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Role of Non-Destructive Examinations in Nuclear Power Plants – an Indian perspective

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Nuclear Power Corporation of India Limited (NPCIL) along with all other constitutes of Department of Atomic Energy of India and its Industry partners are promoting industrial applications of nondestructive testing (NDT) technology, to assure safe and reliable operation of nuclear facilities from start of Nuclear Program in India. NDT technology is essentially needed for improvement of the quality of industrial products, safe performance of equipment and plants, including safety of metallic and concrete structures and constructions of nuclear installations.

In addition to assurance of quality of equipments during manufacturing, Non-destructive testing (NDT) plays an essential role in assessing the structural integrity of the main components of nuclear power plants. On one hand, detecting and sizing flaws during periodic in-service inspection provides input data for integrity assessment and, on the other hand, monitoring material conditions by means of NDT help in assessing material degradation processes in terms of crack or defect growth and thus contribute to possible early warning of component deterioration.

Many of the critical nuclear power plant equipments and structures are neither replaceable during plant life nor they are directly accessible for any examination after their installation. Consequences of failure of these critical equipments affect the operation of plant for a very long period and hence the commercial feasibility of the plant itself. For these types of equipments special NDT techniques are developed, demonstrated on mock-ups and used for examination of these critical and non-accessible equipments/structures for detection of flaws during manufacturing and in-service inspection.

NDT methods like Visual Inspection (VT), Liquid Dye Penetrant Testing (DPT), Magnetic Particle Testing (MPT), Radiography Testing (RT), Ultrasonic Testing (UT) and Eddy Current Testing (ECT) are extensively used for detection, locating and sizing of surface and internal defects (in welds, castings, forging, composite materials, concrete and many more) for various components and structures of a Nuclear Power Plant at various stages (manufacture, construction/commissioning and in-service). These NDT examinations are very useful for assessment and assurance of Quality, Reliability and Safety of equipments, structures and Nuclear Power Plant.

Proper application of NDT methods and techniques is essential part to produce valid results applicable for nuclear power plant equipments. For this purpose, NDT specialists are part of the team responsible for this activity, right from the planning stage to the analysis of data. The role of NDT specialist include the selection of appropriate method/technique and their combination, prepare/review/validate NDT procedures, ensuring that NDT is performed by personnel having the right qualification/certification and analysis of the test results for acceptance or otherwise.
This paper will provide an overview of various NDE methods and modern NDE techniques (Phased Array UT, Time-of-Flight-Diffraction UT, Micro-Focal Radiography etc.) being utilized for assessment of quality of various parts of a Nuclear Power Plant during manufacturing, installation, commissioning and operation (in-service inspection).