ABB

April 15, 1996
LD-96-009

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Report of a Deviating Condition in a Reactor Trip Function

Dear Sir:

Combustion Engineering, Inc. (ABB-CE) hereby notifies the Nuclear Regulatory Commission of a condition or circumstance involving a reactor protection system trip function which has the potential to contribute to the exceeding of a safety limit. The deviating condition evaluated involves nuclear instrumentation decalibration factors, which may not have been adequately compensated for fully when originally setting the trip setpoint, and which, therefore, have the potential to adversely affect the High Logarithmic Power channel trip function. The uncompensated decalibration factors are potentially nonconservative in nature and could, therefore, cause a trip, if needed, to occur at a power level higher than that accounted for in safety analyses.

Evaluations were performed by ABB-CE to determine if this situation would in fact result in exceeding any safety limits. Based on the result of these evaluations ABB-CE has concluded that because of the discretionary conservatism built into the input parameters for the one affected safety analysis, that the original High Logarithmic Power trip setpoint remains acceptable without creating the potential to exceed a safety limit. ABB-CE has chosen to report this condition because the situation could conceivably be applicable to other NSSS vendor designs utilizing a reactor protection system trip for subcritical events based upon absolute power if nuclear instrumentation decalibration factors are not accounted for appropriately. The Enclosure provided herewith summarizes the information available to ABB-CE regarding the subject condition.

Combustion Engineering, Inc. P.O. Box 500 2000 Day Hill Rd. Windsor, CT 06095-0500 Telephone (860) 688-1911 Fax (860) 285-5203

JE09

If you have any questions, please feel free to contact me or Mr. Chuck Molnar of my staff at (203) 285-5205.

Very truly yours,
COMBUSTION ENGINEERING, INC.

I. C. Rickard, Director
Operations Licensing

Enclosure: As stated

cc: R. S. Siudek (ABB-CE)

ENCLOSURE

ABB Combustion Engineering Nuclear Operations

Report of a Deviating Condition in a Reactor Trip Function

April 15, 1996

ABB Combustion Engineering Nuclear Operations
Report of a Deviating Condition in a Reactor Trip Function

(i) Name and address of the individuals informing the Commission:

I. C. Rickard, Director
Operations Licensing
Combustion Engineering, Inc.
2000 Day Hill Road
Windsor, CT 06095-0500

*(ii) **Identification of the facility, the activity, or the basic component supplied or such facility or such activity within the United States which fails to comply or contains a defect:***

The condition being reported was initially identified at the Waterford Steam Electric Station Unit No. 3 (WSES-3). Specifically, the deviating condition involves nuclear instrumentation decalibration factors, which may not have been adequately compensated for fully when originally setting the trip setpoint. These decalibration factors are related to the reactor High Logarithmic Power channel trip function and are potentially nonconservative in nature.

*(iii) **Identification of the firm constructing the facility or supplying the basic component which fails to comply or contains a defect:***

Combustion Engineering, Inc.
2000 Day Hill Road
Windsor, CT 06095-0500

(iv) Nature of the defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply:

Although the High Logarithmic Power trip function is only credited at low power levels (from $\leq 10^{-4}$ % to 2% rated power), the log channel instrument calibration is routinely performed at 100% power. Calibrating the log channels at near full power conditions, however, does not account for the effects of lower primary coolant temperatures, higher boron concentrations, changes in control rod position (all rods in), etc., when a plant is operating in Mode 2 subcritical or Mode 3, the potential condition at the initiation of the subcritical transients.

The effects of the low power, low RCS temperature or more heavily rodded condition are to reduce the neutron flux leakage to the excore detectors. Therefore, the actual power in the core could potentially be higher than the analytical limit utilized in the safety analysis when a High Logarithmic Power trip or a CPC Zero Power Bypass removal occurs.

An investigation of the decalibration effects identified cycle specific core design differences that were not fully compensated for in the original evaluation of the log power trip setpoint.

These effects result in a lower flux reaching the excore detectors for a given power level. The investigation showed that conditions exist at low power, where the High Log Power trip is required, that could introduce nonconservative factors relative to the full-power conditions where the instruments are calibrated.

Tripping the reactor at a power level higher than that analyzed could represent "A condition or circumstance...that could contribute to the exceeding of a safety limit ...".

(v) The date on which the information of such defect or failure to comply was obtained:

ABB-CE concluded that NRC notification may be warranted on April 15, 1996.

(vi) In the case of a basic component which contains a defect or fails to comply, the number and location of all such components in use at, supplied for, or being supplied for one or more facilities or activities subject to the regulations in this part:

The potential for low power decalibration may adversely affect ABB-CE designed NSSS units with Logarithmic Power Level trips (digital plants) as opposed to Start-up Rate trips (analog plants); the affected digital plants include ANO-2, SONGS-2 & 3, Waterford-3, Palo Verde-1, 2 & 3, and Yonggwang-3 & 4.

ABB-CE plants with analog protection systems rely upon a Start-up Rate trip; where the trip is based upon how fast the signal changes in a given time period (decades per minute) versus tripping on an absolute magnitude of the signal (percent power). While the input signal to this trip would still be subject to the same decalibration effects, the relative change in signal (decades per minute) for any given rate of approach to critical would not be adversely impacted. As such, the protective function provided by the Start-up Rate trip would not be adversely impacted.

(vii) The corrective action which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that has been or will be taken to complete the action:

Affected utilities should ensure that log power channels are properly calibrated and cross-correlated to the linear power channels at 100% reactor power. This calibration procedure should include a term adequate to account for the potential differences in flux signal between the conditions at calibration and the conditions where the protective function may be depended upon. Since the actual plant cycle specific conditions determine flux levels needed for instrument calibration, ABB-CE was unable to generically provide the specific data needed to account for differences between 100% power calibration and the actual use point of less than 10^{-4}% power without performing plant specific evaluations. The log power trip is typically bypassed above the 10^{-4}% power level. Further, affects on instrumentation calibration should be specifically considered if fuel management schemes are changed.

As an interim corrective action, ABB-CE determined that lowering the existing trip setpoint by a factor of 10 would conservatively compensate for the decalibrating effects discussed above. Based on the result of plant specific evaluations, ABB-CE has concluded that

because of the discretionary conservatism built into the input parameters for the one affected safety analysis, that the original High Logarithmic Power trip setpoint remains acceptable without creating the potential to exceed a safety limit. That is, the plant specific analyses show that the original trip setpoint (i.e., prior to the interim decrease by a factor of 10) remains acceptable. As a result, removal of the interim measure and continued operation using the original trip setpoint is justified.

(viii) Any advice related to the defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees:

When the subject situation first developed, ABB-CE issued an Infobulletin (attached) to advise owners of ABB-CE designed NSSSs.

ABB

Combustion Engineering *Infobulletin*

No. 96-01

Instrumentation Decalibration at Low Power

Introduction: The High Logarithmic Power trip protects against an inadvertent CEA withdrawal event at low power. An evaluation of readings from the log power excore channels and the linear power channels at one plant identified effects that can contribute to an overall decalibration of the detector readings. The result of these effects can produce potential nonconservative instrumentation readings due to conditions at low power being different from the full power operating conditions at which the instrumentation is calibrated. A conservative upper bound estimate for the magnitude of these decalibration effects and a compensating change in the High Log Power trip setpoint has been made to ensure that the results of certain design basis events remain within the bounds of results currently reported in the updated safety analysis report.

Discussion: Calibrating the log channels at near full power conditions does not account for the effects of lower primary coolant temperatures, higher boron concentrations, all rods in, etc., for a plant operating at less than 10^{-4}% power. An investigation of the decalibration effects identified core design and power level differences that were not fully compensated in the original evaluation of the log power trip setpoint. The investigation showed that conditions exist at low power, where the High Log Power trip is required, that could introduce nonconservative factors relative to the full-power conditions. These effects could result in a lower flux reaching the excore detectors for a given power level. Therefore, the actual power in the core could potentially be higher than the analytical limit when a High Log Power trip or a CPC Zero Power Bypass removal occurs.

Periodic recalibration of this trip setpoint would help identify potential instrument drift problems, but would not eliminate the decalibrating factors between 100% power and zero power. Further, an "electrical-only" calibration of the instrument (which reads in volts) without cross-correlating against flux means that the voltage calibration may not accurately correlate with core power (via the flux measurement of the excores).

Recommendation: Affected utilities should ensure that log power channels are properly calibrated and cross-correlated to the linear power channels at 100% reactor power. Since the actual plant conditions and core design enter into the determination of flux levels needed for instrument calibration, ABB is unable to generically specify the data needed to account for differences between 100% power calibration and the actual conditions of requiring exact Log Power indication power without performing plant specific evaluations. Also, this issue should be specifically considered when fuel management schemes are changed. As an interim corrective action, CE believes that lowering the existing log power trip setpoint by a factor of 10 will compensate conservatively for the decalibrating effects discussed above.

Applicability: The potential for low power decalibration affects all CE NSSS units. However, only those operating plants with digital reactor protection system, including ANO-2, SONGS-2 & 3, Waterford-3, Palo Verde-1, 2 & 3, and Yonggwang-3 & 4, incorporate a trip that could be adversely affected by a change in the absolute magnitude of the log power signal. Earlier plants with analog protection systems are not affected by this decalibration effect since they rely upon the start-up rate trip, where the trip is based upon how fast the signal changes in a given time period (decades per minute) versus tripping on the absolute magnitude of the signal (percent power).

Technical Contact: Kelly McQuoid, 860-285-2326 or Steve O'Hearn, phone, 860-285-2770

PR 21 96350 Vern Hodge

ABB COMBUSTION ENGINEERING NUCLEAR OPERATIONS
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FROM: CHUCK MOLNAR
TELEPHONE: (203) 285-5205
FAX NO: (203) 285-2337

TO: *NRC Operations Center* COMPANY: *NRC*

SUBJECT: Report of a Potential Deviating Condition in a Reactor Trip Channel

Attached is a copy of a letter documenting a potential deviating condition in a reactor trip channel. The evaluation of this condition for ABB-CE plants has determined that there is no resultant safety concern.

I CALLED CHUCK MOLNAR AND HE INDICATED (AFTER SOME DISCUSSION) THAT THIS WAS A PART 21 REPORT

Engineering

PART 21

DATE: April 15, 1996 SIGNED: Chuck Molnar

This is Page 1, with 7 page(s) to follow.