DUKE POWER COMPANY
CATAWBA NUCLEAR STATION

Report No.: SD 413-414/79-02

Report Date: August 20, 1979

Facility: Catawba Nuclear Station - Units 1 and 2

Identification of Deficiency: Steam Generator Water Level Measurement System Errors

Description of Deficiency:

This deficiency is as described in the attached June 22, 1979 letter, NS-TMA-2104, from T M Anderson, Manager, Nuclear Safety, Westinghouse to Victor Stello, Director, Office of Inspection and Enforcement, US Nuclear Regulatory Commission. Westinghouse reported this deficiency to the NRC as a substantial safety hazard under 10CFR21 for operating plants and as a significant deficiency under 10CFR 50.55(e) for plants under construction.

Analysis of Safety Implication:

The safety implications of this deficiency are also presented in the attached Westinghouse letter (NS-TMA-2104). This letter outlines the diverse backup signals that are provided in the plant design for reactor trip and auxiliary feedwater initiation. Due to the above mentioned backup signals, and since this deficiency was identified during the plant construction phase prior to operation, the health and safety of the public were not affected.

Corrective Action:

Westinghouse is pursuing resolution of this deficiency on a generic basis for plants under construction. Upon finalization of this generic solution, the specific corrective action for the Catawba Nuclear Station will be outlined in a subsequent report to NRC.

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June 22, 1979

NS-TMA-2104

POOR ORIGINAL

Mr. Victor Stello
Director, Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
East West Towers Building
4350 East West Highway
Bethesda, Maryland 20014

Dear Mr. Stello:

Subject: Steam Generator Water Level

This is to confirm my telephone conversation of June 21, 1979 with Mr. Norman C. Moseley, Director, Division of Reactor Operation and Inspection and Mr. Samuel E. Bryan, Assistant Director for Field Coordination. In that conversation, I reported that Westinghouse had informed its utility customers of corrections that should be applied to indicated steam generator water level and recommended that they incorporate those corrections in the steam generator low water level protection system setpoints and emergency operating procedures for operating plants as appropriate.

High energy line breaks inside containment can result in heatup of the steam generator level measurement reference leg. Increased reference leg water column temperature will result in a decrease of the water column density with a consequent apparent increase in the indicated steam generator water level (i.e., apparent level exceeding actual level). This potential level bias could result in delayed protection signals (reactor trip and auxiliary feedwater initiation) which are based on low-low steam generator water level. In the case of a feedline rupture, this adverse environment could be present and could delay or prevent the primary signal arising from declining steam generator water level (low-low steam generator level). The following is a list of backup signals available in those Westinghouse plants which take credit in their Final Safety Analysis Reports for steam generator water level trip with an adverse containment environment: overtemperature delta T; high pressurizer pressure; containment pressure and safety injection. For other high energy line breaks which could introduce a similar positive bias to the steam generator water level measurement, steam generator level does not provide the primary trip function and the potential bias would not interfere with needed protective system actuation.

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Westinghouse has advised all customers with affected operating plants that the potential temperature-induced bias in indicated level can be compensated for by raising the steam generator low-low water level setpoint. For immediate action, Westinghouse has recommended a change in the allowable water level setpoint sufficient to accommodate the bias (up to 10% of level) which could result from containment temperatures up to 280°F. Containment analyses following a secondary high energy line break on typical plants have shown that a containment high pressure signal would be generated before the containment temperature reaches 280°F. Thus, postulation of all water-level measurement errors occurring simultaneously in the adverse direction results in the containment high pressure signal becoming the primary protective function following some feedline rupture events, i.e., for those cases in which the containment temperature exceeds 280°F before a steam generator low-low water level trip is actuated, the high containment pressure signal provides protection. The combination of the revised low-low water level setpoint and the high containment pressure signal will provide reactor trip and auxiliary feedwater initiation following a feedline rupture and will ensure that the feedline break criteria stated in the Safety Analysis Reports continue to be met. Some applicants may choose to use plant-specific containment analyses, possibly combined with changes in the containment high-pressure setpoint, to justify reducing the bias introduced due to reference leg heatup which must be accommodated in the steam generator low-low water level setpoint.

The potential steam generator level measurement bias also has implications for post-accident monitoring considerations. Since the post-accident environment for high energy line breaks can exceed 280°F, the level bias can exceed the 10% limit which must be considered for protection system actuation. A positive bias of up to 20% can be anticipated for an extreme environmental condition. The appropriate bias must be coupled with instrumentation and other process errors, to determine the required range of indicated level to be maintained during post-accident monitoring to ensure that the steam generator tubes are fully covered and the steam generator is not water solid. Westinghouse has provided all of its customers with operating plants with information to enable them to modify their emergency operating procedures to ensure that suitable steam generator level temperature bias allowance is made.

In a related area, it has been found that a bias in steam generator level may also be introduced by changes in steam generator pressure, due to changes in steam generator fluid densities. Westinghouse has quantified this effect for all of its customers with operating plants. Westinghouse has notified all customers with operating plants that such a bias will exist in the level indication of all steam generators and that the operator should be instructed to monitor steam generator pressure, as well as level, to ensure that the potential bias is reflected in his post-accident recovery actions.

Also, following depressurization of any steam generator, boiling could conceivably occur in the reference leg and cause a major bias for a short time period. Westinghouse has notified all customers with operating plants that the water level indication in the depressurized steam generators may be erroneous due to the potential boiling in the reference leg.

For plants under construction, customers have been advised of the above affects, and the options open to them for corrective action will be reviewed in a timely manner. The NRC will be advised of proposed resolutions for these plants.

The attached tables have been supplied to all customers. They have been informed that we are reporting this to you as a potential substantial safety hazard under 10CFR21 in operating plants and as a significant deficiency under 10CFR50.55(e) for plants under construction.

Should you have any questions on this material, please contact Mr. K. R. Jordan (412/373-4795).

Very truly yours,

Westinghouse Electric Corporation

T. M. Anderson

T. M. Anderson, Manager
Nuclear Safety

JPC:kk

cc: Mr. Norman C. Moseley
Director, DRO&I

Mr. Samuel E. Bryan
Asst. Director, DRO&I

TABLE 1

Correction to indicated steam generator water level for Reference Leg Heatup effects due to post-accident containment temperature (before reactor trip)

Maximum containment temperature reached before reactor trip, °F	Correction to S/G Level, % of Span
90°	0%
200°	4%
280°	10%
320°	13%
400°	20%

POOR ORIGINAL

BASIS:

- Level Calibration Pressure ≤ 1000 psia
- Reference Leg Calibration Temperature ≥ 90°F
- Height of Reference Leg ≤ 1.1x Level Span

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TABLE 2

Corrections to allowable indicated steam generator water level for Reference Leg Heatup and Pressure changes following a high-energy line break. to assure that true level is between the level taps

POOR ORIGINAL

Containment Temperature °F	Correction To Mininum Allowed Indicated Level, % of Span	Corrections to Maximum Allowed Indicated Level, % of Span
90°	+ 1	- 4
200°	+ 6	- 4
280°	+11	- 4
320°	+14	- 4
400°	+21	- 4

BASIS:

Level Calibration Pressure ≤ 1000 psia

Reference Leg Calibration Temperature ≥ 90°F

Height of Reference Leg ≤ 1.1 x Level Span

Pressure ≥ 50 psia

Pressure ≤ 200 psi + Calibration Pressure

Boiling in the Reference Leg is not assumed.