UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

MAY 28 1981

Mrs. Leo A. Drey
515 West Point Avenue
University City, MO 63130

Dear Mrs. Drey:

This is in final response to your letters of June 28, 1979, June 9, 1980, and June 23, 1980, regarding the embedded steel anchor plates at the Callaway Nuclear Power Plant. Previous NRC letters that were sent to you on this subject were dated October 30, 1979 and July 8, 1980. In addition, a copy of IE Report 50-483/80-14, dated September 16, 1980, was also sent to you. A final review of this matter by NRC Headquarters staff has now been completed. While that review was underway the Atomic Safety and Licensing Board for the OL proceeding issued a Special Prehearing Conference Order (dated April 21, 1981). That Order outlines the petitions submitted, defines the intervenors and describes the contentions that have been admitted for the hearing. Joint Intervenors' Contention 1A stating that, "inadequate and incomp'ete inspection and testing on embedded plates were performed during the plant's construction" has been admitted. This contention will assure Board review of the resolution of the matter of embedded plates.

This reply will provide you with the staff position on this issue. While preparing this response and the specific items in the enclosure, a review was made of the various questions and concerns that you had expressed in the past related to the embedded steel anchor plates that may not have been specifically addressed. These items are listed and a response or the reference to a document you have received previously is provided.

We hope that this information will satisfactorily answer your questions and concerns. We are of the opinion that the questions and concerns related to the concrete embeds installed prior to June 1977 at the Callaway facility have now been resolved to the satisfaction of the staff.

Sincerely,

Victor Stello, Jr., Director
Office of Inspection and Enforcement

Enclosure:
Specific Responses

Enclosure

SPECIFIC RESPONSES

Q1. Isn't it possible that some anchor plates embedded prior to June 1977 are defective?

A1. Yes. It was NRC's continuing concern about the integrity of the anchor plates embedded prior to June 1977 that caused the initiation of the random in-place test and representative test programs that were reported in IE Inspection Report 50-483/80-14, dated September 16, 1980 (see 3rd paragraph on page 6). Considering the small number of defective embeds detected by the re-inspection and testing effort, the NRC has concluded that an equal proportion of defects in installed plates would be well within the tolerance limits of the system design and no more special efforts are required for the installed plates.

Q2. Is it possible to find and replace defective anchor embedments already installed into the concrete?

A2. The use of a visual examination is precluded when embedments such as these in question have, in fact, had the concrete placed around them, unless destruction of the surrounding concrete and reinforcing steel matrix is accomplished. No nondestructive techniques we are aware of could, in this instance, be utilized to provide meaningful results. Therefore, in this case, the first action we deemed necessary was an examination of anchors not already embedded. We concluded that the data obtained in July and August 1977, supplemented by some later information on embeds not yet cast in concrete, could be considered representative of those anchors already embedded. Consequently, a destructive program would become necessary only after it was evident that the failure rates in the ability to carry and respond satisfactorily under load were too high in a similar and representative sample. With high failure rates, it would become necessary to execute extensive load tests or complete the removal of concrete to obtain samples on which to base a conclusion. Although removal of concrete and replacement of embedments is possible, it is a difficult task and requires close control and consideration of the potential for additional damage. In the past, NRC has required the removal of some very complex concrete structural components consisting of many cubic yards of concrete. This situation was certainly not precluded in this case.

Q3. What assurance is there that anchor embeds not already cast into concrete are representative of those already embedded?

A3. From the records available revealing that the anchor embeds had been fabricated, inspected, released, and accepted under the same specifications, contract, and work procedures with the only variable being the time the work was completed, we concluded that those units not yet embedded were representative of those already embedded.

Q4. With regard to the results of inspections performed on manually welded anchor rods for embeds, did the NRC believe Daniel or Bechtel?

A4. The reinspection performed by a team of inspectors consisting of personnel from Daniel, Bechtel, and Union Electric Company, in order to identify the cause for the original rejections made by Daniel, was accepted by the NRC as representing the facts. The findings were discussed in IE Inspection Report 50-483/80-14, dated September 16, 1980 (see pages 8 and 9).

Q5. Compare ASME, AWS and Union Electric criteria on weld undersize for accepting manual welding of anchor rods for anchor embeds.

A5. As noted in the March 10, 1978 letter from Union Electric to which you referred, the ASME Code does not apply to this type of safety-related component. In referring to the ASME Code, the licensee was addressing the ASME Boiler and Pressure Vessel Code, Section III, Division 1 which addresses Class 1, 2 & 3 components, metal containments, component supports and core support structures. These components do not include general structural framing supports, of which these manually welded anchor embeds consisted.

The comparisons of AWS and Union Electric criteria were provided in IE Report 50-483/80-14, dated September 16, 1980 (see page 7). NRC accepted the criteria used by Union Electric.

Q6. What is the applicability of AWS D.1.1-75 for machine stud welding?

A6. As noted in Answers to Questions 6 and 7 of Attachment B, IE Inspection Report 50-483/80-14, dated September 16, 1980, the above standard was intended for application to machine stud welding and acceptance testing.

Q7. Are the requirements for the acceptance of machine stud welding on bridges more stringent than those applied to nuclear power plants?

A7. The following comments are based on a comparison of specifications of the American Welding Society (AWS D.1.1-75) and the American Association of State Highway and Transportation Officials (AASHTO Interim Bridge Specifications for 1975). These listed items constitute the primary differences.

a. AASHTO allows welding when base metal is below 0°F but requires preheating to 70°F and maintaining the base metal above 32°F during stud welding. Two additional 45° angle bend tests are required per 100 studs.

AWS allows no welding when the base metal is below 0°F and imposes additional inspection/test requirements when the base metal is below 32°F.

b. AASHTO requires the contractor to submit the following information to the engineer for approval:

(1) name of manufacturer,

(2) detailed description of the stud and arc shield,

(3) certification from the manufacturer that the stud has met AASHTO qualification tests, and

(4) notarized copy of the qualification test report as certified by the testing laboratory.

The purpose of the qualification testing is to prescribe weldability and strength tests for a given type, size, and arc shield. If all factors that could affect stud performance remain unchanged, such initial qualification tests remain valid.

AWS does not require qualification testing, unless requested by the engineer. Such a request would typically be done in the written specification. The number of tests to be performed is left to the engineer to specify.

c. AASHTO production acceptance inspection for the first two studs on a beam requires bending to 45°, whereas AWS requires only a 30° bend.

d. AASHTO, as you indicated, requires that "each stud shall be given a light blow with a hammer" and "any stud which does not emit a ringing sound when given a light blow with a hammer,... shall be struck with a hammer and bent 15° from the correct axis of installation. Studs that crack either in the weld or in the shank shall be replaced."

In summary it can be stated that there are only minor differences between the AASHTO Standard Specification for Highway Bridges and the AWS Structural Welding Code and that the AASHTO specification is a bit more stingent, undoubtedly because of the need for fatigue life. The two specifications/codes are intended for different types of structures which undergo distinct service conditions. Fatigue is a major concern in the use of studs in composite bridge design as a result of the many load repetitions a bridge receives as opposed to a building structure. It is NRC's position that the requirements placed on a licensee (in conjunction with use of the AWS Code) that include operator training and qualification, quality control, inspection, and correction of identified deficiencies are more than adequate to assure the proper level of safety.

Q8. Will manually welded anchor rods with undersized welds be able to withstand the maximum design load, vibration, and durability requirements?

A8. The analytical calculations completed by the licensee as reported in IE Inspection Report 50-483/80-14, dated September 16, 1980 (see page 8), as well as the additional testing requested by NRC (see page 9 of the above-referenced report), demonstrate quite clearly that the maximum design load can be met. The load-strain curves that reflect the behavior of the six specimens cut from actual anchor embeds clearly illustrate a ductile behavior under load that provides the energy-absorbing capability for response to dynamic loading. Vibratory loads with respect to fatigue-related problems are not considered to be of sufficiently high numbers of

repetitions for these embedded elements to be of significance. Durability is not a major problem with these anchors since the backs of the embedded plate, the weld and the anchor rods are embedded in concrete and are not subjected to an adverse environment.

Q9. Have specifications changed to meet the deviations which were found?

A9. As noted in IE Inspection Report 50-483/80-14, dated September 16, 1980 (see page 7), certain revisions were made by the licensee as Revision 9 to Specification C-131. We do not know the motive for the change, but we have established the technical validity of the revision as noted in the response to Question 8 herein.

Q10. A dangerous percentage of the manual and machine made welds are defective.

A10. During the reinspection of over 81,500 machine-welded studs on 7543 anchor embedments not yet installed, only 0.08% of the studs failed the bend test. It was also found that 0.13% of the anchor embedments had more than one stud failing during the bend test. Testing a sample of 2.5% of the embedded anchors with machine-welded studs to design loads resulted in no signs of distress or indications of inadequacies. There was no evidence to suggest a difference in the frequency of studs failing the bend test on anchors that were embedded or on those anchors that were not embedded in concrete. Our conclusion is that the failure rate to bend tests on individual machine-welded studs was low and would not cause technical questions related to the functioning of an individual anchor as shown by the in-place testing program.

We determined that 10% of the manually welded anchorage rods remained in question and required further study. The further study included actual testing of individual welds of the anchor rod to the embed plate that were cut from the group of anchor embeds that had been on hold since August of 1977. The welds sustained the ultimate failure loads of the base material. Analysis of the weld deficiencies also indicated that the embedments as built would sustain the design loads. There was no evidence to conclude that manually welded anchorage rod to anchor embeds already cast in concrete in June 1977 contained any different or more frequent weld deficiencies than the group examined and tested.

Our conclusion is that there is no danger in the manual or machine-made welds in the anchors embedment cast into concrete prior to June 1977.

Q11. Does Bechtel have a lack of faith in the ability of Daniel inspectors in areas other than the inspection of manually welded anchor rods?

A11. In this case, the Daniel inspectors were being more cautious than necessary, so the problem they identified was brought to the attention of the licensee who in turn obtained the design expertise of the engineering disciplines who resolved any safety questions to the satisfaction of the NRC. We are unaware of any Bechtel concerns; however, we are certain that if there were concerns, Bechtel would report them under 10 CFR 21.

Q12. Who bears the burden of proof regarding safety at the OL proceedings?

A12. As defined in the NRC regulations, the burden of proof rests with the licensee.

Thornburg - Action

FROM:	Rep. Richard A. Gephardt
TO:	Victor Stello

ACTION CONTROL	DATES
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ACKNOWLEDGMENT	7/16/80
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FINAL REPLY	

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DATE OF DOCUMENT 6/25/80

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DESCRIPTION ☐ LETTER ☐ MEMO ☐ REPORT ☐ OTHER

Ltr from Kay Drey concerning embedded plates with faulty stud welds installed at the Callaway plant - req status of review of the situation and any final determinations

SPECIAL INSTRUCTIONS OR REMARKS

EDO-6772

Provide close-out package to Beth Matosko/L. Underwood for dispatch.

H. Thornburg

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COMMENTS, NOTIFY:
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JCAE NOTIFICATION RECOMMENDED: ☐ YES ☐ NO

NRC FORM 232
(11-75)

EXECUTIVE DIRECTOR FOR OPERATIONS

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Rec'd noted

Send acknowledgment saying that we'd be happy to provide the requested information.

HDT

Rec'd 7/8/80

Action: 3-54260

RICHARD A. GEPHARDT
3d District, Missouri
WAYS AND MEANS COMMITTEE
BUDGET COMMITTEE

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June 25, 1980

Mr. Victor Stello, Jr., Director
Office of Inspection and Enforcement
Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Stello:

Recently, you received a request from Mrs. Leo Drey of St. Louis, Missouri, requesting the status of a technical review of the Callaway Nuclear Power Plant, now under construction in Missouri, with regard to fixtures installed in the concrete walls known as embeds.

You had indicated to Mrs. Drey that this review had been rescheduled. Therefore, I am writing to request that you provide me with any further information you might have with regard to your review of this situation and any final determinations you have made.

Thank you for your attention to this matter.

Yours very truly,

Dick Gephardt

Richard A. Gephardt

RAG:fof

DUPE OF 7810220310

University City, MO 63130
June 9, 1980

Mr. Victor Stello, Jr., Director
Office of Inspection and Enforcement
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Stello:

Three years ago today an NRC inspector auditing construction records at the Callaway plant here in Missouri noticed that embedded plates with faulty stud welds had been installed. By that time approximately five percent of the plant construction had been completed, and an estimated 400 embeds had been installed. To quote from page one of the St. Louis Post-Dispatch, October 16, 1977:

> "The most serious complaints, (Nuclear Regulatory) commission officials indicated, involve the fixtures installed in concrete walls to support the ends of load-bearing steel beams. The fixtures — termed 'embeds' because they are embedded in reinforced concrete — are steel plates with short steel studs welded to one face, like the bristles of a brush. They are mounted flush with wall surfaces, with the studs (or bristles) extending into the concrete so that their exposed faces can serve as points of attachment for girders and other structural members. Should an embed tear loose from a wall, the result could be the collapse of an entire floor or roof, construction experts say."

On June 28, 1979, shortly after you became the director of the Office of Inspection and Enforcement, and three hectic months after the Three Mile Island accident began, I wrote to ask you about the embeds. You answered on October 30 as follows:

> "With regard to the steel embeds at Callaway we have no new information to forward to you on the matter until a technical review is completed by the staff. Priorities on other work have prevented the completion of the review. The review has again been rescheduled and we hope to complete the project in the near future. We will then respond to your concerns."

I am writing today, seven months later, to ask for the status of that review, and to state once again the concern many of us here share about the embeds:

— If the embedded plates shipped in 1976 to the Callaway site from the Cives Steel Company (Gouverneur, New York: Purchase Order # 10466-C-131-2) were in one big "pile" when construction began; and

— If hundreds of embeds from that pile were installed prior to June 9, 1977, the day an NRC inspector found records indicating that faulty plates had already been installed, and the day Union Electric then issued orders to stop installing additional plates; and

— If, as the result of several months of special inspections that summer, hundreds of embeds were repaired on site and hundreds more were shipped back to Cives for repair or replacement;

— DOES IT NOT FOLLOW that some of the embeds installed prior to June 9, 1977, may also contain faulty stud welds?

That is, steel embeds fabricated at the same time and place as those found defective are still in the walls of the lower levels at Callaway, supposedly supporting whole floor systems and other critical structural members. Of particular concern are those plates on which the studs were welded mechanically — that is, in the faster, more economical way

3. When the Operating License proceedings for the Callaway plant are held, will the burden of proof that the embeds were fabricated and installed as designed lie with Union Electric, Bechtel/SNUFPS, Daniel International, or the NRC?

Three years of construction are now resting on embeds whose safety has been questioned. Will the questions be resolved only after the plant has been put into operation and the embeds thereby subjected to the resulting vibratory stresses?

Sincerely,

Kay Drey

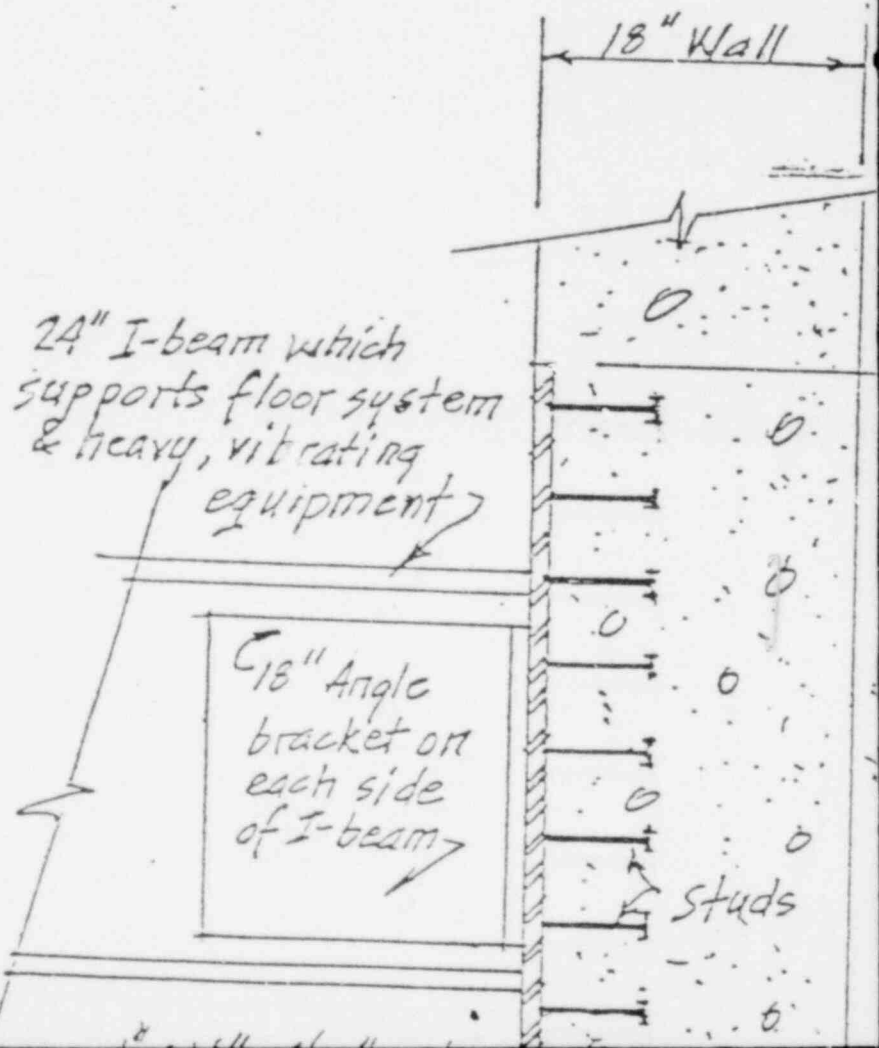
Mrs. Leo Drey (Kay)

cc: Dr. John Ahearne, Acting Chairman, and Members, Nuclear Regulatory Commission
Atomic Safety and Licensing Board, NRC
Advisory Committee on Reactor Safeguards, NRC
Governor Joseph Teasdale
Senator Thomas Eagleton
Senator John Danforth
Congressman William Clay
Congressman Richard Gephardt
Congressman Harold Volkmer
Congressman Robert Young
Mr. James Keppler, Director, Region III, NRC

The average size of a steel embed at Callaway is 14" wide, 4 feet long, and one inch thick — with two rows of studs, ten in each row.

A stud weld should be strong enough to survive being thrown from an airplane. Traditionally ironworkers hammer-test every stud weld, and reweld every defective one. If the welds are not repairable, the plate is rejected.

On many embeds at Callaway 15% of the welds were defective; on some embeds, 85%. Some studs broke off when merely kicked. Others fell off without apparent cause, such as from a 7 ft. high embed that was being installed in February or March 1977 as part of a door frame



etween the Control and Auxiliary
uildings. Ironworker Foreman
ill Smart reported the defective
mbed to Roger Benton, his immedi-
te superintendent. Several days
ater Benton told Smart that he,
enton, had been directed by Andy
ennedy, a top Daniel official, to
ave Smart advise his men to handle
e embeds more carefully in the
uture so that more studs would not
ll off!