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Mr. Vincent S. Noonan, Project Director
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U. S. Nuclear Regulatory Commission
Washington, DC 20555

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
Response to Request for Additional Information
Regarding Paluel Vibration Problem
FSAR Question No. 492.6N, 492.7N and 492.8N

Dear Mr. Noonan:

Houston Lighting & Power Company (HL&P) has received and reviewed your request for additional information (subsequently assigned FSAR Question numbers 492.6N, 492.7N and 492.8N) regarding the recent problem at the Paluel Nuclear Power Station in France dealing with apparent vibration affecting the bottom mounted instrumentation (BMI) inside the reactor vessel. The request was made based upon the fact that there is similarity between the Paluel plant and STP. The attached drawings (Attachment 2) describe the similarity of design for the bottom mounted instrumentation on Paluel, Doel, Tihange and STP Units 1 and 2.

Attachment 1 is our response to the subject questions.

To summarize the attached response, HL&P does not attribute the failure of the Paluel BMI thimbles to the vibration of the 14 foot core but to the use of a more flexible BMI thimble and changes to thimble guide tube configuration. Furthermore, HL&P does not believe that there is a safety concern with STP's reactor internals design and considers the current vessel model flow test to be valid for its intended purpose.

HL&P has investigated the vibration issue and has come to the conclusion that utilizing the heavier walled thimble and reducing the gap around the thimble will result in eliminating excessive thimble vibration. Consequently, HL&P has decided to modify STP Unit 1 such that the BMI column gap size is similar to that of STP Unit 2 (refer to the attached figures in Attachment 2).

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If you should have any questions concerning this matter, please contact Mr. Michael E. Powell at (713) 993-1328.

Very truly yours,

J. H. Goldberg
Group Vice President, Nuclear

CAA/yd

Attachments: Response to RAI Regarding
Paluel Vibration Problem

L1/NRC/ls

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The subject letter presents the NRC staff's background information on the bottom mounted instrumentation (BMI) thimble wear problems that have been experienced at Framatome 14 foot core plants. As a result of this situation the NRC staff has asked that the STP address three specific questions to determine the potential for similar problems and to determine the safety significance of these issues. Before delineating the responses to these questions, it is appropriate to clarify the differences between the Westinghouse and Framatome designs.

Background

It is stated in the Commission's letter that vibration below the fuel assemblies in the lower portion of the reactor vessel is damaging the movable incore instrumentation probe thimbles. These thimbles are inserted through the penetrations in the bottom of the vessel and then they pass through the secondary core support structure. The item that is vibrating is the thimble itself and not the secondary core support structure. It should be noted that Framatome uses a smaller diameter and smaller wall thickness (more flexible) thimble tube than does Westinghouse and preliminary testing indicates that the Westinghouse thimble is less susceptible to vibration than is the Framatome design. This is discussed in greater detail below.

It is also stated in the Commission's letter that "EdF believes this unexpected vibration is due to a design change that...reduced the void (lower plenum) at the bottom of the reactor vessel...thereby creating coolant turbulence". Note that while it is true that the length of the fuel assembly was increased from 12 to 14 feet in both the Westinghouse and Framatome designs, it is not true that the void in the bottom of the reactor vessel was reduced to accomplish this change. The void is the same in 14 foot core plants as it is in existing 12 foot core plants.

The added fuel length was accommodated by removing the lower core plate, upon which the fuel rests in 12 foot core plants, and supporting the fuel directly on the lower support plate. This support plate is present in both the 14 foot core and 12 foot core plants and it forms the upper boundary of the "void" at the bottom of the vessel. The support plate is mounted in the same location in both types of cores. Refer to Figure 1 in Attachment 2. Since the plenum geometry is unchanged, the turbulence of the flow in the lower plenum is essentially identical between 14 and 12 foot core plants. It should also be noted that the BMI thimbles are protected from the turbulent flow in this region by the secondary core support columns through which these thimbles pass.

A more plausible cause for the vibration phenomenon is the reduction in thimble diameter that is used on the French plants coupled with increased flow through the annular gap between the outside diameter (o.d.) of the thimble and the inside diameter (i.d.) of the thimble's guide path. This axial flow velocity is determined primarily by the hydraulic frictional resistance and the pressure drop across the guide path.

Additional relevant background information that recently became known includes the following:

> Two 3 loop 14 foot core plants which were supplied by Westinghouse are in operation in Europe (DOEL 4/TIHANGE 3). Both the Framatome and the Westinghouse thimble tubes have been used in the DOEL 4 plant. Whereas wear was observed after a relatively short period of time when the Framatome thimbles were used, no wear was observed when the Westinghouse thimbles were used for a similar period of time. Furthermore, the TIHANGE 3 plant has Westinghouse thimbles and when the plant recently had to shut down for a unrelated reason, the utility took advantage of that time to perform an eddy current inspection of the thimbles. That inspection also showed no measurable wear.

Question 1 (FSAR Question 492.6N)

Do you attribute the vibrational problems at the Paluel Station to the 14 foot core design?

Response

> Based on our review of the available information and the operational experience of other Westinghouse 14 foot core plants, we do not believe that the 14 foot core change is responsible for the problems at Paluel. The evidence to date indicates that the use of structurally more flexible thimble tubes in conjunction with the larger flow area around the tubes are the primary causes of the problems at that plant.
>
> For 14 foot core plants the lower support plate has a larger number of smaller diameter flow holes than the plate for 12 foot core plants to allow flow up through the fuel. This results in a larger axial pressure gradient across the lower support plate. Thus the axial flow velocity in the annulus between the thimble and its guide structure increases. This may accentuate the potential for experiencing problems of this nature, particularly when the thimble size is reduced.

Westinghouse and STP are closely monitoring the results of the test programs at EdF and Framatome in order to ensure that STP is not adversely affected by similar problems. In addition, Westinghouse is also closely following the performance of the Westinghouse 14 foot core plants that are in operation.

Question 2 (FSAR Question 492.7N)

Do you feel the same vibrational problems are possible at STP? If you do, then quantify the safety impact of such a problem. If you do not, then explain any design differences between STP and Paluel that lead to this conclusion.

Response

As was previously noted, the vibrational problem experienced at Paluel is the vibration of the BMI thimble, not vibration of the reactor vessel lower internals. The South Texas Units 1 & 2 use a flux thimble with a nominal outside diameter of .313". The Paluel units (1, 2, 3, & 4) are using a thimble with an outside diameter of .295". The South Texas thimbles also have a slightly thicker wall than the Paluel thimbles. The larger thimble also results in a smaller annular gap between the flux thimble and the inside of the BMI columns. In conclusion, the stiffer South Texas thimbles, with the smaller gaps, will perform satisfactorily based on the European plant experience to date.

With respect to the safety aspects of a thimble wear problem if it were to occur, we do not believe the issue to be a safety concern. Previous evaluations have been made by Westinghouse regarding the failure of flux thimble tubes. The evaluation concluded that up to three (3) BMI thimble tubes can fail simultaneously with a complete instantaneous guillotine break, and the coolant loss can be made-up by the output of the on-line charging pump. Since the coolant loss would not exceed the make-up capability of normal charging, no SI (safety injection) signal is generated. The occurrence of a thimble tube leak would be identified by the detectors in the seal table room.

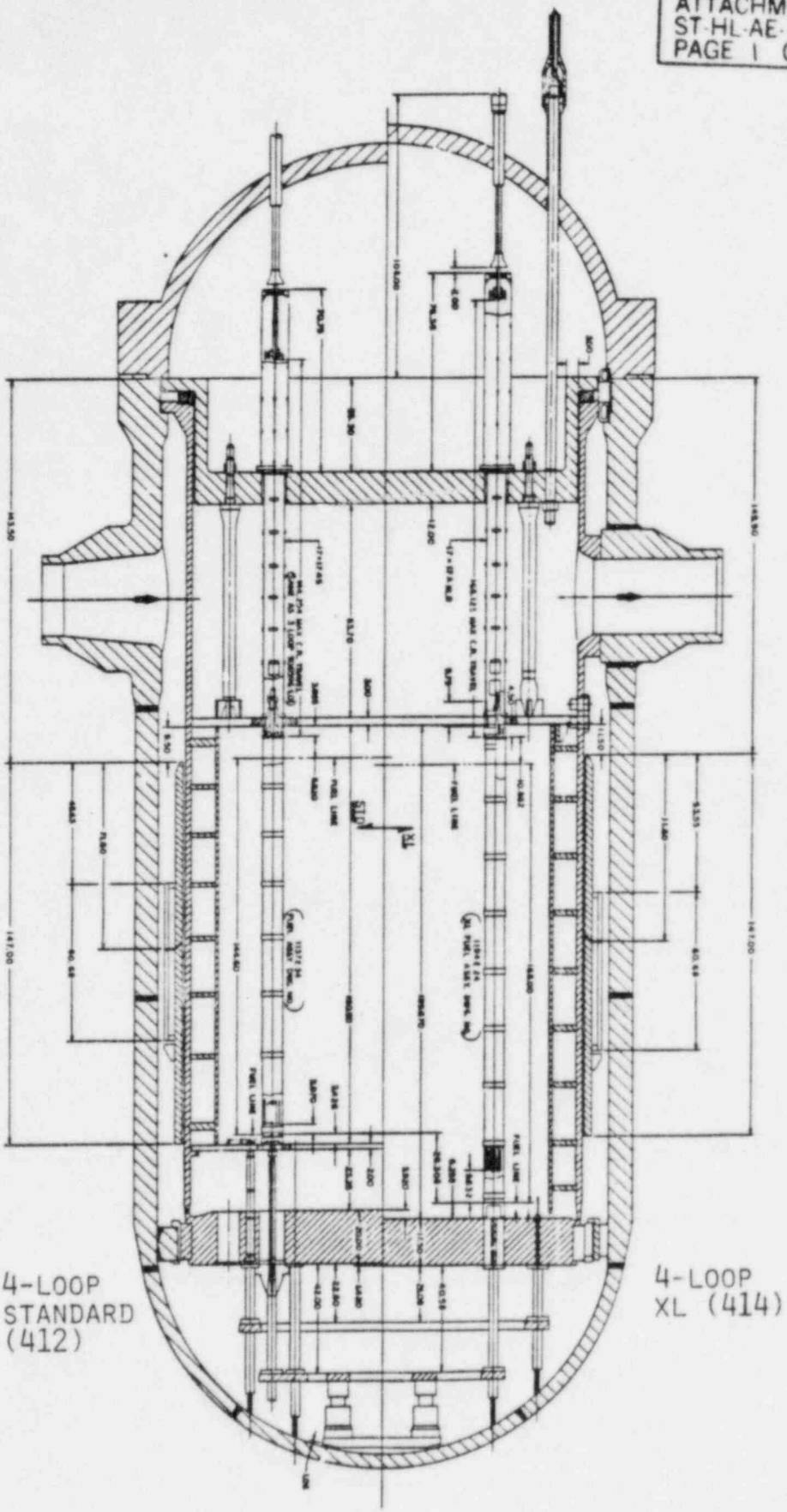
It should be pointed-out that the assumption of three tubes rupturing at the same time is highly conservative. As noted above, even if the tubes ruptured, the plant would easily be able to complete a controlled shutdown so that the leaking thimble could be either isolated or replaced.

Question 3 (FSAR Question 492.8N)

In light of the Paluel experience, do you still believe that the vessel model flow test which you submitted in your FSAR is still valid?

Response

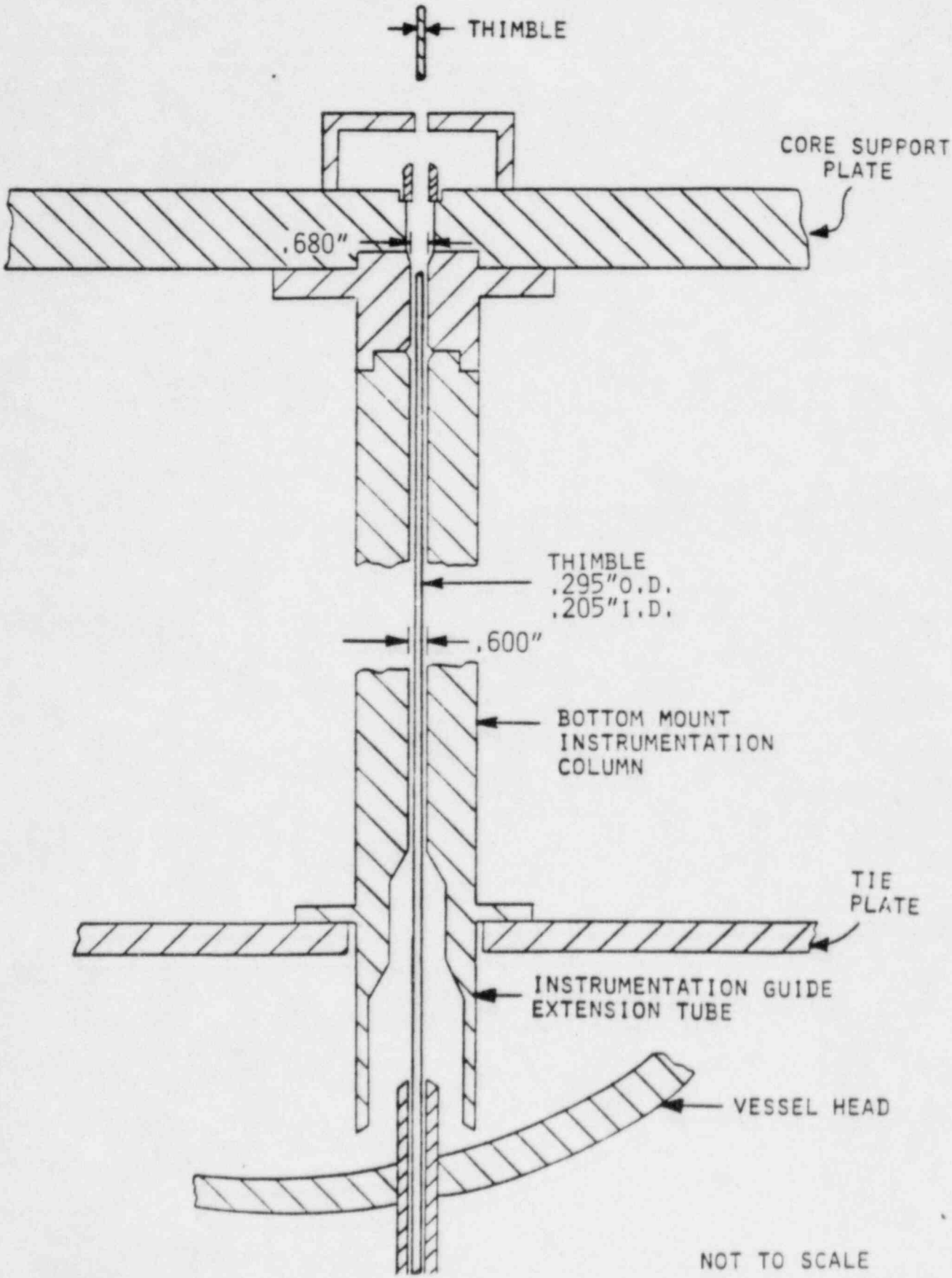
The purpose of the vessel model flow test is to demonstrate the structural integrity of the reactor vessel system and to provide data regarding the response of the reactor internals during operation. The BMI thimbles were not included in the vessel model flow test. Westinghouse has shown that these model tests are accurate and reliable predictors of plant performance and that these objectives were met. The vibratory levels of the reactor internals have been shown to be negligible and the response of the internals is well behaved. As has been previously discussed, the issue here is vibration of the removable thimble tubes, not vibration of the reactor internals. Hence, the vessel model flow test is still valid. Please note that this issue was discussed by Westinghouse at the MEB review on the STP and Westinghouse has provided a vibration assessment report, WCAP-10865, which demonstrates the acceptability of the vibration levels of the STP units.



DESIGN DIFFERENCES BETWEEN 4-XL AND 4-LOOP STANDARD (412) LOWER INTERNALS

FIGURE 1

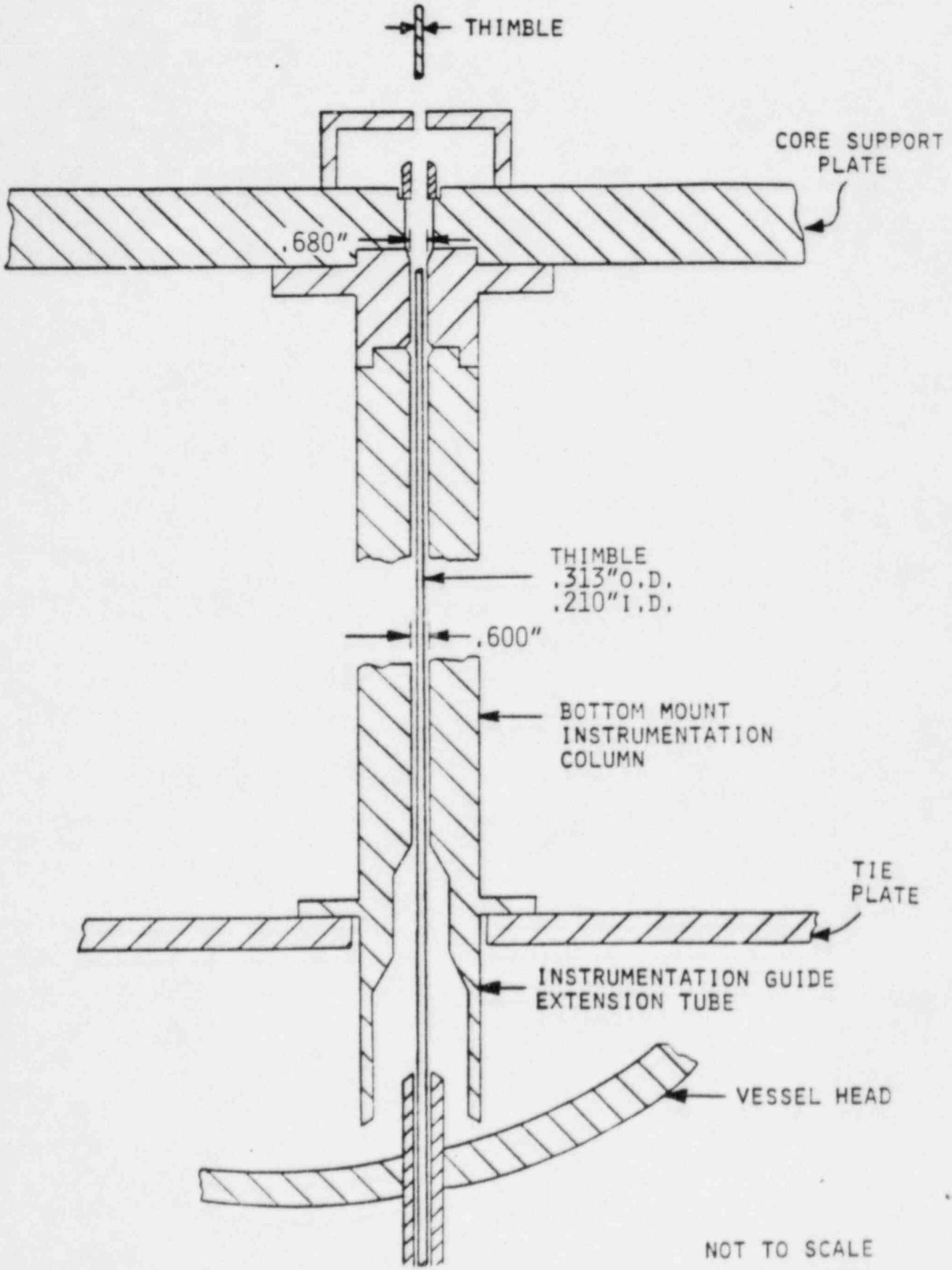
PALUEL



NOT TO SCALE

FIGURE 2

SOUTH TEXAS UNIT 1 TGX



NOT TO SCALE

FIGURE 3

SOUTH TEXAS UNIT 2 THX

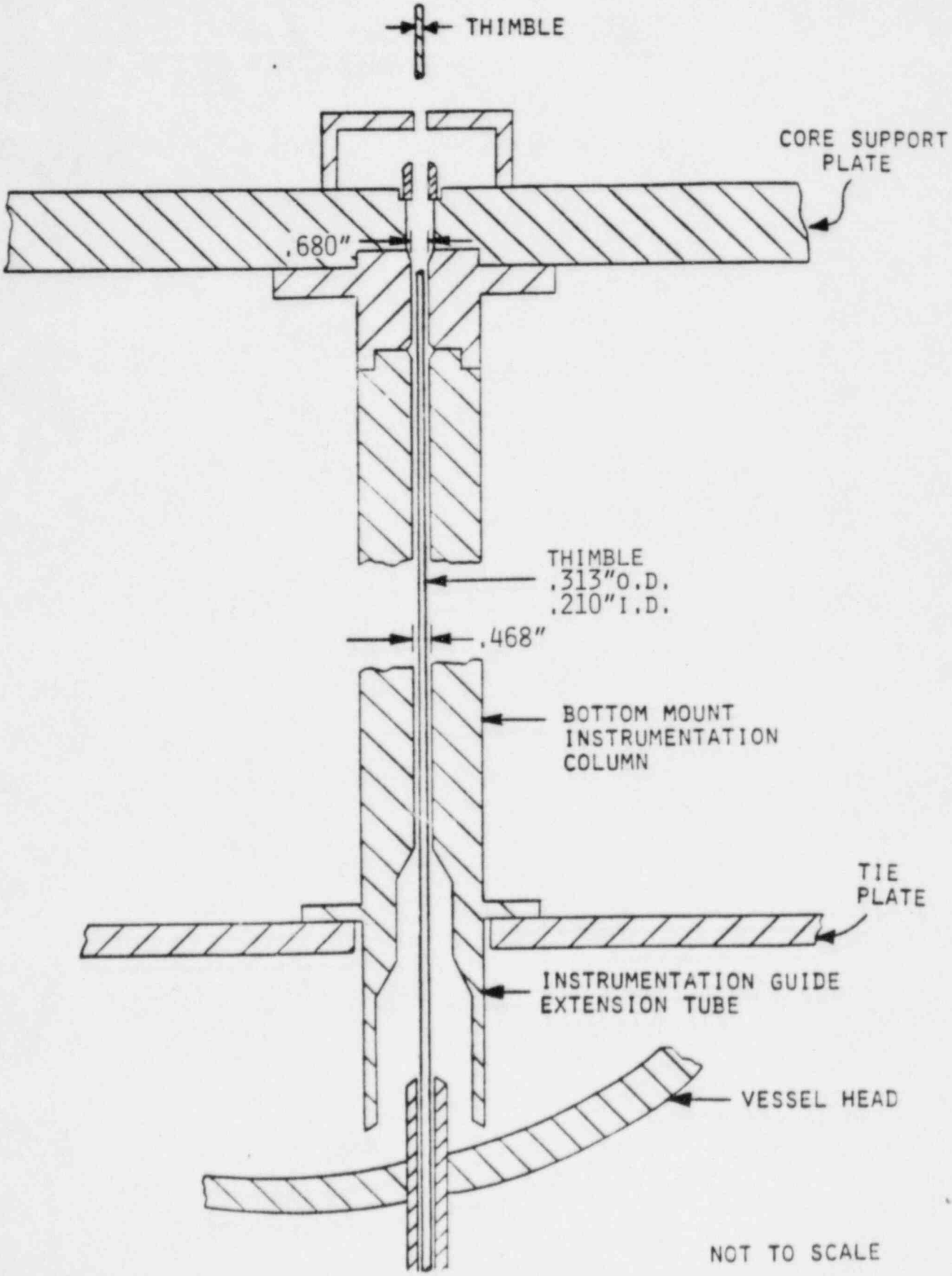


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FIGURE 4

DOEL UNIT 4

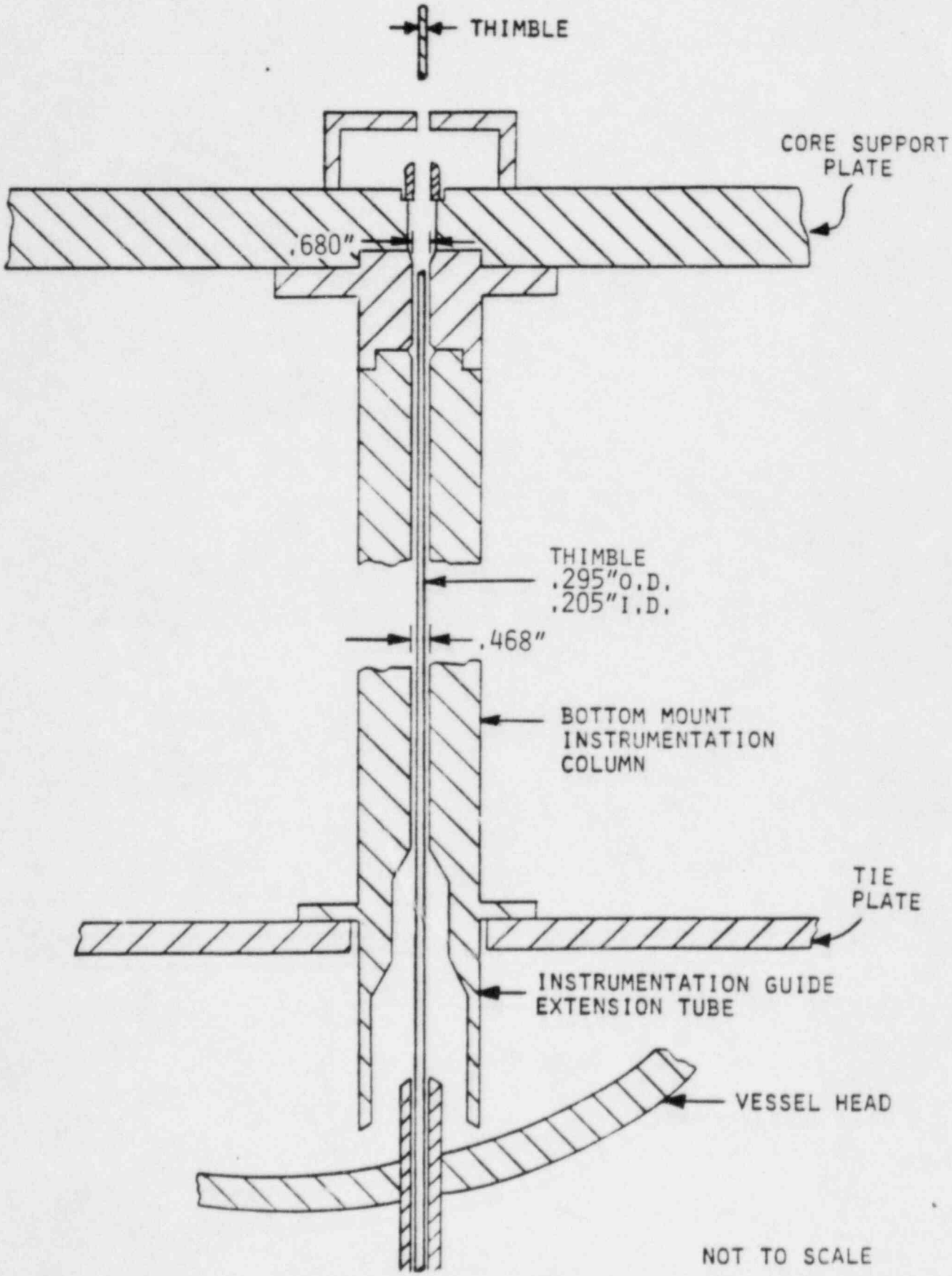

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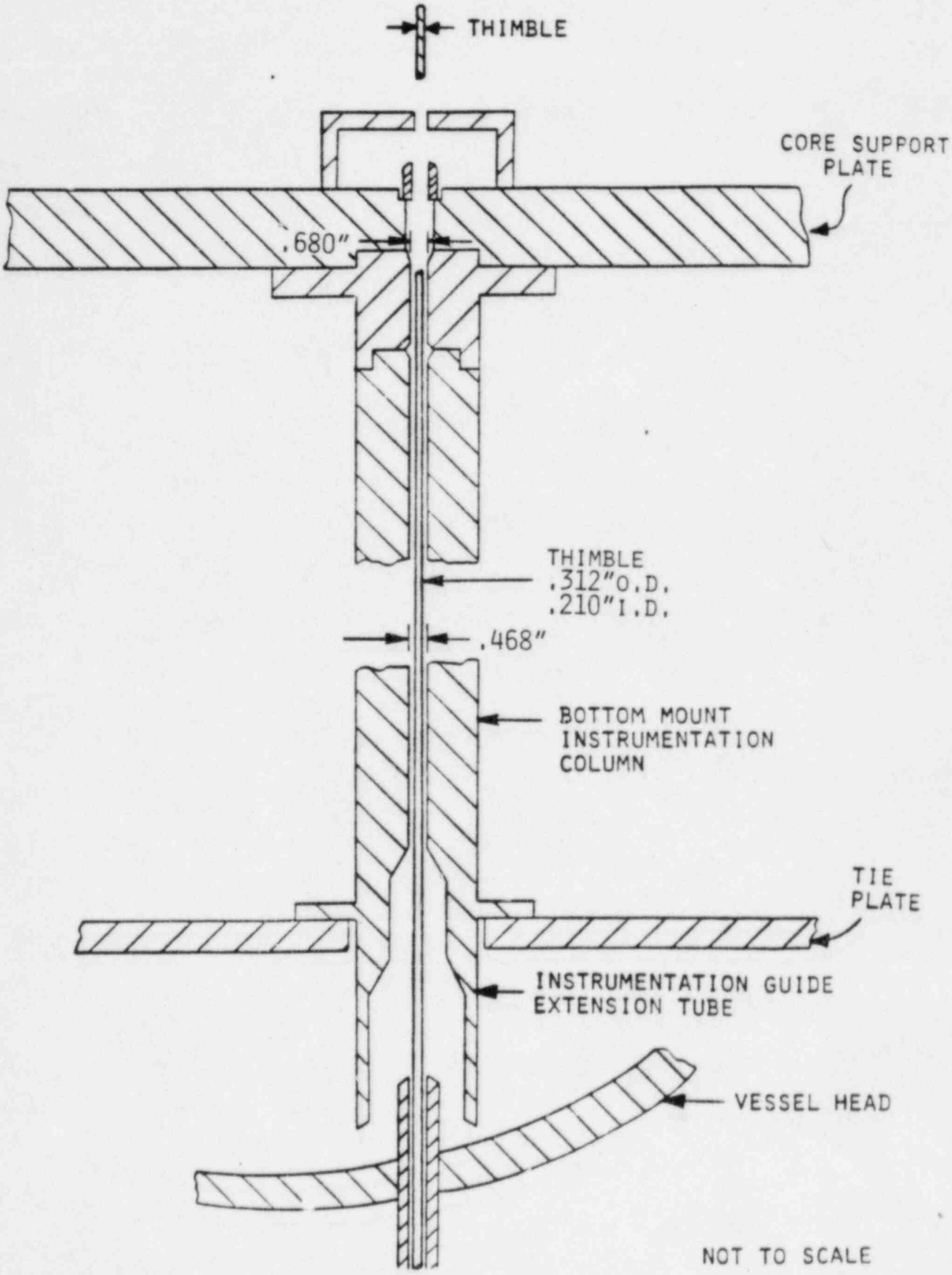
FIGURE 5

TIHANGE UNIT 3



NOT TO SCALE

FIGURE 6