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USNRC REGION II ATLANTA, GEORGIA

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Mr. James P. O'Reilly, Director
U. S. Nuclear Regulatory Commission
Region II, Suite 3100
101 Marietta Street, N. W.
Atlanta, Georgia 30303

Subject: Virgil C. Summer Nuclear Station
Docket No. 50/395
Inspection & Enforcement Bulletins
79-14/79-02 and Open Item 81-16-01

Dear Mr. O'Reilly:

Attached for your review are South Carolina Electric and Gas Company's (SCE&G) responses to IEB 79-14, Revision 2 and IEB 79-02, Revision 3. Included in the response to IEB 79-02 is a discussion of the final resolution to NRC Open Item 81-16-01. These are our final responses to the subject bulletins.

If you require additional information, please advise.

Very truly yours,

T. C. Nichols, Jr.

T. C Nichols, Jr.

GDM:TCN:glb

Attachments 1 and 2

cc: Page Two

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ATTACHMENT 1
V. C. SUMMER NUCLEAR STATION
DOCKET NUMBER 50/395
RESPONSE TO USNRC IEB 79-14, REVISION 2

ORIGINAL: OCTOBER 30, 1979
REVISION 1: MARCH 19, 1981
REVISION 2: FEBRUARY 1982

The Virgil C. Summer Nuclear Station is in the final phases of construction with safety related support installation essentially complete. There are no inaccessible areas as discussed in the bulletin. The following describes the manner and extent in which the requirements of IEB 79-14 have been met.

As-built drawings have been developed for the safety related computer analyzed piping systems. These as-built drawings have included pipe run geometry and dimensions, support types, support and welded attachment locations, and function. A computer reanalysis has been performed on each system generating new support loads. Each support has been subsequently verified including the requirements of IEB 79-02 for plate flexibility and anchor bolt safety factor. Welded attachments have been verified to transmit acceptable loads to the pressure boundary. New supports have been designed as required by the new analysis and released for construction. Modifications and deletions of existing supports have also been released for construction.

Design documents used as input to the piping analysis are as indicated in our original response dated October 30, 1979. Computer analyses of safety related systems have utilized in some cases an overlapping technique of individual subsystems. Attachment A describes the method and extent of use of this technique. Attachment B lists the individual analytical subsystems overlapped.

In addition to the installation QC procedures and inspection requirements discussed in our previous responses, safety related cold spacing criteria analyzed systems of pipe size greater than 2 inches have been and are being verified by review and walkdown. Support designs whose loads are from the cold spacing criteria have been verified as well as any welded attachments involved. Support plates and expansion anchors for these supports have also been verified to the requirements of IEB 79-02.

Verification of the cold spacing criteria has been accomplished by comparison of the criteria's results to that of computer analyses of the same subsystems. This information is contained in, "Simplified-Detailed Dynamic Analysis," GAI report #2343. Subsequent to the NRC audit in July, 1981, (Report 50/395-81-16) over-conservatism in the damping factor used to develop the cold spacing criteria was eliminated. Hence, the supports which were previously overstressed are acceptable and the criteria has been verified to be conservative.

Valve manufacturers and suppliers have been contacted under a separate program to ensure the use of proper valve information including centers of gravity and weight. This information has been used in the revised analyses. Safety related piping systems have been reviewed for correct valve - operator orientation. The discrepancies have been reviewed and resolved.

As part of the installation QC inspection, piping passing through wall sleeves must be installed in the sleeve and not touch the sleeve inside wall. In this manner it is ensured that the analysis is validated for cold systems. Hot piping systems were checked during hot functional testing to the requirements of test procedure TE-1 Rev 2. This included a physical walkdown and measurement procedure of hot systems to verify that the pipe did not contact a non-supporting structure (sleeve, wall, other pipe, etc.).

Piping passing through wall sleeves in some cases require sleeve seals for radiation shielding. This shielding is provided by either grout or lead elastomer poured into the sleeve around the pipe. For computer analyzed safety related systems a review was made to identify those areas where the pipe moved thermally in excess of 1/8 inch. For these systems, specific clearance requirements between the pipe and seal are being generated. The seals will be installed and/or removed to meet these requirements.

Pipe break analyses for high energy systems have been performed in conjunction with the as-built piping analysis. New pipe whip restraints, guides, and shields required by these analyses are being designed and installed. Restraints, guides, and shields that are no longer necessary will be specifically identified on the drawings and may be removed as necessary to facilitate maintenance, access, etc.

Final as-built walkdowns are being performed as computer analyzed safety-related systems become complete. This final walkdown is a 100% review of all supports including those which have been added, modified, and deleted, using the same inspection elements utilized in the original as-built program. Discrepencies and supports which are determined to be out of tolerance, are being reviewed and resolved by the analysts. Out-of-tolerance supports are being justified or relocated within tolerance.

Future modifications involving safety related piping systems will be handled in such a manner as to conform to the requirements of both

IEB 79-14 and IEB 79-02. The following is a list of the procedures and programs which will be used for these future modifications:

1. Administrative Procedure AP-1500, Modification Control
2. Operational QA Plan, Section 6, Design Control
3. Nuclear Engineering Procedures:

   NE-128, Initiation, Evaluation, and Approval of Design Changes
   NE-129, Design Development/Design Package
   NE-131, Design Verification
   NE-130, Design Analysis and Calculations

At this time, support installations and final as-built walkdowns are being completed. It is SCE&G's intent that this work as well as the pipe whip restraint effort be complete by fuel load. However, in the event that this work cannot be completed by that time, SCE&G will prioritize and complete those systems as required by the Technical Specifications to support operational modes 5 and 6. If selective prioritization is required, we will keep the NRC Resident Inspector informed.

OVERLAP PROCEDURE FOR PIPING STRESS ANALYSIS

I. PURPOSE

The purpose of this procedure is to provide guidance for the appropriate methods to be utilized when overlapping piping systems for analysis and describe the degree to which the rigorous analysis must include the connecting pipe to yield valid results.

It should be noted that utilization of overlapping as a piping stress analysis method is based on the following considerations:

a) Overlapping is simply a method of analysis used to divide a large portion of piping to be analyzed into two or more smaller segments. This is done because (1) too large a problem may exceed computer core storage limitations or (2) too large a problem simply becomes impractical to solve because of the iterative nature of piping analysis.

b) If a problem is to be divided, the option to overlapping is to require the addition of a full pipe anchor (translational and rotational restraints). While this does provide for a simpler analysis, at least insofar as managing data, it also creates generally stiffer piping systems and requires a costly hardware fix.

c) It can be seen that based on the preceding, there is not only economic impetus but safety concerns which should dictate development of an adequate overlap procedure; and to correctly address these concerns, the technical basis for the procedure should not be solely to separate the influence of one side to the other of an overlap region, but to appropriately account for these effects.

II. COMPUTER ANALYSIS

1. MODELING/ANALYSIS

A. Overlapping of computer problems will be utilized when the dynamic analysis of the connecting system(s) cannot be performed because of computer core limitations. The Lead Engineer will identify the main system, subsystem(s) and the overlap region(s). These are defined as follows:

Main System: The first problem to be modeled and analyzed of two or more problems which overlap each other.

Subsystem(s): The succeeding problem(s) to be modeled and analyzed of two or more problems which overlap each other.

Overlap Region: The piping and supports that are modeled in both the main system and the subsystem(s).

1. MODELING/ANALYSIS (cont.)

During the iterative process of the main system/subsystem analyses, some modification to the overlap region will necessarily occur and additional supports may be required.

It is recommended that as much as is possible at this stage, the overlap region be selected in area of anticipated low stress, i.e. less than 50% of the allowables.

B. When modeling the main system and subsystem, a heavy broken line shall be drawn around the overlap region on the associated stress isometric drawings. The overlapping problem number and stress isometric drawing number shall be noted near the overlap region of each problem.

C. Although not always possible, an overlap region should ideally include (as a minimum) three seismic restraints in each of the three orthogonal directions; the restraints at the edge of the region shall be rigid guides (restraining the pipe for all loading conditions). As a minimum the overlap region should include a change in pipe direction. If additional supports are needed, approval should be obtained from GAI prior to making any changes.

D. When the overlap region has been established, interface data should be determined for the main "terminal ends" at the edge of the overlap region. It is obviously difficult to accurately predict seismic effects across an overlap region and this uncertainty is reflected in the stress/load combination method recommended for seismic results in section II.2

2. RESULTS

A. Prior to any combinations, results in the overlap region for each overlapped problem should be reviewed using the following guidelines:

   (1) For thermal analyses, stresses, loads and displacements should be of the same order of magnitude near the edges of the region and within 20%-30% of one another near the middle of the region.

   (2) For gravity analysis, results should be within 20% of one another, except at the outermost gravity supports of the region.

B. If the above review reveals apparent discrepancies in the overlap model, results and input should be carefully reviewed (especially thermal) to determine the cause and probable fix. Significant discrepancies may be acceptable if it can be determined that the higher results are conservative.

C. Recommended stress/load/displacement combination methods are as follows:

2. RESULTS (cont.)

   (1) For thermal, envelope results at all nodes in the region.

   (2) For gravity, envelope results at all nodes in the region.

   (3) For seismic, absolute sum all results at all nodes in the region.

D. For stresses, a Stress Summary for Overlapped Piping sheet (Attachment 1) should be completed. This provides a simple initial check against stress allowables using maximum stresses in the total overlap region and also provides documentation of the combination method employed. As can be seen on the form, it is recommended that stresses in an overlap region be maintained at or below approximately 80% of allowables simply to allow for the uncertainties of the overlap process.

E. For the support loads and displacements, the final support load summary, i.e. for the last subsystem analyzed for a particular overlap, should have the loads and displacements lined out and the combined loads displacements written in.

III. SEISMIC/NON-SEISMIC OVERLAP

Overlap of non-seismic piping should be done to ensure that the portion of piping beyond the seismic/non-seismic class break will not induce significant stresses in the seismic piping. As a minimum, three seismic restraints in each of the three orthogonal directions should be included in the overlap region with at least one change of direction. The analyst is responsible for providing additional supports in the non-seismic portion to adequately protect the seismic piping. Supports in these areas should be verified and approved by GAI prior to adding them.

IV. BRANCH LINE EXCLUSION TECHNIQUE

Branch lines and instrument connections may be uncoupled from the analysis model provided the ratio of the moments of inertia are equal to or less than 15%. These excluded lines are normally qualified by the simplified method of analysis. Accelerations at these points will be limited to (3g) horizontal and (2g) vertical. Mass points will be included for these connections and the following weights added:

IV. BRANCH LINE EXCLUSION TECHNIQUE (cont.)

LUMPED WEIGHT FOR RIGOROUS ANALYSIS MODEL

(Lumped Weight = Clamp Weight + Equivalent Weight of Attachment)

BRANCH LINE SIZE	EQUIVALENT WEIGHT OF ATTACHMENT
1/2 Sch 40/80	36
1/2 Sch 120/180	38
3/4 Sch 40/80	42
3/4 Sch 120/160	46
1 Sch 40/80	55
1 Sch 120/160	63
1½ and Larger	L (Weight/Foot of Pipe) = Lumped Weight where L=10 (Pipe O.D.)

RUN LINE SIZE	CLAMP WEIGHT
2½	13
3	13
4	14
6	21
8	23
10	27
12	32
14	35
16	38
18	56
20	93
24	93

ATTACHMENT 1 (to Attachment A)

STRESS SUMMARY FOR OVERLAPPED PIPING

(one set per pipe size in overlap region)

1. Overlapping Problems:

Prob. No.________________________Rev._____Iso.____________Rev.____
Prob. No.________________________Rev._____Iso.____________Rev.____
Prob. No.________________________Rev._____Iso.____________Rev.____

2. Stress Summary (in accordance with ASME Class 2, 3 rules):

P_D = Design pressure (psi)__________ P_P = Peak pressure (psi)__________

D_O (in.)____________________ tn (in.)______________________

	Max. Intensified Stress in Region (psi)				
Load Case	Prob. No.	Prob. No.	Prob. No.	Max. Combined Intensified Stress (psi)	
Gravity					①
Thermal					②
OBE					③
SAM, OBE					④
SSE DBE					⑤
Other_____					⑥
Other_____					⑦

M_A stress = ① = ____________________

Upset M_A + M_B stress = ① + ③ + ④ + ◯ = ____________________

M_C stress = ② = ____________________

M_A + M_C stress = ① + ② = ________________

Emergency M_A + M_B stress = ① + ⑤ + ◯ ____________________

STRESS SUMMARY FOR OVERLAPPED PIPING (cont.)

3. Class 2,3 Stress Evaluation (Answer allowable comparisons "yes" or "no":

A. Sustained Loads (eqn 9, NC-3652.1)

$S_L = \frac{P_D D_O}{4\ tn} + 0.75\ (M_A \text{ stress}) =$ ____________________

$0.8\ S_h =$ ____________________: $S_L \leq 0.8\ S_h$?______________

B. Occasional Loads (eqn 9, NC-3652.2)

$S_{OL} = \frac{P_P\ D_O}{4\ tn} + 0.75\ (\text{Upset } M_A + M_B \text{ stress}) =$ ____________________

$0.8 \times 1.2\ S_h =$ ____________: $S_{OL} \leq 0.8 \times 1.2\ S_h$?_______

C. Thermal Expansion (eqn 10, NC-3652.3)

$S_E = (M_C \text{ stress}) =$ ____________________

$0.8\ S_A =$ ________________ $S_E \leq 0.8\ S_A$?______________

$S_{TE} = \frac{P_D P_O}{4\ tn} + 0.75\ (M_A \text{ stress}) + (M_C \text{ stress}) =$ __________________

$0.8\ (S_h + S_A) =$ _____________: $S_{TE} = 0.8\ (S_h + S_A)$?___________

D. Emergency Loads (eqn 9E, NC-3652.2 modified)

$S_{OLE} = \frac{P_P D_O}{4\ tn} + 0.75\ (\text{Faulted } M_A + M_B \text{ stress}) =$ __________________

$0.8 \times 1.8\ S_h =$ __________: $S_{OLF} = 0.8 \times 1.8\ S_h$?_____________

E. Other (Define)__________________________________

____

____

If the answers to question under A.B,D,E (if applicable) and either one of the two questions under C are "yes", then ASME Code rules are satisfied for this piping:

Check one

ASME Class 2/3 Code Rules satisfied ___________

ASME Class 2/3 Code Rules not satisfied ___________

If Code rules are not satisfied for this simple check, then attach calculation sheets as necessary to evaluate stresses at specific nodes.

ATTACHMENT B

Safety Related Analytical Subsystems Which Used The Overlap Technique

Analysis Code	....overlapped with....	Analysis Code
CC-01/05		CC-04
CC-02		CC-06
CC-11		CC-08/10
CC-13		CC-07
CC-14		CC-15/16
CS-02, 03, 07, and 08 (class 1)		CS-02, 03, 07, and 08 (class 2 and 3)
CS-22		SP-04
RH-03		RH-15 and SP-04
RH-15		CS-21/22
CS-04		RC (non-safety)
SW-03		SW-03 (non-safety)
SW-04		SW-04 (non-safety)
FW-13A, 13B, 13C		*FW-13A, 13B, 13C
MS-04A		*MS-04D
MS-04C		*MS-04D and MS-09

*The overlap region was within the non-safety portion of the system.

ATTACHMENT 2
V. C. SUMMER NUCLEAR STATION
DOCKET NO. 50/395
RESPONSES TO USNRC IEB 79-02 REV. 3

ORIGINAL: July 5, 1979
REVISION 1: AUGUST 17, 1979
REVISION 2: JANUARY 7, 1980
REVISION 3: FEBRUARY 1982

Virgil C. Summer Nuclear Station is in the later stages of construction with essentially all safety related pipe supports installed. The following is a summary, by item, of the manner and extent in which South Carolina Electric & Gas Company has satisfied and will continue to satisfy the requirements of IEB 79-02.

ITEM 1: SCE&G is completing an as-built verification program in which 100% of the calculations for safety related pipe supports have been verified to take into consideration plate flexibility. The analytical model used to account for plate flexibility is as indicated in our original response, figures 1, 2, 3, and 4, except for one subcontractor. This subcontractor used the "Generic I" program. In addition, the PRY-10 computer code was used on supports which were determined unacceptable by hand calculations. Supports failing this iteration were redesigned.

ITEM 2: Expansion anchors used at the Virgil C. Summer Nuclear Station for safety related pipe supports have been the wedge type exclusively. Shell type expansion anchors have not been used. Through the as-built verification program, a minimum factor of safety of 4 has been verified for safety related support plate expansion anchors. The as-built program has taken into consideration the tension-shear interaction for each support plate. The method for including tension-shear interaction has been as discussed in our original response dated July 5, 1979.

QC inspection has been, and is being performed on all expansion anchor bolts of safety related pipe supports. This QC inspection includes the following:

1. bolt size and length
2. embedment depth
3. skewness

4. depth of grout
5. hole depth
6. plate hole size
7. projection
8. thread engagement
9. spacing between bolts of the same plate
10. minimum edge distance
11. spacing between bolts of different plates.

Leveling nuts for grouted plates were not used at the Virgil C. Summer Nuclear Station The QC inspection of previously installed supports revealed a small percentage of supports whose anchor bolts violated the minimum spacing requirements. These supports have been relocated, redesigned, or dispositioned accept as is, by down rating the holding capacity of the bolt.

ITEM 3: In our original response dated July 5, 1979, it was indicated that a factor of 1.5 times the OBE loads was used to produce the design loads. This factor provided for the effects of hardware and erection tolerances and provided additional conservatism for the effects of cyclic loads. This factor was used for the original support design only. Since as-built walkdowns were performed to confirm the location of supports, hardware and erection tolerances were input into the final as-built analyses.

The final as-built verification of the supports utilized reactions generated by these dynamic analyses and; therefore, the 1.5 factor is no longer required. Based on this approach, design requirements for anchor bolts to withstand cyclic loads have been met.

ITEM 4: Expansion anchored plates of safety related pipe supports have been assured continued structural integrity to withstand cyclic loads by ensuring that the bolt preloads are greater than the maximum allowable working load. Expansion anchors for safety related pipe supports have been installed by torquing to a specified value. This torque value has been determined by field tests in order to obtain the required level of bolt tension. The torque value as well as embedment depth, thread engagement, etc., have been verified by 100% QC inspection of safety related pipe supports as discussed in Item 2.

As a part of our commitment in the July 5, 1979, response to IEB 79-02, "Vibration Analysis Functional Test" VB-1 is being performed to review, test, and monitor those systems subject to operational vibration loads. At this time, most of the systems required by the procedure have been tested. Modifications to the supporting schemes were made to the Residual Heat Removal, Main Steam, and Service Water Systems as a direct result of the tests. Those systems not tested at this time will be by fuel load. After fuel load, the Main Steam and Feedwater Systems will be additionally tested according to the procedure.

ITEM 5: Expansion anchored plates of safety related pipe supports were not attached to masonary block walls at V. C. Summer Nuclear Station.

ITEM 6: As indicated in our January 7, 1980, response, 200 supports had been identified to utilize structural shapes instead of plates for safety related pipe supports. It was determined that supports of this type subject to eccentric tension did not in all cases meet the factor of safety of 4 requirements. Safety related pipe supports have now been verified and recalculated for the as-built condition to insure the required safety factor. This was done by applying the short direction prying factor discussed in the January 7, 1980, response except for Teledyne who developed their own criteria. Teledyne's criteria was developed for a number of utilities and was reviewed by the NRC.

ITEM 9: Expansion anchor bolts for future safety related pipe supports will be designed and installed to the requirements of this Bullentin. For further documentation, see response to IEB 79-14.

Inspector Follow-up Item 81-16-01 (Report No. 50-395/81-16) questioned the reduction in safety factor caused by anchor bolt skewness.

The expansion anchor skewness tolernance was established to be 0 to 6 degrees from perpendicular. All deviations beyond this tolerance were documented by nonconformances and/or deficiency notices. Expansion anchors installed beyond 10° were rejected and reworked. The 6° tolerance was established on the basis of being the smallest angle practical to measure, especially considering cases where bolt projection was small. An evaluation was performed for several specific supports whose bolts were installed with skewness at 6° or less using a simplified conservative method. It was determined that there was no significant reduction in safety factor and that this 6° tolerance is in fact acceptable. The NCN's and DN's generated for skewness between 6 and 10 degrees have been reviewed and analyses performed on their respective supports. The results show that the lowest revised factor of safety is 4.55. Therefore, these anchors are also acceptable.