REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:8306230348 DOC.DATE: 83/06/20 NOTARIZED: NO DOCKET #
FACIL:50-331 Duane Arnold Energy Center, Iowa Electric Light & Pow 05000331
AUTH.NAME AUTHOR AFFILIATION
MCGAUGHY,R.W. Iowa Electric Light & Power Co.
RECIP.NAME RECIPIENT AFFILIATION
DENTON,H. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards response to NRC 830428 request for addl info re Mark I containment long-term program,NUTECH rept "Mark I Containment Ring Girder Modelling & Stress Evaluation Utilizing Eccentric Beams" encl.

DISTRIBUTION CODE: A025S COPIES RECEIVED:LTR 1 ENCL 40 SIZE: 6+41
TITLE: OR Submittal: USI A-7 Mark I Containment

NOTES:

	RECIPIENT ID CODE/NAME		COPIES LTTR	ENCL	RECIPIENT ID CODE/NAME		COPIES LTTR	ENCL
	NRR ORB2 BC	01	4	0				
INTERNAL:	EDO		1	0	ELD/HDS2	13	1	0
	NRR DIR		1	0	NRR SIEGEL,B		5	5
	NRR/DE/MEB		4	4	NRR/DE/MTEB		1	1
	~~NRR/DL/ORAB~~	10	1	1	NRR/DSI/CSB	11	1	1
	REG FILE	04	1	1	RGN3		1	1
EXTERNAL:	ACRS	12	10	3	LPDR	03	1	1
	NRC PDR	02	1	1	NSIC	05	1	1
	NTIS		1	1				

TOTAL NUMBER OF COPIES REQUIRED: LTTR 35 ENCL 21

Iowa Electric Light and Power Company

June 20, 1983
NG-83-2093

Mr. Harold Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Duane Arnold Energy Center
Docket No: 50-331
Op. License No: DPR-49
Response to NRC Request for Additional Information on the Mark I Containment Long-Term Program

Dear Mr. Denton:

This letter is submitted in response to Mr. Vassallo's letter of April 28, 1983 which requested additional information in regard to the Duane Arnold Energy Center Plant Unique Analysis Report (DAEC PUAR).

Attachment 1 to this letter provides a response to each of the nine items for which additional information was requested. For convenience, the information is provided in a question and answer format in which the item is repeated, followed by Iowa Electric's response.

Attachment 2 to this letter consists of NUTECH Report MKI-03-008, "Mark I Containment Ring Girder Modelling and Stress Evaluation Utilizing Eccentric Beams", dated April 1980. This report is referenced in response to Item 8 of Attachment 1.

Volume 6 of the DAEC PUAR will be submitted on or before June 30, 1983. Included with that response will be minor corrections which have been identified for the first five volumes of the PUAR.

Please contact this office if there are questions concerning this response.

Very truly yours,

R.W. McGaughy

Richard W. McGaughy
Manager, Nuclear Division

RWM/BWR/dmh*
Attachments

cc: B. Reid
L. Liu
S. Tuthill
F. Apicella
NRC Resident Office
Commitment Control No. 83-0144

A025
1/40

ATTACHMENT 1

REQUEST FOR ADDITIONAL INFORMATION
DUANE ARNOLD ENERGY CENTER
MARK I CONTAINMENT PLANT UNIQUE ANALYSIS REPORT (PUAR)

Item 1: Provide a summary of the analysis with regard to the vacuum breaker piping systems and the vacuum breaker valves; indicate whether they are considered Class 2 components as required by the criteria (1).

Response: There are three different types of vacuum breaker systems:

a) The containment-to-atmosphere vacuum breakers are connected to torus attached piping, which is evaluated as Class 2 piping. This evaluation will be contained in Volume 6 of the DAEC PUAR, scheduled for release to the NRC by June 30, 1983.

b) Operability of the wetwell-to-drywell vacuum breakers is being addressed in a separate program and modifications to these vacuum breakers are scheduled to be installed during the Cycle 8 refueling outage presently planned for the fall of 1984. Structural integrity of the wetwell-to-drywell vacuum breakers and their penetration connection to the vent header is discussed in Volume 3 of the DAEC PUAR.

c) The SRV discharge line vacuum breakers were evaluated along with the SRV discharge lines, which were evaluated as Class 2 piping. This piping evaluation is contained in Volume 5 of the DAEC PUAR.

Item 2: Provide a summary of the analysis of torus attached piping systems consisting of analytical models which represent piping and supports from torus to first rigid anchor (or where the effect of torus motion is insignificant), and classification of piping systems as essential or non-essential for each load combination. Also, indicate whether a response spectrum or time history analysis for dynamic effect of torus motion at the attachment points have been considered.

Response: A complete description of torus attached piping systems, including classification and the methods of analysis, will be included in Volume 6 of the DAEC PUAR. This volume is currently in preparation and is scheduled for submittal to the NRC by June 30, 1983.

Item 3: Provide a summary of the analysis with regard to the active containment system piping systems, piping systems which provide a drywell-to-wetwell pressure differential, and other internal piping systems.

Response: Analysis results of the active containment piping systems and any torus internal piping systems will be described in Volume 6 of the DAEC PUAR. All the Duane Arnold facility piping systems were analyzed assuming a zero drywell-to-wetwell pressure differential, which is a conservative assumption. Operation of piping systems with a pressure differential results in mitigation of the hydrodynamic loading effects. Iowa Electric is planning to implement removal of the existing pressure differential system as a part of long range modifications.

Item 4: Provide a list indicating whether all the piping systems and their supports have been classified as Class 2 or Class 3 piping, or essential or non-essential piping systems, and whether a pump or valve associated with the piping is an active or inactive component, and is considered operable.

Response: The lists of all piping systems evaluated, the classification of said piping systems, and the associated pump and valve evaluations will be included in Volume 6 of the DAEC PUAR.

Item 5: Indicate whether the fatigue usage factors for the SRV piping and the torus attached piping are sufficiently small that a plant-unique fatigue analysis is not warranted for piping. The NRC is expected to review the conclusions of a generic presentation (3) and determine whether it is sufficient for each plant-unique analysis to establish that the expected usage factors for piping are small enough to obviate a plant-unique fatigue analysis of the piping.

Response: As part of the preparation of the Mark I Owners Group response on torus attached and SRV discharge line piping fatigue, NUTECH performed evaluations on several of their client's piping systems. One of these was the core spray suction line for DAEC, a typical torus attached piping line for DAEC. The maximum usage factor calculated for this specific line using the Duane Arnold specific loads was 0.059. In addition, a safety relief valve discharge line from a plant similar to DAEC was evaluated and the maximum usage factor in this case was 0.307. These low usage factors are thus sufficiently small that a plant unique fatigue analysis is not required and the generic Mark I program piping fatigue evaluation (MPR-751) may be utilized.

Item 6: Tables 2-2.4-1 and 3-2.4-1 of Reference 2 indicate that the natural frequencies of the suppression chamber and the vent system are very close to each other for the first three modes. Provide more details of the calculation for the spring stiffness K_{SC} in Figure 3-2.4-1 and show that the coupling effects between the vent system and the suppression chamber have been properly accounted for in the analysis.

Response: From PUAR Table 2-2.4-1, predominant torus frequencies in the vertical direction are 16.33 Hz and 20.98 Hz as indicated by the weight participation for these two modes. Contribution of other modes to the overall response of the torus subjected to shell loads is comparatively small.

The vent system is supported by columns inside the torus at each miter, with these columns connecting to the ring beam (PUAR Figure 3-2.1-4). The vent system support columns are subjected to vertical motion at the miter when the torus is subjected to shell loads. The natural frequency of the torus subjected to loads applied vertically at the ring beam is very high (greater than 50 Hz) as the torus is relatively stiff vertically at the miter joints, due to the ring beam and saddles there. The natural frequency of the vent system in the vertical direction for the case with no water inside the downcomers (condensation oscillation load case) is about 32 Hz (PUAR Table 3-2.4-2 and Figure 3-2.4-5). Therefore, there is no significant dynamic coupling of the response between the torus and vent system, and the torus and vent system can be analyzed independently by decoupling the two structural components.

The torus support spring stiffness K_{SC} in PUAR Figure 3-2.4-1 was calculated using the torus 1/32 finite element shell model (PUAR Figure 2-2.4-1) by applying unit loads at the vent system column support points and computing the corresponding deflections. The stiffness calculated was applied only in the vertical direction and is quite large. The interaction effect of the torus motion on the vent system was included in the overall evaluation of the vent system.

Item 7: Table 2-2.5-3 of Reference 2 indicates that the calculated values of certain stresses are equal to the respective allowables. Indicate conservatisms in the analysis to show that these calculated values would not be exceeded if a different analytical approach were to be used.

Response: The development of event sequences, load definitions, analysis techniques, and assumptions included in the DAEC plant unique analysis are specifically formulated to provide a conservative evaluation. These conservatisms are described in PUAR Section 1-1.4 and are summarized below:

a) In the analyses of the torus due to LOCA and SRV loads, these loads are assumed to be smooth curves of regular or periodic shape. This simplifies load definitions and analyses but maximizes predicted responses. Data from full-scale tests show actual forcing functions to be much less "pure" than those assumed for analyses.

b) Response in PUAR Table 2-2.5-3 is calculated by treating a non-linear problem as a linear, elastic problem with the load "tuned" to the structural frequencies which produce maximum response. The non-linearities which exist in both the pool and structural dynamics would preclude the attainment of the elastic transient and steady-state response that are predicted through linear elastic mathematical solutions.

c) Damping is assumed to be low to maximize the response, but it is likely to be much higher in reality at higher stress levels.

d) Allowable stress levels are low compared to the expected material capabilities.

e) Conservative assumptions have been made in developing the combinations of loading phenomena to be evaluated. The peak responses due to various dynamic loads in a load combination are added absolutely. While this is not an impossible occurrence, the probability is very remote that the actual responses will combine in this fashion.

Thus, it can be concluded that the calculated stress values given in PUAR Table 2-2.5-3 are conservative and would not be exceeded if calculated by any other analytical approach.

Item 8: Provide justification and/or reasons for modeling the torus reinforcing ring as beam elements connected to the torus shell by offset rigid links. Also, discuss the conservatisms, if any, used in the above-mentioned approach in comparison to the modeling of the reinforcing ring as plate elements.

Response: The stresses in the ring beam and the welds at the junction of the ring beam and the suppression chamber shell can be computed just as accurately by modeling the ring beam with offset beam elements as by explicitly modeling the ring beam with plate elements. A study (Reference 8-1)[1] was performed to compare the offset beam element results for the ring beam with the explicit plate element modeling of the ring beam. It was concluded by this study that the stresses in the ring beam and welds connecting the ring beam to the shell can be predicted adequately by modeling the ring beam as offset beam elements.

Item 9: Provide a summary of the analysis of the reinforcing ring which has been analyzed separately for submerged structure loads.

[1] Reference 8-1: NUTECH Report MKI-03-008, "Mark I Containment Ring Girder Modelling and Stress Evaluation Utilizing Eccentric Beams," April 1980.

Response: The 1/32 torus shell finite element model (Figure 2-2.4-1 in PUAR) is used primarily to calculate the response of the torus components and supports due to the loads acting on torus shell. In this model, the ring beam is represented by a series of offset beam elements connected to the nodes on the torus shell by rigid links.

For the submerged structure loads due to LOCA and SRV acting directly on the ring beam, a detailed finite element model of the ring beam was made, including the saddle supports and the torus shell for a distance of one quarter bay on both sides of the ring beam. Equivalent static submerged structure loads on the submerged portion of the ring beam were calculated by using conservative dynamic load factors for each load. These loads are given in PUAR Tables 2-2.2-4, 2-2.2-6, and 2-2.2-8 through 2-2.2-10. The equivalent static loads are then applied to the detailed ring beam finite element model and analyzed statically to calculate stresses at the junction of the ring beam and torus.

The contribution to ring beam stresses and the stresses in the attachment weld of the ring beam to the torus shell due to the loads acting on the torus shell are calculated using the beam end forces and moments from the 1/32 model. Stresses at the centroid of the elements in the detailed finite element model are calculated from the forces and moments acting at the beam section. The total stresses in the ring beam and its attachment weld to the shell are then calculated by combining the effects of submerged structure loads and torus shell loads.