



**EPRI**

ELECTRIC POWER  
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## **Ultrasonic Cable Equivalency Applicable to Conventional Manual Ultrasonic Examination Techniques**

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**PDI/NRC Meeting**

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# Ultrasonic Cable Equivalency

## Project Snapshot

- The objective of this project is to demonstrate that UT cables less than 24' are equivalent regardless of length and type
- This project is needed to:
  - Create more homogenous PDI Table 1 documents
    - 58,828 combinations on Generic Procedure Table 1 documents
  - Minimize the possibility for errors in the field
  - Reduce examiners radiation exposure during inspections
- Project Deliverables
  - Report – Results of the project (Report# 1021059)
    - Publicly available for download at EPRI.com
  - Technology Transfer – Generic Procedure Table 1 Document Modification

# Ultrasonic Cable Equivalency

## Project Approach

- Process
  - Data collection in accordance with ASME Sect XI App VIII Supp 1
  - Acceptance criteria from ASME Sect. XI, App. VIII, Article 4000
  - The equipment selected provided a representative crosscut of PDI generic procedure T1 documents
- Variables
  - Cable lengths tested were 6', 12', 18', and 24'
  - Cable types were limited to RG-174/U and RG-58/U
  - Four UT instruments with different electronic characteristics
  - Search unit frequencies between 1MHz and 5MHz
  - Dual and single element search units
- Constants
  - Three intermediate connectors used in all measurements
  - Data collection equipment and procedure

# Ultrasonic Cable Equivalency

## 2010 Results

- The data collected indicates:
  - All systems tested had BW > 30%
  - System deviations did not exceed 10%
  - Average deviations
    - RG-174 (All Lengths)
      - %DevFC – 1.82%
      - %DevBW – 2.71%
    - RG-58 (All Lengths)
      - %DevFC – 2.09%
      - %DevBW – 3.06%
    - Aggregate
      - %DevFC – 2.76%
      - %DevBW – 4.26%

# Ultrasonic Cable Equivalency

## 2011 NRC/PNNL Review

- Results of the PNNL review identified an area of improvement
  - The equipment was limited to:
    - Only 4 of the 23 scopes on Table 1
    - Only commonly used transducers
- Scopes in the original test plan were chosen due to:
  - The different electronic characteristics
    - Pulser Type, Operating Frequency, Bandwidth, and etc.
  - Use throughout the industry
    - 25,200 (43%) of the 58,828 T1 entries
  - Availability for the study
- Transducers in the original test plan were chosen due to:
  - The different crystal types and sizes
  - Use throughout the industry
    - 36,542 (62%) of the 58,828 T1 entries
    - Availability for the study

# Ultrasonic Cable Equivalency

## 2011 Supplemental Data

- PNNL and EPRI developed a plan to expand the data set to include equipment omitted from the original study
  - Test conditions
    - Remaining Scopes
    - Remaining 5MHz transducers
    - Cable lengths of 6' and 24'
    - Cable type of RG-174
    - Three intermediate connectors
    - Same test procedure and equipment from 2010
  - 172 Different T1 equipment combinations
    - 23 Different Scopes
    - 16 Different Transducers

# Ultrasonic Cable Equivalency

## 2011 Supplemental Data

- In November an email was sent requesting equipment to be used to complete the expanded data set
- Expanded set will include
  - 10 Scopes
  - 3 Transducers

Instrument	
EPOCH 1000i	X
EPOCH 4	X
EPOCH II	
EPOCH IIB	
EPOCH III	X
EPOCH XT	X
Masterscan 330	
Masterscan 335	X
Masterscan 340	
Sonic 1200s	
Sonic 136	X
Sonic 137	X
UI-25	
USK-7D	
USM Go	X
USM-25	
USM-35	
USN-60	X
USN 60sw	X
USN-50	
USN-52	
USN-52L	
USN-52R	

Manufacture	Model	
Megasonic	MST	X
KBA	MSWS	
KBA	MSWQC	X
KBA	MSWQCA	
KBA	COMP-G	X
AUTO	RRW	
Qcorp	RRW	
Panametrics	V543-SM	
Panametrics	A543S	
Panametrics	C543-SM	
Panametrics	Centras	
SONA	PQC	
Staveley	F9L	
TKS	CAB5B	
Harasonic	ABT	
TECH	ABFQ	

# Ultrasonic Cable Equivalency

## 2011 Supplemental Data

- Providing the additional data aligns with the original data set
  - PNNL indicated they would be comfortable extrapolating the results throughout the other un-tested equipment combinations for the scopes and transducer models contained within the study
  - Unfortunately we were unable to obtain all scopes or transducer models on our list
- We will be unable to create a series of homogenous T1 documents



# Ultrasonic Cable Equivalency

## 2011 Plan

- Generate a Legacy Table
  - Will contain all equipment combinations not covered by this study
- Reasoning
  - The majority of equipment is outdated and seldom used
  - Manufacturers no longer sell, calibrate, or repair
- Additional benefits
  - Will shorten T1 documents by eliminating obsolete equipment
- Drawbacks
  - If you need to use old equipment you may need to reference 2 T1 documents

# Ultrasonic Cable Equivalency

## 2011 End-Game

- The Cable Equivalency project ends in 2011
- Preliminary results look very similar to original set
- Utilizing this research throughout the industry
  - Complete the data collection (12/11)
  - Review the additional data set
  - Present findings to PNNL and NRC
  - Modify Table 1 documents
  - Generate Legacy Table 1 documents
- Implementation plan
  - How do we handle this in regulatory space?
  - November 2010 a letter of acceptance was discussed

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