REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:8402070341 DOC.DATE: 84/01/31 NOTARIZED: NO DOCKET #
FACIL:50-305 Kewaunee Nuclear Power Plant, Wisconsin Public Servic 05000305
AUTH.NAME AUTHOR AFFILIATION
GIESLER,C.N. Wisconsin Public Service Corp.
RECIP.NAME RECIPIENT AFFILIATION
VARGA,S.A. Operating Reactors Branch 1

SUBJECT: Forwards final response to IE Bulletin 80-11, "Seismic Qualification of Masonry Walls." Response addresses NRC concerns & util resolutions.

DISTRIBUTION CODE: IE11S COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 11
TITLE: Bulletin Response (50 DKT)

NOTES:

	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL
	NRR ORB1 BC	1	1	GROTENHUIS,M	1	1
INTERNAL:	AEOD	1	1	IE FILE 01	1	1
	IE/DEPER/EGCB	1	1	IE/DEPER/EGCB/S	2	2
	NRR/DE/MEB	2	2	NRR/DE/MTEB	1	1
	NRR/DL/ORAB	1	1			
EXTERNAL:	LPDR	1	1	NRC PDR	1	1
	NSIC	1	1	NTIS	1	1

Orig. To
Add: Reg. File

TOTAL NUMBER OF COPIES REQUIRED: LTTR ~~15~~ 16 ENCL ~~15~~ 16

NRC-84-18

WISCONSIN PUBLIC SERVICE CORPORATION

P.O. Box 1200, Green Bay, Wisconsin 54305

January 31, 1984

Director of Nuclear Reactor Regulation
Attention: Mr. S. A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Varga:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
IE Bulletin 80-11 "Final Report"

References:
1) Letter to Mr. Keppler of NRC from Mr. E. R. Mathews of WPSC, dated July 9, 1980
2) Letter to Mr. Gaston Fiorelli of NRC from Mr. E. R. Mathews of WPSC, dated September 23, 1980
3) Letter to Mr. Gaston Fiorelli of NRC from Mr. E. R. Mathews of WPSC, dated January 14, 1981
4) Letter to Mr. S. A. Varga of NRC from Mr. C. W. Giesler of WPSC, dated April 29, 1983
5) Letter to Mr. J. G. Keppler of NRC from Mr. E. R. Mathews of WPSC, dated December 8, 1980
6) Letter to Mr. C. W. Giesler of WPSC from Mr. W. S. Little of NRC, dated April 20, 1983
7) Letter to Mr. C. W. Giesler of WPSC from Mr. S. A. Varga of NRC, dated February 22, 1983

The enclosed report is submitted as the final report to close out IE Bulletin 80-11 "Seismic Qualification of Masonry Walls." The report discusses NRC concerns and our resolution of the concerns.

Very truly yours,

C. W. Giesler
Vice President - Nuclear Power

JSG/js
Attach.
cc - Mr. Robert Nelson, US NRC
Director, Office of I&E, US NRC

IE11
1/1
ORIGINAL TO
ADD: REG FILE

8402070341 840131
PDR ADOCK 05000305
Q PDR

Introduction

Concern has been expressed in IE Bulletin 80-11 over the adequacy of criteria used for the design of masonry walls, and the lack of coordination between the structural and piping/equipment design groups at A/E firms not associated with the Kewaunee Plant. To assess the relevancy of NRC concerns to the masonry walls at the Kewaunee Nuclear Plant, this report addresses the design criteria used for the design of masonry walls, the coordination between the structural and piping/equipment design groups, and the construction practices as they pertain to masonry walls.

Background

IE Bulletin 80-11, issued May 8, 1980 expressed NRC concerns over the two deficiencies identified at the Trojan Nuclear Plant and the generic implications of similar deficiencies at other operating facilities.

Inspections at Trojan identified masonry walls that did not have adequate structural strength to sustain the required piping system support reactions. The structural weaknesses were attributable to two deficiencies:

1) Lack of final check of certain pipe support locations and reactions to ensure that the supporting elements possessed adequate structural integrity to sustain the required loads.

2) Non-conservative design criteria for the reactions from supports anchored into the face of concrete masonry walls.

The deficiencies identified at the Trojan Nuclear Plant were confirmed and attributed to error in engineering judgement, lack of procedures and procedural detail, and inadequate design criteria.

Discussion

Design Criteria

The criteria used for the design of masonry walls at the Kewaunee Nuclear Plant has been transmitted to the NRC in our submittals dated July 9, 1980; September 23, 1980; January 4, 1981 and April 29, 1983. In response to the NRC concern regarding the adequacy of criteria used for the design of masonry walls a reevaluation of the masonry walls was performed in response to the bulletin using the following criteria:

1) The design allowables are based on UBC-67 which are of the same value or lower than the present ACI 531-79.

2) Load combinations are the same as those specified in Appendix B table B-6.1 of the Kewaunee Nuclear Power Plant USAR.

3) The working stress method of analysis is used.

4) The seismic loads were computed using the following basis:

   - 5% dampening is used for OBE and DBE; this is highly conservative since lowering the dampening factors increases the seismic loadings.

   - Cracked moment of inertia for frequency calculation; this method is similar to that used in designs utilizing reinforced concrete.

   - One way action for frequency calculation; this is a conservative approach where no credit is taken for dampening due to blocks adjacent to the vertical strip wall under examination.

- Boundary conditions were assumed to be simply supported or fixed at the bottom and simply supported or free at the top depending on the construction details at the top or the bottom.

- Torsional effects; the accelerations obtained from the response spectra were further increased to account for overall torsional effects of the buildings. Torsional acceleration of the building as a whole increased the spectral acceleration by 26%. The contribution of the higher modes are small and were not considered because of the other conservative assumptions.

- The loads of the equipment and piping attached to the wall are considered in the analysis.

- All safety related masonry walls are running bond.

- Interstory drift; 3/4 inch was maintained between the top of the wall and the ceiling. The walls were simply supported by steel angles in transverse direction. The above boundary conditions permit the relative motions of the floors without inducing stresses in the wall.

- Dur-O-Wall is used as reinforcement in the horizontal direction for temperature and shrinkage control.

- Vertical reinforcement varies with the wall as needed to resist tensile stresses.

- Masonry walls are interior, non load bearing, single width constructed walls.

Construction Materials

Masonry lightweight units - ASTM C-90, Grade U-1. The units conform to ASTM C-426 tests for moisture.

Mortar and grout - ASTM C-270 Type "S" mortar. Mortar proportions by volume are specified as:

Portland Cement - ASTM C-150, Type I or ASTM C-175, Type IA.

Lime - ASTM C-207

Sand - ASTM C-144

Horizontal reinforcement - Extra heavy weight Dur-O-Wall spaced at 24 inches on center, unless specified otherwise.

Vertical reinforcement - ASTM A-615, Grade 60 deformed billet steel bar.

Construction and Inspection

Reference letters 6 and 7 required us to indicate if construction practices at the Kewaunee Plant conform to the provisions specified in ACI 53-79(9) for Special Inspection Category. We were also to indicate whether quality assurance/quality control information is available to support this categorization.

The safety-related masonry walls at the Kewaunee Plant were designed and constructed according to the provisions of UBC-67. UBC-67 has provisions

to increase design stress levels as knowledge of material properties increased. The design of safety-related masonry walls at the Kewaunee Plant took advantage of these increased stress levels.

The quality control documentation method applied to wall erection in use at the time of masonry wall construction at the Kewaunee Plant consisted of recording deviations in construction rather than attesting to proper installation. In Reference 4 we committed to a special non-destructive inspection of safety-related masonry walls to confirm proper installation, which is necessary to take advantage of the UBC-67 provisions for increasing stress levels.

The inspection consisted of a technique development phase where a reference standard was developed to identify rebar size, an inspection phase where randomly selected masonry wall areas were radiographed, and an assessment phase where rebar size and locations were determined and compared to design drawings.

The technique development phase required the construction of standard blocks in which a spectrum of rebar diameters were grouted in a manner similar to original construction. These blocks were then radiographed at varying durations to determine the proper exposure time at a given distance. This phase resulted in clear radiographs of rebar of known sizes from which size determination could be made from field inspection.

The inspection phase consisted of radiographing masonry wall areas in an ascending sequence. Approximately 17% of the safety-related masonry walls were inspected. The inspection was conducted on October 11 through October 14 and December 27, 1983.

The assessment phase consisted of comparing the results of the non-destructive inspection to the design drawings of the selected safety-related masonry walls. The inspection has shown that all of the walls met the design specifications.

An inspection was conducted on January 24, 1984 to locate horizontal reinforcement (Dur-O-Wal). The instrument used to locate the Dur-O-Wal is a rebar finder (R-meter) which locates metals subsurface to the concrete by magnetic coupling. The R-meter indicates the presence of Dur-O-Wal reinforcement, however, the sensitivity of the instrument does not allow the determination of Dur-O-Wal size. The results of the inspection show that all the walls met the design specifications.

Design Coordination

The document entitled "Structural Engineering Division Responsibilities and Procedures for Design, Procurement, and Quality Assurance on Nuclear Plants" is evidence of the coordination that existed between the various disciplines during the design phase of the Kewaunee Plant.

The Quality Assurance section of the document comprised all planned and systematic actions necessary to provide confidence that a structure, equipment or component would perform adequately in service, comply with AEC requirements, and conform to good engineering practices. Quality Assurance includes quality control, which comprises quality assurance actions related to the physical and chemical characteristics and properties of a material, structure or component which provides assurance that the quality of the material, structure or component meets predetermined requirements.

The Structural Engineer, Licensing, was responsible for the preparation of the structural portion of all AEC licensing documents. He worked with the Project Nuclear Engineer, the Project Structural Engineer, and the Manager, Structural Engineering, in determining the criteria and the design methods that were present in the licensing documents. This material was subject to the approval of the Project Structural Engineer and the Manager, Structural Engineering, before submittal to the Project Manager and the Client for final approval and submittal to the AEC.

The Project Structural Engineer was responsible for the preparation of the structural portion of the Design Manual. A list of all design criteria, codes, materials of construction and loads was prepared and approved by the Manager, Structural Engineering, before being submitted to the Project Manager and Client for final approval.

The Project Structural Engineer and the Structural Engineer, Licensing, participated with the other Project Engineers, the Project Manager and the Client Engineer in developing the preliminary plant layout and preliminary site layout into definitive general arrangement drawings. When a specific piece of design work was ready to proceed, the group leader assigned a designer to prepare the design. The designer and group leader chose the procedure and design method to be used and presented it to the Cognizant Engineer for approval. When the design for a phase of work was complete, the group leader assigned a man (design checker) to check the design. Structural drawings were checked for conformance to the design calculations, and the design checker indicated his approval of the calculations and drawings by signing the drawings in the designated space.

The Cognizant Structural Engineer had primary responsibility for the design and drawings. After the design and drawings for any segment of the work was completed and checked, the Cognizant Structural Engineer reviewed the design and drawings sufficiently to satisfy himself that all had been done properly. He then entered his signature and the date in the designated space on each drawing under the Professional Engineers Certification upon each drawing.

When a drawing was to be released for construction, the Cognizant Structural Engineer was responsible for determining that the design and the drawings had been checked and that the second level review had been completed and documented; that the drawings had been reviewed by the other disciplines; and that the drawing had been reviewed by the Client. The notation "Released for Construction" was then placed in the revision column on the drawing and the Cognizant Structural Engineer placed his initials and the date of release in the revision column.

The Structural Design Engineer Supervisor was responsible for keeping the other disciplines informed of the work in progress. When the structural drawings progressed to the point that most of the structural members were shown, the Design Supervisor obtained a print of each drawing for the following: Project Mechanical Engineer, Project Nuclear Engineer, Project Electrical Engineer and Project I&C Engineer. Each print was marked "Preliminary--for comment" and the date by which the comments were to be made and the prints returned to the Design Supervisor. The same procedure was adhered to whenever the drawings for any phase of the work was about 50% complete and when they were 85% complete. When a drawing was complete and checked, a print was issued to each discipline as

listed above. The print was marked "Final--tracing will be presented for signature within seven days." At the end of the seven-day period, the Design Supervisor presented the tracing to each Project Engineer and to each Group Leader for their initials.

All Specifications for Type 1 Items received reviews by the Cognizant Structural Engineer, Manager, Structural Engineering; Project Manager; the Quality Assurance Engineer; the Client Quality Assurance Personnel, and to the applicable Project Engineers of other disciplines. In addition to the above review, all specifications with Type 1 equipment or fabrication were submitted to the Structural Engineer, Design Review to receive an independent second level design review, to be performed by an engineer capable of confirming the adequacy of the specification and its coordination with the structural drawings.

The information presented in the above paragraphs clearly displays the coordination that existed between the different disciplines at the time of the Kewaunee Nuclear Power Plant design. We have, however, taken several actions to confirm the coordination.

The following actions have been taken in response to the NRC concerns regarding a lack of design coordination between the structural and piping/equipment design groups. A survey was conducted of the Kewaunee Plant to identify all masonry walls that have safety-related equipment attached to or in the vicinity of the walls. Safety and non-safety related attachments were recorded and analyzed to assure that the walls possessed adequate structural integrity to sustain the required loads. Analysis has shown that the attachments have negligible loading

on the safety-related masonry walls. The masonry walls identified as safety-related have been submitted to the NRC in our letters dated December 8, 1980, and April 29, 1983, References 8 and 4. A list of attachments to the safety-related walls and the results of the load analysis has been submitted to the NRC on December 8, 1980, Reference 8.

The supplemental information requested in Inspection Report No. 50-305/83-05 (DE) involves safety-related equipment in proximity to masonry walls that will potentially suffer damage in a postulated wall failure. The materials, testing, analysis, design, construction and inspection related to the design and construction of safety-related masonry walls has been shown to conform to applicable codes and standards, therefore, it is our opinion that the safety-related masonry walls will perform their intended function during a seismic event, and no safety concern exists. Hence, this request would not provide any additional information useful to resolution of this issue.

Conclusion

The design criteria used in the design of masonry walls at the Kewaunee Nuclear Plant has been transmitted to the NRC and shown to conform to applicable codes and standards.

Adequate coordination between the structural and piping groups has been demonstrated via the survey results. Safety related walls and attachments were identified and the attachments were shown by analysis to have negligible loading on the walls.

All of the walls selected for the non-destructive inspections met the design specifications. It is reasonable to conclude, based on the results of the non-destructive inspections, that adequate attention was given to design specifications during construction of safety related walls at the Kewaunee Nuclear Plant.

In conclusion, NRC concerns as expressed in IE Bulletin 80-11 are not applicable to the masonry walls at the Kewaunee Nuclear Plant. The masonry walls were designed and constructed to Quality Assurance-Type 1 standards, and it has been shown that structural integrity would be maintained during a seismic event; therefore, there is no safety concern. The intent of the bulletin has been met and no further work is required.