

Duke Power Company

Oconee Nuclear Station

Attachment 1

Proposed Technical Specification Revision

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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 3.

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 and 3 of Figure 2.1-2C correspond to the expected minimum flow rates with four pumps, three pumps and one pump in each loop, respectively.

The magnitude of the rod bow penalty applied to each fuel cycle is equal to or greater than the necessary burnup independent DNBR rod bow penalty for the applicable cycle minus a credit of 1% for the flow area reduction factor used in the hot channel analysis (4).

All plant operating limits are presently based on an original method of calculating rod bowing penalties that are more conservative than those that would be obtained with new approved procedures (4). For Cycle 6 operation, this subrogation results in a 10% DNBR margin, which is partially used to offset the reduction in DNBR due to fuel rod bowing.

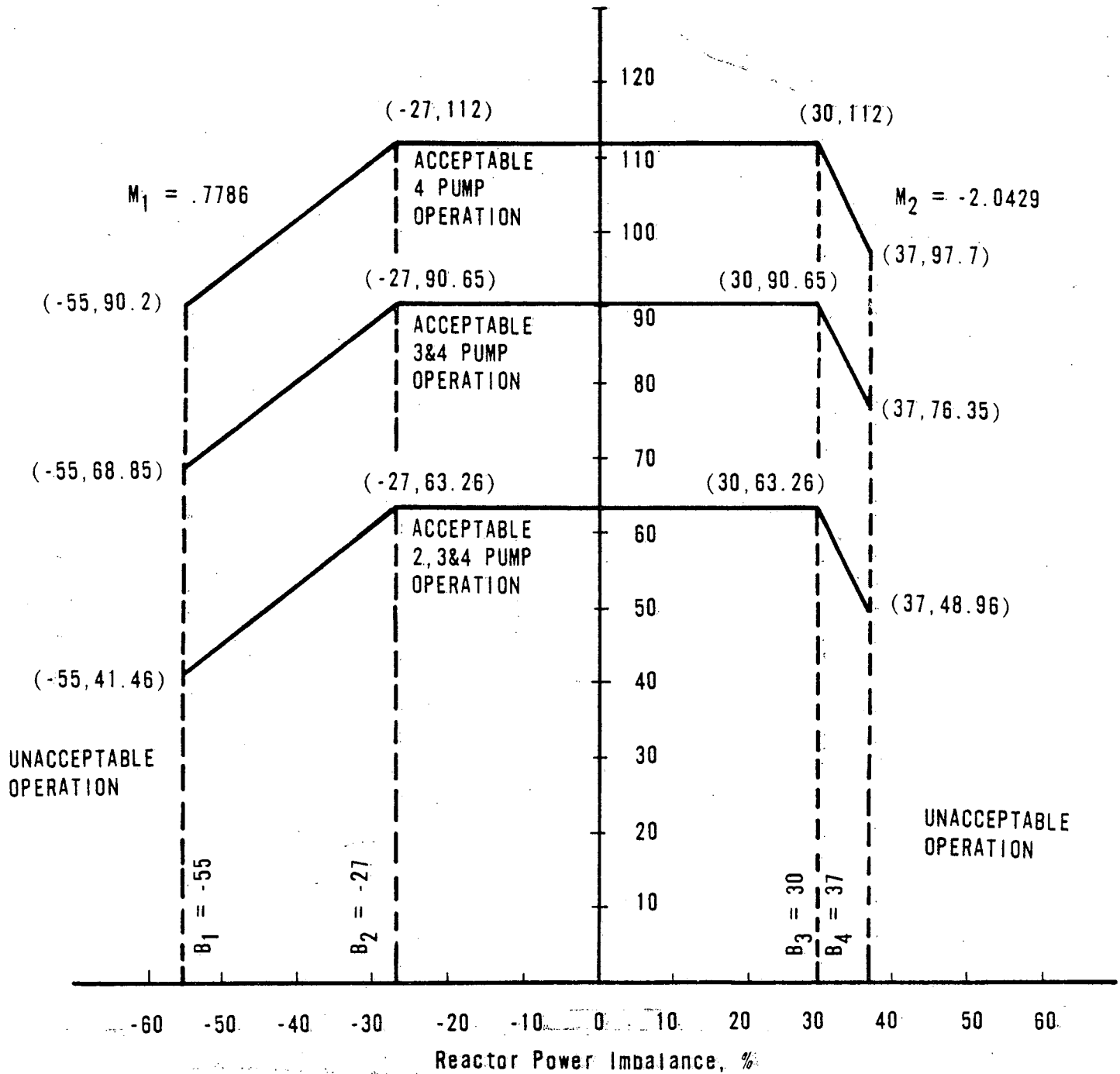
The maximum thermal power for three-pump operation is 90.65 percent due to a power level trip produced by the flux-flow ratio  $74.7 \text{ percent flow} \times 1.08 = 80.7 \text{ percent power}$  plus the maximum calibration and instrument error (Reference 4). The maximum thermal power for other coolant pump conditions are produced in a similar manner.

For each curve of Figure 2.1-3C a pressure-temperature point above and to the left of the curve would result in a DNBR greater than 1.30 or a local quality at the point of minimum DNBR less than 22 percent for that particular reactor coolant pump situation. The curve of Figure 2.1-1C is the most restrictive of all possible reactor coolant pump-maximum thermal power combinations shown in Figure 2.1-3C.

#### References

- (1) Correlation of Critical Heat Flux in a Bundle Cooled by Pressurized Water, BAW-10000, March 1970.
- (2) Oconee 3, Cycle 3 - Reload Report - BAW-1453, August, 1977.
- (3) Amendment 1 - Oconee 3, Cycle 4 - Reload Report - BAW-1486, June 12, 1978.
- (4) Oconee 3, Cycle 6 - Reload Report - BAW-1634, August, 1980.

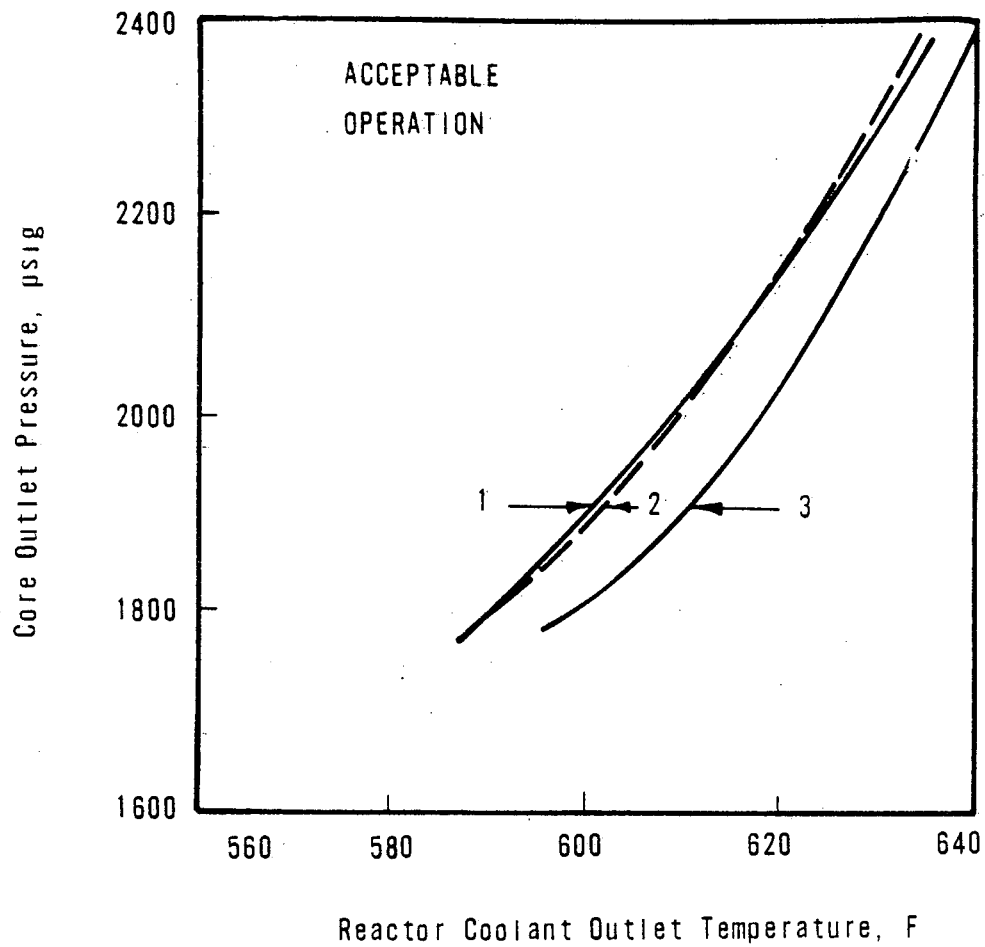
# THERMAL POWER LEVEL, %



CORE PROTECTION SAFETY LIMITS  
UNIT 3  
OCONEE NUCLEAR STATION



Figure 2.1-2C.



<u>CURVE</u>	<u>COOLANT FLOW, GPM</u>	<u>POWER, %</u>	<u>PUMPS OPERATING</u>	<u>TYPE OF LIMIT</u>
1	374,880 (100%)*	112	4	DNBR
2	280,035 (74.7%)	90.65	3	DNBR
3	183,690 (49.0%)	63.26	2	QUALITY

\*106.5% OF FIRST-CORE DESIGN FLOW.

CORE PROTECTION SAFETY LIMITS  
UNIT 3



OCONEE NUCLEAR STATION

Figure 2.1-3C

During normal plant operation with all reactor coolant pumps operating, reactor trip is initiated when the reactor power level reaches 104.9% 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)

#### Overpower Trip Based on Flow and Imbalance

The power level trip setpoint 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 setpoint 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 setpoint 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 situations of Table 2.3-1A are as follows:

1. Trip would occur when four reactor coolant pumps are operating if power is 108% and reactor flow rate is 100%, or flow rate is 92.59% and power level is 100%.
2. Trip would occur when three reactor coolant pumps are operating if power is 80.68% and reactor flow rate is 74.7% or flow rate is 69.44% and power level is 75%.
3. Trip would occur when one reactor coolant pump is operating in each loop (total of two pumps operating) if the power is 52.92 and reactor flow rate is 49.0% or flow rate is 45.37% 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 1.08% - Unit 1 for 1% flow reduction.

1.08% - Unit 2

1.08% - Unit 3

### 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 setpoint is reached before the nuclear over-power trip setpoint. 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<sub>out</sub> - 4706) trip (1800) psig (11.14 T<sub>out</sub> - 4706) (1800) psig (11.14 T<sub>out</sub> - 4706)

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<sub>out</sub> - 4746) (11.14 T<sub>out</sub> - 4746) (11.14 T<sub>out</sub> - 4746)

### Coolant Outlet Temperature

The high reactor coolant outlet temperature trip setting limit (618°F) shown in Figure 2.3-1A has been established to prevent excessive core coolant

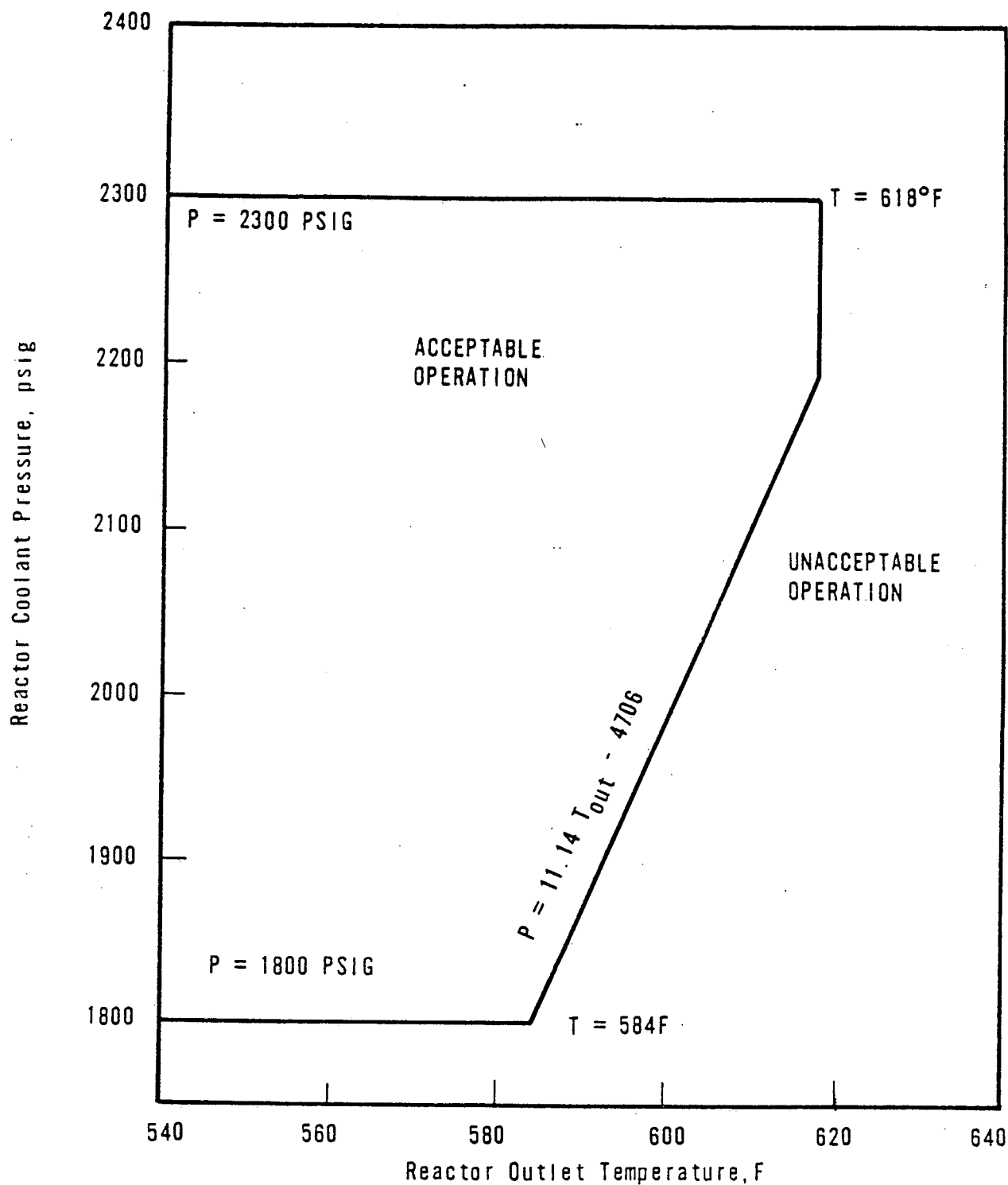
2.3-1B

2.3-1C

temperatures in the operating range. Due to calibration and instrumentation errors, the safety analysis used a trip setpoint of 620°F.

### Reactor Building Pressure

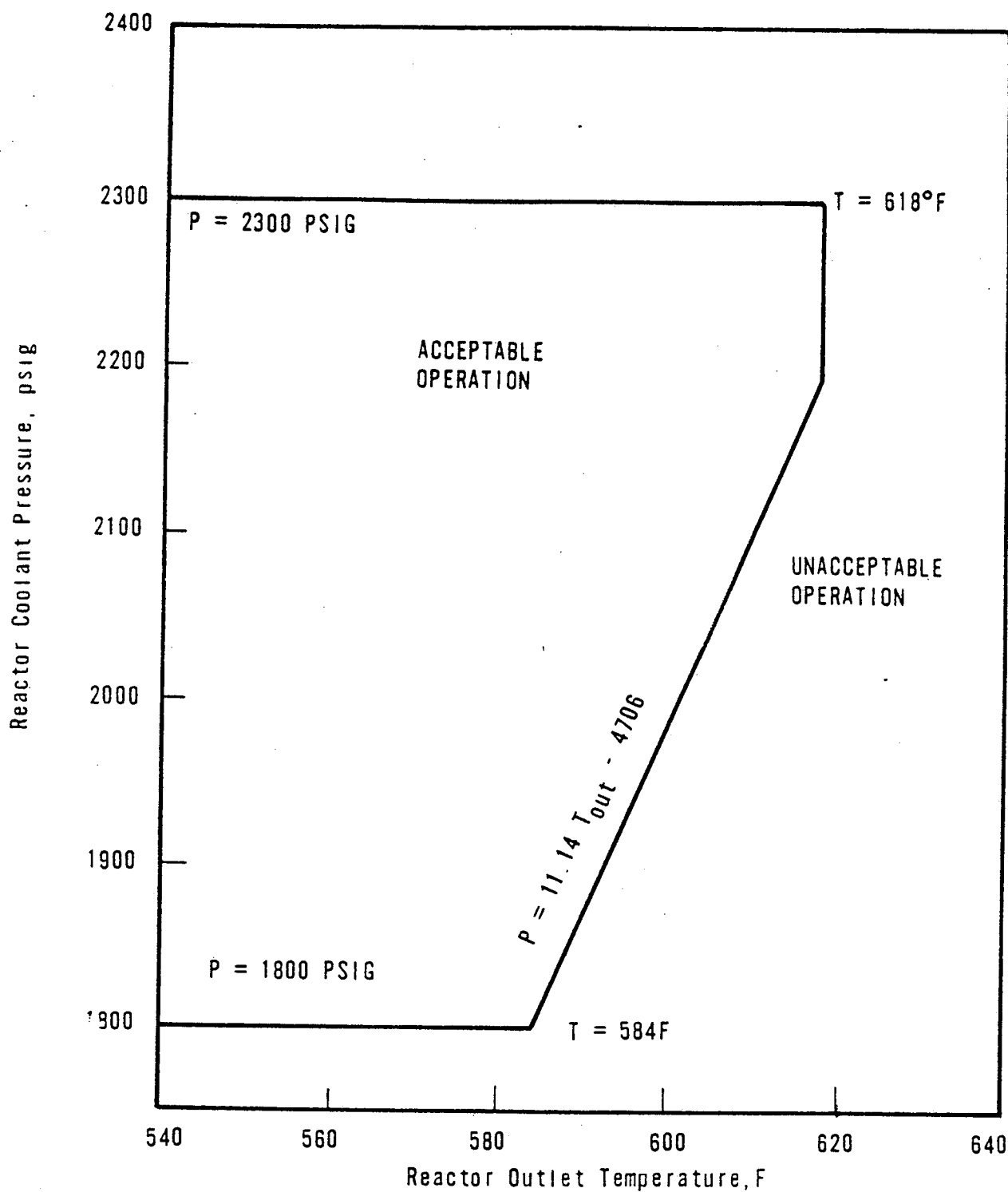
The high reactor building pressure trip setting limit (4 psig) provides positive assurance that a reactor trip will occur in the unlikely event of a loss-of-coolant accident, even in the absence of a low reactor coolant system pressure trip.



PROTECTIVE SYSTEM MAXIMUM  
ALLOWABLE SETPOINTS  
UNIT 1  
OCONEE NUCLEAR STATION



Figure 2.3-1 A

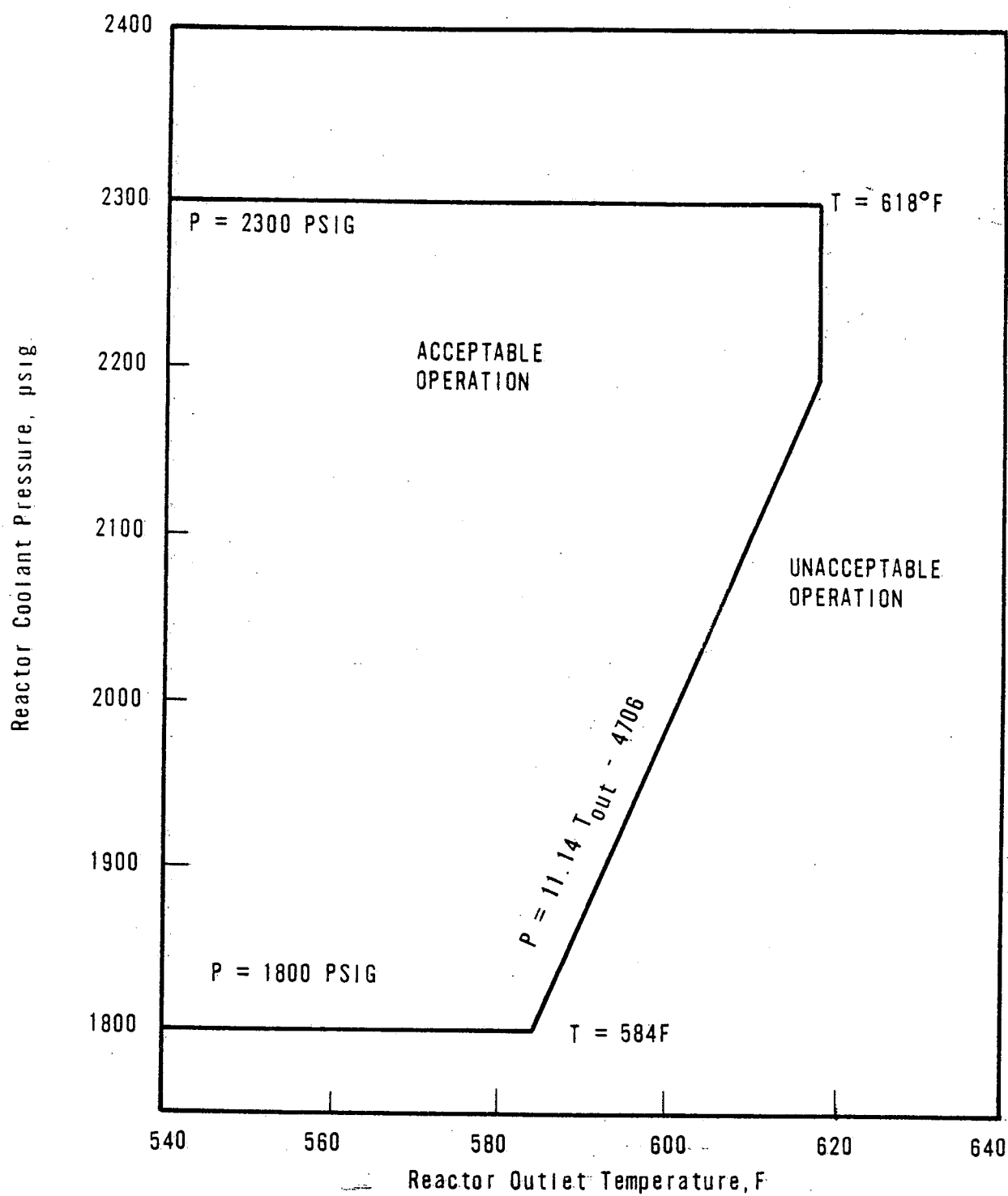


PROTECTIVE SYSTEM MAXIMUM  
ALLOWABLE SETPOINTS  
UNIT 2  
OCONEE NUCLEAR STATION



Figure 2.3-1 B



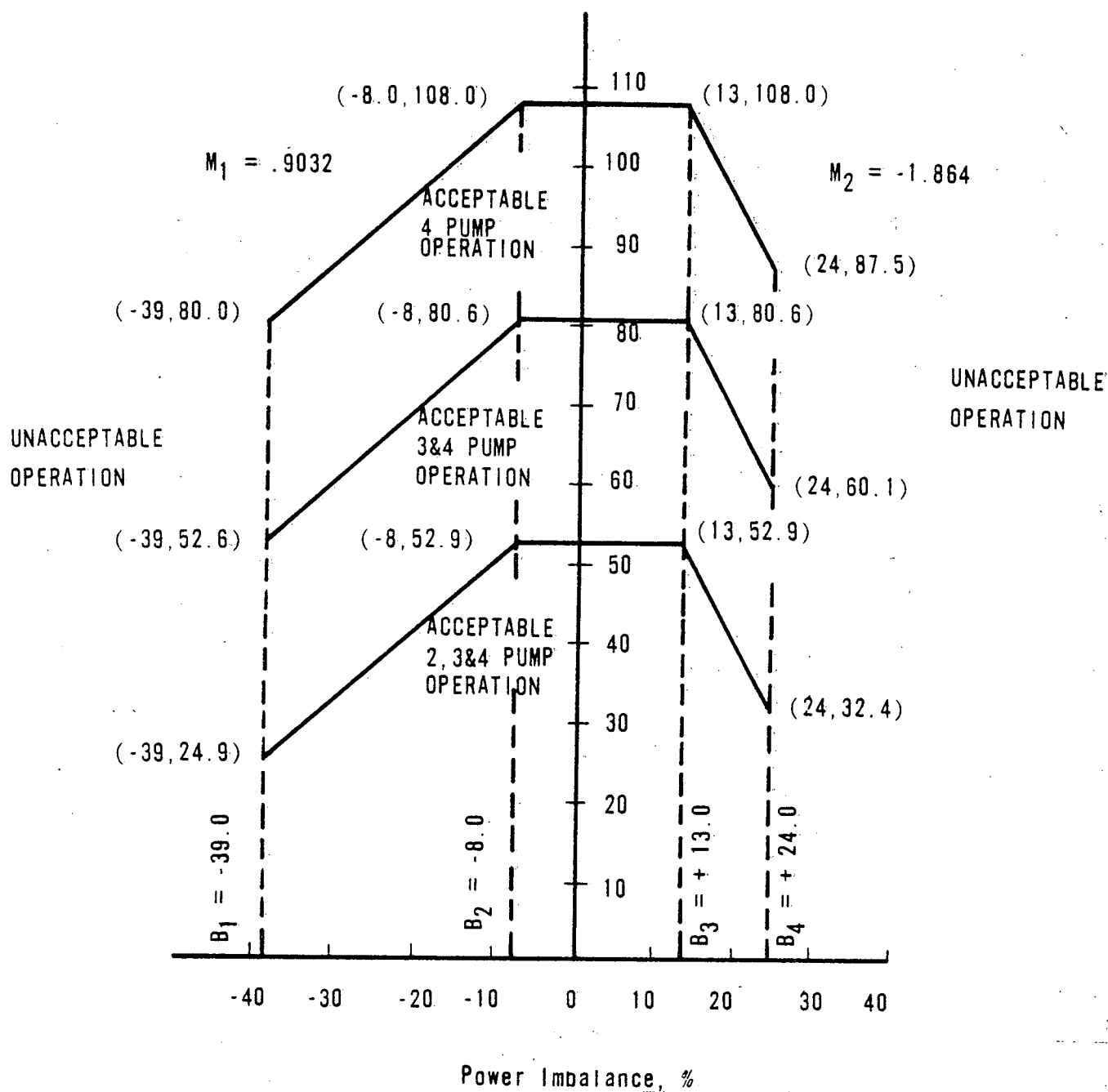


PROTECTIVE SYSTEM MAXIMUM  
ALLOWABLE SETPOINTS  
UNIT 3  
OCONEE NUCLEAR STATION



Figure 2.3-1C

# THERMAL POWER LEVEL, %



PROTECTIVE SYSTEM MAXIMUM  
ALLOWABLE SETPOINTS  
UNIT-3



OCONEE NUCLEAR STATION

Figure 2.3-2C

Table 2.3-1A  
Unit 1

Reactor Protective System Trip Setting Limits

<u>RPS Segment</u>	<u>Four Reactor Coolant Pumps Operating (Operating Power 100% Rated)</u>	<u>Three Reactor Coolant Pumps Operating (Operating Power -75% Rated)</u>	<u>One Reactor Coolant Pump Operating In Each Loop (Operating Power -49% Rated)</u>	<u>Shutdown Bypass</u>
1. Nuclear Power Max. (% Rated)	104.9	104.9	104.9	5.0 <sup>(3)</sup>
2. Nuclear Power Max. Based on Flow (2) and Imbalance, (% Rated)	1.08 times flow minum reduction due to imbalance	1.08 times flow minus reduction due to imbalance	1.08 times flow minus reduction due to imbalance	Bypassed
3. Nuclear Power Max. Bases on Pump Monitors, (% Rated)	NA	NA	55%	Bypassed
4. High Reactor Coolant System Pressure, psig, Max.	2300	2300	2300	1720 <sup>(4)</sup>
5. Low Reactor Coolant System Pressure, psig, Min.	1800	1800	1800	Bypassed
6. Variable Low Reactor Coolant System Pressure psig, Min.	$(11.14T_{out} - 4706)^{(1)}$	$(11.14T_{out} - 4706)^{(1)}$	$(11.14T_{out} - 4706)^{(1)}$	Bypassed
7. Reactor Coolant Temp. F., Max.	618	618	618	618
8. High Reactor Building Pressure, psig, Max.	4	4	4	4

(1)  $T_{out}$  is in degrees Fahrenheit ( $^{\circ}F$ ).

(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.

Table 2.3-1B  
Unit 2

Reactor Protective System Trip Setting Limits

<u>RPS Segment</u>	<u>Four Reactor Coolant Pumps Operating (Operating Power -100% Rated)</u>	<u>Three Reactor Coolant Pumps Operating (Operating Power -75% Rated)</u>	<u>One Reactor Coolant Pump Operating in Each Loop (Operating Power -49% Rated)</u>	<u>Shutdown Bypass</u>
1. Nuclear Power Max. (% Rated)	104.9	104.9	104.9	5.0 <sup>(3)</sup>
2. Nuclear Power Max. Based on Flow (2) and Imbalance, (% Rated)	1.08 times flow minus reduction due to imbalance	1.08 times flow minus reduction due to imbalance	1.08 times flow minus reduction due to imbalance	Bypassed
3. Nuclear Power Max. Based on Pump Monitors, (% Rated)	NA	NA	55%	Bypassed
4. High Reactor Coolant System Pressure, psig, Max.	2300	2300	2300	1720 <sup>(4)</sup>
5. Low Reactor Coolant System Pressure, psig, Min.	1800	1800	1800	Bypassed
6. Variable Low Reactor Coolant System Pressure psig, Min.	$(11.14 T_{out} - 4706)^{(1)}$	$(11.14 T_{out} - 4706)^{(1)}$	$(11.14 T_{out} - 4706)^{(1)}$	Bypassed
7. Reactor Coolant Temp. F., Max.	618	618	618	618
8. High Reactor Building Pressure, psig, Max.	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.

Table 2.3-1C  
Unit 3

Reactor Protective System Trip Setting Limits

<u>RPS Segment</u>	<u>Four Reactor Coolant Pumps Operating (Operating Power -100% Rated)</u>	<u>Three Reactor Coolant Pumps Operating (Operating Power -75% Rated)</u>	<u>One Reactor Coolant Pump Operating in Each Loop (Operating Power -49% Rated)</u>	<u>Shutdown Bypass</u>
1. Nuclear Power Max. (% Rated)	104.9	104.9	104.9	5.0 <sup>(3)</sup>
2. Nuclear Power Max. Based on Flow (2) and Imbalance, (% Rated)	1.08 times flow minus reduction due to imbalance	1.08 times flow minus reduction due to imbalance	1.08 times flow minus reduction due to imbalance	Bypassed
3. Nuclear Power Max. Based on Pump Monitors, (% Rated)	NA	NA	55%	Bypassed
4. High Reactor Coolant System Pressure, psig, Max.	2300	2300	2300	1720 <sup>(4)</sup>
5. Low Reactor Coolant System Pressure, psig, Min.	1800	1800	1800	Bypassed
6. Variable Low Reactor Coolant System Pressure psig, Min.	$(11.14 T_{out} - 4706)^{(1)}$	$(11.14 T_{out} - 4706)^{(1)}$	$(11.14 T_{out} - 4706)^{(1)}$	Bypassed
7. Reactor Coolant Temp. F., Max.	618	618	618	618
8. High Reactor Building Pressure, psig, Max.	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.