

# ADVANCED MODELLING AND TESTING OF THICK SECTION WELDED HCM2S

## OBJECTIVES

The principal aim of the project is to use advanced modelling and testing to extend the size range in which the HCM2S steel can be fabricated with and without post weld heat treatment (PWHT). The specific objectives of the project are:

- to optimise the fabrication of thick section HCM2S utilising practical and efficient welding processes (MMA, FCAW)
- to investigate thoroughly the welding of HCM2S without PWHT
- to model the weld and cross-weld mechanical properties of HCM2S with, and without, PWHT
- to demonstrate acceptable weldment mechanical properties
- to produce fabrication guidelines for thick section HCM2S with, and without, PWHT

## SUMMARY

The recently developed steel alloy HCM2S has a sophisticated system of alloying which potentially allows it to be welded without creating an unacceptable degree of hardening in the heat affected zone. This and the inherent high strength, coupled with relatively low alloy content and therefore cost, offers considerable advantage to employing the steel in both new plant, of advanced design and high efficiency, and in the retrofit situation.

The ability to repair plant, particularly in retrofit, by wholesale replacement of large components without the requirement to post weld heat treat would give enormous advantage in the time required to repair such plant. Even with new build, the ability to weld repair in the future without PWHT could have a strong bearing in the ability to repair such plant.

The programme will develop weld procedures for thick section HCM2S and with a mixture of mechanical testing, including stress rupture testing, and the use of mathematical modelling of the kinetics and thermodynamics of precipitation, describe the optimised welding and, where appropriate, the post weld heat treatment. The same techniques will be employed to investigate the maximum thickness of HCM2S that can be welded without the use of post weld heat treatment. It may be the case that both types of weld would be employed with perhaps the more sophisticated non-post weld heat treatment techniques being retained for site welds.

The use of thick section non-PWHT welds is not generally code compliant though its use is growing in repair situations, especially in the USA. The present work would hope to influence the codes with respect to making the acceptance of non-PWHT HCM2S more common. In the non-PWHT condition residual stress relaxation and creep ductility effects will be modelled. The ageing of such welds will be modelled and the model verified by testing of accelerated thermal ageing.

The programme is unique in that it will model cross weld creep rupture tests incorporating the structure and property gradients in the HAZ.

## COST

The total cost of the project is £219 000 with a contribution of £105 292 from the DTI

## DURATION

3 years – January 2001 to December 2003

## CONTRACTOR

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Manual metal arc welding of advanced steel

Further information on the Cleaner Coal Technology Programme, and copies of publications, can be obtained from:  
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DTI/Pub URN 01/995