



WeldQC, Inc.

SBIR & STTR PROJECT UPDATES

**SP-7 Panel Meeting
August 22-23, 2006**



WeldQC'S PROJECTS

Phase 2

- *Development of an Intelligent Shipyard Welding Procedure System*

Phase 1

- *Penetration Monitoring for Piping Fabrication*



PHASE 2 PROJECT

An Intelligent Shipyard Welding Procedure System

SBIR Project
Sponsored by
Office of Naval Research

Technical POC: Bill Palko





ISWP

Intelligent Shipyard Welding Procedure System

OBJECTIVE

Develop a System for Assisting Vendors in Completing PQRs and WPSs That Satisfy the Requirements of TechPub 248.



PROJECT TEAM

- WeldQC
- Northrop Grumman Newport News
- General Dynamics Electric Boat
- General Dynamics Bath Iron Works





SPECIFICATION IS COMPLEX

Number of Variables on PQR

➤ 15 Elements

➤ 10 Tests

➤ 10 Tests

Test

1 Missing Entry

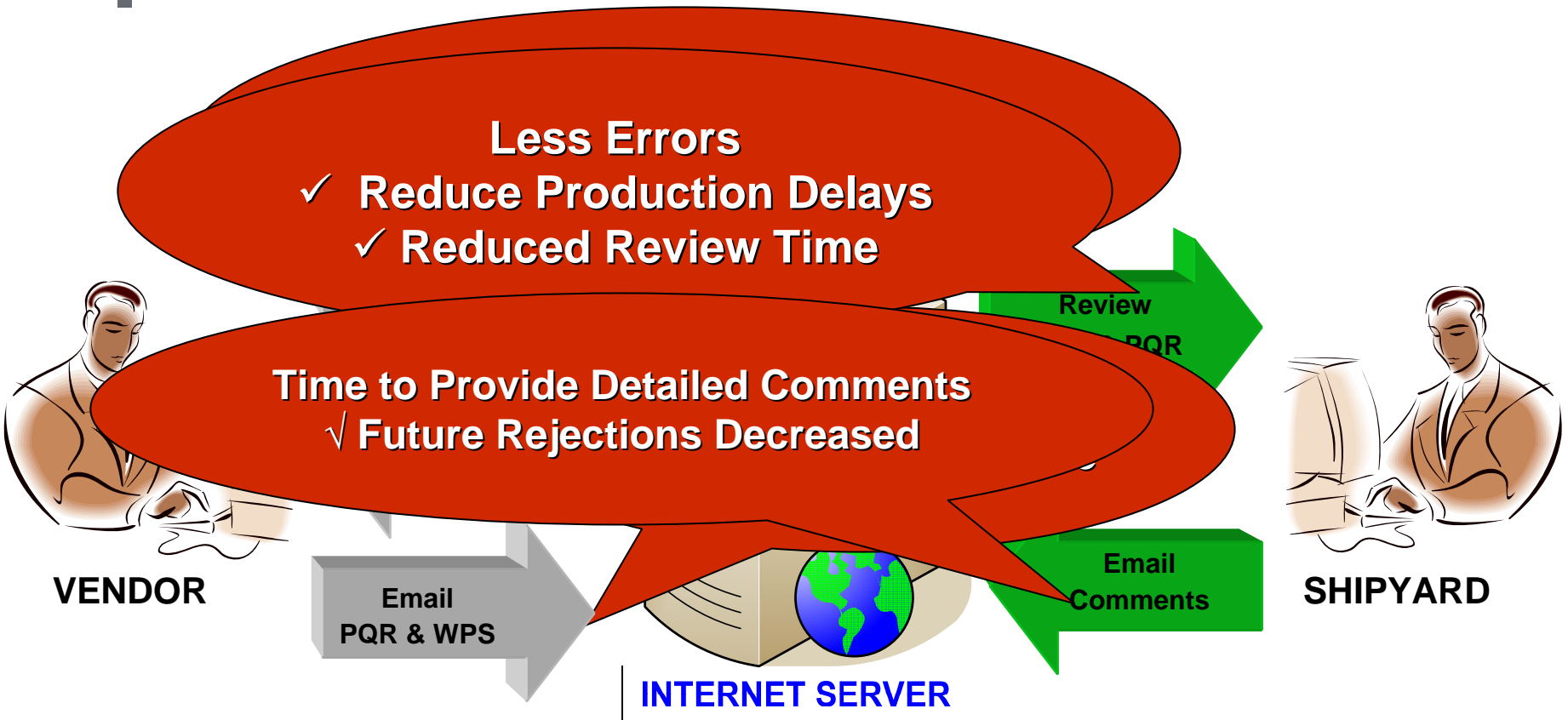


85% Rejection Rate

273 Possible Entries

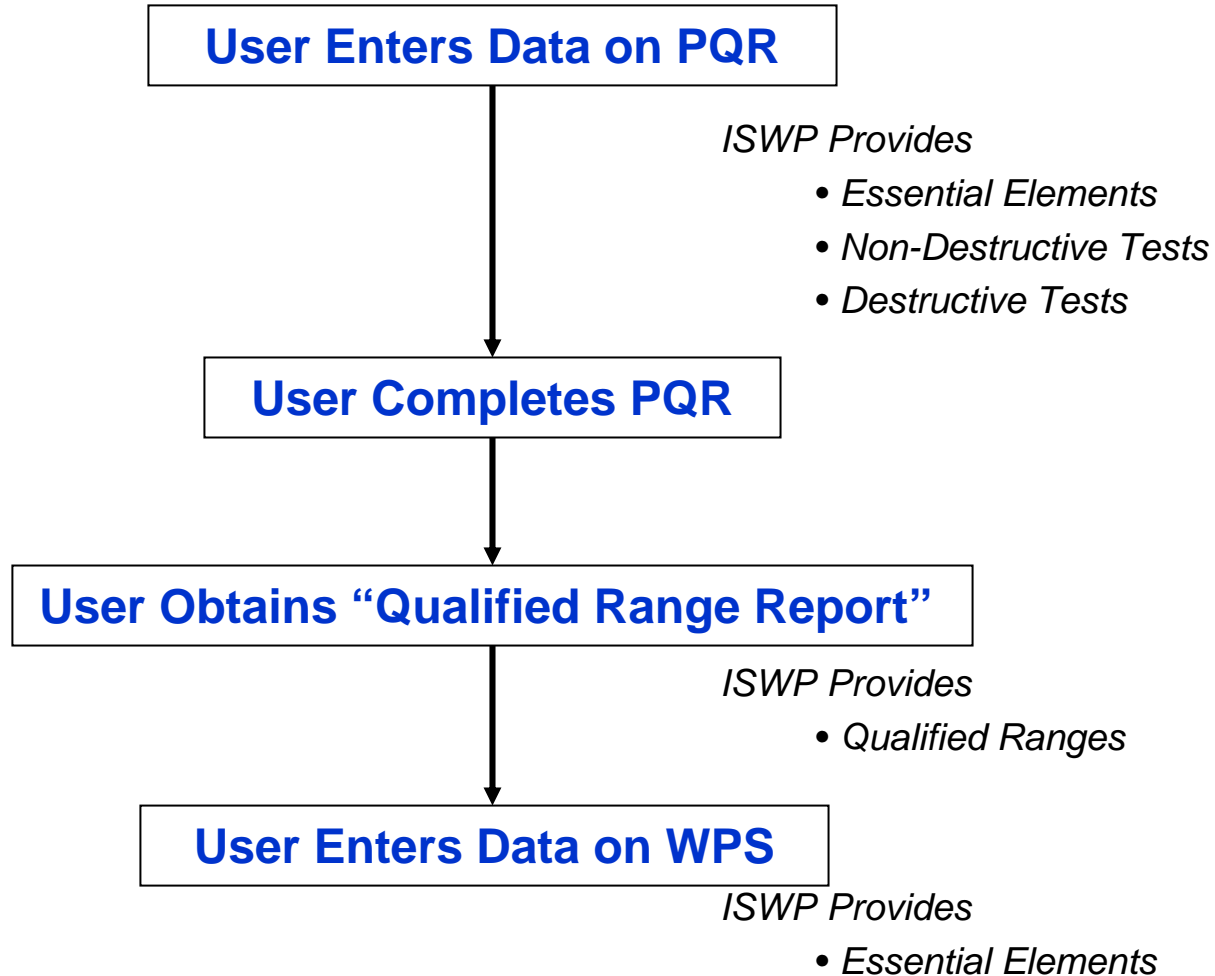


ISWP - OVERVIEW





ISWP – FLOWCHART FOR USE





ISWP - OTHER FEATURES

- Secure Website
- Companies can only access their PQR/WPS
- User-Based Privileges
 - Full
 - Read-Only
 - Vendor Administrator
- Digital Signature
- Ability to Add Pages (Notes & Images)
- Ability to Attach Files



ISWP - STATUS

PQR Module

- Beta-Testing at NGNN COMPLETE
- Beta-Testing at GDEB & BIW In-Progress
- Beta-Testing at Vendors Sept 2006 – Jan 2007

WPS Module

- Software Development In-Progress (Sept 2006)
- Shipyard Beta-Testing Sept 2006 – Oct 2006
- Vendor Beta-Testing Oct 2006 – Nov 2006

Qualified Range Report

- Rules COMPLETE
- Software Development Sept 2006 – Dec 2006
- Beta-Testing Dec 2006 – Jan 2007



SEEKING

Users Interested in Beta-Testing

- Shipyards
- Vendors



ESTIMATED COST SAVINGS for SHIPYARDS

Estimates Based ONLY on Reduction of Review Time

Additional Savings Potentials

- Reduced Production Delays
- Reduced Vendor Costs

Submi
Avg. H
Submi
Total H
Shipya

Other Assumptions:

- 85% to 20% Rejection Rate
- \$75 per man-hour



PROPOSED IMPLEMENTATION

Development Costs

- **ONR & WeldQC Funded Development**
 - **Lower Sales Cost**
 - **Reduces Risk**

Proposed Sales Mechanism

- **Shipyards pay yearly license fee**
 - **Lower Costs as compared to selling to Vendors**



PHASE 1 PROJECT

Penetration Monitoring for Piping Fabrication

SBIR Project
Sponsored by
NAVSEA
(Acquisition Program DD(X))



Technical POC: David Forrest



PENETRATION MONITORING

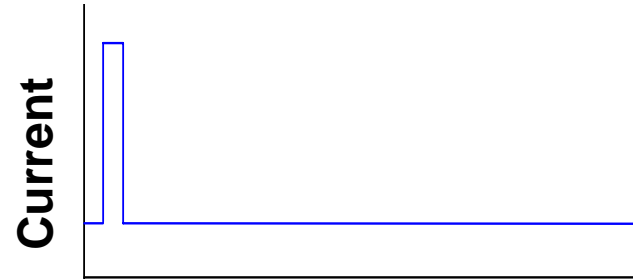
Objectives

Investigate using Multiple-Sensor Data Fusion (MSDF) techniques to detect the amount of GTAW penetration based on Weld Pool Oscillations.

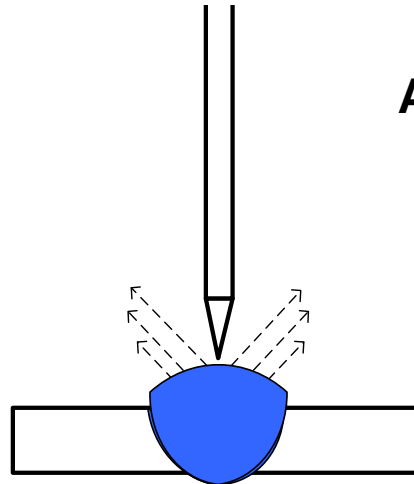


WELD POOL OSCILLATION

Apply Short Pulse of Welding Current



Weld Pool Oscillates Up & Down



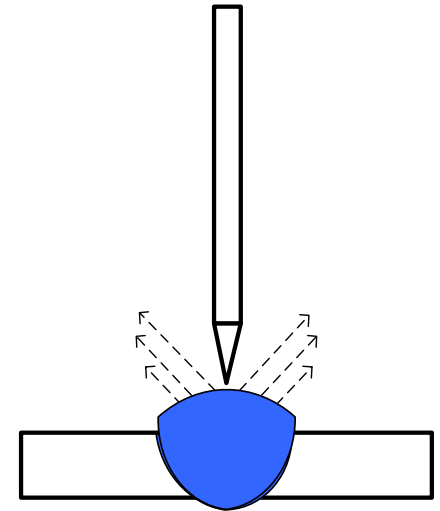
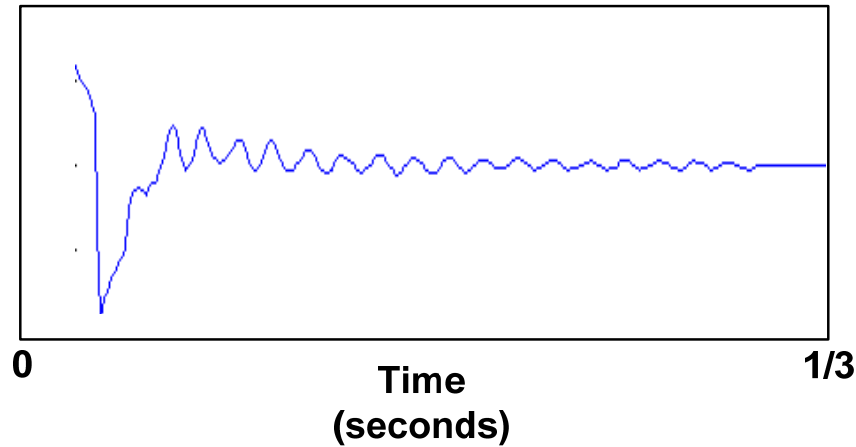
Arc Length Changes Cause

- Arc Voltage Changes
- Arc Light Changes

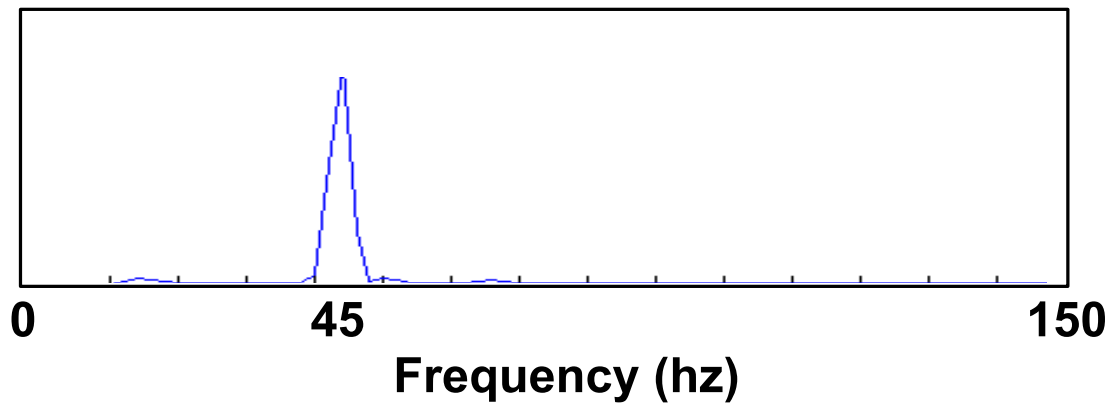


WELD POOL OSCILLATION

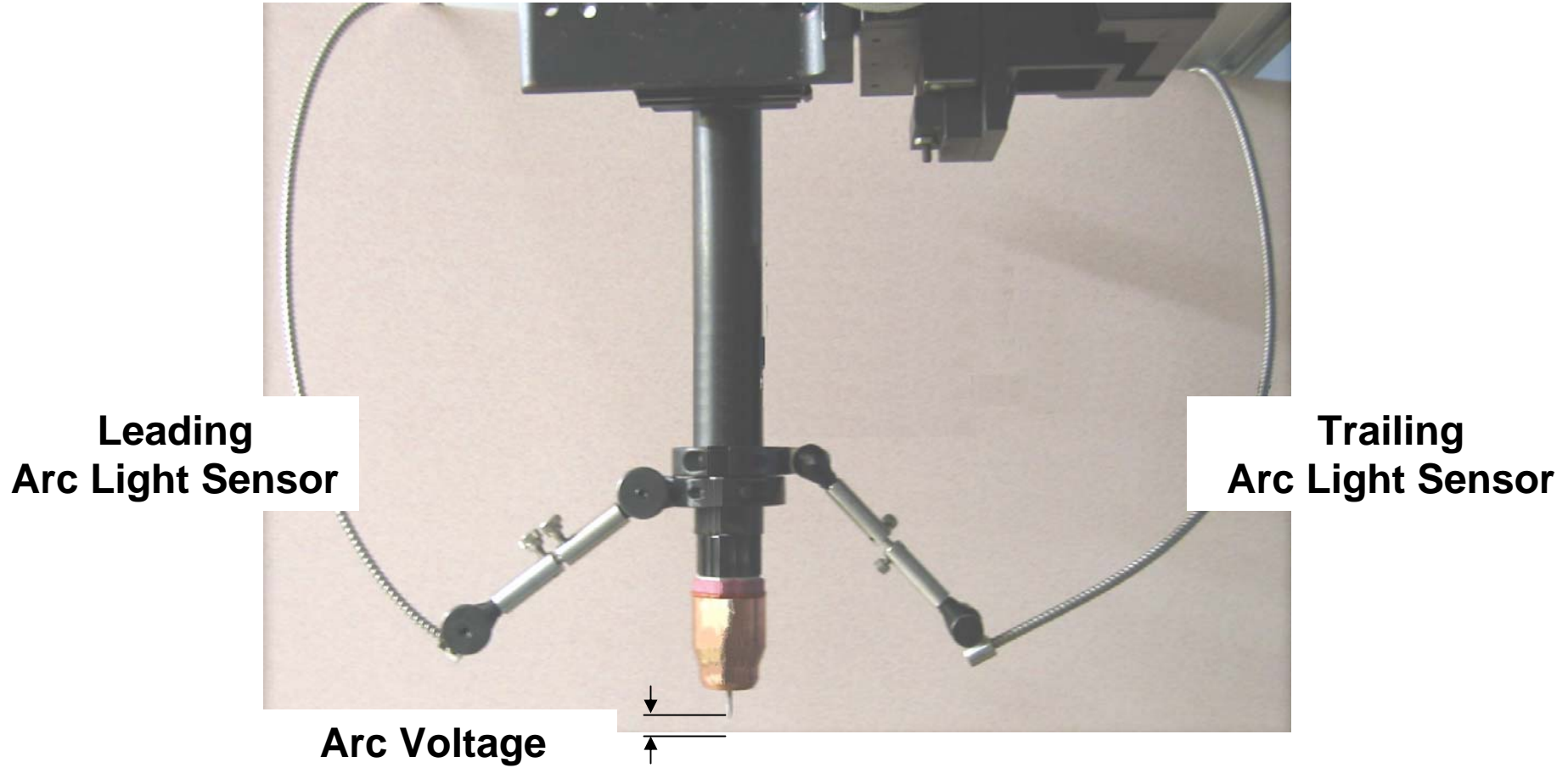
Arc Light vs. Time



Frequency of Arc Light Changes



MULTIPLE SENSORS



**Leading
Arc Light Sensor**

**Trailing
Arc Light Sensor**

Arc Voltage



WELDING TRIALS

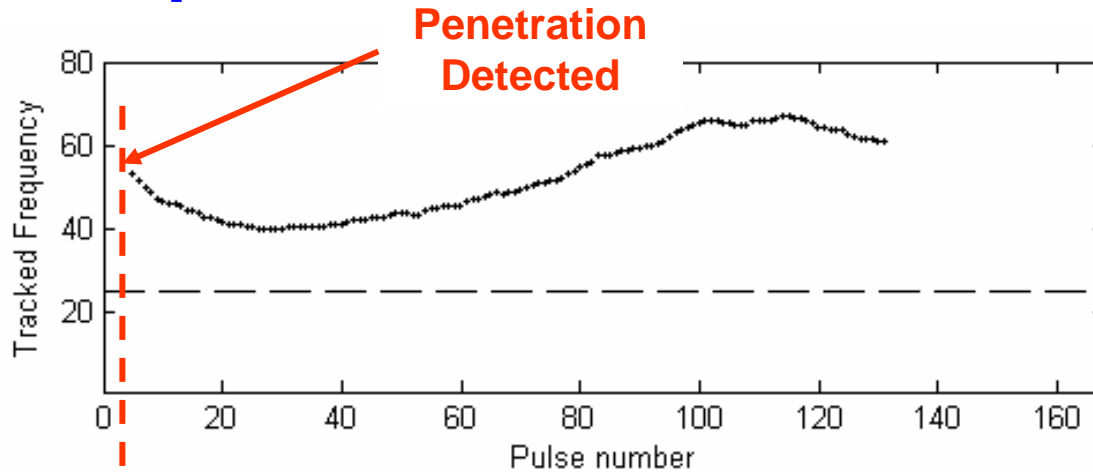
- All Welds were made “Open-Loop”
- 1G Position
- Automatic Voltage Control Used

Material Types	Weld Joint	Wall Schedule & Thickness	Filler Metal
Type 304L	Bead-on-Pipe	0.078-inch	Autogenous
	V-Groove	Schedule 10 (0.120-inch)	Insert
	V-Groove	Schedule 40 (0.203-inch)	Insert
Type 321	V-Groove	Schedule 10 (0.120-inch)	Insert
	V-Groove	Schedule 40 (0.203-inch)	Insert
Copper Nickel	V-Groove	Schedule 10 (0.120-inch)	Autogenous



QUICK DETECTION

Ramped Current from 65A to 45A



Weld Start
65A



Weld End
45A

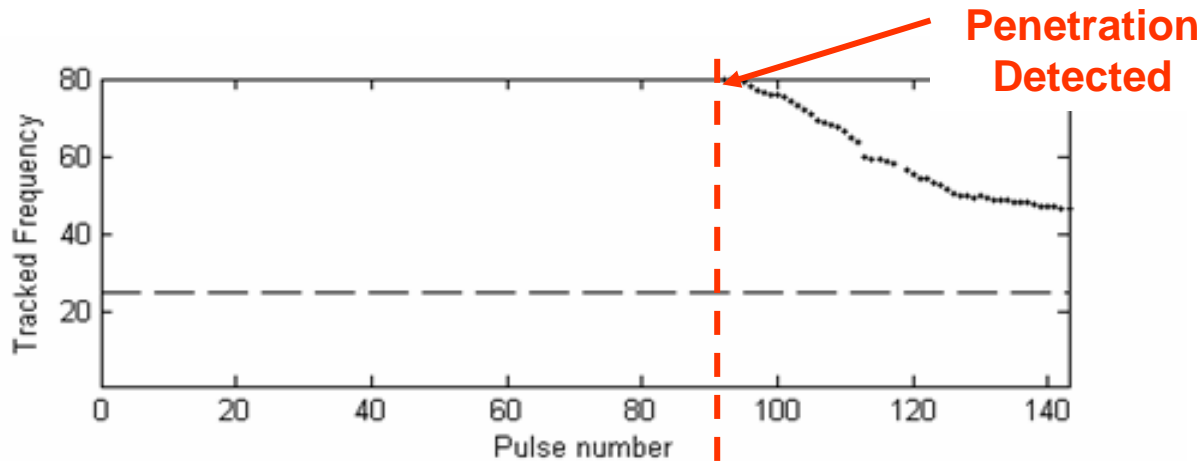
Root

Material: Type 304L
O.D.: 2.9 inch
Wall: 0.078-inch
Travel Speed: 4 ipm
Pulse Freq: 3 hz



ACCURATE DETECTION

Ramped Current from 30A to 60A



Weld Start
65A



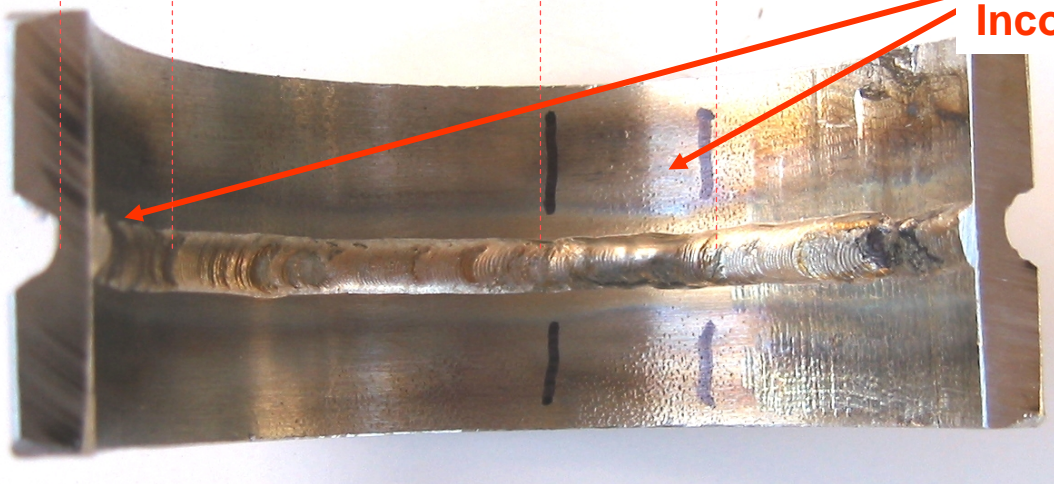
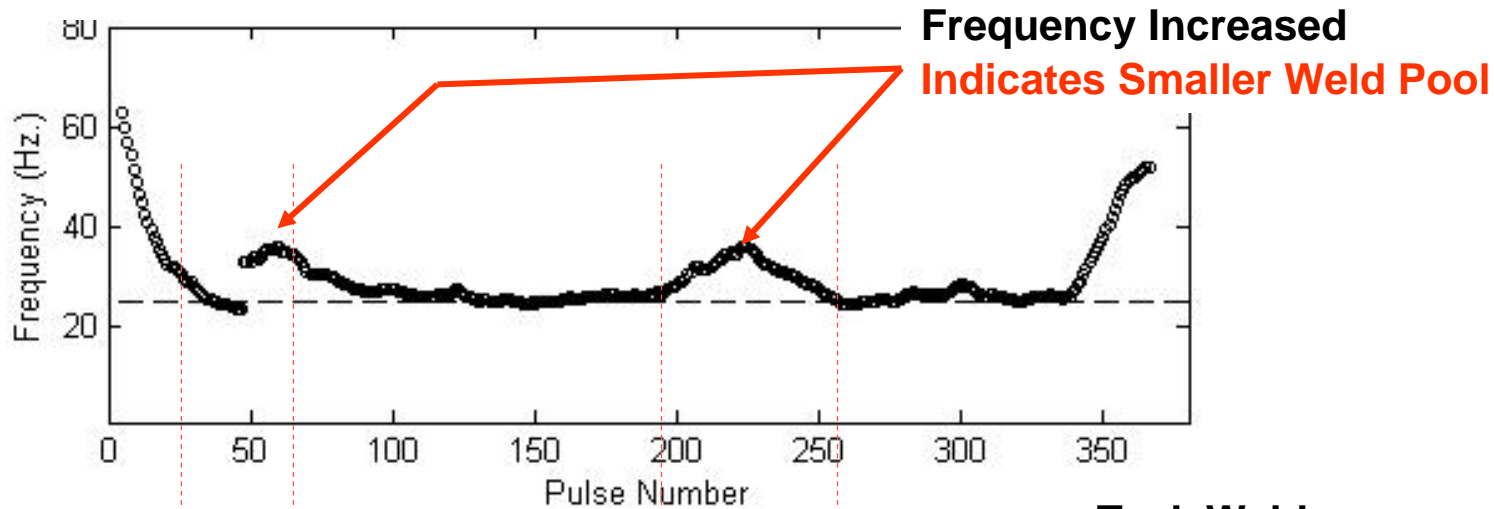
Weld End
45A

Root

Material: Type 304L
O.D.: 2.9 inch
Wall: 0.078-inch
Travel Speed: 4 ipm
Pulse Freq: 3 hz



Type 321 V-Groove w/ Insert



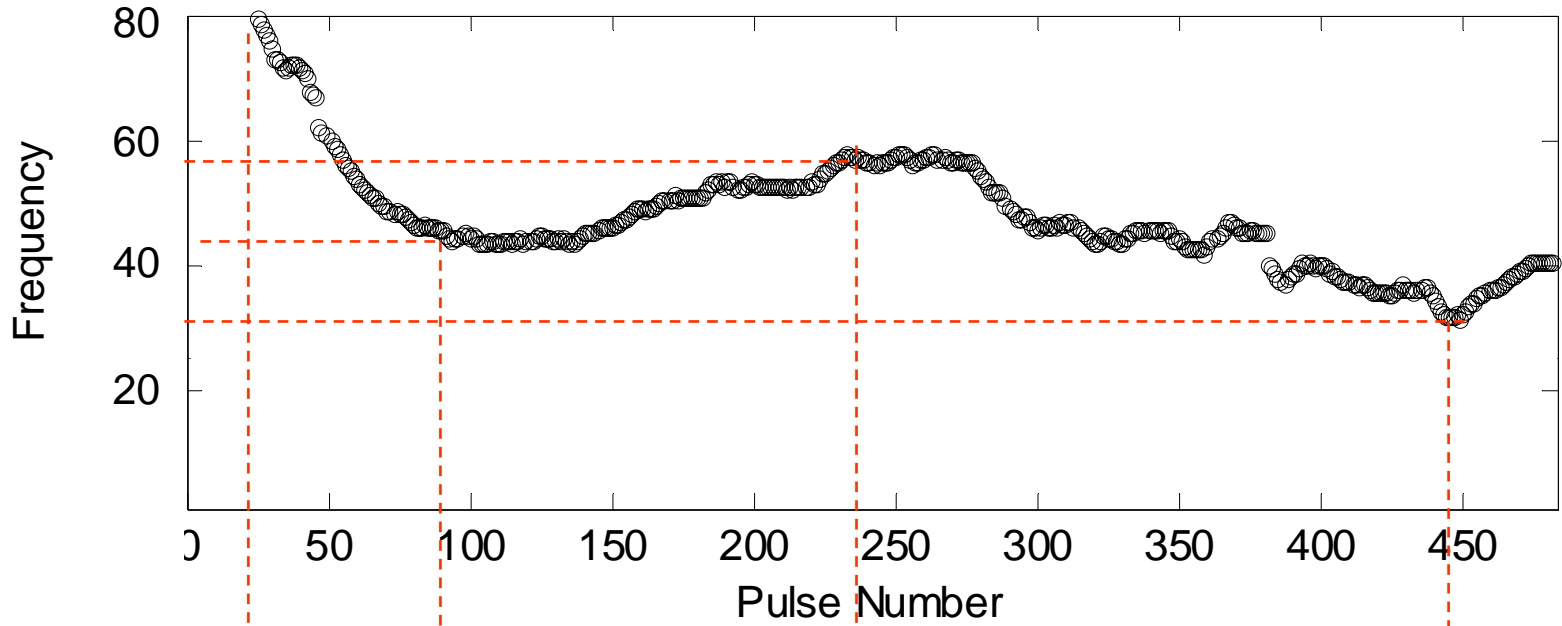
Tack Welds
Incomplete Melting of Insert

Weld No. s321_40_cp1b
Material: Type 321
O.D.: 2.9 inch
Wall: 0.20-inch
Travel Speed: 2 ipm
Pulse Freq: 3 hz



COPPER-NICKEL

Nominal Arc Length at TDC (filename:"scuni_cp1b.tpc")



Root



Penetration Detected

0.226 in.

0.185 in.

0.275 in.



CONCLUSIONS

- Multiple sensors combined with MSDF were able to **accurately** determine the oscillation frequency of the weld pool & thus the amount of weld penetration.
- The MSDF technique does not appear to be dependent on base material or weld joint type.