Task 7: Model development

Background:
The EIF method is based on a PEC/PNEC approach. The PEC *(=Predicted Environmental Concentration*) is the three-dimensional and time variable concentration in the recipient caused by the discharge. The PEC is calculated for all compounds in the release that are assumed to represent a potential for harmful impact on the biota. The calculations are made by means of a numerical model that is fully three-dimensional and time variable. It calculates the fate in the water column of each compound under the influence of

- currents (tidal, residual, meteorological forcing)
- turbulence and mixing (horizontal and vertical)
- evaporation at the sea surface
- reduction of concentration due to biodegradation

For the sediment drilling discharges, the fate of chemicals and particles (cuttings and weighting materials) in the water column is calculated in addition. Impacts on the sediment layer are also calculated as a function of

- amounts that are deposited
- bioturbation
- biodegradation rates
- toxicity of the chemicals and heavy metals in barite
- oxygen depletion

The PNEC (= *Predicted No Effect Concentration*) expresses the lower limit where effects on the marine biota in the recipient may be encountered. The PNEC level is given for each component (or component group) in the discharge. It is derived from laboratory testing of toxicity for each component (or chemical product) in question.

The EIF is related to the recipient water volume (or the sediment surface area) where the ratio PEC/PNEC > 1 for any of the compounds or component groups considered. The ratio PEC/PNEC is related to the probability of damage. When PEC/PNEC = 1, this corresponds to a level of probability of damage equal to 5 %.

Research needs:

1. The type of drilling mud used in the future will preferably be of the Water Based Mud type (WBM). The fate of these type chemicals in the water column is uncertain. What ingredients are transported away in the water column and what ingredients are depositing on the sea floor? Laboratory trials with used mud from a drilling rig might reveal useful results.

2. The drilling debris from the top hole sections (26” and 36” drilling sections) are usually deposited directly on the sea floor. Some of the materials are fines that would have spread in the water column if discharged from the platform. To what extent will these spread in the environment along the sea floor ? What concentrations/depositions should be considered as a potential for impact on

chorals nearby? Methods (field observations, laboratory trials) should be proposed to consider this further.

3. The model has (so far) not been compared to field measurements in order to verify that the model actually simulates the impacts observed. Some drilling locations with appropriate sediment data collected (should include measurements closer to 250 m from the discharge point) should be selected for comparison between the ERMS model and actual observations (*Mulig dette hører hjemme I selve ERMS prosjektet??)*

4. The ERMS model does (at present) not operate with PNEC's or biologic parameters (say, for bioturbation and for re-suspension) that are dependent on the actual biota or fauna on the site in question. There is therefore a need to develop model parameters that can express this dependency to the actual fauna/biota on the site. Model options should be developed in order to include this possibility.

5. Barite particles have shown to cause particle stresses on benthic filtering organisms (mussels, sea scallops). This effect should be studied on pelagic filtering organisms as well (Zooplankton, Calanus Finmarchicus).