

A Study on the Application of Non-Destructive Testing in the Manufacture of Power Plant Components

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The power plant component requires a volumetric non-destructive testing (RT or UT) ruled in most code/technical standards because it is subject to component itself load, operating temperature and pressure. Since it is an environment that can repair detected defects by non-destructive testing during the manufacturing process, workmanship-based acceptance criteria are mainly applied rather than fracture mechanics. Meanwhile, RT and UT, which are volumetric testing, penetrate the test subject (radiation vs. ultrasound) and the obtained result (image vs. signal) is wrong, that is, the physical principle applied is different, so there is a difference in detection ability depending on the type of defect such as cracks and pores as described in ASME Section V. The control element drive mechanism (CEDM) is an important pressure boundary part of the nuclear power plant(reactor upper head) with the function of guiding the neutron control rod, and the pipe of Martensite stainless steel and Inconel-690 is welded with buttering. When film RT is applied to confirm the integrity of this bi-metal welding part, the film image was formed only when the defect had a spatial volume greater than the diameter of the image quality index(IQI) wire by ASME code section III. In other words, in the case of RT, it was confirmed that the defect detection ability was affected not only by defect direction for irradiation beam, but also but also by the volume(width and height) of the defect. On the other hand, the application of UT is less affected by the defect volume, and if there is a length dimension, detection ability is further secured. Boiler tube welds have typically inspected by RT. However, during RT work, the workplace must be isolated and other work cannot be done at the same time, so in the end, the production period and cost increase. To solve this problem, an attempt was made to lieu it with UT, and defect detection was secured by using image-based PAUT such as RT image. Compare RT, most defects secure detection ability at UT, but in the case of circular defects such as pores smaller than UT beam width, has resulting in a lower detection ability due to the signal to noise ratio of the acquired signal was low. To improve this, it was confirmed that single pores with a diameter of 2mm or more were detected by applying the latest ultrasonic testing techniques which are TFM (Total Focusing Method) and PCI (Phase Coherence Imaging). In this paper, the detection ability in the application of non-destructive testing techniques applied to the manufacture of power plant was examined based on experimental data, and it is judged that optimal integrity can be secured if applied complementarily between non-destructive testing techniques.