

FPSO Fracture repair and prevention of crack propagation

August 2020

Project type	Below the waterline crack repair
Area	5m ²
Design	12-25-E
Yard	On-station
Class	DNV-GL
SPS Partner	Marine Offshore Management



Summary

SPS® was applied on the starboard side shell in the diesel oil storage tank to provide a permanent repair and to restore integrity of a damaged (cracked) area of the hull structure. The project was carried out offshore whilst the unit remained in-service. The use of SPS resulted in:

- Faster repair
- Unit remained in-service
- Repair undertaken by small team

Background

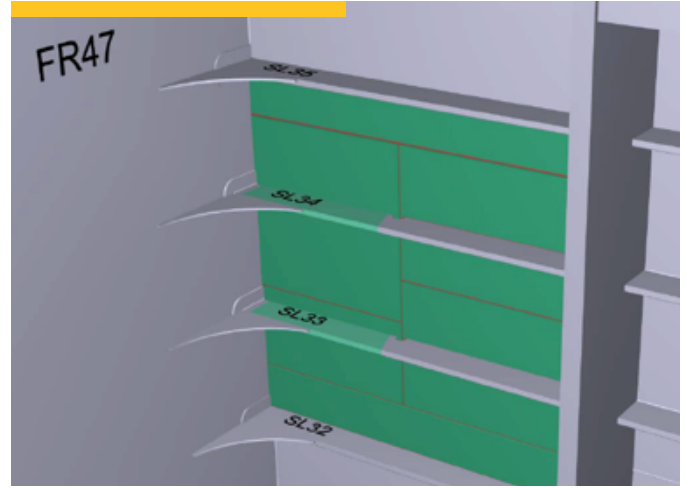
Marine Offshore Management (MOM), a key SPS Technology partner, was asked to provide a permanent repair and restore the integrity of a damaged (cracked) area of the hull structure. Doublers, previously used to provide a temporary repair of the cracks in the side shell were removed and two damaged longitudinal stiffeners cropped and renewed.

Details

The composite construction of SPS enables the structural integrity to be restored by the SPS elastomer core transferring loading/stress levels from the existing plate to new SPS top plate therefore 'bridging the cracks'.

The SPS design was approved by DNV-GL, which also conducted a structural assessment that involved the following analyses to investigate crack growth and inspection frequency:

- Hydrodynamic analysis to calculate the dynamic pressure on the side plate
- Calculation of stress ranges in the plate due to the dynamic pressure
- Crack growth analysis
- Inspection planning based on probabilistic methods



The following conclusions were drawn by DNV-GL from the fracture mechanical study.

“Hydrodynamic analyses have been performed for calculation of long-term dynamic pressures on the side plate in the diesel tank. Stress in the side plate after a SPS repair have been calculated conservatively assuming that the diesel tank is full all the time in a loaded condition. It is noted that the stresses in the side plate will be significantly reduced after the proposed repair as compared with the present situation.”

Crack growth analyses have been performed with crack growth from the stop holes until a crack reaches the bulkhead. A fatigue life of 2116 years after the SPS repair has been calculated. Crack growth parameters corresponding to mean plus two standard deviations have been used in this calculation. This result means that the integrity of the side plate structure is acceptable without any planned in-service inspection of fatigue crack growth from the stop holes after the SPS repair has been performed.”

The use of SPS on the FPSO reduced the cost, disruption and time required for the repair. The FPSO was able to remain on-station and in production.

The SPS was applied from the inside with a 12mm top plate welded to the framing members. Most hot work took place away from the side shell. The SPS elastomer core was injected into the resulting cavity to form the composite sandwich.

SPS used the damaged plating as one side of the steel composite panel formed by a new top plate and an elastomer core. The resulting composite fully restored the strength of the original structure. SPS is approved by all major classification societies.

SPS Product Specification

Fast

Short repair schedules

Non-disruptive

Minimal labour, no or reduced downtime

Economic

Reduced repair costs, lower operating costs, and increased revenue