

Nuclear fission and fusion power plants: Validating models

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Nuclear fission and fusion power plants share many features: complex, often welded structural elements; aggressive environments and service loading; and high safety and economic consequences of structural degradation and failure. Computational modelling of structural performance plays an important role in the safe operation of fission reactors, and fusion plant will be no different.

Much research effort has been expended, both on extending materials and structural modelling over multiple length scales, and on modelling the whole of life, from component manufacture through to final failure in service. This multi-scale, whole life modelling offers the prospect of more reliable and less conservative prediction of component behaviour, with less unpleasant surprises in service.

Modelling is of little use without validation –proof that its predictions match the behaviour of real components. This talk discusses the challenges involved in validation of multi-scale models, via a set of case studies, starting with “conventional”finite element predictions of weld residual stress, and then considering lower length scale techniques that aim to predict microstructure development, such as solid state phase transformation in steels, crystal plasticity , and phase field methods.

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