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April 8, 2004

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station OP1-17
Washington, DC 20555

SUSQUEHANNA STEAM ELECTRIC STATION
PROPOSED RELIEF REQUEST NO. 31 TO THE
SECOND 10-YEAR INSERVICE INSPECTION PROGRAM
FOR SUSQUEHANNA SES UNIT 1
PLA-5744 **Docket No. 50-387**

References: 1) *PLA-5740, B. L. Shriver (PPL) to USNRC, "Proposed Relief Request No. 29 to the Second 10-Year Inservice Inspection Program for Susquehanna SES Unit 1," dated March 26, 2004.*

2) *PLA-5741, B. L. Shriver (PPL) to USNRC, "Proposed Relief Request No. 30 to the Second 10-Year Inservice Inspection Program for Susquehanna SES Unit 1," dated March 26, 2004.*

3) *PLA-5743, B. L. Shriver (PPL) to USNRC, "Proposed Relief Requests No. 29 and 30 to the Second 10-Year Inservice Inspection Program for Susquehanna SES Unit 1," dated April 7, 2004.*

This letter requests NRC approval of Relief Request No. 31 in support of the current refueling and inspection outage to complete the Inservice Inspection repair plan within the scope of Generic Letter 88-01. This relief is requested under the provisions of 10 CFR 50.55a(a)(3)(i). The repair plan per the requirements of Generic Letter 88-01 for the recirculation inlet reactor pressure vessel (RPV) nozzle to safe-end weld (N2J) will be used as an alternative to 10 CFR 50.55a(c)(3)(iv). The repair plan uses a weld overlay repair that represents an alternative to "American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code," Section XI Code repair. The repair plan is similar to that proposed in Reference 1 as supplemented by Reference 3. The Reference 2 Relief Request 30, which identifies that it will be applied to the Inservice Inspection repair plan for the N1B, will also be applied to the N2J repair plan as supplemented by Reference 3. It should be noted that the N1B nozzle (subject of Reference 1) and the N2J nozzle are in different loops of the Unit 1 Reactor Recirculation system.

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A weldment associated with the recirculation inlet nozzle (N2J) has been inspected during the current refueling and inspection outage (U1 13th RIO). An indication has been identified and characterized as a circumferential planar flaw located in the Alloy 182 butter on the safe end and the Alloy 182 weld metal. A repair plan has been developed to restore the weldment to be able to meet or exceed original Code design requirements.

The repair plan includes use of ASME Code Cases N-638 and N-504-2. Certain exceptions taken to these two Code Cases have been approved by the ASME and have been approved by the Nuclear Regulatory Commission (NRC) in Regulatory Guide 1.147, Revision 13. Exceptions to Code Case N-504-1 (an earlier version of N-504-2), which are similar to PPL's request contained in this proposed Relief Request, have been approved by the NRC for the Duane Arnold Energy Center (NRC letter dated November 19, 1999), and more recently for Nine Mile Point Unit 2 (NRC letter dated March 30, 2000). This proposed Relief Request is similar to those submitted by Pilgrim on October 2, 2003 and by TMI on November 3, 2003. The repair plan presented by PPL in the Relief Request is an alternative to the requirements of 10 CFR 50.55a(c)(3)(iv).

Based on the evaluations contained in the Relief Request, PPL has concluded that this alternative provides an acceptable level of quality and safety and that strict adherence to the specified requirements would result in unusual difficulty without a compensating increase in the level of quality and safety. Therefore, this proposed alternative satisfies the requirements of 10 CFR 50.55a(c)(3)(i) and 10 CFR 50.55a(c)(3)(iii).

Review and approval of the proposed Relief Request is requested prior to unit startup. PPL will keep the NRC Project Manager apprised of the schedule.

There are no new commitments made in this letter. If you have any questions, please contact Mr. Michael H. Crowthers at (610) 774-7766.

Sincerely,

B. L. Shriver

Enclosure– Relief Request No. RR-31
Attachments:
Attachment 1 - Weld Sketch
Attachment 2 - EPRI NDE Center Summary Report

copy: NRC Region I
Mr. R. V. Guzman, NRC Project Manager
Mr. S. Hansell, NRC Sr. Resident Inspector
Mr. R. Janati, DEP/BRP

ATTACHMENT TO PLA-5744

RELIEF REQUEST NO. RR-31

PPL SUSQUEHANNA, LLC
SUSQUEHANNA SES UNIT 1
SECOND 10-YEAR INTERVAL
RELIEF REQUEST NO. RR-31

COMPONENT IDENTIFICATION

A full structural weld overlay repair is proposed for the N2J recirculation system inlet nozzle. The current configuration of this nozzle is described below.

The N2J recirculation inlet nozzle to safe-end configuration consists of a type 316L safe-end welded to a SA 508 Cl 2 nozzle. The ends of the safe-end and nozzle were buttered with Alloy 182 weld deposit and subsequently joined with a weld having an Alloy 82 root and hot passes with Alloy 182 fill.

The thickness of the nozzle pipe and original 182 butter are as follows:

Nozzle	1.33 inches
Pipe	1.01 inches
Original 182 butter	See the Sketch in Attachment 1
Final overlay weld	.44 inch

In addition, the thickness of the safe end is the same as the nozzle. The weld overlay was designed assuming a flaw 360 degrees in circumference, 100 % through wall.

The original weld and base metal configuration and the final weld and base metal configuration with the overlay including the final thickness of the overlay are shown in the sketch provided in Attachment 1.

The flaw associated with the N2J recirculation inlet nozzle is located in the weld between the nozzle and the safe-end. It originates in the butter on the safe end side of the nozzle to safe-end weld, and extends to a maximum depth of 0.94 inches from the inside diameter. The thickness of the safe-end at the flaw location is approximately 1.33 inches, and thus, the depth corresponds to approximately 71% through-wall penetration. The flaw runs approximately 12.1 inches in length around the circumference of the safe-end. Since the safe-end is approximately 14.25 inches in diameter at the location of the flaw, the "flaw length to pipe circumference" ratio is approximately 27%.

The ultrasonic data from the flaw has characteristics indicative of a multifaceted and branching indication propagating in a direction consistent with a stress corrosion crack in weld material, which generally follows the dendritic structure of the weld. This type of response is not consistent with the expected responses from a thermal fatigue flaw, which are typically not faceted. The ultrasonic responses from this flaw are also consistent with other IGSCC flaws detected in the industry.

The past examination data reported various types of indications. These results are similar to "Inside Surface Geometry" features discussed in Reference 3. These indications, however, were not required to be reported to the plant for disposition. These were reported simply as notes on the examination data sheets. The level of detail provided from one examination to the other varied with the particular analyst. The present PDI qualified procedure requires all indications, regardless of amplitude, be evaluated and addressed.

The EPRI report (Attachment 2) contains numerous prints that show the location of the previously reported indications and the newly reported crack. It is believed that the previously reported indications were actually the crack. The crack is believed to have been identified in 2004 and not previously because of the improved and newly qualified techniques used in 2004. Improved data collection and analysis allowed the previously reported indications to be more accurately determined to be the reported crack.

Three major changes have occurred from the previous techniques to the newly qualified techniques. 1) The data analysis software is much improved from previous examinations performed prior to 1999. This new software allows the viewing of the data in numerous, coordinated views (A, B, C and D scans). These views make it easier for the examiner to assure adequate contact and coverage is obtained. 2) The amplifier was changed from a linear to a logarithmic amplifier with a much larger dynamic range. This allows the examiner to view the data with a much larger range of gain levels and reduces chances of saturating the signals or running at a gain level that is too low. 3) Search units used with the present PDI qualified procedure are larger and focused closer to the inside surface of the component than the search units used for previous examinations. This results in greater sensitivity for inside surface breaking flaws.

EXAMINATION AND REPAIR REQUIREMENTS

A weld overlay repair has been designed consistent with the requirements of NUREG 0313 Revision 2 (which was implemented by Generic Letter 88-01), ASME Code Case N-504-2, and ASME, Section XI, Paragraph IWB-3640, 1989 Edition with Appendix C (1989 Addenda).

The Code of Record is ASME Section XI 1989 Edition. The present interval is the second. The original code of construction for the reactor vessel nozzle is ASME Code

Section III 1968 Edition up to and including 1970 Summer Addenda. The safe end was fabricated and installed to the ASME Code Section III 1974 Edition with the Summer 1974 Addenda.

WELDER QUALIFICATION AND WELDING PROCEDURES

All welders and welding procedures will be qualified in accordance with ASME Section IX and any special requirements from Section XI or applicable code cases. A manual shielded metal arc weld (SMAW) procedure will be qualified to facilitate localized repairs and to provide a seal weld, prior to depositing the overlay, should the defect be deep enough to be near through-wall or through-wall and leaking. This procedure will make use of SMAW electrodes ENiCrFe-7, UNS W86152, F No. 43, known commercially as Alloy 152. The weld overlay repair will be performed by qualified personnel from WSI. Welding Procedure Specification (WPS 03-08-T-801, Rev. 1) for welding ERNiCrFe-7, UNS N06052, F No. 43 (commercially known as Alloy 52) will be used.

Welding Wire Filler Material

A consumable welding wire highly resistant to intergranular stress corrosion cracking (IGSCC) and interdendritic stress corrosion cracking (IDSCC) was selected for the overlay material. This material, designated UNS N06052 F No. 43 is a nickel-based weld filler material, commonly referred to as Alloy 52, and will be applied using the GTAW (Gas Tungsten Arc Welding) Machine TIG process. Alloy 52 is identified in ASME Section II, Part C as SFA-5.14, ERNiCrFe-7, classification UNS N06052 F No. 43 Filler Material. Alloy 52 contains a nominal 30% Cr that imparts excellent resistance to IGSCC. Where localized repairs are required, Alloy 152 may be used. Alloy 152 is identified in ASME Section II, Part C as SFA-5.11, ENiCrFe-7, classified as UNS W86152. Alloy 152 also contains a nominal 30% Cr that imparts excellent resistance to IGSCC.

Weld Overlay Design

The weld overlay will extend around the full circumference of the safe end to nozzle location in accordance with NUREG 0313 Rev. 2, Code Case N504-2, and Generic Letter 88-01. The overlay length will extend across the projected indication intersection with the outer pipe surface. The design thickness and length will be computed according to guidance provided in ASME Section XI, Code Case N-504-2 and ASME Section XI Paragraph IWB-3640, 1989 Edition with Appendix C (1989 Addenda). The overlay completely covers the defect location and other Alloy 182 susceptible material areas with the highly corrosion resistant Alloy 52 material. Ten (10) layers of weld material are planned to be applied. The final number of layers will be determined based on the number of layers needed to meet the thickness requirement of the overlay. A temper bead welding approach will be used for this repair, because it will be necessary to weld on the P3 Group 3 low alloy steel (LAS) nozzle material. ASME Code Case N-638 will be applied because it provides for machine (GTAW) temper bead weld repairs to P3 Group 3 materials at ambient temperature using dissimilar materials and without need for post weld heat treatment. The temper bead approach was selected because temper bead welding supplants the requirement for post weld heat treatment (PWHT) of heat affected zones in welded LAS material. Temper bead techniques produce excellent toughness and ductility in heat affected zones of the LAS. This approach provides a comprehensive weld overlay repair, and increases the volume of material under the overlay that can be inspected. The weld overlay length will conform to the guidance of Code Case N-504-2, which satisfies the stress requirements.

Examination Requirements

The examination requirements for the weld overlay repairs are summarized in the following table.

Note: No post weld inspections may be performed until after a 48 hour waiting period has elapsed after completing the weld. This is required to be able to identify any possible hydrogen delayed cracking that might occur.

EXAMINATION REQUIREMENTS			
Examination Description	**Method**	**Technique**	**Reference**
Weld and Safe-End Overlay Surface Preparation Exam	PT	Visible Dye	N-504-2
Thickness Measurements	UT	0° Long.	N-504-2
As-Found Exam	Auto UT	45° Ref. Long. 60° Ref. Long. 70° Ref. Long.	IWB-3514
As-Found Sizing	Auto UT	60° Ref. Long. 70° Ref. Long.	IWB-3514
First Weld Overlay Layer Surface Exam	PT	Visible Dye	N-504-2
First Weld Overlay Thickness Checks	UT	0° Long, or Hand Meas.	N-504-2
Surface Exam of Nozzle within 1.5 t of Weld overlay	PT	Visible Dye	NB-5350 N-638
Surface Exam of Completed Overlay	PT	Visible Dye	N-504-2
Exam of Completed Overlay for Lack-of-Bond and Thickness	UT	0° Long.	IWB-3514 N-504-2

EXAMINATION REQUIREMENTS			
Examination Description	**Method**	**Technique**	**Reference**
Volumetric Exam of Nozzle within 1.5 t of Weld Overlay	UT	In accordance with Appendix I. Nozzle geometry will limit this examination.	IWB-3500 N-638
Volumetric Exam of Completed Overlay	UT	Angle beam exam in accordance with qualified P.D.I. procedure implementing Appendix VIII.	IWB-3514 N-504-2
Pre-Service Exam of Completed Overlay and the Outer 25% of the underlying pipe wall to identify the original flaws.	UT	Angle beam exam in accordance with qualified P.D.I. procedure implementing Appendix VIII.	IWB-3514 N-504-2

General Note: The Edition and Addenda for the ASME Section XI acceptance criteria is the 1989 Edition with no Addenda. The weld overlay examinations comply with the recommendations of NUREG-0313, Revision 2, and also with Code Case N-504-2.

There is no ASME Section III Subsection that directly applies to inspection acceptance criteria for weld overlays. NUREG-0313 and Code Case N-504-2 specify an ultrasonic volumetric examination, using methods and personnel qualified through the EPRI NDE Center. Furthermore, NUREG-0313 states that the ultrasonic examinations should be performed in accordance with the requirements of the applicable edition of the ASME Code. The Code of record for the current 10-year in-service inspection interval is the 1989 edition of ASME Section XI with no Addenda. Therefore, the acceptance criteria that will be used for the volumetric examinations will be those of IWB-3514, "Standards for Examination Category B-F, Pressure Retaining Dissimilar Metal Welds, and Examination Category B-J, Pressure Retaining Welds in Piping."

Pressure Testing

The completed repair shall be given a system leakage, in-service or functional test in accordance with ASME Section XI, IWA-5000.

Unusual Difficulty in Meeting Specified Requirements

Preheat and post weld heat treatments (PWHT) are required for welding on P3 Group 3 LAS nozzle material by ASME Section III, Subparagraph NB4622.7. These requirements are impractical without draining the reactor vessel, and may even distort the P3 components involved (nozzle and reactor pressure vessel). To drain the vessel requires a full-core fuel offload. If the vessel were drained, the radiation dose rates around the nozzle would increase significantly, resulting in additional personnel exposure. Therefore, consistent with ALARA practices and prudent utilization of outage personnel, there will be no vessel drain down for this repair. The weld overlays will be completed with water on the inside surface of the nozzles and connected piping. This approach (i.e., no vessel drain down) minimizes fuel movement and thereby enhances nuclear safety.

The alternative, as described below, provides an acceptable level of quality and safety while neither draining the reactor vessel nor applying preheat and post weld heat treatments. Therefore, the alternative alleviates the impracticality of following certain code requirements for this repair activity.

ALTERNATIVE FROM REPAIR REQUIREMENTS

The repair will utilize ASME Code Case N-504-2, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping," and Code Case N-638, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique," with the following exceptions and clarifications.

Clarification of Code Case N-504-2 for Applicability to Nickel-based Austenitic Steel

Code Case N-504-2 was prepared specifically for austenitic stainless steel material. An alternate application to nickel-based austenitic materials (i.e. Alloy 52) is requested due to the specific configuration of the nickel-based austenitic weldment.

Exception to Code Case N-504-2 Paragraph (b)

Code Case N-504-2 paragraph (b) requires that the reinforcement weld metal shall be low carbon (0.035% maximum) austenitic stainless steel. A nickel-based filler is required and Alloy 52 has been selected in place of low carbon austenitic stainless steel.

Exception to Code Case N-504-2 Paragraph (e)

Code Case N-504-2 paragraph (e) requires as-deposited delta ferrite measurements at least a 7.5 FN for the weld reinforcement. These measurements are not to be performed for this overlay, as the nickel filler is a fully austenitic material, containing no ferrite.

Clarification of Code Case N-638 Applicability

Code Case N-638 shall be applied to the P3 Group 3 LAS nozzle material.

Exception to Code Case N-638 Paragraph 1(a)

Code Case N-638 paragraph 1(a) requires the maximum area of an individual weld based on the finished surface shall be 100 square inches. The area for the temper bead weld in this weld overlay design will be approximately 150 square inches.

Exception to Code Case N-638 paragraph 4.0 (b)

Code Case N-638 paragraph 4.0 (b) requires the final weld surface and the band around the area of at least 1½ the component thickness or 5 inches, whichever is less, shall be examined using a surface and ultrasonic methods. For this repair, this equates to 2 inches from the toe of the overlay. Due to the proximity of the nozzle reinforcement and the configuration of the nozzle, the volume of the ultrasonic examination will be limited to the nozzle directly adjacent to the weld overlay toe. The surface examination will cover the entire examination area and in conjunction with the ultrasonic examination, will constitute acceptance of the temper bead welding.

BASIS FOR THE ALTERNATIVE

Clarification of Code Case N-504-2 for Applicability to Nickel-based Austenitic Steel

The weldment being addressed is austenitic material having a mechanical behavior similar to austenitic stainless steel. The weldment is designed to be highly resistant to IGSCC and is compatible with the existing weldment and base metal materials. Accordingly, this alternative provides an acceptable level of quality and safety. Therefore, Code Case N-504-2 should be interpreted to apply equally to both materials.

Exception to Code Case N-504-2 Paragraph (b)

A consumable welding wire highly resistant to IGSCC was selected for the overlay material. This material, designated UNS N06052 F No. 43 is a nickel-based alloy weld filler material, commonly referred to as Alloy 52, and will be applied using the GTAW process. Alloy 52 contains nominally 30% chromium that imparts excellent corrosion resistance to IGSCC. By comparison, Alloy 82, is identified as an IGSCC resistant material in NUREG 0313 Revision 2 and contains nominally 20% chromium while Alloy 182 has a nominal chromium composition of 15% chromium. Alloy 52 with its high chromium content provides a high level of resistance to IGSCC consistent with the requirements of the code case. Therefore, this alternative provides an acceptable level of quality and safety.

Exception to Code Case N-504-2 Paragraph (e)

The composition of nickel-based Alloy 52 is such that delta ferrite does not form during welding. Ferrite measurement requirements were developed for weld deposits of the 300 series stainless steels that require delta ferrite to develop resistance to IGSCC. Welds of Alloy 52 or Alloy 152 are 100% austenitic and contain no delta ferrite due to the high nickel composition (approximately 60% nickel and low iron content). Alloy 52 with its high chromium content provides a high level of resistance to hot cracking and IGSCC consistent with the purpose for the delta ferrite requirements for stainless steels of the code case. Therefore, this alternative provides an acceptable level of quality and safety.

Clarification of Code Case N-638 Applicability

Code Case N-638 was developed for temper bead applications to similar and dissimilar metals. It permits the use of machine (GTAW) welding at ambient temperature without the use of preheat or PWHT on Class 1, 2, and 3 components.

Temper bead welding methodology is not new. Numerous applications over the past decade have demonstrated the acceptability of temper bead technology in nuclear environments. Temper bead welding achieves heat affected zone (HAZ) tempering and grain refinement without subsequent PWHT. Excellent HAZ toughness and ductility are produced. Use of Code Case N-638 has been accepted in Regulatory Guide 1.147 Revision 13 as providing an acceptable level of quality and safety.

A 48-hour post weld hold prior to acceptance inspection is required by Code Case N-638 and will be done to assure that no delayed cracking occurs.

Exception to Code Case N-638 Paragraph 1(a)

Code Case N-638 specifies a limit of 100 square inches for a temper bead weld. Because of the diameter of nozzle N2J (14 1/4 inches), this restriction would limit the weld overlay length to 2 1/4 inches on the LAS nozzle material. This distance could be justified as adequate axial length to provide for load redistribution from the weld overlay back into the nozzle without violating applicable stress limits of Section III for primary local and bending stresses and secondary peak stresses. However, this axial length will not permit a complete examination of the outer 25% of the nozzle thickness as required by Code Case N-504-2. In order to perform a qualified exam of the required volume, the axial length of the overlay on the LAS nozzle will be extended to 2 5/8 inches, encompassing an area less than 150 square inches for the temper bead weld.

This weld overlay repair involves temper bead welding on the low alloy steel nozzle to provide load transfer across the weld. The weld overlay design is based on the requirements of ASME Section XI, IWB-3640 and uses the guidance of Code Case N-504-2, for the weld overlay design; and Code Case N-638 for the ambient temperature temper bead welding. One of the requirements of Code Case N-638 is that the weld overlay repair on the low alloy steel surface be limited to 100 in^2. PPL has requested relief from this restriction such that the overlay covers a low alloy steel surface area of about 150 in^2. The reason for the relief is to allow PPL to ultrasonically inspect the area involving the crack region from the nozzle side of the weld as required by Paragraph 4.0(b) of Code Case N-504-2.

Prior History

There have been a large number of temper bead weld overlay repairs applied to nozzle to safe-end welds in the nuclear industry. For the most part, these have involved smaller diameter components, and have generally been able to be performed while meeting the 100 in^2 requirement of Code Case N-638. However, at least two nozzle to safe end welds have exceeded this limit. These include the nozzle to safe end repair at V. C. Summer, where a nozzle butter was applied to a nominal 30 inch diameter, 3-inch thick nozzle using the temper bead process (this repair involved approximately 300 in^2), and to the Three Mile Island surge nozzle, where a weld overlay repair was extended onto the nozzle to vessel blend radius so as to avoid producing a high stress concentration at the toe of the overlay (this repair involved greater than 200 in^2).

Code Considerations

Code Case N-432 has always allowed temper bead welding on low alloy steel nozzles without limiting the temper bead weld surface area to 100 in^2. The two additional conditions required by N-432 that are not required by Code Case N-638 are that the temper bead repair have preheat when applied and that the procedure qualification be performed on the same specification type, grade and class of material as the component being welded in the field. The first of these requirements would present a severe man-rem radiation burden to PPL when performing this repair. The second condition could readily be met. It is principally for the man-rem exposure reason that Code Case N-638 was selected for performing this repair. Code Case N-638 is more restrictive than N-432 when the size of the repair is considered.

The ASME Code committees have recognized that the 100 in^2 restriction on the overlay surface area size is excessive and a draft code case is currently in progress within ASME Section XI to increase the area limit to 500 in^2. The code case currently has the designation RRM 00-04 and attempts to combine the features of Code Cases N-432 and N-638 into a single code case. The supporting analysis for the draft Code Case

RRM 00-04 (prepared by EPRI) concluded that residual stresses are not detrimentally changed by increasing the area of the repair for ambient temperature temper bead repairs, and that tempering of the heat affected zone is unaffected by the weld overlay application.

The EPRI report that supports the draft code case RRM 00-04 examined the issue of residual stresses and of cracking associated with the weld overlay application. It concluded that the residual stresses were not detrimentally changed and that the tempering effects of the repair were not affected by the size of the overlay.

The issue of cracking and/or distortion of the weld and base metal were not specifically addressed in the code case development work. Since the girth weld and butter, and the weld overlay are fabricated from austenitic materials, with very high inherent toughness, no cracking is expected to occur due to the shrinkage associated with the weld overlay. With respect to the low alloy steel, as was noted above, many temper bead weld overlays have been applied in the BWR industry to these nozzle to safe end locations. In no instance has there been any reported cracking due to the weld overlay application. The stiffness and high toughness inherent in the low alloy steel nozzle is expected to protect against any cracking and severely limit any distortion that might occur in the low alloy steel nozzle. PPL will be measuring and evaluating axial shrinkage for impact on the nozzle and safe end materials and piping system in accordance with Code Case N-504-2.

<u>Summary and Conclusions</u>

Significant laboratory testing and field experience have been documented qualifying the temper bead weld overlay repair for safe end to nozzle welds. These efforts and experience have demonstrated that the remedy provides a very high quality, sound repair to these joints. These repairs have included instances where more than a 100 in^2 surface area repair was applied to low alloy steel nozzles without detrimental effects. The 100 in^2 repair limitation has been examined in detail. It has been concluded that it is acceptable to exceed that limit without detrimental effects. As a result, the draft Code Case RRM 00-04 has been prepared by ASME.

The ASME Code has recognized that the 100 in^2 repair limitation is arbitrary and is progressing with a code case to extend the limit to 500 in^2.

The PPL request for this area limit extension is based upon the desire to perform the best baseline UT possible following the weld overlay application.

Exception to Code Case N-638 paragraph 4.0 (b)

Code Case N-638 paragraph 4.0 (b) requires the band around the nozzle for a distance of 2 inches from the toe of the weld overlay be examined by a surface and ultrasonic methods. For this repair, due to the proximity of the nozzle reinforcement and the configuration of the nozzle the ultrasonic examination will be limited to the nozzle material adjacent to the weld overlay toe, the volume most susceptible to delayed hydrogen cracking. The surface examination will cover the entire examination area. The combination of these examinations are adequate to ensure the detection of delayed hydrogen cracking in the nozzle material.

CONCLUSION

Weld overlays involve the application of weld metal circumferentially around the pipe in the vicinity of the flawed weld to restore ASME Section XI margins. Weld overlays have been used in the nuclear industry as an acceptable method to repair flawed welds. The use of overlay filler material, which provides excellent resistance to IGSCC, develops an effective barrier to crack extension by corrosion processes.

The piping and other components have been evaluated (to the original ASME design code requirements) for the effects due to shrinkage induced into the system during installation of the overlay. The actual shrinkage will be measured. All required documents will be reconciled to the original design code, and updated to reflect these as-built values.

The design of the overlay for the nozzle safe-end uses methods that are standard in the industry for size determination of pipe-to-pipe overlays. There are no new or different approaches used in this overlay design which are considered first of a kind or inconsistent with previous approaches. The overlay is designed as a full structural overlay in accordance with the recommendation of NUREG 0313 Revision 2, which was implemented by Generic Letter 88-01 and by Code Case N-504-2 and ASME Section XI Paragraph IWB-3640, 1989 Edition with Appendix C (1989 Addenda).

Temper bead techniques, as defined by Code Case N-638, will produce the tough corrosion resistant overlay deposit that meets or exceeds all code requirements for the weld overlay.

PPL concludes that the repair plan is justified and presents an acceptable level of quality and safety to satisfy the requirements of 10 CFR 50.55a(c)(3)(i). Furthermore, this evaluation demonstrates that compliance with the 1989 Edition of ASME Section XI with no addenda (the current Code of record for Susquehanna Unit 1) would result in unusual difficulty without a compensating increase in the level of quality and safety pursuant to 10 CFR 50.55a(c)(3)(ii)

A similar proposed alternative to the requirements of 10 CFR 50.55a(c)(3)(iv) has been approved previously by the NRC for the Duane Arnold Energy Center by NRC letter dated November 19, 1999 and for Nine Mile Point Unit 2 by NRC letter dated March 30, 2000. Also, a similar proposed alternative to the requirements of

10 CFR 50.55a(c)(3)(iv) has been submitted by Pilgrim on October 2, 2003 and by TMI on November 3, 2003.

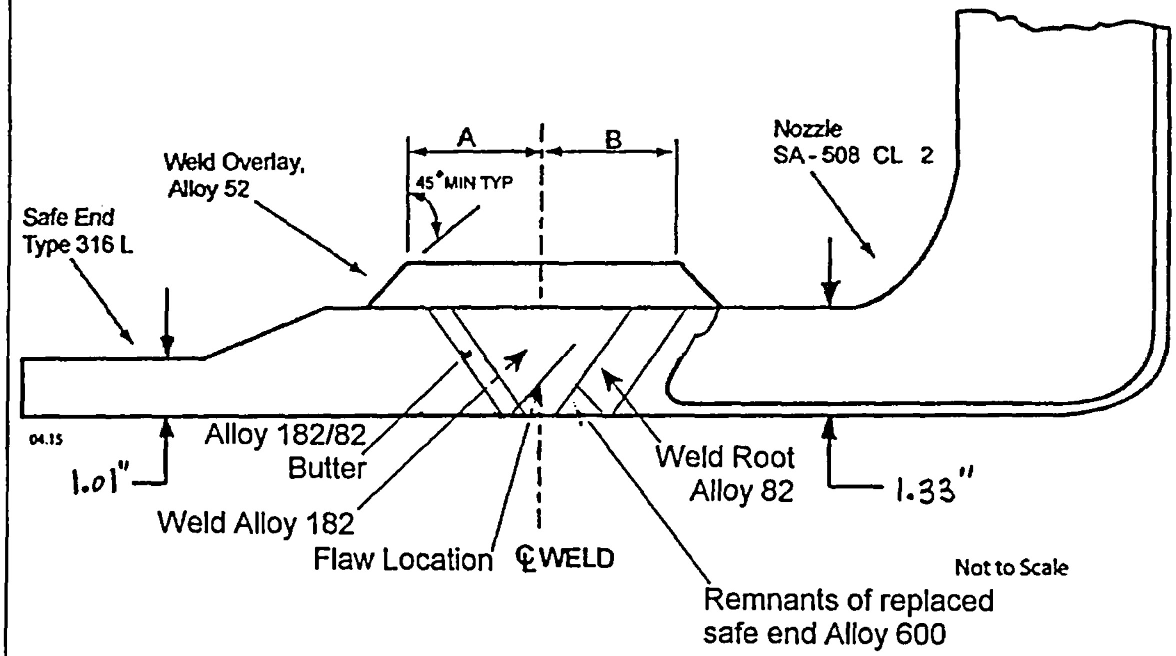
DURATION OF PROPOSED ALTERNATIVE

The proposed alternative applies to the repairs of RPV nozzle to safe-end weld for the scheduled outage and for the remaining service life of this weld.

ATTACHMENT 1 TO PLA-5744

WELD SKETCH

N2J Nozzle and Weld Overlay Configurations



WELD NUMBER	FLAW CHARACTERIZATION	Design Dimenstions			COMMENTS
		t	A	B	
Recirculation Inlet Nozzle N2J	Assumed 360° Circ. 100% throughwall flaw	0.44" min	2.3" min	2.3" min	

ATTACHMENT 2 TO PLA-5743

EPRI NDE CENTER SUMMARY REPORT

Susquehanna Steam Electric Station – Unit 1
Ultrasonic Examinations of N2J Nozzle to Safe End Weld
EPRI NDE Center
Summary Report
April 6, 2004

Scope

EPRI NDE Center staff provided on-site assistance at Susquehanna Steam Electric Station (SSES) during the Unit 1 13th Refueling & Inspection Outage (U1-13RIO). The primary purpose of the on-site support was to perform an independent review of ultrasonic (UT) examination results for the N2J nozzle to safe end (N2J Noz-SE) weld. On-site support for this activity included the following related tasks:

- Review of previous manual and automated ultrasonic examination data
- Review of available fabrication records including construction radiographs
- Assistance with site preparations for weld overlay UT examinations
- Assistance with review and selection of expanded scope welds

Background

During the U1-13RIO inservice inspections (ISI) at SSES, the N2J Noz-SE weld was examined as part of an expansion of scope due to the detection of an SCC in the N1B Noz-SE during this outage. (See additional report data March 26, 2004 for additional details on this weld) The N2J configuration contains a dissimilar metal weld joining the carbon steel nozzle to a stainless safe end (14 inch OD and nominal thickness 1.32 inches). N2J Noz-SE is denoted in SSES's ISI program as a Category "C" weld. This category refers to welds not made of resistant materials that have undergone a stress improvement (SI) process. A mechanical stress improvement process (MSIP) was applied to the N2J Noz-SE weld in 1993. SSES also started Hydrogen Water Chemistry in 2000. Automated UT examinations of the N2J Noz-SE weld was performed during the U1-13RIO using GE Nuclear Energy Procedure GE-UT-209, *"Procedure for Automated Ultrasonic Examination of Dissimilar Metal Welds, and Nozzle to Safe End Welds."* As documented on the applicable Performance Demonstration Qualification Statement (PDQS No. 468) dated Sept. 11, 2003, GE-UT-209 meets the requirements of The Performance Demonstration Initiative's Implementation of The American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI, Appendix VIII, Supplement 10.

Initial examination of this weld indicated a suspect indication in an area where it appeared the search unit was being compromised by weld crown. GENE requested that the surface condition of this weld be improved to eliminate the limitation. After removal of the weld crown restriction the examination was repeated and GENE reported a planar-type, circumferentially oriented indication located at approximately 45 degrees. The planar indication appeared to be contained in the weld material and connected to the inside surface. Evaluation of the qualified UT sizing data showed the flaw to be approximately 12.14 inches long with a through wall dimension of 0.94 inches.

On-site assistance from NDE Center staff was requested by Mr. Randy Linden to support an independent evaluation of the weld and to support expanded scope activities. EPRI's Carl Latiolais traveled to SSES in support of this request. This summary report documents the on-site NDE Center support and provides recommendations for related weld overlay repair NDE activities.

References

1) General Electric Rapid Information Communication Services Information Letter (RICSIL) No: 082 Titled *"Core Spray Nozzle to Safe-end Leak"* Dated October, 17, 1997.

2) GE Nuclear Energy Services Information Letter (SIL) SIL No. 455 Revision 2 Titled " *ISI of additional Alloy 182 Welds"* Dated January 29, 2001.

3) Brookhaven National Laboratory Report Titled *"Metallurgical Evaluation of a Feedwater Nozzle to Safe-End Weld from River Bend Station Unit 1"*. This report was prepared by request of the NRC. (Task Order No; 2, Fin E2089, Subtask No. 5a.) Dated August 1995.

4) NDE Alert Bulletin P-98-009 Titled " *Lessons Learned Regarding Effective Detection and Discrimination of Flaws in Dissimilar Metal Welds."* Issued early 1998.

5) *Dissimilar Metal Piping Weld Examination – Guidance and Technical Basis for Qualification*, EPRI, Palo Alto, CA: 2003. 1008007.

Review of Weld History for SSES Unit 1 Weld N2J

Available documentation was reviewed to determine the examination history of N2J. Records show that N2J was mechanically stress improved (MSIP) in 1993. A review of the UT examination history (see Table 1) for N2J revealed that an automated UT examination performed in 1992 using the GE Smart 2000 system served as the pre-MSIP examination. The examination reported only inside surface geometry and interface. Post MSIP automated UT examination of

N2J in 1993 also was performed using the GE Smart 2000 system. No new indications were recorded during the post-MSIP UT examinations.

Table 1 – N2J Noz-SE Ultrasonic Examination History

Date of Examination	Type of Examination (Automated/Manual)	Results
1979 Note 1	Manual	No Recordable Indications (45 degree shear wave only)
1986	Automated (GE Ultra Image III	No Recordable Indications (45 degree shear wave only)
1990 Note 4	Automated (GE Ultra Image III	Note 4 Non-Relevant Indications, Root Geometry, Inside Surface Geometry
1992 Note 2	Automated (GE Smart 2000)	No Indications Associated with IGSCC, Root Geometry, Inside Surface Geometry, and Acoustic Interface
1993 Note 3	Automated (GE Smart 2000)	No Indications Associated with IGSCC, Root Geometry, Inside Surface Geometry, and Acoustic Interface
1996	Automated (GE Smart 2000)	No Indications Associated with IGSCC, Inside Surface Geometry, Non Relevant Indications
2000 Note 5	Automated (GE Smart 2000)	No Indications Associated with IGSCC, Root Geometry, Inside Surface Geometry, and Acoustic Interface
2004 Note 6 & 7	Automated (GE Smart 2000)	Note 6 & 7

Note 1. Preservice ultrasonic examination.
Note 2. Pre-MSIP ultrasonic examination.
Note 3. Post-MSIP ultrasonic examination.
Note 4. This is the first examination where RL search units were used. All of the previous examinations were performed with shear wave search units only.
Note 5. First examination incorporating lessons learned from Hope Creek (Ref. 4) and RICSIL (see Ref. 1)
Note 6. 2004 examination using PDI qualified procedures.
Note 7. See next section for discussion of 2004 results

Fabrication Records were not available for review at the time of this report. Efforts to locate all fabrication records are on going.

EPRI Review of Examination Results for the N2J Noz-SE Weld

A complete review of all available ultrasonic data was performed and the results are listed in Table 1. TOMOVIEW data analysis software was used to evaluate the data. This software provides the examiners enhanced data analysis capabilities (A, B, C and D Scans) above and beyond what was available to the data analyst during the original analysis. GE incorporated the use of this software based on lessons learned from the Hope Creek failure and recommended its use in the GE SIL-455 Revision 2 (Ref. 2). This software is the same software presently used in GE' PDI qualified procedure.

As a result of this review there is strong evidence that this flaw was actually present in the 1992 (Pre-MISP), 1993 (Post MSIP), 1996 and 2000 data in same location and of the same approximate length. The 1992 data for the 45 degree and 60 degree RL search units was not available for review at the time of this report so no depth evaluation can be made with the 1992 data. Figures 1- 13 illustrate comparisons of ultrasonic responses from each automated inspection. All of the examination data exhibited search unit lift off similar to what was reported in 2004 in the area of the reported flaw. Due to the fact that the data was collected with several different procedures and varying data quality, it was impossible to perform finite depth and length sizing using this data. However, armed with the information from the 2004 data and utilizing the advanced software it is possible to see evidence of the presence of the flaw. Automated examinations were also performed in the 1986 and 1990, but there is no way to read the electronic data files, however pictures were available for the 1990 examination, which identify in the same area of the reported flaw as being affected by lift off due to the OD surface profile in that area.

<u>Conclusions and Recommendations</u>

EPRI personnel were requested to provide on-site assistance at SSES during U1-13RI0 to perform an independent review of examination results for the N2J Noz-SE dissimilar metal weld. Results of this review support GENE's conclusion that N2J Noz-SE weld contains a 12.14 inch long planar-type, circumferential flaw having a 0.94 inch through wall extent. The flaw is ID connected and is contained within the Alloy 82/182 weld material. The characteristics of this flaw are typical of Stress Corrosion Cracking located in Alloy 82/182 weld material.
The initial detection scans were compromised by the weld crown condition at the location of the flaw. Based on a review of previous data this condition was also present in previous examination data and is the probable reason for this flaw not being reported. Armed with the advanced data analysis software and the 2004 data it was possible to confirm that the flaw was actually present as far back as 1992 and of the same relative size since 1993. At the time of this review only the shear wave data from the 1992 examination was available, which cannot be used to make any type of depth determination. However, it did clearly show that an indication on the inside surface of the same approximate length was present prior to MSIP. Automated examination data prior to 1992 could not be reviewed due to incompatibility of software.

Recommendations

EPRI recommends the following:

- Continue search for Longitudinal 1992 data.
- Continue efforts to identify complete fabrication records for N2J Noz-SE.
- To assist in the planned overlay weld repair, EPRI recommends ensuring weld overlay design dimensions adequate for providing coverage of the required examination volumes as depicted in existing PDI qualified overlay procedures.

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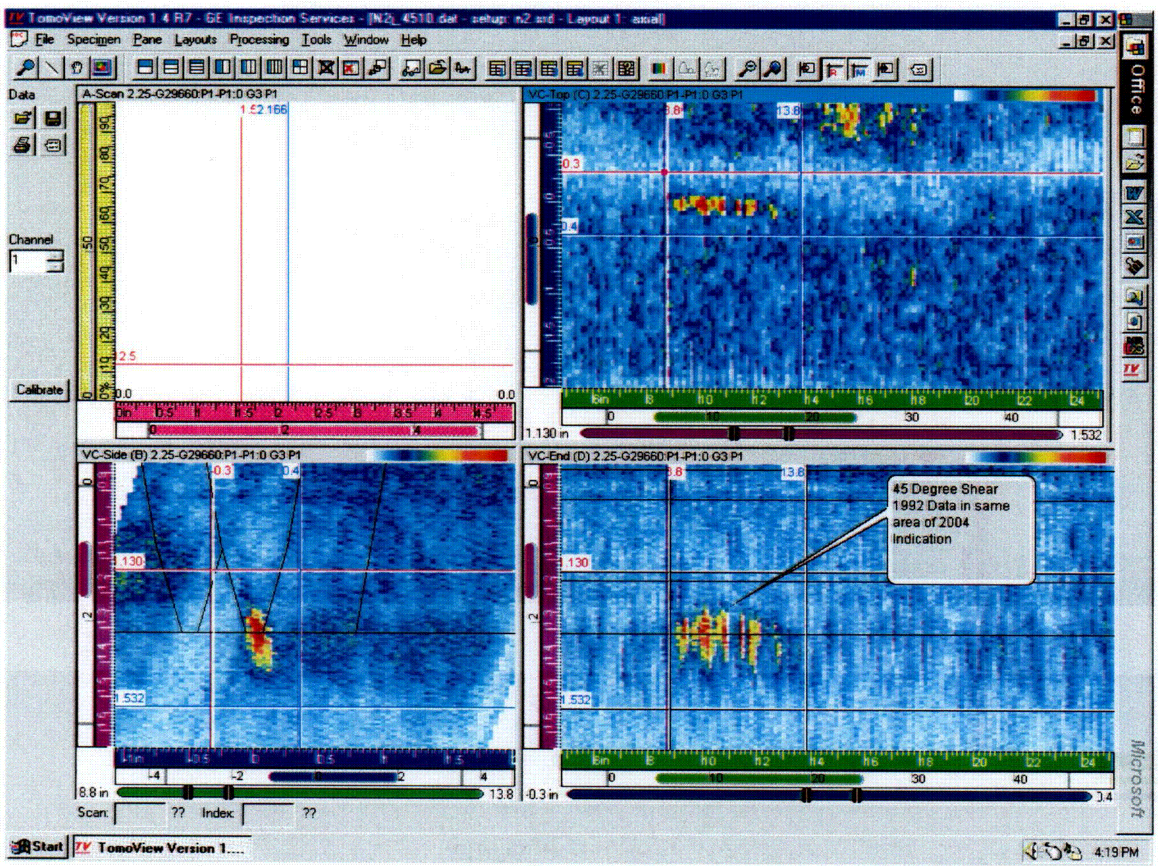
Susquehanna Steam Electric Station – Unit 1
Ultrasonic Examinations of N2J Nozzle to Safe End Weld
EPRI NDE Center
Summary Report (Figures)
April 6, 2004

Figure 1
45 Degree Shear Data from 1992 (Pre MSIP)



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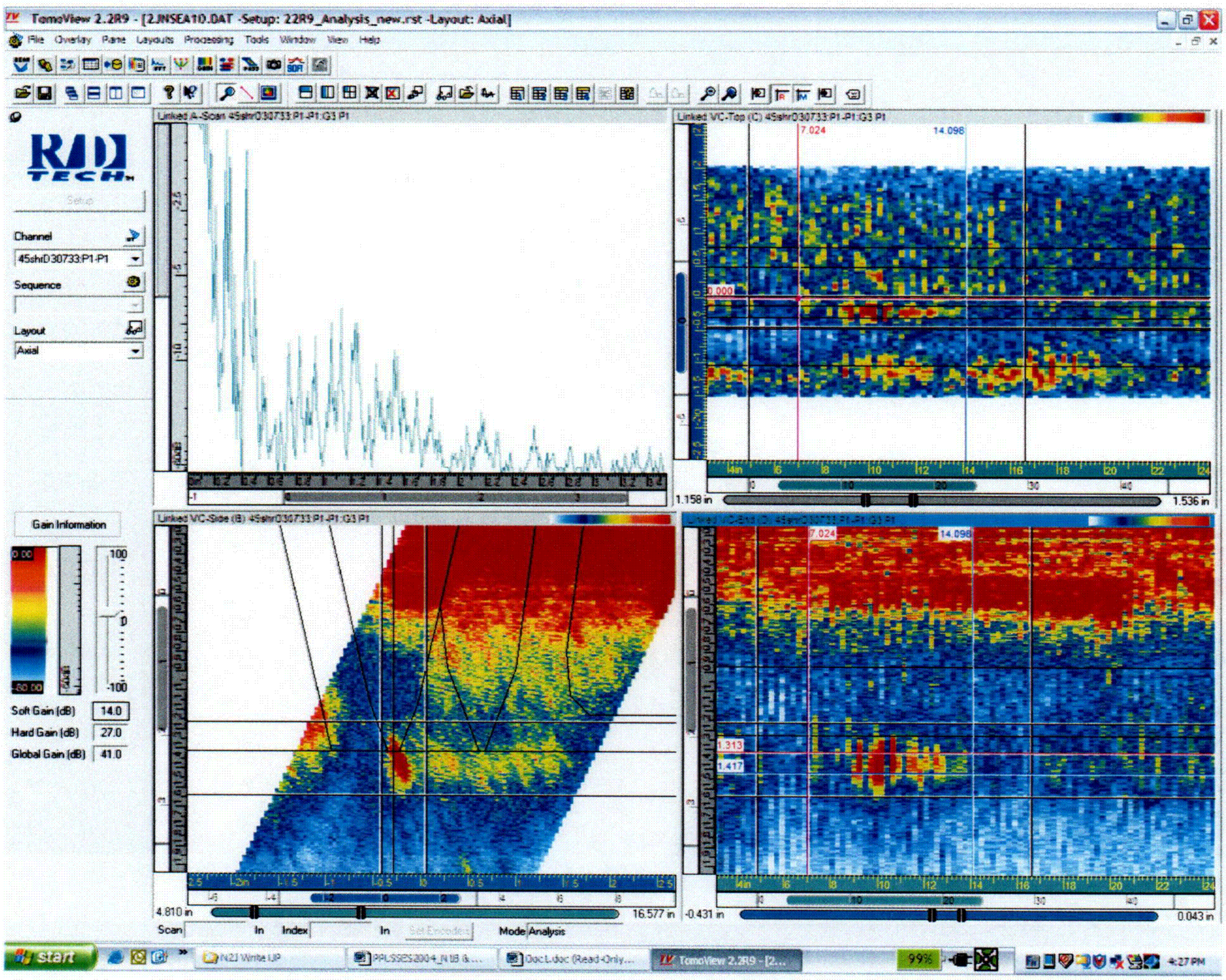
C01

Figure 2
45 Degree Shear Data from 1993 (Post MSIP)



C02

Figure 3
45 Degree RL Data from 1993 (Post MSIP)

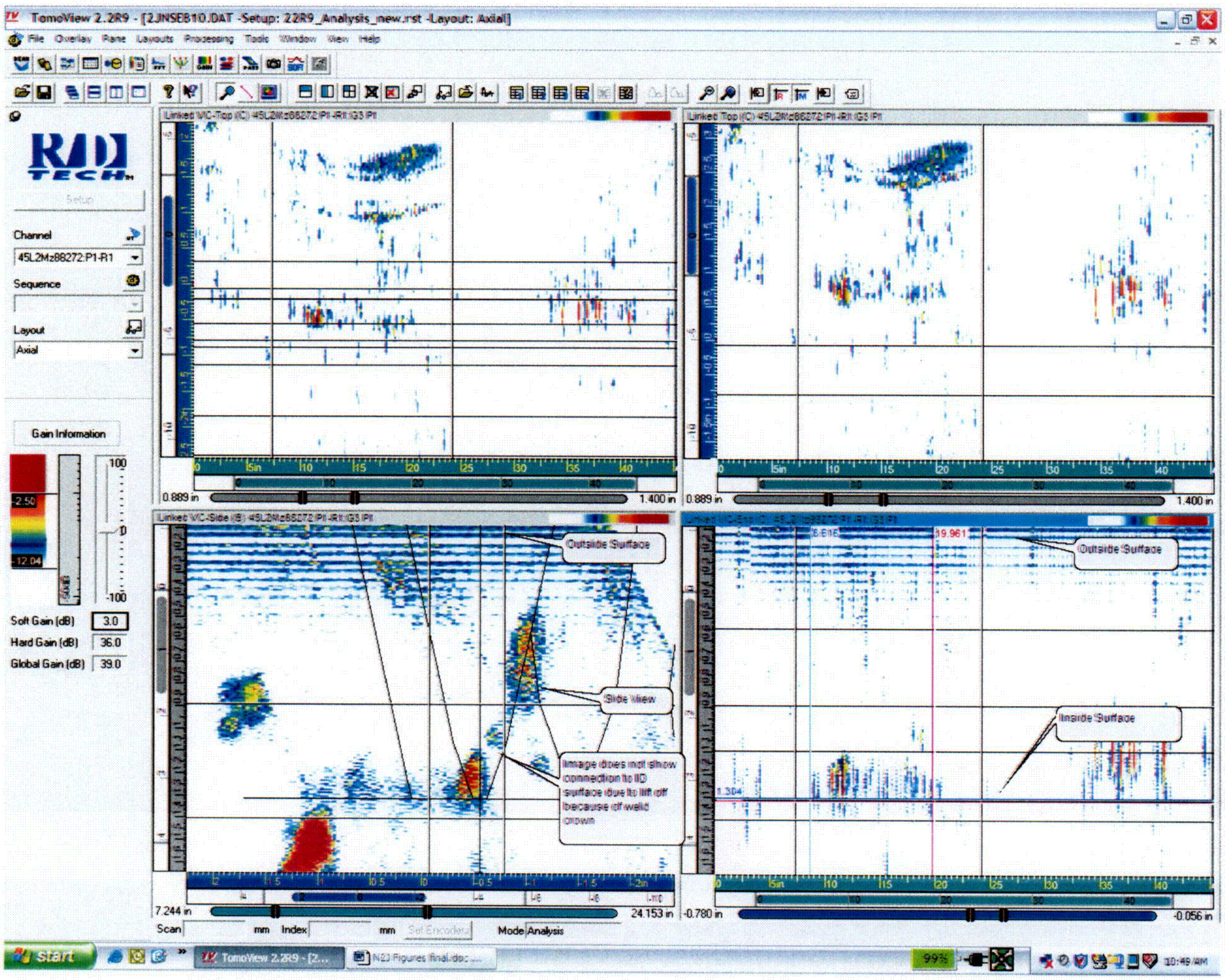
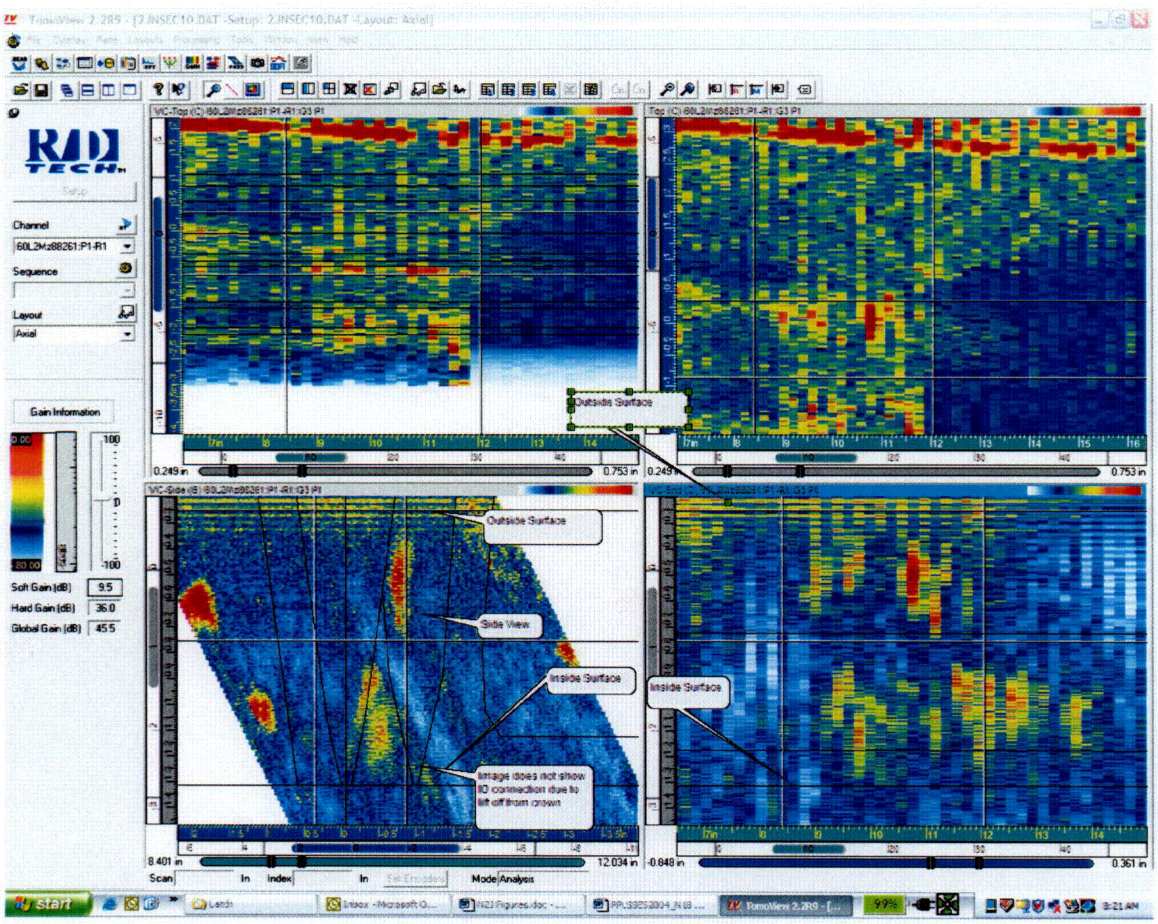
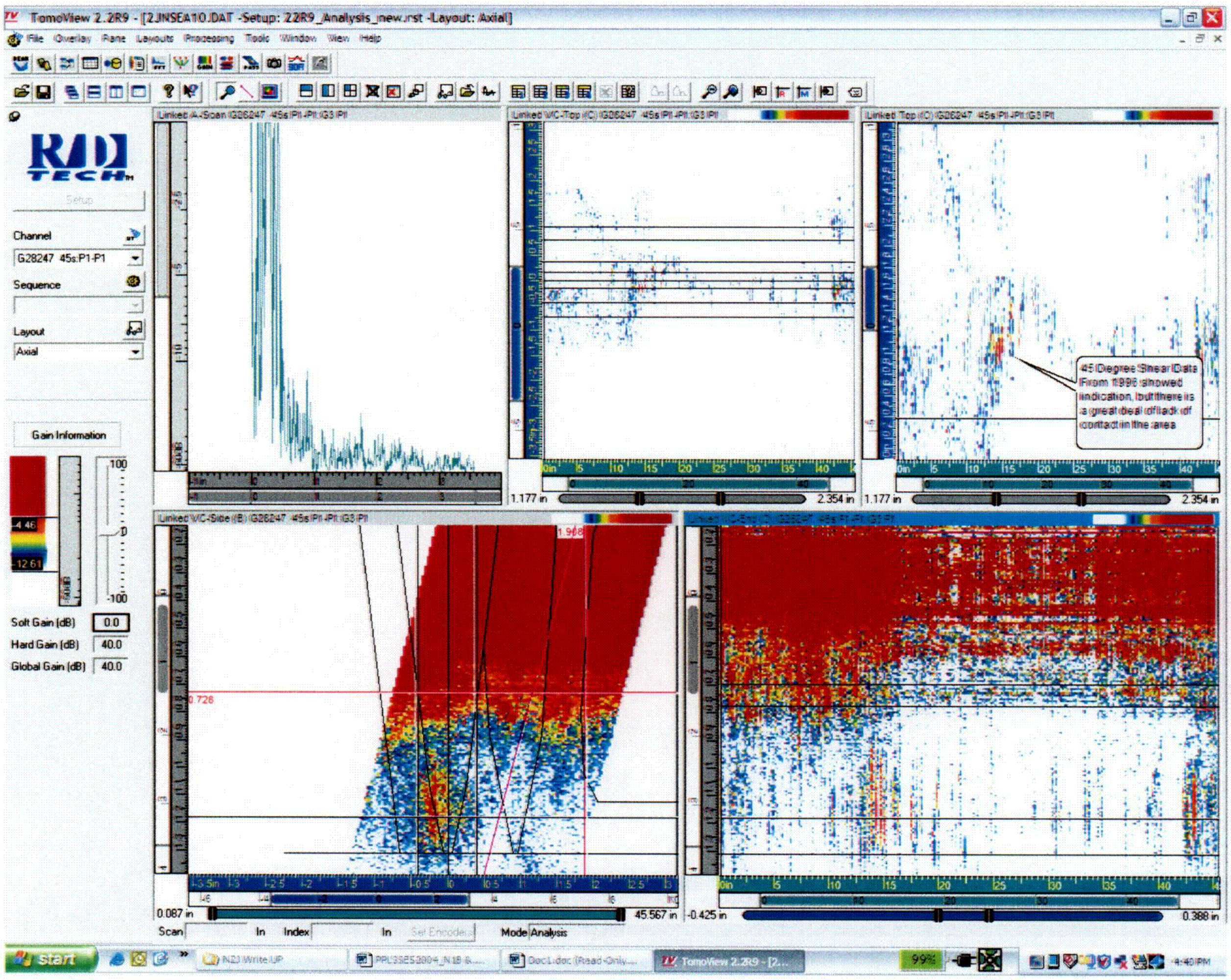


Figure 4
60-Degree RL Data From 1993 (Post to MSIP)



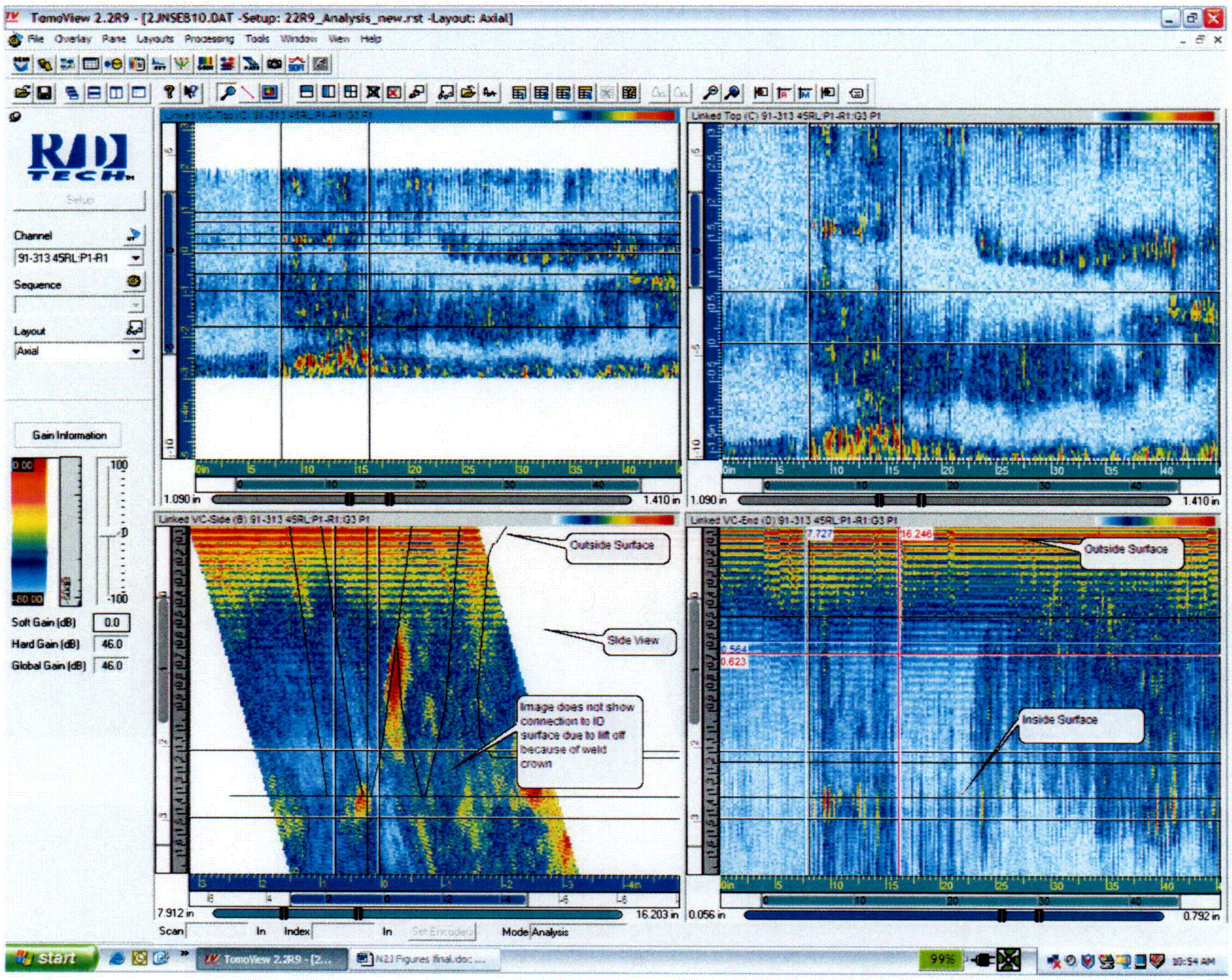
C04

Figure 5
45 Degree Shear Data from 1996



C05

Figure 6
45-Degree RL Data from 1996



C06

Figure 7
60 RL Data from 1996

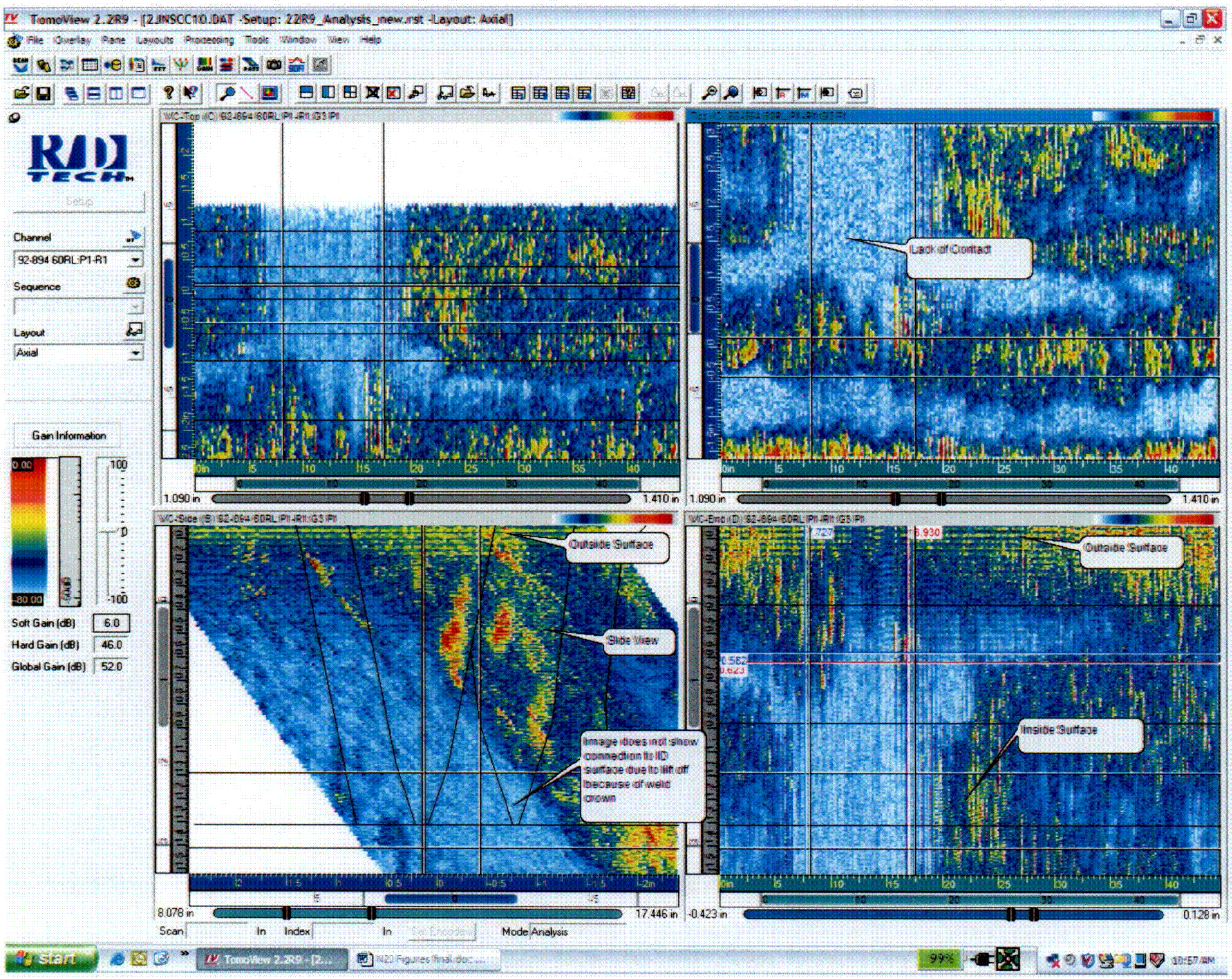
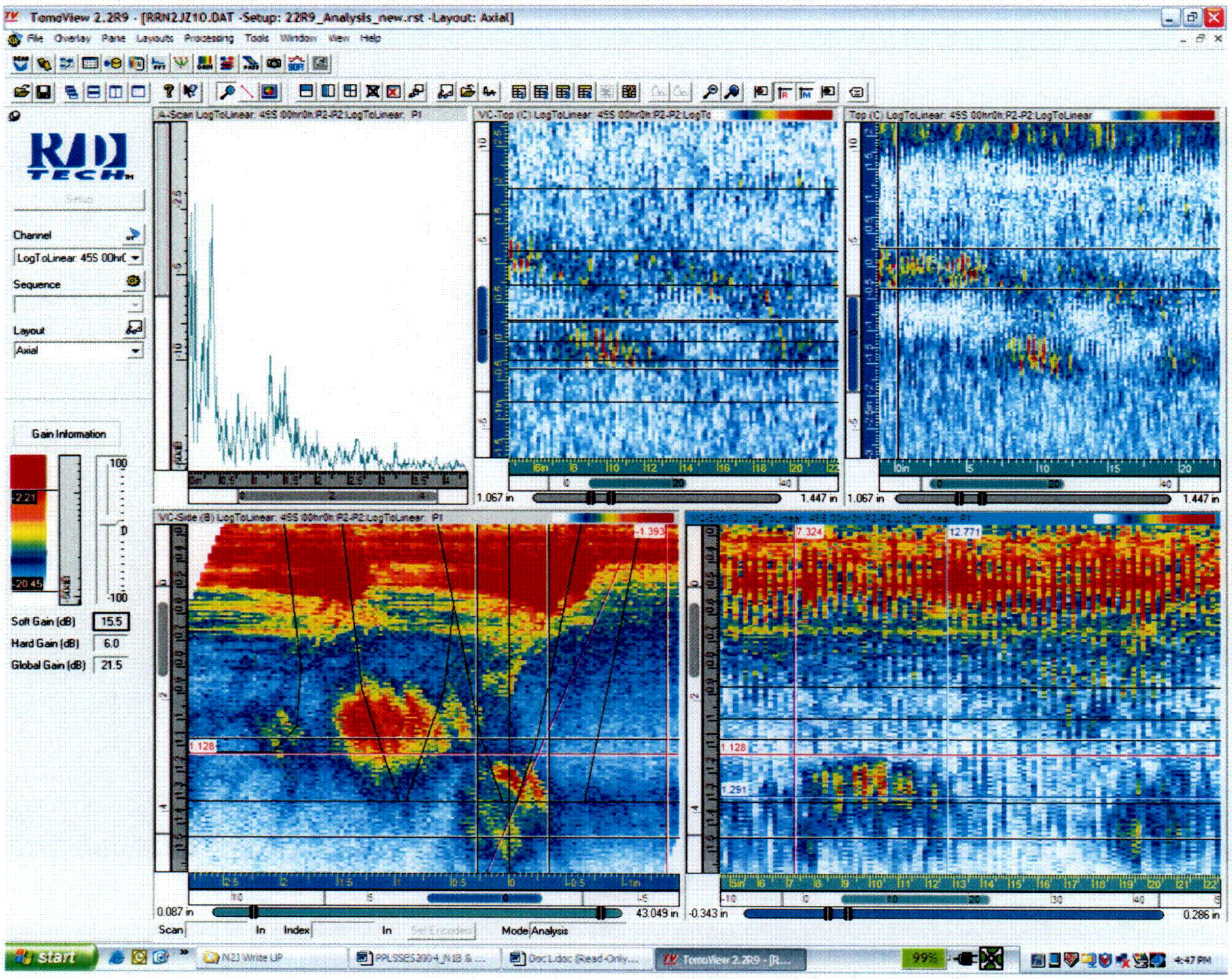
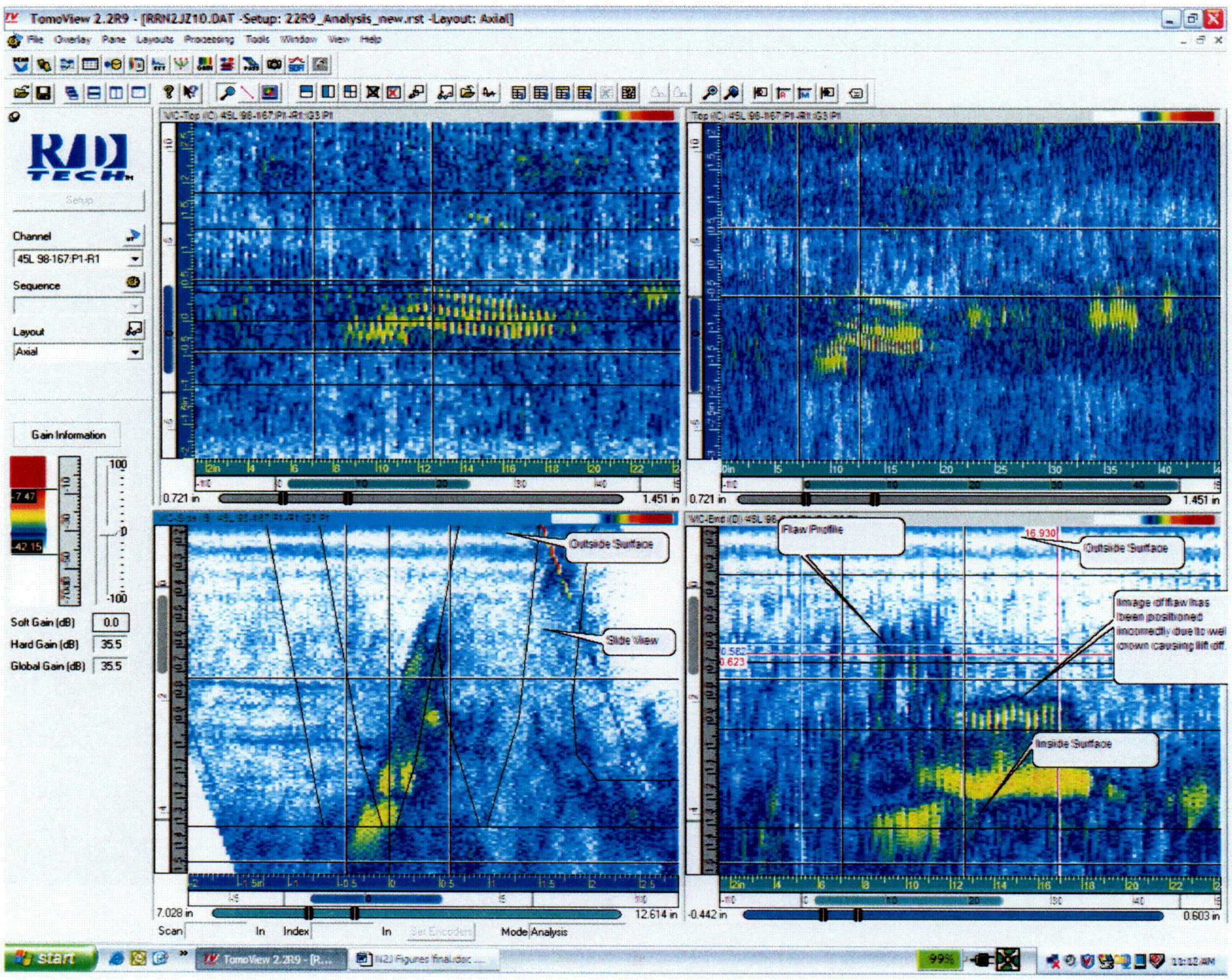


Figure 8
45 Degree Shear Data from 2000



C08

Figure 9
45 degree RL from 2000 data



c09

Figure 10
60 RL data from 2000 data

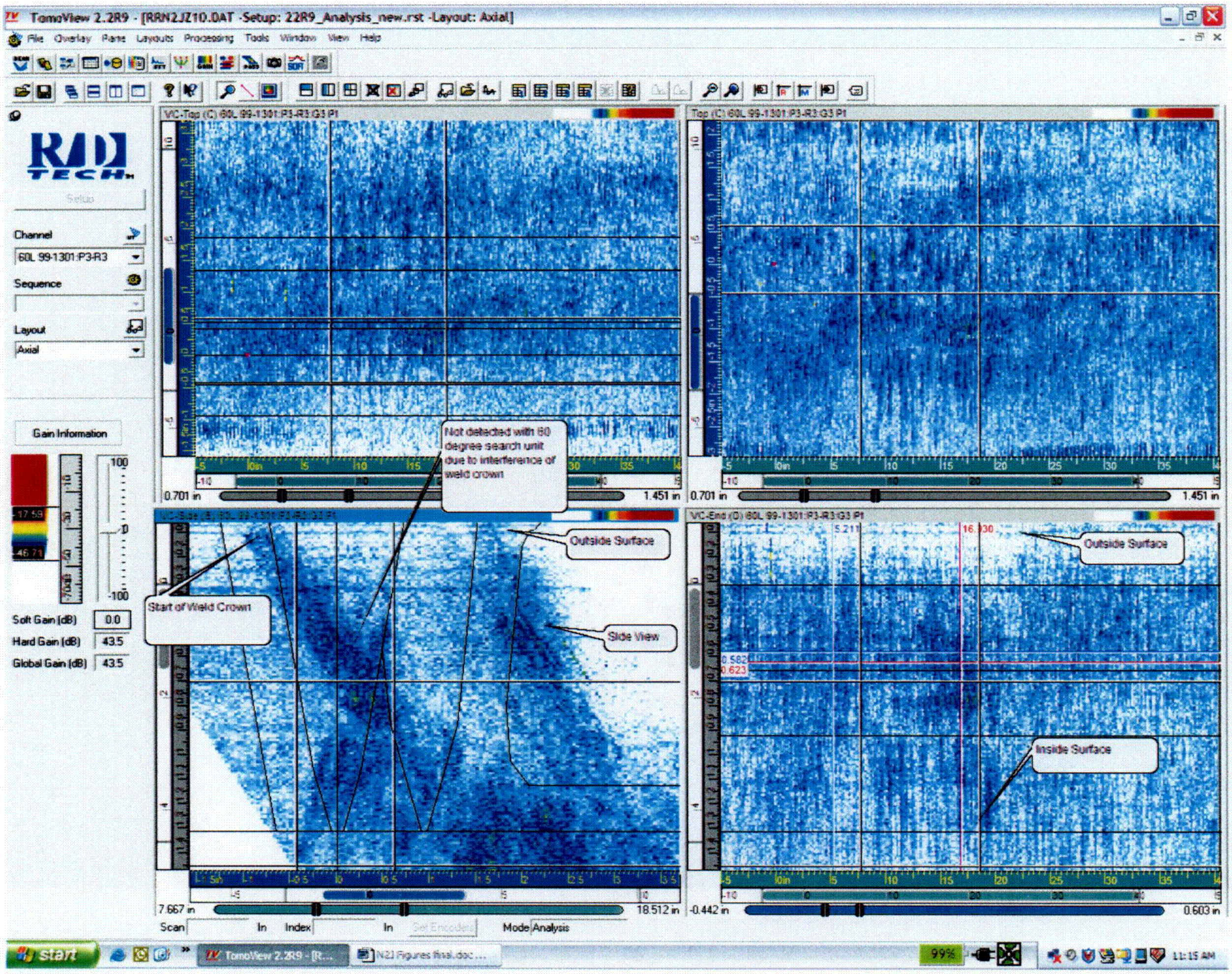


Figure 11
45 Degree Shear Data from 2004

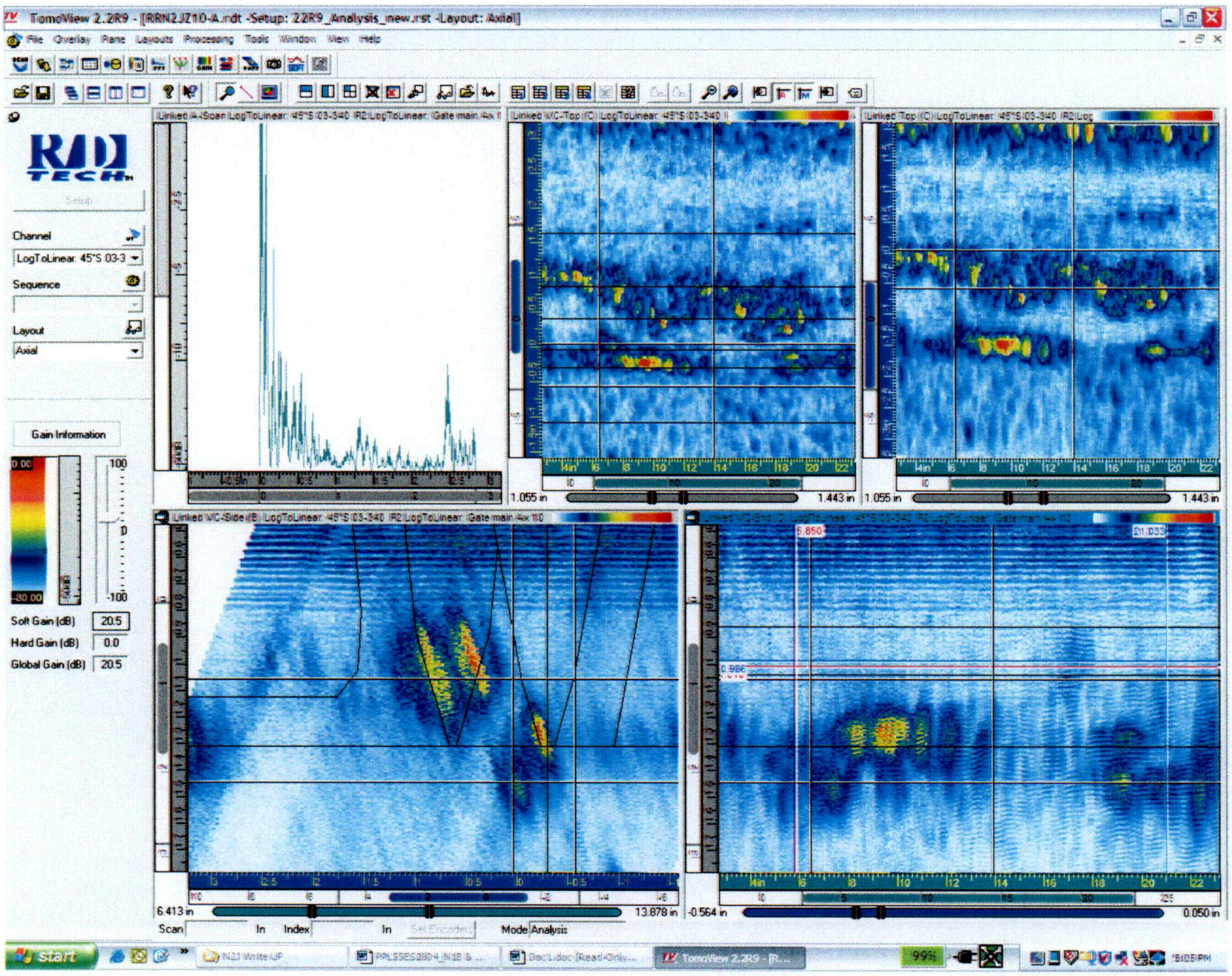


Figure 12
45 Degree RL from 2004 data

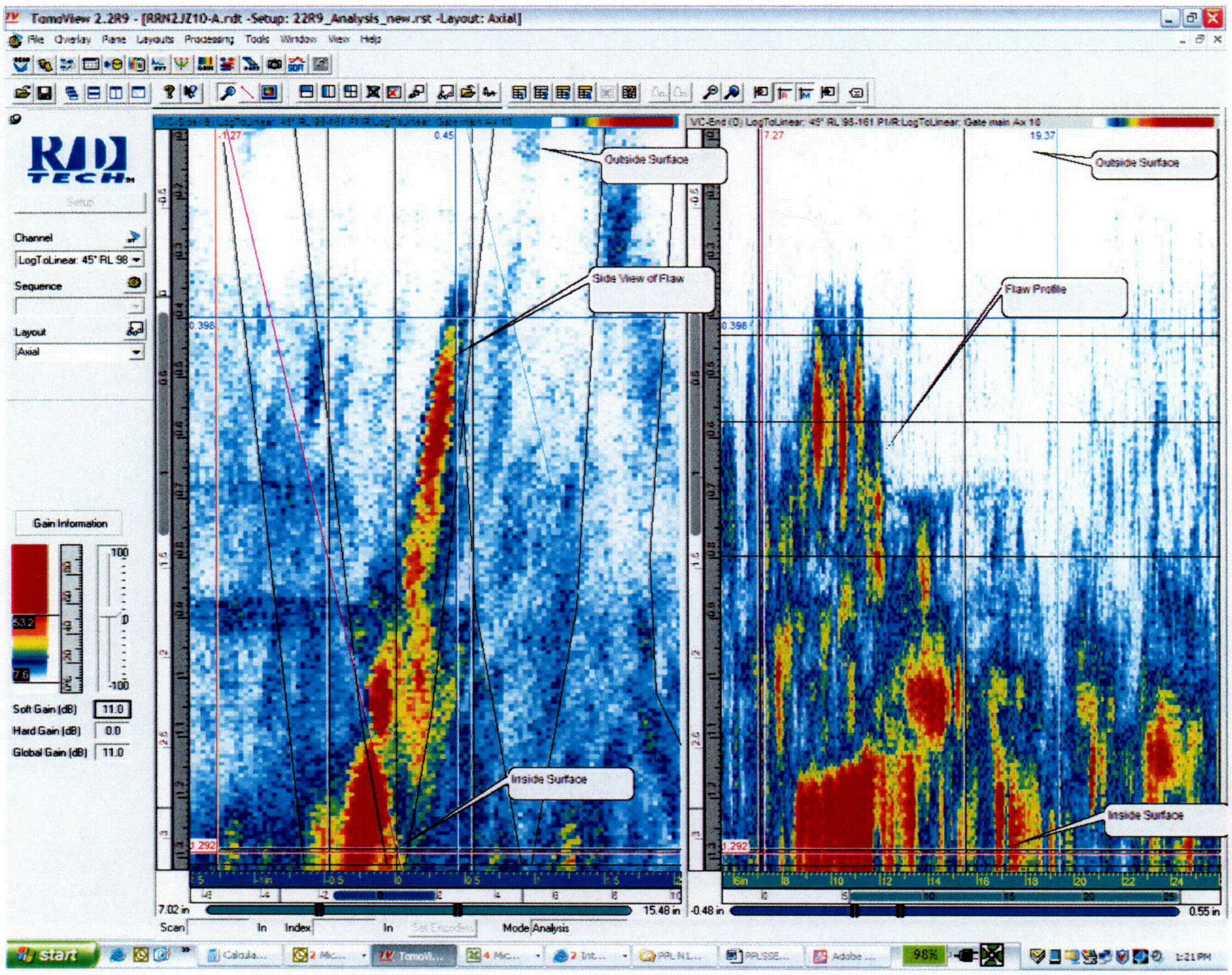


Figure 13
60 Degree RL from 2004 data