Low temperature transformation martensitic weld fillers for repair welding of large power plant components

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Weld repairs are frequently made in large power plant components during construction and when degradation is discovered by in-service inspection. When such repairs are made in the fabrication shop, they can be heat treated to improve the microstructure and relieve residual stresses. But when repairs are made to components and pressurised systems “in the field” this is rarely feasible because of the logistics. The consequence is that high residual stresses remain in the repaired component. Moreover these stresses are usually more tensile and triaxial than the original weld.

A new stainless martensitic steel alloy filler material has been designed to mitigate, or even annihilate, thermally-induced residual stresses. The new material offers the exciting prospect that repair welds can be made with near-zero residual stress. The alloy relies on the strains associated with its martensitic transformation in order to counterbalance thermal contraction. The aim of this project is to determine and evaluate the performance of this alloy for repair welds in large power plant components. Repair weld mock-ups will be created and the residual stresses characterised using neutron diffraction at the ISIS facility in the UK, the ILL facility in France and the contour method. In addition techniques such as SEM and Digital Imaging Correlation (DIC) will be employed to probe the complex metallographic and mechanical variations occurring in the vicinity of these kinds of welds.