

Docket Nos. 50-237/249/254/265/373/374

LICENSEE: Commonwealth Edison Company (CECo)
FACILITIES: DRESDEN NUCLEAR POWER STATION, UNIT NOS. 2 AND 3
QUAD CITIES NUCLEAR POWER STATION, UNITS NOS. 1 AND 2
LASALLE COUNTY STATION, UNIT NOS. 1 AND 2
SUBJECT: SUMMARY OF MEETING HELD ON MAY 13, 1986

The NRC held a meeting with CECo and their contractors, Impell, Sargent and Lundy and S. Levy, Inc. to discuss details of CECo's request for approval of alternate seismic evaluation criteria and methodology for the Dresden, Quad Cities and LaSalle County Stations. A list of attendees is provided in Enclosure 1 and copies of the viewgraphs used by CECo and their representatives during the meeting are presented in Enclosure 2.

Relative to effects on Dresden and Quad Cities, as a result of discussions with the staff during and following the presentation by CECo, et al, these conclusions were reached:

1. CECo should do another seismic evaluation of the Dresden 2 recirculation piping using criteria from Regulatory Guide 1.61 and the updated FSAR.
2. CECo should also recheck the criteria used during the IE Bulletin 79-14 analysis.
3. CECo should also recheck the criteria used during the Systematic Evaluation Program for Dresden 2.
4. N-411 code case damping in conjunction with updated FSAR criteria is not acceptable for use in seismic analysis calculations on these stations.

For LaSalle, a report submitted by CECo on April 25, 1986 for staff review and entitled "Snubber Reduction Topical Report" was discussed. The staff and CECo determined which items in that report are acceptable for universal application at the LaSalle County Station at the present time because CECo wants to use the advanced techniques in the report during its upcoming LaSalle Unit 2 refueling outage. The consensus reached was the following.

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| <u>Item</u> | <u>Agreed Criteria</u> |
|----------------------------------|--|
| 1. Damping | ASME Code Case N-411 with the restriction as stipulated by letter dated April 1, 1986. |
| 2. Peak Shifting | ASME Code Case N-397 |
| 3. High Energy Line Breaks | No arbitrary intermediate break location |
| 4. Seismic Anchor Motions (SAM) | Staff agreed to further review SAM and will indicate its finding. |
| 5. Load Combination | Hydraulic transients will be decoupled from safety relief valve (inertial) loads if time phasing can be justified. A 10 CFR 50.59 Safety Evaluation will be used to document this analysis. Hydraulic transients will continue to be combined with seismic loads by SRSS as the FSAR stipulates. |
| 6. All approved FSAR methodology | |

In addition, the staff agreed that, on a case-by-case basis, it will consider allowing the use of advanced analysis techniques and relaxed design criteria in a limited number of difficult cases at LaSalle. The staff requested that in such cases a deviation request will be made describing the extenuating circumstances and the specific methodology to be used to justify the design change. Finally, it was agreed that CECO would indicate in a letter its understanding of the methodology agreed to at the meeting. The staff would then respond to the letter.

ORIGINAL SIGNED BY

Robert A. Gilbert, Project Manager
 BWR Project Directorate #1
 Division of BWR Licensing

- Enclosures:
 1. List of Attendees
 2. Viewgraph copies

cc w/enclosures:
 See next page

DISTRIBUTION

- | | |
|------------|------------------|
| NRC PDR | RGilbert |
| Local PDR | OELD |
| BWR #1 R/F | EJordan |
| JPartlow | BGrimes |
| JZwolinski | ACRS (10) |
| | NRC Participants |

| | | | | | | |
|------|-----------|-------------|---|---|---|---|
| OFC | :PD:#1DBL | :PD:#1:DBE | : | : | : | : |
| NAME | :RGILBERT | :JZWOLINSKI | : | : | : | : |
| DATE | :6/19/86 | :6/20/86 | : | : | : | : |

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Units 1 & 2

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Dresden Nuclear Power Station
Units 1, 2 and 3 and Quad Cities
Nuclear Power Station, Units 1
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ATTENDANCE LIST

DRESDEN NUCLEAR POWER STATION, UNIT NOS. 2 AND 3

QUAD CITIES NUCLEAR POWER STATION, UNIT NOS. 1 AND 2

LASALLE COUNTY STATION, UNIT NOS. 1 AND 2

MEETING OF MAY 13, 1986

NAME

AFFILIATION

| | |
|----------------|---------------------|
| M. Turbak | Commonwealth Edison |
| S. Javidan | Commonwealth Edison |
| J. Wojnarowski | Commonwealth Edison |
| C. Alen | Commonwealth Edison |
| D. Farrar | Commonwealth Edison |
| J. Marianyi | Commonwealth Edison |
| J. Fox | Commonwealth Edison |
| R. Wheaton | Impell |
| J. Minichiello | Impell |
| T. Wittig | Impell |
| G. Kitz | Sargent & Lundy |
| R. Srinivasan | S. Levy, Inc. |
| R. Gilbert | NRC |
| A. Bournia | NRC |
| E. Adensam | NRC |
| J. Zwolinski | NRC |
| B. Liaw | NRC |
| G. Lainas | NRC |
| R. Bosnak | NRC |
| R. Bernero | NRC |
| Y. Li | NRC |
| H. Shaw | NRC |
| R. Lagrange | NRC |
| G. Bagchi | NRC |
| R. Riggs | NRC |
| M. Hartzman | NRC |
| J. Fair | NRC |

COMMONWEALTH EDISON/NRC MEETING AGENDA
SEISMIC ANALYSIS TECHNIQUES

MAY 13, 1986

- 5 MIN. I. INTRODUCTION/BACKGROUND (DENNY FARRAR-CECO)
- 20 MIN. II. OVERVIEW OF DRESDEN/QUAD CITIES SEPTEMBER 1985
SUBMITTAL (TED WITTIG-IMPELL)
- A. SUMMARY OF TECHNIQUES
 - B. ALTERNATIVE 1
- 20 MIN. III. OVERVIEW OF LASALLE 2 SNUBBER REDUCTION SUBMITTAL
(JUAN MARIANYI-CECO)
- A. BACKGROUND
 - B. SUMMARY OF TECHNIQUES
- 5 MIN. IV. SUMMARY (DENNY FARRAR-CECO)
- V. DISCUSSION/COMMENTS (NRC)
- VI. CONCLUSION/ACTION ITEMS (CECO)

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COMPARISON OF CRITERIA/METHODOLOGIES
PIPING CRITERIA

| FSAR CRITERIA | (ALTERNATE 1) LICENSING SUBMITTAL | NUREG 1061 | REGULATORY GUIDES |
|--|---|---|---|
| <u>DAMPING</u> = 0.5% | ASME CODE CASE N-411 (5% - 2%) | ASME CODE CASE N-411 (VOL. 2, PG 2-5) | 1% - 3% DEPENDING ON PIPE SIZE (RG 1.61) |
| <u>MODAL COMBINATION</u> BY SRSS | MODAL COMBINATION BY SRSS | MODAL COMBINATION BY SRSS (VOL. 4, PG 2-3) | CLOSELY SPACED MODES (RG 1.92) |
| <u>DIRECTION COMBINATION</u> ENVELOP OF NS + V OR EW + V | SRSS OF NS + EW + V | SRSS OF NS + EW + V (VOL. 4, PG 2-3) | SRSS OF NS + EW + V (RG 1.92) |
| <u>HIGH FREQUENCY MODES</u> ONLY MODES BELOW 33 HZ | CONSIDER MODES ABOVE 33 HZ | CONSIDER MODES ABOVE 33 HZ (VOL. 4, PG 2-3) | SUFFICIENT MODES SUCH THAT ADDED RESPONSE INCREASES BY < 10% (SRP 3.7.2.5) |
| <u>PEAK SHIFTING</u> -- NA | ASME CODE CASE N-397 | N-397 (VOL: 2, PG 2-6) | NOT ADDRESSED |
| <u>LOAD GENERATION</u> SPECTRA DERIVED FROM TIME HISTORY OF BUILDING | DIRECT GENERATION FOR ADDED DAMPING VALUES | NA | SYNTHETIC TH TECHNIQUES (SRP SEC. 3.7) |
| <u>INPUT SPECTRA</u> SPECTRA ABOVE THE CENTER OF MASS OR STATIC SEISMIC | EITHER ENVELOPING SPECTRA OR ISM WITH ABS COMB. OR SRSS W/O CORRELATION (BUT NO PEAK SHIFTING) | EITHER ENVELOPING SPECTRA OR ISM WITH ABS COMB. (VOL. 4, PG 2-3) | ENVELOPING SPECTRA (SRP 3.9.2) |
| <u>OBE STRESS ALLOWABLES</u> ANSI B31.1 -1967 | ANSI B31.1 -1967 | FATIGUE COMPARISON | ANSI B31.1 -1967 (10CFR50.55) |
| <u>SSE STRESS ALLOWABLES</u> YIELD STRESS OR STRAINS LIMITED TO PRECLUDE FAILURE BY DEFORMATION | YIELD STRESS OR STRAINS LIMITED TO PRECLUDE FAILURE BY DEFORMATION | FATIGUE/STRAIN COMPARISON WITH 2% STRAIN LIMIT (VOL. 2, SEC. 2.5) | SAFETY (RG 1.29) |
| (ALTERNATE 2) | | | |
| <u>SSE STRESS ALLOWABLES</u> SAME AS ABOVE | 1% MAXIMUM STRAIN WITH FATIGUE LIMITS ON NUMBER OF CYCLES | FATIGUE/STRAIN COMPARISON WITH 2% STRAIN LIMIT (VOL. 2, SEC. 2.5) | SAFETY (RG 1.29) |
| <u>LOAD GENERATION</u> SAME AS ABOVE | REGENERATE SPECTRA USING MODERN SSI TECHNIQUES | NA | SSI TECHNIQUES (SRP 3.7) |
| (ALTERNATE 3) | | | |
| <u>ENERGY BALANCE</u> -- NA | USE OF ENERGY BALANCE FOR SHORT-TERM OPERATION | NA | SAME AS ABOVE |
| <u>STRESS ACCEPTANCE CRITERIA</u> SAME AS ABOVE | SAME AS ALTERNATE 2 | NA | NA |

COMPARISON OF CRITERIA/METHODOLOGIES
PIPE SUPPORT CRITERIA

| FSAR CRITERIA | (ALTERNATE 1) LICENSING SUBMITTAL | NUREG 1061 | REGULATORY GUIDES |
|--|---|--|--|
| <u>OBE ALLOWABLES -- AISC OR VENDOR VALUES</u> | AISC OR VENDOR VALUES | NA | VARIOUS CRITERIA RG 1.124, 1.130 (CLASS 1), SRP 3.9.3) |
| <u>SSE ALLOWABLES</u> NORMAL + SSE < 1.33 AISC BUT LIMITED TO YIELD STRESS OR SAFE SHUTDOWN | NORMAL + SSE < 1.33 AISC BUT LIMITED TO YIELD STRESS OR SAFE SHUTDOWN | NA | VARIOUS CRITERIA (RG 1.124, 1.130 (CLASS 1)) |
| <u>ANCHOR BOLTS</u> FACTOR OF SAFETY = 4 (5 FOR SHELL TYPE) | FS = 4 FOR THE ENTIRE BASEPLATE | NA | FS = 4 (IEB 79-02) |
| <u>MATERIAL OVERSTRENGTH</u> MATERIAL YIELD = CODE MIN. | 1.2 CODE MINIMUM BASED ON MATERIAL DATA. ONLY FOR NORMAL/SHEAR. | NA | CODE MINIMUM |
| <u>SEISMIC ANCHOR MOTIONS</u> NA | SAM + INERTIAL LOADS COMBINED BY SRSS | SAM + INERTIAL LOADS COMBINED BY SRSS (VOL. 4, PG 2-3) | NA |
| (ALTERNATE 2) | | | |
| <u>PLASTIC ACTION -- LIMITED TO YIELD OR SAFE SHUTDOWN</u> | CHECK FUNCTIONALITY WITH DUCTILITY OF 3 | NA | CHECK FUNCTIONALITY (RG 1.124, 1.130) |
| (ALTERNATE 3) | | | |
| <u>PLASTIC ACTION</u> SAME AS ABOVE | USE EITHER ALTERNATE 1 OR ALTERNATE 2 | NA | SAME AS ABOVE |

PRESENT LICENSING BASIS

PIPING ANALYSIS

INPUT MOTION - RESPONSE SPECTRA DERIVED FROM BUILDING
TIME HISTORY ANALYSIS

METHODS/CRITERIA (DYNAMIC ANALYSIS)

- DAMPING EQUAL TO 0.5%
- MODAL COMBINATION BY SRSS
- DIRECTION COMBINATION IS THE LARGEST HORIZONTAL RESPONSE ADDED ABSOLUTELY WITH THE VERTICAL
- DYNAMIC ANALYSIS OF ALL MODES UP TO 33HZ
- SPECTRUM USED IS THAT WHICH ENVELOPES THE PIPING CENTER OF MASS
- ACCEPTANCE CRITERIA IS B31.1, 1967 (OBE); YIELD STRESS FOR SSE OR STRAINS LIMITED TO PRECLUDE FAILURE BY DEFORMATION
- STATIC EQUIVALENT FSAR METHODS, AS EXPLAINED IN AMENDMENTS 19/20 TO THE FSAR, ARE ALSO ALLOWED

PRESENT LICENSING BASIS

PIPE SUPPORT DESIGN

- NORMAL LOADS PLUS OBE LIMITED TO STANDARD AISC OR MANUFACTURER ALLOWABLES
- NORMAL LOADS PLUS SSE LIMITED TO 1.33 TIMES STANDARD ALLOWABLES, IN GENERAL, BUT NOT EXCEEDING MINIMUM YIELD UNLESS IT IS SHOWN THAT SAFE SHUTDOWN CAN BE ACHIEVED
- ANCHOR BOLTS LIMITED TO SAFETY FACTOR OF 4 (WEDGE) OR 5 (SHELL) UNDER ALL LOADING CONDITIONS

PROPOSED ALTERNATIVE 1

PIPING ANALYSIS

INPUT MOTION - GENERATE ADDITIONAL IN-STRUCTURE
SPECTRA AT HIGHER DAMPING VALUES
DIRECTLY FROM AN EXISTING SPECTRA

METHODS/CRITERIA

- ° ENVELOPE DYNAMIC ANALYSIS
- ° INDEPENDENT SUPPORT MOTION ANALYSIS

PROPOSED ALTERNATIVE 1

PIPING ANALYSIS (CONTINUED)

METHODS/CRITERIA - ENVELOPE DYNAMIC ANALYSIS

- N-411 DAMPING VALUES
- MODAL COMBINATION BY SRSS
- DIRECTION COMBINATION BY REG. GUIDE 1.92
- MODAL ANALYSIS TO 33HZ. WITH HIGHER FREQUENCY EFFECTS CONSIDERED
- SPECTRUM USED EQUAL TO THE ENVELOPE OF ALL ATTACHMENT POINTS
- PRESENT FSAR STRESS ACCEPTANCE CRITERIA
- PEAK SHIFTING PER ASME CODE CASE N397

PROPOSED ALTERNATIVE 1

PIPING ANALYSIS (CONTINUED)

METHODS/CRITERIA - INDEPENDENT SUPPORT MOTION ANALYSIS

- PVRC DAMPING
- MODAL COMBINATION BY SRSS
- DIRECTION COMBINATION BY REG. GUIDE 1.92
- LEVEL COMBINATION BY ABS. OR BY SRSS IF THE INPUT MOTIONS ARE UNCORRELATED
- MODAL ANALYSIS TO 33 HZ. WITH HIGHER FREQUENCY EFFECTS CONSIDERED
- PRESENT FSAR STRESS ACCEPTANCE CRITERIA

PROPOSED ALTERNATIVE 1

PIPING SUPPORT DESIGN

- NORMAL LOADS PLUS OBE LIMITED TO STANDARD AISC OR MANUFACTURER ALLOWABLES.
- NORMAL LOADS PLUS SSE LIMITED TO 1.33 TIMES STANDARD ALLOWABLES IN GENERAL, BUT NOT EXCEEDING MINIMUM YIELD UNLESS IT IS SHOWN THAT SAFE SHUTDOWN CAN BE ACHIEVED.
- A FS OF 2 ANCHOR BOLTS UNDER SSE LOADING PROVIDED.
 - A. THERE ARE 4 BOLTS MINIMUM IN THE PLATE, NO MORE THAN HALF IN TENSION.
 - B. ADJACENT SUPPORTS IN THE SAME DIRECTION ARE QUALIFIED ELASTICALLY AND USE A FS OF 4 OR 5 ON ALL OF THEIR BOLTS.
 - C. THE OVERALL FS IS 4 OR 5 FOR THE BASE PLATES.
- A YIELD STRENGTH OF 1.2 TIMES CODE MINIMUM YIELD FOR THOSE MATERIALS FOR WHICH STATISTICAL RESULTS ARE APPLICABLE. NO INCREASE IN WELD STRENGTH ABOVE CODE MINIMUM IS ALLOWED.
- IF APPLICABLE, SAM AND INERTIAL LOADS COMBINED BY SRSS.

PROPOSED ALTERNATIVE 2

PIPING ANALYSIS

INPUT-MOTION - REGENERATE BUILDING SPECTRA AS FOLLOWS:

- DEVELOP 3 DIMENSIONAL BUILDING MODELS
- ACCOUNT FOR SOIL-STRUCTURE INTERACTION, CONSIDERING FREQUENCY DEPENDENT SOIL SPRINGS AND CROSS-COUPLING BETWEEN BUILDING HORIZONTAL AND ROCKING MODES

METHODS/CRITERIA -

- USE A 1% MAXIMUM STRAIN ACCEPTANCE CRITERIA UNDER NORMAL PLUS SSE LOADING

PIPE SUPPORT DESIGN

- NORMAL PLUS OBE LIMITED TO STANDARD ALLOWABLES
- NORMAL PLUS SSE LIMITED BY DUCTILITY LESS THAN 3
- PIPING AND ADJACENT SUPPORTS CHECKED FOR EFFECTS OF EXCESSIVE DEFORMATION AT THE ELASTIC/PLASTIC SUPPORT
- SAM, IF APPLICABLE, COMBINED WITH INERTIAL LOADS BY SRSS

PROPOSED ALTERNATIVE 3

PIPING ANALYSIS

INPUT MOTION - GENERATE ADDITIONAL IN-STRUCTURE SPECTRA AT HIGHER DAMPING DIRECTLY FROM AN EXISTING SPECTRA.

METHODS/CRITERIA - FOR SHORT TERM OPERATION, USE ENERGY BALANCE TECHNIQUES TO SHOW PIPING ACCEPTANCE. THIS MUST BE FOLLOWED BY FORMAL ANALYSIS AGAINST THE ALTERNATIVE ACCEPTED AT THAT TIME. ALSO, SUPPORTS ADJACENT TO THE "FAILED" SUPPORTS MUST BE ACCEPTABLE FOR THE INCREASED LOADS. STRAINS IN PIPING LIMITED TO 1%.

PIPE SUPPORT DESIGN

- LOAD COMBINATION AND CRITERIA AS IN LICENSING BASIS
- A YIELD STRENGTH OF 1.2 TIMES CODE MINIMUM YIELD. WITH NO INCREASE PERMITTED FOR WELDS
- SAM, IF APPLICABLE, COMBINED WITH INERTIA SRSS
- A FS OF 2 ON ANCHOR BOLTS UNDER SSE LOADING. WITH THE REQUIREMENTS NOTED PREVIOUSLY

OR

- DUCTILITY LESS THAN 3 UNDER NORMAL PLUS SSE LOADING WITH ADJACENT SUPPORTS AND PIPING CHECKED FOR THE EFFECT OF DEFORMATION

COMPARISON OF PIPE STRESS CRITERIA

| ITEM | NUREG-1061 | LA SALLE SUBMITTAL |
|---|---|---|
| PVRC DAMPING | ASME CODE CASE N-411 | SAME |
| MODAL COMBINATION | SRSS | SAME |
| DIRECTION COMBINATION (THREE DIRECTIONS) | SRSS | SAME |
| HIGH FREQUENCY MODES | ALGEBRAIC SUM OF HIGH FREQ. MODES | SAME |
| PEAK SHIFTING | ASME CODE CASE N-397 | SAME |
| INPUT SPECTRA | ENVELOPE SPECTRA OR INDEPENDENT SUPPORT MOTION ABS SUM | ENVELOPE SPECTRA OR INDEPENDENT SUPPORT MOTION -SRSS LEVEL B -ABS LEVEL C |
| STRESS CRITERIA | ASME SECTION III | SAME |

LaSalle County Station Snubber Reduction Program
Comparison of Criteria Methodologies Piping Stress Analysis

| FSAR CRITERIA | LICENSING SUBMITTAL | NUREG 1061 | REGULATORY GUIDES |
|--|--|---|--|
| <u>Damping</u> 0.5% OBE, 1% SSE Reg. Guide 1.61 for BWR loads and load combinations. | ASME Code Case N-411 (approved - 4/1/86 letter Adensam to Farrar). | ASME Code Case N-411 (Vol. 2, pg. 2-5) | 1% - 3% depending on pipe size RG. 1.61) |
| <u>Modal Combination</u> Reg. Guide 1.92 | Modal Combination by SRSS | Modal Combination by SRSS (Vol. 4, pg 2-3) | Closely spaced modes (Rg. 1.92) (RG 1.92) |
| <u>Direction Combination</u> SRSS | SRSS of NS + EW + V | SRSS of NS + EW + V (Vol. 4, Pg 2-3) | SRSS of NS + EW + V (RG 1.92) |
| <u>High Frequency Modes</u> 60 Hz (BWR load cases) 33 Hz (Seismic) | Modes above 33 Hz by algebraic sum | Modes above 33 Hz by "missing mass" correction (Vol. 4, pg 2-3) | Sufficient modes such that added response increases by 10% (SRP 3.7.2.5) |
| <u>Peak Shifting</u> Not Considered | ASME Code Case N-397 | N-397 (Vol. 2, pg 2-6) | Not addressed |
| <u>Input Spectra</u> Envelope response spectra method | Either envelope response spectra method or Independent Support Motion (ISM) SRSS - Level B ABS - Level C/D | Either enveloping spectra or IBM with SRSS comb. (Vol. 2, Sec. 2.7) | Enveloping spectra (SRP 3.9.2) |
| <u>OBE Stress Allowables</u> ASME, Section III (1974) | ASME Section III, 1974 | Fatigue/strain comparison with 2% strain limit (Vol. 2, Sec. 2.5)) | 10CFR50.55 |
| <u>SSE Stress Allowables</u> ASME, Section III (1974) | ASME Section III, 1974 | Fatigue/strain comparison with 2% strain limit (Vol. 2, Sec. 2.5)) | (RG 1.29) |
| <u>Load Combination</u> (For BOP Systems) SRV (thrust), Turbine Trip loads combined with seismic and BWR inertial loads by SRSS method. | Decouple SRV (thrust) Turbine Trip Loads from BWR inertial loads | NA | NA |
| <u>High Energy Line Break</u> (HELB) Criteria Terminal Ends and two arbitrary intermediate locations | No new HELB locations will be added unless necessary to satisfy cumulative usage factor (CUF) limits. - CUF 0.4 | NA | NA |
| <u>Alternate Stress/Strain Criteria</u> Not addressed | -Strain Criteria similar to NUREG - 1061 | Strain Criteria (2% limit) with fatigue check | NA |

LaSalle County Station Snubber Reduction Program
Comparison of Criteria Methodologies Piping Stress Analysis

| FSAR CRITERIA | LICENSING SUBMITTAL | NUREG 1061 | REGULATORY GUIDES |
|--|---|---|--|
| <u>OBE Allowables</u> - AISC or vendor values | AISC or Vendor Values | NA | Various criteria (RG 1.124, 1.130 (Class 1), SRP 3.9.3) |
| <u>SSE Allowables</u> Normal + SSE ___ 1.33 AISC but limited to yield stress | Normal + SSE SRP 3.8.4 except for unsymmetric sections | NA | Various criteria (RG 1.124) |
| <u>Anchor Bolts</u> Factor of safety = 4 (5 for shell type) | FS = 2 under certain conditions | NA | FS = 4 (IEB 79-02) |
| <u>Material Overstrength</u> Material yield = code min. | Actual Yield Strength | NA | Code minimum |
| <u>Seismic Anchor Motions</u> NA | SAM + inertial loads combined by SRSS | SAM & inertial loads combined by SRSS (Vol. 4, pg. 2-3) | |
| <u>Ductility Criteria</u> Not addressed | - Ductility Factor of 3 - No increase in Material yield strength | NA | NA |

RECIRCULATION PUMP SNUBBER LOADS

DRESDEN 2

COMPARISON OF COMBINATION TECHNIQUES

(ALL LOADS IN KIPS)

| PUMP | SNUBBER | A | B | C | D |
|------|---------|----|----|----|----|
| A | SS1 | 7 | 7 | 8 | 16 |
| | SS2A | 12 | 12 | 12 | 13 |
| | SS2B | 22 | 22 | 23 | 35 |
| | SS3A | 16 | 15 | 19 | 34 |
| | SS3B | 5 | 4 | 7 | 39 |
| | SS4 | 14 | 18 | 18 | 22 |
| B | SS1 | 12 | 12 | 12 | 20 |
| | SS2A | 15 | 16 | 16 | 16 |
| | SS2B | 17 | 22 | 22 | 29 |
| | SS3A | 17 | 17 | 21 | 39 |
| | SS3B | 10 | 9 | 12 | 44 |
| | SS4 | 9 | 9 | 11 | 14 |

"A" = DIRECT GENERATION PVRC DAMPING SPECTRA, SRSS OF MODES, NO HIGHER MODE EFFECTS, NO SAM, MAXIMUM HORIZONTAL AND VERTICAL (PVRC WITH FSAR).

"B" = "A" WITH SRSS OF BOTH HORIZONTALS AND VERTICAL.

"C" = "B" WITH SAM INCLUDED BY SRSS.

"D" = "C" WITH HIGHER MODE EFFECTS (PVRC WITH SUBMITTAL).