RADIOLOGICAL ASSESSMENT OF ROUTINE RELEASES INTO THE MARINE ENVIRONMENT: HOW ADEQUATE ARE TIME-INDEPENDENT MODELS?

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ABSTRACT

This investigation uses a time-dependent tidally resolving near field marine dispersion model to investigate the time to reach steady state tidal mean water activity concentrations, and variation in water activity concentration throughout the tidal cycle, for the range of hydrographic parameters found at UK nuclear installations. Steady state is reached between 2 and 30 days at the discharge point depending on the local hydrographic conditions. Within a tidal excursion about the discharge point the variation in concentrations through the tidal cycle is between 0.5 and 2.5 times the tidal mean concentration. For continuous discharge the time to reach steady state is not significant relative to assessments for annual mean doses, but care must be taken with validation of models against water concentration measurements.

INTRODUCTION

For the purposes of dose assessments the near-field modelling of dispersion of liquid radioactive effluents routinely discharged into the marine environment is mainly carried out based on the assumption that the system can be approximated as steady state. Although such simplistic approaches suffer from limitations, there are many obvious attractions. With more sophisticated approaches there is rarely sufficient, suitable environmental data for adequate validation, and models of radionuclide uptake into environmental materials to take advantage of a more sophisticated output would need to be developed.

In this paper the time-dependent tidally resolving model SERAM[1] is used to investigate some of the time-dependent aspects to be aware of when applying time-independent models such as the CEFAS model WAT[2] for assessments of routine discharges. The particular aspects investigated include the time to reach steady state in terms of tidal cycle behaviour (cyclical equilibrium), and variation in water activity concentration throughout the tidal cycle once cyclical equilibrium is achieved.

DESCRIPTION OF MODELS

The model WAT outputs a steady state tidal mean water concentration as a function of distance from the discharge point. This output is used with equilibrium concentration factors to calculate uptake to environmental media for dose assessments. It is a two dimensional depth averaged advection-diffusion model based on the assumptions of a straight coastline, simple constant depth bathymetry, and a velocity field consisting of oscillatory tidal and constant residual components. Diffusion is only considered normal to the coast and with a constant diffusion coefficient, although longitudinal diffusion is implicit in the model.