Reduction of Radiation Exposure by Modern Methods of Digital Industrial Radiography

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Abstract. An important aspect of the radiation protection is the reduction of radiation exposure of radiographers during the inspection time. One way is the improvement of the radiation protection training. Another way is the introduction of new technologies as digital detection equipment instead of X-ray film.
New digital detectors (e.g. imaging plates, flat panel detectors) permit the numerical analysis of radiometric images as well as taking them within a shorter exposure time. The computed radiography with imaging plates (IP) can be applied in-service and in-house very efficiently. The exposure time is up to 50% shorter in comparison to an X-ray film lead combination. Examples and applications will be discussed. Digital detector arrays (DDA or flat panels) permit the acquisition of images in few seconds without movement of the detector between measurements. The main application field is the inspection of serial parts in production lines and computed tomography. Mechanised and manual systems explored also the area of mobile inspection during the last years. Classical film applications are substituted and new application areas are developed. The radiation exposure is usually considerably lower than per film inspection. This also allows the extended usage of radiation methods for improved safety and reliability in industry since the new digital techniques can be applied even with enforced laws for radiation protection.
Film replacement by digital radiography is usually motivated by economic constrains, because most digital detectors are distinguished by higher sensitivity than NDT X-ray film. This should enable a considerable reduction of radiation exposure to environment and radiographers. Nevertheless, economic requirements may become a more dominant effect than reduction of radiation dose. The economic advantage of the digital radiography may basically lead to a reduction of dose exposure or to an increase of its application with similar total dose exposure as before.
In principal the following cases can be discussed:
1st The controlled area can be reduced at same exposure time by application of lower activity of gamma sources. Several test teams can work in parallel. Radiographic examinations can be performed at day time instead of night time.
2nd The radiographic examination can be accomplished in a shorter time. The NDT personal will be able to do more testing for a lower price per radiograph.
3rd The radiographic testing is performed with higher contrast sensitivity than film radiography for safety relevant applications. The dose exposure is equal or higher than for film radiography, but increased testing quality contributes to the improved public safety of components and goods.
4th The released radiation dose for testing of a given amount of objects is reduced by the increased sensitivity of the digital detectors, which finally reduces the exposure of people and environment per testing job.