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DENTON,H. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards response to NRC 831130 request for addl info re NUREG-0737,Item II.B.3 concerning posst-accident sampling sys.Boron analysis will be performed per Procedure PASAP 3.4 using carmini acid analysis method.

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Iowa Electric Light and Power Company
January 19, 1984
NG-84-0138

Mr. Harold Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Duane Arnold Energy Center
Docket No: 50-331
Op. License No: DPR-49
NUREG-0737, Item II.B.3, Post-Accident Sampling System

Reference: Letter, D. Vassallo (NRC) to L. Liu (IELP), dated November 30, 1983

Dear Mr. Denton:

In the referenced letter, you requested additional information in order to complete your review of the subject matter.

Attached please find Iowa Electric Light and Power Company's response to the NRC staff's questions.

Should you have any questions, please feel free to call me.

Very truly yours,

R. W. McGaughy

Richard W. McGaughy
Manager, Nuclear Division

RWM/MSG/dmb*
Attachment: 1) Iowa Electric Response to NRC Request for Additional Information

cc: M. Grim
L. Liu
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NRC Resident Office
Commitment Control No. 83-0322

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ATTACHMENT 1

IOWA ELECTRIC LIGHT AND POWER COMPANY
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
NUREG-0737, ITEM II.B.3
POST-ACCIDENT SAMPLING SYSTEM (PASS)

INTRODUCTION

The following provides information requested via NRC letters dated November 5, 1983 and November 30, 1983 regarding NUREG-0737, Item II.B.3, "Post-Accident Sample Capability." The November 15 request references an NRC letter dated August 9, 1982 which provided a discussion of NUREG-0737, Item II.B.3 It is recognized that the requirements for this item are as described in NUREG-0737. Further, it is recognized that the August 9, 1982 NRC letter provides staff guidelines, not requirements for compliance with NUREG-0737 criteria.

1.0 NRC REQUEST

Our clarification of NUREG-0737, Item II.B.3, Post-Accident Sampling System, transmitted to you on August 9, 1982, required that the extent of core damage be evaluated from the radionuclides concentrations and other physical parameters such as core temperature data and sample locations. Provide a description of your core damage estimate procedure including the consideration of radionuclides concentrations and other physical parameters as indicators of core damage.

1.1 IOWA ELECTRIC RESPONSE

General Electric (GE) has developed a generic procedure (NEDO-22215, dated August 1982) for use in developing plant specific procedures to estimate the extent of core damage based on radionuclide concentrations in samples obtained from the Post-Accident Sampling System (PASS) This procedure was transmitted to the NRC as Attachment 1 to BWR Owners' Group letter BWROG-8324, dated June 17, 1983. This generic procedure was used to develop a Duane Arnold Energy Center (DAEC) plant specific procedure for estimating the extent of core damage based on concentrations of I-131 in reactor liquid samples and Xe-133 in containment atmosphere gas samples obtained from the PASS. The procedure is contained in DAEC Post-Accident Sampling and Analysis Procedure (PASAP) 7.2.

Although not required by NUREG-0737, an additional plant procedure (PASAP 7.3) was prepared which utilizes other physical parameters as indicators of core damage. This procedure utilizes readings obtained from the drywell high range radiation monitors, and the torus high range radiation monitors as indicators of potential fuel failure.

2.0 NRC REQUEST

You have proposed to use a turbidimetric method of analysis of chlorides concentration. We feel that the turbidimetric analysis of chlorides, in the presence of significant concentrations of iodides, will not meet the sensitivity requirements of the chloride measurements. Provide a chloride measurement procedure which will meet the sensitivity requirements for chloride concentrations.

2.1 IOWA ELECTRIC RESPONSE

NUREG-0737, Item II.B.3 requires that, for the DAEC, chloride analysis of liquid samples be completed within 4 days, and allows for this analysis to be performed at an offsite laboratory.

The chloride analysis which will be performed at the DAEC (on-site) will be limited to a scoping analysis using the turbidimetric method. Plant procedure PASAP 3.2 provides the procedure for the on-site turbidimetric analysis. The sensitivity of this method is such that coolant concentrations must be greater than 10 ppm for detection in the diluted sample. In addition, iodine can be expected to interfere somewhat with the turbidimetric method by the formation of silver iodide. Tests performed by GE have verified that irradiation has a negligible effect on the accuracy of this analysis.

Provisions have been made with an offsite laboratory for analysis of post-accident samples. Off-site chloride analysis will be accurate ± 10% over the range 0.5 to 20 ppm and ± 0.05 ppm below concentrations of 0.5 ppm. The results of this analysis will be available within the required time period.

3.0 NRC REQUEST

Our clarification of August 9, 1982, required that all equipment and procedures which are used for post-accident sampling and analysis should be calibrated or tested on a solution representative of post-accident coolant at a frequency which will ensure, to a high degree of reliability, that it be available if required. Provide information demonstrating applicability of procedures and instrumentation in the post-accident water chemistry and radiation environment, and on retraining of operators on a semi-annual basis.

3.1 IOWA ELECTRIC RESPONSE

The post-accident sampling and analysis facilities at the DAEC have the accuracy, range, and sensitivity necessary to provide pertinent information to the plant staff in order to describe the radiological and chemical status of the reactor coolant system. The following is a discussion of the analytical capability of the equipment and procedures used at the DAEC.

a. Gross Activity, Gamma Spectra

The DAEC is equipped with a hyperpure germanium detector and computerized multichannel analyzer. Procedures for the use of this equipment to analyze highly radioactive samples of reactor liquid are contained in PASAP 3.5, "Liquid Sample Isotopic".

Primary coolant samples obtained from the sampling station are diluted by a factor of 100 (0.1 ml coolant diluted to 10 ml). Under severe accident conditions a calibrated syringe would be utilized to obtain an aliquot for further dilutions. By using dilution, extended shelf geometry, or absorbers as needed, isotopic analysis can be performed on samples with activity concentrations up to 10 Ci/ml.

Direct counting of the initial 100:1 dilution sample would allow analysis at coolant activity levels down to approximately 10 μCi/ml. In addition, the degassed, undiluted 10 ml sample available from the sample station could be utilized for analysis of samples in the 10^{-2} to 10^{-3} μCi/ml range.

Isotopic analysis is expected to be accurate within at least a factor of two over a coolant activity range of approximately 10 μCi/ml to 10 Ci/ml. Background radiation levels will have no significant effect on the accuracy of the isotopic analysis. The DAEC counting facilities have been provided with shielding designed to maintain background radiation levels (due to contained and external airborne sources) below 2 mrem/hr following a postulated release of fission products equivalent to that described in Item II.B.2 of NUREG-0737. Further, PASAP 3.5 instructs personnel to remove "hot" samples from the counting room, so as not to affect background levels.

b. Boron Analysis

Boron analysis will be performed in accordance with PASAP 3.4, using the carminic acid analysis method. Concentrations between 50 and 1100 ppm are of interest for BWR reactivity control in the event sufficient control rods are not inserted to shutdown the reactor. The use of the carminic acid method with the 100:1 diluted sample will result in an accuracy of ± 50 ppm over this range.

None of the expected post-accident chemical constituents (I^-, Cs^+, Ba^{+2}, La^{+3}, Ce^{+4}, Cl^-, B, Li^+, NO_3^-, NH_4^+, K^+) will interfere with this analysis method. Irradiation tests conducted by GE have demonstrated that the design basis source term activity level causes only a 1 ppm error in the analysis.

c. Chloride Analysis

A discussion of chloride analysis of liquid samples at the DAEC is provided in the response to Question 2 (Section 2.1).

d. Dissolved Gas Analysis

The dissolved gas sampling portion of the DAEC PASS is designed to obtain a sample of dissolved gas collected from a specific volume of a reactor liquid sample. At present, concerns have been identified with the dissolved gas sampling portion of the PASS which affect the accuracy of dissolved gas measurements. However, GE has developed a modification package which will improve the measurement accuracy. Currently, this dissolved gas modification package is scheduled to be available to Iowa Electric in early 1984. These modifications do not require an outage to implement, and are currently planned to be completed as part of the long-term modifications to the DAEC PASS. In the interim, plant procedures have been prepared (PASAP 3.7) to estimate dissolved gas concentration using data obtained from gas expansion within the PASS.

e. pH Analysis

In accordance with PASAP 3.3, the pH of post-accident reactor liquid samples will be measured using pH indicator paper. A pH meter which utilizes a combination electrode can also be used for pH measurement when sample volumes greater than 10 ml are available for analysis.

Irradiation tests of pH indicator paper performed by GE indicated that although the indicator dye is sensitive to irradiation by limiting the time of exposure and the volume of sample used for pH measurement, the indicator paper method can provide results with an accuracy of ±.5 pH units. Other irradiation tests conducted by GE indicated that a typical combination pH electrode exhibited an accuracy of ±.3 pH units. However, the large volume of sample required for the electrode presently used at the DAEC would result in excessive personnel radiation exposure at the design basis activity concentrations.

GE has recently completed testing of two types of combination pH electrodes which require a very small volume of sample (.1-.2 ml) for measurement. The results of this testing indicated that both of these types of electrodes perform satisfactorily under high radiation conditions, and are accurate to within ±.3 pH units. The DAEC is presently reviewing the results of the GE tests to evaluate the feasibility of using one of these electrodes for pH measurement of high activity samples.

This question also requests information regarding operator training. The NRC has issued Generic Letter 83-36, dated November 1, 1983, "NUREG-0737 Technical Specifications." Generic Letter 83-36 requested that licensees propose Technical Specification changes for several NUREG-0737 items, including Item II.B.3. Information regarding the training of sampling personnel will be provided in DAEC response to Generic Letter 83-36.

4.0 NRC REQUEST

Provide a description of your procedures which will assure that reactor coolant samples will be representative of the core inventory and will be suitable for determining the core conditions.

4.1 IOWA ELECTRIC RESPONSE

DAEC procedure PASAP 2.0, "Post-Accident Sampling System" includes guidelines for selecting a sample location in order to obtain a sample which is representative of the actual in-core conditions. For containment atmosphere gas samples PASAP 2.0 provides recommended sample locations as a function of the type of event.

For liquid sampling, PASAP 2.0 indicates that the optimum sample point for all events is the jet pumps as long as there is sufficient reactor pressure to provide a sample from that location. If there is not sufficient reactor pressure to allow a sample to be taken from the jet pumps, then the sample should be taken from the sample point in the RHR system.

After a scram it can take as long as five hours for decay heat power to decrease to the 1% level. If the reactor remains pressurized during the the early hours of an accident, a representative sample is provided by the jet pump sample point because of the higher level of mixing within the core plenum that is associated with decay heat power levels above 1%. In the later phases of an accident when the decay heat power is less than 1%, a representative sample will be obtained from the sample point in the Residual Heat Removal (RHR) system while in the shutdown cooling mode.

If, for some unexpected reason, the reactor remains pressurized for longer than the time it takes to reach 1% decay heat power, some amount of jet pump sample dilution may be experienced. However, this represents a highly unlikely circumstance as one of the operator's prime objectives after an accident is to bring the reactor to a cold shutdown condition. There are no detrimental consequences due to this potential dilution because the personnel on shift will already have obtained data on Reactor Pressure Vessel (RPV) water radiochemistry. Additionally, sampling personnel are cautioned in PASAP 2.0 that dilution is possible under certain peculiar post-accident conditions and will not be misled by it.

It should be noted that the jet pump sample data, although helpful, is not essential to accident mitigation. As discussed in Section 1.1, PASAP 7.3 utilizes other, redundant, Class IE instrumentation to provide indications of core damage. Finally, the period of concern will, if it exists at all, be very brief; a representative sample will be obtained once the RHR shutdown cooling mode is established.