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July 6, 1984

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Byron Generating Station Units 1 & 2
Braidwood Generating Station Units 1 & 2
Subcooling Margin Monitor
NRC Docket Nos. 50-454, 50-455, 50-456, and 50-457

Reference (a): April 20, 1984 letter from B. J. Youngblood to D. L. Farrar.

Dear Mr. Denton:

This letter provides additional information regarding the instrumentation being installed at the Byron/Braidwood units for the detection of inadequate core cooling. Specifically, this letter describes the manner in which the operator can determine the core coolant subcooling with single failures in the instrumentation systems.

Reference (a) requested that Commonwealth Edison document the manner in which the subcooling margin monitoring instrumentation would conform to the NUREG-0737, Item II.F.2 single failure criterion. From discussions with the NRC staff, we understand that this refers to the following portion of Criterion 2 of Appendix B to NUREG-0737:

> "No single failure within either the accident-monitoring instrumentation, its auxiliary supporting features or its power sources concurrent with the failure that are a condition or result of a specific accident should prevent the operator from being presented the information necessary for him to determine the safety status of the plant and to bring the plant to a safe condition and maintain it in a safe condition following that accident."

Attachment A to this letter describes the features of the instrumentation and operating procedures which address this requirement. This description includes changes which have been made to address specific concerns identified during NRC meetings and conference calls. A highly reliable system for operator determination of subcooling margin is being provided. Sufficient redundancy and diversity is provided to support all emergency procedure requirements, even in the event of single failures in the installed instrumentation. Human factors reviews have assured us that the instrumentation and procedures will be easy to use.

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Please address further questions regarding this matter to this office.

One signed original and fifteen copies of this letter and the attachment are provided for NRC review.

Very truly yours,

T. R. Tramm

T. R. Tramm
Nuclear Licensing Administrator

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Attachment

8924N

ATTACHMENT A

Determination of Subcooling Margin

Byron/Braidwood

Instrumentation

Subcooling is normally determined from two separate safety-related wide range reactor coolant pressure instrument channels and sixty-five core exit thermocouples. Operating procedures govern the use of this instrumentation in the determination of subcooling. Other installed instrumentation could be useful in particular emergency situations but no credit needs to be taken for that other equipment to assure an adequate determination of subcooling margin given single failures.

Each of the wide range reactor coolant pressure channels is powered from a separate ESF bus. The pressure is displayed on control board indicators and can also be displayed on any of the various process computer output devices, including the CRT's which are mounted in the main control boards.

Two digital thermocouple monitors are used for control board display of the temperatures measured by the 65 core exit thermocouples. The process computer can also read each thermocouple. The two thermocouple monitor displays are each powered from a separate ESF bus. The 65 thermocouples are separated into two groups, and each group is read by an individual thermocouple monitor display. There are 33 thermocouples on one display unit and 32 on the other. The thermocouples have been grouped so that either monitor can display representative temperatures across the entire core cross section.

Determination of Subcooling Margin

Normally, the plant process computer will compute the degrees of subcooling from saturation and output this number in digital form on the wide range SPDS ionic display. The wide range SPDS iconic will be constantly displayed on one of the two CRT's mounted in the main control board. At the reactor operator's option, the computed subcooling can also be displayed for trending in analogue form on a panel mounted strip chart recorder or on selectable graphic displays.

The Proteus process computer is designed to be highly reliable. It can be powered from either of two AC sources or from a battery during short AC interruptions. Multiple CPU's and redundant internal power supplies also contribute to high computer reliability. These features are described in more detail in the response to FSAR question 31.15. The availability of the process computer is expected to be at least 99%.

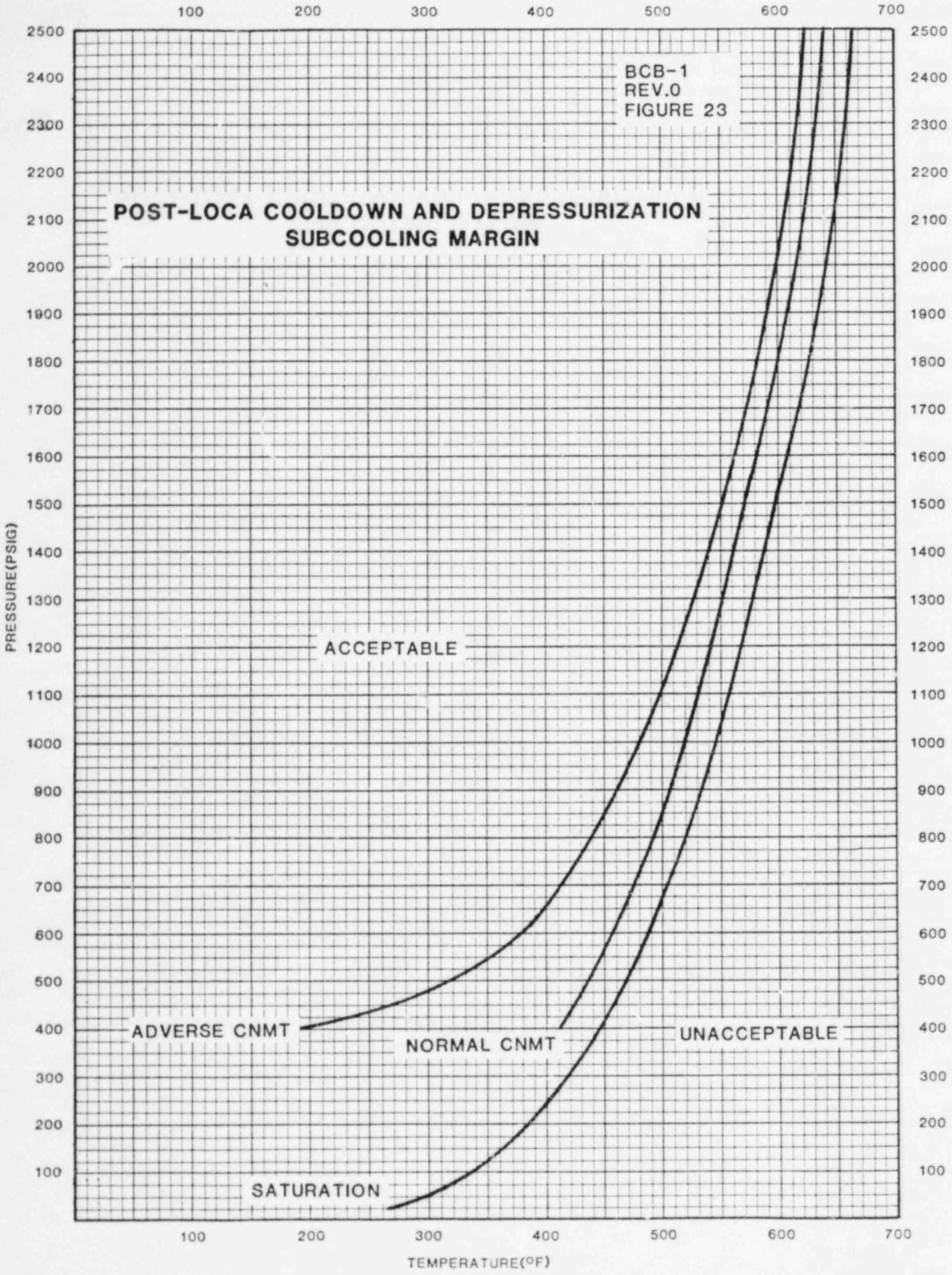
The minimum subcooling margin varies with reactor pressure because of the varying effect of pressure measurement error. Allowances for instrument error are also necessary under adverse containment conditions. The process computer will automatically determine the appropriate subcooling margin. The color of the digital display will change if the measured subcooling does not meet the margin requirement. The preestablished subcooling margin requirements are also available for reference by the operator as described below. The emergency operating procedures specify the actions to be taken when the subcooling margin is determined to be inadequate (usually reinitiation of safety injection).

Alternate Subcooling Margin Determination

In the unlikely event that the process computer display of subcooling is not available, the reactor operator will determine the subcooling manually. The wide range pressure indicators on the main control board are used in conjunction with adjusted saturation curves to determine the maximum allowable core exit temperature. The curves to be used are shown in the attached Figure 23, which is referred to as a job performance aid (JPA). The saturation line has been adjusted to include allowances for instrumentation errors for both normal and adverse containment conditions. The temperature determined from this figure can be compared directly to the average value of the ten highest functional thermocouples which is displayed on each of the two panel-mounted digital thermocouple monitors.

The temperature limits shown on Figure 23 contain allowance for instrument errors. The curve on the right is simply the saturation curve for water. This is provided for reference. The middle curve is the allowable subcooling margin for normal containment. This curve is simply the saturation curve minus the degrees of subcooling error from Table A, column 1. Table A was formerly incorporated into the operating procedures and the operators were required to make this determination under all conditions. The left curve is the adverse containment curve, obtained by subtracting the values of Table A, column 2 from the saturation curve.

Using the wide range pressure, the operator reads across the appropriate subcooling margin curve (adverse or normal). He then reads down to obtain his maximum allowable T/C temperature for comparison with the value displayed on the thermocouple monitors. The operator monitors the four containment pressure indicators at the MCB and the two containment radiation monitors to determine if the containment is at normal or adverse conditions.


BCB-1
REV.0
FIGURE 23
POST-LOCA COOLDOWN AND DEPRESSURIZATION
SUBCOOLING MARGIN
ACCEPTABLE
ADVERSE CNMT
NORMAL CNMT
UNACCEPTABLE
SATURATION
PRESSURE(PSIG)
TEMPERATURE(°F)
100
200
300
400
500
600
700
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100

STEP	ACTION/EXPECTED RESPONSE	RESPONSE NOT OBTAINED

TABLE A
PRESSURE DEPENDENT SUBCOOLING ERROR VALUES

RCS PRESSURE (PSIG)	COLUMN 1 SUBCOOLING ERROR (°F) NORMAL CONTAINMENT	COLUMN 2 * SUBCOOLING ERROR (°F) ADVERSE CONTAINMENT
2500 - 1750	26	42
1700	26	43
1650	26	44
1600	26	45
1550	26	45
1500	26	46
1450	26	48
1400	26	49
1350	26	50
1300	26	51
1250	26	52
1200	26	54
1150	27	56
1100	27	58
1050	27	61
1000	27	63
950	27	66
900	28	69
850	28	73
800	28	77
750	29	83
700	29	89
650	30	98
600	30	108
550	31	125
500	32	155
450	33	214
400	35	260

* Adverse containment is defined as:

(1) Containment pressure greater than 5 PSIG

- OR -

(2) Containment radiation greater than 10^4 R/Hr.