UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SAFETY PARAMETER DISPLAY SYSTEM (SPDS)

DUANE ARNOLD ENERGY CENTER

1.0 Introduction

On May 8, 1984, the NRC transmitted to Iowa Electric Light and Power Company, the licensee for the Duane Arnold Energy Center (DAEC), the SPDS Safety Evaluation. In that evaluation the staff indicated the confirmed implementation of the SPDS program was acceptable. The staff also indicted that the licensee had not provided sufficient information on the isolation devices between the SPDS and the safety systems. The licensee, by a letter dated July 6, 1984, provided the necessary information. Our evaluation of the licensee's submittal addresses the qualification and documentation of the isolators as an acceptable interface between the Class 1E safety-related instrumentation systems and the SPDS.

2.0 Evaluation

The SPDS at Duane Arnold Energy Center is being implemented to assist control room operators in evaluating the safety status of the plant. The SPDS consists of three subsystems, a data acquisition subsystem (DAS), a host processor (HP) and a colorgraphic user terminal (CUT). The DAS encompasses signal acquisition, analog to digital conversion, digital input/output and communication with the host processor. The licensee states that the DAS will interface with safety-related and nonsafety-related signals and will provide Class 1E isolation where required. These cabinets (division I, division II and non-divisional) mounted at remote locations will be configured to handle field

input signals. The division I and division II cabinets will be 1E qualified hardware used to interface with safety-related systems. The nondivisional cabinet will not contain Class 1E qualified hardware and will only interface with nonsafety-related systems. The DAS will transmit digital data via fiber optic links to the SPDS host processor. The host processor contains a data processor, input/output device controllers, data storage facilities and a programmer's console. The CUT will provide hardware and software necessary for accepting, formatting and generating displays for control room operator's overview of critical plant parameters.

Electrical isolation between the safety-related systems and the SPDS is accomplished via the fiber optic cable extending between the division I and division II DAS cabinets and the host processor. The fiber-optic cables are constructed of selica glass fiber surrounded by a Kevlar buffer tube and jacketed with Tefzel. This unique isolator possesses inherent characteristics that cannot be found in other types of isolators within nuclear power plants. The construction of the fiber optic cable is such that the cable contains no electrically conductive material. The relative permittivity (dielectric constant) of a material is a measure of the material's isolation capability. The dielectric constant of a material is referenced relative to free space (a vacuum) and is a dimensionless number. Dry air possesses a dielectric constant of 1.00059. Glass possesses a dielectric constant in the range of 4.0 to 7.0 depending upon

the specific type. The higher the dielectric constant, the greater the isolation that is provided. Thus, fiber-optic cables have an isolation capability that is 4 to 7 times greater than dry air. The voltage breakdown rating of a typical fiber-optic cable is on the order of 250 KV per meter.

A fault at either end of the data link might destroy the modem but will not propagate over the fiber-optic cable. For example, one of the tests that must be performed to qualify an isolator is the application of the maximum credible fault (voltage, current) to the output of the device to verify that the fault does not propagate or degrade the input (Class 1E) side. This postulated failure does not affect fiber-optic cable, as stated above, the optical fibers are totally dielectric (i.e., the electrical energy resulting from the fault will not propagate through the optical fiber). Another characteristic of the optical fiber cable is its nonsusceptibility to the coupling of cross-talk and electromagnetic interference (EMI). Ground loop problems inherent with copper cables are also eliminated.

3.0 Conclusions

Based on our audit of the licensee's information on the isolation devices used in the Duane Arnold Energy Center design, we conclude that the design methodology and the fiber-optic cable used for interfacing the SPDS with safety-related systems are acceptable, and that the proposed equipment meets the Commission's requirements of NUREG-0737, Supplement No. 1 regarding the SPDS.

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