U. S. NUCLEAR REGULATORY COMMISSION

OFFICE OF NUCLEAR REACTOR REGULATION

Division of Reactor Inspection and Safeguards

Report No.: 50-353/88-200
Docket No.: 50-353

Licensee: Philadelphia Electric Company
2301 Market Street
Philadelphia, Pennsylvania 19101

Facility Name: Limerick Generating Station, Unit 2

Inspection At: Stone and Webster Engineering Company Offices,
Cherry Hill, New Jersey

Inspection Conducted: August 8-12, 1988

Inspection Team Members:

IDCA Coordinator: E. V. Imbro, Section Chief, RSIB, NRR

IDA Team Leader: R. W. Parkhill, Team Leader, RSIB, NRR
IDA Mechanical Systems: D. Katze, Reactor Engineer, SRXB, NRR
M. C. Singla, Consultant
IDA Electrical Power Systems: S. V. Athavale, Electrical Engineer, RSIB, NRR
IDA Instrumentation/Controls: J. M. Leivo, Consultant
IDA Mechanical Components: V. P. Ferrarini, Consultant
IDA Civil/Structural: H. B. Wang, Civil Engineer, RSIB, NRR

ICA Team Leader: S. R. Stein, Operations Engineer, RSIB, NRR
ICA Assistant Team Leader: J. M. Sharkey, Operations Engineer, RSIB, NRR
ICA Mechanical: R. Compton, Consultant
ICA Electrical and I&C: D. C. Ford, Consultant
ICA Civil/Structural: A. I. Unsal, Consultant
ICA Welding: W. R. Schick, Consultant
ICA Nondestructive Examination: J. J. McArdle, Consultant

R W Parkhill
Ronald W. Parkhill
IDA Team Leader

9/20/88
Date Signed

E. V. Imbro for
Steven R. Stein
ICA Team Leader

9/20/88
Date Signed

Reviewed By: E. V. Imbro
Eugene V. Imbro, Chief
Team Inspection Development
and Appraisal, Section 2

9/20/88
Date Signed

Approved By: Charles J. Haughney
Charles J. Haughney, Chief
Special Inspection Branch, NRR

9/23/88
Date Signed

LIMERICK UNIT 2

INDEPENDENT DESIGN AND CONSTRUCTION ASSESSMENT (IDCA)
REVIEW PLAN INSPECTION, AUGUST 8-12, 1988

1. BACKGROUND INFORMATION

In a letter to Mr. William M. Alden of Philadelphia Electric Company (PECO) dated July 28, 1988, the NRC accepted the utility's "Program for the Independent Design and Construction Assessment (IDCA) of Limerick Unit 2, Revision 1." The intent of this program was to assess the adequacy of the design and construction process utilized at Limerick Generating Station, Unit 2 by conducting an independent review of selected plant systems, components, and structures associated with the containment heat removal mode of operation of the residual heat removal system (RHRS). The scope of the program was viewed by the staff to be a comprehensive review of the architect/engineer's design as well as a representative sampling of all major construction attributes including component and system testing. The independent contractor selected by PECO to conduct this review was Stone and Webster Engineering Company (SWEC) located in Cherry Hill, New Jersey.

To monitor the proper application of the IDCA, the NRC has decided to inspect both the independent design assessment (IDA) and the independent construction assessment (ICA) in three phases: (1) preparation of review plans or check-lists by SWEC, (2) implementation of the review plans and performance of the review by SWEC and (3) review and evaluation of the final IDCA report including PECO's associated corrective actions.

2. INSPECTION SCOPE AND OBJECTIVE

On August 4-5, 1988, the NRC design and construction inspection teams visited the plant site to attend an overview presentation by the architect/engineer of the subjects selected for review, and to perform a familiarization walkdown of the selected systems, components, and structures. Then, during the week of August 8-12, 1988, the team visited the SWEC offices to evaluate the IDA and ICA review plans.

The objective of this inspection was to establish whether the IDCA review plans were prepared in sufficient technical depth to permit adequate evaluation of the design and construction of Limerick Generating Station, Unit 2.

3. KEY PERSONNEL CONTACTED

Name	Organization
E. J. Sis'in	Senior Vice President, SWEC
W. Baranowski	Assistant Project Manager, IDCA, SWEC
D. J. Wille	Assistant Project Manager, IDA, SWEC
G. E. Hirst	Mechanical Systems Lead, IDA, SWEC
R. E. Petty	Mechanical Systems, IDA, SWEC
E. F. Heneberry	Electrical Lead, IDA, SWEC
E. B. Pickett	Electrical, IDA, SWEC
J. C. Bisti	I&C Lead, IDA, SWEC
J. S. James	I&C Environmental Qualification, IDA, SWEC
N. W. Motiwala	Mechanical Components Lead, IDA, SWEC
T. L. Wang	Mechanical Components, IDA, SWEC
B. E. Ebbeson	Civil/Structural Lead, IDA, SWEC
E. B. Fleming	Assistant Project Manager, ICA, SWEC
J. C. Thompson	Civil/Structural Lead Engineer, ICA, SWEC
J. E. Crossland	Supervisor Field Quality Control, SWEC
B. C. Jersild	Senior Supervisor NDT Division, SWEC
F. J. Qualter	Assistant Division Manager, SWEC Procurement/Quality Assurance
R. J. Scannel	Senior QA Engineer, SWEC
F. N. Morrissey	Electrical/I&C Lead Engineer, ICA, SWEC
C. E. Gay	PQA District Manager, SWEC

4. INSPECTION DETAILS

The following sections present an overview of the inspection team's evaluation, findings, and conclusions concerning the design and construction review plans.

4.1. Independent Design Assessment

The inspection team's evaluation of the IDA review plans addressed each of the five design disciplines: mechanical systems, electrical power systems, instrumentation and controls, mechanical components, and civil/structural. For each discipline, the review plans were categorized into 14 specific areas: final safety analysis report (FSAR) and licensing commitments, design criteria documents, calculations, drawings, diagrams, specifications, equipment qualification, vendor documents, discipline/group interface, design change documentation, nonconformance reports, evaluation of postulated hazards, special system/component tests and site walkdown. The majority of the 14 areas were applicable to all 5 design disciplines. The inspection team reviewed all of the review plans.

4.1.2 Inspection Findings

As a result of the inspection team's evaluation, many review plan additions and clarifications were recommended by the team to achieve an acceptable depth of review. All additions and clarifications recommended by the inspection team are documented in Addendum I to this inspection report. The most significant program enhancements recommended by the team were requested in the electrical power systems and instrumentation/controls (I&C) disciplines, as discussed in the following paragraphs.

4.1.2.1 Electrical Power Systems Discipline

In the electrical power systems discipline, the team recommended that the scope of review include evaluation of interconnections between the safety-related bus and off-site and standby power sources. Also, the team recommended that the electrical scope include a detailed review of bus transfer schemes, the station DC system, electrical penetrations and cable pulling calculations.

4.1.2.2 Instrumentation and Controls Discipline

In the I&C discipline, the team recommended that the scope of review include evaluation of the vital, non-battery backed 120 Vac instrument power system.

4.1.3 Conclusions

Generally, the inspection team's recommended additions and clarifications were intended to ensure that the review plans provided for evaluation of a comprehensive listing of design attributes. Also, the inspection team requested that SWEC evaluate all review plan attributes, even if this meant selecting systems, components, or structures outside of the approved scope of the IDA.

In general, the team found the review plans to be comprehensive, explicit, and logically structured. Discussion with SWEC IDA team members indicated that experienced and technically competent reviewers were being utilized and that SWEC was pursuing the IDA aggressively. With the inclusion of the additions and clarifications listed in Addendum I, the inspection team considers the defined scope of the IDA to be acceptable.

4.2 Independent Construction Assessment

4.2.1 Inspection Scope

The Stone & Webster Engineering Corporation (SWEC) review plans for the Independent Construction Assessment (ICA) were organized into the following eight areas:

LK-C-1901 "Welding and Nondestructive Examination"
LK-C-1902 "Mechanical Components/HVAC System"
LK-C-1903 "Civil/Structural"
LK-C-1904 "Electrical"
LK-C-1905 "Piping and Pipe Supports"
LK-C-1906 "Procurement, Receipt, and Storage"
LK-C-1907 "QA/QC"
LK-C-1908 "Instrumentation"

The team compared the plans and associated audit plan attribute lists to the applicable regulatory requirements, industry standards, FSAR commitments, and other applicable licensing requirements. The construction inspection team reviewed all of the ICA review plans and one IDA review plan, LK-D-1907-C, "Equipment Qualification."

4.2.2 Inspection Findings

The ICA review plans were comprehensive in most areas. They represented a good first effort at identifying the types of construction attributes and kinds of installations that must be reviewed for an adequate overall assessment of construction practices. However, the NRC inspection team concluded that SWEC had not adequately developed the plans to account for the actual condition of the RHR system and the construction status of Limerick Unit 2. In addition to the specific additions and clarifications (addressed in Addendum II to this report), the NRC construction team identified two areas of concern in the ICA review plans: (1) the scope and depth of inspection were incompletely defined in the plans, and (2) the planning, preparation, and training for the ICA were incomplete. The NRC construction team noted that SWEC developed the review plans without a site visit and system walkdown by the principal ICA personnel. The team considered this omission a major contributor to the weaknesses identified in the review plans.

4.2.2.1 Scope and Depth of Inspection

The team's overall concern regarding the scope of the ICA review plans derived from the factors discussed in the following paragraphs.

The ICA review plans did not comprehensively identify all types of items and equipment which SWEC will inspect during the ICA, and in some instances, SWEC had not defined the applicability of identified equipment to the RHR system.

Several ICA review plans lacked a minimum level of effort or a sample selection process. SWEC should include a minimum sample of attributes in the plans for review and inspection. These minimum requirements would permit SWEC to gauge their progress towards meeting the IDCA program goals, and to prevent an assessment of an area of construction based on only one or two data points.

The NRC evaluation of the ICA plans revealed that important audit plan attributes were missing or incomplete. For example, the civil/structural plan, LK-C-1903, did not include an attribute to verify the strength of concrete through a review of concrete compressive test results; and the electrical plan, LK-C-1904, attributes for cable routing involved only a record review without a physical check of actual routing.

Many review plan attributes were no longer applicable to the RHR system since they addressed in-process characteristics and the system was essentially complete. In addition, the ICA plans were inconsistent in distinguishing between document review attributes and physical inspection attributes.

Finally, SWEC had not specified the interfaces between the various disciplines that would contribute to material traceability reviews. Although the principal ICA participants understood that the individual disciplines were to provide equipment and material samples to the procurement reviewer to facilitate the assessment of traceability, the individual plans did not identify the types of items or information they were to provide. In addition, the procurement review plan, LK-C-1906, did not provide the reviewer with any requirements to perform these material traceability reviews on samples identified by the other ICA members.

4.2.2.2 Preparation, Planning, and Training for the ICA

Three basic factors contributed to the NRC construction team's concern regarding the preparation, planning, and training for the ICA effort. First, the ICA group had not reviewed the actual condition and status of the selected RHR system to determine its effect on the ICA and the review plans. An example was the installation of piping insulation which can significantly reduce the number of welds and piping samples accessible for the ICA group's examination.

Secondly the ICA group had not obtained all of the information required for an adequate preparation of the ICA effort. For example, SWEC had not identified the applicable addition or addendum of the ASME Codes for welding and NDE examinations, and had not gathered sufficient detail drawings to determine samples and applicability of attributes.

Thirdly, the staffing level was inadequate for the size of the on-site review effort defined by the plans. The plans required the electrical and civil/structural reviewers to inspect welds in their own areas. They were to call on the weld/NDE reviewers only if needed. However, the welding/NDE review plans were extensive and would occupy the reviewers' time. Similarly, the plans required the individual discipline reviewers to inspect drilled-in anchors in their respective areas using a complicated checklist.

4.2.3 Conclusion

The NRC team discussed all of the individual ICA review comments and concerns (identified above and in Addendum II to this report) with the ICA principal reviewers. SWEC committed to increase the ICA group by adding one additional reviewer in the electrical area and one in the welding area. With the incorporation into the ICA review plans of attributes to address the NRC team's significant items of concern, the plans will be adequate for their purpose. A reasonable assessment of construction at Limerick Unit 2 will be possible if the plans are properly and fully implemented and enough examples of the identified attributes are reviewed and physically verified.

ADDENDUM I

ADDITIONS/CLARIFICATIONS TO THE
INDEPENDENT DESIGN ASSESSMENT (IDA) REVIEW PLANS

1. IDA INSPECTION FINDINGS

As a result of the NRC inspection team's evaluation of the IDA review plans, many additions and clarifications were recommended. The following sections present the recommended changes as they apply to each of the five design disciplines: mechanical systems, electrical power systems, instrumentation and controls, mechanical components, and civil/structural.

1.1 Mechanical Systems Discipline

1.1.1 RHR Heat Exchanger Sizing

The sizing calculation for the RHR heat exchanger should be included since its performance is essential to the system. Since the RHR heat exchanger is a GE-designed component, the team also recommended that SWEC review a typical heat exchanger designed by the architect-engineer. The spent fuel pool cooling heat exchanger was selected for this review purpose.

1.1.2 Relief Valve Sizing

The design basis and design calculations for relief valve sizing were not included in the SWEC review plans. Since the F055 relief valve is required to prevent overpressurization of the RHR system, the team recommended that it be included in the scope of review.

1.1.3 Control Valve Sizing

Control valve sizing should be reviewed by the instrumentation and control discipline including the interfacing data such as pressure drop and flow rate provided by the mechanical systems discipline.

1.1.4 Leak Rate Testing Connections

Leak rate testing connections should be reviewed for 10 CFR Appendix J Type C testing.

1.1.5 RHR Pump Vendor Documents

Vendor documents should be reviewed to ensure that provisions exist for separation or filtration to remove particles from the RHR pump seal water cooling supply which could possibly damage pump seals.

1.1.6 Vendor Test Reports - Valves

Vendor test reports for A/E procured valves should be addressed in the IDA review plans.

1.1.7 Steam Hammer Review

In order to ensure that the A/E adequately performed analyses for highly compressible fluids the team recommended that the transient flow analysis review include steam hammer.

1.1.8 Valve Accumulator Design

Because of problems with the design of air-operated valve accumulators, including the interfacing check valve, the team recommended that a typical accumulator design be reviewed. SWEC suggested an accumulator for the automatic depressurization system (ADS).

1.1.9 ATWS Conditions

The inspection team recommended that SWEC ensure that the A/E had appropriately analyzed anticipated transient without scram (ATWS) conditions transmitted from the nuclear steam supply system (NSSS) vendor.

1.1.10 RHR System Flushing Provisions

Review plans should address the RHR system flushing provisions to ensure proper cleanliness after pump testing to prevent impurities from entering the reactor coolant system during shutdown.

1.1.11 Small Bore Isometric Piping

A review plan attribute should be added addressing small bore isometric piping. SWEC agreed to review the small bore, two-inch bypass line for valve HV2F068B.

1.1.12 Orifice Sizing

The inspection team recommended that a typical orifice design for a high-pressure system such as a reactor core isolation cooling (RCIC) system, be reviewed for cavitation. The orifice sizing would be reviewed by the instrumentation and control discipline based on the process data provided by the mechanical systems discipline.

1.1.13 A/E-Designed Spray Headers

The inspection team recommended that the review plan address the design of the ADS spargers if they were A/E-designed. Alternatively, the team recommended that the plans address the suppression pool spray header or any other A/E-designed spray header. Subsequent to the inspection, SWEC advised the team that the high-pressure coolant injection (HPCI) turbine exhaust sparger would be reviewed.

1.1.14 HELB Pressure and Temperature Profiles

The high energy line break (HELB) pressure and temperature profiles should be reviewed for transmittal of data to the civil/structural discipline for consideration of compartment pressurization design.

1.1.15 Radiological Design of the RHR and Service Water Heat Exchanger

The review plans should address RHR heat exchanger design and residual heat removal service water (RHRSW) system design to ensure that there are adequate provisions to limit the possibility of any radioactive material release to the environment due to a heat exchanger tube leak.

1.1.16 RHR Pump Room Cooler Sizing

The RHR pump room cooler sizing calculation should be reviewed including the worst-case heat load. Also, the heat gain calculation should consider RHR pump motor inefficiency.

1.1.17 RHRSW Pump Quality Standards

The RHRSW pump quality standards should be addressed in the review plan.

1.1.18 Unstable RHRSW Pump Operation

The pump head curve for parallel operation of RHRSW pumps should be reviewed with regard to the potential for unstable pump operation.

1.1.19 Pump Performance

The team requested that the pump performance review consider pump horsepower requirements and electrical power requirements for the pump runout flow condition.

1.1.20 Spray Pond Water Quality

Since the spray pond did not utilize blowdown or makeup during accident conditions, the team recommended that the review plans address the water quality of the spray pond as it affects the RHRSW system including the particulate size for the pump bearing and seal cooling water. Further, the team recommended that this review include justification of the RHRSW intake screen size.

1.1.21 Pump Testing

The review plan should verify that the vendor testing of pumps was appropriately performed and that it included proper reconciliation between design conditions and actual test data.

1.1.22 RHRSW Pump Performance

The effect of pump column losses should be reviewed with regard to the RHRSW pump performance calculations. The team also recommended that the review plans address the possibility of dissolved gases coming out of solution and affecting pump performance.

1.1.23 NPSH Calculation

The team recommended that the review plans address the net positive suction head (NPSH) calculation for the RHRSW pump.

1.1.24 Pump Vortexing

The team recommended that the review plans include an attribute to address pump vortexing.

1.1.25 Spray Pond Design Calculations

During the inspection the team recommended that the review plans address the design of the ultimate heat sink (UHS). However, in subsequent discussions with PECO and SWEC, the team agreed that the review plans need only address the validity of inputs and the proper utilization of outputs associated with the spray pond design calculations. For example, the review plans need address only justification of worst-case assumptions which would maximize spray pond temperature, not the method of heat dissipation from the spray pond.

1.1.26 Total Dynamic Head Calculation

Section 4.1.3, Attribute 1, of review plan no. LK-D-1903-MS, Rev. 0, identified the verification of RHR pump runout flow conditions for "RHR Piping Calculation"; this was a typographical error. The verification should be for "Total Dynamic Head Calculation" to ensure that RHR pump would not be damaged due to runout during low-pressure coolant injection (LPCI) and containment spray mode.

1.2 Electrical Power Systems Discipline

1.2.1 Scope of Electrical Design Review Plans

The inspection team noted that the scope of the electrical design review plans was limited to the 4 kV switchgear in the AC distribution system and the battery sizing calculations in the dc distribution system. The team requested that the following additional areas be included in order to verify the adequacy of the station ac and the dc distribution system's ability to supply operating and control power for all loads required for safe shutdown of the reactor during all modes of plant operation.

a. Evaluation of the off-site power connection to the on-site power including interconnections between units, sizing of associated equipment, loads to be powered for each operating condition, effect of loading and unloading for rating of associated equipment, transfer of buses, and co-ordination and independence between off-site power and on-site power for any fault during any mode of plant operation.

b. Detailed evaluation of the Class 1E diesel generator and the sequencer system including loading, unloading, voltage and frequency drop and recovery, load acceleration during specified time steps, and test-ability of the system during plant operation.

c. Evaluation of the medium voltage distribution system (including the Class 1E diesel generator) for coordination and protection including ground fault protection.

d. Evaluation of the power feed penetration design including the sizing and protection scheme for the reactor recirculation pump motor.

e. Analysis of system voltage drop and minimum terminal voltage of the Class 1E bus for the worst case of degraded voltage even if the worst case analyzed is outside of the RHR system.

f. Evaluation of the Class 1E dc distribution system including short circuit calculations, equipment sizing, voltage drop, interlocking, and protection to verify the system's ability to support safe shutdown of the plant in every mode of operation.

g. Analysis of the interconnection between Class 1E buses and non-Class 1E loads where such loads are not disconnected by the accident signal.

h. Evaluation of cable pulling calculations.

1.2.2 FSAR Commitments

The inspection team noted that although FSAR section 1.8 shows that PECO has committed to Regulatory Guide 1.22 "Periodic Testing of Protection System Actuation Functions," and Regulatory Guide 1.73 "Qualification Tests of Electric Valve Operators," applicability of these regulatory guides to Limerick design was not included in the related review plans.

1.2.3 Review of Elementary Wiring Diagrams

The team noted that the review of elementary wiring diagrams was not included in the review plan.

1.2.4 Reference Standards

The inspection team noted that dates of the applicable reference standards were not included in the reference section of the review plan for environment qualification.

1.2.5 Discipline to Group Interface

The inspection team noted that the review plan for the discipline to group interface did not include the transmittal of electrical equipment heat load information to the mechanical systems discipline or the NSSS vendor requirements for electrical equipment.

1.3 Instrumentation and Controls Discipline

1.3.1 Instrument Power

To address the inspection team's concern identified during the Limerick site visit, any potential safety problems regarding interruption and restoration of vital, non-battery backed 120 Vac instrument power should be assessed; this assessment would be generic to the plant, as well as specific to the RHR and RHRSW systems.

1.3.2 Main Control Board Internal Wiring

To address the inspection team's concern identified during the Limerick site visit, the design and installation of main control board internal wiring should be reviewed to assure proper use of separation, isolation, and barriers.

1.3.3 Instrument Tubing Characteristics

Instrument tubing supports, clamps, and restraints should be reviewed, and conformance to instrument tubing separation criteria should be verified in the IDA.

1.3.4 Control Circuits

Control circuits for "race" conditions (i.e., configurations in which inherent timing characteristics of individual circuit devices or inputs can result in unstable or indeterminate output states) should be reviewed.

1.3.5 Circuit Protection Device

Proper I&C circuit protection device application, ratings, manufacturer and style number, and coordination should be verified in the IDA.

1.3.6 Alarm Circuits

Review of alarm circuits should include assurance that alarm conditions were properly implemented for all relevant plant conditions (i.e., that the resulting alarm was appropriate for the system and did not represent an invalid or nuisance alarm).

1.3.7 Calculations

Calibration calculations, flow measuring element sizing calculations, high pressure restriction orifice sizing and cavitation calculations, and control valve sizing calculations should be reviewed.

1.3.8 FSAR Commitment

The equipment qualification (EQ) review should include Regulatory Guide 1.73, "Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants," as a review attribute, per the Limerick FSAR.

1.3.9 Motor-Operated Valves

The EQ review should address motor operated valves.

1.3.10 SCEW Data

Data on sampled EQ system component evaluation worksheets (SCEW) should be verified against fundamental design input requirements and assumptions, rather than using the results of a calculation not verified by the IDA. For example, the accident scenario assumptions that resulted in the stated environmental conditions for the components of interest would be verified by systems or functional review and walkdown.

1.3.11 Vendor Documents

The vendor document review should include surveillance instructions and requirements.

1.3.12 Discipline Interfaces

The mechanical systems to I&C discipline interface review should address system operational requirements (e.g., operating modes, locations, engineering units, administrative controls). It should also include instrument process tap details and location requirements. Similarly, the I&C to electrical systems discipline interface review should address power quality as well as identification of loads requiring Class 1E power and train or channel assignments.

1.3.13 RHRSW Process Monitor

The RHRSW process monitor should be reviewed, since it is used to isolate RHRSW; and the review should verify that the monitor will not spuriously actuate from high ambient background radiation.

1.3.14 Design Change Documentation and Nonconformance Reports

The review of design change documentation and nonconformance reports should include verification that these documents contain adequate discussion of the root cause and extent of the problem leading to the change as well as an adequate problem definition. This item was applicable to all the associated discipline review plans.

1.3.15 Instrument Line Pulsation Dampeners

A review of the use of instrument line pulsation dampeners should be included.

1.3.16 Computer-Based, Safety-Related Systems

Computer-based safety-related systems included in the RHR or RHRSW systems should be reviewed to ensure that an adequate verification and validation program is in place for real-time software.

1.3.17 Instrumentation Channels

The inspection team reviewed the preliminary sample of instrumentation channels (outlined in the table below), which had been tentatively selected by SWEC for the IDA review. The team understood that SWEC would review these channels end to end, including interfaces, against the attributes identified in the review plans.

System	Tag No.	Function	Scope
RHR Train B	FT 2N052B	RHR HX outlet flow (mini-flow control)	GE
	PDT 2N058B HV 2F017B	RHR isolation	GE
	--	RHR pump control	GE/B
RHRSW Train B	PSL 001D	RHRSW pump discharge pressure	B
	FT 2N007B	RHRSW flow to RHR HX (break detection)	GE
	HV 2F068B	RHR HX SW outlet isolation	B
HVAC Train B	TE 223B	RHR pump cubicle temperature	B

To promote a more representative assessment of system functionality as well as to increase the portion of Bechtel items that would be reviewed, the inspection team recommended the addition of the following instrumentation channels and items to the sample.

a. RHRSW process radiation monitor (discussed previously)

b. A representative high-pressure flow restriction orifice (to be reviewed for cavitation problems, as discussed previously)

c. RHRSW pump control

d. Drywell pressure (permissive for manual containment heat removal)

e. Reactor pressure (interlock with RHR suction valves)

f. Remote shutdown panel circuit (requires review of a train A circuit, since no remote shutdown panel circuits are in train B)

g. Isolation devices in I&C circuits (SWEC intended to cover this item in the individual diagram and specification or vendor reviews)

1.3.18 Additional Clarifications

The following additional clarifications were discussed with SWEC and did not require revision of the review plans.

a. As the IDCA progresses, SWEC would assure that the NRC notices, bulletins, and circulars referenced in the review plans were appropriate and complete for the review of interest.

b. SWEC would verify conformance to appropriate Bechtel specifications and engineering procedures when that documentation was identified and made available to SWEC.

c. Review of wiring diagrams would verify that they were consistent with wire numbers assigned on elementary diagrams.

d. Review of surge protection and isolation device ratings and qualifications would be addressed in the electrical systems review plan.

1.4 Mechanical Components Discipline

1.4.1 Piping Analysis Overlap Techniques

The team recommended that the design reviews include a piping analysis that utilized overlap techniques.

1.4.2 Seismic Qualification of RHR Heat Exchanger

The team recommended that the EQ review plan be expanded to include a review of the seismic qualification of the RHR heat exchanger, including supports, one tank including supports (e.g., ADS accumulation), and three motor-operated valves, as a minimum.

1.4.3 Internally-Generated Missiles

The team recommended that the review plan include a review of internally-generated missiles including consequence evaluation.

1.4.4 Multi-Discipline Hazards Analysis Review

The team recommended that SWEC ensure that a multiple-discipline review is conducted for the hazards analyses of internal missiles, seismic II over I, moderate energy line break analysis (MELBA), and high energy line break analysis (HELBA). For example, in HELBA, the mechanical components discipline typically would be involved in the postulated pipe break analysis, identification of impacted targets, evaluation of the effects of impacted piping and pipe support targets, and the determination of internal flood levels. The mechanical systems discipline would calculate the compartment pressure and environmental parameters, and would evaluate whether the impacted targets are necessary for safe shutdown of the plant with assistance provided as necessary from the electrical and I&C disciplines. The effects of equipment submergence would be reviewed by electrical, I&C, and mechanical system disciplines. Finally, the civil/structural discipline would provide the necessary structural protection for targets determined to be necessary for safe shutdown, and would evaluate the structural adequacy associated with the effect of compartment pressurization.

1.4.5 Field Audits

The team recommended that SWEC verify that the field audits identified in FSAR section 3.2.1.d(2) had been adequately performed. These audits are required for items included in the seismic Category I piping analysis but not within the actual seismic boundary, to ensure that the final installation of these items meets the more stringent seismic Category I standards.

1.4.6 Design Criteria Documents

The design criteria documents review plan needs to clarify that Attribute 21 in Section 4.1 refers to the assessment of irregularities such as dents, and not pipe wall thinning due to erosion or corrosion.

1.4.7 Pipe Stress Analysis

For pipe stress analysis, the team recommended that SWEC review an analysis consisting of both ASME Code Class 1 and 2 piping to ensure that each segment has been qualified to its respective ASME Code requirements.

1.4.8 Pipe Support Design

The team recommended that SWEC's review of pipe support structural member sizes include an evaluation of actual stresses, including torsional effects, and a verification that they were within the appropriate, allowable limits. Also, the team specifically recommended that these attributes be evaluated for all structural pipe supports reviewed and not limited to the first few selected. The pipe support review also should include an evaluation of the following characteristics.

a. Web crippling, flange bending, and punching shear for structural members

b. Maximum and minimum weld sizes

c. Special weld configurations such as tube steel radii when a computer program is used to calculate weld sizes

d. Anchor bolt embedment length, including consideration of non-structural concrete toppings

e. Spring hanger variability

f. Appropriateness of design tolerances and clearances

1.4.8 Weld Length

The team recommended that intermittent weld length and spacing be included in SWEC's evaluation of weld length for HVAC duct and support qualification.

1.4.9 Support Amplification

The inspection team recommended that support amplification be evaluated for equipment seismic qualification.

1.4.10 Additional Clarifications

In general, for all the mechanical component review plans, the inspection team recommended that specific FSAR sections be listed under the "References" heading.

1.5 Civil/Structural Discipline

1.5.1 Floor Slab Flexibility

The flexibility of floor slabs should be included in SWEC's review plan to ensure that floor amplified response spectra generation was not compromised.

1.5.2 SRV Hydrodynamic Loads

Miscellaneous steel structures located under the reactor vessel safety or relief valves (SRV) should be included in the review plans to ensure that they were properly designed for pool swell hydrodynamic loads. The team also recommended that SWEC evaluate the structural design of the primary containment building to ensure that it would accommodate the most severe combination of the SRV hydrodynamic reaction loads.

1.5.3 Category I Structures

Tank support loadings should be included in the review plan for Category I structures. Also, the interaction of a nonseismic building (e.g., turbine building) with a seismic Category I building should be evaluated.

ADDENDUM II

INDEPENDENT CONSTRUCTION ASSESSMENT REVIEW PLAN COMMENTS

1.1 ICA Inspection Scope

The NRC construction team reviewed revision 0 of the SWEC ICA review plans in each of the disciplines. The NRC reviews evaluated whether the attributes in the plans were comprehensive enough to determine the adequacy of Limerick Unit 2 construction in each area. The review plans for QA/QC and procurement, receipt, and storage were reviewed by each member of the NRC team for adequacy of requirements in their respective disciplines. In addition, the team reviewed the IDA review plan for equipment qualification.

1.2 ICA Inspection Findings

As a result of the NRC team's evaluation of the ICA review plans, many additions and clarifications were requested. The following sections present the recommended changes as they apply to each of the nine review plans:

LK-C-1901 "Welding and Nondestructive Examination"
LK-C-1902 "Mechanical Components/HVAC System"
LK-C-1903 "Civil/Structural"
LK-C-1904 "Electrical"
LK-C-1905 "Piping and Pipe Supports"
LK-C-1906 "Procurement, Receipt, and Storage"
LK-C-1907 "QA/QC"
LK-C-1908 "Instrumentation"
LK-D-1907-C "Equipment Qualification"

1.2.1 Welding and Nondestructive Examination (LK-C-1901)

1.2.1.1 General Comments on Welding and NDE

Welding assessments will be performed by the piping and piping supports SWEC team. Other systems that involve welding will also use the inspection of the piping and piping supports team. These systems include the welded components in the following ICA review plans.

LK-C-1901	Welding and NDE Examination
LK-C-1902	Mechanical Components/HVAC System
LK-C-1905	Piping and Piping Supports

Some assistance will be required for visual welding inspections in the civil/structural and electrical power systems disciplines, as deemed necessary by the system team leader.

The ICA review plans identified above were reviewed and considered to be inadequate to implement the overall SWEC welding approach, and lacking in several general considerations. The NRC team also had specific comments on the audit plan items. Much of this criticism is attributed to SWEC's lack of knowledge of the plant construction status and the applicable Codes and regulations for the construction phases of the audit. General areas of concern are

based on the fact that the plant construction is 94 percent completed and the RHR B loop pipe line selected for the audit is largely covered with insulation and is therefore not likely to be accessible for inspection.

The supplied or procured components for many of the systems were built to 1971 Codes and various subsequent Codes and Regulations. The acceptance of stored equipment has not been addressed for completeness or adequacy of records to justify use without some verification inspections. Some of the components were constructed 16 years ago, possibly without quality assurance verification and records with supporting evidence that they still meet required regulations and FSAR requirements. A contingency inspection plan should address components which lack adequate documentation packages, particularly with respect to radiographs of piping weld joints of shop supplied spool pieces.

A general assessment of the SWEC review plans for the welding discipline is summarized as follows.

a. Traceability of piping materials through ISO drawings and procurement is identified only for welding materials and only for in-process weld joints. This verification should be expanded to pipe spool pieces and should include a follow-up for radiographic acceptance and materials traceability. SWEC agreed to change the program to include 10 spool pieces for verification.

b. Shop welds and supplied equipment weldments such as piping spools have not been included in the audit plan. SWEC agreed to include review of the piping spools. This review will be accomplished in the same manner as materials traceability; i.e., the identification and heat numbers for the spool pieces will be provided to the procurement reviewer for verification.

c. Applicable ASME Codes and Regulations should be identified for system components as part of the audit plan. Bechtel piping specification P-360 invokes various revisions of the ASME Boiler and Pressure Vessel Code for different equipment. Bechtel has also identified 18 Code cases that apply to Unit 2, including requirements invoked on vendors. Nondestructive examination (NDE) relates to both ASME Code Sections III and XI. The SWEC ICA group agreed to include proper reference to these Codes in the audit plan and received this information from Bechtel an August 10, 1988.

d. In-process attributes were on the checklist for many items in the review plans. The sample selected (field piping welds on RHR loop B) may not be accessible for the inspection because the work has been finished and the pipe was covered with insulation. Inadequate sampling due to a lack of ongoing pipe welding may be remedied by adding in-process inspection for other systems that are not yet completed.

e. Valid welding inspections may be limited by protective coatings that have been applied to components of the RHR system. One example was the HVAC duct supports to which a zinc coating was applied over the joints after welding.

f. In-process welding inspection should be reported on an individual form rather than merely a notation on the matrix check sheet form identified by SWEC for inspection implementation. Visual examination and an in-process

welding audit should be reported as an individual audit report consisting of all of the checklist items for that joint. This part of the review plan needs to be developed at the site before actual inspections begin.

g. Visual weld inspections will be performed for all construction disciplines. A review of resumes for SWEC personnel assigned to the ICA team shows that there are five certified visual inspectors to examine all selected welds. Two of the five inspectors have an additional duty of reviewing radiographs and may not be available for visual inspection. One other individual has prior experience in weld inspection and could perform visual weld inspection as needed. Because of the large scope of weld inspection defined in the ICA plan, SWEC should review its staffing requirements in the area of visual weld inspection.

1.2.1.2 Specific Comments on Review Plan LK-C-1901: Welding and NDE

The SWEC-prepared verification checklist for NDE contained attributes for NDE personnel qualification, and NDE records. The verifications pertained to field fabricated welds and attachments in Safety Class 1, 2, and 3 piping of the RHR system. SWEC intends to perform visual weld examinations and a review of radiographs for selected piping welds.

The SWEC review plan was not detailed enough to identify specifically the documents that would be reviewed for NDE procedure compliance and personnel qualification. An essential procedure, Bechtel's procedure for NDE personnel qualification, had not been addressed.

The selection of welds and NDE procedures to be verified was incomplete and addressed only field welds. Shop welds on the RHR heat exchanger, RHR pump, and piping spool pieces should be included.

The following specific comments address the welding/NDE concerns of the NRC inspection team.

a. Page 3

SWEC should identify the applicable welding Codes and Regulations before the audit begins.

b. Paragraph 2.0

Only field welds for fabrication and installation were listed. Provisions should be included for inspection of spool pieces and piping joints, including shop welds.

c. Paragraph 3.3

Both the shop and field welded spool pieces should be considered, and the identifying ISOs and weld numbers should be traced.

d. Paragraph 3.4

Nondestructive examination inspector effectiveness evaluation may be limited since the plant is essentially completed and there is little ongoing work to audit.

e. Audit Plan Attributes Part I - Welding and NDE

(1) Attributes 1 through 6 involve field welding material control procedures that may no longer be relevant to plant construction which is essentially completed for the RHR system. There is only one field weld, a pipe tie-in, remaining to be completed with RHR system. Verification that these procedures were implemented is an audit attribute which is now after-the-fact.

(2) Attributes 10 through 12 concern welder performance qualification. The comment concerning Attributes 1 through 6 applies to these attributes, as well. Alternative system welds should be selected to provide an adequate audit sampling.

(3) Attributes 13 through 17 - In-Process Welding: Audit of in-process welds is essentially unavailable except for one tie-in weld joining that remains to be completed. Alternative system welds should be selected to provide an adequate audit sampling.

(4) Attribute 14 - Verify welding materials: Materials traceability should include sufficient audit examples of welds, as well as base material heat numbers. This information would be used for verification of piping and spool pieces traced to the ISOs, and for further verification by the ICA procurement reviewer.

(5) Attribute 17 - SWEC should review field weld joint records in depth, not only for weld defect disposition and repair, but also for completeness of inspections and required operations.

(6) Attribute 23: The verification of NDE and visual examinations should include a review of examination procedures for compliance with the applicable ASME Codes.

(7) Attribute 24: Bechtel's personnel qualification procedure should be reviewed for compliance to SNT-TC-1A.

(8) Attributes 25, 26, 27, 28, 29: The current checklist addresses personnel qualification in terms of SNT-TC-1A and not the constructor's implementing procedure.

(9) Attribute 33: Small diameter Class-3 piping lines were not identified in paragraph 3.3 of the welding and NDE Plan. P&ID drawings available at SWEC did not identify any small diameter Class 3 lines subject to inspection. SWEC committed to inspect 2-inch and smaller 300-lb rated lines (GBC-204-1 and GBC-210-1) in the RHR system. Since piping lines 2-1/2 inches nominal pipe size and larger rated greater than 300 lbs are not in the RHR system, SWEC committed to inspect a similar line in another system.

1.2.1.3 Specific Comments on Review Plan LK-C-1902: Mechanical Components/HVAC System

The following specific comments address the NRC team's welding and NDE concerns about LK-C-1902.

a. Attribute 4: Weld quality of the duct work may be obscured from visual inspection by a zinc coating applied to the welds. Therefore, this attribute should include a review of the site QC inspection records for these welds.

b. Attribute 15: Weld quality of duct work supports: Same comment as attribute 4.

c. Attribute 19: RHR pumps and base plate welding: These apparent pump support structural joints should be subjected to a visual weld inspection performed by a qualified inspector.

d. Attribute 25 (a thru k) - RHR heat exchanger: Same comment as Attribute 19.

e. Attribute 30 (g) - RHRSW pump support structure: Same comment as attribute 19.

1.2.1.4 Specific Comments on Review Plan LK-C-1905: Piping and Pipe Supports

The following specific comments address the NRC team's concerns about LK-C-1905, as it relates to welding and NDE.

a. Review Plan Attributes Part I - Piping. Attributes 2 and 3: SWEC should provide weld numbers for RHR loop B as identification for the ICA NDE and QA reviews. (This change was accomplished on August 9, 1988.)

b. Review Plan Attributes Part II - Piping Supports

   (1) Attributes 24 and 25: SWEC should use qualified personnel for the visual weld examinations. Each of the weld IDs should be recorded for cross checking with the welder qualification records. SWEC committed to add the identification and verification of shop welds to the audit attribute checklist.

   (2) Matrix Inspection Check Sheet: This sheet is satisfactory for implementing the inspection plan. However, an inspection data sheet should also be used to facilitate proper recording and documentation of the inspection findings.

1.2.2 Mechanical Components/HVAC System (LK-C-1902)

The initial issue (Revision 0) of the review plan was examined for completeness and adequacy to implement the ICA Program Plan. Lack of specificity and missing or unclear attributes were major weaknesses identified in the review plan examination. The specific concerns and weaknesses are noted below. These concerns were discussed with the responsible lead discipline inspector.

a. Paragraph 3.2.3 stated that attributes may be modified as necessary, but did not detail any controls or requirements for these modifications.

b. No sample size or scope (type and distribution) was specified for ducting or duct supports.

c. Fire dampers were not listed as items to be included in the assessment. The one listed damper attribute did not address the inspection criteria needed for fire dampers (such as cleanliness, damage, warpage, orientation, type, or fusible link temperature rating). Operability should be verified mechanically, or at least by review of documentation substantiating that operability had been tested in place.

d. Attribute 10, related to duct stiffeners, did not allow for the possibility that stiffeners were riveted instead of welded, and did not require verification of the adequacy of the attachment method or stiffener spacing along the duct.

e. No inspection of HVAC support attachment location to embeds, structural steel or baseplates was required. Attachment location such as edge distance and centerline tolerance can be a critical element of the structural design.

f. Attribute 24 for the RHR heat exchanger did not include verification of the structural bolting that is part of the foundation. Features such as material type, washer installation, tightness, slotted holes, should be verified. In addition, foundation attachment location tolerances were not verified for this item.

g. The various attributes were sometimes unclear as to whether the verification would consist of physical field inspection or simply a review of completed documentation. This was especially true for verification of expansion anchor installations. For example, the attributes did not indicate how to verify that bolts were "tightened to the required installation torque." In addition, the review plan identified attributes (such as hole size, depth, and cleanliness) that could not be verified after installation.

h. The review plan did not detail or even reference the methods and documentation that would be necessary to track and control the field inspection effort for the various items covered by this plan. For example, the plan did not indicate whether drawings would be marked up, separate checklists developed, or logs maintained, and it did not specify the documents that would be retained as permanent records of the work performed. The review plan itself did not appear suitable for use as a field tracking and documentation vehicle. Prior to the end of the NRC inspection, SWEC's lead inspectors drafted matrices to perform these functions, but they did not cross reference the review plan attributes by number and in some cases, did not include all of the attributes listed in the review plan.

i. The review plan did not define how the QC inspector effectiveness attributes (No. 35-41) were to be implemented (i.e., how many inspectors, how they were to be selected, how and where they were to be interviewed, etc.).

j. The review plan did not specify whether paint would be removed from welds to permit valid inspections of weld quality. Surface defects such as cracks, porosity, and arc strikes often cannot be identified through paint. If paint is not removed, the conclusions based on the inspections performed must be qualified.

1.2.3 Civil/Structural (LK-C-1903)

This review plan included attributes related to reinforced concrete, structural steel, stud welding, grouting, cadwelding, block wall masonry, drilled-in anchors, liners and earthwork. The NRC team reviewed the attributes of each of these areas to determine whether the plans covered the major elements in the construction of Limerick Unit 2. This evaluation showed that the review plan was comprehensive and included the major aspects of civil/structural-related construction at Limerick Unit 2. However, at the time of the NRC evaluation, the plan did not identify the specific elements that would be reviewed by SWEC. The size of the samples that would be evaluated by SWEC was also not yet decided. The SWEC ICA reviewer stated that all elements selected for review by the SWEC IDA review team would also be reviewed by the SWEC ICA team.

In order to determine the civil/structural elements that would be reviewed by the SWEC ICA team, the NRC construction team reviewed IDA review plan LK-D-1903-S (Calculations), Section 3.2. This section includes the elements that would be reviewed by the SWEC civil/structural IDA and ICA teams. The elements selected in this section of the IDA plan covered the major aspects of construction. However, the locations of specific samples in each category were not available at the time of this inspection; they would be determined by SWEC after a walkdown of the plant.

In general, the team found the attributes in this review plan to be comprehensive. However, the NRC team believes that the following attributes should be added in order to facilitate a proper assessment of the civil/structural construction at Limerick Unit 2.

a. A review plan attribute should be added to evaluate the concrete compressive test results for each pour. Such a review is necessary to determine whether the proper concrete design strengths were attained in construction. Specifically, the review should determine whether the concrete design strengths are in accordance with the requirements stated in FSAR section 3.8.6.1.2.

b. A review plan attribute should be added to evaluate the tests of reinforcing steel and to determine whether they meet the guidelines of Regulatory Guide 1.15 (a commitment in FSAR section 3.8.6.2.1).

c. The review plan should be revised to include an attribute that would require a review of the concrete test laboratory operation and testing personnel qualifications, since these factors represent FSAR commitments in section 3.8.6.1.5.

d. The review plan should be revised to include an attribute for evaluation of drilled-in anchor test results. The attribute should determine whether the appropriate concrete strengths were used in these tests as stated in Limerick design specification 8031-C-61. Such a review is necessary to

determine whether the site specific concrete strengths were used in developing this specification as it relates to drilled-in anchors.

e. The review plan should be revised to add an attribute for an inspection of the bolting material used in structural connections. The attribute should determine whether the proper bolting material was used as required by design. The NRC team believes that such an attribute is necessary to assure the structural adequacy of the bolted steel connections.

1.2.4 Electrical (LK-C-1904)

The NRC assessment of the electrical portion of the SWEC ICA program consisted of an evaluation of the appropriate construction review plan, and interviews with SWEC personnel who authored or will implement the requirements of the IDCA program. The review plan attributes were compared with regulatory, industry, licensing, and facility specification requirements. In general, the NRC assessment of the SWEC review plan indicated that it provided an adequate basis for IDCA program implementation. Knowledge of regulatory and industry requirements were evidenced in the review plan. Comments and observations resulting from this review were then forwarded to SWEC in order to facilitate program revision.

a. Attribute 10 should be modified to ensure that equipment mounting configurations match the orientation used to establish seismic qualification. This attribute should also include examination of fillet welds used to mount electrical equipment; and should ensure physical examination of mounting bolts and review of pertinent bolt torque records. Additionally, consideration should be given to performance of torque checks on selected mounting bolts.

b. Attribute 17 should be modified to incorporate a check for both nomenclature and color coding of equipment nameplates.

c. Attribute 28 should be modified to include inspection of both type and rating of molded case circuit breakers.

d. Attribute 45 should be modified to ensure that internal wiring (vendor and field-installed jumpers) of valve motor-operators are of the appropriate material type and meet environmental qualification.

e. The intent of attribute 52, examination of battery rack bolting, should be clarified to include the rack connection and mounting bolts.

f. Attribute 60 should be modified to ensure that inspection of Class 1E cabling is accomplished by physical examination (hand-over-hand or signal tracing).

g. Additional attributes should be written, or attributes modified, to ensure inspection for physical damage of electrical equipment.

h. The scope of the review plan should be modified to include inspection of vendor wiring (damage and minimum bend radius) inside distribution cabinets.

i. Additional attributes should be included in the review plan to ensure that maintenance activities have been performed. These activities include lubrication and rotation of Class 1E motors, cleaning of Class 1E motor vents and filters to ensure that they are free of debris, and battery maintenance including electrolyte level, specific gravity, and intercell resistance checks.

j. Inspection attributes should be added to ensure that batteries have not been damaged by construction activity and that battery room ventilation systems are operating.

k. Inspection attributes should be added to ensure that valve motor-operator components (such as limit and torque switch rotor contacts) have not been damaged and do not have cracked insulation.

l. An inspection attribute should be added to ensure that valve stem travel is not inhibited or obstructed by component location.

m. The inspection of cables should ensure that they are not exposed to external hazards such as hot pipes or steam.

n. Exposed or free-air cables should be examined for separation requirements.

o. Physical examination of cable trays should address overfill conditions.

p. Attribute 80 (concerning PGCC cables) should include verification that floor modules are sealed where separation is required.

q. In the area of electrical terminations, attributes should be added to ensure that wires are not damaged by cuts, nicks, or abrasion of insulation.

r. Bend radius requirements should be verified for terminations.

s. Attributes should be added to ensure that conduit bushing and tray edge protectors have been installed, and that flexible conduits have not been damaged or broken.

t. Cable sample should include a sample of instrumentation cable.

u. An attribute should be added to evaluate the set point calibration of 4160V system breakers.

v. Maintenance of system relay shunt trips and any corrective action associated with relay failures should be reviewed.

1.2.5. Piping and Pipe Supports (LK-C-1905)

a. Paragraph 3.2.3 stated that attributes may be modified as necessary, but did not detail any controls or requirements for these modifications. Such details should be added to the review plan.

b. No sample size or scope (type and distribution) was specified for pipe supports, nor was there a stipulation that a sample from other parts of the

RHR system or other systems may be necessary to obtain an adequate, representative sample. This information should be added to the review plan.

c. The smallest diameter piping contained in the list of piping runs to be inspected was 12 inches (with the exception of several feet of smaller bore branch lines). This lack of listed small bore piping implied that field run piping and the pipe bend attribute (No. 7) would not be inspected. In addition, the lack of piping smaller than 12 inches adversely affected the pipe support sample. Small bore piping should be included in the list of piping runs to be inspected.

d. The review plan did not indicate type(s) of drawings that will be used for verification of piping installation. The review plan should specify whether the will include plan and elevation physicals, design stress isometrics, [illegible] isometrics, or P&IDs.

e. Attributes 1 and 4 did not reference tolerances for the location of equipment and valves. Responsible SWEC personnel were unable to identify where these tolerances were detailed. The required references should be identified and added to the review plan.

f. Attribute 7, related to pipe bends, did not address ovality, one of the basic inspection features detailed in Construction Specification 80931-P-301, paragraph 8.2.6. This feature should be added.

g. Neither attribute 11, related to piping bolted joints, nor the specification section referenced bolt diameter, length, type, tightness, thread engagement, or gasket type. These are all critical features of bolted connections, and should be addressed by the review plan.

h. The various attributes were sometimes unclear as to whether the verification will consist of physical field inspections or simply a review of completed documentation. For example, the attributes did not specify the methods of verifying the type of material for dissimilar metal transition pieces and the torquing of pipe support fasteners. This problem was especially true for expansion anchor installations. In addition, [illegible] attributes such as hole size, depth and cleanliness were identified that could not be verified after installation. The verification methods should be clearly identified in the review plan.

i. Attribute 26, related to as-built verification of pipe supports, contained errroneous references to other attributes, did not reference documents containing Limerick as-built requirements or tolerances, or reference the type of drawings the inspectors would use for this verification. Lead inspection personnel were not knowledgeable of these requirements. The attribute should be modified accordingly.

j. Attribute 27, related to pipe whip restraints, did not contain sufficient criteria to perform an acceptable inspection. For example there were no references to welding, bolting, configuration, member size, or attachments to structures. In addition, there were no references to specifications, drawings, or procedures. This information should be added.

k. The pipe support and restraint attributes did not address snubber and strut spherical bearings, spacers, or rod end thread engagement. These features have been problems at many sites and have been the subject of NRC Bulletins and Notices. They should be addressed specifically in the review plan.

l. The review plan did not specify whether paint would be removed from welds to permit valid inspections of weld quality. Surface defects such as cracks, porosity, and arc strikes often cannot be identified through paint. If paint is not removed, the conclusions based on the inspections performed must be clearly qualified.

m. The review plan did not detail or reference the methods and documentation that would be necessary to track and control the field inspection effort of the various items covered by this plan. For example, the plan did not indicate whether drawings will be marked up, separate checklists developed, or logs maintained, and it did not specify the documents that will be retained as permanent records of the work performed. The review plan itself did not appear suitable for use as a field tracking and documentation vehicle. Prior to the end of the NRC inspection, SWEC's lead inspectors drafted matrices to perform these functions, but they did not cross reference the review plan attributes by number and, in some cases, did not include all of the attributes listed in the review plan.

n. It appeared that Attribute 6 of the expansion anchor section did not include verification of the anchor-to-concrete free edge distance (to penetrations and corners), a critical design feature. This feature should be addressed by the review plan.

o. The review plan did not define how the QC inspector effectiveness attributes (No. 28-34) were to be implemented (i.e., how many inspectors, how they were to be selected, and how and where they were to be interviewed). This information should be added to the review plan.

1.2.6. Procurement, Receipt and Storage (LK-C-1906)

The review of this plan by the NRC team indicated that it was comprehensive, with the exception that the following attributes should be added.

a. Section 3.3 of this review plan listed reinforcement steel and selected structural steel as the only two civil/structural materials that would be reviewed. However, the NRC team believes that the scope of this section should be revised to include other materials that are within the scope of the samples that will be reviewed in review plan LK-C-1903 such as cement, liner steel, and masonry blocks. This change will permit SWEC to assess whether all the proper materials were used during the construction of Limerick Unit 2.

No manual, air, or solenoid operated valves or bolting material were included in the samples listed in paragraph 3.3. These items are important system commodities that have had procurement and traceability problems at other sites and have been the subject of NRC Bulletins and Notices. They should be included in the review plan.

b. Paragraph 3.2.3 stated that attributes may be modified as necessary, but did not detail any controls or requirements for these modifications. Such details should be added to the review plan.

c. The various attributes were sometimes unclear as to whether the verification would consist of physical field inspections or simply a review of completed documentation. This comment particularly applied to the material storage attributes in the Procurement and Storage sections of this review plan. The verification methods should be clearly identified in all relevant sections of the plan.

d. The review plan did not define how the QC inspector effectiveness attributes (No. 39-45) were to be implemented (i.e., how many inspectors, how they were to be selected, how and where they were to be interviewed, etc.). This information should be added to the review plan.

e. Attributes 14, 15, and 16 should address how the GE-supplied items were evaluated by Bechtel, et al, to determine suitability for installation and service. The storage procedure and the implementation of the procedure for the RHR equipment should also be evaluated.

1.2.7 QA/QC (LK-C-1907)

Although the plan was comprehensive, it lacked specifics concerning which documents would be reviewed that related to Corrective Action System and Design Change Mechanism. The discussions with the SWEC ICA lead in this area revealed that nonconformances and design changes would be identified by the civil/structural ICA reviewer. In turn, these differences from design would be investigated by the QA/QC reviewer to determine whether such items received a proper engineering disposition in a timely manner.

a. It was not clear in the plan how attribute 1, Turnover, would be implemented or which other disciplines would verify the installed condition and the as-built piping and component drawings.

b. Attributes 7 through 12 and 15 through 26, construction testing and hydrostatic/pneumatic testing, did not indicate whether the QA/QC audit would include an in-process audit of any systems that are available. SWEC committed to include an audit of any hydro or test in progress.

c. This review plan did not specify by name the documents that would be reviewed or whether they would include engineering change notices (ECNs), field change requests (FCRs), design change notices (DCNs), nonconformance reports (NCRs), corrective action reports (CARs), or other site-specific types of documents. In addition, the review plan did not specify the status of the documents (in-process or stored) or nominal sample numbers. This information should be included.

d. No site-specific Bechtel procedures were referenced in the review plan. Pertinent implementing procedures are necessary to facilitate proper preparation for this assessment.

e. Paragraph 3.4.4 stated that attributes may be modified as necessary, but did not detail any controls or requirements for these modifications. Such details should be included in the review plan.

f. The various attributes were sometimes unclear as to whether the verification would consist of physical field inspections or simply a review of completed documentation. This comment applied to the Turnover, Design Change Mechanisms, Corrective Action Programs, and Protective Coatings inspection attributes. The NRC team considers physical verification of these attributes necessary to proper assessment.

g. The review plan should define how the QC inspector effectiveness attributes (No. 59-66) will be implemented (i.e., how many inspectors, how they will be selected, how and where they will be interviewed, etc.).

h. The protective coatings attributes did not reference features such as type, location, thickness, or adequacy of inspection documentation. These features should be addressed in the review plan.

1.2.8 Instrumentation (LK-C-1908)

a. Attribute 36 should include ar examination of tubing for arc strikes.

b. Attribute 37 should require physical inspection of 1/2-inch per foot slope requirement.

c. An attribute should be added to ensure proper spacing of instrument tubing supports.

1.2.9 Equipment Qualification (LK-D-1907-C)

a. The sample of equipment in this area is too narrow.

b. The cable sample should be expanded to include routings which occur in harsh environments and within containment.

c. The list of equipment to be examined for seismic qualification should be expanded to include items such as battery racks and Class 1E distribution panels.