A COUPLED EULER LAGRANGIAN FINITE ELEMENT APPROACH TO FLEXIBLE PIPE SEABED INTERACTION DURING DROPPED OBJECT IMPACT

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ABSTRACT

With the increase in equipment and pipeline density on the seabed around offshore assets in the oil and gas industry the risk to pressurised pipelines through dropped object impact is increasing. The use of flexible pipe technology, while beneficial in many respects, increases this risk further. This paper reviews a non-linear finite element analysis approach that was performed to examine the likelihood of failure of a number of flexible pipelines subjected to a 10kJ dropped object impact. The analysis was highly non-linear due to contact between dropped object and pipeline, non-linear material behavior through a combination of plastic deformation and contact between the various layers making up the flexible pipe and friction within and between the armor layers and the other layers of the flexible pipe. In addition contact between the flexible pipe and the seabed along with the pipe-soil interaction added yet more non-linearity. The Coupled Euler Lagrangian method within the ABAQUS finite element software was used to enhance the study to more fully capture the interaction between the structure and the surrounding fluids, in this case seawater and soil. The flexible pipe was treated as a conventional finite element assembly in a Lagrangian reference frame. The pipe interacted with the soil, modelled as a non-linear material, and seawater both of which were modelled in an Eulerian reference frame.