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O'REILLY,J.P. Region 2, Atlanta, Office of the Director

SUBJECT: Forwards summary of 790810 meeting w/NRC to discuss potential OBE/DBE design deficiency.

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DUKE POWER COMPANY
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WILLIAM O. PARKER, JR.
VICE PRESIDENT
STEAM PRODUCTION

August 17, 1979

TELEPHONE: AREA 704
373-4083

Mr. J. P. O'Reilly, Director
U.S. Nuclear Regulatory Commission
Region II
101 Marietta Street, Suite 3100
Atlanta, GA 30303

Re: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287

Dear Mr. O'Reilly:

On August 10, 1979, a meeting was held with members of the NRC Staff and Duke Power Company to discuss the potential OBE/DBE design deficiency at Oconee Nuclear Station. Attached is a summary of this meeting and responses to the areas of concern raised during the course of the meeting.

Very truly yours,

William O. Parker, Jr.

RLG/sch

Attachment

cc: Director, Office of Nuclear Reactor Regulation
Director, Office of Inspection and Enforcement

OCONEE NUCLEAR STATION
USNRC/Duke Power Company Meeting on August 10, 1979
USNRC Request For Additional Information

REQUEST 1: Submit a summary to document Duke's presentation at the August 10, 1979 meeting with NRC.

RESPONSE 1: On August 10, 1979, representatives of Duke Power Company met with the USNRC at I&E Headquarters, Bethesda, Maryland to discuss seismic design of piping supports/restraints at Oconee Nuclear Station. Duke had reported a potential design deficiency to USNRC, Region II, on August 7, 1979, which was discovered in re-analysis work being performed in response to USNRC I&E Bulletin 79-02. Duke had reported that because Operating Basis Earthquake (OBE) loads were the only seismic loading components documented on the support/restraint drawings it was not clear that Design Basis Earthquake (DBE) loads had been accounted for by the original support/restraint designer. The August 10, 1979 meeting was called for the purpose of discussing progress Duke Power Company had made in confirming that DBE loadings were properly accounted for in piping support/restraint designs. A list of attendees is attached.

Duke outlined the results of the investigation conducted to resolve the potential deficiency. Duke reported that sufficient evidence had been located in Duke, ITT Grinnell Corporation and Bechtel Power Corporation files to confirm that the pipe supports/restraints were properly sized for DBE seismic loadings. The following information was presented by Duke supporting this conclusion:

Original Support/Restraint Design Responsibilities

Duke Power Company was responsible for the original seismic piping analysis for piping located in the Auxiliary and Turbine Buildings. Piping seismic dynamic analysis was run for the OBE load combination only. DBE results were obtained by multiplying the OBE results by a factor of 2. Piping support/restraint load summaries and locations were transmitted to ITT Grinnell Corporation for design of the support/restraint assemblies and selection of standard hanger components. These load summaries included the OBE seismic loads and did not address DBE loads.

Bechtel Power Corporation was responsible for the original seismic piping analysis for piping located in the Reactor Buildings. Piping seismic dynamic analysis was run for the OBE load combination only. DBE results were obtained by multiplying the OBE results by a factor of 2. Bechtel was

also responsible for design of the pipe supports/restraints. ITT Grinnell Corporation supplied the support/restraint materials based on Bechtel design drawings.

ITT Grinnell Support/Restraint Design Criteria

ITT Grinnell Corporation was able to establish, through existing Oconee calculations, that tensile stress allowables were limited to the values listed in the Manufacturers Standardization Society of the Valve and Fittings Industry, Code of Standard Practice No. 58 (MSS SP-58) or ANSI B31.1. Review of ITT Grinnell shop stock lists for Oconee indicate that A53 or A106 Grade B pipe, A515 Grade 55 or 65 plate and ASTM A36 structural shapes were the materials used in the supports/restraints. The allowable tensile stress for ASTM A36 steel was 13,800 psi (.38 Fy). Allowable shear stress on the throat of fillet welds were as follows:

Fillet Size (inch)	Allowable Load (lb/in)
1/4	1200
3/8	1800
1/2	2400
5/8	3000
3/4	3600

ITT Grinnell established the allowable weld shear stress by concluding that welds to seamless carbon steel pipe governed (minimum allowable 12000 psi) and reducing the base allowable stress in accordance with ANSI B31.1 for welded attachments. This process reduced the allowable weld stress to 7200 psi by applying the applicable factors of .8 and .75. The resulting allowables were then used for structural welds in addition to pipe welds. E60XX or stronger weld material was used on the supports/restraints.

Phillips Red-Head self-drilling expansion anchors were used exclusively. Allowable anchor loads were as follows:

Size (inch)	Tensile (lbs)	Shear (lbs)
1/2	1040	1370
5/8	1520	2430
3/4	1760	3300
7/8	2190	3760

These allowables were established by ITT Grinnell applying a factor of safety of 5 to test results published by Phillips for installations in 2500 psi concrete. In a limited number of cases the support/restraint calculations show the use of a factor of safety of 4 in accordance with manufacturer's recommendations.

All standard components were selected from ITT Grinnell Hanger Catalogs which are load rated based on MSS SP-58 and ANSI B31.1 stress allowables.

Use of OBE/DBE Seismic Loads by ITT Grinnell

All hanger designs by ITT Grinnell were based on the OBE seismic load component and the aforementioned stress and load allowables. In a limited number of cases a 20% increase in allowable tensile stress was used as permitted by ANSI C31.1.

The Oconee Nuclear Station FSAR permits utilization of the material's full yield strength when considering the DBE loadings. The allowables utilized for OBE loadings were generally considerably less than 1/2 that permitted for loadings. Thus, OBE was normally the governing load combination. Duke and ITT Grinnell have concluded that because of such conservative allowables for OBE loadings, the original designers did not find it necessary to address loadings directly.

Bechtel Support/Restraint Design Criteria

Two Bechtel Departments were involved in designing the pipe supports/restraints. The Civil Engineering Department was responsible for designing Auxiliary structural steel which formed a part of the support/restraint and the Pipe Design Department was responsible for selecting the appropriate standard hanger components. Both departments received support/restraing load summaries from the Piping Analysis Department with seismic loads based on the OBE. The Civil Engineering Department multiplied the OBE load components by 2 to obtain DBE loads. The resultant design loads were then summarized and finally multiplied by a safety factor of 2 to account for future changes. The resulting material stresses were then limited to normal AISC allowables. In a few select cases a 33% increase in allowable stress was used as permitted by AISC. Allowable expansion anchor loads were in accordance with Bechtel Standard C-322.22 and were as follows:

Size (inch)	Tensile (lbs)	Shear (lbs)
1/2	1830	915
5.8	2760	1380
3/4	3870	1935
7/8	3870	1935

In general, the allowable tensile and shear loads were divided by a based on high operating temperature or importance of the structure.

The Pipe Design Department selected the standard hanger components from ITT Grinnell Catalogs based on loads which included the OBE load components.

Use of OBE/DBE Seismic Loads by Bechtel

DBE loads were explicitly included in each Auxiliary steel design by the Bechtel Civil Engineering Department. Standard hanger components were selected by the Bechtel Pipe Design Department based on OBE loadings. This selection process, based on OBE, was identical to that previously discussed for ITT Grinnell support/restraint designs and Duke analyzed piping.

Stress allowables utilized with OBE loads were sufficiently restrictive to preclude the necessity to consider DBE loads in standard component selection. Duke and Bechtel have concluded that DBE was properly accounted for in design of pipe supports/restraints for piping in the Reactor Buildings.

Related Data

Review of Reactor Coolant System design related correspondence and applicable sections of the Oconee FSAR have confirmed that DBE loadings were appropriately accounted for by factoring OBE seismic results by 2.

Duke also provided an update to the design deficiency previously reported on August 3, 1979 to USNRC, Region II, regarding Hangers H-64 and R-9 which are located on single trains of Unit 1 and Unit 2 main feedwater lines. Duke reported that re-analysis of the piping in each unit with the two (2) hangers assumed to be absent resulted in lower pipe wall stress and a slight overstress in two (2) non-Nuclear Safety Related rod hangers in the Turbine Building. This analysis was above tl establish that the Nuclear Safety Related segment of this line (to the upstream containment isolation valve) is protected in all cases and is no longer a safety concern. Expansion anchor factors of safety were also presented for the Unit 1 emergency

feedwater line supports/restraints as an example of the level of conservatism existing in the original design and to demonstrate system operability during the DBE.

In response to USNRC Staff questions, Duke outlined its graded analysis approach to the computation of expansion anchor factors of safety. All initial calculations of factors of safety are based on conservative hand calculational techniques. Supports/restraints which are screened in this process as having expansion anchor factors of safety of less than 5 are then reviewed individually for potential refinements such as justification of less conservative boundary conditions (e.g. partial rotational restraint vs. full fixity) or finite element analysis. Increased expansion anchor load capacity based on actual inplace concrete strength is also a potential basis for considerable margin. However to date, it has not been necessary to utilize this reserve.

REQUEST 2: What stress allowables were used by ITT Grinnell for design of supports/restraints when values were not specified by MSS SP-58 (e.g. compressive and shear allowables).

RESPONSE 2: Existing calculations, which were inspected, show that bending and tensile stresses were generally found to be governing. None of the calculations reviewed had substantial shear loads in connecting members and no evidence was found indicating the designers had reason to compute nominal shear stress and compare it to an allowable. Some of the calculations did consider buckling (computation of slenderness, ratios, etc.), however the actual design criteria have not been established.

ITT Grinnell is currently verifying that existing Oconee designs have appropriate margins with respect to buckling and shear. This verification will be done by screening a sample of existing Oconee support/restraint calculations with a simplified and conservative set of design limits for buckling and shear, consistent with the requirements of the Oconee FSAR. The sample will be selected starting with the loadings and support/restraint configurations which are determined to have significant buckling and shear loads.

REQUEST 3: Was the "Overlap" Technique used to substructure (subdivide) piping analysis problems at Oconee Nuclear Station? If yes, what was the "Overlap" Criteria. What was justification for methods used.

RESPONSE 3: As requested, the following response addresses separately the techniques used by Bechtel, EDS Nuclear (Design Consultants) and Duke on their respective scope of analysis.

In general, only the seismic analysis of the Oconee Piping Systems required piping problem interface consideration.

Bechtel has reviewed approximately 10% of the seismic piping analysis assigned to their scope on Oconee Nuclear Station, and has determined that the "overlap" technique was not used as a method of problem boundary interface.

EDS has reviewed approximately 80% of the seismic piping calculations assigned to their scope and have determined that the "overlap" technique was generally used. The extent of overlap utilized in the piping analysis problems was based on engineering judgements considered appropriate for the specific problem being analyzed.

Duke has reviewed approximately 50% of the seismic piping calculations assigned to it's scope. This review confirms that the "overlap" technique was generally used in the analysis. Duke felt that the extent of overlap employed in piping analysis was adequate, and did reasonably model the influence of adjacent piping on the problem being analyzed.

In general, the thermal and weight analysis for all piping systems at Oconee was conducted without problem interfacing. In the few cases where problem interfacing was required for thermal and weight analysis, the technique of imposed rotations and displacements through applied end loads was utilized.

Duke believes that the analytical methods used on Oconee were and are adequate to develop realistic support/restraint loads and to assure safe and reliable plant operation to meet all design criteria.

OCONEE NUCLEAR STATION
USNRC/Duke Power Company Meeting
East-West Towers, Bethesda, Maryland
August 10, 1979

LIST OF ATTENDEES

Name	Affiliation
Howard Wong	NRC/I&E/HQ
Ed Jordan	"
Ken Herring	NRC/DOR/EB
Bob LaGrange	"
Keith Wichman	"
J. Zudans	"
R. W. Reid	NRC/DOR/ORB4
M. B. Fairtile	"
R. M. Compton	NRC/I&E/RII
W. P. Ang	"
Bob Masterson	ITT Grinnell Corporation
T. E. Smith	"
J. W. Chiloro	Bechtel Power Corporation
S. R. Kalavar	"
W. F. Brittle	"
H. S. Kassel, Jr.	"
R. B. Priory	Duke Power Company
L. C. Dail	"
W. O. Parker, Jr.	"
K. S. Canady	"
C. L. Ray, Jr.	"
S. K. Blackley, Jr.	"
W. H. Scheffler, Jr.	"
R. E. Miller	"