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ILLINOIS POWER COMPANY

CLINTON POWER STATION, P.O. BOX 678, CLINTON, ILLINOIS 61727

March 10, 1986

Docket No. 50-461

Director of Nuclear Reactor Regulation
Attention: Dr. W. R. Butler, Director
BWR Project Directorate No. 4
Division of BWR Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Clinton Power Station
Effluent Radiation Monitor Calibration

Dear Dr. Butler:

Illinois Power (IP) has procured and installed Accident-Range Effluent Radiation Monitors (AXM-1s) to meet the requirements for measuring high level noble gas releases from Clinton Power Station (CPS) as outlined in NUREG-0737, Item II.F.1 - Part 1. Clinton's station Heating, Ventilation and Air Conditioning (HVAC) and Standby Gas Treatment System (SGTS) effluent stacks are equipped with Eberline Corporation AXM-1s which utilize noble gas detectors with a low range capability of 10^{-4} uCi/cc. Since NUREG-0737 specifies that noble gases be monitored to As-Low-As-Reasonably-Achievable (ALARA) levels, IP will also utilize the low-range noble gas channels of the HVAC and SGTS Normal-Range Effluent Radiation Monitors to meet the NUREG-0737 low-range requirement.

Several methods for calibrating the above monitors have been reviewed both internally and with NRC Region III. IP is implementing what it considers to be the most appropriate approach for CPS and is submitting it for your review. IP will utilize vendor supplied primary calibration data as well as on-site test data to calibrate the noble gas channels for these monitors. The calibration methodologies to be used are described in Attachment 1 (normal-range monitors) and 2 (accident-range monitors) to this letter.

If you should have any comments on the attached information, we would be pleased to discuss them with you.

Sincerely yours,

F. A. Spangenberg
Manager - Licensing and Safety

JBD/ckc

Attachments

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cc: Mr. B. L. Siegel, NRC Clinton Licensing Project Manager
NRC Resident Office
Regional Administrator, Region III USNRC
C. F. Gill, Region III USNRC
Illinois Department of Nuclear Safety

Attachment 1

PROPOSED CALIBRATION METHODOLOGY FOR NORMAL-RANGE NOBLE GAS EFFLUENT MONITORS

During and following an accident at Clinton Power Station, all potential release paths would be isolated with the exception of the station Heating, Ventilation and Air Conditioning (HVAC) and Standby Gas Treatment System (SGTS) effluent stacks. The HVAC and SGTS stacks are equipped with Accident-Range Effluent Radiation Monitors (AXM-1s) which provide high-range noble gas detection and particulate and iodine sampling capabilities. The low-range noble gas channels of the Normal-Range Effluent Radiation Monitors are considered necessary to meet NUREG-0737, Item II.F.1(1) which specifies that noble gases be monitored to As-Low-As-Reasonably-Achievable (ALARA) levels. Eberline RDA-3S radiation detector assemblies are utilized for the low-range channels on these monitors. IPC intends to perform the calibration of these detector assemblies using solid source transfer standards and primary calibration data supplied by the vendor. This will be performed prior to Fuel Load and additionally a validation test will be performed prior to exceeding five percent rated reactor power, using plant process off-gas or Xenon-133 (Xe-133) calibration gas.

Calibration Description

As part of the Startup Preoperational Testing program, operation of the normal-range HVAC & SGTS effluent monitor low-range channels will be demonstrated per design documents and FSAR description (FSAR Sections 7.7.1.19, 11.5.1, 11.5.2.2.3, and 11.5.2.2.4). The detectors will be calibrated using solid Technetium-99 (Tc-99) sources and vendor supplied National Bureau of Standards (NBS) traceable noble gas response data. Calibration will be in units of uCi/cc of the FSAR design basis gas mix for normal operation (FSAR Table 11.3-9). Correction factor curves have been generated to adjust monitor readings based on a normal noble gas effluent mix to reflect the monitor response to the time-varying post-accident noble gas mix, and will be included in station procedures.

Using vendor supplied responses to Krypton-85(Kr-85) and Xe-133 calibration standards, as well as energy response data for solid sources, IPC will determine a generic response to the FSAR gas mix for the RDA-3S detectors. Next, an average monitor-specific response to Tc-99 will be determined by exposing the detector to two Tc-99 sources of different strengths. This specific response is verified to be within ± 20% of the generic response determined by Eberline. Given the similarities between the generic detectors and the Clinton specific detectors (i.e., geometry, size, and scintillation material), the ratio of the monitor-specific response for Tc-99 to the Eberline supplied generic response for Tc-99 is equal to the ratio of the monitor-specific response to the FSAR gas mix and the generic response to the FSAR gas mix. This allows the monitor-specific calibration constants to be determined.

Calibration Validation

At some time following initial criticality, yet prior to exceeding five percent power, the calibration will be verified using plant process gas or Xe-133 calibration gas. Samples of process gas will be drawn from the Off-Gas Pretreatment sample point. These samples will be analyzed by the onsite Spectral Analysis and Records Keeping system to determine the actual gas mix.

This process gas will then be introduced into the detector chambers and the actual response verified against the predicted response. If the process gas activity is not sufficient for this test, Xe-133 calibration gas will be used instead. Further, as additional generic response data is received from the vendor it will be reviewed and incorporated into applicable plant calibration procedures.

Attachment 2

PROPOSED CALIBRATION METHODOLOGY FOR
ACCIDENT-RANGE NOBLE GAS EFFLUENT MONITORS

As stated in Attachment 1, Illinois Power Company (IPC) has purchased and installed Eberline Accident-Range Effluent Radiation Monitors (AXM-1s) to provide the capability to measure high level post-accident releases of radioactive noble gases from the HVAC and SGTS effluent stacks. The AXM-1 noble gas pallets contain two noble gas detector assemblies. Both the SA-14 (mid-range) and the SA-15 (high-range) detector assemblies utilize energy compensated G-M tubes which are shielded by a minimum of 5 inches of lead. IPC will calibrate the AXM-1 noble gas detectors using secondary transfer standards and primary calibration data supplied by the vendor. The calibration will be performed prior to Fuel Load. In addition, a validation test will be performed prior to exceeding five percent rated reactor power using Xe-133 calibration gas.

Calibration Description

As part of the Startup Preoperational Testing program, operation of the AXM-1s will be demonstrated per design documents and FSAR description (FSAR Sections 7.6.1.2.6, 7.6.1.2.7, 11.5.2.1.6, and 11.5.2.1.7). The monitors will be calibrated using solid sources, a gamma field calibrator, Kr-85 gas source (SA-15 only) and vendor-supplied NBS traceable gas data. Calibration will be in units of uCi/cc of FSAR design basis gas mix for normal operation (see FSAR Table 11.3-9). Correction factor curves have been generated to adjust monitor readings based on a normal noble gas effluent mix to reflect the monitor response to the time-varying post-accident noble gas mix, and will be included in station procedures.

Using vendor-supplied response data for noble gases and onsite measurements of energy dependency, IPC will determine the generic response to the FSAR gas mix for the SA-14 and SA-15 detector assemblies. Monitor-specific response to the FSAR gas mix is derived from free air exposure to a Cesium-137 (Cs-137) source for the SA-14 and Kr-85 exposure for the SA-15. Both the SA-14 and SA-15 assembly G-M tubes will be exposed to various strength gamma radiation fields to determine a non-linearity correction factor.

The ratio of the specific response of the SA-14 G-M tube to gamma radiation fields, and the vendor supplied generic response has been shown to be equal to the ratio of the specific response of the SA-14 G-M tube to the FSAR gas mix and the previously calculated generic response. The SA-15 G-M tube will be exposed to a sealed Kr-85 source. The vendor has provided generic response data for a Kr-85 source of identical geometry. The ratio of the responses to Kr-85 is used to scale the generic to specific response of the gas mix. In this manner, specific responses to the gas mix for both sample assemblies will be calculated and nominal ranges determined. If necessary, the non-linearity correction factors would then be applied to compensate for errors introduced at high count rates by detector dead time.

Calibration Validation

At some time following initial criticality, yet prior to exceeding five percent power, the monitor calibrations will be verified using known concentrations of Xe-133 gas. The sample chambers of both the SA-14 and SA-15 detector assemblies will be filled with a sufficient concentration of Xe-133 gas to bring the SA-15 on scale. Dry nitrogen will be used to dilute the Xe-133 to reduce the activity to within the range of the SA-14 detector assembly. Actual monitor response to Xe-133 will be verified against the predicted response based on vendor supplied Xe-133 data.

Eberline is currently in the process of establishing generic monitor energy response data based on exposure of prototype monitors to several nuclides. As this data becomes available to IPC, it will be reviewed and incorporated into applicable plant calibration procedures.