

5.1.2. COMPUTED RADIOGRAPHY TECHNIQUE FOR WELD INSPECTION: THE PROCESS OF QUALIFICATION AND VALIDATION OF INSPECTION PROCEDURES IN BRAZIL

Marinho C.A., Rabello J.M.B., Aiub M., Iguchi E., Lopes R.T., Oliveira D.F., Silva A.S.S., Castro L., Ferreira L., Santos S., Milani H., Freitas N., Petrobras Research Center Leopoldo A. Miguez de Melo, CENPES, PETROBRAS, Cidade Universitária, Rio de Janeiro, RJ, Brazil

Abstract

Actually, until nowadays Computed Radiography testing procedures are still based on experiments, trial and error, as a consolidated methodology to choose parameters, as in conventional radiography, is not in place yet. Petrobras, the Brazilian Energy Company, has worked in order to implant Computed Radiography for in-site weld inspection, running a big project in a partnership with the Federal University of Rio de Janeiro, Carestream Health, GE Inspection Technologies, Dürr NDT, and some Brazilian Inspection Companies: ArcTest – Technical Services in Maintenance and Inspection and Qualitec – Engineering with Quality. This work presents the results delivered by the CR systems found in the market, applied to welding inspections using the double wall double image technique (DWDI). Radioactive sources and X-Ray equipment were used.

Introduction

In order to qualify and validate procedures to inspect welded joints using CR, Petrobras has manufactured several uneven welded specimens, and then hired CR System manufacturers, which sealed partnerships with Brazilian inspection companies to begin the sample testing. The results delivered by each system used will define which system will be able to provide field services in Petrobras' worksites. The project was divided into three phases:

1. Preparation of inspecting procedures in keeping with Petrobras' internal standards.
2. Procedure qualification and preparation of relevant recording document.
3. Reproduction of lab conditions in field testing, using the documents previously prepared.

The following standards are used as standard criteria: ASME B31.3 – Process Piping, ASME Boiler and Pressure Vessel Code, Section V and Petrobras N-2821 (Non-Destructive Testing – Computed Radiography of Welded Joints), BS EN 14784 part 1 (Non-Destructive Testing – Industrial Computed Radiography with Storage Phosphor Imaging Plates – Part 1: Classifications of Systems), ASTM E-2445 (Standard Practice for Qualification and Long-Term Stability of Computed Radiology Systems) and ASTM E-2446 (Standard Practice for Classification of Computed Radiology Systems). The approved systems must meet the requirements of these Standards within the inspected diameter and thickness range.

In the initial phase, radioactive sources (Ir-192 and Se-75) and X-Ray equipment were used. Only satisfactory results acquired in a previous phase would allow the participation in the next step.

Results and discussion

As expected, the use of standard imaging plates, instead of high quality IPs, also proved improper as quality was jeopardized.

The use of isotopes presents some constraints due to the source size, usually higher than the 1mm recommended. Even the HDCR system was partially approved in only 35%

of the trials with gamma rays, although it fully meets the standard requirements by using X-Rays; the performance with gamma rays was poorer and insufficient. That is why these sources were only used during the first step of this project.

Imaging plates are much more sensitive to low energy radiations than industrial films, and also seem to be more susceptible to image deterioration as a function of little deviations in the radiographic setup. That is the reason Petrobras requires the double wire IQI visualization over the images.

Another aspect is the behavior of CR when the total penetrated thickness changes. It is not simple to plot an exposure chart that guarantees equivalent detectability with conventional radiography, because CR needs correction in exposure, even if the thickness variation be less than 2 mm. The pipe diameter seems to have an extra effect, not observed in conventional radiography. The effective area for analysis shows some reduction also, mainly in cases where overlapping technique is used instead of elliptical view.

The scanner's photomultiplier gain has a very important effect over the exposure time. These results will be different if this parameter change.

By reviewing the results, it was possible to observe that the companies needed change their culture related to radiography. CR requires more knowledge and training.

Conclusion

Petrobras qualified and validated some inspection procedures of two inspection companies using three CR systems. More ranges of diameter/thickness tube or pipes can be qualified, as well more companies.