UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

LONG-TERM HYDROGEN MONITORING CAPABILITIES AND RELIEF REQUESTS

ENTERGY OPERATIONS

ARKANSAS NUCLEAR ONE, UNIT NOS. 1 AND 2

DOCKET NOS. 50-313 AND 50-368

1.0 INTRODUCTION

On August 9, 1989, while performing a safety analysis report review, Arkansas Power and Light Company (AP&L) identified a condition outside the design basis for Arkansas Nuclear One, Unit 2 (ANO-2). The plant has two containment hydrogen analyzers located outside containment, each having independent suction and return lines to containment. Each line is equipped with one containment isolation valve (CIV) located inside containment and one outside containment. During its analysis, the licensee postulated a single failure scenario for these analyzers by failing the common power source to the two inside motor operated CIVs on the two independent return lines. The valves, which receive closure signals on high containment pressure or low pressurizer pressure, are designed to fail as is upon a loss of actuating power. It was found that if an accident scenario were to occur in which an isolation signal was received by these valves and which was later followed by a loss of power to the common 480V bus supplying them, then the valves could not be reopened and neither hydrogen analyzer would be immediately available for post-accident monitoring. In fact, the 30 minute operability criterion as set forth by NUREG-0737, Item II.F.1, Attachment 6, could not be met during this scenario. In a submittal dated August 25, 1989, the licensee provided short- term corrective actions to address this problem, and committed to conduct additional design evaluations to identify a long-term solution to the design deficiency itself. The staff reviewed the licensee's proposal, and on August 30, 1989, issued a letter which accepted AP&L's short-term corrective actions and acknowledged its commitment to a long-term solution.

In a follow-up letter dated January 19, 1990, the licensee provided the staff with a long-term solution to the design deficiency in the hydrogen sampling lines. The solution has been proposed for both ANO-1 and ANO-2 (ANO-1/2). AP&L also concentrated its efforts on reducing the overall time required to place the hydrogen analyzers in service after a LOCA. While the licensee was successful in finding a solution to the single failure problem for the CIVs, and has taken steps to reduce the amount of time required to initiate hydrogen monitoring, it proposes that unforeseen failures could complicate the sequence of steps such that the hydrogen analyzers might not become operable for up to 90 minutes. Therefore, the licensee has requested that relief be granted for both ANO-1/2 from the requirement to have hydrogen monitoring available within 30 minutes. The licensee has instead proposed that the time requirement be changed to 1 hour and 30 minutes. The staff's evaluation of the licensee's request and supporting information follows in the paragraphs below.

2.0 EVALUATION

The staff reviewed two aspects of the licensee's submittal: (1) the long-term solution to the single failure problem with the CIVs in the hydrogen analyzer lines, and (2) the request that the 30 minute criterion for initiating hydrogen monitoring be changed to 1 hour and 30 minutes for ANO-1/2. The staff's evaluation of each proposal is separated into sections 2.1 and 2.2 below.

2.1 Design change to the isulation valves on the hydrogen analyzer lines

The design deficiency identified in August 1989 pertained to AP&L's failure to meet the single failure criterion for the ANO-2 hydrogen analyzers. The licensee found that a set of assumed events occurring in a particular order could preclude the availability of the post-LOCA hydrogen monitoring system for containment. Specifically, the CIVs located on the two hydrogen return lines inside containment are both powered from the same "red" power source (a common 480 volt bus). These two valves are motor operated and are designed to fail as is upon a loss of actuating power. Consequently, if the valves were to successfully close upon receipt of a containment isolation signal, and a loss of power to the common 480V bus were to subsequently occur, these valves would fail as is--in the closed position--thus precluding immediate operation of the associated hydrogen analyzers. A failure of "green" AC, DC, or "red" DC power would result in at least one redundant train of hydrogen monitoring capability being available because of the system's electrical configuration (see attached figure and failure analysis chart). The licensee has conducted design evaluations for the affected lines and has determined that by replacing the motor operated CIV inside containment on the return line of the green train analyzer with a solenoid operated valve, which automatically opens upon a failure of "red" AC power, post-accident hydrogen monitoring could still be achieved and would not be affected by a single failure.

The staff has reviewed the schematic for the design change and agrees with the licensee that the containment isolation capability (as required by 10 CFR Part 50, Appendix A, Criteria 54 and 56) is not jeopardized by the valve replacement because containment isolation could still be achieved by the existing redundant isolation valve located outside containment, which is powered by "green" DC power. Although containment isolation reliability is reduced somewhat by replacing a fails-as-is valve with a fails-open valve, containment isolation integrity is still assured by the redundant valve in this line (as it is in all four lines) in that, despite any single active failure, each line will still isolate. This arrangement is in accordance with SRP 6.2.4, paragraph 6.j.

The staff concludes that the slight reduction in containment isolation reliability caused by the above modification is acceptable since it provides for an increased availability for monitoring hydrogen. The staff, with consideration of the costs which would be associated with system redesign, concludes that the advantages of the increased availability of hydrogen monitoring capability outweighs the disadvantages of the reduction in containment isolation reliability; therefore, the modification to the design of the hydrogen monitoring system containment isolation valves is acceptable.

2.2 Relief from the 30 minute criterion of NUREG-0737

The licensee has determined that, even after implementation of the modification described above along with other provisions as outlined in their submittals, it is possible that the hydrogen monitoring system might not be operating for up to 1 hour and 30 minutes following a LOCA. This position is based on the fact that other failures (e.g., a loss of off-site power, the failure of an Engineered Safeguards actuated component, etc.) when figured into the transient could delay the progression of steps (as outlined in the station Emergency Operating Procedures) necessary to initiate monitoring. Based on staff conversations with the licensee, simulated accident scenarios (with the unexpected extenuating failures) have been performed which indicate that it could take up to half an hour to turn on the hydrogen monitors. Furthermore, the time required for the system to transport gas from the containment to the monitors is on the order of half an hour. Therefore, the licensee has requested to have the 30 minute requirement extended to 1 hour and 30 minutes for ANO-1/2.

The staff has considered the above information and has determined that the capability for monitoring hydrogen concentration levels in the containment structure following a LOCA should be available in no more than 30 minutes, as stated in NUREG-0737. During a LOCA scenario where it is postulated that significantly higher levels (than those considered for the design basis accident) of hydrogen gas may be or may have been generated (such as a TMI-type accident), it will be necessary for plant operators to have early indication of hydrogen concentration in containment in order to help determine what is happening to the plant, so that the operators may take timely action to mitigate the accident. For some accident scenarios, if actions were delayed beyond 30 minutes, the accident would proceed to a much more serious state than would occur if operator actions were taken earlier. To facilitate proper accident management in this area, the staff issued NUREG-0737 which includes its position on the continuous indication of hydrogen concentration in the containment atmosphere. For those licensees for which continuous indication was not available at all times, the staff clarified its position by not requiring continuous indication of hydrogen concentration during normal operations. Instead, licensees were allowed 30 minutes following the start of a LOCA in which to have continuous indication and recording functioning. The staff decided that the positive indication of containment hydrogen concentration can be delayed for 30 minutes following the start of a LOCA. This was a compromise. Although immediate availability is desired, the 30 minute delay was allowed to preclude continuous operation. However, the staff concludes that allowing more than 30 minutes to elapse following the start of a LOCA without any monitoring of hydrogen gas concentration in containment could jeopardize the plant staff's ability to successfully manage the accident.

Based on the above, the staff concludes that the intent of NUREG-0737 would not be met and that the licensee's request for an extension of the requirement from 30 minutes to 1 hour and 30 minutes is unacceptable.

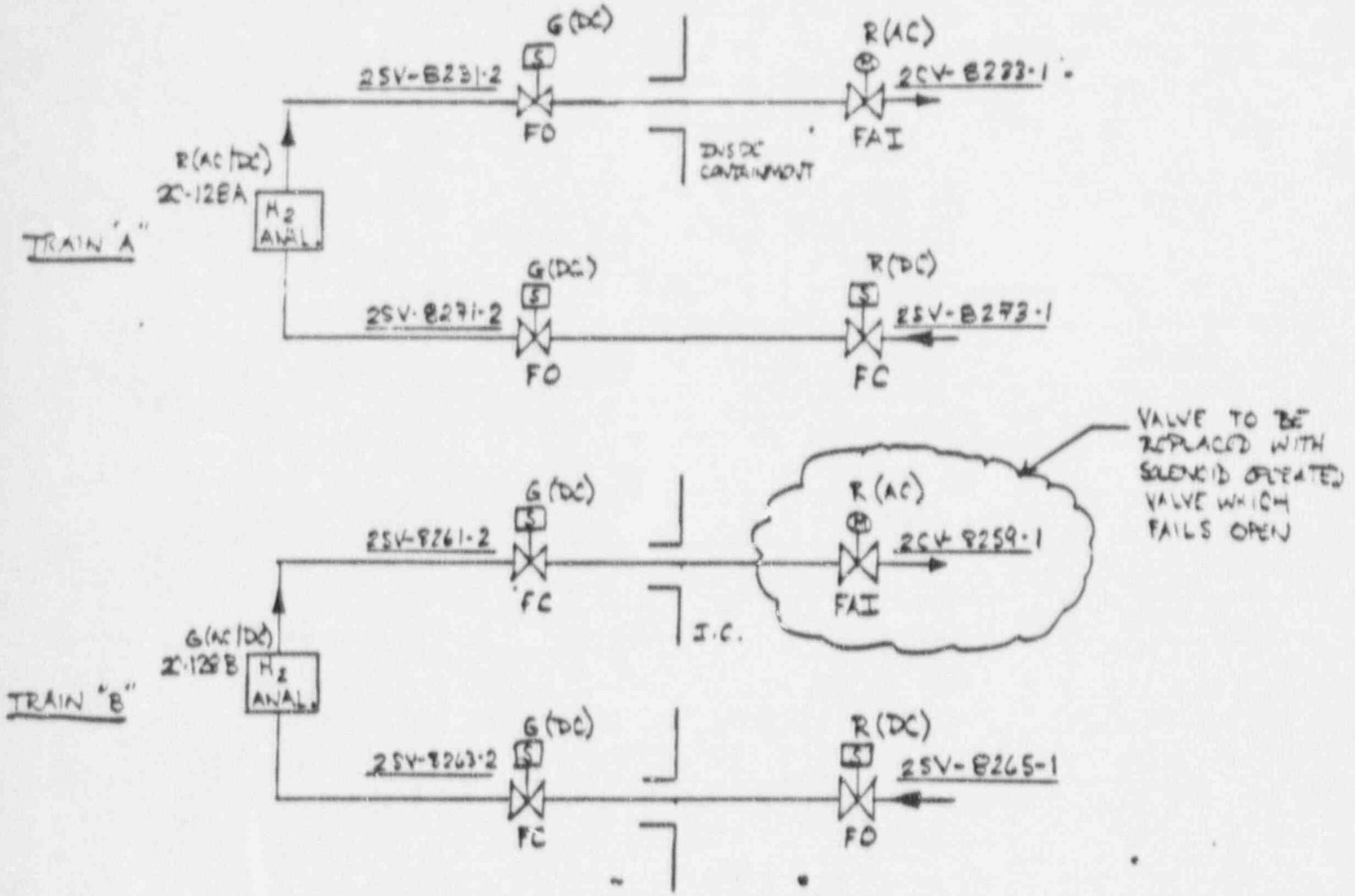
3.0 CONCLUSION

Based on our review of the licensee's proposed request to: (1) approve a design change to the CIVs on the hydrogen analyzer lines inside containment, and (2) allow a 1 hour extension to the 30 minute requirement of NUREG-0737 for post-accident hydrogen monitoring, the staff concludes that for request (1) the hydrogen monitoring system will be able to perform its safety function. In addition, the requirements for containment isolation, as delineated in GDCs 54 and 56, are satisfied by the design change. Therefore, the staff finds request (1), as described above, to be acceptable. However, the staff finds request (2) unacceptable on the basis that it does not meet the intent of the position in NUREG-0737.

Dated:

Principal Contributor: D. Roberts

FIGURE



FAILURE MODES FOR VALVES/PANELS (SEE CHART, NEXT PAGE)

(1) Concurrent failure of red DC
(2) Delayed failure of red DC
(3) Concurrent failure of red AC
(4) Delayed failure of red AC
(5) Concurrent failure of green DC
(6) Delayed failure of green DC
(7) Concurrent failure of green AC
(8) Delayed failure of green AC

- Sketch not to scale
- Sketch reproduced from 8/24/89 telecopy (P&ID M-2261,sh.1)
- Sketch represents both Units 1 and 2

TRAIN "B"

FAILURE MODE	25V-8265-1	25V-8263-2	25V-8261-2	20V-8259-1	2C-128B	CONT. ISOL. CAPAB.	H_2 SAMPLING CAPAB.
1	FO	FUNCTIONAL	FUNCTIONAL	FUNCTIONAL	FUNCTIONAL	✓	✓
2	"	"	"	"	"	✓	✓
3	FUNCTIONAL	"	"	FO	"	✓	✓
4	"	"	"	FC	"	✓	NOT AVAIL. *
5	"	FC	FC	FUNCTIONAL	INOPERABLE	✓	NOT AVAIL.
6	"	"	"	"	"	✓	NOT AVAIL.
7	"	FUNCTIONAL	FUNCTIONAL	"	"	✓	NOT AVAIL.
8	"	"	"	"	"	✓	NOT AVAIL.

TRAIN "A"

FAILURE MODE	25V-8273-1	25V-8271-2	25V-8231-2	20V-8233-1	2C-128A	CONT. ISOL. CAPAB.	H_2 SAMPLING CAPAB.
1	FC	FUNCTIONAL	FUNCTIONAL	FUNCTIONAL	INOPERABLE	✓	NOT AVAIL.
2	FC	"	"	"	"	✓	NOT AVAIL.
3	FUNCTIONAL	"	"	FO	"	✓	NOT AVAIL.
4	"	"	"	FC	"	✓	NOT AVAIL. *
5	"	FO	FO	FUNCTIONAL	FUNCTIONAL	✓	✓
6	"	"	"	"	"	✓	✓
7	"	FUNCTIONAL	FUNCTIONAL	"	"	✓	✓
8	"	"	"	"	"	✓	✓

RESULTS

- No concerns regarding containment isolation capability
- Failure modes 1,2,3,5,6,7 & 8 will always result in at least one channel operable
- * Problem is with failure mode 4, delayed failure of red AC results in "B" loop flow not being available with the "B" H_2 analyzer cabinet functional (also "A" loop analyzer cabinet would not be functional)

November 30, 1990
ANO 1/2 HYDRO TACS 75922/3

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