Abstract

A major challenge faced by the oil industry during the appraisal of a hydrocarbon discovery and the development of potential development plans is the estimation of uncertainty emanating from a diverse ranges of sources. Whilst the problem is difficult enough when considering one class of uncertainty source in isolation, such as either geological or engineering, it is quite a deal more complex when attempting to estimate uncertainties from multiple classes of sources.

The use of modern, petroleum industry-related experimental design and sensitivity analysis procedures permit a far more rapid and quantitative assessment of multi-class uncertainties. Such methods facilitate the ranking of the relative magnitude of uncertainties both within and between classes. Once the major sources of uncertainty have been identified, these techniques permit the development of robust and rapid models for the quantification of the impact of uncertain parameters on the output responses of interest, such as oil production or water cut development. Additionally, these newly available procedures permit the optimisation of controllable parameters such as well location to ensure the optimum output response, such as oil production.

The use of experimental design and risk analysis procedures is described in the appraisal of an oilfield situated offshore of north western Australia. Software developed by the Institut Français du Pétrole in the context of the COUGAR Joint Industry Project was used in the evaluation, as well as BHP Billiton internally developed software. Initially just engineering uncertainties were investigated using COUGAR. This assessment included not only the effects of continuously varying parameters, but also discontinuous parameters such as tubing size, which was evaluated using the COUGAR joint modelling method. Subsequently, geological uncertainty was incorporated via two different techniques; first by using the COUGAR joint modelling method to consider discrete model realisations from classically constructed models and secondly by having realisations refined using the results of seismic inversions obtained using the BHP Billiton Bayesian-based seismic inversion application, DELIVERY.

The importance of the quantification of uncertainty as outlined above on the subsequent appraisal and development planning of the field is emphasised.