PART 21 IDENTIFICATION NO. 80-303-000 COMPANY NAME General Electric

DATE OF LETTER 10/24/80 DOCKET NO. 50-259/260/296; 50-237/249; 50-254/265

DATE DISTRIBUTED 10/28/80 p.m. ORIGINAL REPORT [X] SUPPLEMENTARY [ ]

DISTRIBUTION:

REACTOR (R) [X]

IE FILES
AD/ROI
AD/RCI
REGIONS I,II,III,IV,V
VENDOR BR. R-IV
LOEB / MPA MNB 5715
AEOD MNB 7602
NRR/DOE
NRR/DSI
NRR/DST
NRR/DOL
ASLBP E/W 450

CENTRAL FILES 016
CENTRAL FILES (CHRON)
PDR
LPDR
TERA

FUEL CYCLE & MATERIALS (M) [ ]

IE FILES
AD/FFMSI
REGIONS I,II,III,IV,V
VENDOR BR. R-IV
NMSS / FCMS SS-396
LOEB / MPA MNB 5715
AEOD MNB 7602
ASLBP E/W 450
SAP/SP MNB-7210A

CENTRAL FILES 016
CENTRAL FILES (CHRON)
PDR
LPDR
TERA

SAFEGUARDS (S) [ ]

IE FILES
AD/SG
AD/ROI
REGIONS I,II,III,IV,V
VENDOR BR. R-IV
NRR/DOL
NMSS / SG SS-881
LOEB / MPA MNB 5715
AEOD MNB 7602
ASLBP E/W 450

CENTRAL FILES 016
CENTRAL FILES (CHRON)
CENTRAL FILES SS-395
PDR
LPDR
TERA

ACTION:

PRELIMINARY EVALUATION OF THE ATTACHED REPORT INDICATES LEAD RESPONSIBILITY FOR FOLLOWUP AS SHOWN BELOW:

IE [X] NRR [ ] NMSS [ ] OTHER [ ]

RCI
ROI
SG
FFMSI

8011030629

5

REV. 8/1/80
9/17/80

NRC Part 21 #15
50-303-006

GENERAL ELECTRIC

NUCLEAR POWER

SYSTEMS DIVISION

GENERAL ELECTRIC COMPANY, 175 CURTNER AVE., SAN JOSE, CALIFORNIA 95125
MC 682, (408) 925-5040

MFN-182-80
TRR-124-80

50-259/260/296 •
50-237/249 •
50-254/265 •

October 24, 1980

U. S. Nuclear Regulatory Commission
Office of Inspection and Enforcement
Washington, D. C. 20555

Attention: Victor Stello, Jr., Director

Gentlemen:

SUBJECT: REPORTABLE CONDITION CONTAINMENT ATMOSPHERE MONITORING SYSTEM (CAMS)

This is to advise the NRC of a reportable defect per 10CFR, Part 21 as reported to Mr. H. D. Thornburg your office by Walter H. D'Ardenne, Manager, Safety Evaluation Programs on October 23, 1980. This defect is in the CAMS system.

The condition is the failure of the Containment Atmosphere Monitoring System (CAMS) hydrogen sensors to provide accurate hydrogen concentration measurements in the containment following a LOCA. Although it is a very unlikely event, when subjected to radiation of 10^4, 10^5, and 10^6 R/hr, the sensor error is approximately 10%, 75%, and 300% respectively. Realistic LOCA analysis show radiation levels in the range of 10^4 R/hr; however, conservative licensing analysis show 10^5 to 10^6 R/hr and thus reportable under 10CFR Part 21. A revised operating procedure will ensure proper operation of the hydrogen detectors.

The new procedure referred to a "Digital Mode Operating Procedure" will provide a method to determine whether hydrogen is present in the containment and whether the concentration of hydrogen is above or below a particular value.

The defect was judged reportable on October 23, 1980. Attached is the report of the defect as it affects BWR's.

General Electric has informed the utilities affected by the defect and advised them of the corrective action.

Very truly yours,

Glenn G. Sherwood, Manager
Safety and Licensing Operation

GGS:csc:ggo/2K

Attachment

cc: Mr. V. Potapovs, NRC, Region IV

HYDROGEN SENSOR INACCURACIES

Recent testing of hydrogen sensors for post-LOCA containment hydrogen measurement revealed inaccuracies in the output of the sensors. When exposed to radiation doses of 10^4 R/hr, 10^5 R/hr, and 10^6 R/hr, and 10^6 R/hr, the sensor output was in error by 10%, 75%, and 300% respectively at 75°F. Results of testing at high temperatures (185°F) were the same as the testing at 75°F with the exception of a dose rate of 10^4 R/hr. At a dose rate of 10^4 R/Hr and 185°F it could not be determined with certainty whether or not there was a radiation effect.

The suspected cause of the sensor output inaccuracy is radiolysis of the sulphuric acid/water electrolyte increasing the sensing chamber hydrogen concentration.

General Electric has informed the utilities affected by the defect and advised them of the corrective action. This procedure is based on the fact that the sensors exhibit a rapid, easily discernible response to a step change in hydrogen concentration. The details are described in Attachment A.

The affected plants are:

Browns Ferry 1, 2 and 3
Dresden 2 and 3
Quad Cities 1 and 2

TRR:csc:ggo/2M1

ATTACHMENT A

"DIGITAL" OPERATING PROCEDURES FOR GE VALLEY FORGE HYDROGEN SENSORS IN BWRs WITH INERTED CONTAINMENTS AND CONTAINMENT ATMOSPHERE DILUTION SYSTEMS

1.0 Summary

This report describes a revised set of operating procedures for the hydrogen sensors supplied by General Electric as part of the Containment Atmosphere Monitoring System (CAMS). These procedures are applicable to Boiling Water Reactors having inerted containments and Containment Atmosphere Dilution Systems. These procedures shall be implemented in order to ensure that previously accepted estimates of containment hydrogen concentration and offsite radiation dose will not be exceeded in the event of a loss-of-coolant accident (LOCA).

2.0 Digital Operating Procedures

2.1 Concept

The hydrogen sensors currently supplied as part of the CAM system are manufactured by the General Electric Space Division in Valley Forge, Pennsylvania.

These sensors were originally qualified for post-LOCA service in 1976. Since that time there has been extensive additional testing of these sensors, both in laboratory and field use. These tests have continually demonstrated a specific functional characteristic of the sensors, namely, that they exhibit a rapid and easily discernible change in output in response to a step change in hydrogen concentration. By virtue of this characteristic, the "digital" procedures described in this section can be used following a LOCA to determine quickly and easily;

1) whether hydrogen is present in the containment, and

2) whether the concentration of hydrogen in the containment is above or below a particular value.

Specifically, if the sensor in a post-LOCA environment is subjected to a step change in hydrogen concentration by the application of a calibration gas, the output of the sensor will abruptly change as follows:

a) increase when the hydrogen concentration in the calibration gas is greater than in the containment,
b) remain unchanged when the hydrogen concentration in the calibration gas is equal to that in the containment,
c) decrease when the hydrogen concentration in the calibration gas is lower than in the containment.

In the special case where the hydrogen concentration in the applied calibration gas is zero, a decrease in sensor output would indicate the presence of hydrogen in the containment.

2.2 Applicability

The procedures described in the following sections are applicable to inerted BWRs in which post-LOCA hydrogen control is achieved by use of the Containment Atmosphere Dilution and Containment Purge (CAD/Purge) Systems. Similar procedures can be applied to other plants utilizing GE Valley Forge hydrogen sensors as well; however, such applications are discussed in separate reports.

2.3 Hardware Change

The following change is necessary to implement the digital procedures in section 2.5:

Replace the existing "span" calibration gas with 3.5% H_2 in N_2.

2.4 Pre-LOCA Surveillance Procedures

If sensors are to be used in the digital mode following a LOCA, monthly surveillance testing need only demonstrate that the sensor continues to be functional. Since there are no absoluate sensitivity criteria which must be met, specific surveillance procedures will not be addressed in this report. However, in order to facilitate the early steps following a LOCA, it is recommended that the final step during surveillance testing be to flow N_2 gas (zero calibration gas) to the sensor long enough to purge any remaining span gas from the calibration gas supply lines.

2.5 Post-LOCA Digital Procedures (single sensor)

Following a LOCA:

a) Turn on the zero calibration gas for 2 minutes. If the slope of the sensor output decreases, initiate CAD at the design flow rate and proceed to b).

   If the slope of the sensor output does not decrease, repeat this step every 20 minutes.

b) Step "a" has indicated that H_2 is present in the post-LOCA containment atmosphere. Turn on the span gas for at least 10 minutes to purge the zero gas from the calibration gas lines, then turn off. Wait 20 minutes and then proceed to c).

c) Turn on the span gas for 2 minutes. If the slope of the sensor output decreases, initiate purge (at the maximum permissible rate consistent with offsite dose considerations) and proceed to d).

   If the drywell pressure reaches the currently specified limit for CAD operation, terminate CAD operation.

Repeat this step every 20 minutes, as long as containment hydrogen concentration remains below decision concentration.*

d) Step c) has shown the containment hydrogen concentration to be above the decision concentration.

If the drywell pressure is below the limit, use CAD and purge at the maximum permissible rates until the concentration drops below the decision concentration (check every 20 minutes using procedure of step c)). Then go to step c). If the drywell pressure reaches the limit, reduce the CAD injection rate to equal the maximum permissible purge rate until the hydrogen concentration drops below the decision concentration. (Check every 20 minutes using the procedure of step c)). Then go to step c).

In addition to the digital procedures defined above, additional sensors, if available, may be recalibrated following the LOCA and used in the conventional mode to provide basic trend information. However, only measurements made in the digital mode should be relied upon for CAD/Purge decisions.

3.0 Discussion of Safety Impact of Digital Mode Operation

Analyses have been performed and verified which confirm that operation of CAD/Purge systems in accordance with the procedures of section 2.5 will not result in unacceptable post-LOCA hydrogen concentrations or offsite radiation doses. The following example pertains specifically to Browns Ferry; however, the conclusions are applicable to all plants meeting the criteria of Section 2.2.

---

*Decision concentration = 3.5% H_2

The current post-LOCA procedures for Browns Ferry can be summarized as follows:

a) Add N_2 to primary containment to maintain H_2 <4% by volume

b) If containment pressure reaches 30 psig, or ten days after LOCA, begin venting. If venting begins within the first 10 days, it shall be limited to 100 scfm.

A bounding case analysis for post-LOCA hydrogen control at Browns Ferry is referenced and discussed in the Browns Ferry Plant Technical Specifications. In that analysis, CAD is initiated at t=2 hours post-LOCA, and containment venting commences at approximately t=20 hours in order to maintain containment hydrogen concentrations below 4%. It is clear that if the current operating procedures are replaced by the digital operating procedures of section 2.5, the effect might be to initiate CAD somewhat earlier, i.e., within the first 2 hours. However, containment purge would not commence until somewhat later than in the existing analysis, since earlier CAD initiation would postpone the time at which the containment hydrogen concentration would approach 4%. Thus, it is clear that there would be no increase in offsite dose or in peak hydrogen concentration resulting from operation under the digital procedures.

4.0 Digital Mode Verification

Tests to verify the feasibility of the digital mode procedures were conducted by the sensor vendor in late August and early September, 1980. The test procedures and test report can be found in Appendix A of this report.

Test results show that the sensors respond quickly and definitively to step changes in hydrogen concentration of 0.3% absolute H_2. It can therefore be concluded that the overall accuracy of the digital procedures is better than 0.5% absolute H_2. Of course, allowance must be made for

any uncertainty in the actual hydrogen concentration of the calibration gases. This demonstrated accuracy is sufficient to meet all post-LOCA safety criteria.