

Title	Research report 489: structural strengthening of offshore topsides structures as part of explosion risk reduction methods
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Executive Summary	<p>This report deals with the re-assessment and strengthening methods for blast walls, decks and floors. Re-assessment of offshore structures may often be necessary for a variety of reasons including:</p> <ul style="list-style-type: none"> • Many existing offshore structures are being used well beyond their original design life, which necessitates the assessment of state of the structure in case of any deterioration. • Continuous advances being made in the field of safety of offshore structures against fires and explosions, which necessitates the re-assessment of the structure taking into account new data related to gas and explosion loading and response models. • The UK Health and Safety Executive (HSE) requires the duty holder to carry out an assessment to demonstrate that risks have been reduced to As Low As Reasonably Practicable (ALARP). <p>The above three factors indicate that re-assessment studies are being regularly carried out. Based on the results of the assessment studies the duty holder may decide that the risks to people, assets or environment from fire and/or explosions to the structure are intolerable and as a result may decide to implement risk reduction measures. Physical strengthening of the structure is one of various risk reduction measures that will be considered in the report.</p> <p>The objectives of this study were to:</p> <ul style="list-style-type: none"> • Carry out a review to determine how and when structural re-assessments are carried out and of the various strengthening schemes that are currently being employed, and those that may be employed in the future (based on recent research findings), • Carry out a review of how the ALARP regime is being implemented, and in particular how decisions are made regarding the selection of suitable risk reduction measures. <p>In summary, the main strengthening schemes that are used on offshore structures were reviewed. Both strength and ductility based schemes are currently being employed. In many cases it was necessary to modify the structure to ensure it has ductile behaviour under explosion loading. A methodology for screening and strengthening of structures has been developed. It starts by using linear elastic codes to determine utilisation ratios based on considering the maximum explosion load as a static load. Members with utilisation ratios above 0.7 are identified for higher level analysis. The proposed level 2 analysis consists of carrying out SDOF analysis to determine a dynamic load factor to be multiplied by the maximum blast load and used in the static analysis. Members that still show high utilisation ratios are selected for further analysis consisting of nonlinear dynamic finite element analysis. At any stage within the process it is possible to reduce the risk, rather than carrying out a higher level analysis, by choosing from a variety of strengthening and ductility measures for blast walls, topsides and connections.</p> <p>It must be stressed that although the work has been taken with the support of the HSE, the views expressed in this report are the author's own opinion and not those of the HSE.</p>
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