LOUISIANA POWER & LIGHT / 142 DELARONDE STREET • P.O. BOX 6008
NEW ORLEANS, LOUISIANA 70174-6008 • (504) 366-2345

MIDDLE SOUTH UTILITIES SYSTEM

July 17, 1985

W3P85-2175
A4.05

Director of Nuclear Reactor Regulation
Attention: Mr. G.W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: Waterford SES Unit 3
Docket No. 50-382
Detailed Control Room Design Review
Response to Audit Confirmatory Item

Dear Sir:

On June 3-6, 1985, representatives of your Human Factors Engineering Branch conducted a Detailed Control Room Design Review (DCRDR) Audit at Waterford 3. The results of the audit as presented during the exit interview were positive, with confirmatory information requested by the audit team on one item. Enclosed please find the requested information concerning the relationship between control room instrumentation characteristics (e.g. range, accuracy, etc.) and the plant safety analyses.

In discussions with your Ms. Ann Ramey-Smith we understand that this response, in conjunction with the DCRDR conducted by LP&L, should satisfy the requirements of NUREG 0737 Supplement 1 with respect to both the DCRDR and the function and task analysis requirements for the emergency operating procedures.

Should you have further questions on this matter please feel free to contact Mike Meisner at (504) 595-2832.

Yours very truly,

K.W. Cook

K.W. Cook
Nuclear Support & Licensing Manager

KWC/MJM/pcl

Enclosure

cc: B.W. Churchill, W.M. Stevenson, R.D. Martin, D.M. Crutchfield, J. Wilson, T.A. Flippo, A. Ramey-Smith

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WATERFORD 3 RESPONSE TO DCRDR AUDIT

Introduction

During the DCRDR audit conducted June 3-6, 1985 at Waterford 3, the NRC raised one confirmatory item at the exit interview, paraphased as follows:

> What steps have been taken to ensure that the instrumentation installed in the control room is consistent with the FSAR Safety Analyses? That is, are range, accuracy, etc., suitable for operating the plant, and for reliable operator guidance under emergency conditions?

Over the period of design and construction of Waterford 3, multiple iterative processes have been employed to confirm adequacy of the control room instrumentation in the context of the safety analyses. In the discussions which follow, we will describe the design process employed by the Architect-Engineer (Ebasco) and the NSSS Supplier (CE); the implementation of Regulatory Guide 1.97; the FSAR Consistency and Technical Specification Verification Reviews; the analytical basis of CEN-152, CE Emergency Procedure Guidelines; and the Procedures Generation Package process used in developing the Waterford 3 emergency operating procedures. As will be seen, the Waterford 3 control room instrumentation is consistent with the Safety Analyses. The ranges, accuracy, etc. provide reliable operator guidance under normal and emergency conditions.

Design Process

As the NSSS Supplier, Combustion Engineering was responsible for NSSS-related instrumentation while Ebasco was responsible for balance of plant instrumentation. Due to overlap of responsibilities, as well as Ebasco's role as Architect-Engineer, an interactive iterative process amongst LP&L, Ebasco and CE was utilized to develop and finalize the design of Waterford 3. A brief description of the internal design process for Ebasco and CE, as it relates to instrumentation, is included in the following.

Ebasco:

The instrumentation selected for use at Waterford was chosen on the basis of quality and performance, i.e. the best available production devices were purchased. The sensitivities and accuracies chosen were specified to exceed those required to ensure compliance with the Technical Specifications (which are based on the Safety Analyses). For instrumentation required to support the NSSS, the device was supplied by Combustion Engineering and reviewed and approved by Ebasco in an iterative process. Where specified by CE, interface instrumentation was procured in accordance with those specifications as reviewed and approved by Ebasco.

In cases where Ebasco had sole responsibility for instrumentation, accepted engineering practices and requirements of Regulatory Guides, where applicable. were used to establish the scale range for measurement of each individual parameter in the balance-of-plant. However, depending on the type of parameter to be displayed, a general source of information for establishment of the indicator scale ranges may be identified as indicated below:

In the case of the level parameters, the range of instruments and scales on indicators are determined on the basis of the physical dimensions of the equipment.

In the case of pressure or temperature parameters, the maximum values of the operating pressures and temperatures are indicated in the Piping Line List which is a controlled design document developed and maintained by the Mechanical Engineering Group.

In the case of flow parameters, the flow data is established by Mechanical Engineering either as a response to the NSSS interface requirements or through design calculation and is documented in the Mechanical Engineering Calculation books. The scale range of indicators is determined by adding approximately 20% margin to the values found in the Mechanical Engineering Calculation books. Also, the equipment specification design requirements are used to establish the base for instrument ranges when the magnitude of flow is determined by the design of equipment, such as minimum flow requirement for a pump.

In the case of electrical parameters, the nameplate data of electrical equipment is used to establish the operating range of the parameters. The scale range of indicators are determined by adding approximately 20% margin to the operating range value.

The scale ranges for indicators that are related to the HVAC systems were determined by calculations in accordance with the plant design.

In addition to the above, range selections were based on the understanding the engineer had of the operator needs. Accuracy and resolution were evaluated to determine the need for split ranges or multiple readouts. An example of the consideration given to range selection is the area of containment pressure. Four distinct groups of safety related instrumentation provide pressure indication with sufficient accuracy to verify normal operations, SIAS and CIAS actuations, tech spec requirements including vacuum relief and, lastly, a range required by Regulatory Guide 1.97.

In summary, all instrumentation ranges are determined by analyzing the needs of the operator, the optimum display accuracy and the physical properties measured. The physical properties are determined through calculation and Chapter 15 analyses in the FSAR. Where single ranges on displays do not provide sufficient resolution for the operator, multiple overlapping instrumentation is provided.

Combustion Engineering:

The design process for all safety related equipment and systems, including Instrumentation and Control equipment is provided in detail in Section 5 of CE's Quality Assurance of Design Manual (QADM).

In the preliminary design as described in the PSAR, all of the basic plant operating parameters and limits were defined, and the types of instrumentation, control, and protection equipment to be supplied was identified on P&IDs. Analyses of the "standard" accidents were performed, and instrument ranges and setpoints consistent with the preliminary design were used to verify that acceptable results could be obtained. During completion of the systems design, P&IDs were iteratively reviewed by LP&L and Ebasco as well as by internal CE groups until the final P&IDs had been generated.

As the final system designs and P&IDs were completed, Plant Engineering prepared Measurement Channel Requirement Sheets (MCRSs) for each instrument channel. The MCRSs described the number, location, range, accuracy, safety function, and environmental and seismic requirements. The MCRSs were then transmitted to the Instrumentation Engineering (ICE) group for action. ICE determined if the requirements imposed by the MCRSs were realistic and responded to the systems group with alternative recommendations as necessary. When agreement was reached, ICE used this information to prepare equipment specifications and ultimately purchase orders. Compliance with the specification requirements was ensured by the Quality Assurance Program.

In preparation for the Final Safety Analyses, the analytical group submitted formal data requests to the functional groups. The responses to the data requests were prepared in accordance with the QADM to ensure that the instrumentation, control and protection system actions incorporated into the safety analyses were consistent with equipment that had been installed at Waterford 3. It is worthwhile to note that the characteristics (e.g. ranges, accuracies, response times) of the actual installed equipment were used as input to the safety analyses.

The final check on the acceptability of the instrumentation was completed when the Setpoint Document was prepared. Equipment setpoints were generated in accordance with prescribed procedures incorporating all of the variables which can affect the response of an instrument channel, such as drift, environmental effects, setting tolerances, or voltage and frequency variations. These equipment setpoints and associated surveillance requirements became a part of the Technical Specifications.

Regulatory Guide 1.97

Much of the instrumentation required by operators while following emergency operating procedures is discussed in Regulatory guide 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident". In the Regulatory Guide particular instrumentation is specified for the control room operators' use in determining whether plant safety functions are being accomplished. Also specified are required instrumentation ranges and qualification.

Many of the required instrument ranges are characterized with reference to either Technical Specification limits (e.g. primary coolant activity - ½ Tech Spec limit to 100 times Tech Spec limit), or design limits (e.g. containment pressure - 10 psia to design pressure). As such, the underlying safety analyses are automatically incorporated into the instrument ranges. The instrument ranges specified as absolute values have been reviewed by Ebasco and determined to envelope the design basis parameter values contained in the safety analysis.

LP&L responded to Regulatory Guide 1.97 in letter W3P83-0177 date July 6, 1983. The response indicated compliance with the Regulatory Guide with minor exceptions.

FSAR Consistency and Technical Specification Verification Reviews

During the Spring of 1983, in anticipation of plant licensing, LP&L initiated an FSAR Consistency Review to ensure that any inaccuracies or inconsistencies that may have crept into the FSAR during the construction period were corrected. The intent was to provide an accurate and updated FSAR reflecting all design and analysis changes through the history of the Waterford 3 project.

The review was a large effort coordinated by LP&L and involving Ebasco and Combustion Engineering. The review scope included all instrumentation described in the FSAR as well as FSAR Safety Analyses and the Technical Specifications (which, in accordance with 10CFR50.36, are derived from the safety analyses). As noted previously, existing instrumentation was assumed as input to the safety analyses. Therefore, such a review provides additional confirmation that the control room instrumentation (ranges, accuracies, etc.) is firmly grounded in the safety analyses.

The Consistency Review was completed in the Fall of 1983, resulting in minimal changes to the FSAR, most of minor nature. These changes were included in FSAR Amendment 33 (see Amendment 33 submittal letter W3P83-3089 dated September 28, 1983).

In April, 1984, after events at the Grand Gulf Nuclear Plant had focused attention on the overall adequacy of Technical Specifications, LP&L undertook a Technical Specification Verification Program. Verification of the Technical Specifications was accomplished by determining consistency between the Tech Specs, the FSAR, the "as-built" plant, and the NRC's Safety Evaluation Report as supplemented. The review included a documented in-depth comparison between the FSAR safety analyses and the Tech Specs. As with the earlier FSAR Consistency Review, the Verification Program provides additional confirmation that control room instrumentation is firmly grounded in the safety analyses.

The Technical Specification Verification Program concluded that the Waterford 3 Technical Specifications adequately validate the assumptions in the accident analyses; reflect plant specific considerations; and satisfy the requirements of 10 CFR 50.36. Additionally, it was concluded that the Technical Specifications accurately reflect the plant, the Final Safety Analysis Report, and the NRC Safety Evaluation Report analyses.

In letter W3P84-1590 dated June 8, 1984 LP&L, based on the results of the Verification Program, certified the accuracy of the Waterford 3 Technical Specifications.

CEN-152

LP&L has been a participant in the CE Owners Group since its inception. An early task adopted by the CEOG concerned the development of generic Emergency Procedure Guidelines (EPGs) in response in NUREG 0737, Item I.C.1. Briefly, I.C.1 required reanalysis of transients and accidents to support development of EPGs. It was recognized that the Owners Group generic submittals could be referenced to support the reanalysis and guideline development.

In response to NUREG 0737, Item I.C.1 (and earlier guidance documents) the CEOG undertook extensive analyses documented, in part, in the following:

- CEN-114-NP Amendment 1-NP, "Review of Small Break Transients in Combustion Engineering Nuclear Steam Supply Systems"

- CEN-117, "Inadequate Core Cooling, A Response to NRC IE Bulletin 79-06C, Item 5, for Combustion Engineering Nuclear Steam Supply Systems"

- CEN-128, "Response of Combustion Engineering Nuclear Steam Supply System to Transients and Accidents"

The background of this process, and demonstration of compliance with NUREG 0737 Item I.C.1, is described in Sections 1.2 and 1.3, respectively, of CEN-152, "Combustion Engineering Emergency Procedure Guidelines". Revision 2 of CEN-152 was submitted to the NRC by the CEOG on May 8, 1984.

Each guideline contained in CEN-152 includes a Bases section. The Bases present a condensed version of a large body of information (including analyses) from which utility personnel may draw in writing emergency operating procedures. In addition to providing the characteristics and overview of the event, the Bases section includes a detailed discussion of the range and trend of plant parameter responses to an event or class of events. In other words, the underlying analyses have been translated into bounding ranges for individual parameters that the operators would be expected to monitor via control room instrumentation. (See the Bases discussion in, for instance, Section 1.6.2.1 of CEN-152.) A representative example is the Safety Function Status Check Bases for Steam Generator Tube Rupture contained in Figures 6-19a to 6-19c of CEN-152.

The Guidelines (and Bases) were developed through an iterative workshop process as described in Section 11.0 of CEN-152, "CEOG EPG Validation". Instrumentation needs were explicitly addressed and tied to the analyses. For instance, provided to the workshop participants were lists of the minimum required responses of various mitigating systems, the expected ranges and trending of parameter variations, and the expected response to control room instrumentation throughout the course of each event. The workshops provided a verification of expected equipment and instrument response as encompasses by each guideline.

Waterford 3 Procedures Generation Package (PGP)

NUREG 0737 Supplement 1 specifies a set of steps to be followed in translating the generic EPGs, as contained in CEN-152, into plant-specific emergency operating procedures (EOPs). In complying with Supplement 1, LP&L developed plant-specific Technical Guidelines from the generic CE EPGs. The Technical Guidelines, and the entire PGP, were submitted to the NRC through a series of letter (W3P83-4103 dated December 19, 1983; W3P84-0494 dated March 5, 1984; W3P84-1242 dated May 2, 1984; W3P84-2062 dated July 31, 1984; and W3P84-2573 dated September 19, 1984).

For every plant-specific Technical Guideline developed by LP&L a review was conducted to either confirm the generic values, ranges, etc. contained in CEN-152, or develop plant-specific values for Waterford 3. The review included experienced engineering judgement, calculations and reanalyses as appropriate. The Operations Group requested, and received, engineering input on areas as diverse as instrument error induced by a high energy line break, and pressurizer heater and auxiliary spray response for void indication. The major review results are incorporated into the Parameter Values Document contained in Volume 3, Section 5.10 of the PGP. For each parameter value identified in the document, the basis for the value, the instrument number, accuracy and EOP step are documented. In addition, for every plant-specific Technical Guideline a list of instruments and ranges is provided. See, for instance, Section 5.3.4 of the Loss of Coolant Accident Technical Guideline (OP-902-002).

Having established the technical basis for instrumentation needs, the plant specific Technical Guidelines were then processed through a Verification and Validation program, the results of which are described in Volume 4 Sections 1.0-3.0 of the PGP. It is worthwhile to note that the primary verification purpose served by the control room walkthrough during this phase of the PGP was the confirmation of the presence of required instrumentation and controls as identified in the Technical Guidelines.

Summary

As described above, multiple independent paths exist at Waterford 3 to ensure that control room instrumentation characteristics are firmly based on transient and accident analyses:

1. The design process itself, as confirmed through the FSAR Consistency and Technical Specification Verification Reviews, utilized existing control room instrumentation capability as input to the safety analyses;

2. Compliance with Regulatory Guide 1.97 requirements ensured equivalent or wider bounds for instrument ranges than those required for Waterford 3 design basis events; and

3. The Procedures Generations Package process employed confirmation of instrumentation adequacy of EOPs independently of the design and Regulatory Guide 1.97 processes.

LP&L is confident that, based upon these processes, the control room instrumentation provided at Waterford 3 will meet the needs of the operators during emergency situations.