1.12.3. ROLE OF WELD ROOT GEOMETRY – BACKING RINGS IN FLOW ACCELERATED CORROSION (FAC): RADIOGRAPHY TESTING IS AN ALTERNATE NDT METHOD FOR DETECTION – AN EXPERIENCE AT TARAPUR ATOMIC POWER STATION-1&2

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Tarapur Atomic Power Station is a twin unit Boiling Water Reactors (BWRs) built in 1960's and operating presently at 160 MWe. TAPS was designed to generate 210 MWe out of which 70% was from reactor primary steam and the remaining from Secondary Steam Generators (SSGs). This dual cycle of primary and secondary steam permits operation of the turbine to follow the system load demands automatically over a reasonable power range. However due to frequent tube leak related problems, SSGs were isolated in the year 1984 and units are operating at re-rated capacity of 160 MWe since then. Therefore the associated components of secondary cycle were isolated.

Of late it has been identified that Flow Accelerated Corrosion (FAC) is one of the degradation mechanisms with High Energy system piping components. The sudden failure of high energy (Enthalpy) piping components lead to loss of human lives as well as property loss in addition to the unplanned down times. The power industry is now reviewing their effectiveness of detection and monitoring programmes to identify & mitigate the consequences. The recent pipe rupture incidents in overseas NPPs in secondary cycle piping has alarmed Indian NPPs. This issue was reviewed in detail at TAPS-1&2 and corrective & measures have been formulated for timely detection of degredations.

Tarapur Atomic Power Station (TAPS) is one of the vintage reactors operating in the world and belongs to earlier generation of BWRs has completed 40 years of successful, commercial and safe operation. During these four decades TAPS has engineered many inspection methodologies to detect various degradation mechanisms such as IGSCC (Inter Granular Stress Corrosion Cracking), TGSCC (Trans-Granular Stress Corrosion Cracking), Erosion-Corrosion (EC), Stress Corrosion Cracking (SCC) and Flow Accelerated Corrosion (FAC). These degradation mechanisms were timely detected using various inspection methodologies developed time to time. The expertise gained from the operation and maintenance of both the units for the past four decades has strengthened the capabilities of the station personnel to develop various inspection methodologies & their application in the filed. One such inspection methodology was developed by the station which has potential to detect the degradation of high energy system piping components vulnerable to FAC, especially the weld root inaccuracies. This inspection technique is established at site NDT facility with in-house expertise and effectively utilized to detect the piping components degradation due to FAC.

The six influence factors that affects FAC mechanisms are (1) Trace Element Content (2) Geometry (3) Temperature (4) PH (5) Fluid Velocity and (6) Dissolved Oxygen content. Ultrasonic thickness measurement is one of the detection methods to identify the extent of material loss. However, this method would not detect the material loss under the weld portion and/or adjacent to weld toe. This type of degradation is possible due to vulnerable geometry at the root either due to (a) Excess Penetration or (b) Use of backing rings or un-fused consumable insert rings. Since beginning TAPS is monitoring the piping degradation by ultrasonic thickness measurements based on the information & feed back

received from overseas reactors from time to time through various correspondences/ technical information notices etc.

TAPS followed the methodology of thickness measurement by measuring thickness at pre-determined location of piping components at grid intersection points. In spite of following this methodology scrupulously to monitor FAC degradation, one of the piping components had failed in condensate feed water system while unit is under operation at full power. This has been analyzed in detail and failure analysis & studies were carried out to detect the degradation mechanism. Conventional methods could not detect the degradation effectively. Therefore a detailed analysis & study was carried out in-house at TAPS-1&2 and suitable methodology has been worked out. GE/Bechtel who is the designer and construction consultancy for TAPS-1&2 has used backing rings at the root in some of the systems. Erosion of these rings promoted FAC and resulted in unexpected failure of the piping components in the form of pinhole at adjacent to the weld toe. Radiography testing has been used to effectively detect the degradation at the weld root as well as weld tow adjacent portions to detect & identify this type of failure.

This paper gives a brief insight into the various inspection methodologies followed at TAPS for timely detection of degradation mechanisms avoiding catastrophic failure of High Energy system piping components. TAPS has effectively utilized these inspection methodologies and implemented to assess such component's integrity have also been briefly discussed.