UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

February 15, 1990

Docket 50-395

LICENSEE: South Carolina Electric & Gas Company

FACILITY: V. C. Summer Nuclear Station, Unit No. 1

SUBJECT: SUMMARY OF FEBRUARY 8, 1990 MEETING WITH SOUTH CAROLINA ELECTRIC & GAS COMPANY ON INSPECTIONS COVERING BULLETINS 79-02 AND 79-14.

GENERAL

On February 8, 1990, representatives of the Office of Nuclear Reactor Regulation and Region II met with representatives of South Carolina Electric & Gas Company (SCE&G) and their consultants to discuss certain issues associated with inspection conducted November 27 through December 1, 1989 and December 11 through 15, 1989 at the V. C. Summer Nuclear Station, Unit No. 1 with respect to the implementation of Inspection and Enforcement Bulletins 79-02, "Pipe Support Baseplate Designs Using Expansion Anchor Bolts," and 79-14, "Seismic Analysis for As-Built Safety-Related Piping Systems". The meeting was held at the NRR offices in Rockville, Maryland. A list of those persons who attended the meeting is included as Enclosure 1.

DISCUSSION

In Inspection Report 50-395/89-200 four issues were identified which required additional review by the NRC. These issues were:

1. non-uniform consideration of zero period acceleration (ZPA) at the Summer Station;

2. exclusion of seismic anchor movements (SAM) less than 1/8 inch without any quantitative technical basis;

3. exclusion of containment penetration movements in the piping analysis for the effects of post-accident pressurization or steady state temperature growth; and

4. utilization of a potentially nonconservative piping decoupling criterion.

A handout was provided at the meeting which presented SCE&G's position with respect to the above issues. This handout is included as Enclosure 2. As a result of the meeting the staff concluded that SCE&G needed to do the following to assist the staff in evaluating the four issues.

DF03
1/1

1. With respect to ZPA and the decoupling criterion, SCE&G should formalize the work which was presented at the meeting. The bases for the test case should be enumerated along with the factors in selecting the test case. The details of the analyses should be presented.

2. With respect to SAM, SCE&G should evaluate the effects of SAM when piping runs inside a building. The design guidance documents should contain criteria for SAM inside of a building.

3. For containment movement, the Summer criteria of nonadditive displacement as a result of pressure and thermal effects should be justified.

4. Summer's FSAR commitment with respect to the utilization of the square root of the sum of the squares for combining displacement of two different buildings should be provided.

Original Signed By:

John J. Hayes, Jr., Project Manager
Project Directorate II-1
Division of Reactor Projects I/II
Office of Nuclear Reactor Regulation

Enclosures:
As stated

cc w/encls:
See next page

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*Copies sent persons on facility service list

Enclosure 1

LIST OF ATTENDEES

NRC	SCE&G	SCE&G CONSULTANTS
F. Cantrell	A. Barth	C. Chen
J. Hayes	O. Bradham	K. Chu
C. Hehl	A. Koon	A. Hoffert
C. Julian	D. Moore	D. Landers
P. Kuo	K. Nettles	
W. Lanning		
A. Lee		
L. Modenos		
R. Parkhill		
E. Tourigny		

Enclosure 2

SCE&G PRESENTATION

on

INSPECTION REPORT 89-200

"IEB 79-02/14"

FEBRUARY 8, 1990

ROCKVILLE, MARYLAND

SCE&G ATTENDEES

Ollie Bradham	Vice President Nuclear Plant Operations
Ken Nettles	General Manager Nuclear Safety
Dave Moore	General Manager Engineering Services
Al Koon	Manager Nuclear Licensing
Andy Barth	SCE&G Design Engineering
Fred Hoffert	Consultant Gilbert/Commonwealth
Chang Chen	Consultant Gilbert/Commonwealth
Don Landers	Consultant Teledyne
K. Y. Chu	Consultant Stone & Webster

NRC MEETING

IEB 79-02 and 79-14

FEBRUARY 8, 1990

AGENDA

I.	Introduction	O. S. Bradham
II.	Licensing Issues	K. W. Nettles
III.	Technical Issues	D. R. Moore
IV.	Summary	O. S. Bradham

NRC 79-14 - 79-02 MEETING

February 8, 1990

PRESENTATION EMPHASIS

- INSPECTION TEAM CONCLUDED:
  - SCE&G met the intent of 79-14 and 79-02.
  - Identified deficiencies raise no significant safety concern.
- HISTORICAL COMPLIANCE SUMMARY REGARDING ISSUES RAISED DURING INSPECTION.
- DISCUSSION OF FOUR GENERIC ISSUES IDENTIFIED DURING INSPECTION.
- SUMMARY OF CONCERNS AND PLANNED ACTIONS.

KEN NETTLES

LICENSING ISSUES

- IEB 79-14 History
- VCSNS Compliance with IEB 79-14
- Licensing Basis for Piping Analyses
- Current Licensing Issues

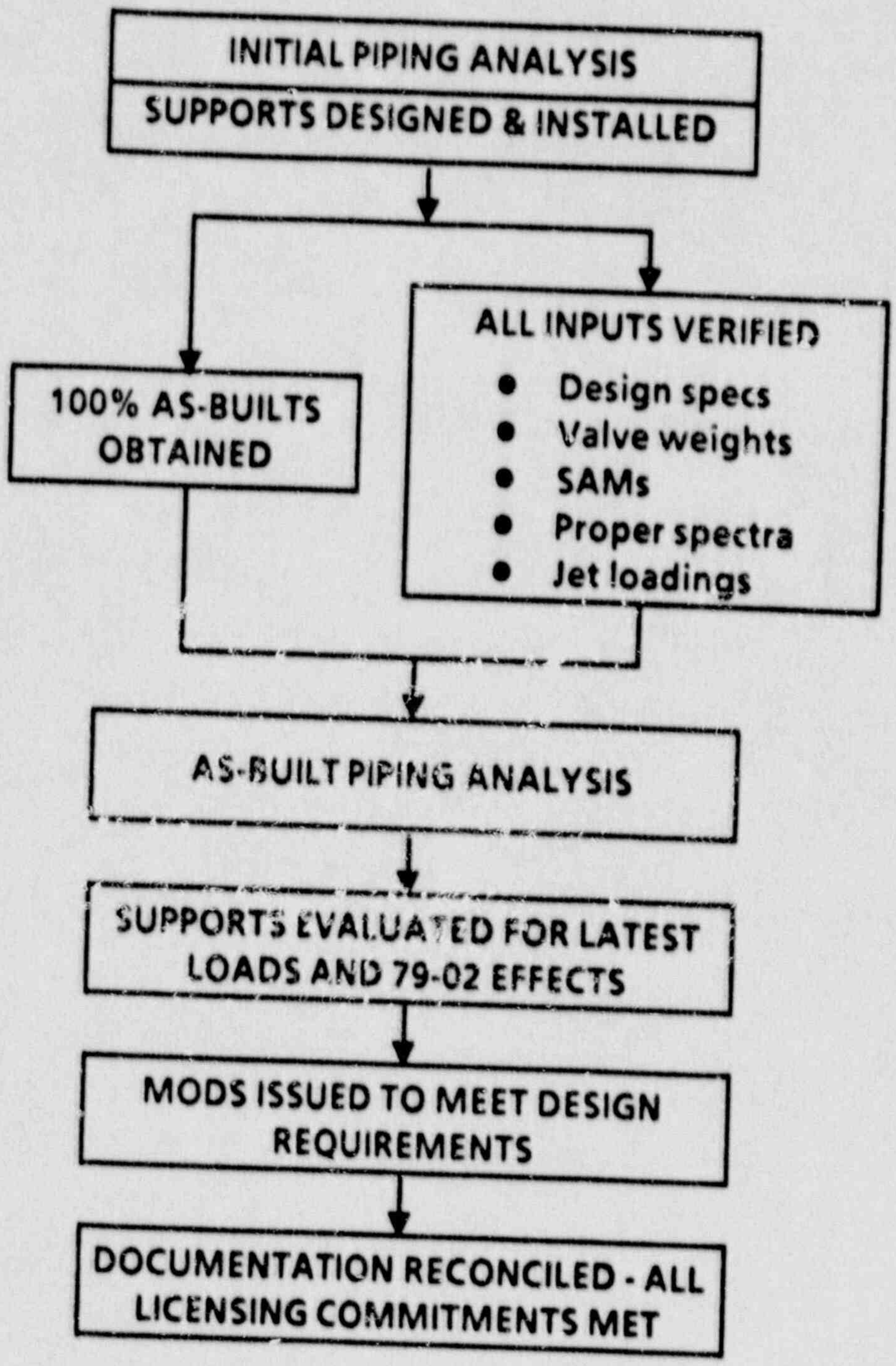
IEB 79-14 HISTORY

IEB 79-14	Issued July 2, 1979 to address the seismic analysis of as-built safety-related piping systems
Revision 1	Issued July 18, 1979 to clarify the scope of piping systems affected (i.e., NSR piping $\geq 2\frac{1}{2}$" and seismic Cat I of all sizes if computer analyzed)
Supplement 1	Issued August 15, 1979 providing additional guidance and definition for licensee action on inspection; on nonconformances; and on QA requirements
Supplement 2	Issued September 7, 1979 providing additional guidance on inspection; on nonconformances; and schedule. Additionally listed specific differences between design and as-built conditions at specific nuclear power plants (Ref: Appendix "A" to Supplement 2)

VCSNS Compliance With IEB 79-14 Requirements

- 1980 - 1982 Inspections and Re-Analysis of All Piping Systems
  - Used EDS, TES, GAI and <u>W</u>
  - Technical Management by GAI
  - Used Different Models and Modeling Techniques
  - Effective Design Control
- Estimated $20 M Cost
- IEB 79-14 and IEB 79-02 Closed August 1983
- Nine (9) NRC Inspection Reports During the Period 2/80 - 8/83
- Resolved Overlap Issue

PROCESS


INITIAL PIPING ANALYSIS
SUPPORTS DESIGNED & INSTALLED
100% AS-BUILTS OBTAINED
ALL INPUTS VERIFIED
Design specs
Valve weights
SAMs
Proper spectra
Jet loadings
AS-BUILT PIPING ANALYSIS
SUPPORTS EVALUATED FOR LATEST LOADS AND 79-02 EFFECTS
MODS ISSUED TO MEET DESIGN REQUIREMENTS
DOCUMENTATION RECONCILED - ALL LICENSING COMMITMENTS MET

PIPING ANALYSIS LICENSING BASIS

- FSAR
- ASME Code Compliance
- NRC Reg Guides 1.29, 1.48, 1.61, 1.84 & 1.85
- SER

Section 3.9.1

- Independent confirmatory analysis by Battelle Northwest Pacific Lab
- Demonstrated compliance with ASME code allowables
- Confirmation of ability to use computer models

Supplement 4 Section 3.7.4

- Licensee committed to an independent seismic analysis of EFW system including computer analysis verification

Supplement 5 Section 3.7.4

- Final report submitted by SWEC
- Report addressed:
  - Field walkdown for as-built verification
  - Independent stress analysis and evaluation
  - Design Control Audit
- Subsystems analyzed were originally analyzed by TES
- Results:
  - Minor differences in analytical results due to modeling
  - No generic ramifications
  - No hardware changes
  - Used commonly accepted industry practices
  - Seismic requirements as stated in design criteria met

Supplement 5 Section 17.5

- SWEC Audit of GAI design control and interface control with TES
- Results:
  - Overall program adequate

CURRENT LICENSING ISSUES

- Lack of prescribed criteria
- Use of industry practices for license timeframe versus current industry practices
- No Significant Safety Concerns

INDUSTRY SURVEY

- **ZPA**

  VCSNS
  - 8 PLANTS DID NOT CONSIDER ZPA IN THEIR ORIGINAL PIPING ANALYSIS
  - 5 PLANTS DID CONSIDER ZPA IN THEIR ORIGINAL PIPING ANALYSIS

- **DECOUPLING**
  - 1 PLANT USED 40% MOMENT OF INERTIA
  - 3 PLANTS USED 25% MOMENT OF INERTIA
  - VCSNS - 2 PLANTS USED 15% MOMENT OF INERTIA
  - 3 PLANTS USED 10% MOMENT OF INERTIA
  - 1 PLANT USED 7% MOMENT OF INERTIA
  - 1 PLANT USED 10% SECTION MODULUS
  - 2 PLANTS CRITERIA UNIDENTIFIED

- **CONTAINMENT THERMAL GROWTH**

  VCSNS
  - 7 0f 7 PLANTS OF OUR CONTAINMENT TYPE DID NOT CONSIDER STEADY STATE THERMAL GROWTH OF CONTAINMENT

- **CONTAINMENT LOCA PRESSURE**
  - 6 OF 7 PLANTS OF OUR CONTAINMENT TYPE DID NOT CONSIDER LOCA PRESSURE GROWTH OF CONTAINMENT

- **SAMs THRESHOLD**

  VCSNS
  - 2 PLANTS ANALYZED SAMs > 1/8" IN THEIR PIPING ANALYSIS
  - 5 PLANTS ANALYZED SAMs > 1/16" IN THEIR PIPING ANALYSIS
  - 4 PLANTS IDENTIFIED SAMs AS BEING INSIGNIFICANT AND DO NOT CONSIDER THEM IN THEIR PIPING ANALYSIS
  - 1 PLANT ANALYZED ALL SAMs IN THEIR PIPING ANALYSIS
  - 1 PLANT COULD NOT IDENTIFY THEIR SAMs CRITERIA FOR PIPING ANALYSIS

- **SAMs BETWEEN BUILDINGS**

  VCSNS
  - 7 PLANTS USED SRSS BETWEEN BUILDINGS
  - 1 PLANT USED ASUM BETWEEN BUILDINGS
  - 3 PLANTS USED A COMBINATION OF SRSS AND ASUM BETWEEN BUILDINGS
  - 1 PLANT IDENTIFIED SAMs BETWEEN BUILDINGS AS NOT APPLICABLE
  - 1 PLANTS COULD NOT IDENTIFY THEIR SAMs BETWEEN BUILDINGS CRITERIA

DAVE MOORE

TECHNICAL ISSUES

- POSITIVE ATTRIBUTES OF PIPING DESIGN
- ZPA
- DECOUPLING
- SEISMIC ANCHOR MOVEMENTS
- CONTAINMENT MOVEMENT
- INDEPENDENT SEISMIC DESIGN VERIFICATION
- SCE&G PRACTICES

POSITIVE ATTRIBUTES OF PIPING DESIGN

- PIPING AS-BUILTS AND ANALYSES HAVE CLOSE CORRELATION
- DOCUMENTATION IS VERY THOROUGH AND EASILY RETRIEVABLE
- DRILLED ANCHORS FOR PIPE SUPPORTS WERE 100% INSPECTED
- ECCENTRIC MASS EFFECTS OF VALVE ACTUATORS CONSIDERED
- SPRING CAN AND SNUBBER SETTINGS WERE VERIFIED
- INHERENT CONSERVATISMS
  - REG. GUIDE 1.61 SPECTRA DAMPING VALUES USED
  - SUPPORT GAPS NOT CONSIDERED - PROVIDES RELIEF FOR SAMs
- PROCEDURES IN PLACE TO ASSURE CONTINUED COMPLIANCE
- STRONG SCE&G MANAGEMENT COMMITMENT TO MAINTAIN A WELL DOCUMENTED PIPING PROGRAM

ZPA

TEST CASE EF-02

- STRESS INCREASES OCCURRED IN LOW STRESS REGIONS OF SYSTEM

  - 1507 PSI HIGHEST SEISMIC STRESS IN AREAS WERE ZPA GOVERNED

- SUPPORT LOADS INCREASED SIGNIFICANTLY IN ZPA ANALYSIS; HOWEVER, THE LARGE CHANGES WERE FOUND IN THE LIGHTLY LOADED SUPPORTS.

- CHECK OF SUPPORT DESIGN CALCULATIONS FOR INCREASED LOADS SHOWED THAT ALL LOADS WOULD BE ACCEPTABLE WITHOUT ANY MODIFICATIONS - 7 (OF 7) SNUBBERS AND 14 (OF 20) RESTRAINTS HAD LOAD INCREASES.

- IMPLICATION OF RESULTS

  - STRESS INCREASES APPEAR TO BE IN THE LOW STRESS REGIONS OF THE PIPING. HIGHEST SUBSYSTEM STRESS WILL NOT CHANGE.

  - SUPPORT LOADS APPEAR TO BE MOST SIGNIFICANT ON LIGHTLY LOADED SUPPORTS AND DID NOT OVER STRESS SUPPORTS ON THE TEST CASE

  - DID NOT INVALIDATE THE TEST CASE PERFORMED BY SWEC IN 1982

ZPA

- ZPA WAS NOT A CRITERIA AT SUMMER STATION, NOR AN INDUSTRY STANDARD IN 1982. THE SYSTEMS THAT GILBERT AND IMPELL ANALYZED HAVE ADDITIONAL CONSERVATISM BECAUSE THEY CONSIDERED ZPA

- DISCUSSION ON ZPA INTRODUCED BY NRC VIA NUREG-1061 ISSUED IN 1984. DISCUSSES METHOD FOR COMBINING LOW AND HIGH FREQUENCY RESPONSE.

- SEVERAL INDUSTRY STUDIES SHOW THAT CRITERIA USED TO DESIGN NUCLEAR PIPING OVERESTIMATE SEISMIC RESPONSE

- CURRENT RESPONSE SPECTRA ARE CONSERVATIVE

  - REG. GUIDE 1.61 DAMPING VALUES USED IN LIEU OF CURRENTLY ACCEPTED N411 VALUES WHICH ARE HIGHER

- RESPONSE SPECTRA ANALYSIS OVERPREDICTS THE PEAK RESPONSE WHEN COMPARED TO TIME HISTORY ANALYSIS

- INDUSTRY SURVEY SHOWS THAT ZPA WAS NOT GENERALLY CONSIDERED FOR PIPING ANALYSIS PRIOR TO 1982

VCSNS
- 8 PLANTS DID NOT CONSIDER ZPA IN THEIR ORIGINAL PIPING ANALYSIS
- 5 PLANTS DID CONSIDER ZPA IN THEIR ORIGINAL PIPING ANALYSIS

<u>CONCLUSION</u>

METHODS USED PLUS THE QUALITY AND CONTINUING MAINTENANCE OF THE AS-BUILT PROGRAM AT V.C. SUMMER ENSURE THE ADEQUACY OF THE PIPING SYSTEMS.

IF THE PIPING SYSTEMS WERE TO BE REANALYZED TODAY USING CURRENT METHODS WITH REDUCED CONSERVATISMS ALLOWED, LITTLE OR NO CHANGE WOULD BE EXPECTED.

INDUSTRY STUDIES SHOWING THAT CRITERIA USED TO DESIGN NUCLEAR PIPING OVER ESTIMATE SEISMIC RESPONSE

- The EPRI/USNRC Piping and Fitting Dynamic Reliability Program concludes that current Code rules based on static collapse for dynamic load considerations are overly conservative (ref. Taggart, S.W., et. al., "Seismic Analysis and Testing of Piping Systems and Components", PVP-Vol. 144 Seismic Engineering 1988, ASME PVP Conference, Pittsburgh, June, 1988 p. 229 - 236).

- Tests at the Heissdampfreaktor test facility in W. Germany suggest that the highly restrained piping design typical of a U.S. plant is excessively conservative. (ref. Malcher, L., Schrammel, D., and Steinhiller, H., "High Level Seismic Tests of a Piping System at the HDR-Facility", PVP-Vol. 182, Seismic Engineering - 1989, Design, Analysis, Testing, and Qualification Methods, ASME/JSME-PVP Conference, Honolulu, July 1989, p. 231-237).

- NUREG 1061, Vol. 2 states that piping in power plants subject to severe earthquakes has not failed under inertia loading. It further states that the methods, procedures, and acceptance criteria currently used to design nuclear power plant piping greatly overestimate the seismic response of piping.

- EPRI Report NP-5617, Vol. 1,(by EQE, Inc.) states the following:

  "The primary conclusion reached during the course of this study is that failures of welded steel piping have not been observed as a result of piping inertial loads. All piping has in fact exhibited a very high degree of resistance to failure during earthquakes up to 0.9-g peak ground acceleration."

DECOUPLING

- SMALLER PERCENTAGE COULD HAVE CAUSED OTHER PROBLEMS IN THE AREA OF COMPUTER TECHNOLOGY OF THE TIME

- INDUSTRY SURVEY SHOWS THAT THE CRITERIA USED FOR DECOUPLING FOR PIPING ANALYSIS PRIOR TO 1982 VARIES BUT SUMMER STATION IS CONSERVATIVE

  - 1 PLANT USED 40% MOMENT OF INERTIA
  - 3 PLANTS USED 25% MOMENT OF INERTIA
  - 2 PLANTS USED 15% MOMENT OF INERTIA (VCSNS)
  - 3 PLANTS USED 10% MOMENT OF INERTIA
  - 1 PLANT USED 7% MOMENT OF INERTIA
  - 1 PLANT USED 10% SECTION MODULUS
  - 2 PLANTS CRITERIA UNIDENTIFIED

DECOUPLING

V.C.SUMMER CRITERIA IMPOSED ADDITIONAL CONSERVATISM TO DECOUPLING CRITERIA THROUGH OTHER REQUIREMENTS

- RUN LINE ACCELERATIONS MUST BE LIMITED TO:

  3g HORIZONTAL RESULTANT ACCELERATION
  2g VERTICAL ACCELERATION

- LUMP MASS MUST BE ADDED TO THE RUN PIPE AT THE BRANCH LOCATION

  $$M = wL$$

  where:
  M = Lump Mass
  w = Linear Weight of Branch Pipe + Contents (lbs/foot)
  L = 10 x O.D. of Branch Pipe

- THERMAL MOVEMENTS OF THE RUN PIPE ARE INCLUDED IN ANALYSIS OF THE BRANCH PIPE

- EFFECTS OF CRITERIA ON THE RUN PIPE (LUMP MASS)

  - ADDS STRESS IN DEAD WEIGHT AND SEISMIC ANALYSIS

- EFFECTS OF CRITERIA ON BRANCH LINE

  - DYNAMIC INPUT AT RUN PIPE CONNECTION CONSIDERED
  - ACCELERATION LIMITED AT BRANCH RUN INTERFACE
  - SUMMER STATION PIPING IS GENERALLY DESIGNED TO THE 'RIGID' SIDE OF THE ACCELERATION PEAKS; THEREFORE, SEISMIC DISPLACEMENTS ARE SMALL

DECOUPLING

TEST CASE

- REVIEWED P&IDs TO IDENTIFY CONTROLLING DECOUPLED RATIO
- ANALYZED REAL LOCATION WITH 3 INCH DIAMETER BRANCH LINE DECOUPLED FROM A 6 INCH DIAMETER RUN LINE

$$\frac{I_{BRANCH}}{I_{RUN}} = 11\%$$

- NO OTHER DECOUPLED BRANCH LINES WERE FOUND TO BE NEAR THE 15% THRESHOLD.
- RESULTS - DECOUPLED VS. SINGLE MODEL
  - LESS THAN 10% STRESS INCREASE
    - 3.8% INCREASE IN DEAD WEIGHT STRESS
    - 7.5% INCREASE IN DYNAMIC STRESS
  - LESS THAN 10% SUPPORT LOAD INCREASE

  THE BRANCH AND RUN LINE HAD SIMILAR FREQUENCIES; THEREFORE, THIS MODEL WILL REPRESENT A WORST CASE CONDITION FOR THE SIZES INVOLVED.

<u>CONCLUSION</u>:

BASED ON INDUSTRY PRACTICE AT THE TIME OF ANALYSIS, AVAILABLE COMPUTER TECHNOLOGY, CRITERIA IMPOSED, AND THE RESULTS OF THE TEST CASE THE DECOUPLING METHODOLOGY EMPLOYED FOR V.C. SUMMER IS BOTH ADEQUATE AND PRUDENT.

SEISMIC ANCHOR MOVEMENTS

AND

CONTAINMENT MOVEMENT

- STRESSES ARE SECONDARY AND AFFECT THE FATIGUE LIFE OF THE PIPING
- FATIGUE FAILURE CAN BE PREDICTED BASED UPON MARKL'S WORK AND TEST RESULTS:

$$i\,SN^{0.2} = C$$

- COMPARISON OF 1/6" VS. 1/8" THRESHOLD FOR SAM ANALYSES USING MARKL'S APPROACH

$$i\,SN^{0.2} = C$$
$$i \times S = \text{INTENSIFIED STRESS} = S_E$$
$$\text{NORMALLY, } S_E <= S_A$$

- HOWEVER, TO EVALUATE EFFECTS OF 1/8" SAM & 1/8" CONTAINMENT GROWTH, TAKE $S_E = 2.5\ S_A$
- COMPUTED CYCLES TO FAILURE = 50,000
- DESIGN BASIS CYCLES = 400 (CONSERVATIVELY)
- FACTOR OF SAFETY = 125

SEISMIC ANCHOR MOVEMENTS
AND
CONTAINMENT MOVEMENT

- SAM between buildings combined by SRSS
  - Similar to method of Reg. Guide 1.92 for combination of modes
  - NUREG 1061 suggests elimination of the closely spaced mode consideration
  - Building movements would act in a similar fashion - maximum displacement in opposite directions is unlikely to occur at the same instant in time

SEISMIC ANCHOR MOVEMENT AND CONTAINMENT MOVEMENT

- Containment expansion due to LOCA pressure
  - Approximately 1/8" worst case location
  - Single event in life of plant

- Effect on Pipe
  - Secondary stress on pipe
  - Not considered in analysis and accepted by audit team

- Effect on Pipe Supports
  - Not considered in support loads (similar to thermal expansion loads)
  - Thermal (similar secondary load) is not considered for emergency or faulted cases per FSAR Table 3.9-2

SEISMIC ANCHOR MOVEMENTS AND CONTAINMENT MOVEMENT

- INDUSTRY SURVEY SHOWS THAT CONTAINMENT STEADY STATE THERMAL MOVEMENTS WERE GENERALLY NOT CONSIDERED FOR OUR CONTAINMENT TYPE IN PIPING ANALYSIS PRIOR TO 1982

VCSNS
- 7 of 7 PLANTS OF OUR CONTAINMENT DESIGN DID NOT CONSIDER CONTAINMENT STEADY STATE THERMAL MOVEMENTS IN THEIR PIPING ANALYSIS

- INDUSTRY SURVEY SHOWS THAT CONTAINMENT LOCA PRESSURE MOVEMENTS WERE GENERALLY NOT CONSIDERED FOR OUR CONTAINMENT TYPE IN PIPING ANALYSIS PRIOR TO 1982

VCSNS
- 6 OF 7 PLANTS OF OUR CONTAINMENT DESIGN DID NOT CONSIDER CONTAINMENT LOCA PRESSURE MOVEMENTS IN THEIR PIPING ANALYSIS

- INDUSTRY SURVEY SHOWS THAT SAM THRESHOLDS WERE NOT CONSISTENTLY CONSIDERED FOR PIPING ANALYSIS PRIOR TO 1982, HOWEVER SUMMER STATION IS MORE CONSERVATIVE THAN SEVERAL OTHER PLANTS

VCSNS
- 2 PLANTS ANALYZED SAMs > 1/8" IN THEIR PIPING ANALYSIS
- 5 PLANTS ANALYZED SAMs > 1/16" IN THEIR PIPING ANALYSIS
- 4 PLANTS IDENTIFIED SAMs AS BEING INSIGNIFICANT AND DO NOT CONSIDER THEM IN THEIR PIPING ANALYSIS
- 1 PLANT ANALYZED ALL SAMs IN THEIR PIPING ANALYSIS
- 1 PLANT COULD NOT IDENTIFY THEIR SAMs CRITERIA FOR PIPING ANALYSIS

- INDUSTRY SURVEY SHOWS THAT SAMs BETWEEN BUILDINGS WERE GENERALLY COMBINED BY SQUARE ROOT SUM OF THE SQUARE (SRSS) FOR PIPING ANALYSIS PRIOR TO 1982

VCSNS
- 7 PLANTS USED SRSS BETWEEN BUILDINGS
- 1 PLANT USED ABSOLUTE SUMMATION (ASUM) BETWEEN BUILDINGS
- 3 PLANTS USED A COMBINATION OF SRSS AND ASUM BETWEEN BUILDINGS
- 1 PLANT IDENTIFIED SAMs BETWEEN BUILDINGS AS NOT APPLICABLE
- 1 PLANT COULD NOT IDENTIFY THEIR SAMs BETWEEN BUILDINGS CRITERIA

INDEPENDENT SEISMIC DESIGN VERIFICATION

- **ZPA**
  - RESPONSE SPECTRA ANALYSIS OVERPREDICTS THE PEAK RESPONSE WHEN COMPARED TO TIME HISTORY ANALYSIS
  - ACCEPTED TES [TELEDYNE] ANALYSIS PROCEDURES AND AGREED THAT ITS IMPLEMENTATION WOULD LEAD TO AN ACCEPTABLE DESIGN
- **SAMs**
  - SAMs AT SUPPORT LOCATIONS ARE BASICALLY IN-PHASE DUE TO RIGID BODY MOTION
  - BOX-TYPE SUPPORTS GENERALLY HAVE A TOTAL OF 1/8 INCH GAPS
  - RIGID BODY MOTION WOULD NOT CAUSE ANY STRESS AT THE PIPING
  - FOR SOME OTHER PLANT ANALYSES OF THIS VINTAGE SAMs WERE NOT EVEN CONSIDERED
- **DECOUPLING**
  - INDUSTRY CRITERIA FOR THIS VINTAGE WAS A MOMENT OF INERTIA RATIO OF 1:10 OR 1:7
  - SMALLER RATIO COULD HAVE CAUSED OTHER PROBLEMS IN THE AREA OF COMPUTER TECHNOLOGY OF THE TIME
- **CONTAINMENT THERMAL GROWTH**
  - SMALL THERMAL GROWTH AT CONTAINMENT WOULD NOT CAUSE AN OVERSTRESS CONDITION
  - PIPING STRESS ANALYSIS WAS NORMALLY GOVERNED BY ASME III, NC-3600, EQUATION 9, WHICH DOES NOT INCLUDE THE THERMAL EFFECTS
  - THE EFFECTS ON SUPPORT LOADS SHOULD ALSO BE MINIMAL BECAUSE THERMAL AND DESIGN BASIS EARTHQUAKE LOADS ARE NOT REQUIRED TO BE COMBINED

"SCE&G EXERCISED PRUDENT DESIGN CONTROL THROUGH THE SELECTION OF A COMPETENT DESIGNER, TES, WITHOUT BEING PRESCRIPTIVE OF THE ANALYTICAL AND DESIGN TECHNIQUES"

SCE&G PRACTICES

ZPA
Original Analysis: ZPA not considered on TES systems, ZPA considered on G/C and Impell Systems.

New and Re-analysis: ZPA will be considered on all systems, and handled as a plant up-grade.

<u>REMAINING ISSUES</u>

DECOUPLING
Original Analysis: 15% movement of inertia.

SAM-THRESHOLD
Original Analysis: SAM < 1/8 inch can be neglected.

SAM-BETWEEN BUILDINGS
Original Analysis: SAMs between buildings were combined by square root sum of the square.

CONTAINMENT MOVEMENT
Original Analysis: Thermal growth not considered.

New and Re-analysis: We will evaluate our original practice and the current industry standards to determine criteria.

OLLIE BRADHAM

SUMMARY AND CONCLUSION

- Adequate Technical Management Through GAI
- Use of Various Contractors with Different Models and Different Modeling Techniques Was And Is An Acceptable Practice
- Design Inputs Were Adequately Coordinated By GAI
- Rigorous Design Verification Was Performed
- SWEC Independent Design Verification Supports The Adequacy of Our Program From A Technical and Quality Base
- Used Industry Accepted Practices
- Engineering Staff Adequate
- Specific Compliance Deficiencies Identified Will Be corrected and Evaluated as We Feel Appropriate For Generic Impact
- No significant Safety Issues Were Identified
- Retrofiting To Current "State of the Art" Neither Warranted Nor Justified

SEISMIC ANCHOR MOVEMENTS AND CONTAINMENT MOVEMENT

Conclusion

The 1/8 inch threshold for SAM analysis and the 1/8 inch containment thermal growth not included in the analysis do not reduce safety margins. Adequate safety margins are demonstrated by the very conservative fatigue evaluation presented; and therefore, the engineering judgment, that the industry practice is acceptable, is demonstrated valid.

The SRSS method of combining SAM between building is consistent with the industry practice and with the methodology recommended and employed for similar loadings.

Containment movement due to LOCA pressure is addressed for pipe stress and support design loads in accordance with the intent of the commitments in the FSAR.

Mr. O. S. Bradham
South Carolina Electric & Gas Company

Virgil C. Summer Nuclear Station

cc:

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