Jeffrey B. Archie
Vice President, Nuclear Operations
803.345.4214

SCE&G®
A SCANA COMPANY

October 19, 2006
RC-06-0190

Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Sir / Madam:

Subject: VIRGIL C. SUMMER NUCLEAR STATION (VCSNS)
DOCKET NO. 50/395
OPERATING LICENSE NO. NPF-12
SUPPLEMENTAL INFORMATION REGARDING REQUEST TO USE ALTERNATIVES TO ASME CODE REQUIREMENTS IN VCSNS THIRD INSERVICE INSPECTION INTERVAL (RR-III-03, RR-III-04)

References:
1. R. E. Martin (NRC) Electronic Communication to J. Turkett (SCE&G), "Request for Additional Information RR-III-03, III-04," September 20, 2006.
2. J. B. Archie (SCE&G) Letter (RC-06-0117) to Document Control Desk (NRC), dated June 20, 2006, Request to Use Alternatives to ASME Code, Section XI, Requirements in VCSNS Third Inservice Inspection Interval (RR-III-03, RR-III-04) (C-06-1703) [ML061720495]
3. NRC Letter to SCE&G, Virgil C. Summer Nuclear Station - Second 10-Year Inservice Inspection, Request for Relief RR-II-20, RR-II-20 ADDENDA, and RR-II-21 (TAC NO. MC0108), February 3, 2004, [ML040340450]

South Carolina Electric & Gas Company (SCE&G) hereby submits the attached requests for using alternatives to the examination requirements of the ASME Code. SCE&G has determined that the proposed alternatives will provide an acceptable level of quality and safety.

Relief Request RR-III-03 and RR-III-04 were originally submitted by the referenced June 20, 2006, letter (Reference 2). Both relief requests addressed the Inservice Inspection (ISI) examination for reactor vessel nozzle to pipe weld on the "B" reactor vessel hot leg. Both requests sought to obtain relief similar to that granted for VCSNS ISI Interval II through RR-II-20-ADDENDA.

SCE&G was requested to provide more detailed information in a July 31, 2006, teleconference between SCE&G, the VCSNS NRC Project Manager, and NRC technical reviewer.

A047

A detailed description of the proposed alternatives, including basis for relief, is included as attachments to this letter. SCE&G requests NRC review and approval of these requests by October 30, 2006 in order to apply to the VCSNS Examination Program during VCSNS refuel outage 16 currently scheduled for October 15, 2006.

Similar relief requests were previously submitted for the Second Inservice Inspection Interval and were approved by the NRC (Reference 3).

SCE&G is submitting the attached relief request in accordance with 10 CFR 50.55a(a)(3)(i).

Should you have any questions, please call Mr. Robert G. Sweet at (803) 345-4080.

Very truly yours,

Jeffrey B. Archie

JT/JBA/dr
Attachment

c: K. B. Marsh
S. A. Byrne
N. S. Carns
J. H. Hamilton, Jr. (w/o Attachments)
R. J. White
W. D. Travers
R. E. Martin
K. M. Sutton
F. A. Miller
D. G. Dobson
S. C. Smith
T. A. McAlister
NRC Resident Inspector
NSRC
RTS (C-06-1703)
File (810.19-2)
DMS (RC-06-0190)

**SOUTH CAROLINA ELECTRIC & GAS COMPANY (SCE&G)
RESPONSE TO
USNRC REQUEST FOR ADDITIONAL INFORMATION (RAI)
CONCERNING SCE&G REQUEST TO USE ALTERNATIVES
TO
ASME CODE REQUIREMENTS
IN V.C. SUMMER NUCLEAR STATION (VCSNS)
THIRD INSERVICE INSPECTION (ISI) INTERVAL**

Requested Information from request for additional information to issued September 20, 2006:

Based on a review of the licensee's submittal dated June 20, 2006 and the supplemental information dated August xx, 2006, the licensee's responses to the following requests for additional information (RAIs) are needed in order for the staff to complete its safety evaluation:

(1) In your submittal, you proposed the performance of an eddy current examination to supplement the ultrasonic examination in areas with rough surface condition. Discuss and confirm that the technique/procedure, equipment and personnel used in the eddy current examination meet the requirements provided in ASME Code, Section XI, 1998 edition with 2000 Addenda and the requirements in Section V as referenced in Section XI.

Response (1):

The requirements for Eddy Current examination of the inside surfaces of class 1 piping are currently not included in the ASME Code, Section V or Section XI. The usefulness of this approach is recognized and action is underway in the Code body to formalize this particular application as a supplemental exam. Task Group ECT Supplemental (Section XI) was formed and is currently charged with this task. There are a number of NRC representatives and consultants involved in the Task Group.

Note that there is further discussion on this issue under response to Question #4.

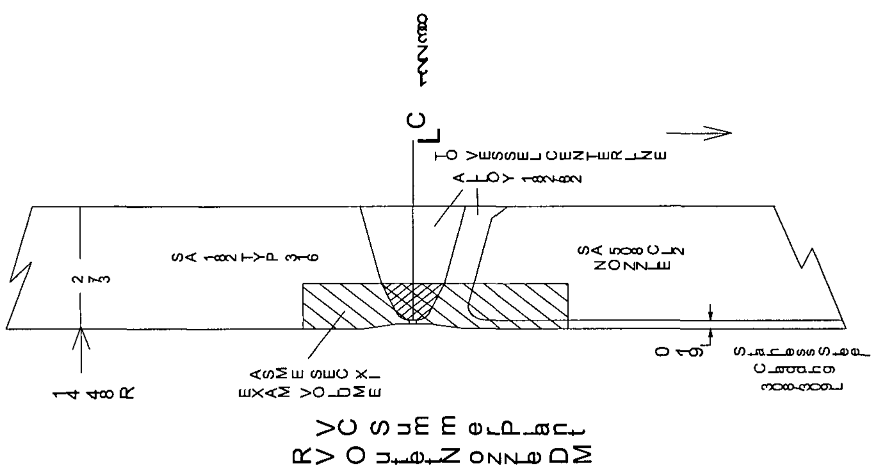
(2) The staff notes that the proposed alternatives in relief requests RR-III-03 and RR-III-04 apply to the inservice inspection of a reactor vessel bravo hot leg nozzle to pipe weld. Provide the following information pertaining to this weld: (a) weld identification number, (b) materials of nozzle, pipe and weld, (c) dimensions of nozzle, pipe and weld including outside diameter and wall thickness, (d) a sketch to show the configuration of the weld joint including the counterbore, weld root condition and other relevant surface condition that would affect the ultrasonic examination.

<u>Response (2):</u>

(a)	Weld ID	–	4200A-1DM,2
(b)	Nozzle material	–	SA508 Class 2 Carbon Steel Forging
	Pipe	–	SA-182 Type 316 Stainless Steel Forging
	Weld and Buttering	–	Inconel , Alloy 182/82
	Cladding	–	Type 308/309L
(c)	Inside diameter	-	28.97 inches
	Outside diameter	-	34.44 inches
	Thickness	–	2.73 inches estimated.

The counter-bore changes shape from essentially flat to typical indented counter-bore at various angular locations about the inner circumference. Conditions affecting ultrasonic probe contact include counter-bore, root protrusion, suck-back and mis-match. Any surface unevenness can contribute to transducer non-contact.

(d) Sketch



(3) For relief requests RR-III-03 and RR-III-04, identify specific code paragraphs and requirements language to which you have proposed alternatives in your submittals.

Response (3):

ASME Section XI, Table IWB-2500-1, Examination Category B-F, Pressure Retaining Dissimilar Metal Welds in Vessel Nozzles, Item B5.10 NPS 4 or Larger, Nozzle-to-Safe End Butt Welds. Examination method for which alternative is proposed is Volumetric. The current requirement is to perform this examination in accordance with procedures and personnel qualified in accordance with Section XI, Appendix VIII. Vendor limitations to these procedures in the areas of detection of axial flaws in the presence of counter-bore and depth sizing within .125" RMSE limit are the reasons for this request.

(4) In relief request RR-III-03, you proposed the use of Code Case N-695 with a RMSE of 0.189 inches instead of 0.125 inches for depth sizing. You also stated the examination vendors have qualified for detection and length sizing on these welds except meeting the established root mean square error (RMSE) requirement for depth sizing. However, this is not consistent with the discussion provided in relief request RR-III-04, indicating that the procedures used by the contracted inspection vendor are not fully qualified to the Appendix VIII, Supplement 10 as the procedure is fully qualified only for the detection and length sizing of circumferential flaws. Please clarify the discrepancy regarding the examination vendor's qualification. Since you propose the use of Code Case N–695 which was approved by NRC in Regulatory Guide 1.147, the examination vendor only needs to meet the requirements specified in the subject Code Case. If the statement in relief request RR-III-03 is correct, then the relief request RR-III-04 regarding the potential effect of surface roughness on UT examination is an issue pertaining to meeting the required extent of coverage, not an examiner's qualification issue, and the subject relief request should be modified, accordingly.

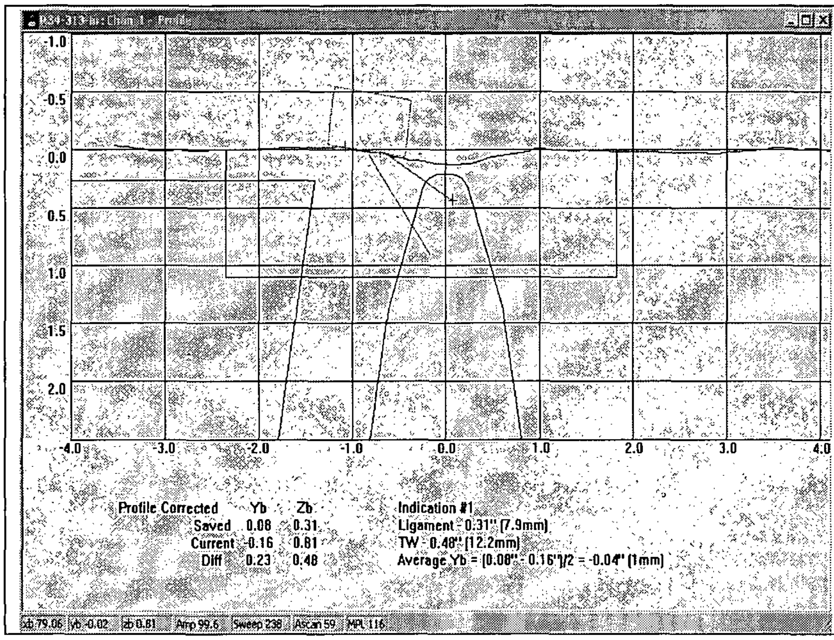
Response (4):

SCE&G fully appreciates there are two issues involved here and offers the following for clarity:

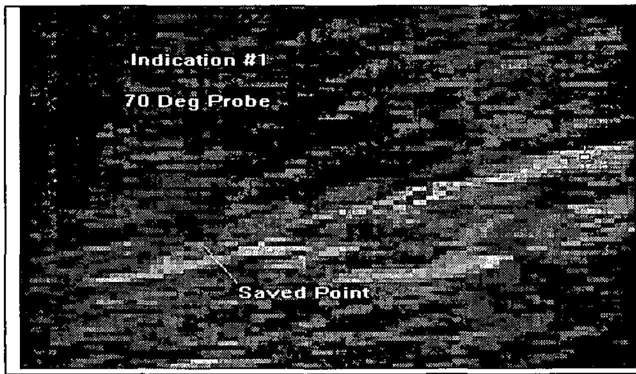
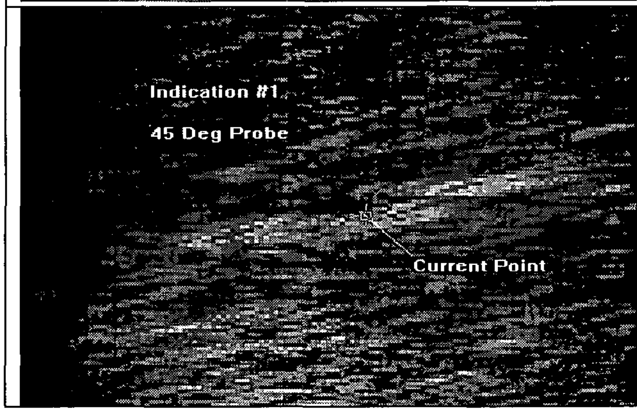
RR-III-03 is specifically requesting relief from the requirement to meet the 0.125 inch RMSE for depth sizing of any detected indications. RR-III-03 does not address any issues with the ability to detect flaws, but instead provides for the inability to depth size any detected flaws within the allowed tolerance (0.125 inch) RMSE accepted by the NRC. The relief request specifically indicates that if a flaw is detected during the course of the examination that requires depth sizing, the flaw will be sized within the limits of the examination technique (0.189 inch) RMSE and the difference (0.064 inch) between the 0.189 inch achievable RMSE and the 0.125 inch target RMSE will be added to the measured size of the flaw in the evaluation and analyses process.

RR-III-04 specifically requests relief from the qualification requirements of Appendix VIII of ASME Section XI, pertinent to the detection of axially oriented flaws. The vendor has demonstrated that under certain unfavorable ID geometry conditions the UT transducer may experience "liftoff" from the surface thereby inhibiting the ability to detect a flaw in the specific area that the "liftoff" has occurred. During the qualification process, the ultrasonic examiners concluded that transducer contact could not be maintained in certain areas of the specimen during scanning for axial defects. In the procedure performance summary issued by the Performance Demonstration Initiative (PDI), a limitation is noted for the detection of axial flaws in Supplement 10 field weld configurations.

As an alternative methodology to address the procedure detection limitation, SCE&G proposes to use advanced surface geometry profiling software to help the examiner confirm locations where the raw data indicates lack of transducer contact due to problematic surface geometry. In this technique, a focused immersion transducer is positioned ahead of the transducer bundle on the examination array. This transducer location permits accurate profile data across the exam volume with minimal tilt and jitter from the array. This data is translated into a scale representation of the exam surface where specific points in the raw data can be imported as presented in the following discussion:



For Indication #1, the 70° probe data provided the best estimate of the upper planar flaw boundary and the 45° probe data provided the best estimate of the lower planar flaw boundary. Both points are shown in the beam plots in the Profile View and are documented (Yb and Zb positions) in the left table below the plot. The 'Diff' is the arithmetic difference between the 'Saved' and 'Current' coordinates. The 'Saved' Zb point is the ligament to the ID surface. The through-wall depth of the planar flaw is the 'Diff Zb'. The flaw location is the average between the 'Saved' and 'Current' positions.

	The 70° probe data shows a target motion line at a depth shallower than the depth with the 45° probe data. Double left clicking on the mouse button with the cursor on the center of the target motion line displays the beam plot in the Profile View corrected for the ID surface contour. This point is then saved on the Profile View. The point is marked on the Profile View by an '+' and the corrected Yb and Zb coordinates are shown in the table below the beam plot as 'Saved'. This point is to be taken as the upper planar flaw boundary.
	The 45° probe data shows a deeper target motion line indicative of the lower planar flaw boundary. Double left clicking on the mouse button with the cursor on the center of the target motion line displays the beam plot in the Profile View corrected for the ID surface contour. The point is marked as the end of the line emanating from the probe. The corrected Yb and Zb coordinates are shown in the table below the beam plot as 'Current'. This point is taken as the lower planar flaw boundary.

With this data the examiner can adjust flaw bounding dimensions, determine metal ligament if applicable, and better judge if limitations apparent in the raw data can be supported by local surface profile data. This last feature is the more important capability of the process as it pertains directly to the potential adverse surface geometry of the VCSNS primary loop dissimilar metal welds. The process is as follows:

1) Regular 22mm x 22mm (0.86" x 0.86") transducers for detection of circumferential defects. This is the "standard technique" qualified for detection and length sizing. These transducers will also be used initially for axial defect scans.
2) 100% profiling of the nozzle to primary piping dissimilar metal weld ID surface.
3) Evaluation of the raw data for transducer contact and profile data for supporting evidence.

Additionally SCE&G proposes to use Eddy Current examination techniques to interrogate the surface of the examination volume for this dissimilar metal field weld. Eddy current data will be used to provide assurance of detection of surface breaking defects in those areas identified by the examiner as limited in the ultrasonic data. The eddy current probes are pencil-sized and spring loaded, allowing them to more closely follow the surface geometry of counter-bore, mismatch and root protrusions.

Eddy current acquisition techniques will be essentially the same as those used in the Second 10 Year ISI examination according at VCSNS. Two Plus-Point probes in the driver pickup mode are planned.

The eddy current characterization criteria in this procedure were developed experimentally through investigations conducted on the VCSNS Loop "A" dissimilar metal weld removed from service in 2000. A correlation will be conducted between the eddy current data and areas where the ultrasonic examination may have been limited.

It is SCE&G's position that compensating for the flaw through-wall sizing error band in fracture mechanics evaluation and the procedure/equipment enhancements will assure detection and will provide an acceptable margin of safety for the in-service examinations of VCSNS reactor vessel nozzle to primary loop dissimilar metal field welds.

(5) Provide additional discussion with graphical assistance to explain the reasons that the surface roughness will only affect the detection of axial flaw, not the detection of circumferential flaw and the sizing of axial flaw. Also discuss what are the acceptance criteria for the surface roughness when analyzing the profiling data and their bases.

Response (5):

The qualification exercise is a blind test, defined as a test where the vendor does not have specific knowledge of the locations or sizes of flaws. It is correct that detection was achieved without limitation for circumferentially oriented flaws and was limited for axial. Since the vendor has no specific knowledge of axial defect size, location, morphology or the proximity of the flaw to surface geometry in the test set, it is not possible to model the condition causing non-detection of the axial flaw. Accordingly, with the same lack of specific information, the vendor is not able to illustrate the manner in which successful detection of circumferential flaws is achieved. Specific information regarding vendor procedure limitations resides with PDI, the administrators of the test.

The acceptance criteria for surface roughness is simply evidence of surface roughness consistent with the limiting statement in the performance demonstration qualification summary (PDQS). The PDQS states a limitation for detection of axial flaws in the presence of counter-bore. The exam team will look at surface profile measurements of the weld and identify areas inside the examination volume at the inside diameter surface where counter bore is present. These areas are considered limited. Thus the Eddy Current test methods are applied for detection of service induced surface breaking flaws.

(6) In your discussion of eddy current technique, you stated that the target flaw size for the eddy current procedure is 0.28 inches long, which is well within the ASME code linear flaw acceptance standard of 0.45 inches long for austenitic materials. Please provide additional discussion regarding the following: (a) the definition and meaning of target flaw size and how it was determined and (b) identify the specific ASME Code Table that provides the referenced acceptance standard of 0.45 inches for austenitic materials.

Response (6):

The target size of 0.28 inches is the minimum size detection capability achieved in a rigorous Swedish SQC qualification program for the Ringhalls reactor vessel examination. Since the qualification criteria for this method is currently under development in the USA, this prior effort remains the basis for qualification experience. The 0.45 inch length value comes from Section XI, Table IWB-3514-2, Inservice Examination, Surface Exam Method. The surface flaw length identified for 2.0 inch wall thickness is 0.45 inches. Even though the VCSNS wall thickness is approximately 2.7 inches, 0.45 inches is a conservative value.

(7) Discuss the reasons why vendors fully qualified to Code Case –695 can not be contracted to perform the subject examination. Also describe your current and future effort in contracting fully qualified vendors to perform the subject examinations.

Response (7):

As of the date of this response, the through-wall sizing limit of 0.125 inch RMS has not been achieved by any vendor (even with numerous attempts) because there are some ultrasonically problematic materials in some of the samples leading to exaggerated sizing measurement. The ASME Code is addressing this issue in part by re-opening the Task Group for Cast Stainless Steel Pipe. The charter of this group will be to investigate and develop a qualification methodology for cast materials. Hopefully this will lead to more realistic qualification criteria.

Relative to the detection limitation for axially oriented flaws, this limitation exists only in the presence of ID geometries that impact the ability of the transducer to maintain contact with the ID surface during the scan. In the absence of such geometry, the selected vendor does not experience such a limitation. In an effort to be proactive and assure the highest degree of success in our examination, VCSNS has determined that the application of the additional examination techniques is prudent and conservative.

The use of the ID profiling and the ET during this examination will confirm whether the qualified UT techniques are within their limitations for the detection of planar flaws. If this ID profiling confirms the presence of counter-bore, the ET methodology will assure that we have achieved an examination that has adequately assessed the integrity of the subject weld. Our vendor has provided a high degree of reliability and accountability in approximately 12 similar examination scenarios in the last 2-3 years. In those cases, the utilities, with NRC concurrence, satisfied concerns for plant safety in the combined ET/UT approach.

Additional requests for information pertaining to the WestDyne examination procedures were presented to SCE&G during a conference call on October 11, 2006.

(8) The NRC reviewer, Mr. William Koo, indicated he desired a review of the WesDyne eddy current procedure relative to the requirements of ASME Code, Section V, Article 8.

Response (8):

The eddy current inspection of the nozzle safe-end welds at VCSNS is a supplemental examination. Ultrasonic inspection techniques are the primary in-service inspection of the weld. Ultrasonic techniques are intended to perform a complete volumetric inspection of the weld. However, there is a region near the inside surface of the weld where incipient degradation could go undetected. The eddy current inspection is intended to fill that gap.

Within the ASME Code Section V Article 8 there is no specific reference to using eddy current techniques for the surface inspection of non-magnetic components other than tubular products as used in heat exchangers. However, the WesDyne procedure (WDI-STD-146, Rev 6) used to inspect the safe-end welds was developed to incorporate the concepts embodied in the Article 8 (T-810 to T-892).

The safe-end weld inspection procedure (WDI-STD-146, Rev 6) is structured to follow the flow of the inspection process and therefore does not follow directly the sections T-810 through T-892. The concepts embodied in Article 8, however, have been integrated into the procedure. For example, the process essential variables and their control (T-823, T-830, T-832) are identified in Sections 1, 4, 5, 6 and 8 and in Appendices 2 and 3 of the procedure, while inspection documentation T-890 is identified in Sections 6, 8, 9, 11, 12 and 13 and Appendix 4. In all cases, the procedure is structured so that the inspection process is both documented and reproducible.

(9) The NRC reviewer, Mr. William Koo, indicated that he had some degree of question relative to why the WesDyne UT process had a limitation for detection of axial flaws and did not have a limitation in the detection of circumferential oriented flaws.

Response (9):

WesDyne Procedure PDI-ISI-254-SE is an ultrasonic examination procedure for the detection and measurement of flaws in the nozzle to safe end and safe end to pipe welds with a nominal pipe diameter greater than 24 inches. Examinations performed according to this procedure are conducted exclusively from the inside diameter of the pipe using an automated ultrasonic data acquisition system and a robotic scanner. Ultrasonic data is collected, processed and analyzed using the WesDyne Paragon system. The procedure was demonstrated and qualified in accordance with the ASME Code, Section XI, Appendix VIII for examinations of Supplement 2 (austenitic steel), Supplement 3 (ferritic steel), and Supplement 10 (dissimilar metal). At the conclusion of testing, the PDI (Performance Demonstration Initiative) issued a PDQS (Performance Demonstration Qualification Summary) for the procedure and examiners. This document states a limitation of the procedure as follows:

> "This procedure/candidate is not qualified to detect axial flaws in either supplement 2 or 10 welds that are not either ground or machined smooth with no exposed root or counterbore".

This limitation refers to surface condition of the component under examination and describes the conditions and flaw orientation under which WesDyne may not claim unlimited detection. As stated, for axial flaws, the surface condition must be machined or ground smooth for detection to be claimed without limitation.

As stated in a previous response to similar questions, WesDyne has no information of the exact nature of the axial flaws that were not successfully detected in the procedure qualification exercise. It is against the security protocol of the PDI test administrators to divulge information regarding the actual sizes, orientations and locations of flaws to the exam team. In this particular qualification, the position of the flaw within surface geometry was also not disclosed to the exam team. Since the non-detection involved surface geometry, it is a reasonable assumption that the problematic axial flaws were located within a surface bump and, at that particular point, the transducer is not able to make full intimate contact with the surface for proper transmission of ultrasound to the flaw.

Detection of circumferential flaws was accomplished without limitation in the qualification exercise, and no limitations are noted on the PDQS. The fact that circumferential flaws are detectable in the presence of geometry, and axial flaws were not detected in the same geometry, is understandable considering the differences in beam approach and transducer position on the surface.

In Figure 1, two circumferential flaws are depicted within an ID surface geometry having a counterbore and root protrusion. Section AA depicts a crack at the edge of the counterbore. Even though the flaw is located in a surface ridge, the transducer does have a good "look" at the flaw from one direction with the beam directed perpendicular or normal to the flaw. In Figure 1, a second circumferential flaw is depicted in Section BB. This flaw is located in the root protrusion, but detection is still possible since the transducer does not interact with the root bump and instead is able to transmit sound perpendicular to the flaw from the flat land on either side of the root.

In Figure 2, the same surface geometry is shown with a small axial flaw intersecting the root bump. In Section CC, we see the transducer does not have intimate contact with the surface and actually makes contact with a very small part of the crown of the bump during circumferential scanning. As a result, there is always a certain amount of water gap between the transducer and the surface. The transducer does not function properly in this orientation and inadequate sound penetration occurs. It is under this condition that a non-detection of an axial flaw could occur.

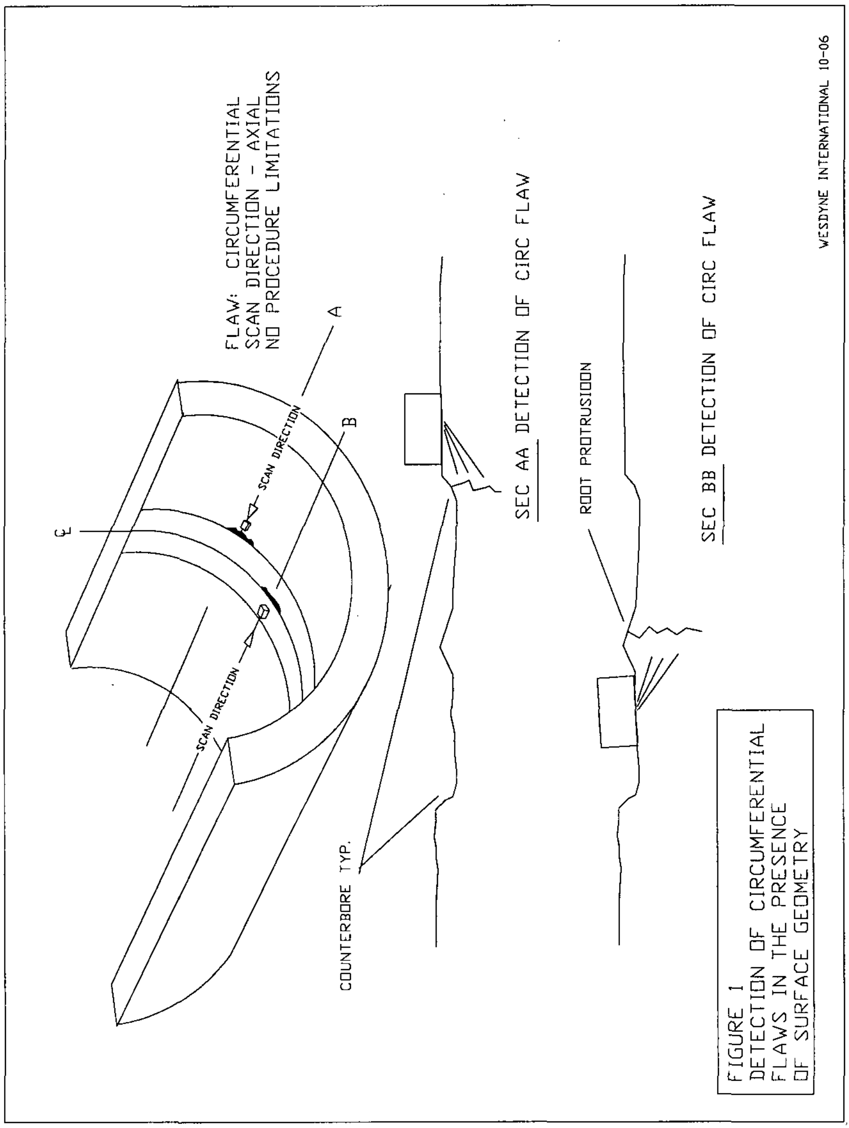


FIGURE 1
DETECTION OF CIRCUMFERENTIAL
FLAWS IN THE PRESENCE
OF SURFACE GEOMETRY

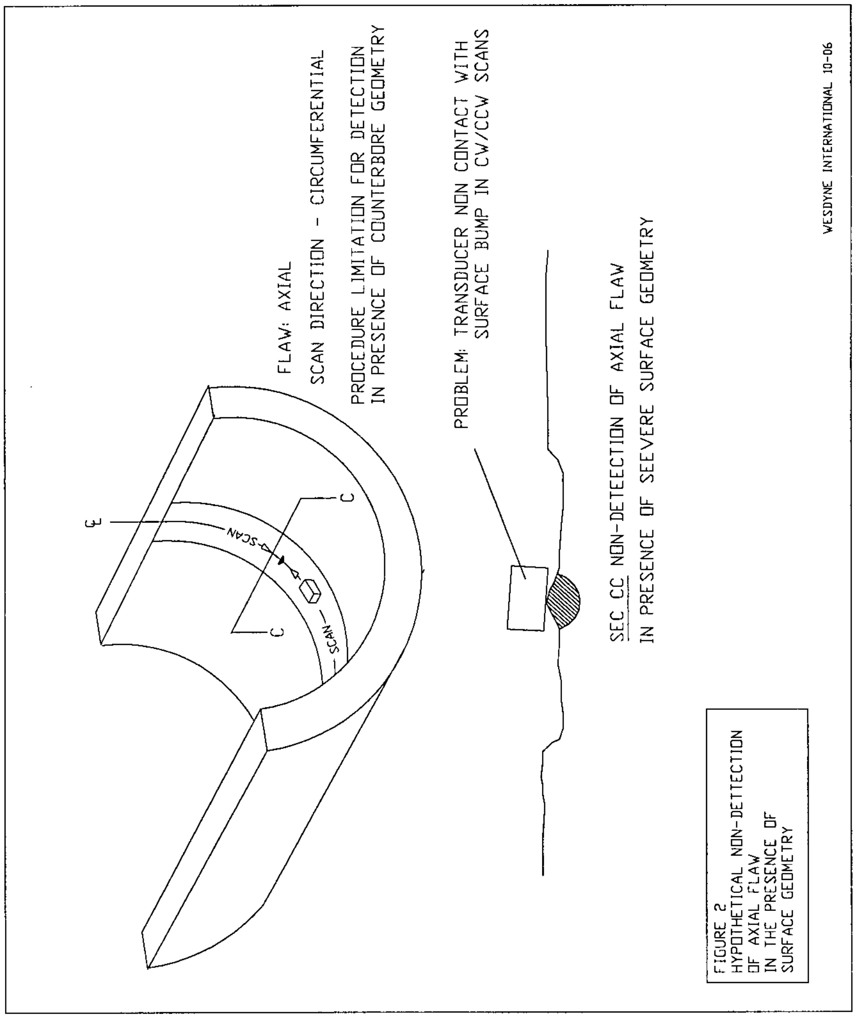


FIGURE 2
HYPOTHETICAL NON-DETECTION
OF AXIAL FLAW
IN THE PRESENCE OF
SURFACE GEOMETRY