



Web-Based Welding Procedure System

MANTECH and SBIR Projects

NSRP SP-7 Committee Meeting

April 8, 2009





Project Objective

Reduce the cost of developing & reviewing welding procedures for U.S. Shipyards & their vendors.





Issues

- **Rejection Rate $> 90\%$**
- **Requirements complex**
- **Review time consuming**





Solution

Develop a web-based software application to assist the vendor in developing PQR, WPS, & WPQR that satisfy Navy requirements.





Integrated Project Team (IPT)

- PMS 378
- NAVSEA/05V2
- NSWCCD
- NMC (*CTC*)
- Northrop Grumman Shipbuilding – Newport News
- General Dynamics Electric Boat
- WeldQC

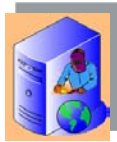




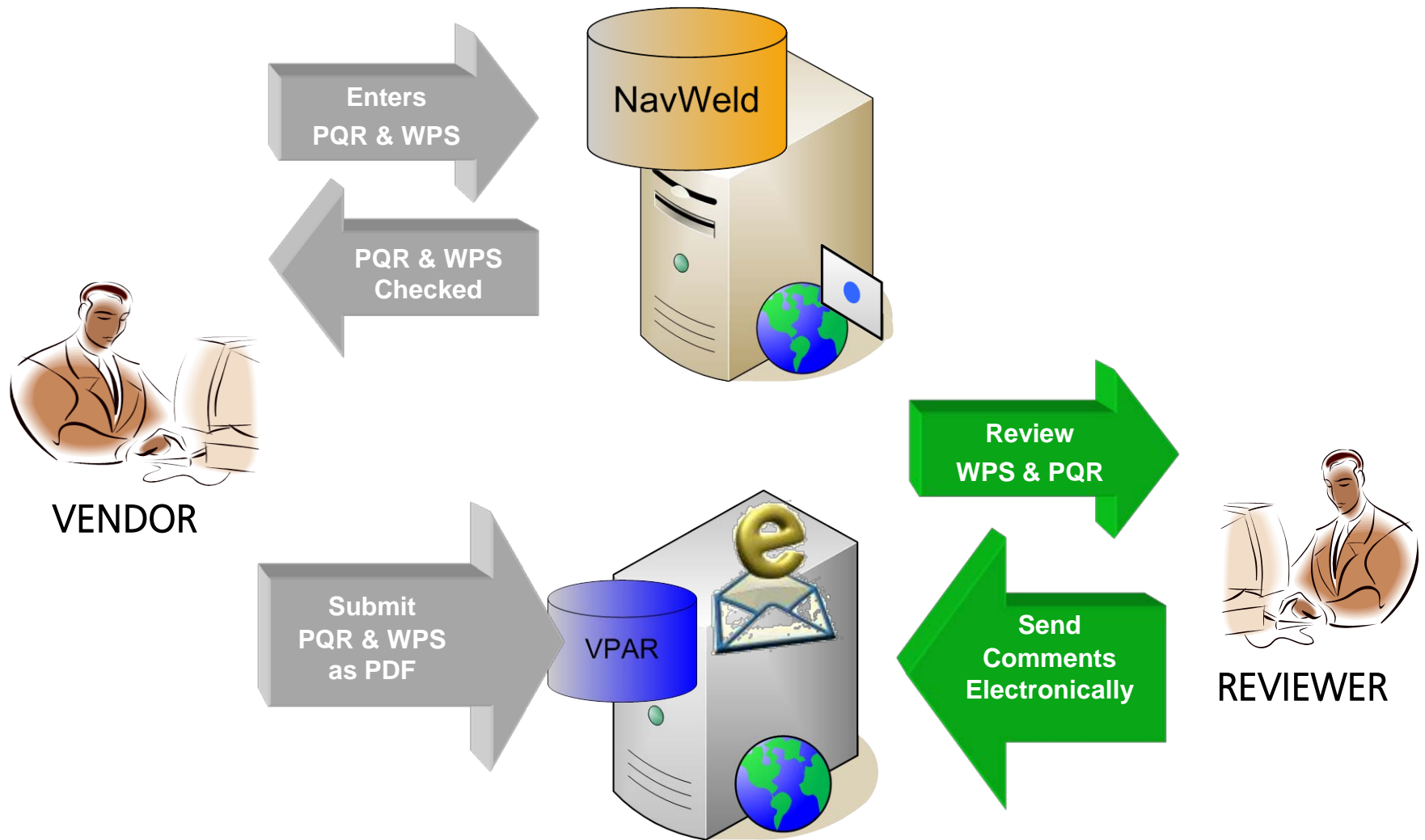
Navy Requirements

Process	Qualification Documents	Fabrication Documents
Arc	<ul style="list-style-type: none">• TP248• ABS/NVR - 2007	<ul style="list-style-type: none">• TP278• TP1688• MIL-STD-1689A• ABS/NVR - 2007
Stud	<ul style="list-style-type: none">• TP248• ABS/NVR - 2007	<ul style="list-style-type: none">• TP1688• MIL-STD-1689A• ABS/NVR - 2007
Resistance	AWS D17.2	AWS D17.2
Brazing (Piping)	0900-LP-001-7000	0900-LP-001-7000





System Overview





NavWeld Will

Determine:

- ✓ Essential Elements
- ✓ NDE Tests
- ✓ Destructive Tests & Number of Samples
- ✓ Qualified Ranges
- ✓ Fabrication Document Requirements





NavWeld Will

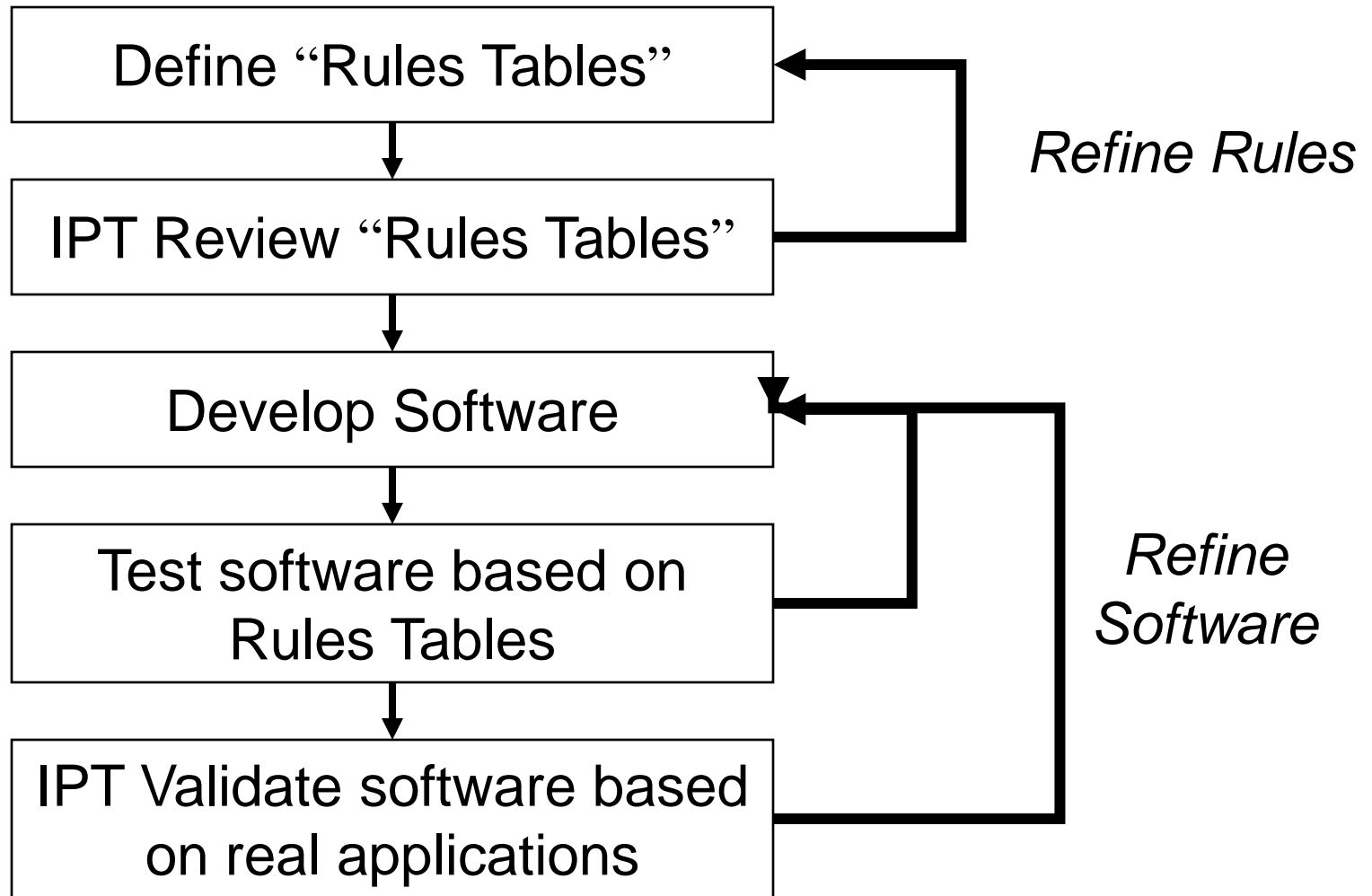
NOT:

- Automatically fill in entries
- Determine if testing results are acceptable
- Eliminate the need for human review





Project Methodology





Fabrication Rules

	No. of Fabrication Rules
Base & Filler Metal	986
Preheat & Interpass Temperatures	327
Post-Weld Heat-Treatment	55
Heat Input	19
Welding Process	7
Welding Progression	3
Backing Gas	4
Back Gouging	4
Single Pass Welds	1
Total	1406





Documents

User Selects Fab. & Qual. Documents:

Do Not Publish to Read-Only Users

Company Name:

Welding Process Groups:

Fabrication Document:

Welding Qualification Document:

This WPS includes S-11 Base Metals

Fabrication Document for S-11 Base Metals:

NavWeld will only apply the rules for MIL-STD-1689A or TP1688 instead of TP278.
"Other" will only apply the rules from TP278.

Determines:

- Available Base & Filler Metals
- Rules





“Grouped” Base Metals

Base Metal Selection - Windows Internet Explorer
https://www.navweld.com/PQR/BaseMetalSelect.aspx?TP=TOP&IN=ctl00_PQRPlaceholder_

Base Metals are listed in the Fabrication & Qualification Documents selected on the General Information Page

Filter table by selecting one or any combination of the drop-down lists below

Specification: <SELECT SPEC>

Class/Type: <SELECT CLASS/TYPE>

SNumber: S-1 / Carbon Steel

Select	SNumber	Specification	Class/Type	Grouping Letter	Cognizant Shipyard
SELECT	S-1	ABS	Grade A	10310 OPR: 05M22.2 Ser 05M2/167 Dated 5/27/88	Northrup Grumman - Newport News
SELECT	S-1	ASTM A 178	Grade A		
SELECT	S-1	ASTM A 178	Grade C		
SELECT	S-1	ASTM A 178	Grade D		
SELECT	S-1	ASTM A 216	Grade WCB		



Essential Elements

- GTAW
- Manual
- 1GR

- GTAW
- Machine
- 1GR

Technique

Tungsten Electrode Type: *

Tungsten Electrode Size: *

Weld Passes: *

Welding Arcs: *

Back Gouging: *

Contact Tip-to-Work Distance: (in) TO Optional
(##.##) (##.##)

Gas Cup-to-Work Distance: (in) TO Optional
(##.##) (##.##)

Torch Travel Angle: Optional

Torch Travel Angle Measurement: (dgs) TO
(##.##) (##.##)

Wire Feed Angle: Optional

Wire Feed Angle Measurement: (dgs) TO
(##.##) (##.##)

Torch Offset Direction:

Torch Offset: (in) TO Optional
(##.##) (##.##)



Technique

Tungsten Electrode Type: *

Tungsten Electrode Size: *

Weld Passes: *

Welding Arcs: *

Back Gouging: *

Contact Tip-to-Work Distance: (in) TO Optional
(##.##) (##.##)

Gas Cup-to-Work Distance: (in) TO Optional
(##.##) (##.##)

Torch Travel Angle: *

Torch Travel Angle Measurement: (dgs) * TO
(##.##) (##.##)

Wire Feed Angle: *

Wire Feed Angle Measurement: (dgs) * TO
(##.##) (##.##)

Torch Offset Direction: *

Torch Offset: (in) * TO Optional
(##.##) (##.##)





Destructive Tests

Ability to Add Optional Tests

PQR qualified to previous version of MIL-STD-248. Make ALL NDE Tests Optional.

Add an optional Destructive Test
 All Weld Metal Tensile Add Test

Use Face and Root Bend Tests Instead of Side Bend Test

Remove this Destructive Test Upon Saving

⚠ Transverse Tensile Tests -- (Minimum of 2 Full Thickness Tests Required)

Specimen No.	Test Type	Width/Dia. (in) (###)	Thickness (in) (##.##)	Area (sq. in) (##.##)	Total Load (lbs) (##.##)	Unit Stress (psi) (##.##)	Failure Type	Failure Location
<input type="checkbox"/>	Reduced						Ductile	Base M
<input type="checkbox"/>	Reduced						Ductile	Base M

Add Specimen Delete Checked Specimen

Remove this Destructive Test Upon Saving

⚠ Side Bend Tests -- (Minimum of 3 Full Thickness Tests Required)

Specimen No.	Acceptance Criteria	Width (in) (###)	Thickness (in) (##.##)	Bend Radius (in) (##.##)	Result	Notes (Optional)
<input type="checkbox"/>					<SELECT>	
<input type="checkbox"/>					<SELECT>	
<input type="checkbox"/>					<SELECT>	

Add Specimen Delete Checked Specimen

Required Tests

Minimum Number of Specimens

Ability to Add Specimens





PQR - Qualified Ranges

Level 1 & 2 Qualified Ranges for:

- Essential Elements
- Thickness
- Position
- Base/Filler Metal Cross Qualification





PQR - Qualified Ranges

Base Metal Thickness Table for Groove and Fillet Welds

Thickness (T) on PQR used to determine qualified thickness		Qualified Base Metal Thickness ¹		
		Groove, Autogenous (Groove) ¹ & Seal (Groove) Welds		Fillet, Autogenous (Fillet), ¹ Socket (Fillet) Welds
		Pipe (min/max)	Plate (min/max)	Pipe & Plate (min/max)
Thinnest Base Metal	1.25	0.125 / Unlimited	0.1875 / 2T	0.058 / Unlimited

Thickness on PQR

Qualified Thicknesses





Fabrication Document Rules

- **Base & Filler Metal Combinations**
- **Preheat & Interpass**
- **Post-Weld Heat-Treatment**
- **Heat Input**

- **Welding Process**
- **Welding Progression**
- **Backing Gas**
- **Back Gouging**
- **Single Pass Welds**





Fabrication Rules

- Process
- Weld Type
- Welding Position
- Filler Metal Review Fab. Spec. Messages
- Gas
- Preheat / Interpass

Fabrication Specification Rules - Windows Internet Explorer

https://www.navweld.com/PQR/FabRules.aspx?ID=ed56a420-21f3-462d-a0a7-22df8c397c1f&TP=FMETAL&SC=ARC

Filler Metal

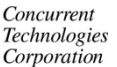
The Filler Metal for the combination of Base Metal, Welding Process and Weld Type was checked accordingly to the requirements of the Fabrication Document.

NavWeld does NOT check the other Essential Elements in the Filler Metal section. Please review the following messages to determine if any actions are required.

The Filler Metal for the combination of Base Metal, Welding Process and Weld Type could NOT be identified in the Fabrication Document. Refer to the Fabrication Document to determine how to proceed.

Done

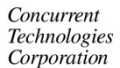
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WPQR

- ✓ Essential Elements
- ✓ NDE Tests
- ✓ Destructive Tests & Number of Samples
- ✓ Qualified Ranges
- ✓ Search based on Qualifications
- ✓ Tracks History





WPQR - Qualified Ranges

WPS No.	_____		WPS Rev.	_____	
PQR No.	_____		PQR Rev.	_____	
Qualification Test No.	Other				
Fabrication Doc(s)	NAVSEA S9074-AR-GIB-010/278 (1995)		Welding Qual Doc(s)	NAVSEA S9074-AQ-GIB-010/248 (1995)	
Welder Qual. Type	Welder		Qualified For	Welder	
Scope	_____				

WELDING PROCESS					
	WPQ Value	Qualified For	Messages		
Welding Process	Test Values	Qualified for			
Process Type					

BASE METAL					
	WPQ Value	Qualified For	Messages		
	Base Metal #1	Base Metal #2			
Base Metal S-No.	S-1	S-1	Unrestricted		
Base Metal Spec	ASTM A 178	ASTM A 178	Unrestricted		
Type Or Grade	Grade A	Grade A	Unrestricted		
Base Metal Form	Plate	Plate	Plate Pipe	Pipe O.D. 2-7/8 to Unlimited	
Thickness	0.25	0.25	Pipe - 0.058 TO 0.500 Plate - 0.058 TO 0.500		
Pipe Diameter			Pipe - 2-7/8		
Nominal Pipe Size					
Pipe Wall Schedule					

WELD JOINT			
	WPQ Value	Qualified For	Messages
Joint Penetration	Full	Full or Partial	Without Backing limited to Partial Penetration welds or welds Welded from Both Sides.





WPQR – Qualified Search

Qualified Ranges (based on individual welder)

Search Results (2)

Welder	Qual Type
VanLeaven, Larry	Welder
<input type="radio"/> Smith, Bob	Welder

Indicates the welder is out of qualification

Update Welder History - Windows Internet Explorer

https://www.navweld.com/WQR/WQRWelderHistory.aspx?WID=68&PID=GTAW

Welder: VanLeaven, Larry (LV123)

Welding Process Used: GTAW (Non-Pulsed)

Date Process Used: 4/4/2009

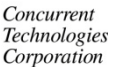
Titanium Welded

Save Cancel

Pipe O.D.: Minimum Maximum

<Select O.D.>

Search Reset New WPQ





Welder & Brazer Maintenance

Welder	Brazer
Welding Process History	Brazing Process History
Vision Tests	
Color Vision Tests for Titanium	
Workmanship Training	





Reviewer Tools

Standard Format

BASE METAL		
S-No.	S-1	to S-1
Material Specification	ASTM A565	to ASTM A565
Type Or Grade	Grade A	to Grade A
Form	Plate	to Plate
Condition or Temper	as rec'd	to as rec'd
Toughness Required?	NO	to NO
Prod. Thickness >= 1/2 in.?	NO	to NO
Thickness	1 (in)	to 1 (in)
Notes		

WELD JOINT	
Joint Type	B1S.1/Square Butt (welded one side)
Joint Parameters	
T (in)	
Y (in)	
Joint Backing	Without Joint Backing
Backing Type	NONE
Notes:	

WELD TYPE	
Weld Type(s)	Groove
Primer Or Bare	BARE
Joint Penetration	
Welded Single/Both Sides	
Notes	

INCOMPLETE SECTION(S)
(Weld Joint, Process, NDE Tests, DST Tests, Certification, Digital Approval)

NavWeld Ver. 1.0
S9074-AQ-GIB-010/248

m

Base Metal was NOT selected from pre-defined list

i

Section is Incomplete



Reviewer Tools

Fabrication Specification Messages printed on
PQR & WPS

PQR No. TP278

PQR Rev. _____

Page: 6/6

FABRICATION DOCUMENT RULES

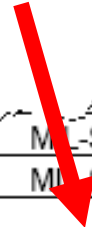
Group Number (A-No)(DEF): The combination of Base Metal, Filler Metal, Welding Process and Weld Type is NOT identified in the Fabrication Document. You will need approval to use this combination.

Preheat(RNG): The Preheat Temperature is NOT within the limits specified in the Fabrication Document. NavWeld uses the highest Preheat Temperature based on the requirements of the Base Metals (and/or Filler Metal, if specified) in the Fabrication Document.



Reviewer Tools

Ability to add comments electronically in
Adobe®



Magnetic Particle		ML-STD-2035 Rev.A Class 1	PASS	
Ultrasonic		ML-STD-2035 Rev.A Class 1	PASS	

Transverse Tensile (min 2 full thickness tests required)								
Specimen No.	Test Type	Width (in)	Thickness (in)			Unit Stress (psi)	Failure Type	Failure Location
Tensile 1	Reduced	1.00	0.5	0.5	18000	36000	Ductile	Base Metal
	N/A	1.00	0.5	0.5	18000	36500	Ductile	Base Metal

Sticky Note 10/30/2008 11:4

Troy Options

Tensile Strength does NOT meet the requirements of



Status

- Validation & software refinement: May 1, 2009



Concurrent
Technologies
Corporation