



PDI Piping & Bolting Program Update

NRC / PDI Meeting
May, 2007

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PDI Piping & Bolting Program

Objectives

- General Piping Program Update
- 2007 Session Schedule
- Generic Procedure Revisions
- Phased Array Qualification Status
- DM Program Status Update
- Fabrication Activities
- DM Weld Assessments

PDI Piping Program: General Update

- Piping & Bolting Program remains highly utilized...
 - Summer sessions are at or nearing maximum capacity
 - Schedule qualifications early!
 - Foreign participation continues to increase
 - Summer Sessions exceeded previous Lab capacities
 - Seating increased to 20 Candidates in '06
 - Will operate at new capacity during summer '07

Laboratory Updates



- Significant renovations in the last few years!



Summer Sessions 2007

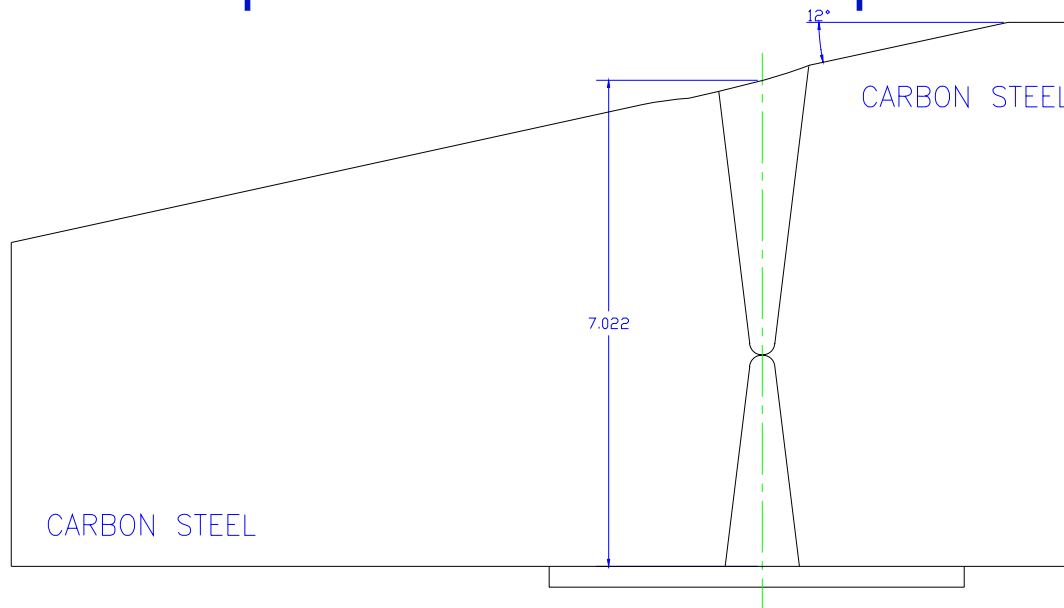
- Personnel Qualifications
 - Completed spring '07
 - 84 personnel qualifications
 - Approximately 60% re-qualifications
 - Scheduled for remainder of '07
 - Approximately 100 additional personnel qualifications
- Working hard to reduce processing time for PDQS issuance

Procedure Qualifications 2007

- Procedure qualification activities **completed** (Spring '07)
 - Semi-Auto DM Phased Array procedure expansion
 - Existing procedure/new hardware
 - Semi-Auto IGSCC Phased Array procedure expansion
 - Existing procedure/new hardware
 - Manual Phased Array weld overlay procedure
 - Existing procedure/technique demonstration
- Procedure qualification activities **scheduled** for remainder of '07
 - OD procedure qualifications
 - Manual Phased Array IGSCC piping
 - Manual Phased Array weld overlay
 - Automated Phased Array IGSCC piping
 - Automated Phased Array DM welds
 - Automated Phased Array weld overlay (tentative)
 - ID Automated DM procedure qualification
 - Phased Array

Generic Procedure Work

- PDI-UT-1 & PDI-UT-3 expansions (CS only)
 - Thickness/Diameter expansion
 - Diameter expanded to 55" (> 24")
 - Thickness expanded to 7.00" (up from 3.85")
- Expansions performed to cover replacement SG tip welds



Phased Array Qualification Status

- Phased Array quickly becoming the primary method
 - All piping supplements now have qualified Phased Array techniques (no bolting)
 - Multiple organizations
 - Multiple techniques
 - Automated
 - Manual
 - 1D arrays & 2D arrays
 - Linear scanning (e-raster)
 - Azimuthal scanning
 - On and on...
 - Very flexible technology
 - All procedure qualifications scheduled in '07 are using Phased Array.

Phased Array Qualification Status

- EPRI
 - Similar metal piping welds from the OD, including IGSCC
 - Detection, length and depth sizing
- General Electric automated procedure
 - Similar metal piping welds from the OD, including IGSCC
 - Detection, length and depth sizing
 - Based on EPRI procedure
- EPRI/Zetec semi-automated procedures
 - Similar metal piping welds from the OD, including IGSCC
 - Detection, length and depth sizing
 - DM welds from the OD
 - Detection, length and depth sizing
 - Joint effort with EPRI
- Structural Integrity Associates
 - Weld Overlay
 - Including non-standard configurations

Phased Array Qualification Status

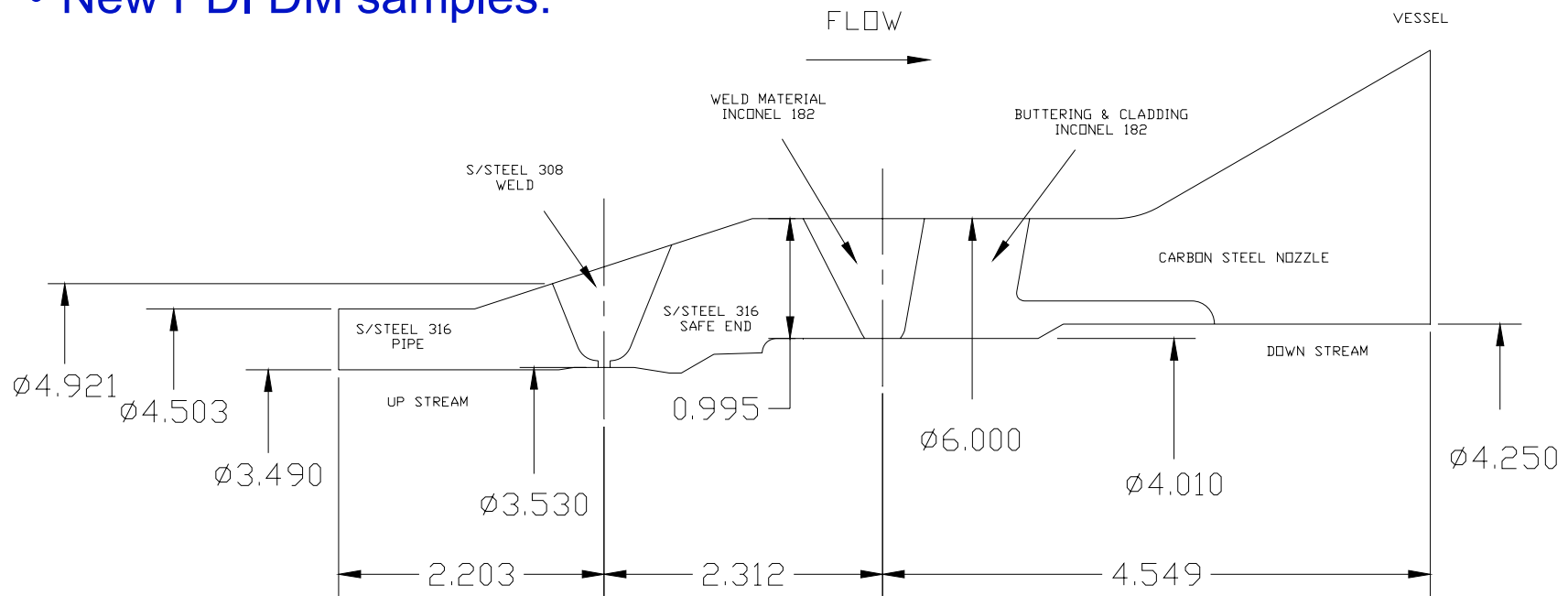
- Areva (Germany)
 - DM welds from the ID with Phased Array
- IHISWT
 - DM welds from the ID with Phased Array
- Several additional organizations planning Phased Array qualification work...
 - Existing procedure expansions/new configurations
 - Manual Phased Array on piping welds, including IGSCC
 - Manual Phased Array on DM welds, including depth sizing
 - Manual Phased Array on Overlays
- 2007 EPRI planning work on complex DM weld geometries
 - Initial work underway, looking toward qualification work end of '07 or '08
- 2007/2008 EPRI project for manual Phased Array procedures
 - Weld overlay, DM (detection, length & depth), IGSCC

DM Program Status Update

- Qualified NDE (detection & sizing) is available for large population of DM welds – EPRI complex geometry project will help close existing gaps
- The PDI sample set spans the majority of configurations present in plants
 - New samples have been fabricated to cover additional configurations
- Remaining limitations are primarily due to geometry
 - Tapers
 - ID geometry
 - Weld crowns
 - Adjacent welds
 - Slope of vessel nozzle
 - Short safe-ends
 - Cast SS

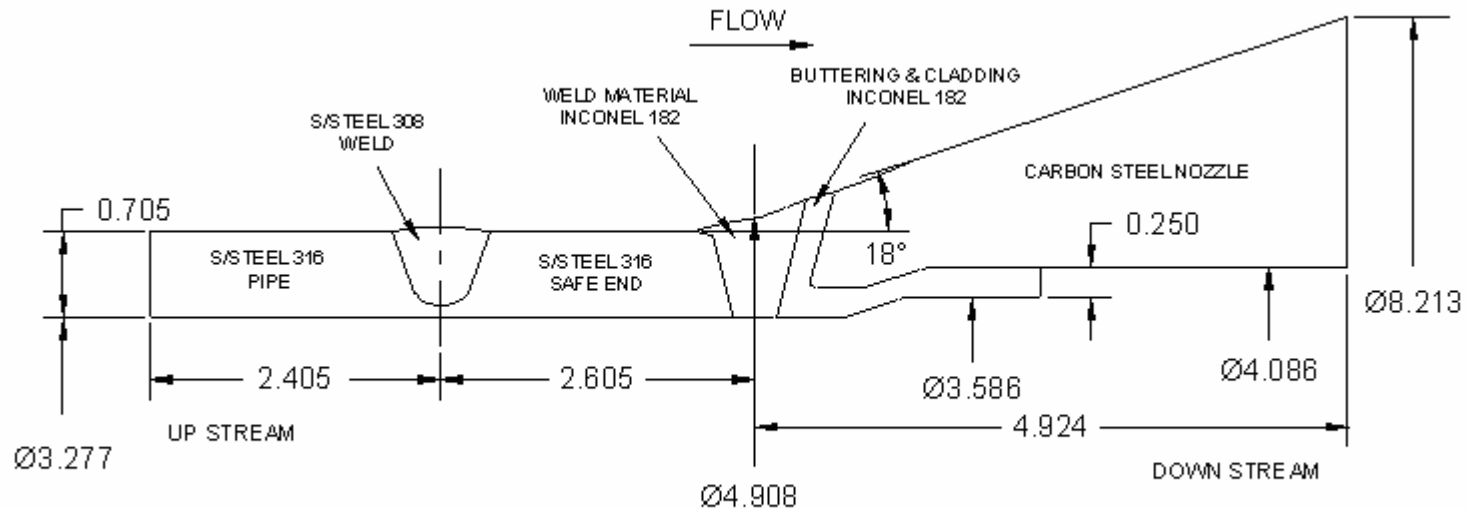
DM Program Status Update

- New PDI DM samples:



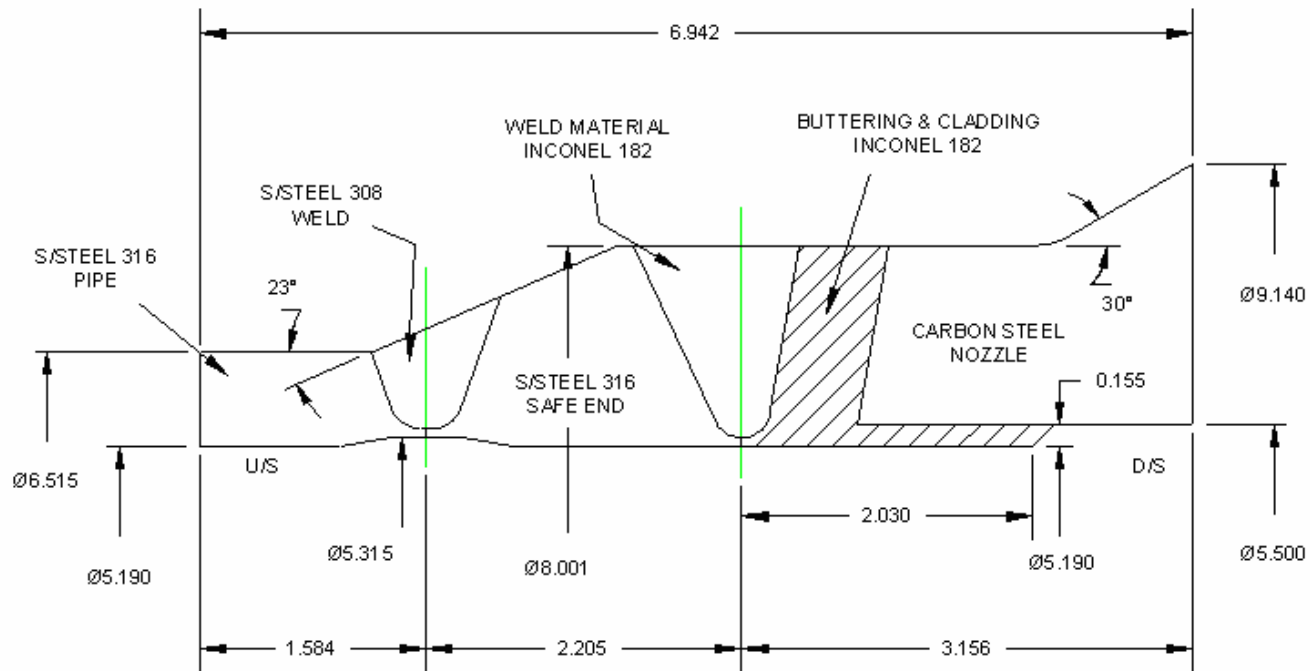
702/X – Pressurizer Spray Nozzle Design (Westinghouse)

DM Program Status Update



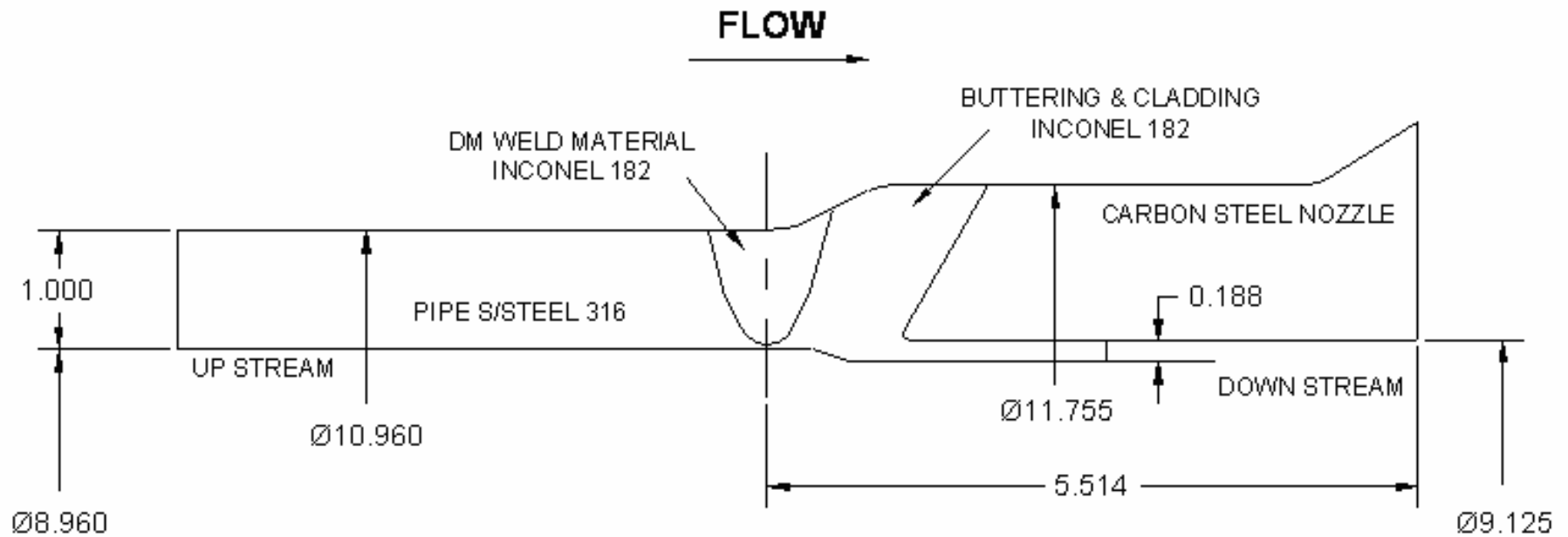
Pressurizer Spray Nozzle (Cumbustion Engineering) Design - 702/X

DM Program Status Update



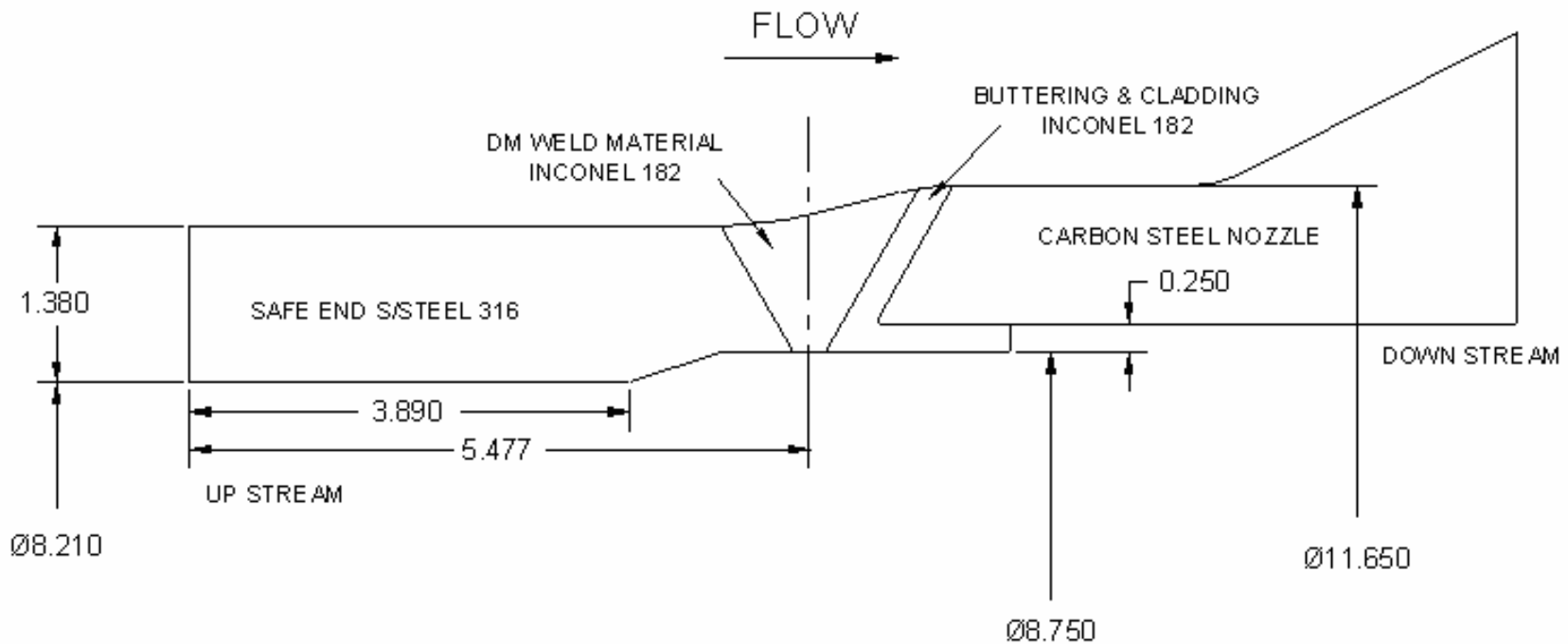
704IX - PRESSURIZER SAFETY/RELIEF NOZZLE DESIGN (WESTINGHOUSE)

DM Program Status Update



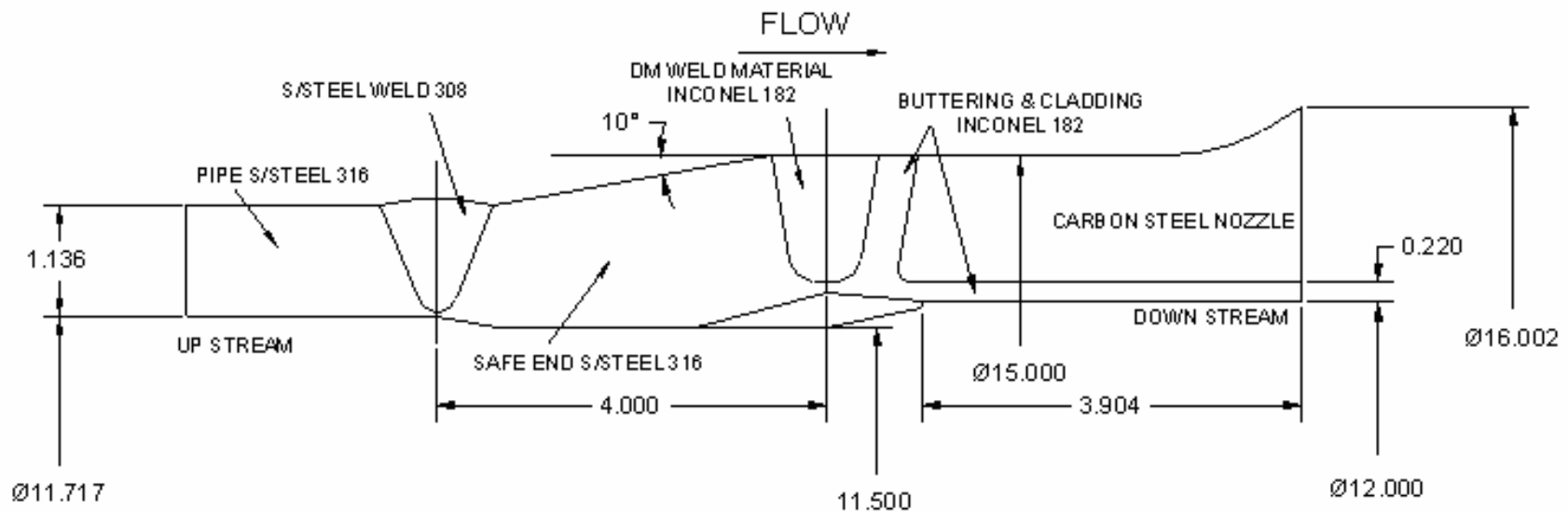
708/X – Hot Leg Surge Nozzle Design (Babcox & Wilcox)

DM Program Status Update



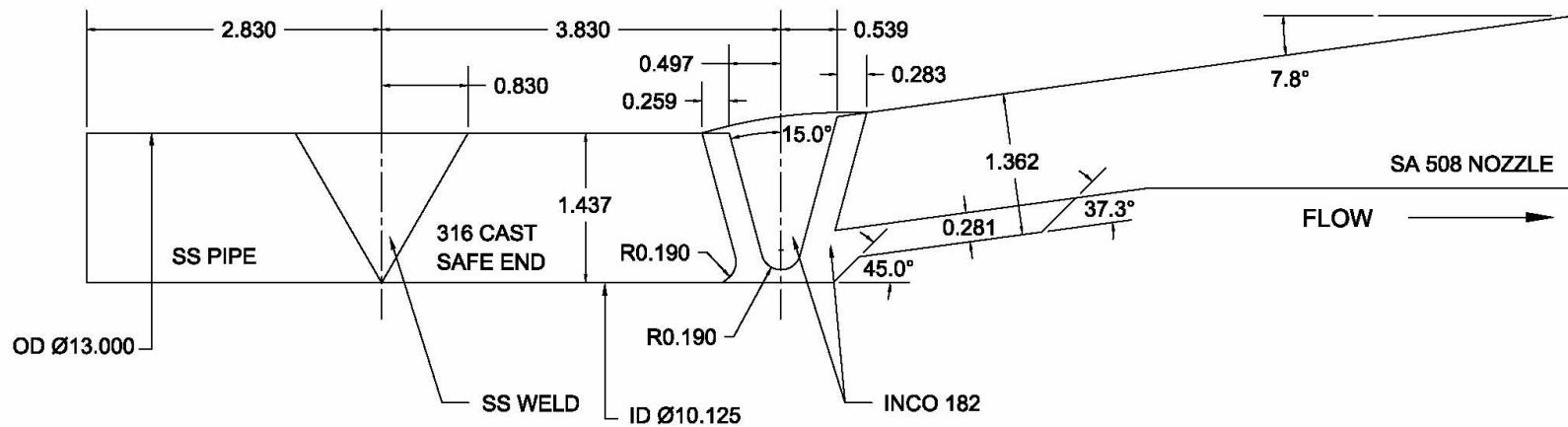
708/X – Pressurizer Surge Nozzle Design (Babcox & Wilcox)

DM Program Status Update



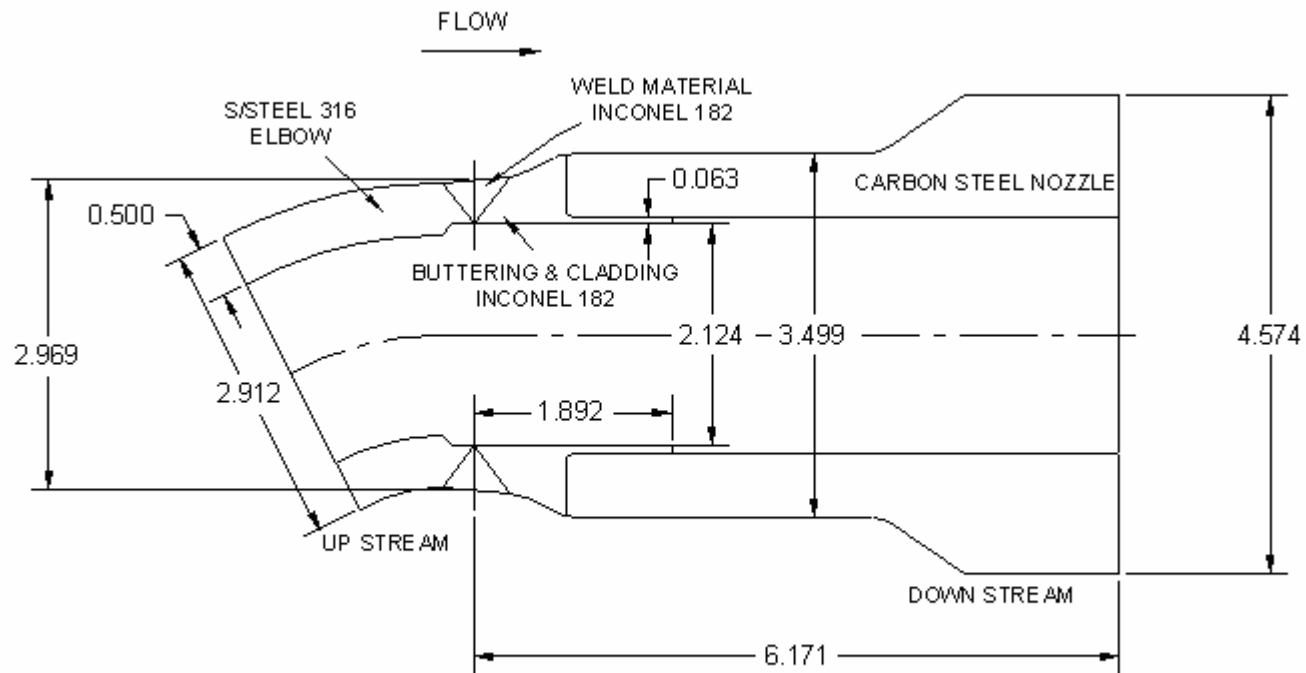
Pressurizer Surge Nozzle (Westinghouse) Design - 708/X

DM Program Status Update



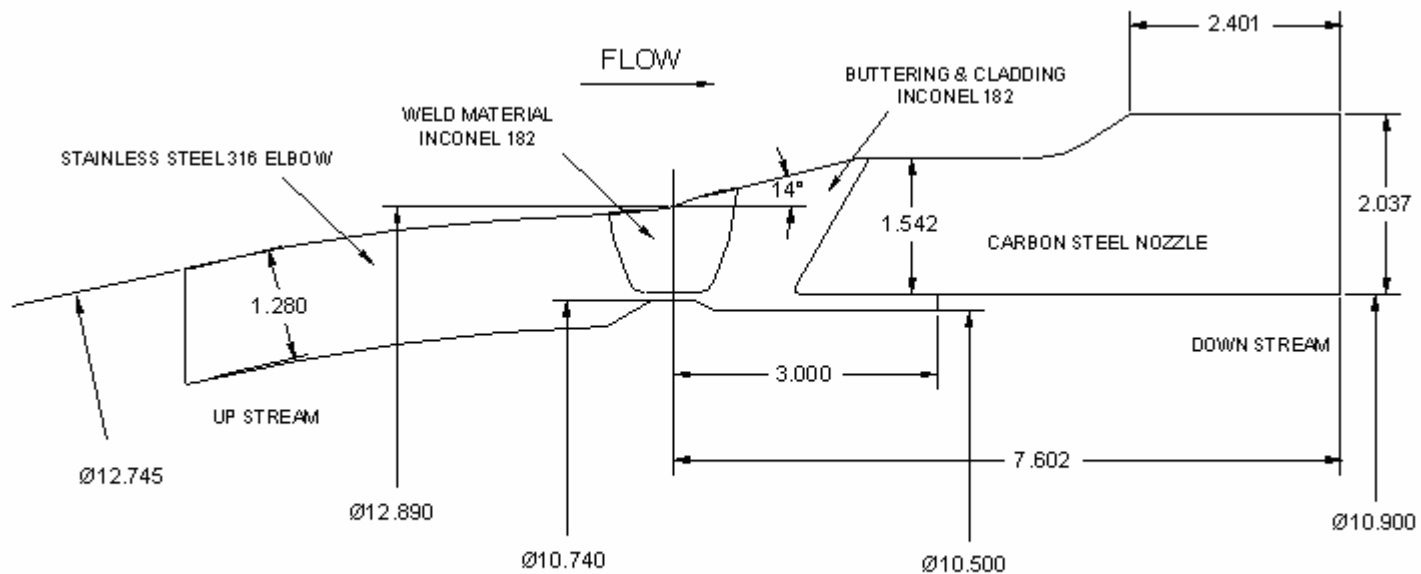
708/X – Pressurizer Surge Nozzle Design (Combustion Engineering)

DM Program Status Update



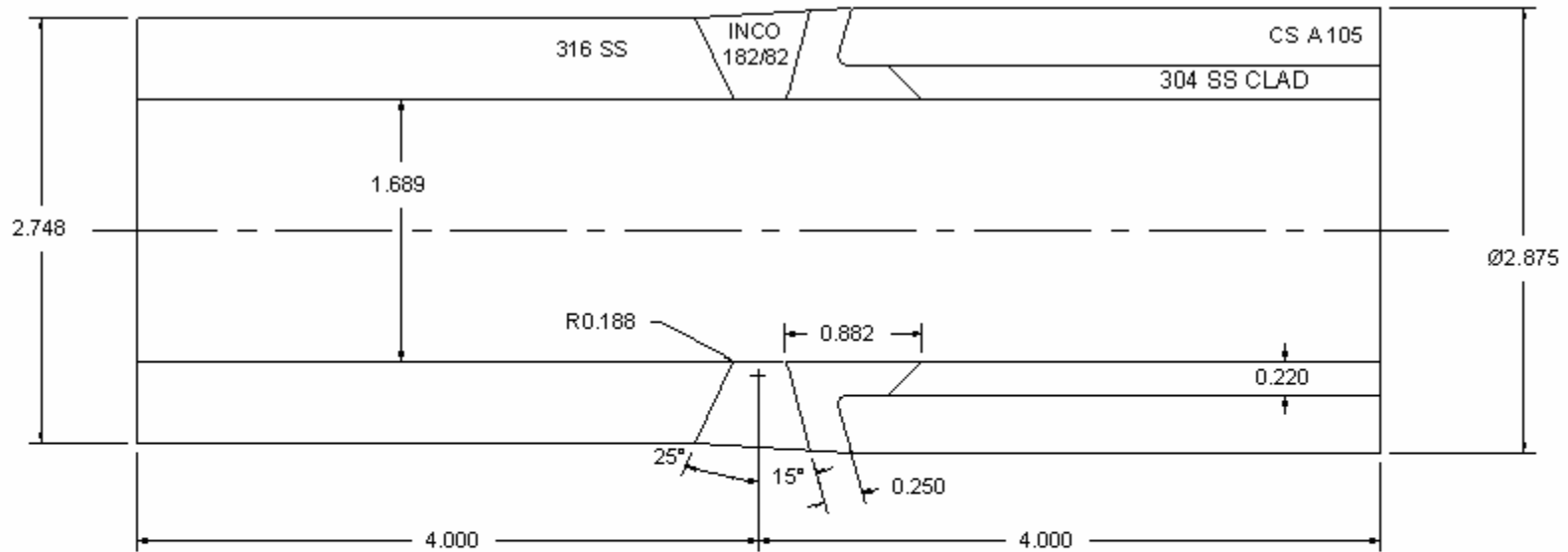
Cold Leg Drain Nozzle (Babcox & Wilcox) Design - 714/X

DM Program Status Update



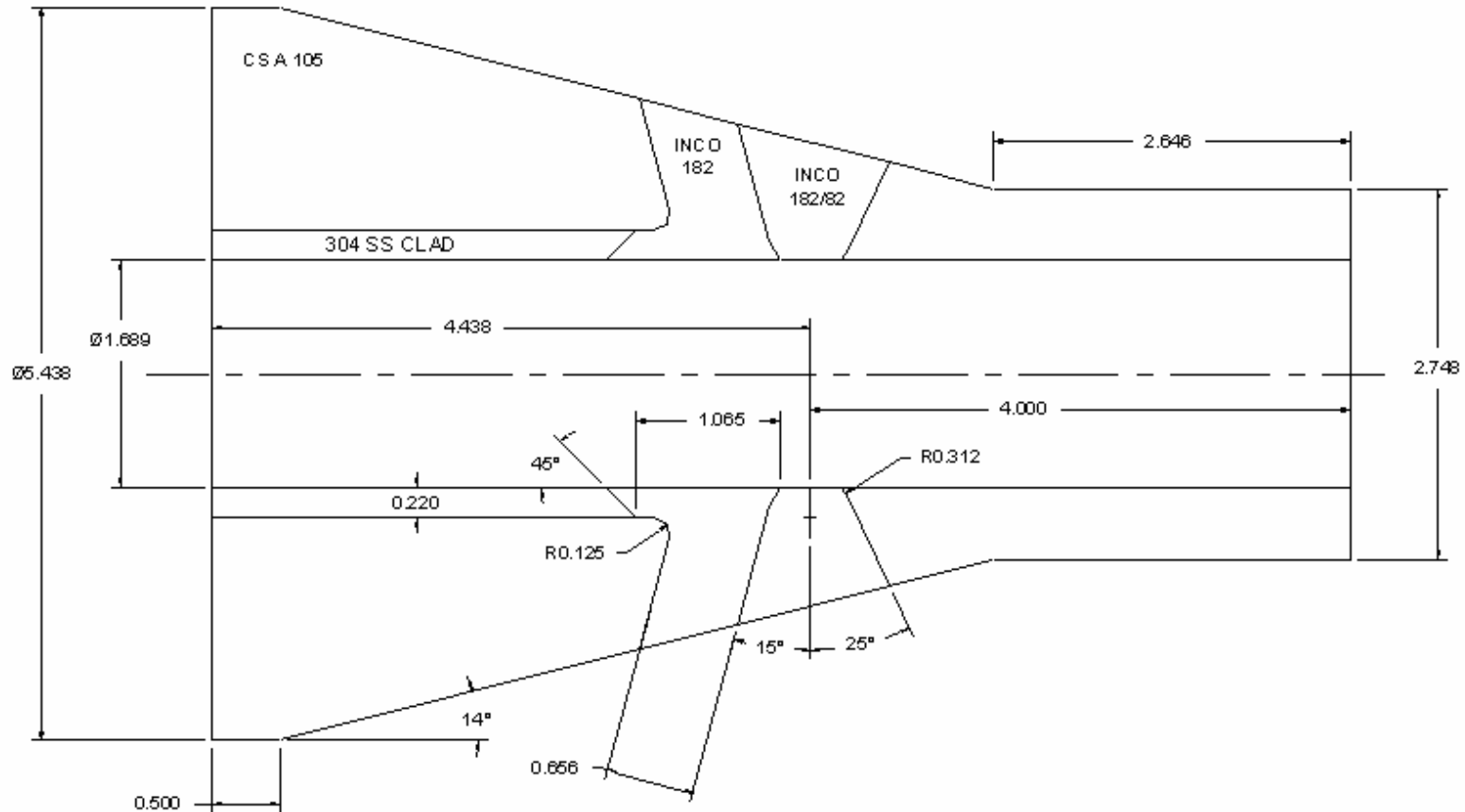
Decay Heat Nozzle (Babcox & Wilcox) Design - 715/X

DM Program Status Update



716/X – Hot Leg Drain (Type 1) Design (Combustion Engineering)

DM Program Status Update



716/X – Hot Leg Drain (Type 2) Design (Combustion Engineering)

DM Program Status Update

- Qualification status overview
 - From the OD
 - Current manual techniques
 - Qualified for detection & length sizing
 - Current automated techniques
 - Qualified for detection, length & depth sizing
 - From the ID
 - Current techniques
 - Qualified for detection & length sizing
 - Depth sizing reliability demonstrated, but > than acceptable RMS value

DM Program Status Update

- Qualification status from the OD
 - No new qualifications since last update
 - Automated
 - 5 vendors have qualified procedures for detection and length sizing
 - General Electric
 - Framatome ANP
 - WESDYNE
 - LMT
 - Zetec (semi-automated)
 - 4 vendors have qualified acceptable (<0.125 "RMS) depth sizing procedures
 - General Electric
 - Framatome
 - WESDYNE
 - Zetec (semi-automated)
 - Some procedures have been expanded to cover tapered components on a limited basis – PDI samples/site specific mock-ups

DM Program Status Update

- Manual DM Qualifications
 - Number of People Qualified
 - \approx 93 people have detection
 - \approx 63 people have length sizing
 - 0 people have depth sizing
 - Phased Array procedure for manual depth sizing to be developed
 - Part of EPRI project
 - Phased Array shows significant promise

DM Program Status Update

- Qualification status from the ID
 - No new ID procedures have been qualified
 - 5 vendors qualified for detection and length sizing
 - WESDYNE (USA)
 - AREVA (USA)
 - AREVA (GERMANY)
 - INTETEC (CROATIA)
 - IHISWT (USA)
 - 3 vendors have demonstrated reliable depth sizing capability, but above code acceptance criteria
 - AREVA (USA)
 - AREVA (GERMANY)
 - WESDYNE

Sample Fabrication Activities

- **Site Specific mock ups (Complete)**
 - Steam Generator Mockups
 - McGuire
 - Kewaunee
 - Prairie Island
 - Callaway
 - Beaver Valley
 - Watts Bar
 - Ft. Calhoun
 - Byron/Braidwood
 - Farley

Sample Fabrication Activities

- **Site Specific mock ups cont.**
 - Pump Stud Mockups
 - V.C. Summer
 - Head Spray Nozzle Mockup
 - Oyster Creek
 - Control Rod Drive Return Line Mockup
 - Nine Mile Point
 - Residual Heat Removal 24” Valve & Tee Mockups
 - J.A. FitzPatrick
 - Core Spray and Low Pressure Coolant Injection Surface Condition Mockups
 - Limerick

Sample Fabrication Activities

- **Site Specific mock ups (In Progress)**
 - FPL (St. Lucie) Mockups
 - Safety Injection Nozzle
 - Safety Relief Nozzle
 - Drain Line Nozzle (Type 1- No Taper)
 - Drain Line Nozzle (Type 2 - Taper)
 - Spray Nozzle
 - TVA (Browns Ferry) Mockups
 - 4" RCWU pipe to valve
 - 4" RDRC pipe to valve

Sample Fabrication Activities

- **Site Specific mock ups cont. (In Progress)**
 - Dominion
 - PWOL Spray Nozzle – Rhino III
 - Exelon (TMI)
 - Decay Heat (Mods to existing PDI Program Sample)
 - Surge Nozzle (Mods to existing PDI Program Sample)

Sample Fabrication Activities

- **New PDI Program/R&D Samples**
 - Cast Safe End Configurations
 - CE Safety/Relief Nozzle
 - CE Surge Nozzle
 - Overlay Configurations
 - CE Surge Nozzle (Cast Safe End)
 - Westinghouse Surge Nozzle
 - PWOL Spray Nozzle – Rhino II
 - Supplement III Block
 - Large Diameter and Thickness
 - Program Expansion

Sample Fabrication Activities

- **PDI Program gap samples (Recently Completed)**
 - Small Diameter Pressurizer DM Welds
 - B&W Configurations
 - Cold Leg Drain Nozzle
 - Surge Nozzle
 - Hot Leg Surge Nozzle
 - Decay Heat Nozzle
 - Combustion Engineering Configurations
 - Surge Nozzle
 - Spray Nozzle
 - Westinghouse Configurations
 - Surge Nozzle
 - Spray Nozzle
 - Safety/Relief Nozzle

Sample Fabrication Activities

- **R&D Samples**
 - MEOG/MTAG Rough Surface Condition Mockups (Complete)
 - 703 series
 - 705 Series
 - 706 Series
 - 707 Series
- **In-progress Mockup and Sample Activity**
 - CE Cast Overlay
 - Reactor Coolant Pump
 - Shutdown Cooling
 - Safety Injection
 - Weld Inlays

DM Weld Assessments

- 246 welds evaluated to date
- Several units in progress
- Strong potential for foreign assessments

Utility	# Welds	Site	Status	NSSS
First Energy Nuclear Operating Company	17	Davis Besse	Complete	B&W
First Energy Nuclear Operating Company	1	DC Cook	Complete	W4
Southern California Edison	4	SONGS 2	Complete	CE
Entergy	29	Waterford	Complete	CE
FP&L	5	St Lucie 1	Complete	CE
FP&L	15	St Lucie 2	Complete	CE
FP&L	6	Seabrook	Complete	W4
Southern Nuclear	6	Farley 1	Complete	W3
Southern Nuclear	6	Farley 2	Complete	W3
Progress Energy	6	Shearon Harris	Complete	W3
South Carolina Electric & Gas	12	VC Summer	Complete	W3
Southern Nuclear	6	Votgle 1	Complete	W4
Southern Nuclear	6	Votgle 2	Complete	W4
STP Nuclear Operating Co	6	STP Unit 2	Complete	W4
STP Nuclear Operating Co	6	STP Unit 1		W4
PG&E	6	Diablo Canyon		W4
Ameren UE	6	Callaway	Complete	W4
TXU Electric	6	Comanche Peak 1		W4
Exelon	15	TMI	Complete	B&W
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Dominion Generation	28	Millstone Unit 2	In Progress	CE
TXU Electric	6	Comanche Peak 2	In Progress	W4
Entergy South	23	ANO 2	In Progress	CE
STP Nuclear Operating Co	1	STP Steam Generator, Unit 2	In Progress	W4
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Entergy South	24	ANO 1	Complete/In Revision	B&W
TOTAL WELDS	246			
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Potential Future Assessment Efforts				
Japan				
Korea				
Spain				

Summary

- Program utilization remains very high
 - Summer sessions at or near capacity
 - Full load of procedure qualifications
- Utilities/Vendors embracing Phased Array technology
- Generic Procedure work
 - New revisions
- DM weld assessment reports
 - Many completed
 - Some in progress
 - Potential for many foreign assessments
- Fabrication Program
 - Site specific mock ups
 - PDI program samples
 - R&D samples



Together...Shaping the Future of Electricity