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To whom it may concern.

This is to certify that Paul W.H. Voorhaar has been working on the F3 project as a specialist lead engineer for the pipe stress team.
He has been responsible for the riser design, the support locations and loadings on the supports and also has played an important role in the riser clamp design.

The F3 project comprises the first concrete Gravity Based Structure in the Dutch Field of the North Sea and has been built during 1991-1992.

Generally a riser should withstand loadings from Design Environmental Loads (wind, waves, current etc.) and the simultaneously acting Functional Loads (weight, pressure, thermal expansion etc.). To perform the riser analysis the most unfavourable combination of forces in terms of position and direction, which could act simultaneously, have been used.
Wave and current loadings will induce forces in the submerged portion of the riser, such as inertia, lift and drag forces. Some indirect environmental loads have also been considered, such as platform displacement due to soil deformation.

Additionally the possibility of riser vibrations from vortex shedding as well as vibration by direct wave action have been considered.

The pipe stress analysis for the 16" oil export riser, the 24" NOGAT riser, J-tube and 10",12",14" and 16" future risers have been performed with the pipe stress analysis programme P10 since the calculations have been submitted to Stoomwezen (the Dutch Certification Authority) and to DnVC (Det Norske Veritas Certification) for approval.

Stoomwezen only approves a few pipe stress analysis programmes and P10 is on of them. Since P10 is designed to perform static analyses, Paul W.H. Voorhaar has specially developed for this project a Fatigue Analysis Programme in Pascal, working in conjunction with P10. Furthermore he developed a Lotus-123 interface for implementing the results of the wave loading calculations automatically in the P10 input.
Both for the Dynamic Response Analysis as for the Earthquake Analysis he has developed an interface between P10 and the Finite Element Programme ASAP.
Further Mr. Voorhaar has developed special application programmes for the GBS pipe support loadings (embedments and riser clamps) working in conjunction with P10.

Since the GBS is positioned in shallow water, the impact of the concrete structure to the water velocities is very high. The forces acting on the F3 risers are locally nine times higher in comparison to an open jacket platform.

Although the complete project (engineering, procurement, construction and installation) should be performed in a relative short time span, the client decided at a very late date about final diameter, wall thickness and material of the oil export riser.
In order to reduce the delay and the impact of this late decision on the construction of the GBS, Paul Voorhaar has made considerable overtime for an extended period.

W.C. Horden
Design Manager F3 Project.