being produced when performing the physics tests. Sufficient natural circulation (5) would be available to remove 5.0% of rated power if none of the reactor coolant pumps were operating.

Two Pump Operation

A. Two Loop Operation

Operation with one pump in each loop will be allowed only following reactor shutdown. After shutdown has occurred, reset the pump contact monitor power level trip setpoint to 55.0%.

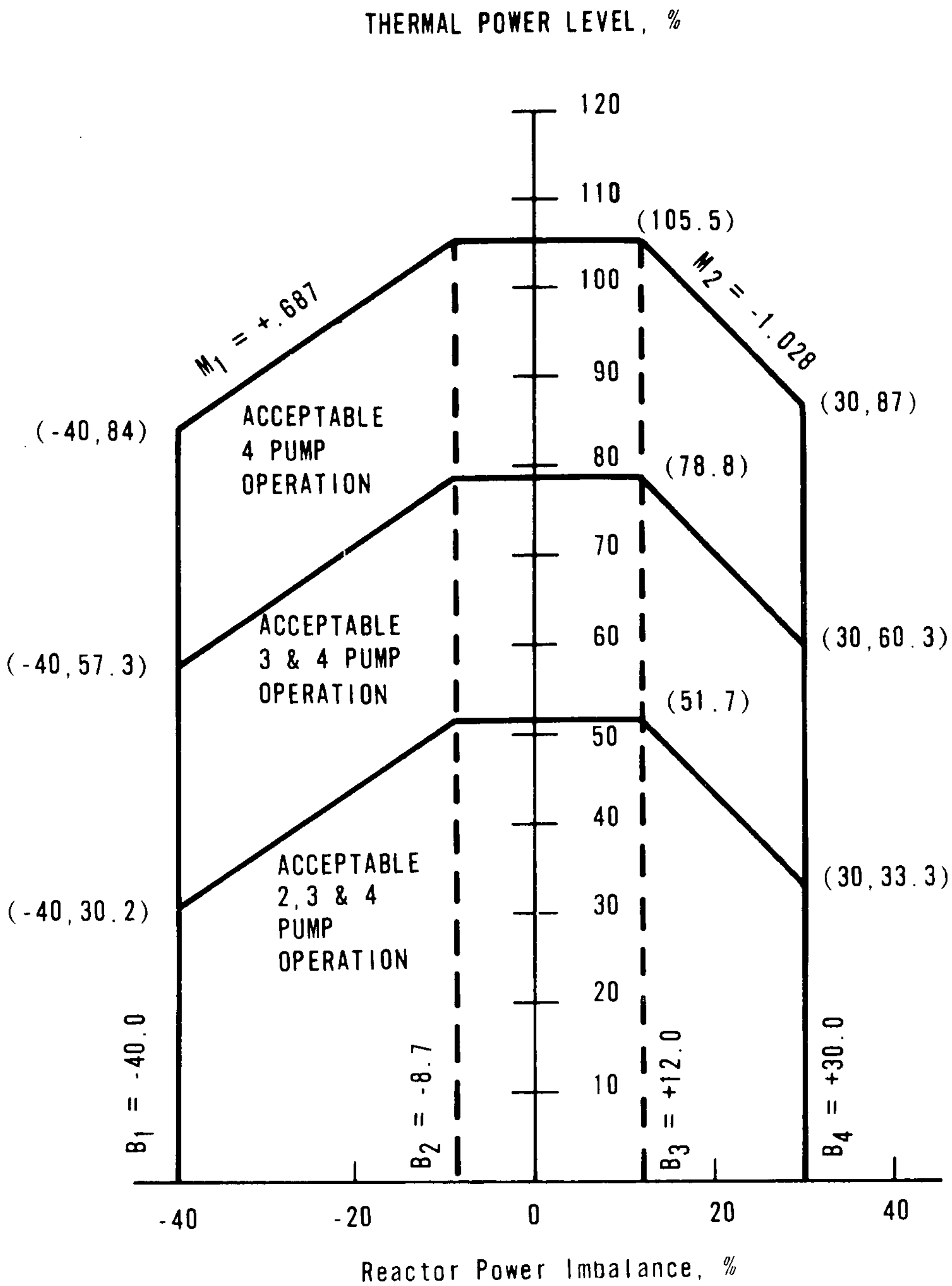
B. Single Loop Operation

Single loop operation is permitted only after the reactor has been tripped. After the pump contact monitor trip has occurred, the following actions will permit single loop operation:

1. Reset the pump contact monitor power level trip setpoint to 55.0%.
2. Trip one of the two protective channels receiving outlet temperature information from sensors in the Idle Loop.
3. Reset flux-flow setpoint to 0.949 (Unit 1)
   0.961 (Unit 2)
   0.961 (Unit 3)

REFERENCES

(1) FSAR, Section 14.1.2.2
(2) FSAR, Section 14.1.2.7
(3) FSAR, Section 14.1.2.8
(4) FSAR, Section 14.1.2.3
(5) FSAR, Section 14.1.2.6



PROTECTIVE SYSTEM MAXIMUM
ALLOWABLE SETPOINTS
UNIT 1
OCONEE NUCLEAR STATION
Figure 2.3-2A

Table 2.3-1A
Unit 1

Reactor Protective System Trip Setting Limits

	RPS Segment	Four Reactor Coolant Pumps Operating (Operating Power -100% Rated)	Three Reactor Coolant Pumps Operating (Operating Power -75% Rated)	Two Reactor Coolant Pumps Operating in A Single Loop (Operating Power -46% Rated)	One Reactor Coolant Pump Operating in Each Loop (Operating Power -49% Rated)	Shutdown Bypass
1.	Nuclear Power Max. (% Rated)	105.5	105.5	105.5	105.5	5.0[3]
2.	Nuclear Power Max. Based on Flow (2) and Imbalance, (% Rated)	1.055 times flow minus reduction due to imbalance	1.055 times flow minus reduction due to imbalance	0.949 times flow minus reduction due to imbalance	1.055 times flow minus reduction due to imbalance	Bypassed
3.	Nuclear Power Max. Based on Pump Monitors, (%, Rated)	NA	NA	55% (5)(6)	55% (5)	Bypassed
4.	High Reactor Coolant System Pressure, psig, Max.	2355	2355	2355	2355	1720[4]
5.	Low Reactor Coolant System Pressure, psig, Min.	1800	1800	1800	1800	Bypassed
6.	Variable Low Reactor Coolant System Pressure psig, Min.	$(11.14\ T_{out} - 4706)^{(1)}$	$(11.14\ T_{out} - 4706)^{(1)}$	$(11.14\ T_{out} - 4706)^{(1)}$	$(11.14\ T_{out} - 4706)^{(1)}$	Bypassed
7.	Reactor Coolant Temp. F., Max.	619	619	619 (6)	619	619
8.	High Reactor Building Pressure, psig, Max.	4	4	4	4	4

(1) T_{out} is in degrees Fahrenheit (°F).

(2) Reactor Coolant System Flow, %.

(3) Administratively controlled reduction set only during reactor shutdown.

(4) Automatically set when other segments of the RPS are bypassed.

(5) Reactor power level trip set point produced by pump contact monitor reset to 55.0%.

(6) Specification 3.1.8 applies. Trip one of the two protection channels receiving outlet temperature information from sensors in the idle loop.

(3) Except as provided in specification 3.5.2.4.b, the reactor shall be brought to the hot shutdown condition within four hours if the quadrant power tilt is not reduced to less than 3.41% Unit 1 within 24 hours.
3.41% Unit 2
3.41% Unit 3

b. If the quadrant tilt exceeds +3.41% Unit 1 and there is simultaneous
3.41% Unit 2
3.41% Unit 3
indication of a misaligned control rod per Specification 3.5.2.2, reactor operation may continue provided power is reduced to 60% of the thermal power allowable for the reactor coolant pump combination.

c. Except for physics test, if quadrant tilt exceeds 9.44% Unit 1,
9.44% Unit 2
9.44% Unit 3
a controlled shutdown shall be initiated immediately, and the reactor shall be brought to the hot shutdown condition within four hours.

d. Whenever the reactor is brought to hot shutdown pursuant to 3.5.2.4.a(3) or 3.5.2.4.c above, subsequent reactor operation is permitted for the purpose of measurement, testing, and corrective action provided the thermal power and the power range high flux setpoint allowable for the reactor coolant pump combination are restricted by a reduction of 2 percent of full power for each 1 percent tilt for the maximum tilt observed prior to shutdown.

e. Quadrant power tilt shall be monitored on a minimum frequency of once every two hours during power operation above 15 percent of rated power.

3.5.2.5 Control Rod Positions

a. Technical Specification 3.1.3.5 does not prohibit the exercising of individual safety rods as required by Table 4.1-2 or apply to inoperable safety rod limits in Technical Specification 3.5.2.2.

b. Operating rod group overlap shall be 25% ± 5% between two sequential groups, except for physics tests.

c. Position limits are specified for regulating and axial power shaping control rods. Except for physics tests or exercising control rods, the regulating control rod insertion/withdrawal limits are specified on figures 3.5.2-1A1, 3.5.2-1A2 and 3.5.2-1A3 (Unit 1); 3.5.2-1B1, 3.5.2-1B2 and 3.5.2-1B3 (Unit 2); 3.5.2-1C1, 3.5.2-1C2 and 3.5.2-1C3 (Unit 3) for four pump operation, and on figures 3.5.2-2A1, 3.5.2-2A2 and 3.5.2-2A3 (Unit 1); 3.5.2-2B1, 3.5.2-2B2 and 3.5.2-2B3 (Unit 2); 3.5.2-2C1, 3.5.2-2C2 and 3.5.2-2C3 (Unit 3) for two or three

pump operation. Also, excepting physics tests or exercising control rods, the axial power shaping control rod insertion/withdrawal limits are specified on figures 3.5.2-4A1, 3.5.2-4A2 and 3.5.2-4A3 (Unit 1). If the control rod position limits are exceeded, corrective measures shall be taken immediately to achieve an acceptable control rod position. An acceptable control rod position shall then be attained within two hours. The minimum shutdown margin required by Specification 3.5.2.1 shall be maintained at all times.

d. Except for physics tests, power shall not be increased above the power level cutoff as shown on Figures 3.5.2-1A1, 3.5.2-1A2 (Unit 1), 3.5.2-1B1, 3.5.2-1B2, and 3.5.2-1B3 (Unit 2), and 3.5.2-1C1, 3.5.2-1C2, 3.5.2-1C3 (Unit 3), unless the following requirements are met.

(1) The xenon reactivity shall be within 10 percent of the value for operation at steady-state rated power.

(2) The xenon reactivity shall be asymptotically approaching the value for operation at the power level cutoff.

3.5.2.6 Reactor power imbalance shall be monitored on a frequency not to exceed two hours during power operation above 40 percent rated power. Except for physics tests, imbalance shall be maintained within the envelope defined by Figures 3.5.2-3A1, 3.5.2-3A2, 3.5.2-3A3, 3.5.3-3B1, 3.5.2-3B2, 3.5.2-3B3, 3.5.2-3C1, 3.5.2-3C2, and 3.5.2-3C3. If the imbalance is not within the envelope defined by these figures, corrective measures shall be taken to achieve an acceptable imbalance. If an acceptable imbalance is not achieved within two hours, reactor power shall be reduced until imbalance limits are met.

3.5.2.7 The control rod drive patch panels shall be locked at all times with limited access to be authorized by the manager.

Bases

The power-imbalance envelope defined in Figures 3.5.2-3A1, 3.5.2-3A2, 3.5.2-3A3, 3.5.2-3B1, 3.5.2-3B2, 3.5.2-3B3, 3.5.2-3C1, 3.5.2-3C2 and 3.5.2-3C3 is based on LOCA analyses which have defined the maximum linear heat rate (See Figure 3.5.2-5) such that the maximum clad temperature will not exceed the Final Acceptance Criteria. Corrective measures will be taken immediately should the indicated quadrant tilt, rod position, or imbalance be outside their specified boundary. Operation in a situation that would cause the Final Acceptance Criteria to be approached should a LOCA occur is highly improbable because all of the power distribution parameters (quadrant tilt, rod position, and imbalance) must be at their limits while simultaneously all other engineering and uncertainty factors are also at their limits.** Conservatism is introduced by application of:

a. Nuclear uncertainty factors
b. Thermal calibration
c. Fuel densification effects
d. Hot rod manufacturing tolerance factors
e. Fuel rod bowing effects

The 25% ± 5% overlap between successive control rod groups is allowed since the worth of a rod is lower at the upper and lower part of the stroke. Control rods are arranged in groups or banks defined as follows:

Group	Function
1	Safety
2	Safety
3	Safety
4	Safety
5	Regulating
6	Regulating
7	Xenon transient override
8	APSR (axial power shaping bank)

The rod position limits are based on the most limiting of the following three criteria: ECCS power peaking, shutdown margin, and potential ejected rod worth. Therefore, compliance with the ECCS power peaking criterion is ensured by the rod position limits. The minimum available rod worth, consistent with the rod position limits, provides for achieving hot shutdown by reactor trip at any time, assuming the highest worth control rod that is withdrawn remains in the full out position(1). The rod position limits also ensure that inserted rod groups will not contain single rod worths greater than 0.65% $\Delta k/k$ at rated power. These values have been shown to be safe by the safety analysis (2,3,4,5) of the hypothetical rod ejection accident. A maximum single inserted control rod worth of 1.0% $\Delta k/k$ is allowed by the rod positions limits at hot zero power. A single inserted control rod worth of 1.0% $\Delta k/k$ at beginning-of-life, hot zero power would result in a lower transient peak thermal power and, therefore, less severe environmental consequences than a 0.65% $\Delta k/k$ ejected rod worth at rated power.

**Actual operating limits depend on whether or not incore or excore detectors are used and their respective instrument and calibration errors. The method used to define the operating limits is defined in plant operating procedures.

Control rod groups are withdrawn in sequence beginning with Group 1. Groups 5, 6, and 7 are overlapped 25 percent. The normal position at power is for Groups 6 and 7 to be partially inserted.

The quadrant power tilt limits set forth in Specification 3.5.2.4 have been established with consideration of potential effects of rod bowing and fuel densification to prevent the linear heat rate peaking increase associated with a positive quadrant power tilt during normal power operation from exceeding 5.10% for Unit 1. The limits shown in Specification 3.5.2.4
5.10% for Unit 2
5.10% for Unit 3
are measurement system independent. The actual operating limits, with the appropriate allowance for observability and instrumentation errors, for each measurement system are defined in the station operating procedures.

The quadrant tilt and axial imbalance monitoring in Specification 3.5.2.4 and 3.5.2.6, respectively, normally will be performed in the process computer. The two-hour frequency for monitoring these quantities will provide adequate surveillance when the computer is out of service.

Allowance is provided for withdrawal limits and reactor power imbalance limits to be exceeded for a period of two hours without specification violation. Acceptable rod positions and imbalance must be achieved within the two-hour time period or appropriate action such as a reduction of power taken.

Operating restrictions are included in Technical Specification 3.5.2.5d to prevent excessive power peaking by transient xenon. The xenon reactivity must be beyond the "undershoot" region and asymptotically approaching its equilibrium value at the power level cutoff.

REFERENCES

[1]FSAR, Section 3.2.2.1.2

[2]FSAR, Section 14.2.2.2

[3]FSAR, SUPPLEMENT 9

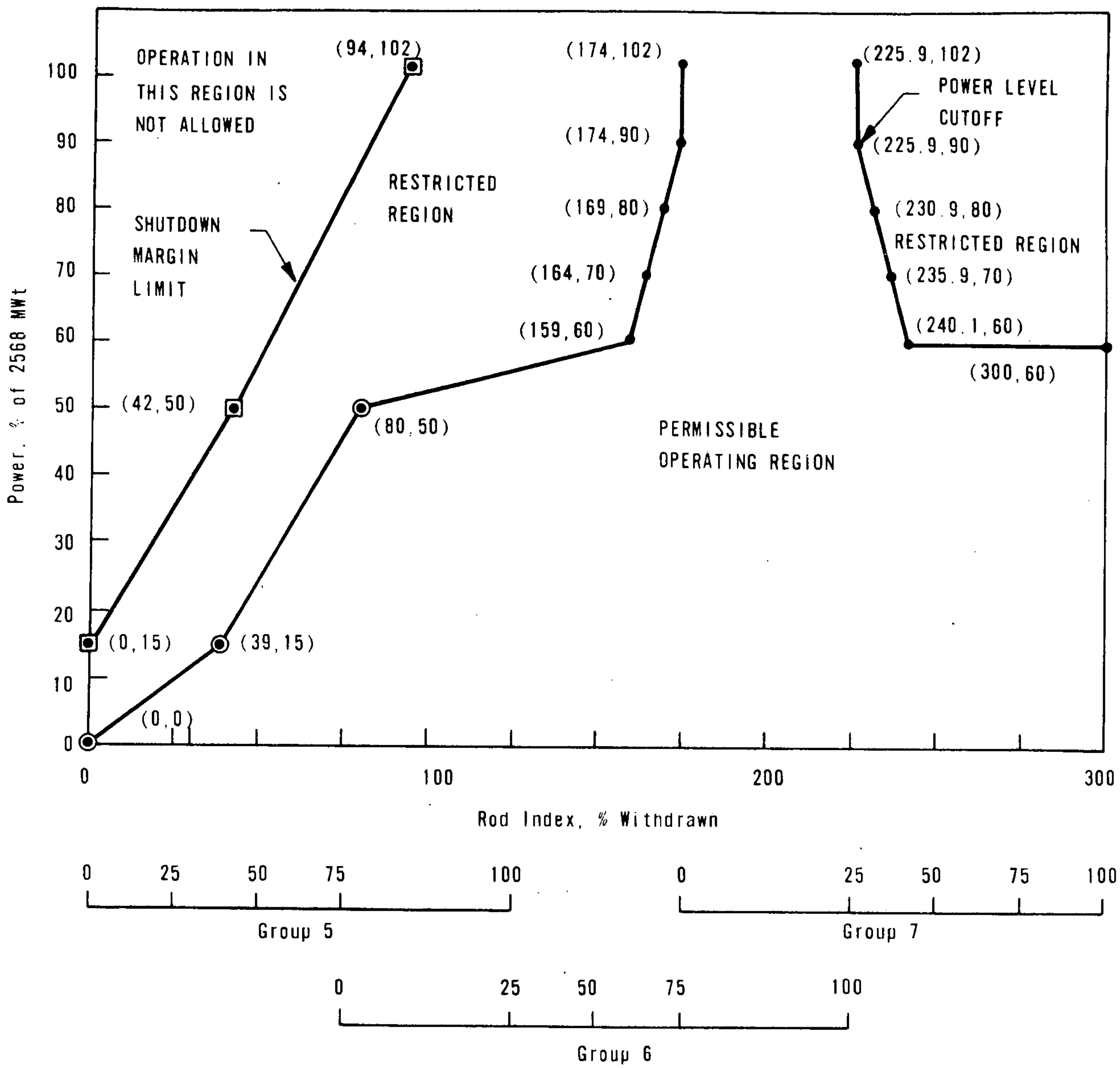
[4]B&W FUEL DENSIFICATION REPORT

BAW-1409 (UNIT 1)

BAW-1396 (UNIT 2)

BAW-1400 (UNIT 3)

[5]Oconee 1, Cycle 4 - Reload Report - BAW-1447, March 1977.

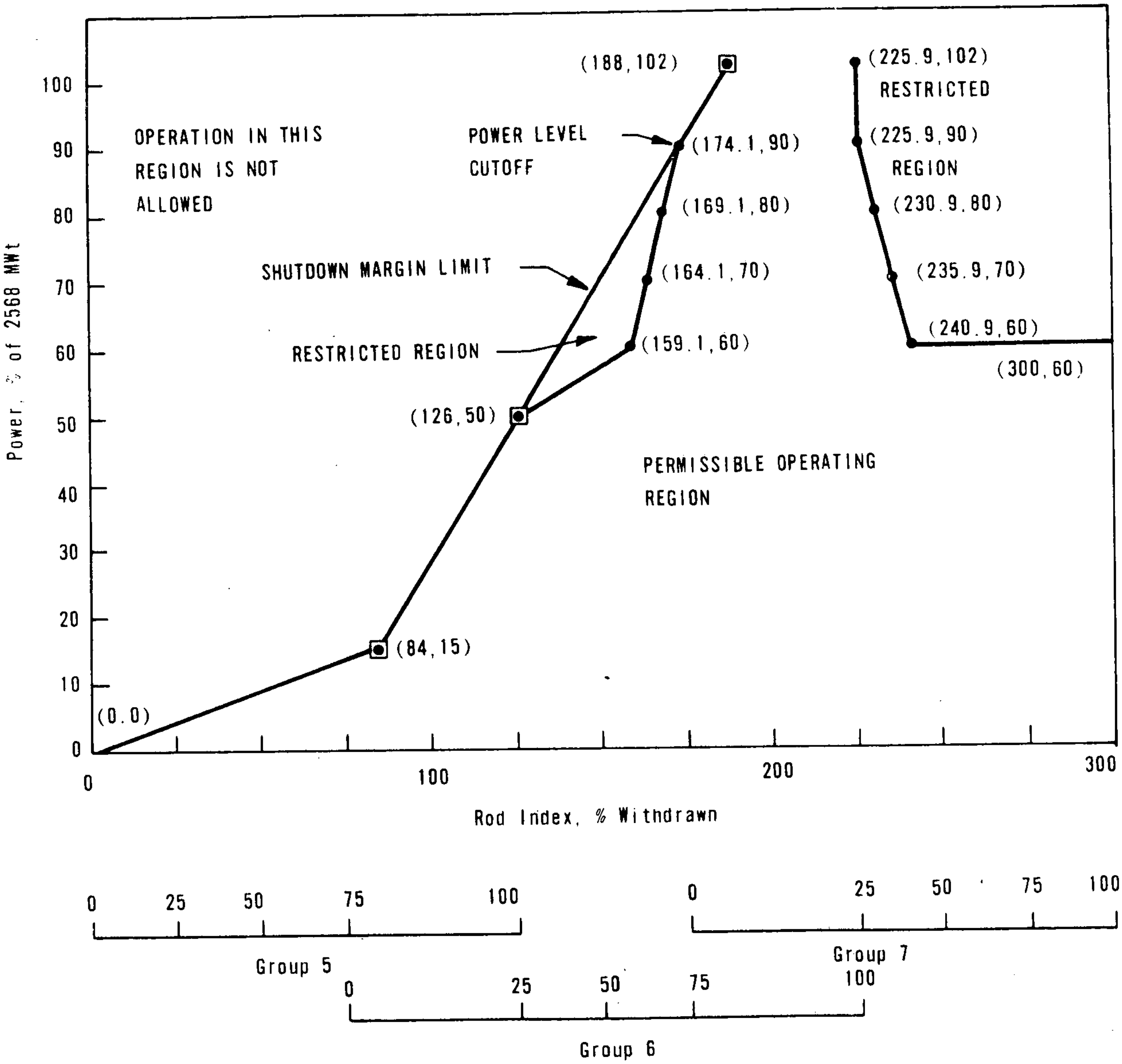


Rod index is the percentage sum of the withdrawal of Groups 5,6 and 7

ROD POSITION LIMITS FOR FOUR-PUMP OPERATION FROM 0 TO 100 (±10) EFPD, UNIT 1

OCONEE NUCLEAR STATION

Figure 3.5.2-1A1

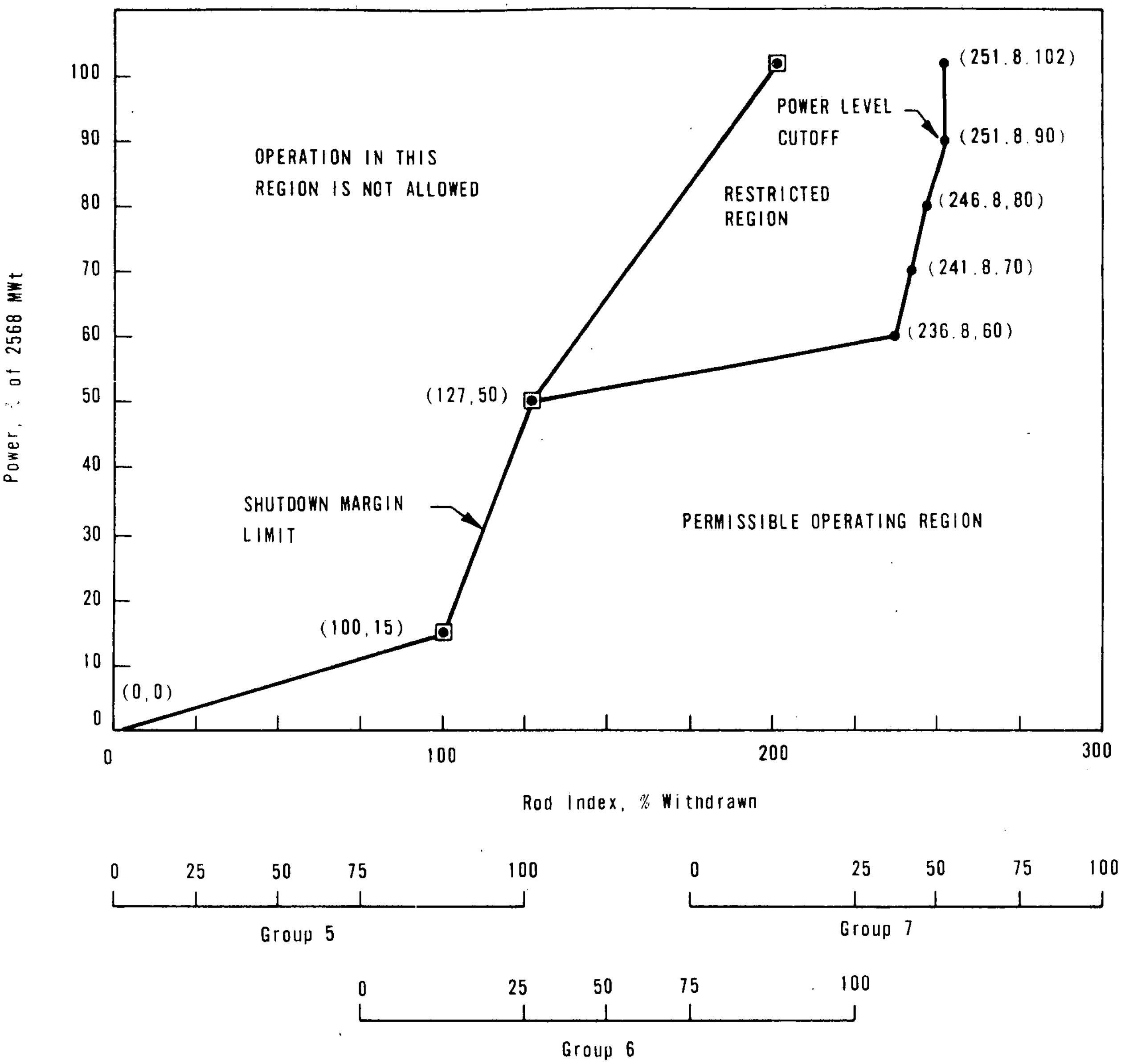


Rod index is the percentage sum of the withdrawal of Groups 5,6 and 7

ROD POSITION FOR FOUR-PUMP OPERATION FROM 100 (±10) TO 250 (±10) EFPD, UNIT 1

OCONEE NUCLEAR STATION

Figure 3.5.2-1A2

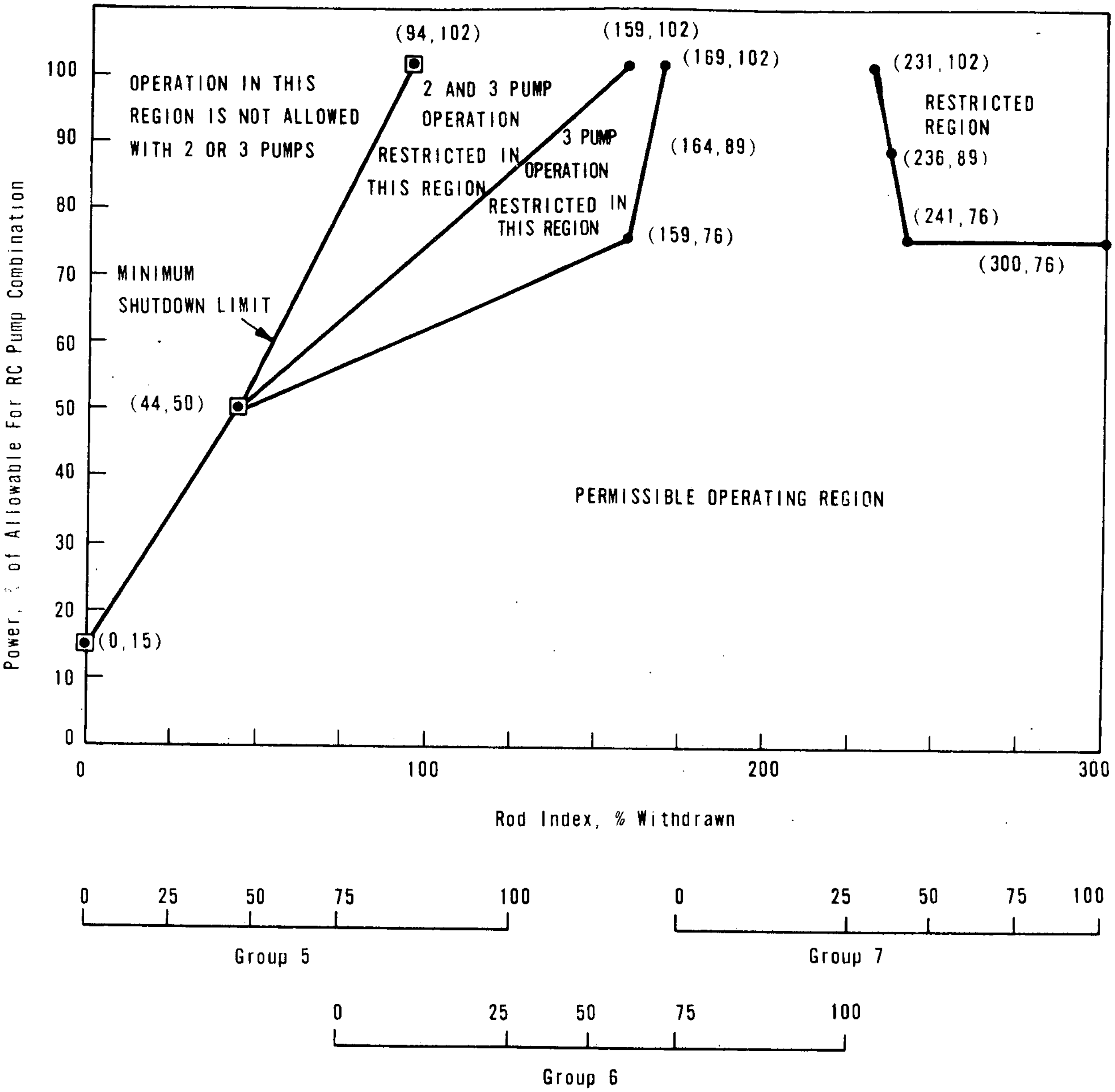


Rod index is the percentage sum of the withdrawal of Groups 5,6 and 7

ROD POSITION LIMITS FOR FOUR-PUMP OPERATION AFTER 250 (±10) EFPD, UNIT 1

OCONEE NUCLEAR STATION

Figure 3.5.2-1A3

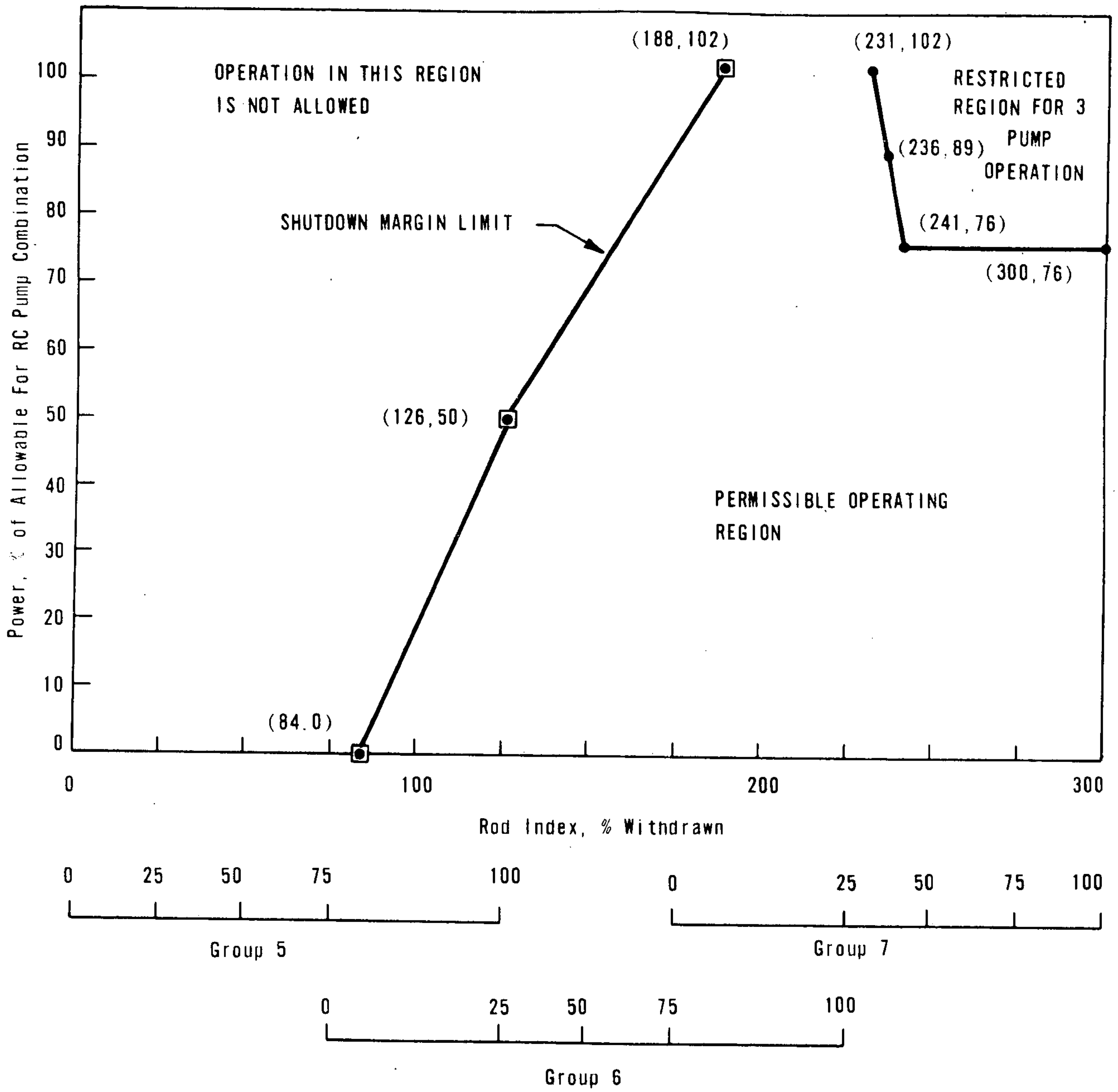


Rod index is the percentage sum of the withdrawal of Groups 5,6 and 7

ROD POSITION LIMITS FOR TWO-AND THREE-PUMP OPERATION FROM 0 TO 100 (±10) EFPD, UNIT 1

OCONEE NUCLEAR STATION

Figure 3.5.2-2A1

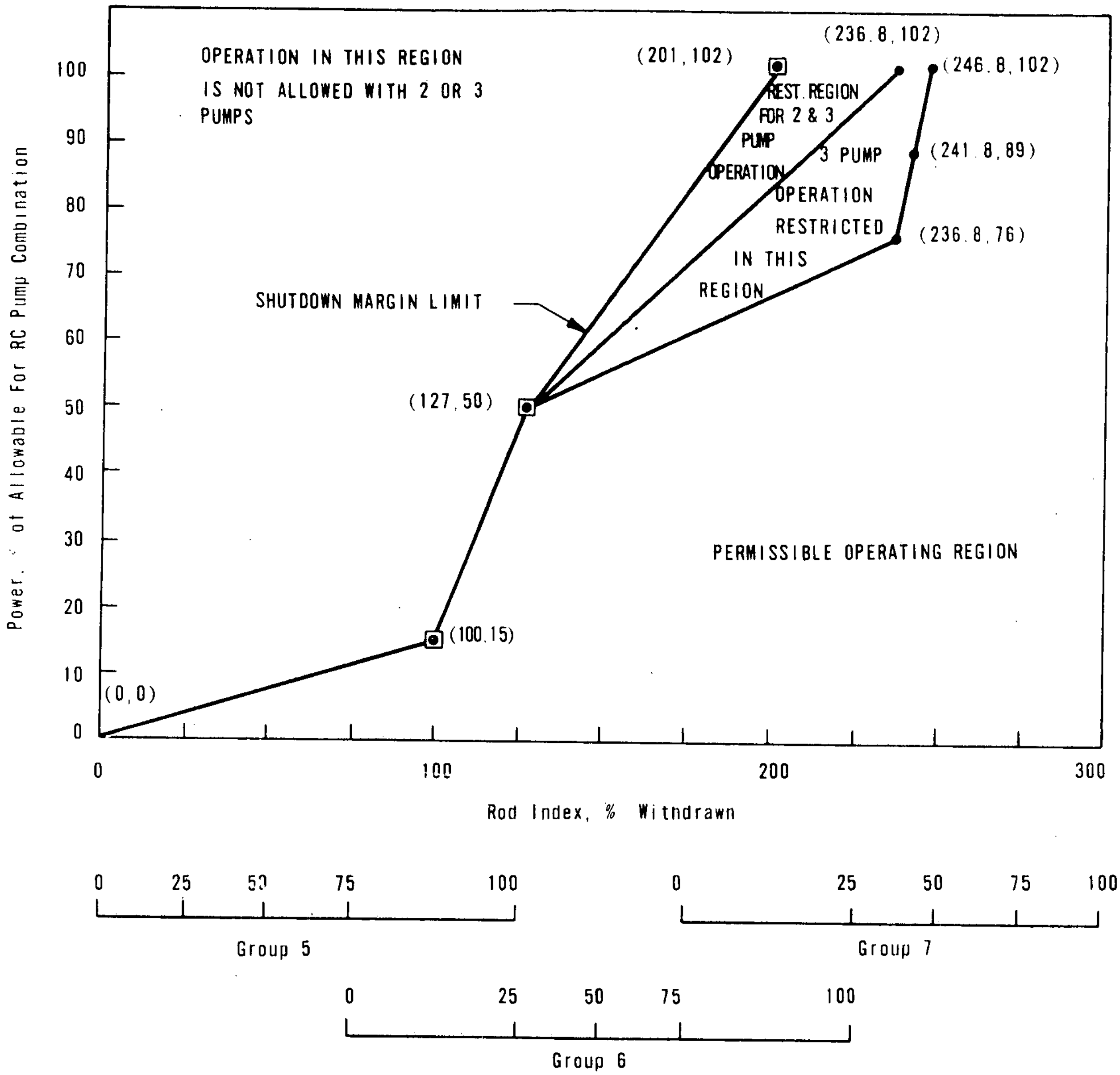


Rod index is the percentage sum of the withdrawal of Groups 5,6 and 7

ROD POSITION LIMITS FOR TWO-
AND THREE-PUMP OPERATION FROM
100 (±10) TO 250 (±10), EFPD
UNIT 1

OCONEE NUCLEAR STATION

Figure 3.5.2-2A2

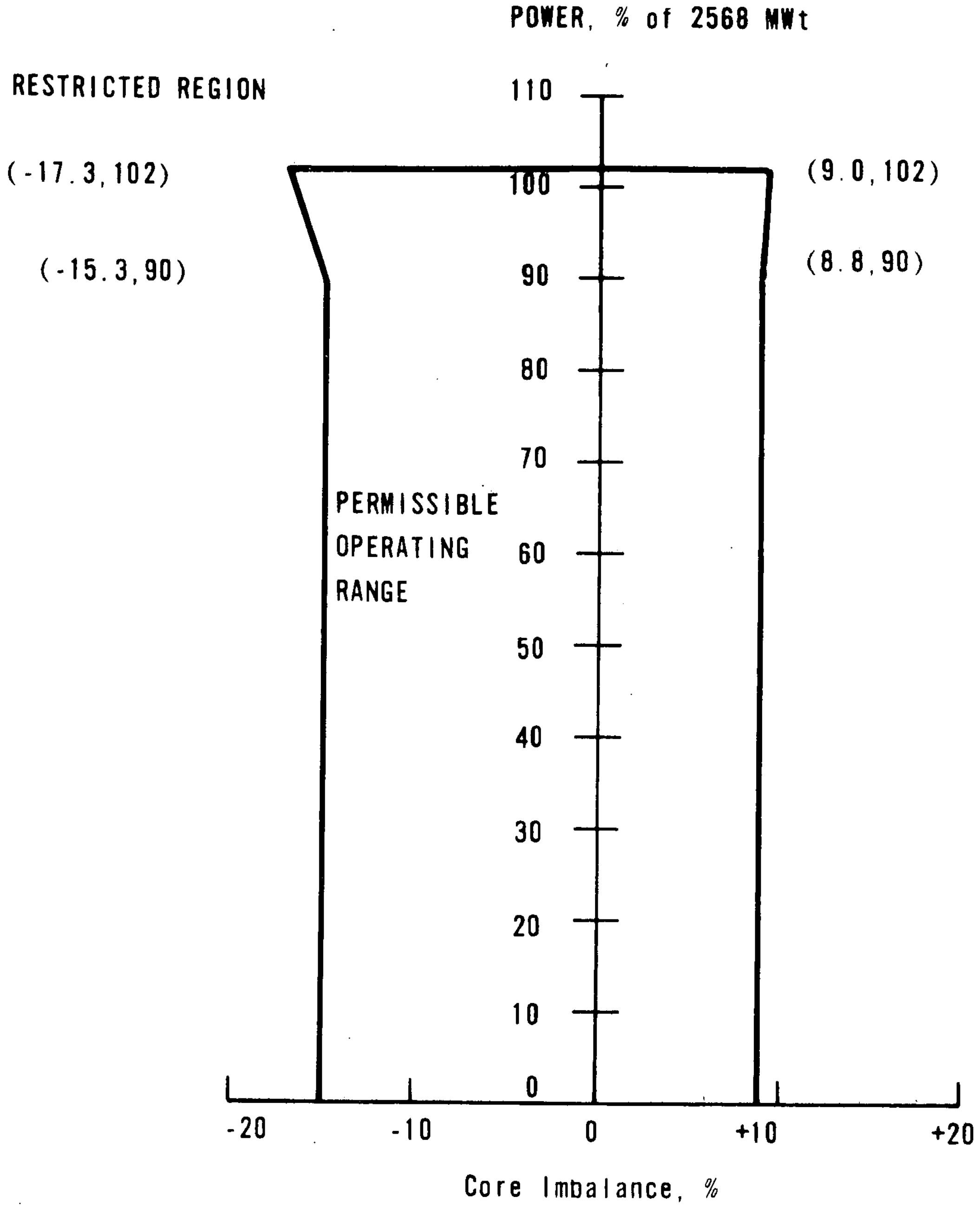


Rod index is the percentage sum of the withdrawal of Groups 5,6 and 7

ROD POSITION LIMITS FOR TWO-
AND THREE-PUMP OPERATION AFTER
250 (±10) EFPD, UNIT 1

OCONEE NUCLEAR STATION

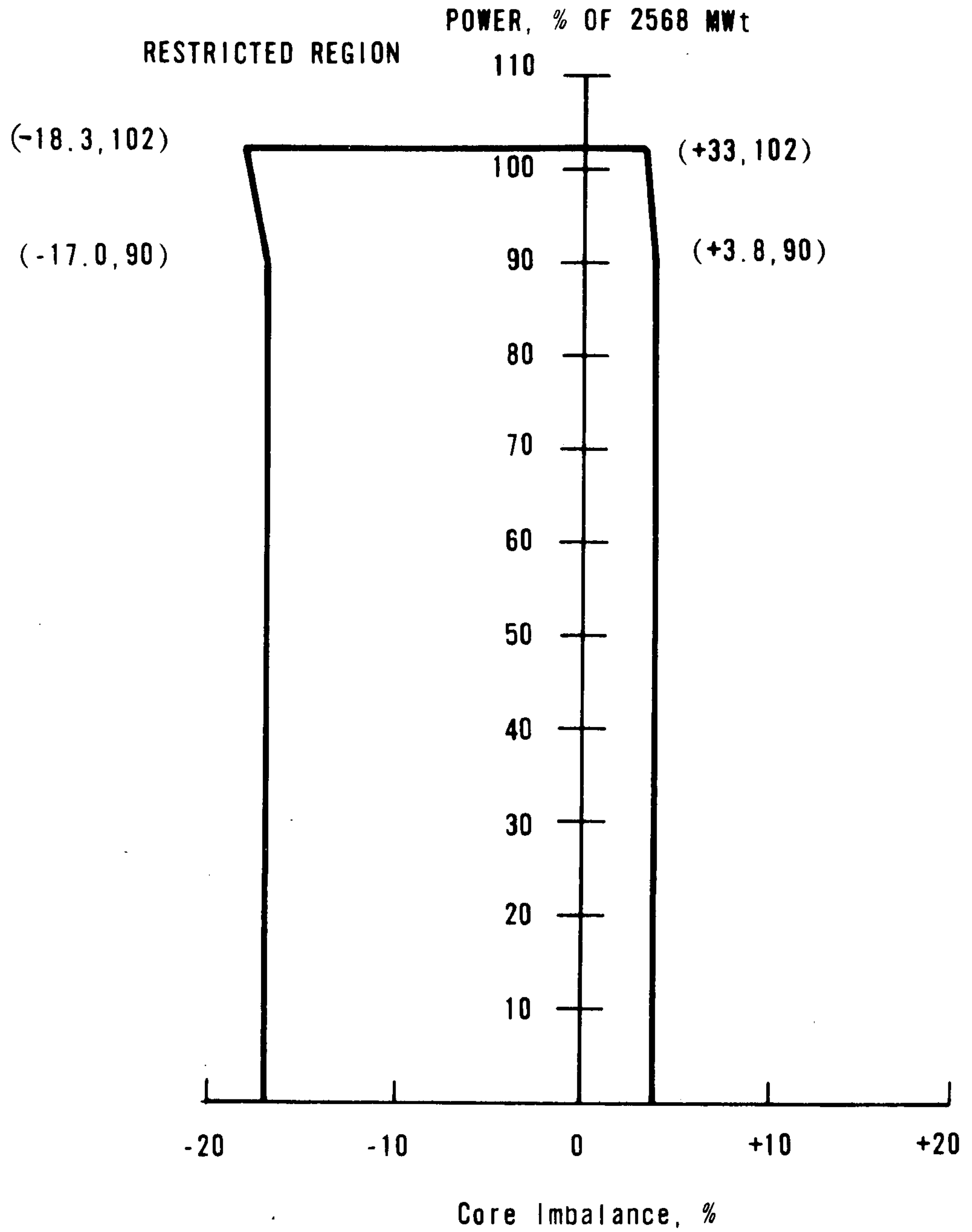
Figure 3.5.2-2A3



OPERATIONAL POWER IMBALANCE ENVELOPE FOR OPERATION FROM 0 TO 100 (±10) EFPD, UNIT 1

OCONEE NUCLEAR STATION

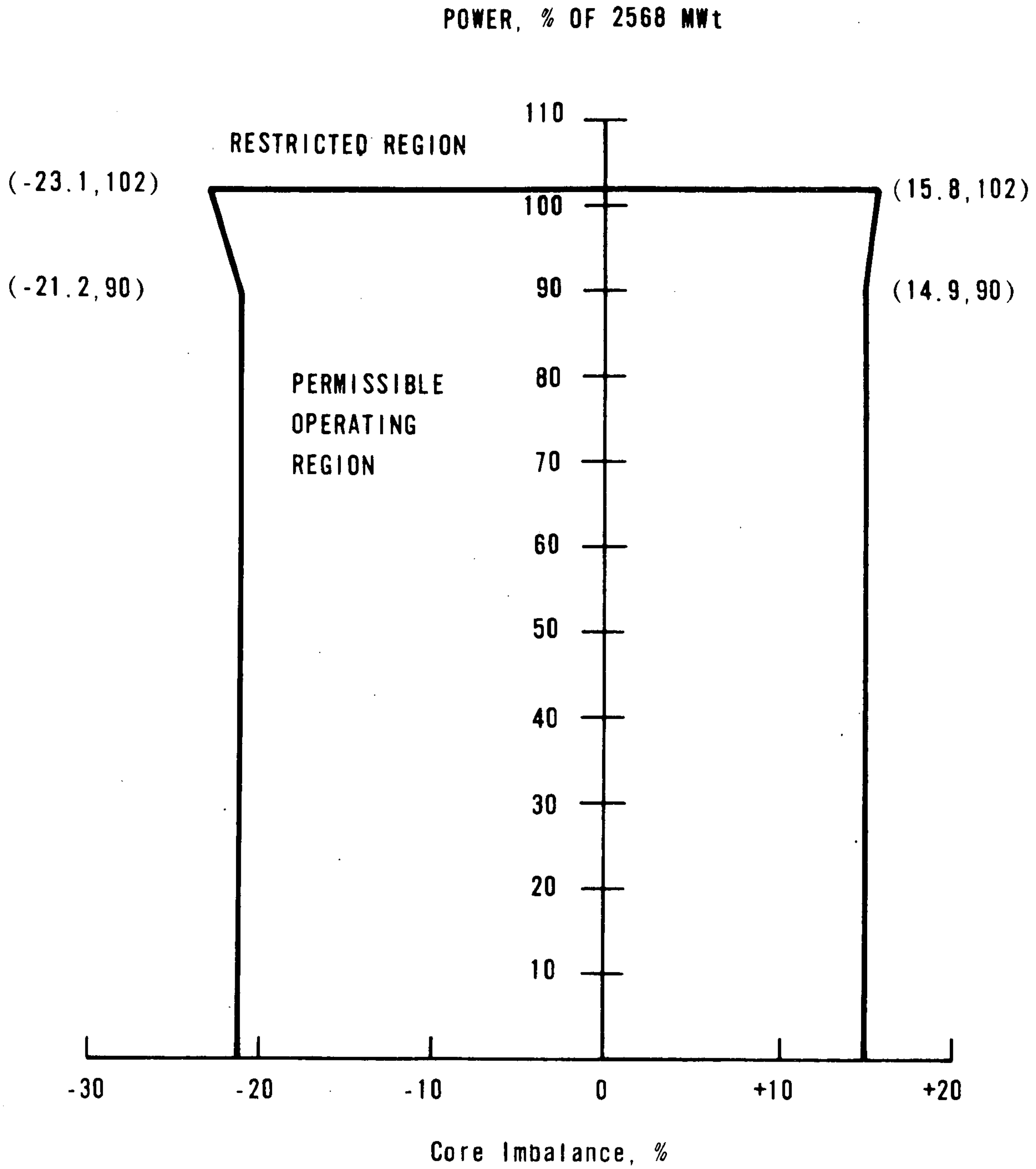
Figure 3.5.2-3A1



OPERATIONAL POWER IMBALANCE ENVELOPE FOR OPERATION FROM 100 (±10) TO 250 (±10) EFPD, UNIT 1

OCONEE NUCLEAR STATION

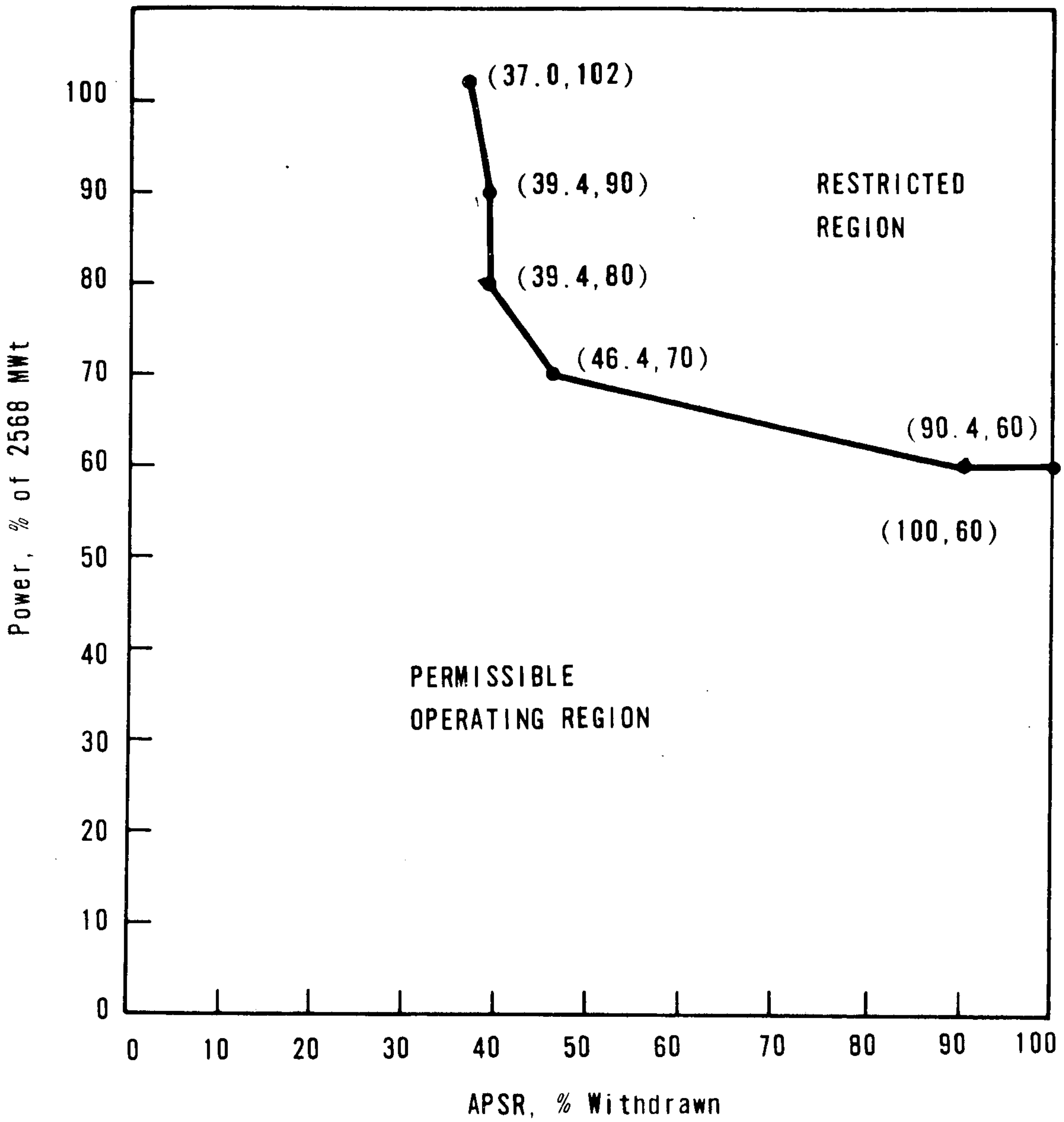
Figure 3.5.2-3A2



OPERATIONAL POWER IMBALANCE
ENVELOPE FOR OPERATION AFTER
250 (±10) EFPD, UNIT 1

OCONEE NUCLEAR STATION

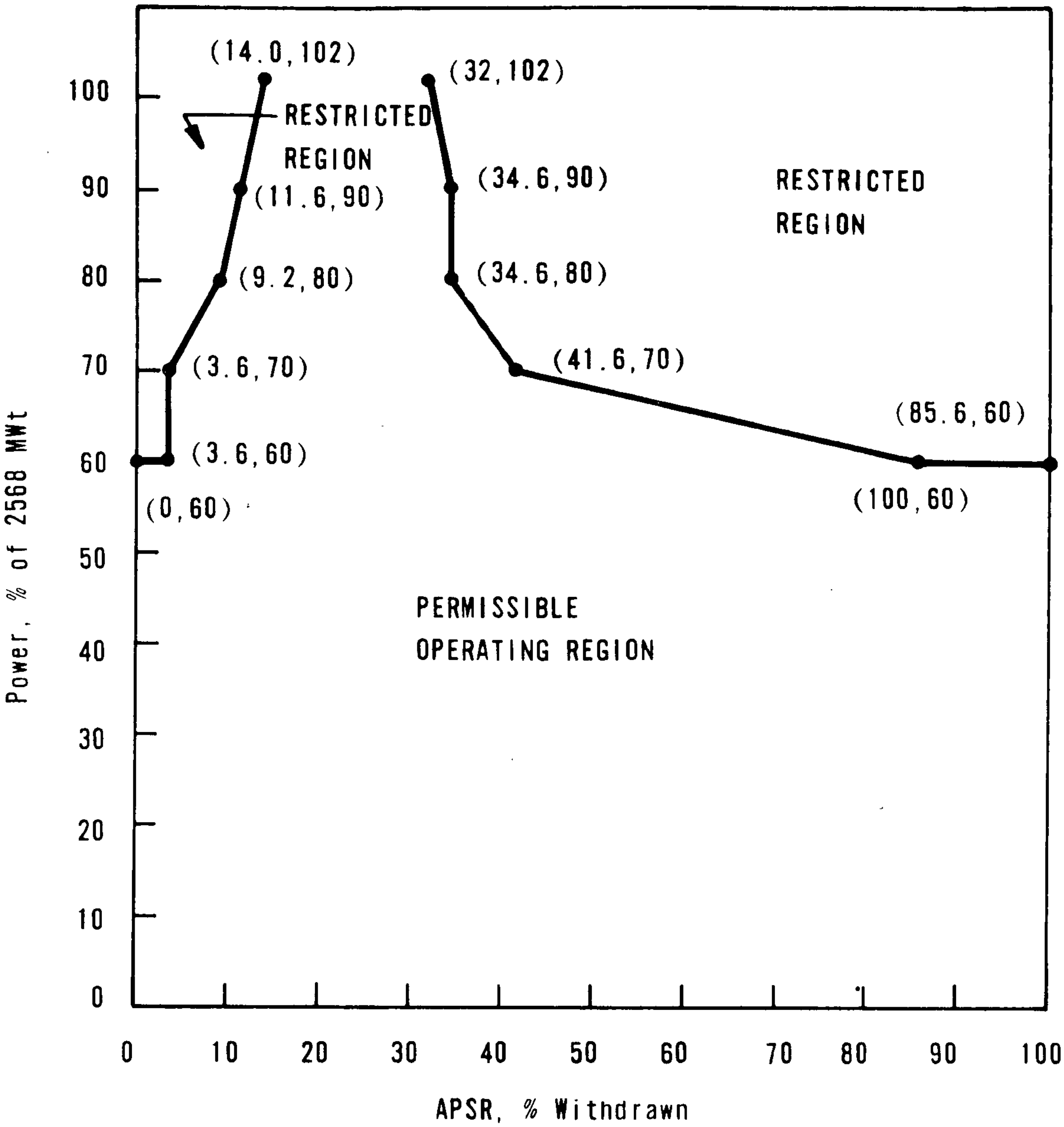
Figure 3.5.2-3A3



APSR POSITION LIMITS FOR
OPERATION FROM 0 TO 100
(±10) EFPD, UNIT 1

OCONEE NUCLEAR STATION

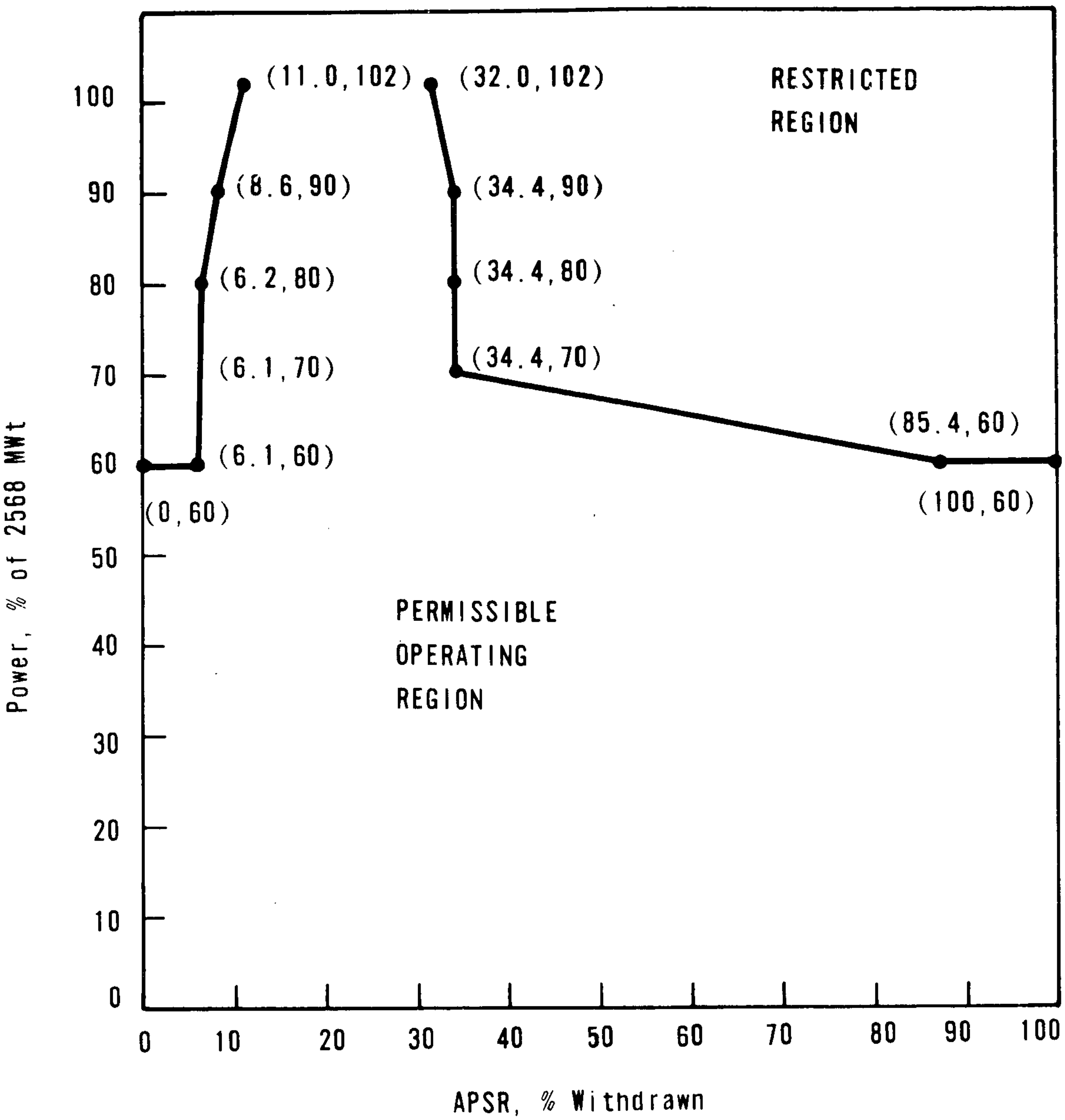
Figure 3.5.2-4A1



APSR POSITION LIMITS FOR
OPERATION FROM 100 (±10)
TO 250 (±10) EFPD, UNIT 1

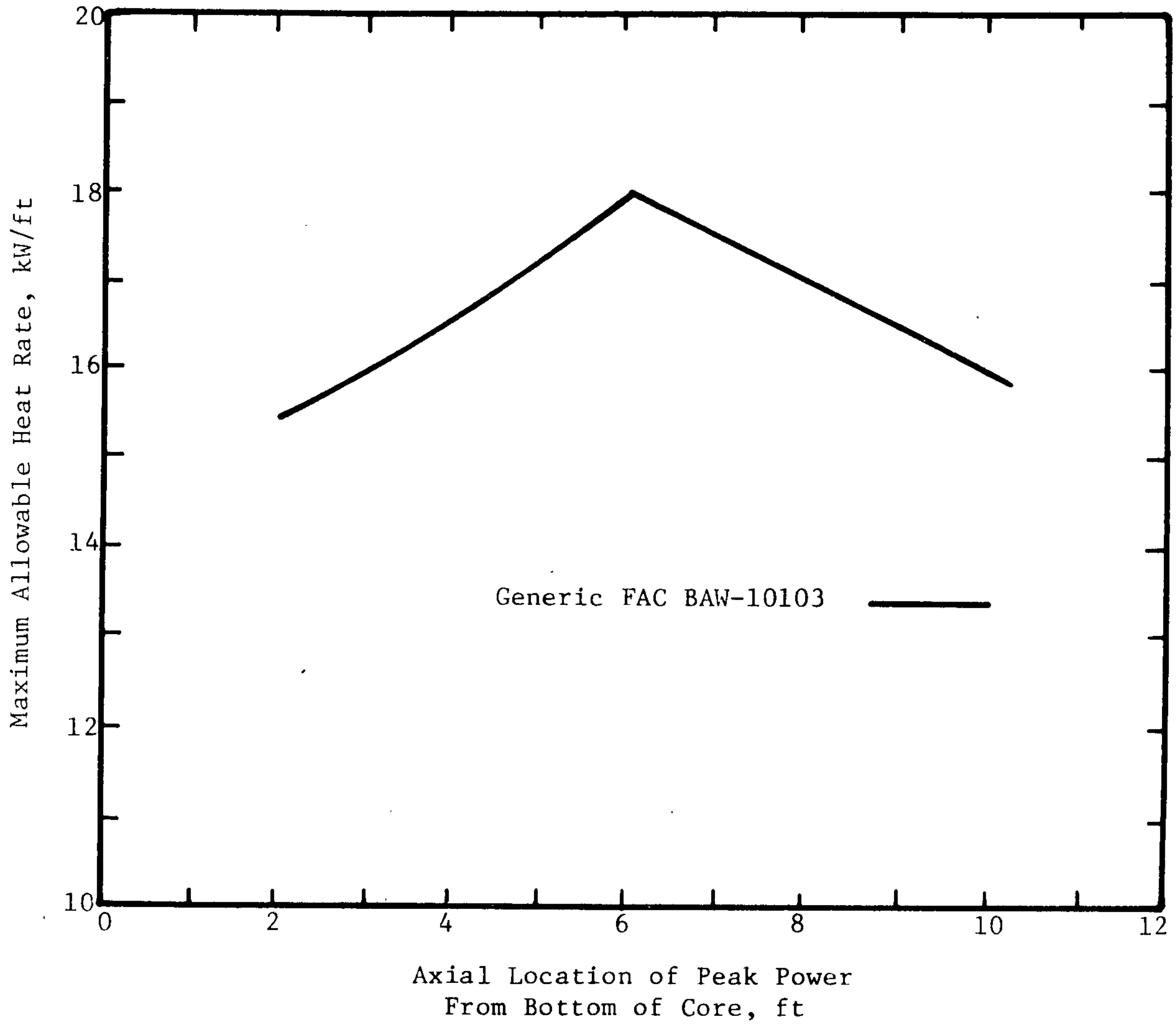
OCONEE NUCLEAR STATION

Figure 3.5.2-4A2



APSR POSITION LIMITS FOR
OPERATION AFTER 250 (±10)
EFPD, UNIT 1

OCONEE NUCLEAR STATION
Figure 3.5.2-4A3



LOCA-LIMITED MAXIMUM ALLOWABLE
LINEAR HEAT

OCONEE NUCLEAR STATION

Figure 3.5.2-5