2.1 LIMITING SAFETY SYSTEM SETTING - REACTOR PROTECTION SYSTEM

Applicability

Applies to reactor trip settings and bypasses for the instrument channels monitoring the process variables which influence the safe operation of the plant.

Objective

To provide automatic protective action in the even that the process variables approach a safety limit.

Specification

The Reactor Protective System trip setting limits and bypasses for the required operable instrument channels shall be as follows:

2.1.1 Core Protection

a) Variable Nuclear Overpower:

Less than or equal to Q + 10, or 106.5 (whichever is smaller) for Q greater than or equal to 10 and less than or equal to 100, and less than or equal to 20 for Q less than or equal to 10.

Where

Q = percent thermal or nuclear power, whichever is larger.

b) Thermal Margin/Low Pressure:

Greater than or equal to: $A\ Q_{DNB} + BT_c + C$, or 1835 psig (whichever is larger).

Where

T_c = cold leg temperature, ^oF
A = 2168.6]]
B = 17.0]]
C = -9600.1]]
Q_{DNB} = $A_1 \times QR_1$

A_1 and QR_1 are given in Figures 2.1-1a and 2.1-1b, respectively.

This trip may be bypassed below 10% of rated power.

c) The symmetric offset trip and pretrip function shall not exceed the limits shown in Figure 2.1-2 for three-loop operation. This trip may be bypassed below 15% of rated power.

2.2 SAFETY LIMITS - REACTOR CORE

Applicability

Applies to the limiting combinations of reactor power, and Reactor Coolant System flow, temperature, and pressure during operation.

Objective

To maintain the integrity of the fuel cladding and prevent the release of significant amounts of fission products to the reactor coolant.

Specifications

A. The reactor and the Reactor Protection System shall be operated such that the Specified Acceptable Fuel Design Limit (SAFDL) on the departure from nucleate boiling heat flux ratio (DNBR):

DNBR = 1.30 using the W-3 DNB heat flux correlation

is not exceeded during normal operation and anticipated operational occurrences.

B. The reactor and the Reactor Protection System shall be operated such that the SAFDLs for prevention of fuel centerline melting:

A steady-state peak linear heat rate equal to:

21 kW/ft for Types E, K, and L fuel,

and

20 kW/ft for Type J fuel,

are not exceeded during normal operation and anticipated operational occurrences.

Basis

To maintain the integrity of the fuel cladding, thus preventing fission product release to the Primary System, it is necessary to prevent overheating of the cladding. This is accomplished by operating within the nucleate boiling regime of heat transfer, and with a peak linear heat rate that will not cause fuel centerline melting in any fuel rod. First, by operating within the nucleate boiling regime of heat transfer, the heat transfer coefficient is large enough so that the maximum clad surface temperature is only slightly greater than the coolant saturation 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 higher cladding temperature and the possibility of cladding failure.

The correlation listed predicts DNB heat flux and the location of DNB for axially uniform and non-uniform heat flux distributions. The local DNB heat flux ratio (DNBR), defined as the ratio of the predicted DNB heat flux at a particular core location to the actual heat flux at that location, is indicative of the margin to DNB. The minimum value of DNBR during anticipated operational occurrences is limited to 1.30 for the W-3 correlation.[1]]]

Second, operation with a peak linear heat rate below that which would cause fuel centerline melting maintains fuel rod and cladding integrity. Above this peak linear heat rate level (i.e., with some melting in the center), fuel rod integrity would be maintained only if the design and operating conditions are appropriate throughout the life of the fuel rods. Volume changes which accompany the solid to liquid phase change are significant and require accommodation. Another consideration involves the redistribution of the fuel which depends on the extent of the melting and the physical state of the fuel rod at the time of melting. Because of the above factors, the determined values of the peak linear heat rates which would not cause fuel centerline melting for the various fuel types resident in the core are established as specified fuel design limits.

Limiting safety system settings for the TM/LP, symmetric offset trips, and limiting conditions for operation on DNBR and kW/ft margin are specified such that there is a high degree of confidence that the specified acceptable fuel design limits are not exceeded during normal operation and design basis anticipated operational occurrences.

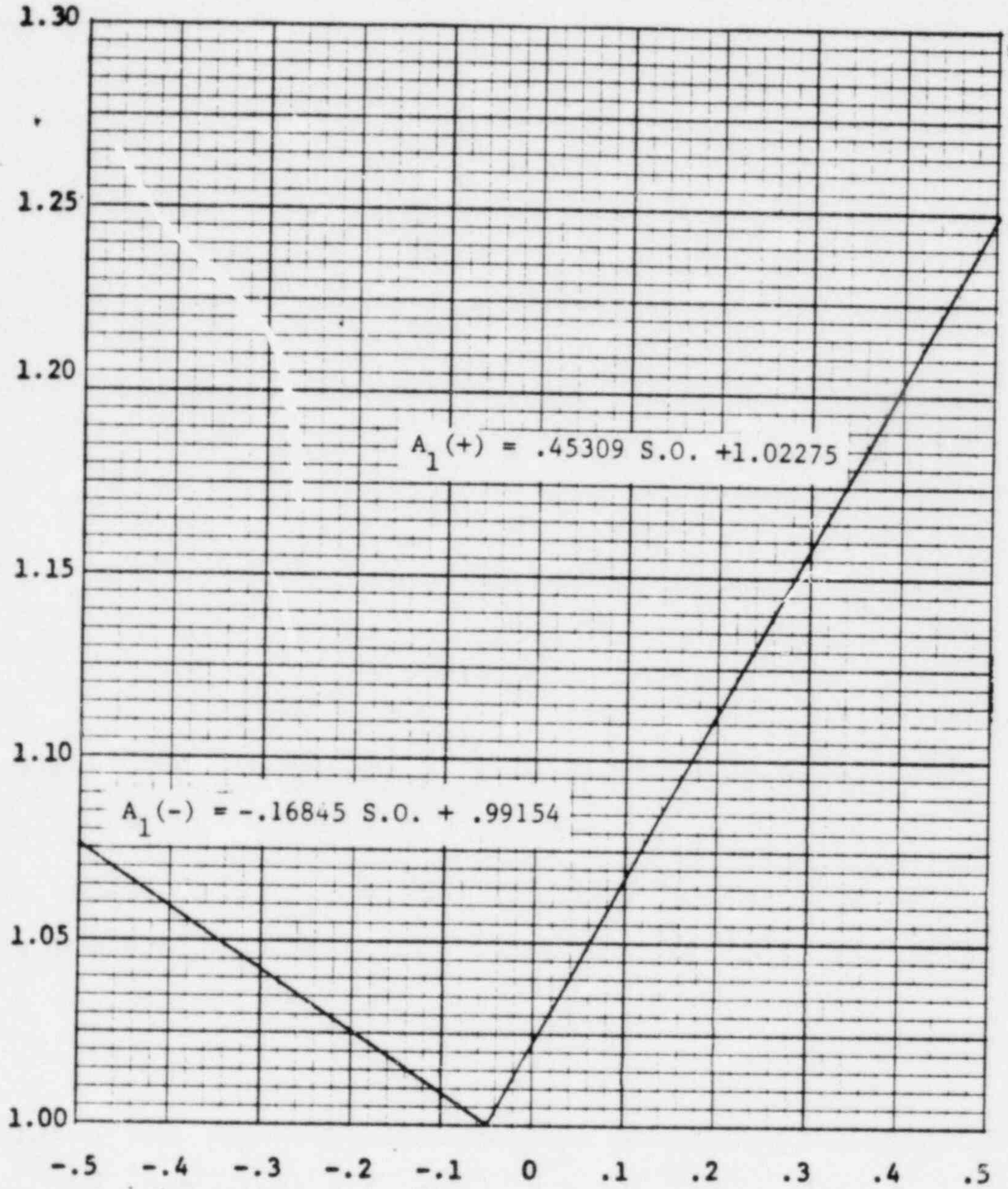
References

(1) FSAR Section 3.5.

Where: $Q_{DNB} = A_1 \times QR_1$

and $P_{var}^{trip} = 2168.6\ Q_{DNB} + 17.0T_c - 9600.1$

T_{in} = Cold leg temperature, ^oF

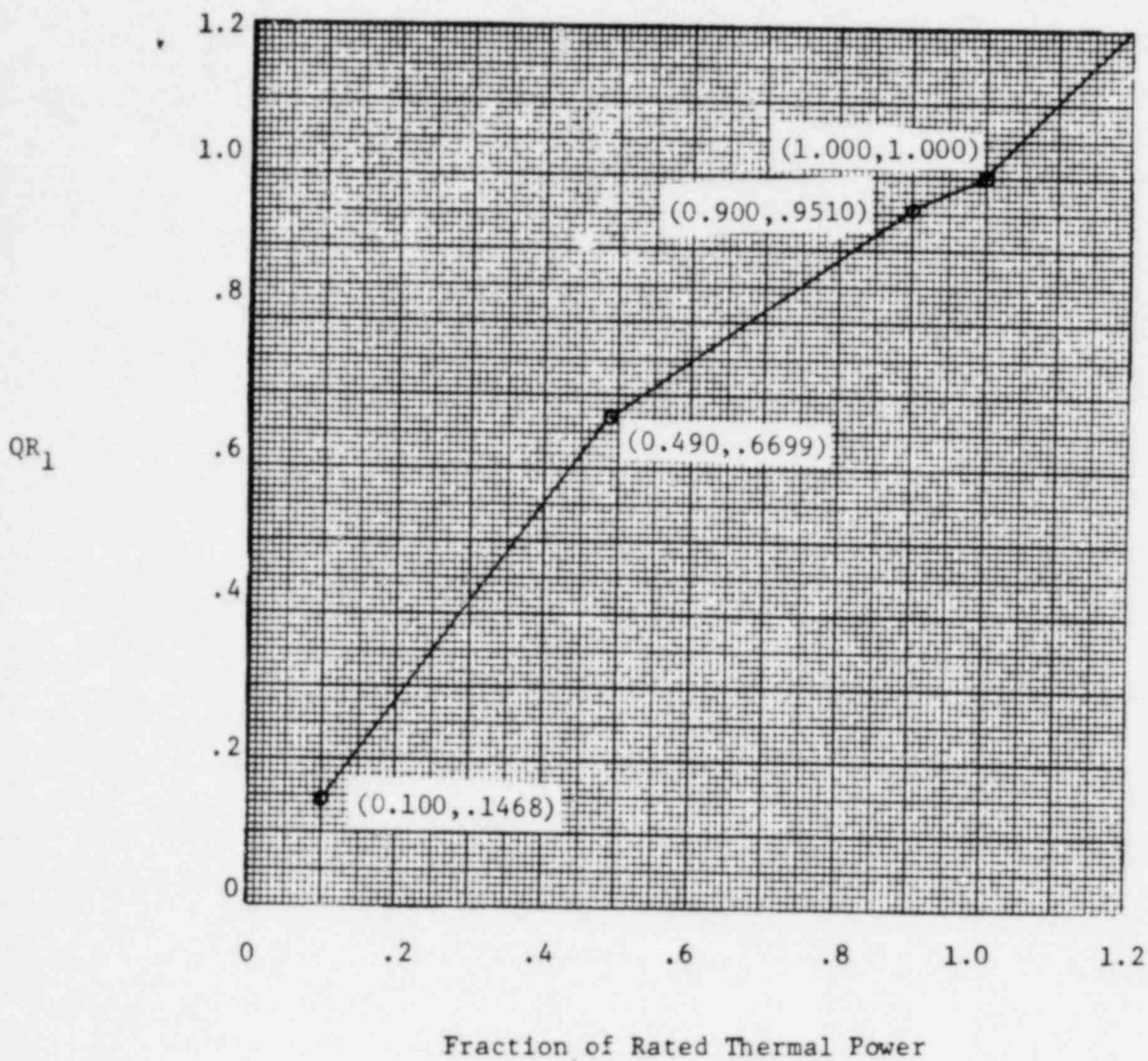


MAINE YANKEE Technical Specification	Thermal Margin/Low Pressure Trip Setpoint Versus (Y_I versus A_1)	Figure 2.1-1a

Where: $Q_{DNB} = A_1 \times QR_1$

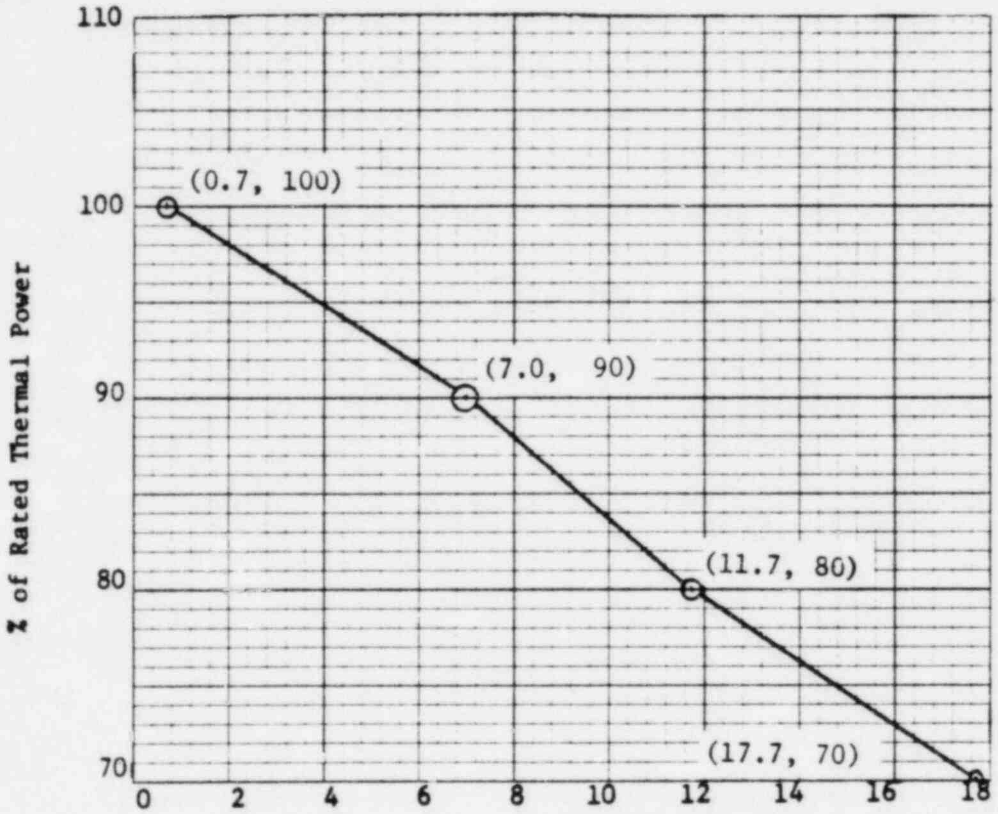
$ptrip_{var} = 2168.6\ Q_{DNB} + 17.0\ T_{in} - 9600.1$

T_{in} = Cold leg temperature



MAINE YANKEE Technical Specifications	Thermal Margin/Low Pressure Trip Setpoint Part 2 (Fraction of Rated Thermal Power versus QR_1)	Figure 2.1-1b

Note: CEA's are maintained at or above the 100% power insertion limit when applying 3.10.B.2.2b



Allowable % Increase in F_R^T (above Figure 3.10-4)

MAINE YANKEE Technical Specification	Allowable Power Level vs. Increase in Total Radial Peak	Figure 3.10-5