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February 5, 1980

Mr. Karl V. Seyfrit, Director
U.S. Nuclear Regulatory Commission
Office of Inspection and Enforcement
Region IV
611 Ryan Plaza Drive
Suite 1000
Arlington, Texas 76011

Subject: IE Bulletin No. 79-02 "Pipe Support Base Plate
Designs Using Concrete Expansion Anchor Bolts"

Reference: 1) Letter from J. Pilant to K. Seyfrit
Dated December 10, 1979, Same Subject

Dear Mr. Seyfrit:

Revision 2 to the subject bulletin required a factor of safety of five for shell type anchors when subjected to maximum support loadings including the SSE condition. As submitted in Reference 1, the original design criterion for Class IS pipe hangers and supports at Cooper Nuclear Station was a factor of safety of five for loading conditions including the OBE, which corresponds to a factor of safety of approximately 2.5 for the SSE. The impact of this major clarification in Revision 2 has been discussed at length with the staff, and as a result the following information is submitted per the staff's request.

Request

Submit a schedule of the efforts to be accomplished in order to obtain a factor of safety of 5 for loading conditions including the effects of SSE.

Response

1. Torque verification of all expansion anchors on supports for 2-1/2" diameter and larger piping has been completed with satisfactory results (less than .4% defective in approximately 5600 anchor bolts tested). All bolts reported as unacceptable were immediately replaced with properly torqued wedge anchors as manufactured by ITT Phillips Drill Division.
2. All Class IS hangers and supports supporting lines 2-1/2" and larger are currently being further inspected for additional assurance of parameters added in Revision 1 of the subject bulletin. Further inspection involves removal of each anchor bolt and a check for:

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embedment depth, thread engagement, plate hole size, bolt spacing, edge of concrete member, and full expansion of the concrete anchor. This inspection is approximately 95% complete and is being done in conjunction with hanger modifications identified to date. Anticipated completion is during the refueling outage commencing March 15, 1980.

3. Analytical work has been completed and recommended fixes for supports with factors of safety less than five for the loading conditions including the OBE have been proposed. (This amounted to approximately 134 of the 1642 hangers reviewed which fell into the subject bulletin category.) Approximately 80% of those hangers identified as having a marginal factor of safety have now been modified. The remainder are expected to be completed during the outage commencing March 15, 1980.
4. During the March 15, 1980 outage all inaccessible supports found to be below a factor of safety of five for shell and/or 4 for wedge type anchors for loading conditions including the SSE will be reviewed and/or modified as necessary.
5. After the upcoming refueling outage, review and/or modification will commence for accessible supports found to be below a factor of safety of five for loading conditions including the SSE.

Under this analytical review the architect-engineer for CNS has proposed to extend its evaluation to incorporate the following additional criteria:

- A) Development of increased ultimate capacity of the expansion anchor's permissible loading due to actual concrete strength present (i.e., $f'c = 3500$ psi original vs. 5000 psi from statistical review of actual 90-day concrete cylinder breaks for various building areas).
- B) Utilization of the combination of spatial components for seismic loads as described in Reg. Guide 1.92, Dec. '74, Par. C.3, for loading conditions including the SSE. (Under the loading condition for OBE this approach was not used. Each spatial seismic component was applied simultaneously.)
- C) Utilization of an elliptical tension shear interaction formula developed by fitting a curve to previously published test data. This curve utilizes the tension and shear ratios raised to the $4/3$ power and set equal to 1.

The architect-engineer for CNS estimates that at least 90-95% of the supports will meet a factor of safety of five or greater when loading conditions including the SSE are established and after the required fixes for OBE loadings are completed. Of the 5 to 10% remaining, the minimum factor of safety is approximated to be 3.5 or greater for SSE loading conditions.

A minimum factor of safety of 3.5 is considered more than adequate to ensure the safe shutdown capability of CNS since all anchor bolt installation parameters will have been verified; however, these supports will be investigated and/or modified as necessary based upon combinations of the following considerations:

- A) Supports with the lowest factor of safety will be modified first.
- B) At least one redundant loop of all essential systems will be initially modified to upgrade its factor of safety to an acceptable level.
- C) The benefit gained in elevating the factor of safety versus the radiation dose incurred to personnel will be considered.

From a safety standpoint it is inadvisable to modify numerous supports on an operating system simultaneously; therefore, increasing the number of crews performing the modifications is not beneficial. There are, and have been since May 1979, 10 to 15 people performing piping support modifications at CNS on an overtime basis.

It must be recognized that because of confined pipe spacing, modifications to supports in an operating plant take a considerable number of iterations between the station staff and the architect-engineer performing the analytical work. These interactions occur due to unforeseen interference problems, work space problems, temporary support conditions, etc. Modifications to one support may take on the order of weeks. This additional time required is compounded by the finite number of stress analysts in the industry and the concurrent intensive analytical effort being performed under IE Bulletin 79-14.

Request

Regarding the epoxy used for the installation of anchors at CNS:

- a) what type epoxy was utilized
- b) where and how was it used
- c) did procedures govern the installation practices
- d) is any test data available on its use

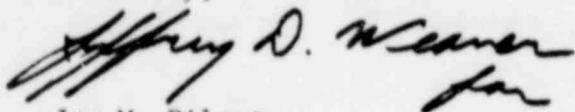
Response

The Phillips "S" type anchors at CNS were installed with an epoxy adhesive; Colma-Dur Bonding Compound as manufactured by the Sika Chemical Corporation. The installation was done in accordance with the contractor's procedure JP-1007 Rev. 2 (approved by the architect-engineer) which required the shell (with plug inserted) to be dipped into the adhesive prior to installation into the previously drilled hole. The adhesive was utilized specifically to reduce the possibility of loosening of the expansion anchors under cyclic or vibratory loadings. As an additional benefit, approximately 5% increase in ultimate strength (based on similar installations) is gained; however, no additional credit for this benefit was taken in the analytical calculations of the required factor of safety. No specific testing of the epoxy has been performed; however, several Phillips "S" type anchors have been replaced with larger wedge type anchors to comply with the required factors of safety and during the replacement process our field experience indicates that the epoxy is of definite benefit.

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If you have any questions regarding this response, please contact me.

Sincerely,

A handwritten signature in cursive script that reads "Jeffrey D. Weaver". The signature is written in dark ink and is positioned above the typed name of the signatory.

Jay M. Pilant
Director of Licensing
and Quality Assurance

JDW/cmk