Comparison Between Existing Deep-Well Anodes and Distributed Anode Design with Multiple Controllers for Cathodic Protection Upgrade in Petrochemical Plant

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Deep-well anodes have been a conventional design for cathodic protection (CP) systems in petrochemical plants. However, past projects have revealed significant limitations, including unbalanced protection, underprotection in central process areas which likely due to current shielding by underground structures such as reinforced concrete foundations and grounding grids—and overprotection near the deep-well locations leading to coating disbondment or hydrogen embrittlement. Furthermore, synchronized portable interrupters for CP monitoring are often impractical to install and operate. To address these problems, an alternative design was proposed using distributed anode beds entire the plant, powered by a single transformer rectifier unit (TRU) with multiple output controllers. Each controller enables to interrupt through built-in interrupter mode and fine-tuned current distribution by adjustable variable resistors for each anode bed in anode junction box as well. The design current was based on depolarization testing and current drainage test (CDT) equations to determine site-specific current requirements. Post-commissioning results demonstrated that the upgraded system achieved effective protection compliant with NACE SP0169 criteria at all test points with current outputting expected to achieve design life of 30 years. Fine-tuning remains necessary in some areas to correct minor overprotection.

This upgraded design improves CP current distribution and reliability while simplifying monitoring. However, this system still has some disadvantages, such as the lack of a backup TRU and the higher cost of installation. Overall, the distributed design provides a more suitable solution for complex underground pipeline networks in petrochemical facilities.