Condition Monitoring and Diagnostics of Nuclear Mechanical Components

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ABSTRACT

Typically, there exist two pressure boundary systems in a PWR(Pressurized Water Reactor) NPP(Nuclear Power Plant). One is the reactor coolant system(RCS) called as the primary system or Nuclear Steam Supply System(NSSS). The other is balance of power(BOP) called as the secondary system. The key mechanical components of the primary system is mainly comprised of reactor pressure vessel(RPV), pressurizer(PZR), steam generator(SG), reactor coolant pump(RCP) and pipings. The NIMS(NSSS Integrity Monitoring System) has been developed to monitor and diagnose the structural safety of the NSSS components on an on-line basis. In this paper, the Korean NIMS developed by KAERI is introduced. It is comprised of four independent sub-systems such as IVMS(Internal Vibration Monitoring System), LPMS(Loose Part Monitoring System), ALMS(Acoustic Leakage Monitoring System), and RCPVMS(Reactor Coolant Pump Vibration Monitoring System). The IVMS has been developed for early detection of the degradation of the preload condition of the reactor internal components by measuring the change of vibratory modal frequencies of the core barrel assembly. The LPMS is to monitor the presence of a loosened or detached metallic object within the reactor coolant system using the vibration sensors installed on the surface of the system. The primary purpose of the ALMS is to monitor coolant leakage at the potential leak regions such as the reactor vessel, welded region in pipings, and valves, etc. The second purpose is to detect initiation of crack on the surface of the pressure boundary of the reactor coolant system. The RCPVMS is to provide diagnostic information for detecting such symptoms as the shaft crack, the RCP misalignment, rotor unbalance, and the abnormalities of support bearings.