SG Structural Inspection Plan In Support of Braidwood-1 and Byron-1 3.0 Volt IPC

COMMONWEALTH EDISON COMPANY
SEPTEMBER 1995
REV.0

SG Structural Inspection Plan
Support of Braidwood-1 and Byron-1 3.0 Volt IPC

Table of Contents

EXECUTIVE SUMMARY

The objective of this inspection plan is to provide adequate assurance that the steam generator (SG) internals steam, line break (SLB) load path components for a 3 volt interim plugging criteria (IPC), are not degraded.

As part of ComEd's work to develop a 3 volt IPC, and respond to NRC requests for additional information, the following facts have been identified:

1. No load path component degradation has been observed in Westinghouse fabricated SGs without denting.
2. No load path component degradation was observed found during the secondary side tube pull operations conducted in the Braidwood Unit 1 "C" SG 1994. This inspection included: a visual inspection of the top tube support plate (TSP), vertical bars and wedges above the top TSP.
3. No design differences were noted during the Braidwood Unit 1 "C" SG visual inspection.
4. No operational mechanisms other than TSP corrosion induced SG tube denting has been identified that would degrade the load path components. Braidwood Unit 1 and Byron Unit 1 have not seen TSP corrosion induced SG tube denting.
5. Review of fabrication records for the Byron Unit 1 and Braidwood Unit 1 SGs concluded that the load path components were installed per the design.
6. A survey of other utilities regarding load path component integrity has not identified degradation other than that associated with TSP corrosion induced SG tube denting.
7. Wrapper misalignment has not been observed at Byron and Braidwood as evidenced by sludge lancing tool insertion.
8. Foreign experience with degradation of the load path components has been included in the ComEd evaluation.

Based on these facts, ComEd has concluded that there is no bases to believe that load path components have or will degrade as the result of unit operation unless SG tube denting has occurred. Eddy current testing of the SG tubing will readily identify tube denting. Such testing has not identified TSP corrosion induced SG tube denting at Byron or Braidwood. Therefore, ComEd has concluded that

a. load path components are not degraded, and
b. load path components will not degrade during the remaining cycles of operation before replacement of the Byron Unit 1 and Braidwood Unit 1 SGs.

As a defense in depth measure, to assure these assessments are correct, ComEd has developed the inspection program detailed with this document and outlined below. This inspection plan takes into consideration personnel safety, personnel dose, risk of leaving loose parts inside the SG and load path component accessibility.

Braidwood Refuel Outage (9/95)

All 4 SGs

- Eddy Current of TSPs
- Visual of lower flow distribution baffle (FDB) vertical support bar welds (72)

S/G 1"A"

- Visual of top TSP
- Visual of stayrod nuts (9)
- Visual of stayrod spacers (7)
- Visual of verification of wrapper alignment
- Visual inspection of TSP vertical support bars and welds
    - Mechanically cleaned (24)
    - Bundle flushed cleaned (approx 85)

Byron Mid-Cycle Inspection (10/95)

All 4 SGs

- Eddy current of TSPs

1 S/G

- Visual of stayrod nuts (7)

Although visual inspections of the sampling program described above are concentrated in 1 SG at Braidwood Unit 1, ComEd has concluded that SGs in units operated with similar chemistry and relatively close in age will degrade equally. Those portions of the inspection program outlined above that are performed on all 4 SGs during the Braidwood Unit 1 refuel outage will provide additional assurance that there is no load path degradation.

1.0 INTRODUCTION

The Byron Unit 1 and Braidwood Unit 1 3.0 volt IPC amendment request relies on hot leg outside diameter stress corrosion cracking (ODSCC) indications remaining within the bounds of the TSPs during a SLB event. Analyses have been performed to determine the loads placed on each TSP and resulting displacements during such an event.

This inspection program has been developed to assure that the SG load path components are not degraded. The program contains specific inspection acceptance criteria, scope, and inspection techniques.

The TSPs are supported by stayrods with spacers, and by vertical support bars welded to the wrapper, which is supported by the SG shell. Figures 1 and 2 give an outline of the location of these components.

- There are 11 stayrods which consist of 1" nominal diameter studs, 10 of which extend from the top TSP to the tubesheet. The other stayrod extends from the top TSP to the top of the preheater divider plate. The spacers are 1.25" schedule 80 carbon steel (0.191" thick) pipe which extend from the top of one TSP to the bottom of the next higher TSP. A nut is threaded on the top of each stayrod to hold the stack of TSPs and spacers in place.

- The TSP vertical support bars are 2" square blocks, the majority of which are 6" long. Bars are positioned above and below the peripheral boundary of TSPs at multiple locations and the bars are welded to the wrapper.

- To center the TSPs relative to the tubes in the SG, wedges are inserted between the TSPs and the wrapper at several locations, typically six per plate. The wrapper is reinforced at these locations so that the radial wedge load is transmitted to the SG shell. The small end of the wedges is positioned down relative to the plates, and the wedges are welded to the wrapper.

- Wrapper support blocks transmit loads between the wrapper and the SG shell. There are 7 locations around the circumference of the wrapper.

Program development began by assessing the significance of the various load carrying components during SLB. Specifically, it was determined that the stayrods were the most important to limiting TSP displacements, followed by the TSP vertical support bars and wrapper support blocks. The TSPs transmit the load to the surrounding support structures. As such, the TSPs must maintain a stiffness comparable to that used in the TSP displacement analysis. The TSP motion during SLB is limited by the stayrod and vertical support bar structures. The wedges are not taken credit for in the TSP displacement analysis. They provide additional restraint to upward TSP displacement on the upper 5 TSPs. The lower TSPs move downwards during a SLB event, therefore, the wedges will not provide restraint for these TSPs.

Active degradation of the welds in the carbon steel load path components, two mechanisms are plausible, corrosion fatigue and stress corrosion cracking (SCC). Since active stresses and variations in stress are low in these components, corrosion fatigue is unlikely. This includes either initiation or propagation. Environmental effects have been observed in corrosion fatigue tests of carbon and low alloy steels in high temperature water. However, high cycle stresses and / or oxygen levels are needed for these effects to be substantial. The operating conditions for the Byron and Braidwood units are low oxygen and high pH. Carbon steel does not corrode under these conditions. Therefore, corrosion fatigue is highly unlikely.

High welding residual stresses make SCC a more likely active degradation mode. However, under constant loading, highly oxidizing conditions are needed for the onset of SCC. At high temperatures, oxidizing conditions equivalent to about 100 ppb of dissolved oxygen are needed for SCC to occur. The Byron and Braidwood SGs have operated with low oxygen levels, (typically less than 2 ppb). This low dissolved oxygen level is further supported by the elevated hydrazine program. Therefore, SCC of carbon steel welds is highly unlikely. Even if high residual stresses would cause cracking of the weld, the cracking would be across the weld (perpendicular to the weld) which would not significantly effect the load carrying capability of the weld.

ComEd has contacted utility personnel representing 69 out of 75 domestic PWR units, including 10 units that have replaced SGs. No SG internal structural concerns have been reported at 58 units. TSP cracking has been observed at 11 units as confirmed by visual inspection. The TSP cracking occurred in units with severe TSP corrosion induced denting of SG tubes. TSP corrosion induced denting of SG tubes is associated with tube to TSP crevices filled with strong, acidic solutions i.e., high sulfate and chloride. SG tube ODSCC is associated with crevices filled with strong, caustic solutions i.e., high sodium and potassium. If excessive ODSCC is present in a SG, as has been seen at Byron Unit 1 and Braidwood Unit 1, then acidic crevices are not present. Therefore, corrosion induced TSP cracking in the Byron Unit 1 and Braidwood Unit 1 SGs will not occur.

Byron Unit 1 and Braidwood Unit 1 have not observed denting in either unit. It is ComEd's conclusion that the TSP's in the SG's at Byron Unit 1 and Braidwood Unit 1 are structurally sound. Provisions to assess the level of TSP denting and restriction on the use of a 3.0 volt IPC, if such denting is present, are contained within WCAP-14273.

2.0 INSPECTION SUMMARY AND CONCLUSIONS

ComEd does not believe TSP cracking or load path component degradation exists in the Braidwood Unit 1 or Byron Unit 1 SGs. This is based on the following:

- Visual inspection results from the Braidwood 1"C" SG in 1994 showed no evidence of degradation of the top TSP, vertical support bars or wedges.

- In the absence of denting, there has been no evidence of service related degradation of any load path component in any Westinghouse fabricated unit.

- Corrosion behavior of carbon steel components in a low oxygen, high pH environment is well understood. Therefore, there is no basis to expect corrosion of the load path components in a non-heat transfer application.

As a defense-in-depth measure, to assure these assessments are correct, ComEd has developed the inspection program detailed with this document and outlined below. This inspection plan takes into consideration personnel safety, personnel dose, risk of leaving loose parts inside the SG, and load path component accessibility.

<u>Braidwood Refuel Outage (9/95)</u>

<u>All 4 SGs</u>

- Eddy Current of TSPs
- Visual of lower FDB vertical support bar welds (72)

S/G 1"A"

- Visual of top TSP
- Visual of stayrod nuts (9)
- Visual of stayrod spacers (7)
- Visual verification of wrapper alignment
- Visual inspection of TSP vertical support bars and welds
    - Mechanically cleaned (24)
    - Bundle flushed cleaned (approx 85)

Byron Mid-Cycle Inspection (10/95)

All 4 SGs

- Eddy current of TSPs

1 S/G

- Visual of stayrod nuts (7)

Although visual inspections of the sampling program described above are mainly concentrated in 1 SG at Braidwood Unit 1, ComEd has concluded that SGs in units operated with similar chemistry and relatively close in age will degrade equally. Those portions of the inspection program outlined above that are performed on all 4 SGs during the Braidwood Unit 1 refuel outage will provide additional assurance that there is no load path degradation.

ComEd does not believe the dose (6.7 Person Rem), the time (850 Person Hours), the risk of leaving loose parts inside the SG, and the cost associated with the inspection of additional SGs is warranted.

3.0 TSP LOAD PATH INSPECTION PLAN

3.1 Vertical Support Bars

3.1.1 Background

Only the hot leg TSP supports are essential to limiting SLB TSP displacements. In addition, the loads on the upper 5 hot leg TSPs are in the upward direction while the loads on the lower 2 hot leg TSPs are in the downward direction. While the TSP vertical support bars are located above and below the plate, only the top or lower bars at a given plate are essential to limiting TSP displacements.

The TSP vertical support bars have longitudinal welds on each side attaching the bars to the wrapper (see Figure 3). These welds provide a factor of 6 margin against the largest SLB load on any bar. Therefore, only 1/6 of the total weld length or 1/3 of one weld must be structurally sound to support the TSP displacement analyses. Since less than one weld without cracks is acceptable, each weld, rather than each bar, can be considered to be an inspection sample.

Table 3.1 summarizes the number of hot leg TSP vertical support bars and also the number of cold leg vertical support bars for TSPs above or below the preheater divider plate. For TSPs 3 to 7, which are split plates separated by the preheater divider plate, the number of cold leg vertical support bars are not of interest to this inspection plan. There are a total of 51 TSP hot leg vertical support bars per SG that are required to limit TSP displacements in a SLB event, note that the support bars that are associated with the FDB are not listed in this population since the 3.0 volt IPC will not be applied at this location.

The temperature, environment and chemistry are essentially the same for all TSP vertical support bars, hot and cold leg. Environmental changes from the top to bottom of the SG are primarily increases in void fraction as a function of elevation in the SG while temperature is nearly constant at the secondary water saturation temperature. Thus, all TSP vertical support bars (above and below the TSP or hot and cold leg) are equally susceptible to the same potential for service induced degradation. Similarly, manufacturing differences between vertical support bars are negligible. Therefore, for the purpose of sampling, any weld on any bar is a random weld and an acceptable sample for inspection. This permits the inspection to be based on inspection of any hot leg or cold leg vertical support bars weld. Table 3.1 identifies the number of both hot and cold leg vertical support bar locations that are candidates for inspection. That is, 57 hot leg and 30 cold leg vertical support bars locations. Since there are vertical support bars above and below the plate and two welds per bars, there are 174 bars and 348 welds that can be considered as inspection candidates to support the integrity of the 51 TSP vertical support bars that are important to the TSP displacements.

3.1.2 Inspection Scope/Requirements

The total population of vertical support bars in the four SGs at Byron Unit 1 or Braidwood Unit 1 is 1040, of which 87 are accessible for visual inspection. Since each bar is attached to the wrapper using two welds, the population of welds in the four SGs is 2080, of which 125 are accessible for visual inspection. The fabrication quality of the welds are considered to be uniform since all of the welds were subject to the same inspection criteria. In addition, there are no degradation or loading mechanisms which would focus the inspection on specific welds. The welds that are accessible in a single steam generator are listed on Table 3.1 This determination was based on review of SG drawings and discussion with both Westinghouse and R. Brooks Associates Inc. The welds listed as accessible on Table 3.1 are further classified into high, medium and low risk of inspection. These classifications take into consideration risk of not being able to retrieve the video inspection device, probability of performing a successful inspection based on SG geometries, and need to insert the inspection devices while being in a high dose area. Drawings detailing the inspection access path and location of each component considered for inspection on a TSP by TSP basis are provided in Attachment B.

For the purposes of this inspection ComEd has determined that those welds listed as "low risk" (64 welds) will be performed and those listed as medium risk (45 welds) will be performed to the extent possible. In addition, the welds at the bottom of the FDB in all SGs will be visually inspected as part of the post sludge lance video inspection. Note that the vertical support blocks for the FDB are only 1" long. ComEd is not applying the 3.0 volt IPC to indications at the FDB and not taking credit for limited displacement at this location. These inspections provide assurance the internal structures in the other SGs are performing similarly.

3.1.3 Visual Inspection Detection Requirements

Preparation of Welds

Prior to the secondary side inspections at Braidwood, a "bundle flush" operation will be performed. The process involves draining the SG, placing hoses through the swirl vanes in the moisture separator region and washing down through the bundle. This removes loose sludge, from the steam generator internal surfaces which is then removed from the SG by sludge lancing of the tubesheet area. The process will be most effective in the upper bundle regions of the SG.

The upper vertical support bar welds (24) on top of the top support plate in the SG selected for inspection will be mechanically cleaned, if necessary, prior to inspection. This will provide additional assurance that magnetite coating remaining after the bundle flush operation is removed from the weld area.

The welds of the lower vertical support bars (24 in each SG) on the bottom of the FDB, will be inspected in each of the four steam generators after sludge lance operations at Braidwood Unit 1. The vertical support bars below the FDB are approximately 5" above the top of tubesheet. Byron Unit 1 will not be performing sludge lancing during their Fall 1995 mid-cycle outage; therefore, the FDB lower vertical support bars will not be inspected.

ComEd, working with Westinghouse and R. Brooks Associates Inc., has determined that a high resolution video camera (XL-10) will be used for the inspection of the welds at the top support plate. Below the top support plate, Welch Allyn Video Probes of various diameters will be used. These cameras are typically used in steam generator internals inspection due to their high resolution and ability to access tight areas. They are considered state of the art for video inspection for this application.

The visual inspection device must be capable of resolving a 1/32" blackline on an 18% neutral gray card at the distance and lighting to be inspected. Inspections are to be performed at an angle no less than 30 degrees to the surface of the area being inspected. These requirements are contained in ASME Section XI VT-1 visual inspection requirements. All demonstrations of resolution will be performed prior to inspection and recorded for each video inspection device used.

All visual inspections will be performed by personnel who are VT-1 Level II certified in accordance with ComEd's certification program. This will assure that the inspectors are familiar with the inspection requirements, equipment capabilities and cleanliness required to perform adequate inspections.

3.1.4 Acceptance Criteria

General Requirements

Visual inspections will be performed to determine the general condition and appearance of the vertical support bars. The bars must be in-place with no visible signs of corrosion or distortion.

Weld Inspection

The accessible welds for each vertical support bars are to be inspected to determine if longitudinal cracking exists. If cracking is found, an assessment will be performed to determine if the vertical support bar can still perform its intended function. The factor of 6 margin built into each vertical support bar requires that only 1/6 of the total weld length or 1/3 of a single weld be present for a vertical support bar to be considered functional.

For those welds which mechanical cleaning can not be performed i.e., all welds below the top TSP, a best effort inspection will be conducted after bundle flush and sludge lancing operations. These welds are expected to have a uniform magnetite coating present but should not be covered with sludge deposits. With a factor of 6 margin built into the design of these welds, significant longitudinal cracking (greater than 2" in length) , is required before a weld would be unable to perform its intended function. The vertical blocks that are scheduled for inspection below the FDB are only 1" in length. These welds will be inspected for general degradation in each of the four SGs.

3.1.5 Dose / Person hour Estimates

Attachment A provides an estimate of the dose and Person Hours required to perform these inspections. Approximately 5 Person-Rem per SG is attributed to having to gain access to the internals through the secondary side lower deck plate and mechanical cleaning of the welds on the upper vertical support bars. The Braidwood Station Unit 1 Refuel 5 ALARA goal is 236 Person-Rem.

The visual inspection of one steam generator requires approximately 850 person hours including support personnel, inspection personnel and health physics coverage. The inspections of a single steam generator can be conducted without impact on critical path.

3.2 STAYRODS and SPACERS

3.2.1 Background

There are 5 stayrods on each of the hot and cold legs that extend from the tubesheet to the top TSP. Figure 4 details a typical stayrod configuration. In addition, there is a stayrod at the center of the SG that extends from the top of the preheater divider (plate 8) to the top TSP. For limiting TSP displacements, only the 5 stayrods in the hot leg and the stayrod at the center of the SG are critical to limiting hot leg displacements. The stayrods are 1.0" diameter carbon steel rods. The spacers are 1.25" schedule 80 carbon steel (0.191" thick) and hold separation distance between each TSP.

3.2.2 Inspection Scope/Requirements

Each of the stayrod/spacers assemblies consist of a single stayrod and eight spacers. The stayrod is threaded into the top of the tubesheet at the bottom end, and a nut is threaded onto the stayrod at the top end. The nut is welded to the top of the top TSP at two locations and to the stayrod at one location. Each of the welds is a minimum of one inch in length. There are no known instances of a failure of the stayrod in any Westinghouse SG. The stayrod is completely enclosed in the spacers and is therefore not inspectable visually. The inspection will confirm that separation of the stayrod from the TSP has not occurred. Postulating a failure of the nut/TSP welds leads to postulating that the rod/nut could unthread from the tubesheet.

Postulating a failure of the nut/stayrod weld leads to postulating that the rod could unthread from the tubesheet through the nut. Therefore, inspection to assure the welds are present and no displacement has occurred assures that these failure modes are not present.

Drawings indicate that nine stayrods should be inspectable in a single SG. Access to the top nut of seven of the stayrods will be through the 1.875" wrapper opening at the top TSP. Two of the stayrods top nuts will be inspected from the top of the tube bundle. A 6 mm video probe will be inserted down the tube bundle center lane and directed at a 90 degree angle down the appropriate columns. A similar inspection will also be performed at the 8 TSP elevation to evaluate the condition of the spacers between the 8 and 9 TSP. Due to the internal geometries of the SG, the inspection may be limited to seven spacers. These inspections as described above, will be performed during the Braidwood Unit 1 Refueling Outage. Inspection of the top stay rod nut of seven stayrods will be conducted during the Byron midcycle inspection. Drawings showing the access path for stayrod inspections are contained in Attachment B for TSPs 8 and 11. Since Byron will not be entering the SG through the lower deck plate, the additional two stayrods that will be inspected at Braidwood will not be accessible at Byron.

3.2.3 Visual Inspection Detection Requirements

For Braidwood Unit 1, prior to commencement of the secondary side inspections, a "bundle flush" operation will be performed. The process involves draining the SG then placing hoses through the swirl vanes in the moisture separator region and letting wash down through the bundle. This removes loose sludge, from the steam generator internal surfaces which is then removed from the SG by sludge lancing the tubesheet area. The process will be most effective in the upper bundle regions of the SG. Bundle flush operations will not be performed during the Byron Mid-cycle outage inspection.

The visual inspection device must be capable of resolving a 1/32" blackline on an 18% neutral gray card at the distance and lighting to be inspected. Inspections are to be performed at an angle no less than 30 degrees to the surface of the area being inspected. These requirements are contained in ASME Section XI VT-1 visual inspection requirements. All demonstrations of resolution will be performed prior to inspection and recorded for each video inspection device used.

All visual inspections will be performed by personnel who are VT-1 Level II certified in accordance with ComEd's certification program. This will assure that the inspectors are familiar with the inspection requirements, equipment capabilities and cleanliness required to perform adequate inspections.

3.2.4 Acceptance Criteria

The stayrod is threaded into the top of the tubesheet at the bottom end, and a nut is threaded onto the stayrod at the top end. The nut is welded to the top of the TSP at two locations and to the stayrod at one location. Each of the welds is a minimum of one inch in length.

The inspection shall be focused on assuring that SLB loads will be transmitted to the stayrods/spaces during a postulated SLB event. The upper plates deform in the upward direction, so resistance to TSP motion must be via the top TSP to the nut to the stayrods. To assure this resistance is present, it is sufficient that the nut be in contact with the top TSP.

The visual inspection shall verify that the nut at the top of the stayrod is in contact with the top support plate. It shall also verify that the weld between the nut and stayrod, and nut and TSP is not degraded. If degradation is present, an evaluation of the possibility of the nut becoming unthreaded from the stayrod will be made.

The accessible spacers between the 8 and 9 TSP will be inspected for signs of degradation, i.e. bowing, cracking and corrosion.

3.2.5 Dose / Person hour Estimates

Attachment A provides an estimate of the dose and Person Hours required to perform these inspections. Approximately 1 Person Rem per SG is required to perform these inspections, including building the 25' of scaffolding required to reach the inspection ports and removal of the inspection port covers.

The person hours associated with building scaffolding, removing the 2" inspection covers, performing inspections and health physics coverage, is approximately 100 hours.

3.3 Wedges

3.3.1 Background

The wedges are inserted between the TSP and wrapper at specified locations at each TSP elevation. They occur in groups of 2 or 3 and are held in place by welding between the wedge and wrapper (see figure 5). The wedges are designed to allow minor movement of the TSP due to thermal expansion while keeping the TSP approximately centered within the wrapper.

The TSP displacement analysis takes no credit for wedges even though they provide additional restraint to upward motion.

3.3.2 Inspection Scope/Requirements

Since the TSP displacement analysis does not take credit for the wedges limiting movement, only those wedges that can be readily inspected during the course of other SG internal visual inspections will be examined. This includes those wedges that will be accessible during the visual inspection of the top TSP of the SG selected for inspection. Inspection will consist of verifying the wedges are present in their specified locations.

3.3.3 Visual Inspection Detection Requirements

The video inspection devices used for inspection of the wedge groups must be capable of resolving a 1/32" blackline on an 18% neutral gray card at the distance and lighting to be inspected. Inspections are to be performed at an angle no less than 30 degrees to the surface of the area being inspected. These requirements are contained in ASME Section XI VT-1 visual inspection requirements. All demonstrations of resolution will be performed prior to inspection and recorded for each video inspection device used.

All visual inspections will be performed by personnel who are VT-1 Level II certified in accordance with ComEd's certification program. This will assure that the inspectors are familiar with the inspection requirements, equipment capabilities and cleanliness required to perform adequate inspections.

3.3.4 Acceptance Criteria

Verify the wedges are in place and the welds between the wedges and the wrapper are present

3.3.5 Dose / Person hour Estimates

The additional dose and person hours associated with inspection of the wedge groups is considered negligible since it will be conducted in the course of other inspections required by this program.

3.4 Wrapper Support Blocks

3.4.1 Background

The wrapper support blocks transmit loads between the wrapper and the shell. There are seven locations distributed around the wrapper circumference where wrapper support blocks are installed. Figure 6 shows the wrapper block supports. Th ıly known degradation of this structure was seen at a foreign unit with a different internals design. The damage mechanism resulted in the entire wrapper "dropping" within the SG. This was discovered when a secondary inspection port was opened for sludge lancing and the sludge lance equipment could no longer enter the tube bundle due to misalignment.

3.4.2 Inspection Scope/Requirements

The alignment of the wrapper to shell will be visually verified through the 2" inspection port openings between the wrapper and the shell. These openings are located at 90 degree intervals around the circumference of the SG. These inspection ports are opened as part of the normal sludge lancing operation, which occurs at scheduled refueling outages. The alignment will be verified during the Braidwood Unit 1 refuel outage (Fall 1995), and the Byron Unit 1 refuel outage (Spring 1996). Sludge lancing has been performed 4 times on the Braidwood Unit 1 SGs and 6 times on the Byron Unit 1 SGs. No misalignment has been observed. If the wrapper had "dropped" sludge lance equipment will be unable to pass through the 2" inspection port openings.

3.4.3 Visual Inspection Detection Requirements

The video inspection device must be capable of resolving a 1/32" blackline on an 18% neutral gray card at the distance and lighting to be inspected. Inspections are to be performed at an angle no less than 30 degrees to the surface of the area being inspected. These requirements are contained in ASME Section XI VT-

1 visual inspection requirements. All demonstrations of resolution will be performed prior to the inspection and recorded if video inspection devices are used.

All visual inspections will be performed by personnel who are VT-1 Level II certified in accordance with ComEd's certification program. This will assure that the inspectors are familiar with the inspection requirements, equipment capabilities and cleanliness required to perform adequate inspections.

3.4.4 Acceptance Criteria

No misalignment of the sludge lance or inspection ports between shell and wrapper.

3.4.5 Dose / Person hour Estimates

The additional dose and time associated with visually verifying wrapper alignment will be approximately 0.12 Person Rem.

4.0 TSP INSPECTION PLAN

4.1 Background

An EPRI sponsored laboratory program to demonstrate acceptable eddy current detectability of cracked TSPs is underway and is expected to develop procedures to be applied for inspection of the TSPs. The program is scheduled for completion by the end of September of 1995. The TSP inspection plan is based on:

1. eddy current inspection to verify TSP presence,
2. a visual inspection of the top TSP in one SG to support the adequacy of the eddy current inspection procedures, and
3. application of the EPRI inspection technique for cracked TSP detection upon successful completion of the laboratory program.

Based on domestic utility experience, the only known damage mechanism that has resulted in TSP cracking is caused by severe corrosion of the TSPs resulting in denting of the SG tubes. Provisions to assess the level of tube denting at support plate intersections and restrictions on the use of 3.0 volt IPC, if such denting is present, are contained within WCAP-14273.

4.2 Inspection Scope/Requirements

Based on a foreign utilities experience it is be reasonable to consider inspecting the corresponding TSP locations at Braidwood and Byron. This experience was presented to the NRC in proprietary meetings on July 20, 1995 and August 17, 1995. ComEd has evaluated this experience and concluded that this inspection program is sufficient to support the internals integrity requirements.

Prior to the secondary side visual inspections, a "bundle flush" operation will be performed. A visual inspection of the top TSP in one SG at Braidwood will be conducted. The areas to be inspected are the outer periphery of the TSP with emphasis in the areas of the three anti-rotation devices. In the area of the anti-rotation devices, video inspections will be performed, at the top TSP, within the tube bundle approximately 5 rows deep. This will provide assurance that TSP ligament cracking is not present.

The requirements for the eddy current testing inspection techniques are:

1. verify the presence of the TSPs, and
2. the unambiguous characterization of TSP degradation.

The presence of a TSP signal will be verified at each inspected TSP intersection.

Eddy current inspection techniques, when developed in the EPRI sponsored program, will be applied to groupings of approximately 50 tubes in each of the 3 locations adjacent to the anti-rotation devices at the top TSP in each SG. If the EPRI sponsored eddy current program does not meet the requirements of this inspection program, the differences will be evaluated. This evaluation will be provided to the NRC along with any necessary changes to the inspection program.

4.3 Visual Inspection Detection Requirements

The video inspection devices used for inspection of the top TSP must be capable of resolving a 1/32" blackline on an 18% neutral gray card at the distance and lighting to be inspected. Inspections are to be performed at an angle no less than 30 degrees to the surface of the area being inspected. These requirements are contained in ASME Section XI VT-1 visual inspection requirements. All demonstrations of resolution will be performed prior to inspection and recorded for each video inspection device used.

All visual inspections will be performed by personnel who are VT-1 Level II certified in accordance with ComEd's certification program. This will assure that the inspectors are familiar with the inspection requirements, equipment capabilities and cleanliness required to perform adequate inspections.

4.4 Acceptance Criteria

If any TSP cracking is detected by either visual inspection or eddy current, the significance of the degradation must be assessed. The evaluation of the cracking must determine if increased TSP displacements would result.

If it is determined that unacceptable TSP cracking has been found, ComEd will request that the 1.0 volt, multi-cycle, alternate plugging criteria (APC) Technical Specification submittal be approved for Braidwood Unit 1. Byron Unit 1 currently has a 1.0 volt IPC approved for the remainder of their present cycle.

TSP SUPPORT SYSTEM

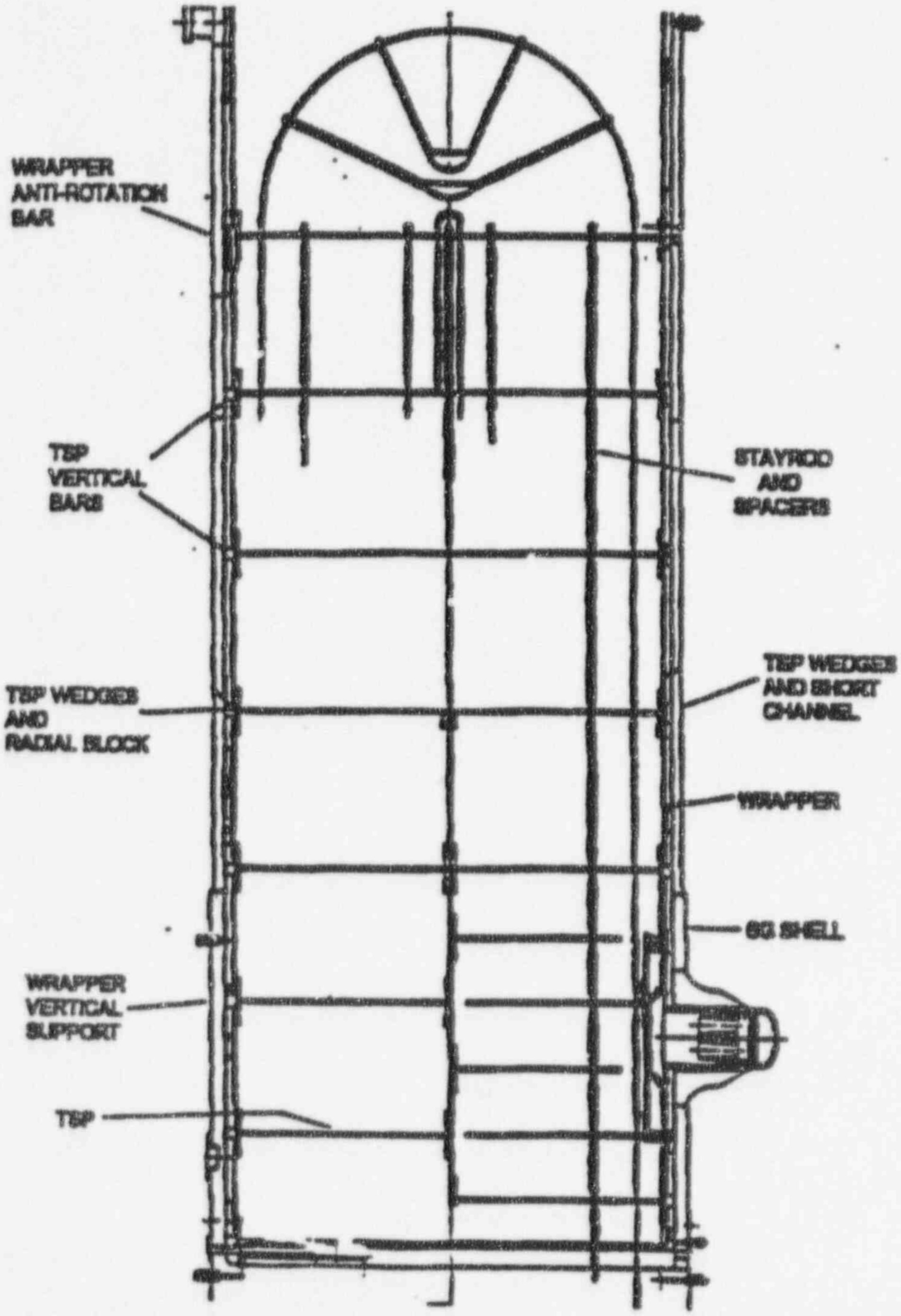
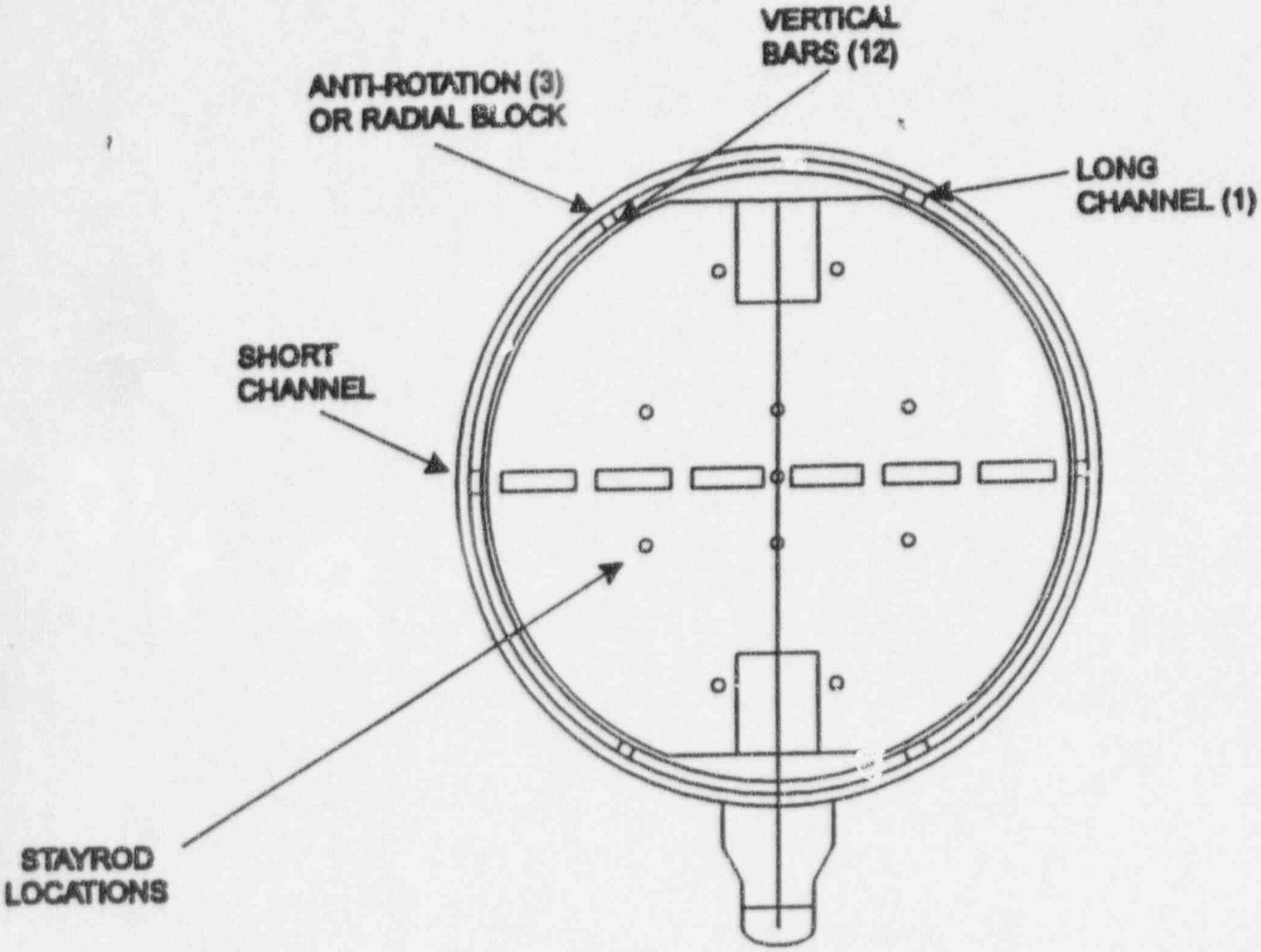
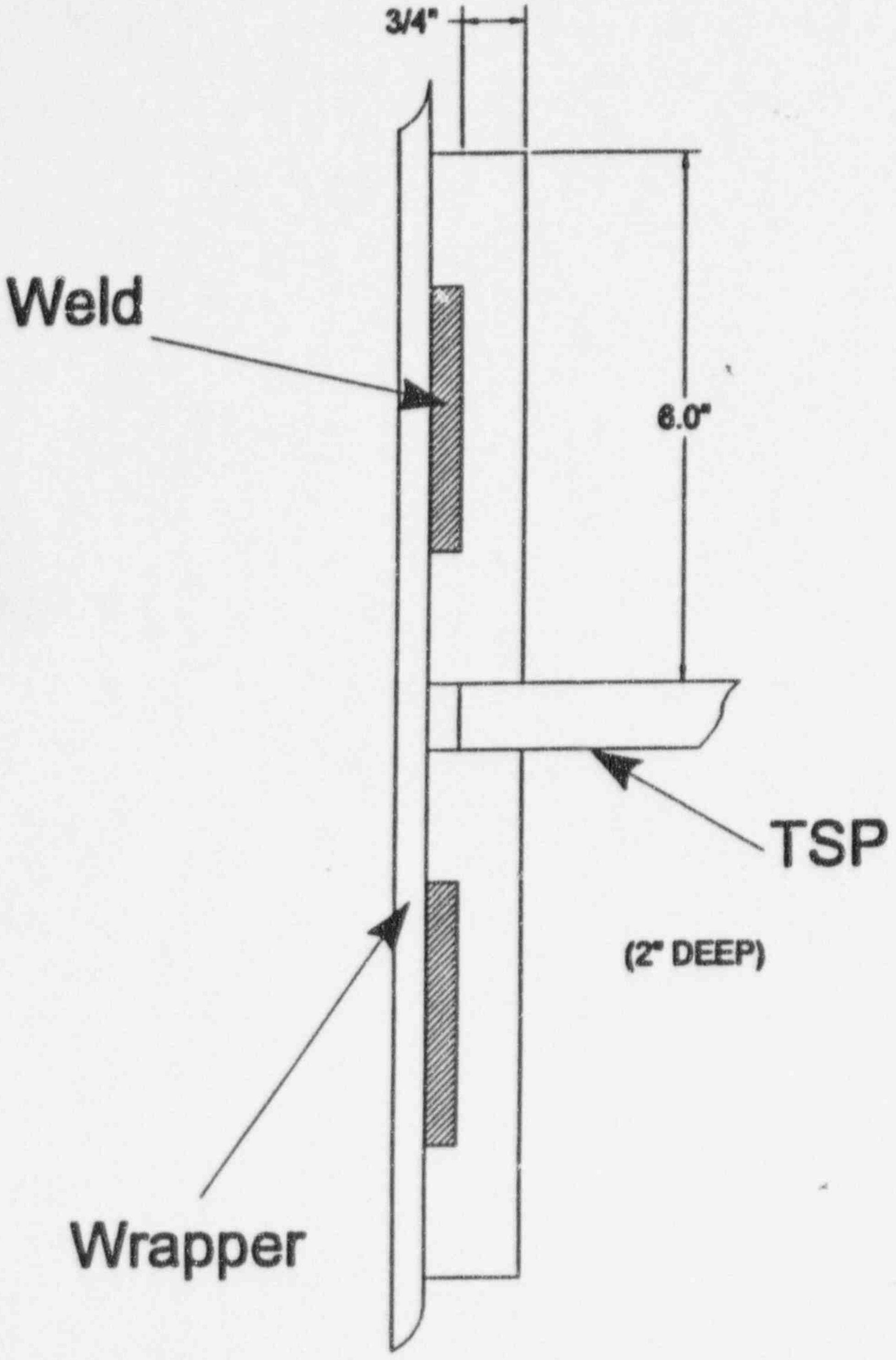


FIGURE 1



MODEL D4
TOP PLATE

ICURE 2



MODEL D4
TSP SUPPORT
(12 PER PLATE)

FIGURE 3

STAYRODS AND SPACERS

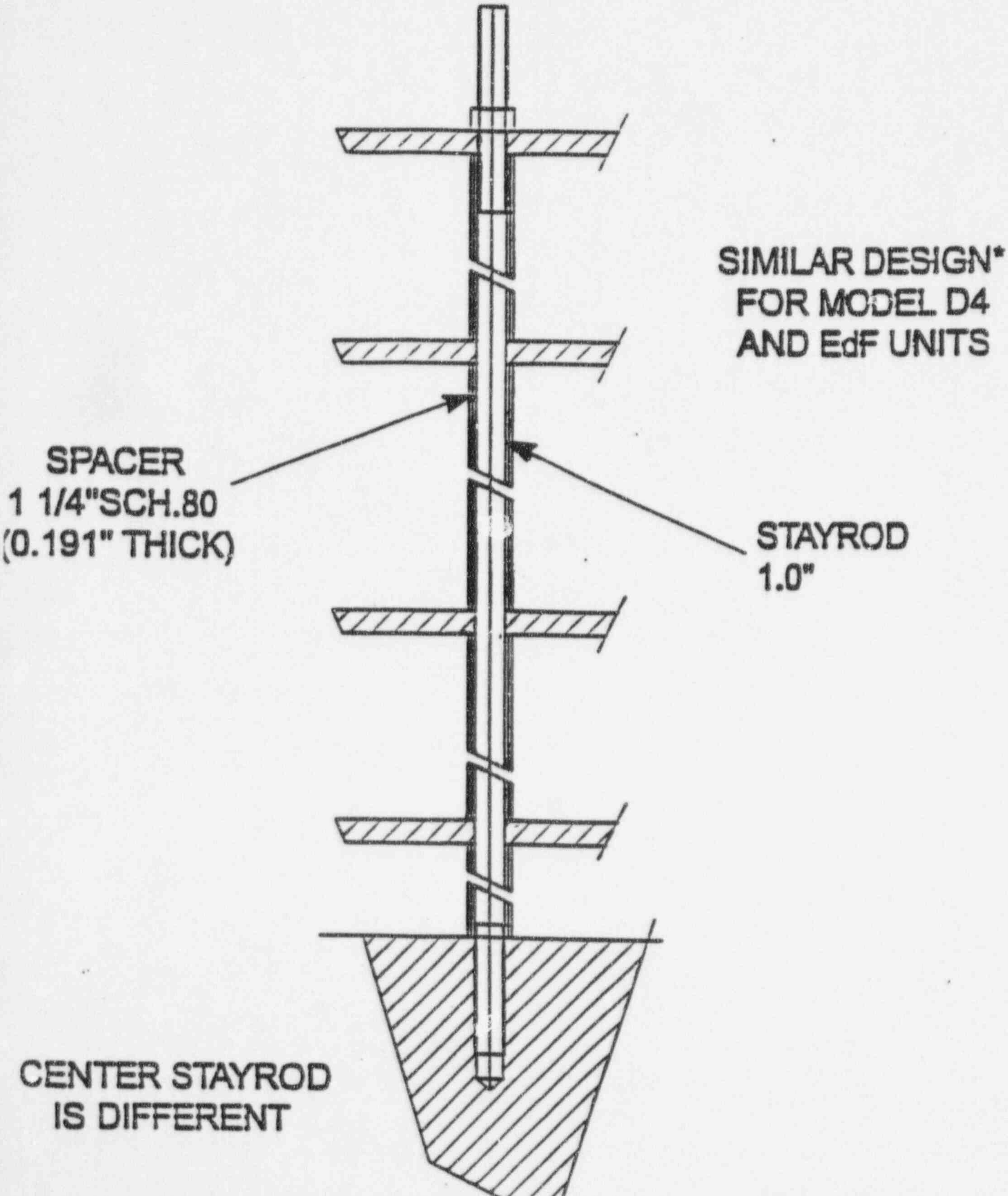
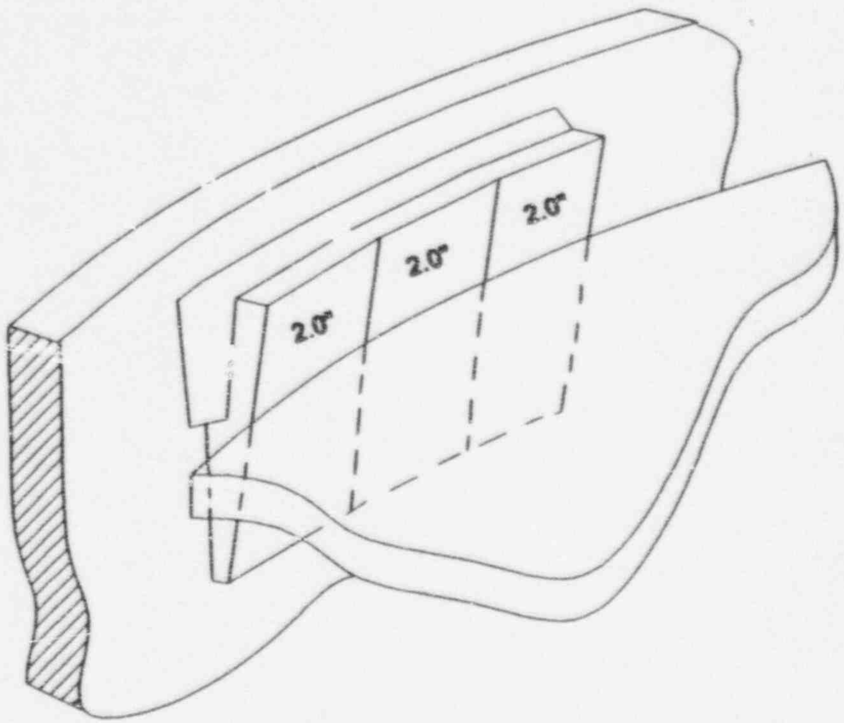
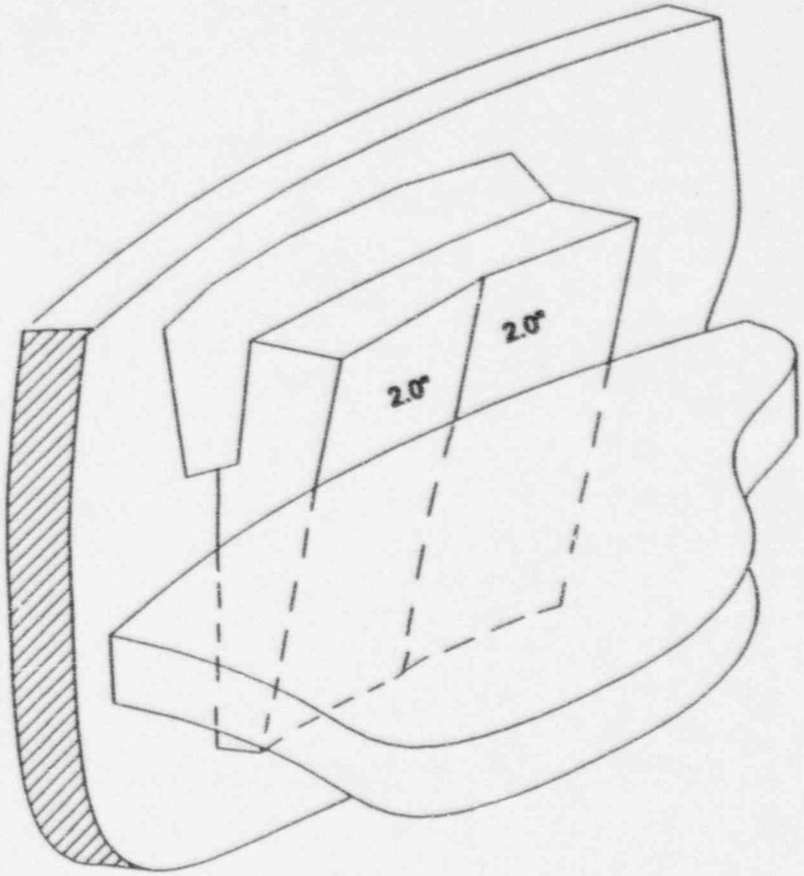


FIGURE 4

FIGURE 5



THREE WEDGE LOCATION



TWO WEDGE LOCATION

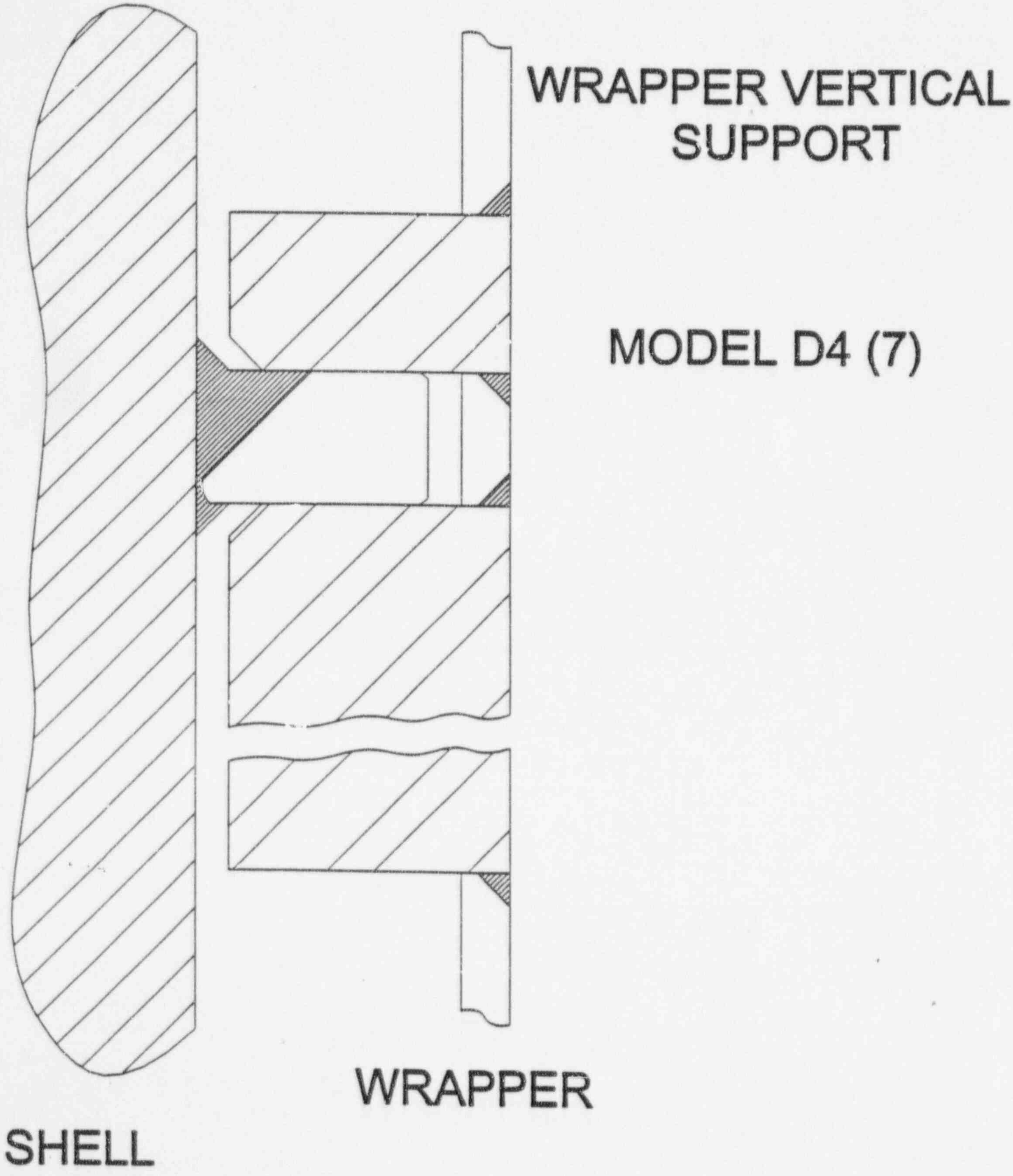


FIGURE 6

TABLE 3.1: ACCESSIBLE VERTICAL SUPPORT BAR WELDS

TSP	TSP Locations			Accessible Welds			High Risk **		Med Risk **		Low Risk **		Totals	Comments	Potential Outcome of High or Med
	# HL Loc.	# CL Loc.	Totals	HL	CL	Totals	HL	CL	HL	CL	HL	CL			
11 TSP	6	6	***12***	24	24	***48***	0	0	12	12	12	12	***48***	**MED**-Insert probe between wrapper and TSP for lower bars.	None.
10 TSP	6	6	***12***	10	10	***20***	0	0	8	8	2	2	***20***	**MED**-Inserting probe between wrapper and TSP.	Hanging up probe.
09 TSP	6	6	***12***	2	2	***4***	0	0	0	0	2	2	***4***	To achieve this inspection, probe must drop through 2 TSP's at a cutout location.	None.
08 TSP	6	6	***12***	6	6	***12***	2	2	0	0	4	4	***12***	**HIGH**-Insert probe through 2 TSP's and small hole on 1	Hanging up probe.
07 TSP	9	N/A	***9***	7	N/A	***7***	2	0	5	0	0	0	***7***	**HIGH**-Inserting probe through 2 TSP's and small hole on 2 TSP's. **MED**-Insert probe through handhole loc. and dropping 1TSP through flowslots.	Hanging up probe.
05 TSP	9	N/A	***9***	5	N/A	***5***	5	0	0	0	0	0	***5***	**HIGH**-Inserting probe through 3 TSP's and small hole on 2 TSP's & Insert probe through handhole loc. and dropping 2 TSP's	Hanging up probe.
03 TSP	9	N/A	***9***	5	N/A	***5***	5	0	0	0	0	0	***5***	**HIGH**-Inserting probe through 4 TSP's and small hole on 2 TSP's. & Insert probe through handhole loc. and dropping 3 TSP's	Hanging up probe.
FDB	6	6	***12***	12	12	***24***	0	0	0	0	12	12	***24***	Inspection can be performed as normal part of Sludge	None.
Totals (*)	***57***	***30***	***87***	***71***	***54***	***125***	***14***	***2***	***25***	***20***	***32***	***32***	***125***		

*** 87 Locations (2 bars per location - upper/lower)*(2 welds per bar) = 348 welds**

**** Inspection risk assesses personnel safety, personel dose, and probability of getting probe stuck in tight clearance areas**

ATTACHMENT A

ATTACHMENT A: DOSE ESTIMATES TO SUPPORT SG INTERNALS INSPECTIONS

DESCRIPTION	SET-UP TIME	PERSON HOURS	PERSON REM	COMMENTS
GAIN ACCESS TO TOP TSP THROUGH LOWER DECK PLATE	100	424	1.76	INCLUDES: MANWAY REMOVAL, LEAD SHIELDING, CUTTING OF LOWER DECK PLATE, SEAL OFF
BUNDLE FLUSH ACTIVITIES	24	72	0.36	CLEAN LOOSE DEBRIS FROM TOP OF BUNDLE
MANUALLY CLEAN VERTICAL BAR WELDS AT TOP TSP	0.5	0.5	2	CLEAN TOP WELDS OF 11 TSP VERTICAL BARS
PERFORM VISUAL INSPECTIONS OF ACCESSIBLE AREAS FROM TOP TSP	12	48	1	ASSUMES WATER LEVEL JUST BELOW TOP TSP DURING INSPECTIONS (*)
PERFORM VISUAL INSPECTIONS THROUGH 2" INSPECTION PORT AT 11 TSP	10	50	0.5	REQUIRES 25' SCAFFOLD AND REMOVAL OF 1 COVER
VISUAL INSPECTION OF WRAPPER ALIGNMENT	12	24	0.12	WRAPPER ALIGNMENT VERIFIED BY SLUDGE LANCE EQUIPMENT ACCESSIBILITY AND VISUAL INSPECTION
PERFORM VISUAL INSPECTIONS THROUGH 2" INSPECTION PORT AT 8 TSP	10	50	0.5	REQUIRES 15' SCAFFOLD AND REMOVAL OF 1 COVER
PERFORM VISUAL INSPECTION OF LOWER VERTICAL BARS AT FDB	0.5	10	0.25	PERFORM AS PART OF FOSAR AFTER SLUDGE LANCING
MISC HP COVERAGE	169	169	0.275	HP SUPPORT OF ACTIVITIES
TOTAL PER STEAM GENERATOR INSPECTED	169	847.5	6.765	

** IF ABLE TO PERFORM INSPECTIONS WITH WATER OVER TOP OF BUNDLE PERSON REM EXPOSURE LOWERED TO 0.8.

ATTACHMENT B

ATTACHMENT B: VERTICAL BLOCK SUPPORT PLATE DRAWINGS

TSP	DESCRIPTION OF DRAWING
11 H	Drawing represents 1/2 of the hot leg TSP. Inspections can be performed on hot and cold legs equally for the vertical block welds. Inspections can be performed on hot and cold legs closest to handhole for stayrods.
10 H	Drawing represents 1/2 of the hot leg TSP. Inspections can be performed on hot and cold legs equally for the vertical block welds.
09 H	Drawing represents 1/2 of the hot leg TSP. Inspections can be performed on hot and cold legs equally for the vertical block welds.
08 H	Drawing represents 1/2 of the hot leg TSP. Inspections for the vertical block spaced at 78 degrees can be performed on hot and cold legs equally. However, those vertical blocks spaced at 15 and 41 degrees can only be performed on the hot and cold leg side closest to the handhole. Inspections can be performed on hot and cold legs closest to handhole for stayrod spacers.
07 H	Drawing represents 1/2 of the hot leg TSP. Inspections for the vertical blocks spaced at 78 degrees can be performed on hot and cold legs equally. However, only those vertical blocks down the tube lane closest to the handhole can be inspected.
05 H	Drawing represents 1/2 of the hot leg TSP. Inspections for the vertical blocks spaced at 78 degrees can be performed on hot and cold legs equally. However, only those vertical blocks down the tube lane closest to the handhole can be inspected.
03 H	Drawing represents 1/2 of the hot leg TSP. Inspections for the vertical blocks spaced at 78 degrees can be performed on hot and cold legs equally. However, only those vertical blocks down the tube lane closest to the handhole can be inspected.
FDB	Drawing represents 1/2 of the hot leg TSP. Inspections can be performed on hot and cold legs equally for the vertical block welds. Vertical blocks are only 1 inch in length.

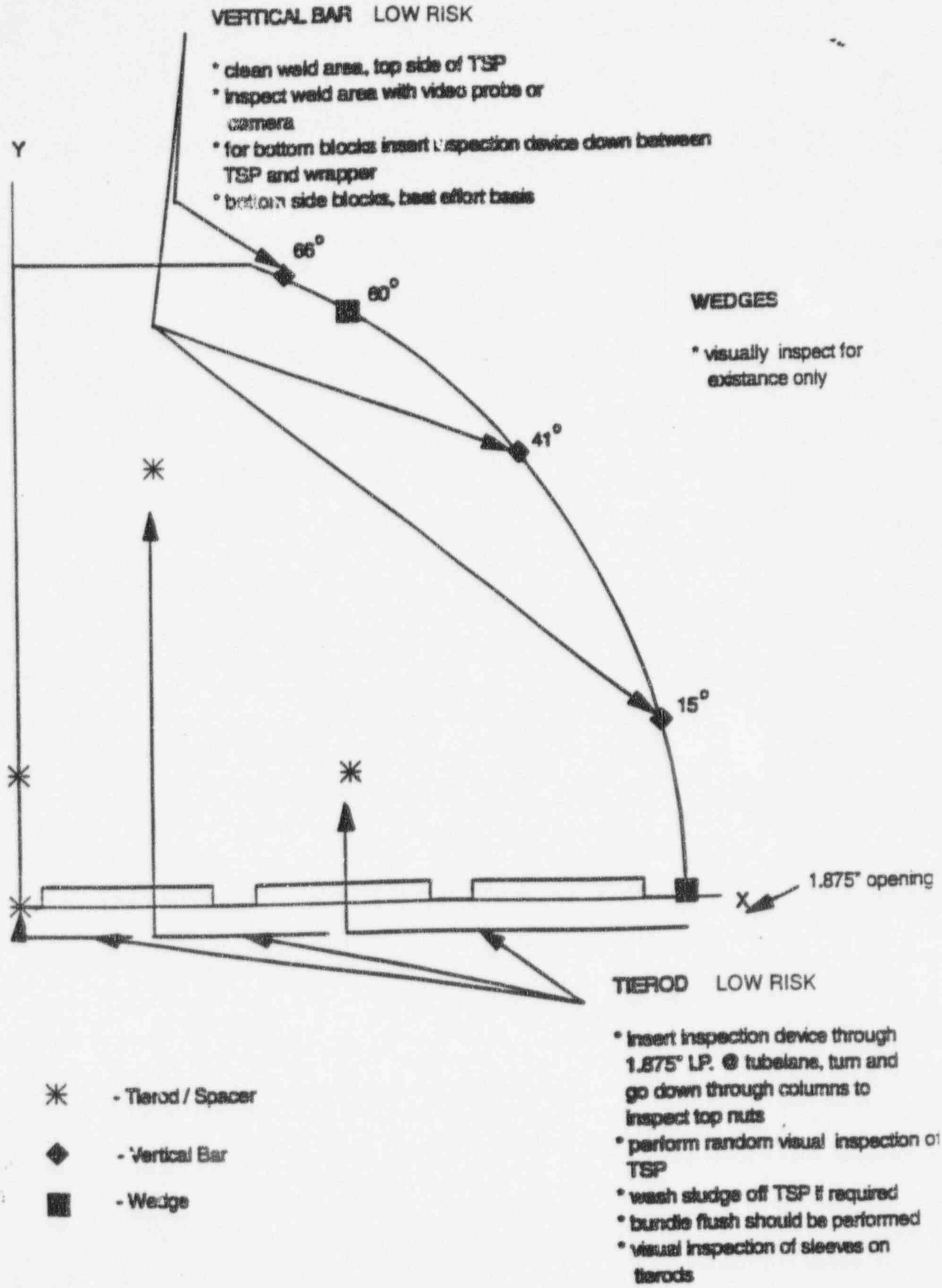


Plate P (11H) Support Locations

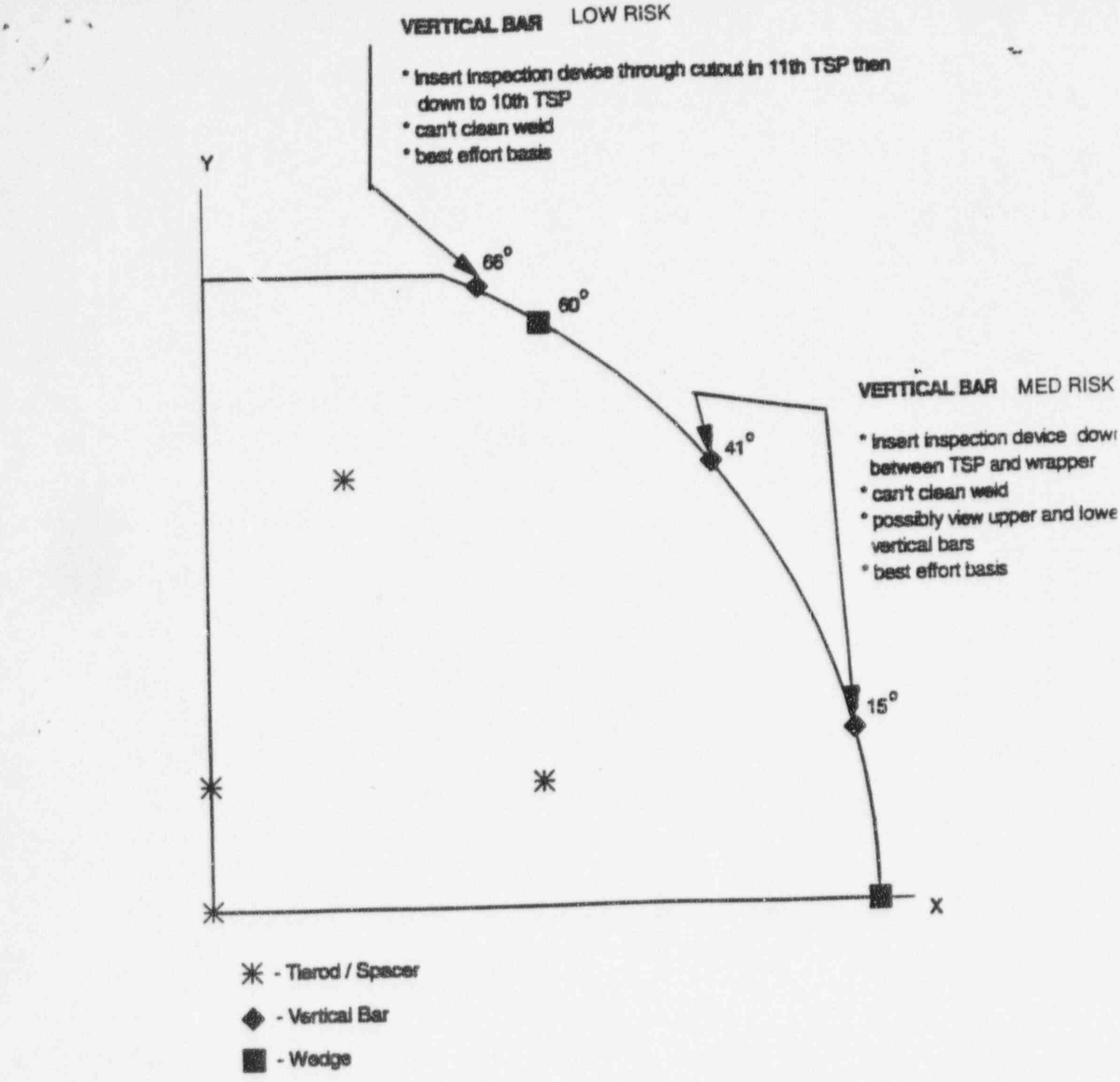


Plate N (10H) Support Locations

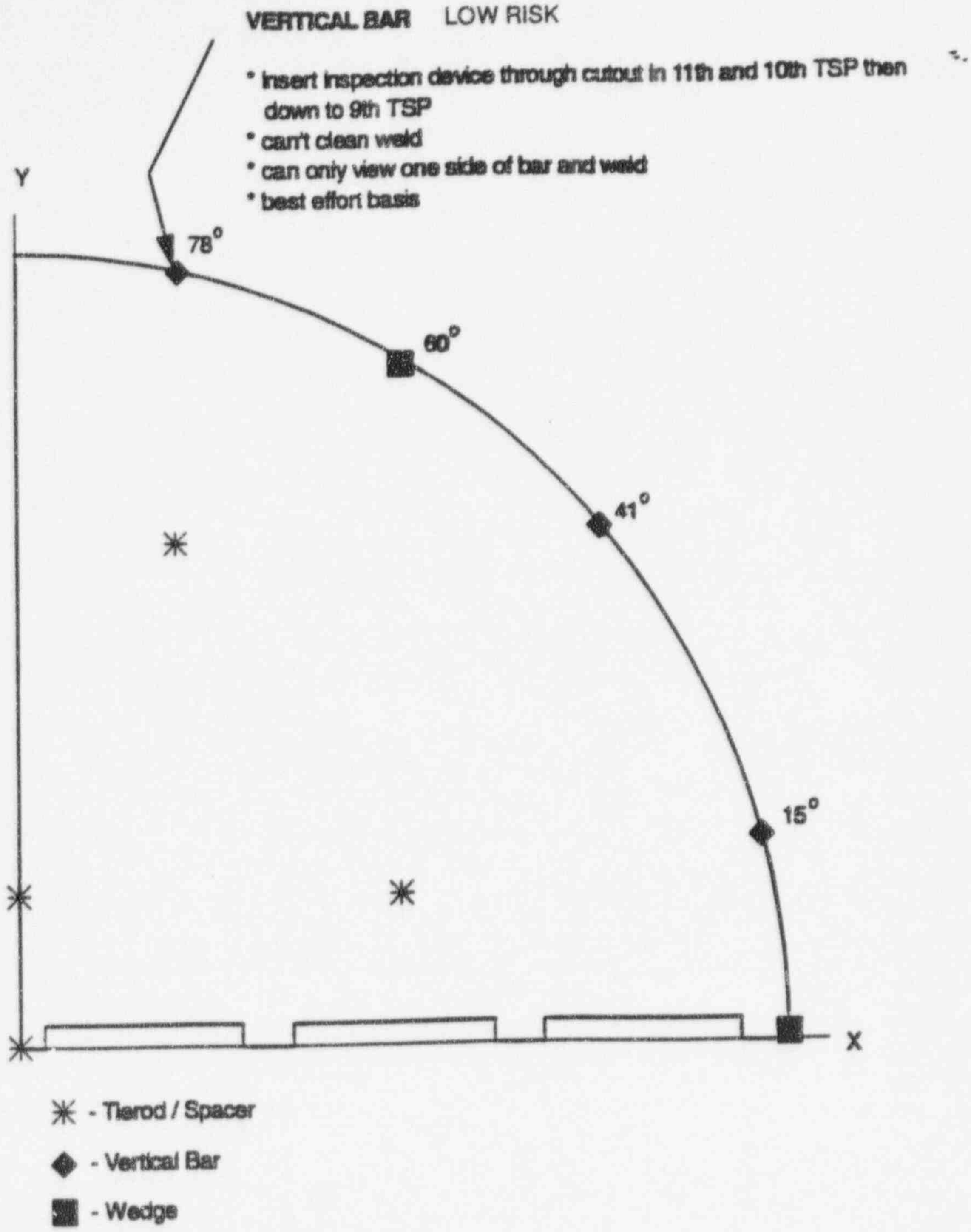


Plate M (9H) Support Locations

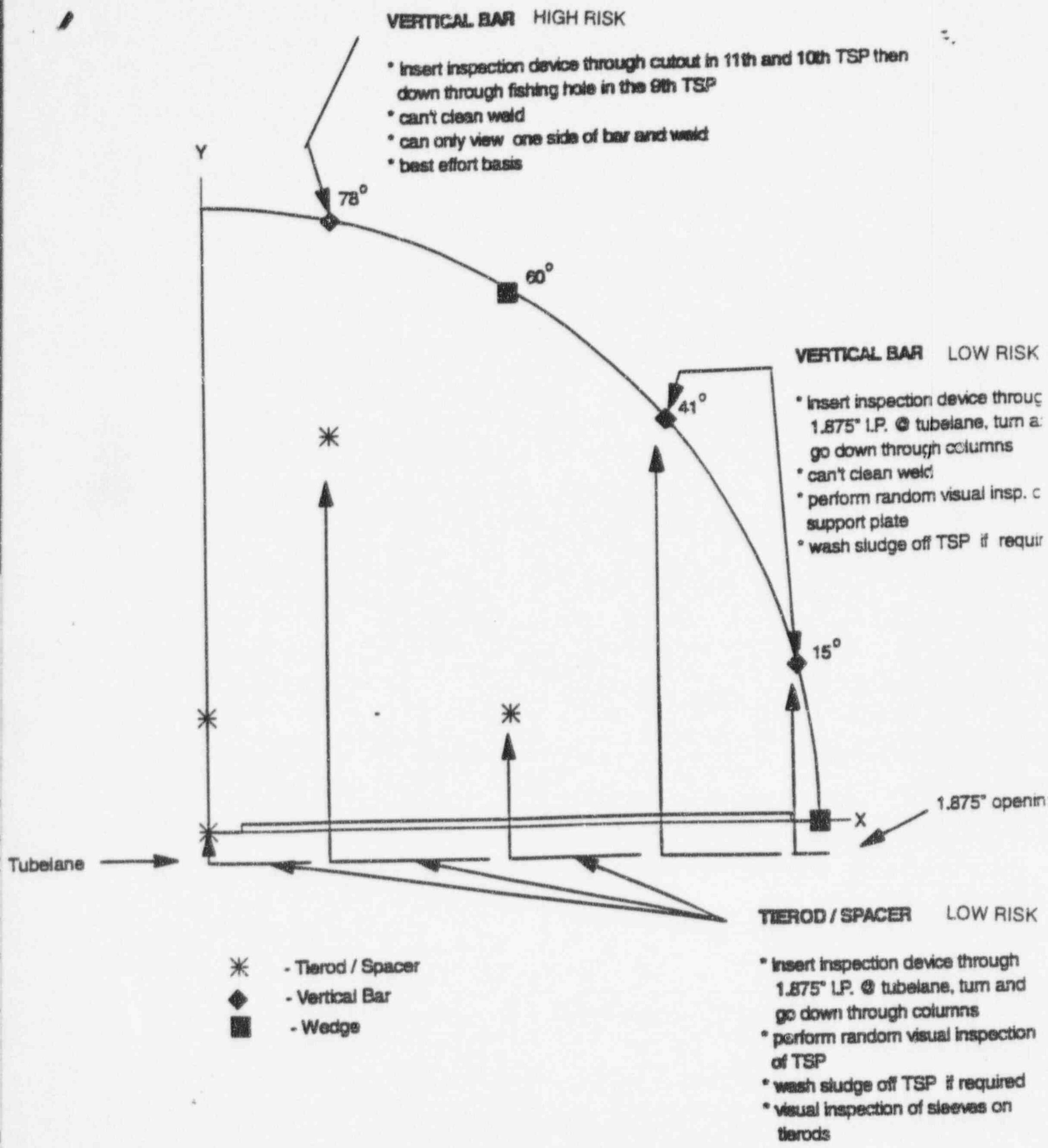


Plate L (8H) Support Locations

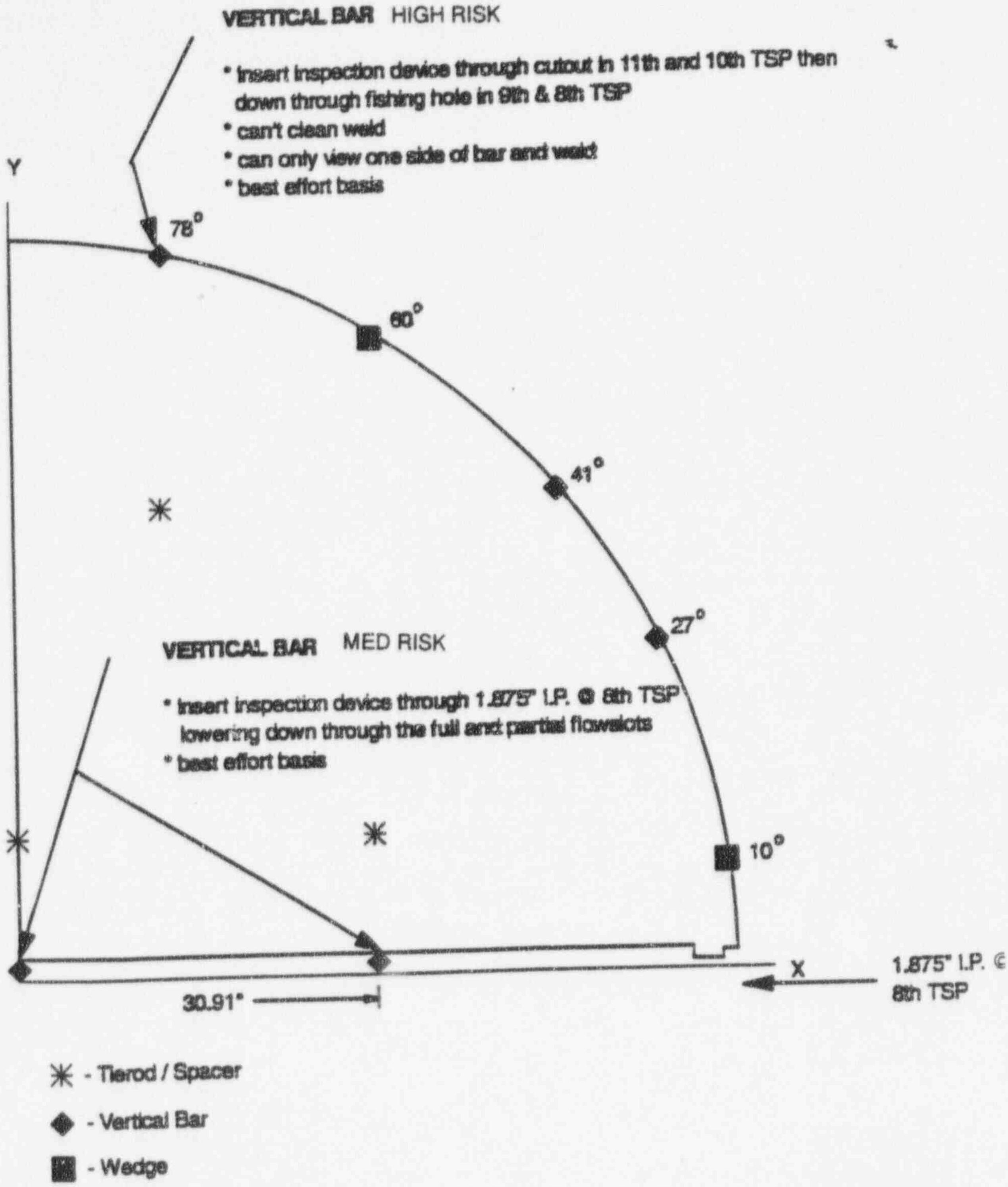


Plate J (7H) Support Locations

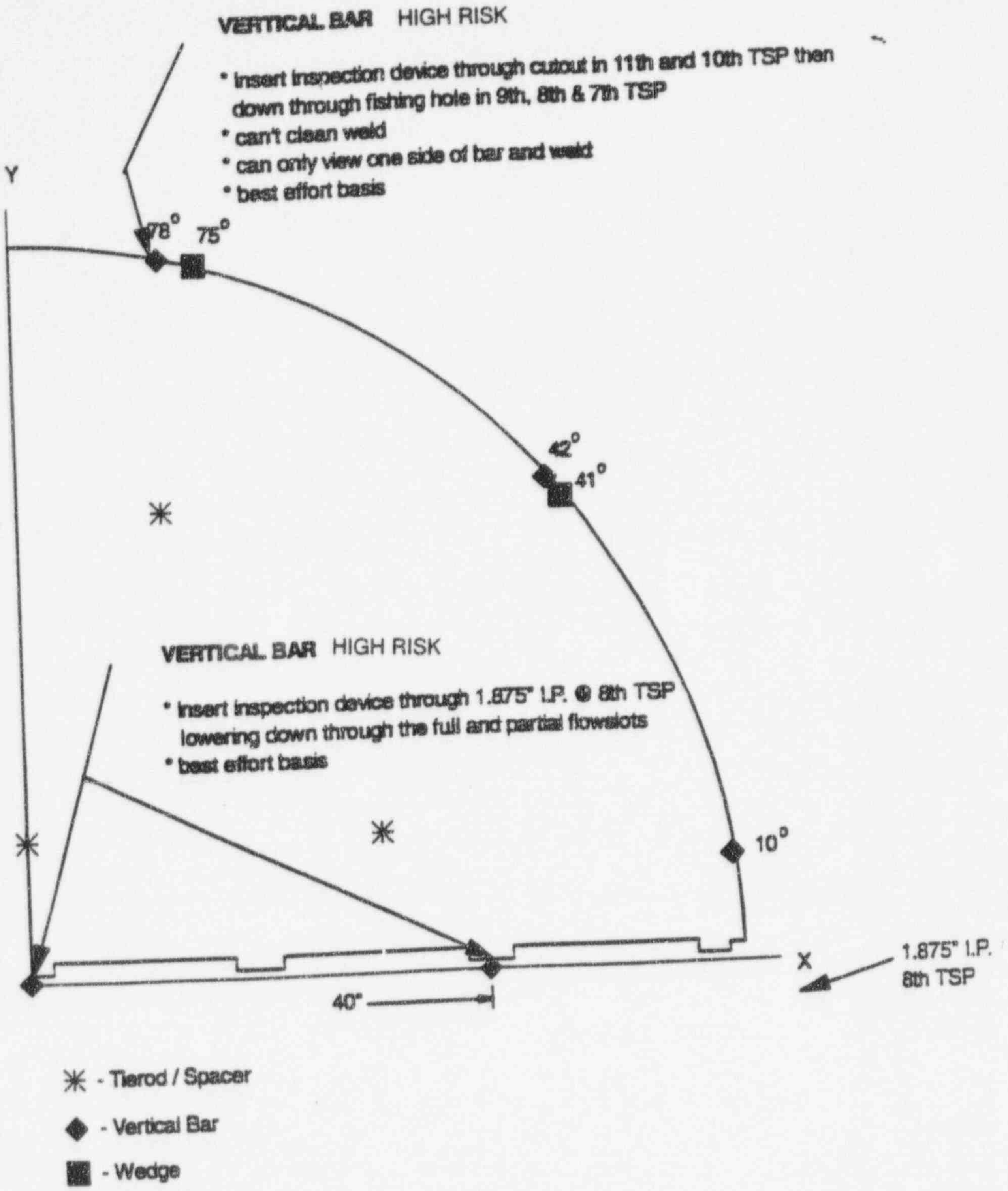


Plate F (5H) Support Locations

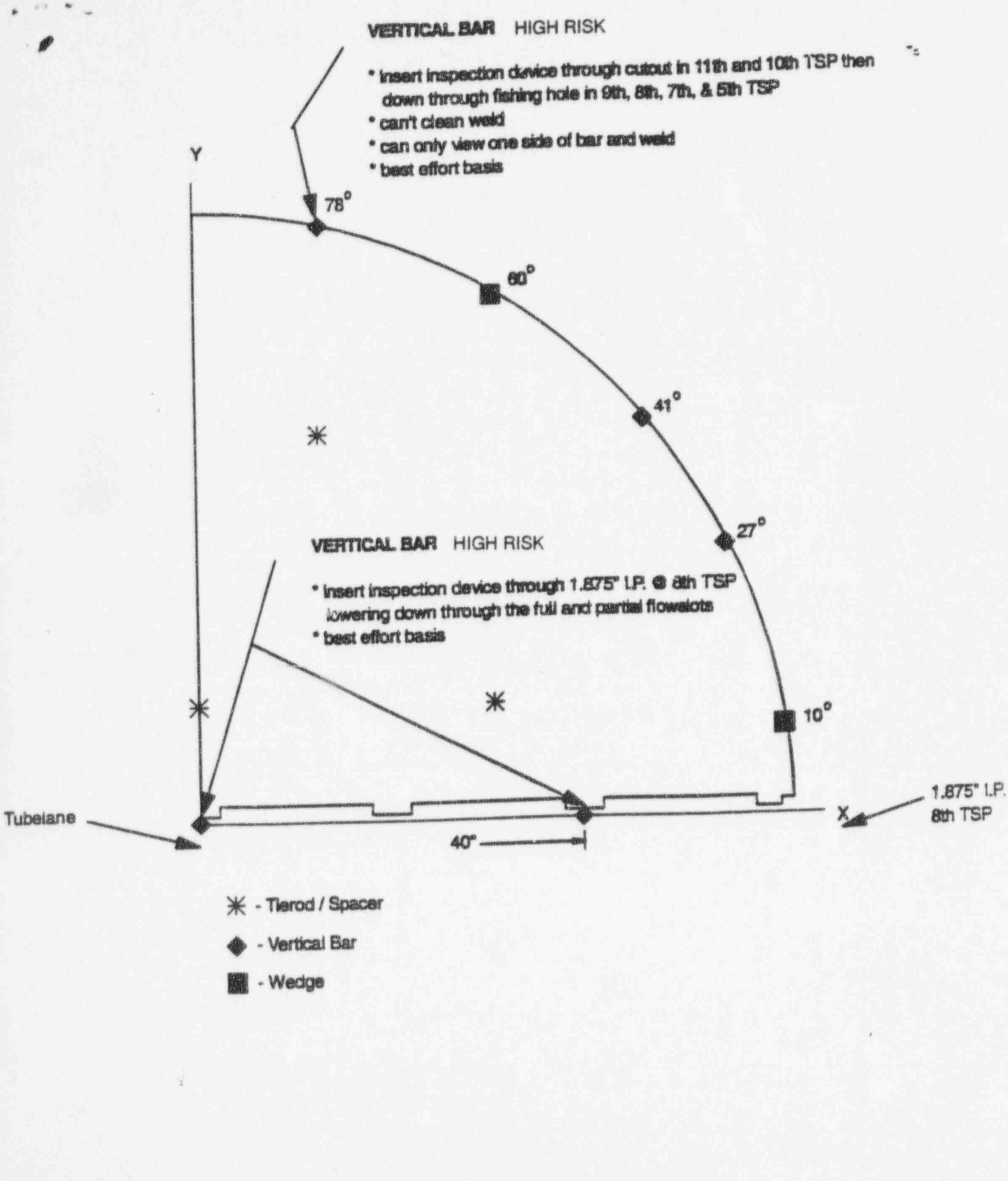


Plate C (3H) Support Locations

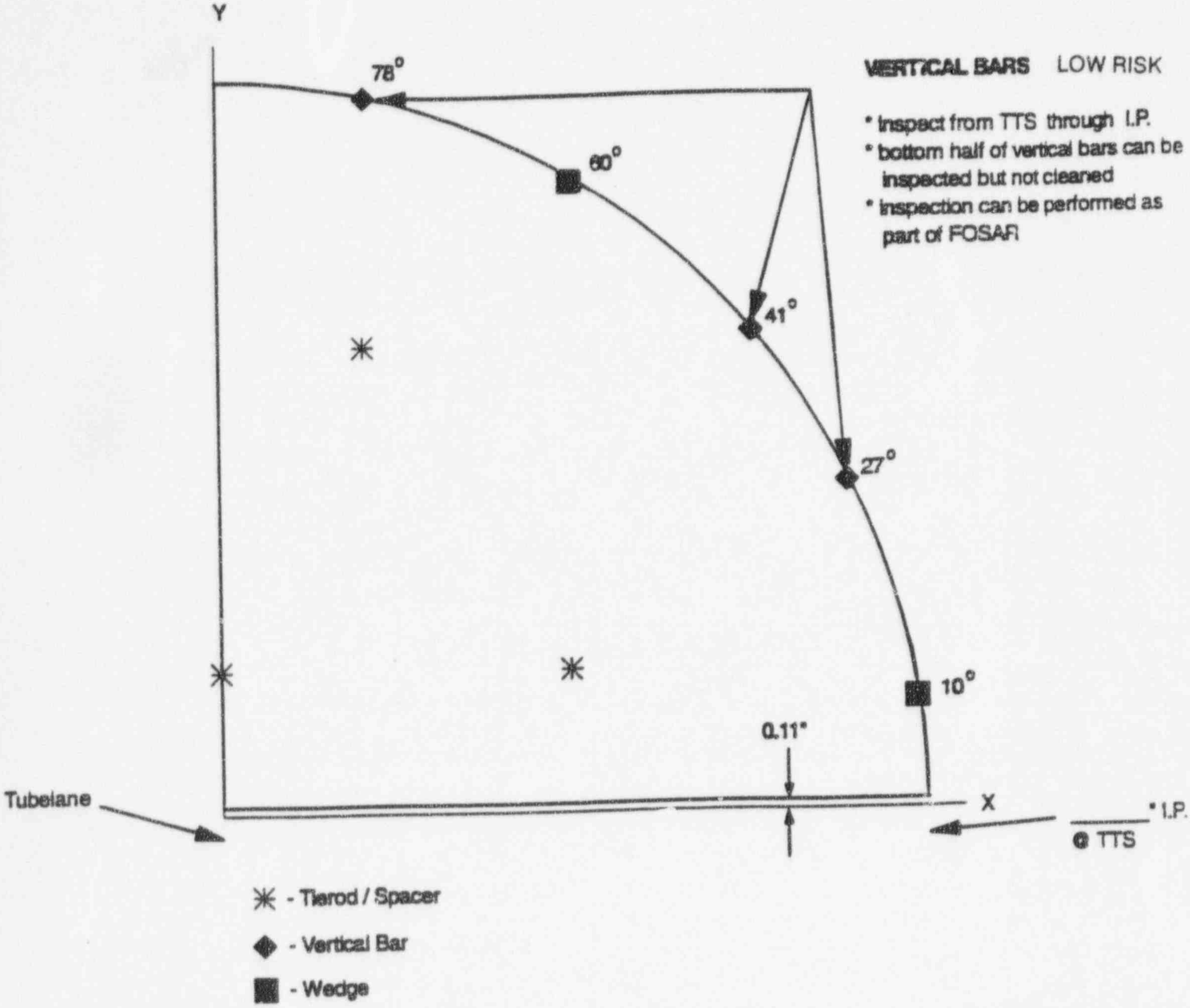


Plate A (1H) Support Locations