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ENGINEERING AND RESEARCH DEPARTMENT

May 13, 1983

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Docket Nos: 50-352
50-353

SUBJECT: Limerick Generating Station, Units 1 & 2
DSER Open items from Chemical Engineering Branch

REFERENCE: Letter, A. Schwencer to E. G. Bauer, Jr.
dated March 11, 1983

Dear Mr. Schwencer:

Transmitted herewith are draft FSAR page changes related to open items from the Chemical Technology Section DSER which was transmitted by the reference letter. These pages are provided in draft form at the request of Mr. Witt, NRC staff reviewer.

These page changes will be incorporated into FSAR Revision 20 to be submitted in May, 1983.

Very truly yours,

Eugene J. Bradley

JLP/mjb 5/11/83-1

Copy to: See attached service list

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b. Secondary Containment Atmosphere

A sample line is provided to allow sampling of secondary containment atmosphere to aid in determining post-accident accessibility of the reactor enclosure. Samples are taken in the vicinity of access doors 191 (Unit 1) and 287 (Unit 2) on El. 217 ft.

c. Reactor Coolant and Suppression Pool

When the reactor is pressurized, reactor coolant samples are obtained from a tap off the jet pump pressure instrument system. The sample point is on a noncalibrated jet pump instrument line outside the primary containment and downstream of the excess flow check valve. This sample point location is preferred over the normal reactor sample points on the reactor water cleanup system inlet line and recirculation line because the reactor cleanup system is expected to remain isolated under accident conditions, and it is possible that the recirculation line containing the sample line may be isolated. The jet pump pressure tap is in a location protected from damage and debris. This sample point provides representative samples of reactor coolant under ~~all pressurized~~ various reactor conditions:

- Normal operation/small pipe break: Reactor water level can be maintained at or near normal water level. With a nearly normal water level, or at least water in the upper plenum, natural circulation will occur with a large loop from the downcomer to the shroud region via the jet pumps. With thermal conditions pumping water up through the core and back down past the tap from which the PASS sample is taken, a representative relationship will exist which will allow the results of the sample to be related to the condition of the core.

- Large Pipe Break: A large pipe break, such as a recirculation pump suction line break, may occur wherein the water level may be controlled only by the height of the jet pumps and the ability to add water to the vessel. The sample taps are located sufficiently low to permit sampling at a reactor water level even below the lower core support plate. As reactor pressure decays, low pressure coolant injection (LPCI) is initiated into the core

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region. This water volume supplies more coolant than is boiled off by the decay heat. This excess water will flow down past the core, up through the jet pumps, and out through the postulated break, assuring a representative sample at the sample point.

Samples will be taken from the reactor via the jet pump pressure instrument lines as long as possible. This allows a more direct and therefore faster response to core conditions. Upon decay or loss of reactor pressure, the jet pump sample point is lost, and the RHR loops sample points must be employed for sampling. Reactor coolant and/or suppression pool samples may be taken from the RHR sample lines, depending on the mode of RHR operation. These sample lines tap off downstream of the second system isolation valve in the RHR system sample lines at the discharge of each RHR heat exchanger.

- LPCI: Suppression pool water is injected into the core, flows up through the jet pumps, and back to the suppression pool via the postulated break. The system will be operated for an estimated 30 minutes minimum prior to sampling of the suppression pool water to ensure that a representative sample is obtained at the sample taps.

- Shutdown Cooling: The RHR system, aligned in the shutdown cooling mode, provides cooling and circulation of reactor coolant through the core, resulting in a representative sample at the RHR sample taps.

- Suppression Pool Cooling: The RHR system, aligned in the suppression pool cooling mode, provides cooling and circulation of the suppression pool water. The system will be operated for an estimated 30 minutes minimum prior to sampling of the suppression pool water to ensure that a representative sample is obtained at the RHR sample taps.

In order to ensure a representative liquid sample from the jet pumps at low (<1%) power conditions for small break or non-break events, the reactor water level ~~will~~ would be raised to the level of the moisture separator. This will fully flood the separators and will provide a thermally induced recirculation flow path for mixing.

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When this action is not inconsistent with station emergency procedures.

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11.5.5.1.4.4 Sample Station Sump

The sample station is provided with a bottom sump to collect liquid leakage. This sump can be isolated, pressurized, and discharged into the sample station liquid return line to the suppression pool.

11.5.5.1.4.5 Sample Handling Tools and Transport Containers

Appropriate sample handling tools and transporting casks are used. Gas vials are installed and removed by use of a vial positioner through the front of the gas sampler. The vial is manually lowered into a shielded cask directly from the positioning tool. This allows the operator to maintain a distance of about three feet from the unshielded vial. The cask provides about 1-1/8 inches of lead shielding. A 1/8-inch diameter hole is drilled in the cask so that an aliquot can be withdrawn from the vial with a gas syringe without exposing the analyst to the unshielded vial.

The particulate and iodine cartridges are removed via a drawer arrangement. The quantity of activity accumulated on the cartridge is limited by controlling the line flow using a flow orifice and by timing the sample duration either manually or by use of preset timer. In addition, the radioactivity level is monitored during sampling using a radiation probe installed adjacent to the cartridge. These samples will be limited to activity levels that will not require shielded sample carriers.

The small volume (diluted) liquid sample cask is a cylinder with a lead wall thickness of about 2 inches. The cask weighs approximately 50 pounds and has a handle which allows it to be carried by one person.

The 10 milliliter undiluted sample is taken in a 700 pound lead shielded cask which is transported and positioned by a four-wheel dolly. The sample is shielded by about 5-1/2 inches of lead. A licensed shipping cask has been procured with a group of other utilities. (for transport of the undiluted samples to the offsite analysis facility (Section 11.5.5.2.2)

11.5.5.1.4.6 Sample Station Power Supply

The PASS isolation and control valves, sample station control panels, and auxiliary equipment are connected to an instrument ac distribution panel which is powered from an engineered safeguard system (ESS) bus. Following a loss of offsite power, the ESS bus

This cask will be located in a centrally located, continuously attended warehouse facility.

The existing counting facility located adjacent to the chemistry laboratory is equipped to handle the gamma spectra analyses required for post-accident samples. The counting room is equipped with two Ge (Li) detectors with 4-inch lead shields connected to a computer based analyzer system. The system has automatic peak search and isotope identification capabilities. The Ge (Li) detector and shelf assembly in the lead shield can be isolated and the capability to purge the volume within the shield with compressed gas will be provided. This will help prevent atmospheric noble gas activity released during an accident from swamping the detector.

It is expected that the first set of post-accident samples will be analyzed in the radwaste enclosure chemistry lab/counting room facilities approximately two hours after the start of an accident. At this time, the chemistry lab will be a Zone III area and therefore accessible for performing the required chemical analyses. The lab becomes a Zone II area within 20 hours following an accident. The counting room is a Zone II area within two hours, and a Zone I area within 6 hours following an accident. Shielding for the PASS is further discussed in Section 1.13.2 (Item II.B.2).

The most direct route from the sampler location to the chemistry lab is through the control structure and Unit 1 turbine enclosure to the radwaste enclosure on El. 217 ft. However, during the first 20 hours following an accident, high radiation in portions of this access path require that an alternate route from sampler to labs be taken. Operators must exit through the north of the turbine enclosure, travel around the west end of the radwaste building, and enter the lab/counting room area throgh the south of the radwaste building.

11.5.5.2.2 Arrangements for Offsite Analyses

A part of the Limerick approach to post-accident sampling is the establishment of prior arrangements with an offsite laboratory for confirmatory and supplemental analyses.

11.5.5.3 Sample Collection and Transport Procedures

It is anticipated that the first set of samples will be taken within one hour following a LOCA, with samples taken approximately every 4 hours for the remainder of the first 24 hours. Following day one, it is expected that three samples per day ~~will~~ may be taken for the remainder of the first week, with

method by the formation of silver iodide. Tests performed by GE have verified that irradiation has a negligible effect on the accuracy of the analysis.

Offsite provisions for chloride analysis will be accurate ±10 percent over the range 0.5 to 20 ppm and ±0.05 ppm below concentrations of 0.5 ppm.

d. A combination electrode will be used to measure the pH of coolant samples. Testing performed by GE has verified that expected levels of irradiation result in a shift of less than 0.3 pH units.

e. The post-accident sample station is equipped with a 0.1 cm^{-1} conductivity cell. The conductivity meter has a linear scale with a six-position range selector switch to give conductivity ranges of 0-3, 0-10, 0-30, 0-100, 0-300, and 0-1000 micromho/cm when using the 0.1 cm^{-1} cell. This conductivity measurement system will be used to determine the primary coolant or suppression pool conductivity. During normal operation the BWR technical specifications require maintaining the primary coolant below 0.1 micromho/cm, and conductivity measurements are the primary method of coolant chemical control.

Conductivity measurements are, of course, non-specific, but they serve the important function of indicating changes in chemical concentrations and conditions. Perhaps even more important, in the case of the BWR primary coolant, the conductivity measurements can establish upper limits of possible chemical concentrations and can eliminate the need for additional analyses.

The conductivity measurement can also be used to bound the possible range of pH values.

11.5.5.4.3 Radiochemical Analysis--Gamma Ray Spectroscopy

After the samples have been brought to the chemistry laboratory and appropriately diluted, they can be carried without shielding to the counting room which is adjacent to the chemistry laboratory. The appropriate dilution factors will be somewhat dependent on the detector and shelf arrangements available. A prior determination of the maximum desirable dose rates for the

various shelf configuration will be made to minimize this problem. The present high resolution, high efficiency Ge(Li) detectors, coupled with the multichannel analyzers, and computer data reduction in the onsite counting room will handle the analysis of these samples within 3 hours from the time a decision is made to sample.

The gas samples will be counted in the PASS gas sample vials, and the liquid samples will be counted in the standard sample bottles used during normal operation because calibration curves for these geometries will be available and regularly updated. Calibration curves will also be available for the particulate filter and iodine cartridge geometries. In general, the counting of the post-accident sample will follow the normal counting room procedures. ~~A special post-accident library will have to be developed for use by the computer peak search and identification routine to supplement the normal isotope library.~~ The ~~post-accident~~ peak search and identification library will contain the principal gamma rays of the following isotopes in addition to the standard activated corrosion products:

a. Noble gases: Kr-85, Kr-85m, Kr-87, Kr-88, Xe-131m, Xe-133, Xe-133m, Xe-135

b. Iodines: I-131, I-132, I-133, I-135

c. Cesiums: Cs-134, Cs-137

d. Others: Ba/La-140, Ce-141, Ce-144, Ru-106, Te-129, Te-129a, Te-131, Te-131m, Np-239

If the levels of noble gases in the ambient atmosphere surrounding the detector are high enough to cause significant interference or to overload the detector, a compressed air or nitrogen purge of the detector shield volume will be maintained.

The onsite radiological and chemical laboratory facilities are equipped with gamma spectral analysis equipment to quantify the radionuclides present in gas and liquid samples. Shielding is provided for the radiation detectors to minimize the effect of background radiation. Initial dilutions are performed in the process of taking liquid samples at the sample stations. Any additional dilutions required will be performed in the laboratory fume hood behind a lead brick pile.

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11.5.5.4.4 Gas Analysis-Gas Chromatography

A gas chromatograph will be used to measure hydrogen and oxygen concentrations in containment atmosphere and dissolved gas samples.

a. Dissolved hydrogen concentrations - - An accuracy of ±10 percent can be expected over the range of concentrations from 50 to 2000 cc/Kg. Below 50 cc/Kg, the accuracy will be ±0.05 cc/Kg. Gas chromatography has been successfully demonstrated for the determination of hydrogen in TMI-2 post-accident gas samples.

b. Dissolved oxygen concentrations - - Dissolved oxygen will be measured indirectly using the residual hydrogen method of analysis. Using this method, dissolved oxygen concentration is verified to be less than 0.1 ppm by measurement of positive hydrogen residuals of greater than 10 cc/Kg.

11.5.5.4.5 Determination of Extent of Core Damage

A procedure to assess the extent of core damage based on radionuclide concentrations and other parameters has been prepared by GE and will be used at Limerick.
[ref. _] ← to be provided later

11.5.5.4.6 Storage and Disposal of Samples

Short-term sample storage areas will be provided in the chemistry laboratory and counting room facilities. An area for long-term storage of the samples will be designated at a later date. Low level wastes generated by the chemistry procedures will be flushed to radwaste. Ultimate procedures for disposal of the samples will be determined later; however, after a sufficiently long decay period, the activity levels will be significantly reduced. This will ease exposure problems during disposal.

11.5.5.4.7 System Testing and Operator Training

Equipment used for post-accident sampling and analyses will be calibrated or tested approximately every six months. ~~Personnel training in the collection and onsite analysis of samples will be performed annually~~. At least five members of the onsite

organization will participate in ~~the training to ensure the availability of trained personnel~~ sampling operations within any 6 month period.

11.5.5.5 Dose Rate Analysis

The post-LOCA core inventory of fission products was calculated assuming a three-year irradiation, 100 percent availability, and reactor operation at 102 percent of rated power. Fractional releases of fission products from the fuel to the reactor water, suppression pool, and containment atmosphere were based on Regulatory Guide 1.3 and 1.7 assumptions. The resulting source terms were used in the design of PASS shielding and in determining doses to operators.

The sampling and analysis provisions at Limerick have been designed such that it will be possible to obtain and analyze a sample following an accident without exceeding the criteria of GDC 19. Time sequences and calculated dose rates to verify compliance for a sample taken one hour post-LOCA are given in Table 11.5-6.