



FPSO model in steep fronted waves.

## Major step forward in FPSO SAFE-FLOW destined

**Commenting on the successful completion of the SAFE-FLOW project, Joaquín López-Cortijo of IZAR FENE shipyards, concluded: "These results will certainly change future FPSO design and operation." As the three-year SAFE-FLOW project comes to an end, Report assesses its impact.**

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In a final meeting held in Singapore on April 1, the results of the SAFE-FLOW project were presented to specialist representatives of oil companies, shipyards, engineering companies and classification societies. The objective of this three year Joint Industry Project (JIP), in which 26 companies participated, was to develop guidance, calculation methods and risk assessment procedures, for green water and wave impact loading for FPSOs. The JIP was managed by MARIN and was performed in co-operation with a number of other European Specialists in this field.

Tools developed in the project were presented and the consequences of the JIP for FPSO design and classification were discussed in the meeting. In his opening statement, chairman of the participant's steering committee, López-Cortijo reminded the participants of the situation prior to the start of

the project, cited from a study by the HSE at that time: "Insufficient and inadequate guidance is available for design against green water and wave slam loading. More research and analysis are considered necessary."

### Combining knowledge

SAFE-FLOW project manager Bas Buchner of MARIN gave an overview of the project which was initiated following incidents reported by the HSE and NPD on green water loading events on UK and Norwegian FPSOs. Another trigger for the start of the project was the damage to the bow of the Schiehallion FPSO suffered during the night of November 9, 1998. "In the SAFE-FLOW project we tried to combine knowledge about waves and hydrodynamic loading, with structural design of FPSOs and the related reliability based methods", he said. "The project found for instance, that the wave impacts on the bow and the structural response are closely related to the steepness of the fronts of the waves."

Arjan Voogt of MARIN presented the 'BowLab' program which has been developed by MARIN, based on the results of the SAFE-FLOW project. In parallel to the existing 'GreenLab' program that focuses on green water loading, the BowLab program allows the designer to predict the wave impact loading on the outside of the bow.

## Recommendations

Trevor Hodgson of Galbraith Consulting then discussed the implications of the SAFE-FLOW results for FPSO design. Using the BowLab methodology developed in the project, he presented a case study with a 1750 kPa design pressure (175 m water head) for an FPSO bow. He concluded that these predicted pressure magnitudes are high but not unrealistic. Ongoing monitoring of the loads on the Schiehallion bow confirm that these type of loads can be expected in the long term. “Although these loads are high”, he concluded,



Damage to the Schiehallion FPSO.

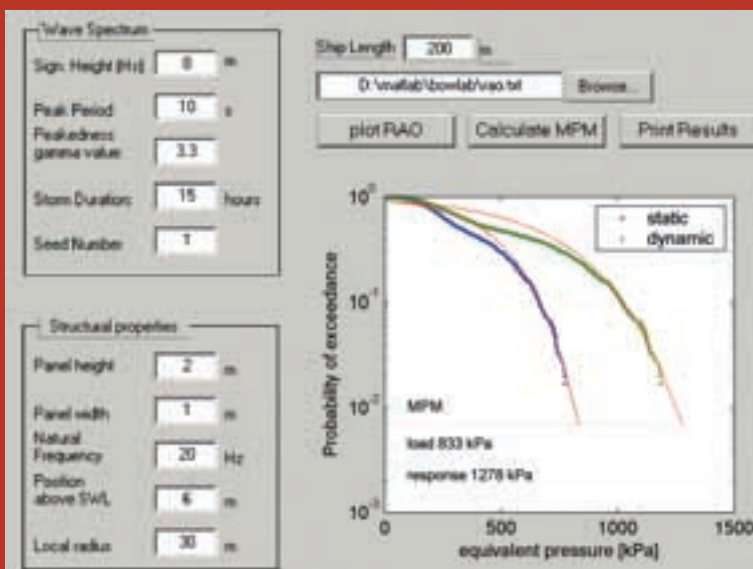
# to change future design

“stiffer and plate design is still possible with these loads.” In addition, he mentioned that better bow shape designs can reduce these pressures.

Michel Francois of Bureau Veritas presented an evaluation of the present classification society rules, based on the SAFE-FLOW results and came with recommendations for improvements. He said that it is important to identify the limits of applicability of the rules for a specific FPSO, based on a study of the relative wave motions around the FPSO and the results from SAFE-FLOW now available. “Rules should be applied by experienced engineers”, he stressed.

Based on the results of SAFE-FLOW, he will propose adjustments of certain aspects in the rules to Bureau Veritas and other classification societies. These proposals were strongly supported by the participating companies at the meeting. “Classification society rules should reflect the present state of knowledge”, one of the participants said.

Buchner concluded that “it always takes time for the industry to digest the results of this type of joint industry research, but I am confident that in the end the results will be used for an improved design of safe and efficient FPSOs.” **MARIN**



BowLab output screen.