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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RESPONSE TO GENERIC LETTER 84-09

NEBRA KA PUBLIC POWER DISTRICT

COOPER NUCLEAR STATION

DOCKET NO. 50-298

1.0 INTRODUCTION

On December 2, 1981, 10 CFR 50.44 was changed to add additional post-Three Mile Island (TMI) requirements for combustible gas control in light water power reactors. The revised 10 CFR 50.44 established new requirements for Mark I containments including requirements that (1) the containment be inerted [10 CFR 50.44(c)(3)(i)], and (2) if the primary means of combustible gas control is a purge-repressurization system, additional recombiner capability be provided [10 CFR 50.44(c)(3)(ii)].

In response to the first of the above mentioned new requirements, it is noted that the Cooper Nuclear Station was licensed and operating with an inerted containment. An application (J. Pilant letter dated April 5, 1976) was pending which would have approved an air containment atmosphere dilution (ACAD) system and uninerted operation, but the staff had terminated its review of that application at the time of the TMI accident due to priority considerations. Inerted operation is not an issue, nor the subject of this evaluation. It is the second (recombiner) requirement, relating to GL 84-09, which is the subject of this evaluation.

In response to the second new requirement, the BWR Owners Group (BWROG) undertook an effort to demonstrate that inerted Mark I containments do not require recombiners. The BWROG's effort resulted in their conclusion that the staff should reconsider the recombiner requirement for Mark I plants (Ref: Letter from T.J. Dente dated August 12, 1982).

In response to the BWROG request, the staff, with the assistance of its consultant (A.O. Allen), conducted independent confirmatory analyses for a wide spectrum of non-design-basis severe accidents. The staff's analyses confirmed the BWROG findings. Based on realistic radiolysis oxygen generation rates, neither purge/repressurization capability or recombiner capability would be required following an accident. The staff then concluded that the BWROG methodology provides an acceptable basis for a finding that purge/repressurization need not be considered the *primary* means of combustible gas control. However, the staff continued to recognize the methodology of Regulatory Guide (RG) 1.7 as the appropriate deterministic, conservative methodology for use in evaluating the adequacy of systems which were a part of

the original design-basis accident/loss-of-coolant accident (DBA/LOCA) mitigation scheme.

The staff findings were presened to the Commission in SECY-83-292. The staff subsequently issued Generic Letter (GL) 84-09 with the understanding that it was applicable only to inerted BWR Mark I facilities having a combustible gas control system capable of mitigating DBA/LOCA conditions as defined by RG 1.7.

2.0 DISCUSSION AND EVALUATION

2.1 Conformance to Generic Letter 84-09

Generic Letter 84-09 states that the Commission has determined that a Mark I BWR plant will be found to not rely upon purge/repressurization systems as the primary means of hydrogen control, (and thus does not need recombiner capability), if certain technical criteria were satisfied. These criteria are:

(1) The facility has technical specifications requiring that the containment be inerted to less than 4% oxygen,

(2) The facility has only nitrogen or recycled containment atmosphere for use in all pneumatic control systems within containment, and

(3) There are no potential post-accident containment oxygen sources other than radiolysis.

Cooper Nuclear Station Technical Specification (TS) 3.7.A.5 specifies that an oxygen concentration of greater than 4% cannot be present during reactor power operation. This satisfies the first criterion. The licensee has also stated that all pneumatic control systems use nitrogen for operation. This satisfies the second criterion. The final requirement in GL 84-09 is that there be no potential sources of oxygen in containment other than that resulting from radiolysis of the reactor coolant. Previously, the staff voiced an issue concerning the ACAD system as a post accident source of oxygen. To resolve this, the licensee has completely removed the ACAD compressors from service. This included the removal of all electrical service to the systems as well as cutting and capping the piping from the units. As a result, both trains of the ACAD system are no longer considered potential oxygen sources. As a result of these modifications, the facility now meets the three GL 84-09 criteria.

2.2 Related 10 CFR 50.44(g) Requirements

For a Mark I facility to be encompassed by the supporting basis for GL 84-09 described above, and thereby qualify for relief from the recombiner requirement, it must first have an acceptable combustible gas control system

which complies with 10 CFR 50.44(g) including conformance with General Design Criteria (GDC) 41, 42, and 43.

2.2.1 Combustible Gas Control System Capability

In its letter dated September 28, 1989, noted above, the licensee provided a description of the new SBNI system. ("SBNI" is an acronym for Standby Nitrogen Injection). The SBNI system is similar to a conventional nitrogen containment atmosphere dilution (NCAD) system. The letter also provided an analysis based on Standard Review Plan acceptance criteria, including RG 1.7 fission product release and hydrogen/oxygen source term assumptions, which indicates that sufficient nitrogen is available and can be reliably injected into the containment, using the SBNI system, so as to preclude combustible mixtures.

SBNI System Performance: The licensee's plant specific analysis computed the time after a LOCA when the containment oxygen concentration would reach 5% (flammable concentration) by volume. The main source of oxygen production was due to radiolysis and the production rates were calculated using the methodology of Section 6.2.5, Appendix A, of the Standard Review Plan and RG 1.7 assumptions. The initial assumed conditions in the containment were as follows:

	Drywell	Wetwell
Temperature, °F	135	90
Relative Humidity, %	90	100
Air Volume, ft^3	132,000	106,850
Pressure, psig	0.75	0.75

An initial oxygen concentration of 4% by volume was assumed in the analysis to be consistent with the plant technical specification 3.7.A.5 during reactor power operation. The minimum times to reach an oxygen concentration of 5% by volume from an initial 4% concentration are as follows:

Wetwell	Drywell	Mixed WW + DW
10 hrs.	17 hrs.	13 hrs.

The licensee chose to use the most conservative case of 10 hours as a basis for the remaining results of the analysis. Prior to reaching 10 hours after the LOCA, the licensee would manually initiate the SBNI system for combustible gas control. Once initiated, the amount of additional nitrogen that would need to be injected into the containment to limit the oxygen concentration to below 5% during the first 48 hours is 43,800 standard cubic feet (scf). The maximum required injection flow rate is approximately 40 scfm during the initial nitrogen makeup stages. This required injection flow rate is well within the maximum flow rate for the system.

Based on this analysis, the SBNI system is capable of precluding combustible mixtures in the containment during the course of a DBA-LOCA.

2.2.2 Conformance to General Design Criteria

GDC 41: GDC 41 requires suitable redundancy such that the system function can be performed with a single failure and loss of offsite power. The SBNI system consists of two independent and redundant nitrogen injection paths into both the drywell and suppression chamber portions of the primary containment. The system utilizes the existing inerting and makeup piping, valves, and containment penetrations. Most piping within the system is located within the reactor building and is seismically qualified, ASME Section III, Class II, 1.5" diameter welded pipe. The piping design pressure and temperature have been determined to be 125 psig and 350°F respectively. The maximum flow rate is 80 scfm.

The proposed nitrogen flow paths to the containment contain a minimum number of active components. The existing containment isolation valves (CIVs) within the system are the only active components inside the Reactor Building. These valves are remotely operated from the Control Room and are powered from Class IE divisional AC and DC power sources. Override switches and valve position indication for these CIVs are available in the Control Room. The valves mentioned above have also been environmentally qualified to the requirements of 10 CFR 50.49. Additional active components, such as nitrogen flow measurement and regulation instrumentation is provided outside the Reactor Building near the nitrogen supply connections.

The SBNI system can be supplied from various nitrogen supply sources. The source which would normally be used consists of the preexisting nitrogen source utilized by the inerting system which vaporizes liquid nitrogen to gaseous form by means of a heated water vaporization pit. The vaporization pit utilizes heaters that are energized from offsite power. In the event of a loss of offsite power, the heaters would be inoperable but the latent heat of water in the pit would be sufficient to vaporize the liquid nitrogen until power is restored. The licensee's calculations indicate that the required gas flow rate of vaporized nitrogen could be maintained for approximately 20 hours under outside temperature conditions of -5°F.

A second source of nitrogen is available from portable gaseous nitrogen bottles stored on site. Fourteen portable racks holding 12 bottles each contains approximately 51,000 scf of nitrogen. This amount is more than the 43,800 scf needed for post accident combustible gas control during the first 48 hours following a LOCA. The portable racks are stored within the Protected Area and are restrained to secure the bottles and racks during natural phenomenon occurrences. This source of nitrogen would be transported to one of the SBNI connection points where dedicated quick-connect flexible hoses will be used to supply nitrogen to either nitrogen injection path. This action can be easily completed within the first 10 hours after the event. One

of several fork lift trucks would be used to transport the rack to the desired location.

Before the onsite nitrogen sources have been depleted, the licensee has the opportunity to have additional sources brought onsite. An agreement to maintain the liquid nitrogen tank exists between the licensee and a Kansas City firm. The gaseous bottles will be regenerated by a firm in the Omaha area. The licensee has committed that any additional nitrogen sources can be delivered to the site within 24 hours during emergency situations.

Any actions required to connect an alternate nitrogen supply have been minimized by the licensee's use of dedicated quick connect flexible hoses. These hoses are permanently located in the immediate vicinity as well as any necessary hand tools to install the hose. Connecting an alternate source is uncomplicated in nature and can be easily completed within 10 hours after an event. This time period is based on the results of the analysis mentioned above. The rack of nitrogen bottles would normally be transported from the storage site to the hook up station via a fork lift truck. There are several available on site at all times. However, if necessary, a rack can be moved manually.

The SBNI system is a manually activated system. When it is necessary to initiate the SBNI system, an operator will be dispatched to a local panel to operate the system. The operator actions for setup of the system all take place outside the Reactor Building which will minimize any radiation or thermal exposure received during any operator action. The components that need to be operated in order to complete the setup are accessible for operator use in accident scenarios. During this time, constant communication between the SBNI system operator and the Control Room will be maintained via hand-held radios to assure proper coordination of the nitrogen injection activities. In combination, they will control and monitor nitrogen flow into either the drywell, suppression chamber, or both through various CIVs that are operated from the Control Room.

Based on the discussion above and redundancy inherent in the design of the SBNI system, The staff concludes that GDC 41 is met.

GDC 42: GDC 42 requires that SBNI system include provisions for periodic inspection of components as necessary to insure integrity and capability. Compliance with GDC 42 is met by having all "important components" accessible for periodic inspections. The licensee performs system walkdowns verifying this capability. The components outside of the containment are inspected and calibrated by LINDY of Kansas City. If the plant finds a component inoperable, or needs the liquid nitrogen supply replaced, LINDY has assured the licensee that repairs will be completed within 24 hours. A Union Carbide affiliate in Omaha has agreed to refill the nitrogen bottles when needed with either liquid or gaseous nitrogen. The inventory of additional bottles kept

by the supplier is to be verified by the licensee in order to justify that a gaseous supply will be available in emergency situations.

The licensee stated in a July 13, 1990, letter that all "important components" in the SBNI system will be accessible for periodic inspections. The testing and inspection of the components are controlled by plant procedures. The staff therefore concludes that GDC 42 is satisfied.

GDC 43: GDC requires the capability for periodic operability testing. Testing and inspection of the SBNI will be governed by plant procedures. Measurements of flow and pressure regulation for the nitrogen sources can be taken at the nitrogen connection locations. In addition, oxygen concentrations and pressure measurements provided in the control room can also be used to verify system function. The licensee provided a detailed description of a five step testing program that is to be completed once per operating cycle. Step one consists of a general examination of the gaseous nitrogen bottles and the bottle storage devices. The purpose of this is to identify any corrosion or paint surface degradation on the bottles or devices. In addition, the bottle restraining equipment is inspected for proper performance.

Step two is the nitrogen cluster inventory check. During this part of the test, each nitrogen bottle is opened and checked for a pressure reduction. If the pressure measures less than 2100 psi, the bottle is sent to be replenished.

The pressure regulator assembly test is step three. Here, the licensee connects a standard bottle to the quick disconnect hoses and the regulator. The leak tightness of the system is checked along with the operation of the hoses. In addition the regulator is recalibrated if necessary.

Both trains of the system will be pressure tested in part four. A pressure test on the system is performed in accordance with a system surveillance procedure once per operating cycle. The pressure decay method test ensures leak tightness within the system. Once per operating cycle, a system operability inspection and flow test is performed as part of the system surveillance procedure. This inspection and testing will assure the operability of the system. The procedures state that the piping leakage on the containment side of the regulator will not exceed the sum of the leakage for the two penetrations. Discrepancies will be corrected prior to startup.

The final step consists of a functional test where the system is aligned and 45 cfm of air is injected into the containment using the actual system instrumentation. The staff pointed out to the licensee that by leaving air in the piping once the functional test is completed a possible source of air in the containment is created.

The licensee subsequently calculated the amount of air in the piping to be less than 10 scf. Since the containment volume is 238,850 cu.ft., this amount is insignificant.

The licensee's October 5, 1992, letter provided a discussion of planned preventative maintenance to be performed, indicating that this will be performed during the once-each-cycle operability testing.

Based on the above, the staff concludes that GDC 43 is met.

Emergency Operating Procedures: During the resolution of these combustible gas issues, a series of meetings were held to discuss a number of concerns raised by the staff relative to overall consistency among the generic Emergency Procedure Guidelines (EPG), the Cooper Emergency Operating Procedures (EOPs) and the Final Safety Analysis Report (FSAR). The licensee indicated that they were following the guidance provided by the EPGs without exception. This includes a directive not to repressurize the containment for combustible gas control. Therefore, this issue was directed to the BWROG for generic resolution.

During a meeting held in January 1991, the BWROG stated that they had reevaluated the combustible gas control actions within the EPGs and have concluded that the current procedures provide the best guidance for use of the NCAD (or SBNI) system. The FSAR analysis uses RG 1.7 and 10 CFR 50.44 criteria for determining the hydrogen generation profiles. For purposes of the EPG evaluation, the BWROG indicated that the "realistic" methodology of NEDO-22155 was used and that repressurization would not be used in conjunction with vent/purging.

The staff indicated that operation of the SBNI should be based on pressurization with nitrogen to prevent the oxygen from exceeding the combustible concentration of 5% until the containment pressure reaches about 50% of design. The containment would then be vented to some lower pressure and the entire process is repeated.

This discussion was followed by a listing of benefits and drawbacks of the repressurization mode of SBNI operation. The staff agreed with the categorization of the individual drawbacks and benefits, but concluded that the benefits outweighed the drawbacks could not be made without a review of plant specific analyses. The results of several Mark I plants using the pressurization and nonpressurization options will be compared, and a meaningful basis for selection of the appropriate method will be established. The method to be used at the Cooper Station will be based on the generic resolution of this issue. Until final resolution, however, the licensee will continue to follow the existing EPG guidance. This approach is acceptable to the staff.

3.0 CONCLUSION

Based on its review of the information provided by the licensee, the staff has concluded that the licensee's modifications and supporting analyses are acceptable. The SBNI system would be incorporated as part of the facility's current licensing basis. Also, the staff finds that the criteria of GL 84-09 have been met and recombiners need not be included in the current licensing basis. The licensee should proceed with the final phases of implementation of the SBNI system.

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Date: November 19, 1992