Ultrasonic Flaw Detection of Inter-granular Stress Corrosion Cracks as Observed Through Austenitic Stainless Steel Piping Welds

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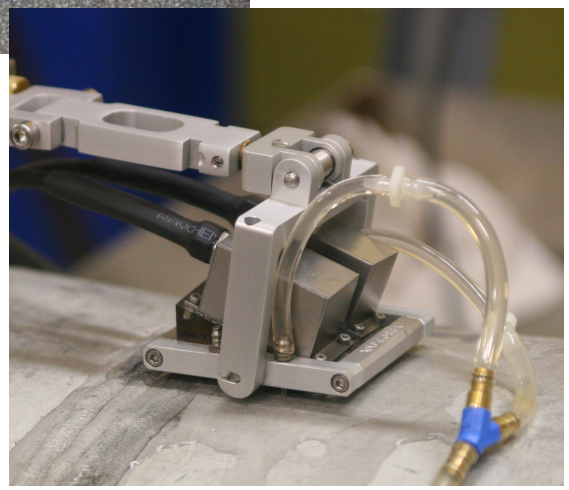
Introduction

- Field-removed piping segments containing inter-granular stress corrosion cracks were examined with ultrasonic phased array methods
- Data was analyzed for detection only (at crack location)
  - Given that the crack location true state was known for the secure specimens
  - No sizing was attempted
  - Discrimination of all inspection signals was not addressed in this initial exercise
- Success of crack detection as Yes, No, or Marginal was recorded along with signal-to-noise ratio
- Two sets of data (on practice and secure specimens) were analyzed and results were combined
- Secure data was maintained by EPRI NDE Center staff

Phased Array Probes Employed: 1.5 MHz TRL, 2 MHz Mini TRL, 2 MHz TRS

2 MHz, Mini-TRL

2 MHz TRS



1.5 MHz TRL

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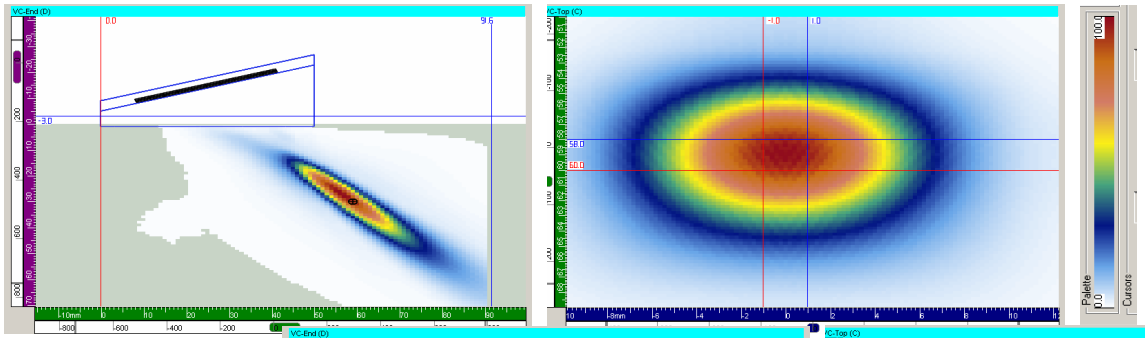
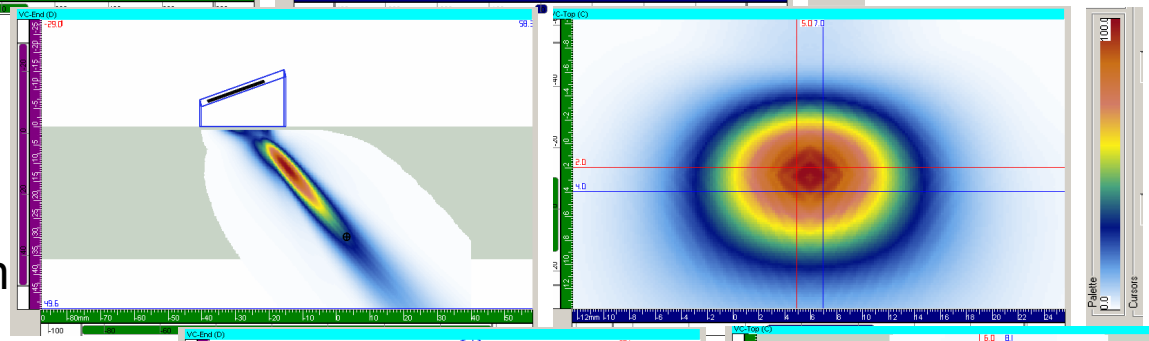
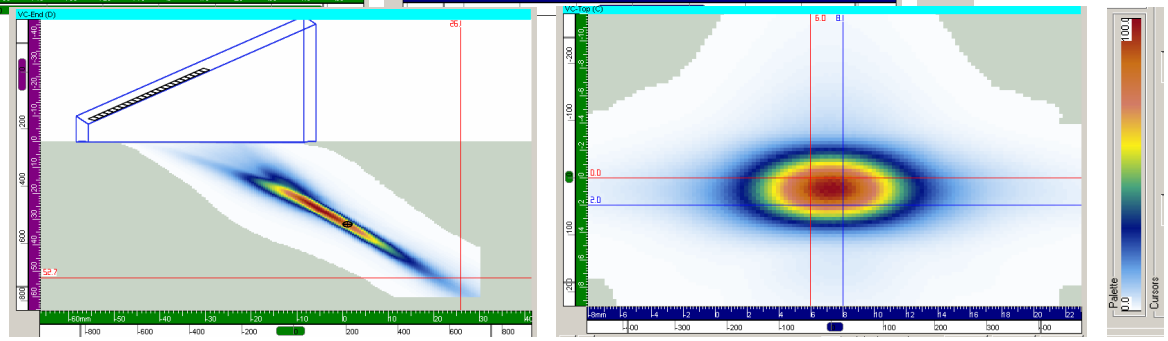
Modeled Sound Field Beam Profiles in Stainless Steel for Each Probe



1.5 MHz
TRL: 3.4 x
2.7 mm
spot size



2 MHz
Mini TRL:
5 x 4.3 mm
spot size



2 MHz
TRS: 2.9 x
1.7 mm
spot size

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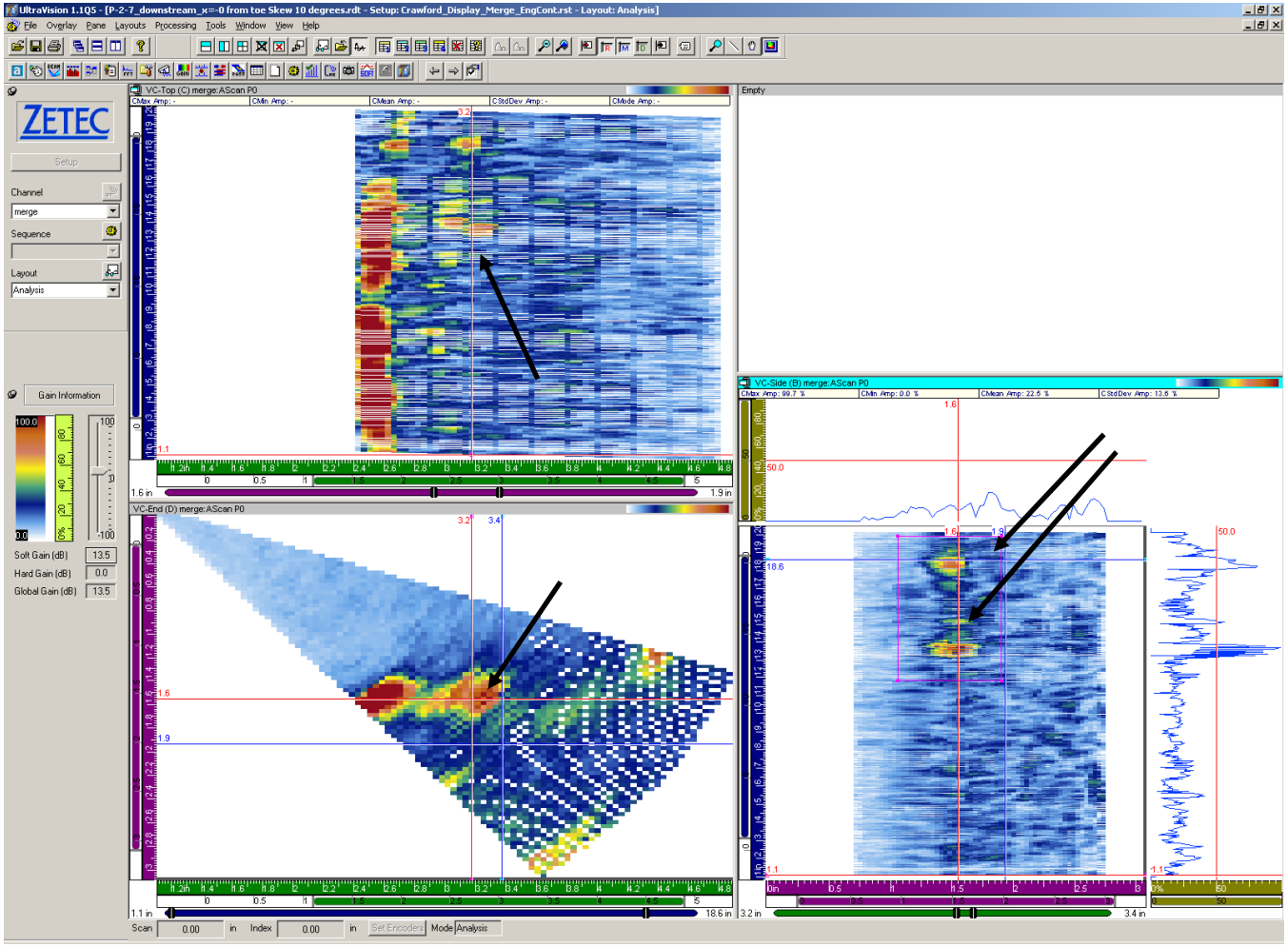
Detection Rated as Yes – Clear flaw signals distinct from geometry indications with good S/N



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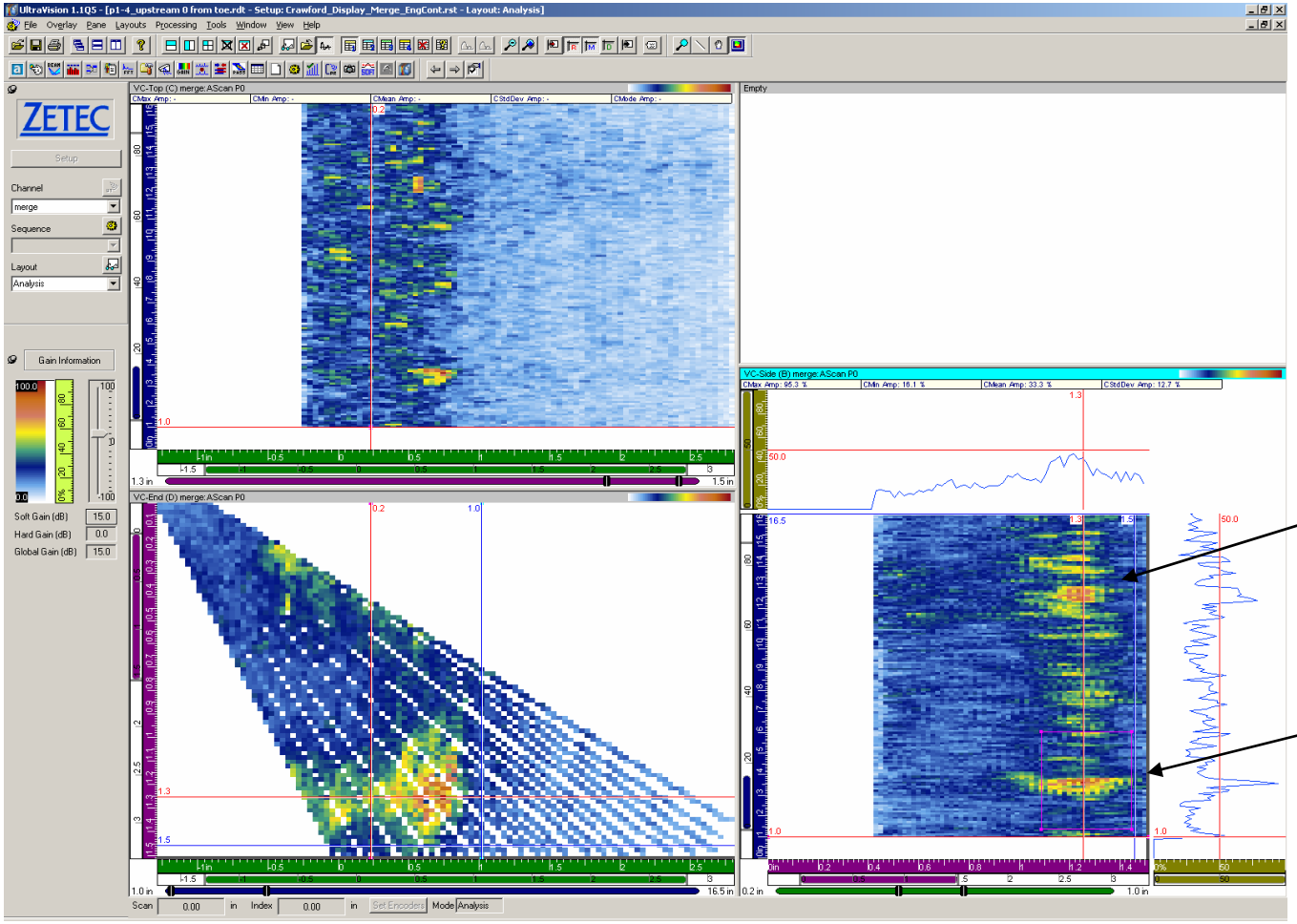
Marginal Detection – Flaw with good S/N was observed but in presence of other indications that may cause difficult detection call



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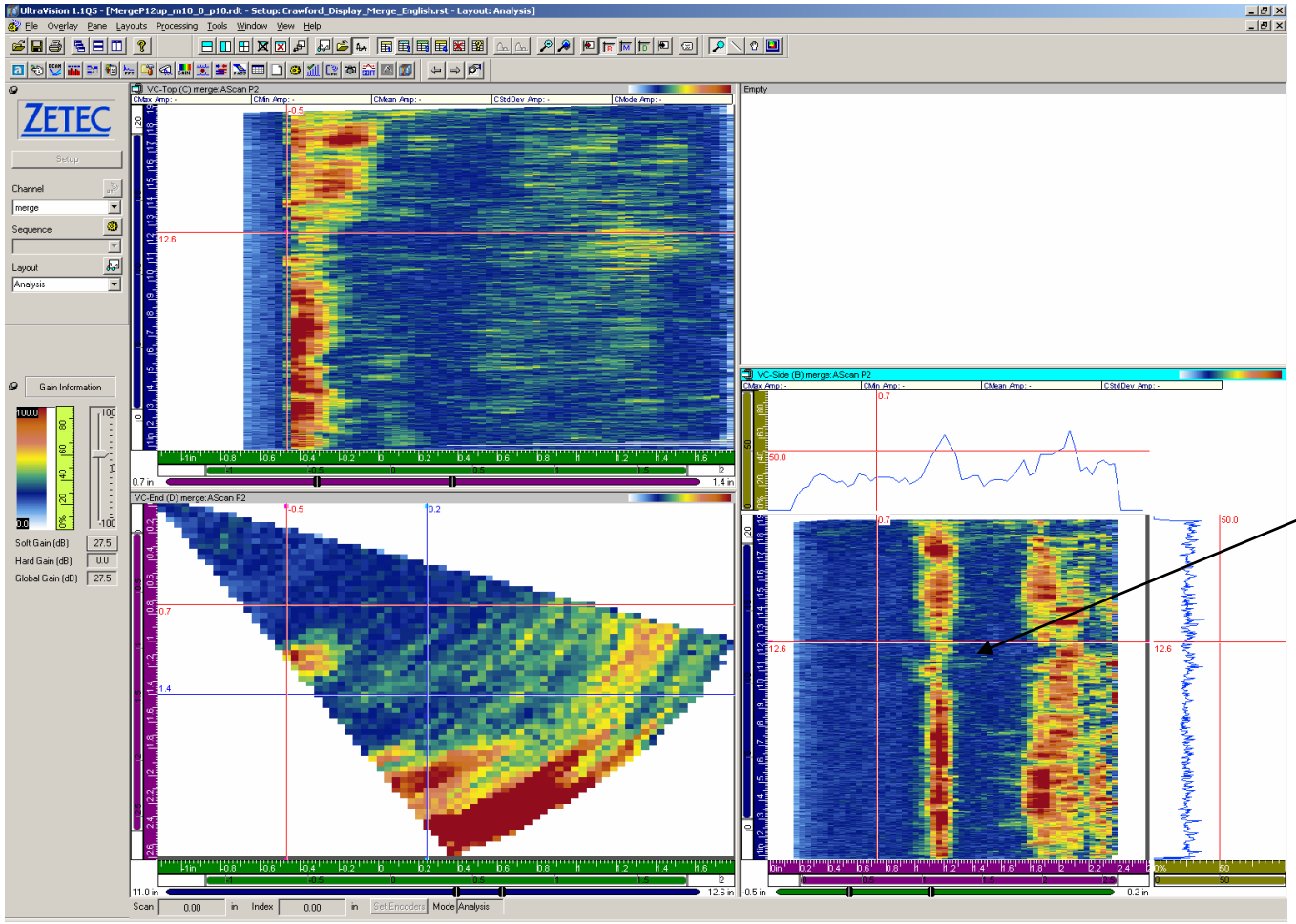
No Detection – No clearly observed signal from flaw location



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Data Summary – Detection (%)
Includes Practice and Secure Results

	1.5 MHz TRL			2.0 MHz TRL			2.0 MHz TRS		
Access	Yes	No	Marginal	Yes	No	Marginal	Yes	No	Marginal
Near Side	73.5	14.7	11.8	78.8	18.2	3.0	70.6	26.5	2.9
Far Side	67.6	14.7	17.6	69.0	20.7	10.3	51.5	36.4	12.1

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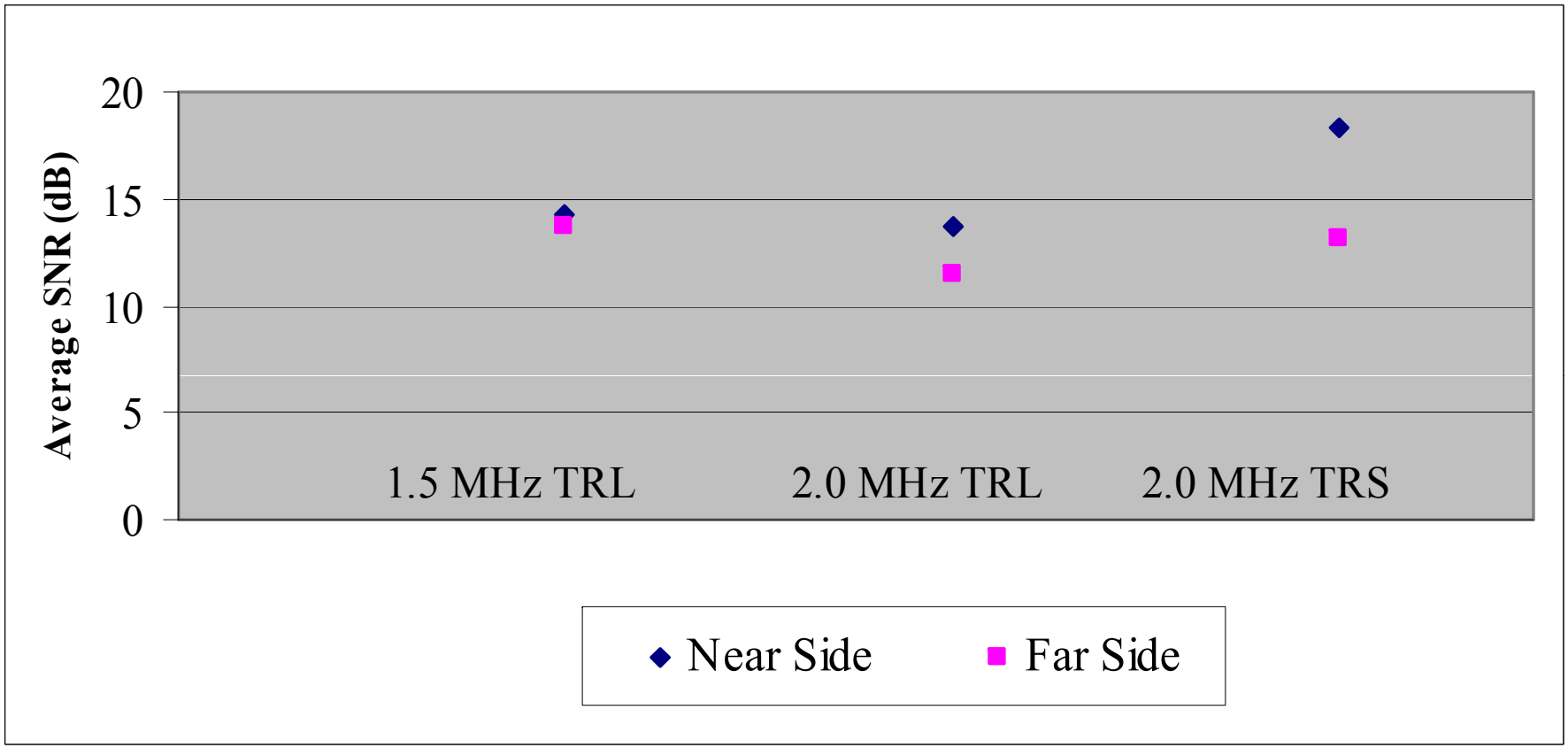
Average Signal to Noise Ratio



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Summary/Preliminary Conclusions

- Initial PNNL thru-weld examination of IGSCC with phased arrays – Can one get far side response from cracks?
  - True state was known, i.e. not a blind test
- Most crack signals are detected through the weld
  - Suggests detection possible, but signal discrimination may require further technique optimization with demonstration of capabilities
- Removal of weld crowns to allow scanning on the weld may allow
  - Peaking of ultrasonic signals
  - Specimen profiling in critical area
  - Enhanced detection
  - Depth sizing of flaws
- Signal to noise ratios are good (> 10 dB)
  - Most signals have good S/N, although the weld crown prevented optimizing the S/N