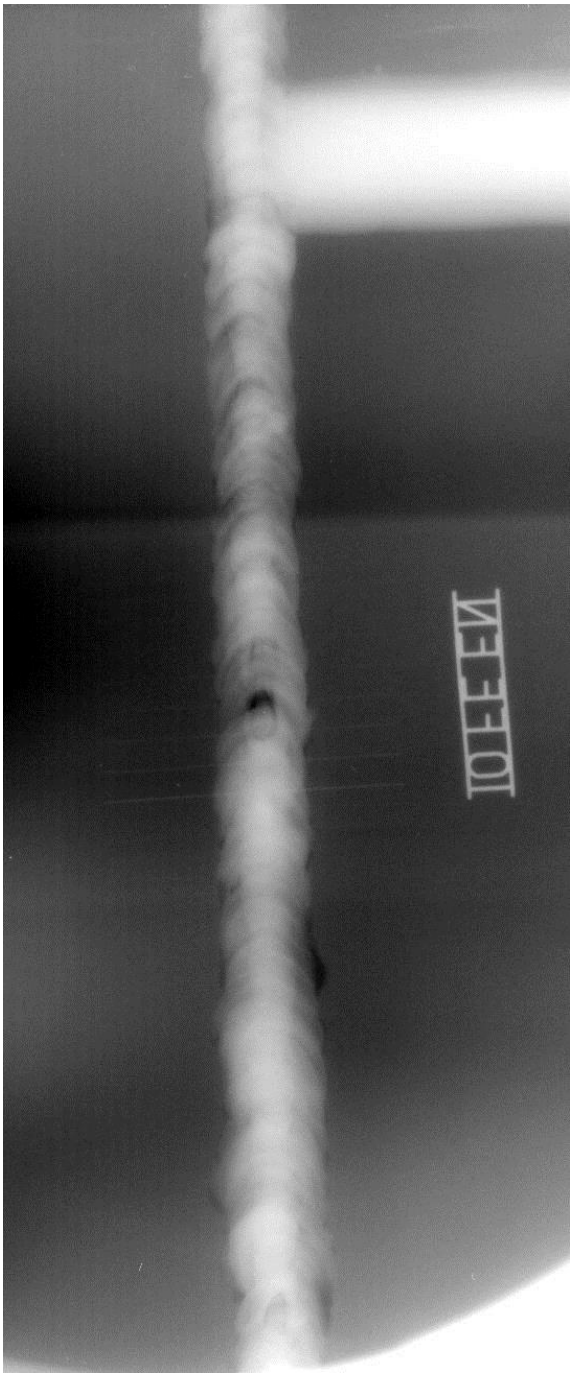
Weld Inspection



Using

Digital Radiography (DR)Technology

Executive Summary

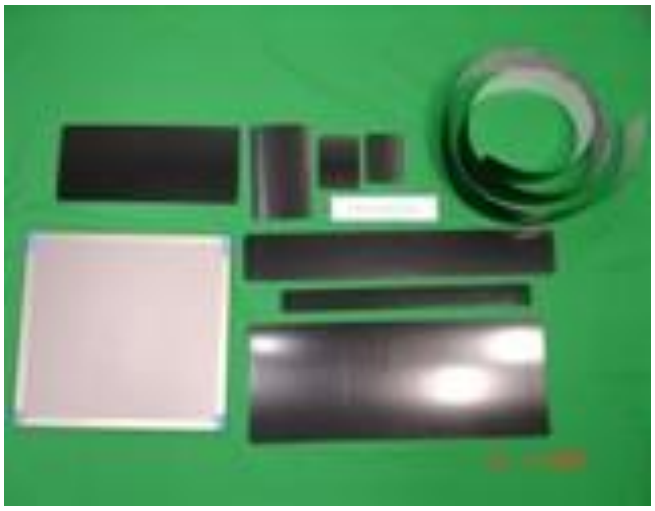
Cost reductions in constructions, maintenance projects are the major driving force to explore alternatives without sacrificing product quality during the entire life cycle of the products.

Digital Radiography technology is revolutionary; mature that provides one of the means that enable such economic benefits to be achieved. Compliance with regulatory standards and incorporated to enables an extremely powerful management that no enterprise, construction company can or should miss.This document describes salient features that provide insight into the method of achieving is to enable .

Introduction

Major tank and pipeline construction contractors, end customers can achieve the reduced project costs by adopting the digital radiographic technology against conventional traditional film radiography.

Traditional methods of radiography used the conventional film, which was exposed to the radiation. The exposed films were wet films processed and dried before reporting from the radiographs. These were then filed in boxes and archived for the duration of the life cycle of the product under climatic controlled environments and possible degradation of the radiograph films with ageing.



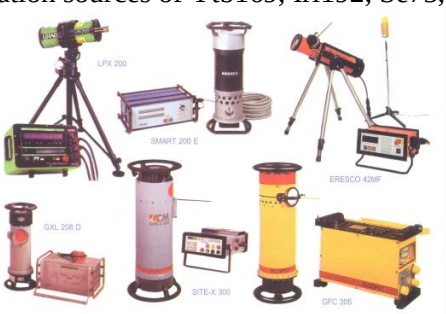
Phosphor plates are;

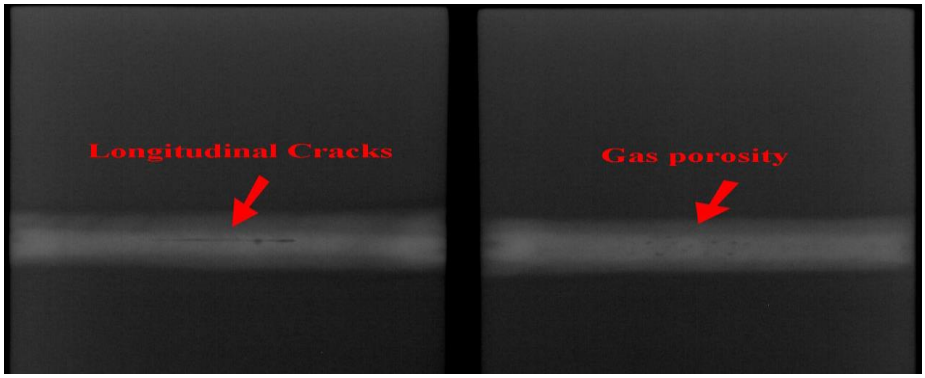
- Flexible, (as conventional films)
- Different size of plates are available
- (10x24 – 30x40-10x1500 cm. etc)
- Reusable (more than 50.000 times)

The exposed flexible phosphor plate is **processed a laser scanner** instead of chemical film processing. Laser scanning delivering **digital image** on to very high resolution monitor.

A hand written report was generated, submitted to the end customers, which was archived in the project files, filed in storage areas for later usage. Time has proven that pipeline like any products the pipework undergo wear and tear, corrosion/erosion and condition monitoring requires access and review of this archived information for preventing any ecological disasters and failures which can have an high impact on loss of revenue.
The DR technology enables pipelines and pipework welds to be inspected by using the reusable flexible digital imaging plates and a radiographic computer system for archival of captured radiographic images on optical disk storage with a data life of 100 years.

The radiographic images meet with the acceptance standards and without loss of image quality. This technology uses lower radiation and reduced exposure time as against conventional radiograph films and direct electronic detectors. A circumference weld can be inspected within the following times based upon existing radiation sources of Ytb169, Iri192, Se75, X-rays, Cobalt.





Advantages of Digital Radiography

- ✓ Same radiation sources and techniques are used as conventional RT
- ✓ Easy to adaptation
- ✓ No requirement for darkroom, processing facilities or conventional film
- ✓ No requirement of film viewer
- ✓ Up to 50 000 times re-usable phosphor plates
- ✓ Radiation hazards are reduced by means of;
  - ✓ Reduced radiation source requirements
  - ✓ Reduced controlled area
  - ✓ Reduced exposure time from 5 to 10 time less than against conventional films
- ✓ Ideal for site radiography
- ✓ Direct evaluation on site
- ✓ Reduced number of exposure for multi-thickness sections
- ✓ Digital data therefore instantly reviewable remote from site by e-mail
- ✓ Consistent, repeatable interpretation and measurement of anomalies
- ✓ Easy to achieving to CD-DVD-hard disk
- ✓ No image degradation over time
- ✓ Complied Digital Radiography / Standards
  - ✓ ASME Section V Article VIII on phosphor imaging on digital radiography
  - ✓ API 1104 Welding of Pipelines and Related Facilities
  - ✓ CEN 472/473 radiographic training system requirements
  - ✓ ASTM 7002,2003,7020 technical working and practice inspection data

FAQ on Digital Radiography Technology

No	Question	Response
1	What are the common application of digital radiography in the petrochemical & Refinery?	1. Corrosion and condition monitoring 2. Profile radiography for thin wall pipes upto 7mm 3. Tangential radiography for 7mm to 12mm 4. Material loss thickness assessment for corrosion and pitting of wall thickness from 4mm to 95mm 5. Pipe under lagging corrosion assessment 6. Pipe weld radiography 7. Checking status of valves open and close 8. Radiography with OR without product flowing 9. Assemblies internal 10. Bend pipes
2	What is the exposure method for the pipe joints by digital radiography?	✓ Using portable battery powered X-ray units 120kV, 160kV, 250kV and 450kV half wave, rectified ✓ Using Se75 radiation isotope ✓ Using Ir192 radiation isotope ✓ Using co60 radiation isotope ✓ Using panoramic and directional mode
3	What are the limitations in terms of pipe dia., thickness & materials in digital radiography?	With DR system, we can inspect 12.5mm dia 1.7mm wall thickness pipes upto 84" and wall thickness of 110mm
4	How the exposure time is calculated for the various thickness of the job?	On the basis of radiographic device. For instance **1. Ir 192, Ytb169, Co60** a. For corrosion work 5% exposure of conventional film b. General work is 10% of exposure of conventional film c. Pipe welds and pipe-work is 15% of exposure of conventional film d. Others TBA based upon the application **2. X-ray** a. Reduced mA to a minimum that an X-ray can deliver 1mA or 5 mA b. X-ray kV reduction of 20 to 25% based upon the thickness and the quality of the X-ray generator. For CP units maximum saving can be provided
5	How the image density is achieved on the plate & is their any density requirements?	ASME V does say that we should ignore the density equivalence as the radiographic films. However DR has incorporated a method based on the histogram statistical model which gives us the quality of the image achieved.
6	Is it possible to take digital radiography at higher elevations?	Yes, as the CR plates are flexible or mounted into rigid or flexible cassette. The equipment and the imaging plates can be used at higher elevations
7	What power source is required for digital radiography at site?	The equipment is designed for 110 volts or 240 volts or can be engineering for battery powered equipment
8	How the sensitivity & resolution is taken care in digital radiography?	The resolution is based upon: 1. The type of imaging plate used whether SDTD or HR 2. The scanner resolution which is selectable from 20 microns, 30,40,50,60,70,80,100.125 microns

		The sensivity can be controlled by the **1.** Setting the gain parameter of the scanner which in-fact selects the DIP CLASS of operation. So the same imaging plate can used for the set for different speed of operation similar to the speed of X-ray films **2.** The radiographic technique is developed for the component under inspection where the exposure and the image quality penetameters dictate the radiographic sensivity
9	Is 2 % sensitivity is achievable in digital radiography?	Yes in all the product range defined above**.**
10	What type of pentameters/IQI are used?	✓ CEN international wire type for steel, Al, FE ✓ ASME Plaque with or without shims ✓ Duplex EN 462-5 IQI
11	What are the surface preparation / temperature requirements for weld inspection?	1 None for digital radiography at normal or down to –50 degrees **2** At high temperatures with thermal bands upto 150 deg C. For higher temperature heat management practice has to be adopted if it is contact shot of one may use radiographic standoff exposure
12	How the source to job distance is calculated in digital radiography?	Similar to the conventional film radiography formulae of radiographic set-up /unsharpness
13	What is the approximate size & weight of the equipment & is it suitable for site inspection job?	Yes, the DR equipment is suitable for site inspection job and can be mounted in the vehicle or in land rover or porta cabin. Different configurations are available to suit different circumstances. Most important images captured upon one system can be read by the other system
14	How the interpretation in the digital radiography are carried out?	Level II or Level III radiographers are trained to interpret from digital radiography systems. The candidates learn about the correct use of the inspectors tools based upon the conventional film radiography interpretations rules. The DR systems are designed to replace conventional film radiography hence the digital radiography images match the images achieved with the radiographic films.
15	How the defects sizing is carried out on digital radiography?	Defect sizing is done with ASME template overlay and alternatively the inspectors can use the measuring tools provided in the advanced radiographic analysis package.
16	Is it possible to get depth of the defects along with the size in digital radiography?	Yes, by using the tube shift method and the flaw depth assessment the inspector can carry out the flaw depth position and thickness measurement.
17	Whether digital radiography is complying the code requirements e.g. ASME B31.3/31.1? Can the results of digital radiography be interpreted directly in terms of acceptance criteria as given in ASME code?	Yes , DR has a special function that enables the results can be interpretated and reports generated.

18	As source strength used for digital radiography are of less strength, does it have direct impact on exposure time?	Yes the exposure time or the radiation activity level is reduced when conducting radiography.	
19	Is the source strength can be changed as per the job thickness?	Yes, CIT has radiographic technique created by the radiographic level III and the source strength can be changed	
20	What is the minimum pipe diameter where digital radiography can be deployed?	CIT has applied this 8mm diameter nuclear nozzle welds and has been accepted	
21	How many exposures are required for one joint. Is it depends on the dia. of pipe?	Yes , it is based upon the diagnostic length and the pipe diameter. The mathematical formulae can be applied to ensure the material change within the diagnostic length is within plus minus tolerance	
22	Up to what maximum thickness digital radiography can be carried out?	DR has carried out practical digital radiography for upto 250mm steel with linear accelerators	
23	How the identifications details are entered & the segments are marked?	Radiographic identifications can be entered by 1. Lead number plates 2. or electronic ID generated which is embedded in the radiographic image 3. Segments can be labelled with lead numbers	
24	What is the difference between digital radiography, Real time radiography and computed radiography? Whether any of these types are in use in any Refinery/Petrochemical plant construction?	**Digital Radiography**	1. An electronic radiograph image is generated and archived from different captured devices: a. Radiograph film digitisation b. X-ray image intensifiers c. Flat panel detectors d. DDA detectors e. Computed radiography or phosphor imaging 2. The complete system than handle and manage the digital radiography image is classed as digital radiography **ASME V and CEN international standards are <u>not</u> approved as yet**
		Real time radiography	Radiographic images generated with image intensifiers or flat panel detectors and allow live images to be displayed on the computer monitors, sometimes known as radioscopy systems

		Computed radiography	1. Radiographic images generated by scanning flexible reusable phosphor or computed radiography exposed plates high quality images to be displayed on the computer screen 2. **ASME V and CEN international standards are now approved and adopted by the industry. DR technology has been given approval by rolls Royce, shipbuilding, nuclear sector**
25	On radiation hazard front, how these new techniques i.e. Digital radiography, Computed Radiography or Real time radiography are differ from conventional Ir 192 radiography?	With the computed radiography technology radiation hazards are reduced by means of ✓ Reduced radiation source requirements ✓ Reduced controlled area down to 2 metre with flexible radiation shielding. Ideal for site radiography ✓ Reduced exposure time and saving of upto 90% against conventional film	