



SubseaMaster™:

Experience database for subsea production systems

Background and objective

This project was kicked off in April 1999 with Petrobras as the client. The objective of the project was to develop and implement an experience database on subsea production systems for Petrobras' operations. The main focus of the project is collection and analysis of reliability data and systematic learning and improvement on the basis of failure cause analysis and feedback to involved parties.

This was achieved through combining Petrobras' own skills and experience on subsea production systems and ExproSoft's experience from design/operation of major reliability/event databases. Petrobras is today considered the leading deepwater operating company worldwide, with more than 500 subsea completed wells in a water depth range from 200 to 2000 meters.



Figure A: Wet X-mas tree being readied for field installation.

Petrobras has focused on cost efficient solutions and high flexibility for its subsea production systems.

Project description

The following equipment is included in the database:

- Wellhead
- X-mas tree, tree block, structure
- Connectors

- Tree valves
- Isolation valves
- Injection valves
- Control system including pods and various control system modules
- Flowlines/umbilicals
- Manifolds (structure, piping, connections, sensors)
- Chokes
- Multiphase flow meters
- Wireline BOP (disconnect package)
- Completion risers
- Intervention tools/systems (ROT/ROV)
- Pipelines

Key data on vessels and interventions performing operations on the subsea production system are included in the database.



Figure B: Installation of 250 tons subsea manifold in the Marlim field .

Benefits

The software/database is the first database worldwide to integrate a full description of well completions and subsea production systems with full reliability data input, retrieval and analysis capability. As such, the database is an indispensable tool during quantitative risk assessment of subsea production systems.

The system offers a variety of benefits and applications:

- Comparison of performance of various systems/suppliers
- Improved understanding of failure mechanisms as input to new field developments
- Source for generation of input data to risk/reliability analysis
- Future platform for exchange of experience data with other operating companies

Software/database solution

The software is based on use of the following tools:

- Visual Basic version 6.0
- Microsoft Visual C++ 6.0
- Oracle database

The system is implemented as a client/server based database system with accessibility from multiple sites within the organizations of the participating oil companies.

Version 3.0 of the SubseaMaster software is currently under development with a number of new features incorporate. Excel-spreadsheet based import of equipment inventory data is a major improvement of the system in the latest version.

User interface

The majority of input is via a graphical user interface, with close similarity to solutions implemented in ExproSoft's WellMaster 5.0 software. This incorporates graphical symbols for the different subsea equipment items, as well as full drawing capability for flow diagrams illustrating manifolds, wet trees, pipeline end terminals, etc. Input of failure data and repair/intervention data is also be via this graphical interface. Re-use of parts of the source code from the WellMaster 5.0 software was pursued to achieve time and cost savings when developing the graphical user interface.

Time schedule and future plans

The project is run in phases, with history and current status as follows:

Phase I: April 1999 through July 2000. Participation and funding from Petrobras and ExproSoft, with major influence on database modelling and program specification from Petrobras' engineers. The program is made in an English base version, with features included for easy translation of commands/dialog boxes/reports to a Portuguese version and other languages. A simplified reporting module will be prepared with reliability analysis capability. The program is made as a 32-bits version for Windows XP/2000/NT, making extensive use of so-called Active-X controls. This allows smooth transition to an Internet/Intranet application in the future if requested by the users.

Phase II: Launched as a Joint Industry Project (JIP) with participation from a group of major subsea operators (Petrobras, Chevron, Texaco, Kerr-McGee and Conoco). In Phase II, a more powerful analysis module was included and the capability of the software was improved.

The project was performed from June 2001 through June 2003. Extensive data collection was performed, covering a total of 123 recent failures on subsea items (manifolds, x-mas trees, umbilicals, subsea control modules, sensors, etc.). As an example, for subsea x-mas trees alone, a total of 333 years in service is recorded in the database. Both installation and in-service failures are covered in the database. In Phase II, the WellMaster and SubseaMaster databases and software were merged, to maximize synergies for the participating companies. The merged software and database forms a unique tool for risk reduction and reliability improvement during planning and operation of oil/gas fields – especially deepwater developments.

The final report from the Phase II JIP is now commercially available from ExproSoft's web site following expiration of the confidentiality period (see 'Publications' on the web site).

Phase III: This project is a direct follow-up of Phase II with main emphasis on continued reliability and experience data collection and analysis of subsea production

systems. Several major oil/gas companies and subsea manufacturers are participating, with the project being kicked off in March 2004. All participating oil companies are requested to provide data to the JIP database. The JIP is open to new participants, who will also get access to results from Phase II upon participation.

As of completion of the SubseaMaster Phase II, the database contains data on some 333 well-years of service for x-mas trees. A total of 123 failures are recorded on various items of subsea production systems. Refer to Figure C for an overview of failures per sub-system and operating company.

Sub-system	Number of failures			Total
	ChevronTexaco	Conoco	Petrobras	
X-mas tree	8	10	16	34
Manifold	71	8	5	84
Lines	1	3	1	5
Total	80	21	22	123

Figure C: Overview of subsea failures per sub-system and operating company.

In Phase III, Chevron is the most active user of the system and provider of subsea data. In addition to Chevron, ENI and Petrobras are members of this phase.

Integration with other software/databases

To ExproSoft's knowledge, SubseaMaster is the only subsea reliability database worldwide which is integrated with a downhole completion reliability database (WellMaster). Further, integration with our FieldSim package allows simulation and analysis of alternative field development schemes at early planning stage, producing vital reliability and operational cost data as output.