Federal Working Group on Industrial Digital Radiography

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Digital Imaging and Communication in Nondestructive Evaluation (DICONDE) Conformance and Verification

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Federal Working Group on Industrial Digital Radiography (FWGIDR) - The FWGIDR is a self-chartered organization consisting of federal and government contract employees and endorsed by the Defense Working Group on Nondestructive Testing (DWGNDT). This working group provides a platform for identifying common concerns and critical issues facing the federal industrial radiographic community as it transitions from film to digital radiography (DR). The FWGIDR, utilizing expertise from within the community, organizes and coordinates technical committees that formulate positions, guidance, and/or solutions for the community's common concerns and issues.

Background – Recognizing significant difficulties in addressing technical advances in the digital radiographic field, several engineers from the Department of Energy (DOE) and Department of Defense (DoD) organized the FWGIDR in 2007 to address the problems and concerns faced by the industrial radiographic community in transitioning to DR. Digital X-ray systems are revolutionizing medical radiology, as digital cameras revolutionized the photographic community, and similarly haves an ever-increasing role in radiographic nondestructive testing. Medical radiology, backed by significant development and funding, and digital photography, with rapid public acceptance, have demonstrated the advantages that digital systems offer in image intensive applications. The FWGIDR is focused on a vision for the future radiographic inspection facility, and that vision is digital radiography.

The rapid growth in DR has created transitional issues difficult for the industrial community to assimilate while transitioning from film to digital techniques. These issues include personnel training; data formatting, storage and retrieval; technique development and qualification; equipment qualification and monitoring; process control; and development and acquisition of equipment suitable for industrial applications.

Participants in the FWGIDR are organizations that employ nondestructive testing in support of government contracts. DOE, DoD, prime government contractors, along with other government and contractor personnel are actively contributing to and supporting the efforts of this working group.

Digital Imaging and Communication in Nondestructive Evaluation (DICONDE) Conformance and Verification-

The ASTM 2339 standard, Digital Imaging and Communication in Nondestructive Evaluation (DICONDE), references the NEMA Standards Publication entitled Digital Imaging and Communications in Medicine (DICOM), and Section 4.3.1 of ASTM 2339 specifies, "In the case where no replacement … exists, the DICOM Standard should be followed." As neither media storage of DICONDE data nor transmission of DICONDE data across communications networks are explicitly defined by any ASTM standard, archival techniques and media must conform to guidelines established in Parts 10-12 of the DICOM standard and data communications must conform to Parts 7-8 of the DICOM standard,

The vendor shall provide a DICONDE conformance statement as specified in Section 4.4 of ASTM 2339, which states that "This document shall define the service classes, information objects, communication protocols, and media storage applications supported by the [product]." The vendor shall also provide DICONDE data of an inspection by supplying the procurement officer with optical media of the officer's choice that complies with Part 10 of the DICOM standard. Verification that the product adheres to the vendor's conformance statement shall be demonstrated by examining the following capabilities of the product:

I. Data management support for one or more imaging modalities
II. Metadata Support
III. Media Compliance to DICOM Part 10 CDs
IV. Data transmission using DICOM protocols
V. Documentation

Failure to provide verification of the first two items will constitute sufficient justification for eliminating the vendor's product from further consideration on the basis that the product and the vendor's proposal are technically unacceptable. In this case, the proposal will not be evaluated further. This action is justified on the basis that DICONDE data can be migrated to systems that exhibit greater or full compliance to the standard if these elements are in place. Each of the items shall be evaluated through a testing protocol established by the procurement officer and conducted by that officer or his designee. The procurement officer shall specify the actual media to be supplied by the vendor and the associated weights assigned to each of the capabilities.

I. Data management support for one or more imaging modalities

Defined as Service Object Pair (SOP) Class support in DICONDE nomenclature, this refers to the data that are recognized by the product and the operations that can be performed upon them. The data are instances of an Information Object Definition (IOD), which has been defined in an ASTM Standard Practice. A DICOM Message Service Element (DIMSE) is a command that stores DICONDE data or retrieves it, searches for DICONDE data with selected attributes, or verifies communications between two DICONDE-compliant systems. The combination of an IOD and a DIMSE defines an SOP Class and an actual operation performed for a particular imaging modality represents an SOP Class Instance. The manufacturers of DICONDE-compliant NDT imaging

equipment will produce a DICONDE Compliance Statement that indicates which SOP Classes are supported.

II. Metadata Support

At a minimum, the vendor's product must be evaluated against its ability to store all of the attributes and attribute values and compared to the required and optional values for all supported SOP classes by the product. This functionality should be tested using a validation tool that can evaluate the completeness of DICONDE metadata based on the information object definitions presented in the ASTM Standard Practices developed specified for the required NDT inspection modalities, see below.

- ASTM E 2738 Standard Practice for Digital Imaging and Communication in Nondestructive Evaluation [DICONDE] for Computed Radiography (CR) Test Methods
- ASTM E 2767 Standard Practice for Digital Imaging and Communication in Nondestructive Evaluation [DICONDE] for Computed Tomography (CT) Test Methods
- ASTM E 2699 Standard Practice for Digital Imaging and Communication in Nondestructive Evaluation [DICONDE] for Digital Radiography (DR) Test Methods
- ASTM E 2663 Standard Practice for Digital Imaging and Communication in Nondestructive Evaluation [DICONDE] for Ultrasonic Test Methods

III. Media Compliance to Part 10 CDs

At a minimum, the vendor's product must be evaluated against its ability to read and store all metadata and imagery associated with an instance of an SOP class on optical media of the procurement officer's choice according to Part 10 of the DICOM standard. This functionality shall be tested by generating specific optical media and examining its contents using a DICONDE validation tool chosen by the procurement officer that has the following capabilities:

- Lists all the attributes and attribute values in a DICONDE Part 10 file ordered by ascending tag number.
- Compares those values to the required and optional values for the SOP Class.
- Reports missing or incorrect attributes based on DICONDE elements for the SOP Class.
- Displays a formatted report of all attributes ordered by information module

A product's failure to provide one or more these capabilities does not prohibit selection of that product, but the weight assigned to that capability by the procurement officer or his designee shall be zero.

IV. Data transmission using DICOM protocols

At a minimum, the vendor's product must be evaluated against its ability to transmit DICONDE studies according to the communication profiles and protocols established in Part 8 of the DICOM Standard. This functionality shall be tested by communicating with an existing DICONDE-compliant system to validate the following capabilities:

- Performs DICONDE ping tests to verify network communications between two Application Entities (AEs)
- Performs DICONDE validation that identifies all SOP classes supported by the called AE
- Performs a fetch of a DICONDE study in each supported SOP class from the called AE
- Performs a store of a DICONDE study in each supported SOP class to the called AE

A product's failure to provide one or more of these capabilities does not prohibit selection of that product, but the weight assigned to that capability by the procurement officer or his designee shall be zero.

V. Documentation

An evaluation report shall be prepared by the procurement officer or his designee that documents the degree to which each vendor's product conforms to the ASTM DICONDE 2339 standard and the vendor's own compliance document.