

Flow Assurance  
Capability Statement



Growing Reliable Partnership

Technical Training	Field Development	Subsea Systems	Subsea Pipelines	Floating Structures
Marine Risers	<b>Flow Assurance</b>	Advance Engineering	Renewable Energies	Integrity Management

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## 1.0 Introduction

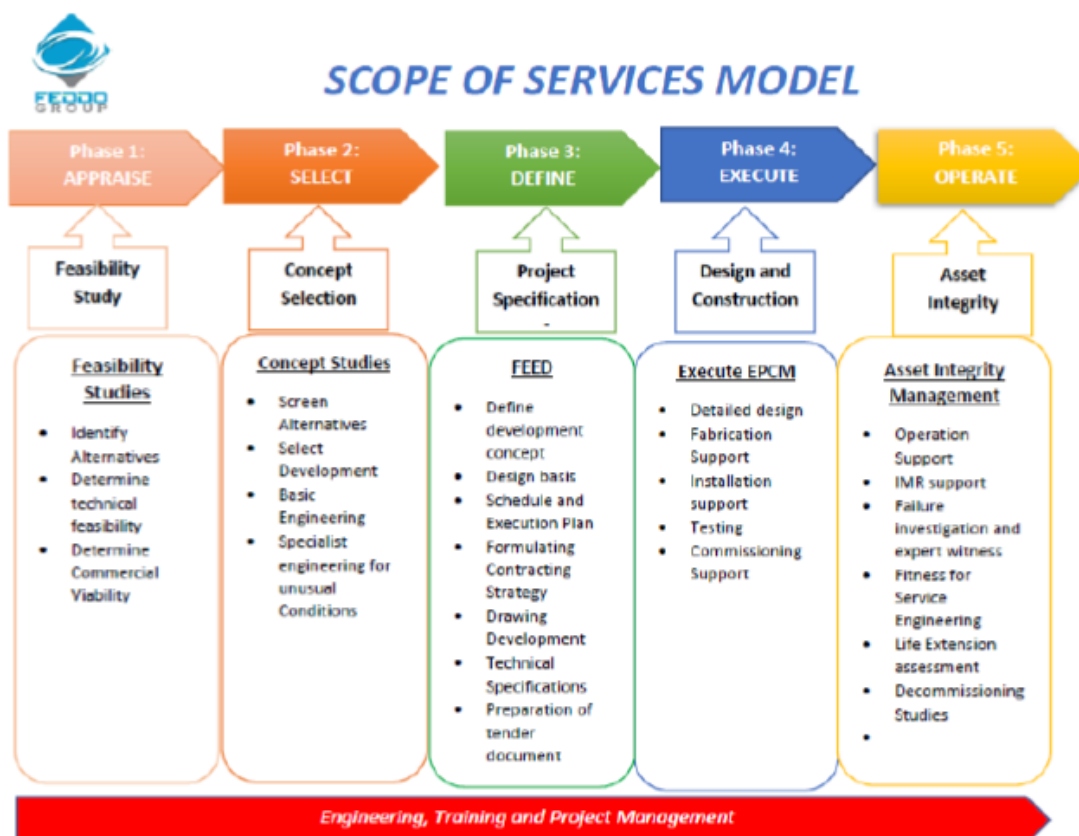
FEDDO Group was established in 2013 as a Global company, registered and headquartered in Australia (Perth)

The main aim is to serve the Energy and Mining sector, providing a range of Consulting Services to the Industry which includes both the Oil & Gas sector, Metal and Minerals and the Renewables sector. FEDDO GROUP specializes in offshore engineering, subsea field developments, subsea and Onshore pipeline systems, integrity management and pigging, life extension, decommissioning, and construction management. We also offer technical training solutions to develop skills and capabilities for the whole life of field covering every aspect of design, operation, integrity management and maintenance.

FEDDO GROUP business model works on a network of regional engineering centres which enable specialised skills, knowledge and expertise to be shared across its global operations.

Our global operational head office is located at Perth, Australia covering Australia and Asia, FEDDO GROUP also has operating offices in Houston, covering the Americas, London, United Kingdom, covering Europe; and Lagos covering Africa, apart from these we have commercial presence (Marketing office) in Kuala Lumpur mainly for South east Asia Region; Abu Dhabi targeting Middle East Region.

It is our practice to work with client to turn complex situations into positive practical results, by bringing professional insight to support critical business decisions. We work in all phases of project development from appraise, select, define to execute and operate.



FEDDO GROUP provide system engineering comprising the following disciplines:

- Technical Training Solution;
- Field Development;
- Subsea Systems;
- Subsea Pipelines;
- Floating Structures;
- Marine Risers;
- **Flow Assurance;**
- Advance Engineering;
- Renewable Energies; and
- Asset Integrity Management.

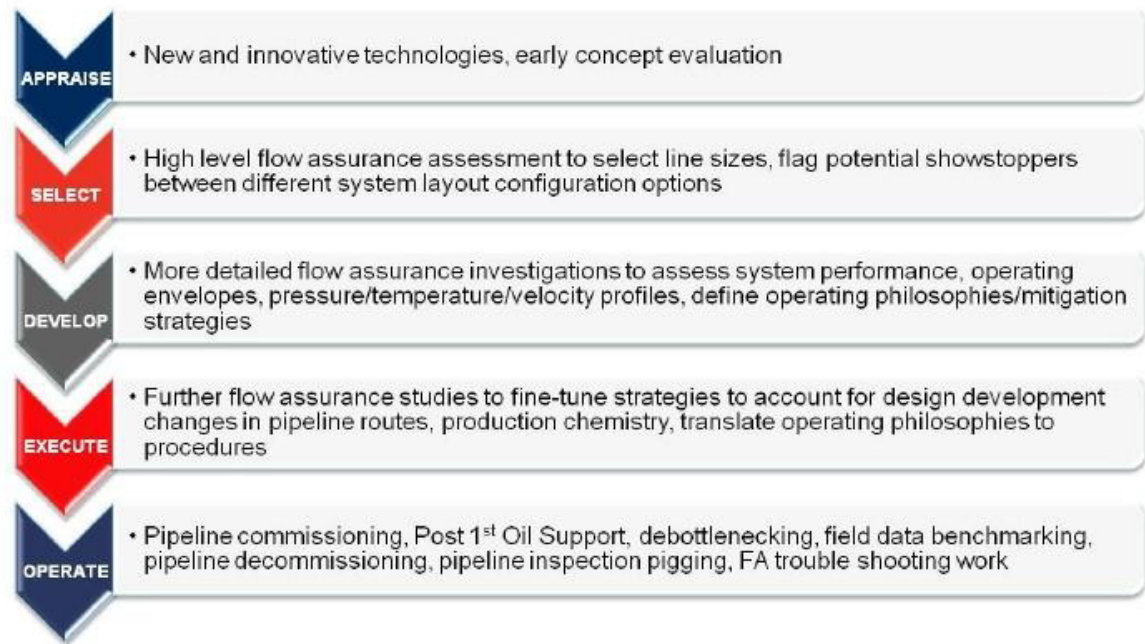
This document provides details of our capabilities in **Flow Assurance**



## 2.0 Flow Assurance Capabilities

For many field developments and challenging export system projects, flow assurance is one of the first and most crucial activities to be undertaken. FEDDO GROUP has in-depth knowledge and extensive experience in dealing with the most complex flow assurance problems.

Typically, the flow assurance work undertaken by FEDDO GROUP during project design engineering phases broadly covers the following activities:



Flow assurance capabilities include:

- Life of field analysis (IPM)
- Dynamic/transient analysis
- Wax and asphaltene
- Hydrates remediation and MEG management
- Slugging and slug mitigation/ catching
- End-to-end transient multiphase simulation (OLGA-HYSYS)
- Wellbore (and Reservoir) modelling
- Operational management tools
- Hydrate, wax control and remediation
- Operability reviews
- System design and engineering
- Systems architecture
- Functional interface management
- Flow assurance manuals
- Operating manuals
- Fluid characterization
- Chemical injection design
- Pigging system design
- Flow Induced Vibration (FIV) Potential

## 3.0 Flow Assurance Engineering Services

### 3.1 Thermal Hydraulic Simulations

In performing thermal-hydraulic simulations, fluids are modelled with black oil and/or compositional models, as appropriate and as detailed compositions are available. When tuning data is available, fluid characterizations are developed. Insulation characteristics of downhole production tubing and subsea flowlines are realistically modelled. Schlumberger's PIPESIM is used for steady state, multiphase, thermal-hydraulic simulation of both single-line and network models. Life of field simulations are performed to examine the operability of the system with time. The OLGA transient multiphase simulator is used for dynamic simulations such as startup, shutdown, slugging, and pigging.

### 3.2 Hydrate Prediction, Inhibition, and Remediation

The prediction of hydrate formation temperatures/pressures and the design of the overall system to prevent plug formation during system startup, steady state operation, and shutdown are fundamental to the design and operability of subsea production systems. Starting from fresh-water hydrate dissociation curve predictions, FEDDO GROUP adjusts those curves to account for formation water salinity. Analytical tools from Calsep (PVTSim) and Infochem (Multiflash) are used to calculate the hydrate dissociation curves and to assess the effect of inhibitors. In designing the system, a choice is often made to prevent hydrate formation by using inhibitors or to prevent them by keeping the fluid warm (insulation) and/or reducing pressure using subsea chokes. Active flowline heating is also an option and can be considered where appropriate.

### 3.3 Production Chemistry – Wax and Asphaltene Management

The selection of chemicals to prevent or inhibit wax and asphaltene deposition is often challenging. It is likely that field experience will be required to reliably determine what chemicals work and at which injection rates they will be required. Chemical inhibition issues strongly influence flow system design, chemical inhibition design, and system operating philosophies/strategies and procedures. For instance, the technical issues and the costs and benefits of chemical inhibition, wellbore and flowline insulation, and pigging for deposition control all have to be considered together to arrive at an overall design solution. FEDDO GROUP can assist customers with inhibitor test plans. Wax deposition modelling with OLGA is an important analytical simulation in determining the impact of wax formation on the development.

### 3.4 Production Chemistry – Scale Management

Understanding of scales formation and their prevention/remediation are important for seamless operation of oil and gas production facilities. Scale formation may be due to changes in temperature, pressure, out-gassing, shifts in pH, and contact with incompatible brines. FEDDO GROUP personnel have extensive experience in the management of scales along with their prevention and remediation.

### 3.5 Production and Flow System Operability

Operability is intrinsic to the Flow Assurance and System Design Process. FEDDO GROUP has made significant contributions in the assessment of system operability issues and in developing operating philosophies and strategies to avoid the formation of hydrate or wax at any time during system operation. These capabilities have been developed on long-offset, deepwater, subsea development projects for several clients. “Operability” is the set of design provisions and operating strategies that ensure that the production system can be started, operated, and shut down under all conditions (planned and unplanned) throughout the operating life of the total system.

### 3.6 Slug Prediction and Slug Catcher Sizing

In general, for offshore floating and/or platform-based systems, slug catchers are undesirable from a weight and space perspective. Where possible, and particularly for oil/gas systems, it may be preferable to use separator inlet chokes (possibly brought into play by the level control circuitry) to control separator liquid ingress and/or dump rate, and the resultant separator volume. The use and/or design of slug catchers are part of the overall system hardware and operational design. Liquid management in large complex offshore gas-condensate projects, is a challenging issue. FEDDO GROUP can examine a range of operational constraints to evaluate the slug catcher size and operational procedures.

### 3.7 Flow Induced Vibration (FIV) Potential

Flow Induced Vibration can be defined as structural and mechanical oscillations of structures conveying fluid flow as a result of an interaction between the fluid dynamic forces and the inertia, damping, and elastic forces in the structures. Similar oscillations are experienced by structures submerged in a fluid flow - Vortex Induced Vibrations.

Turbulence due to flow depends on flow regime. The main sources of turbulence are flow discontinuities in the system. This in turn generates high levels of broad band Kinetic Energy which can propagate through the Piping system. This leads to excitation of low frequency vibration modes of the pipe work causing vibrations of piping and in some cases pipe supports, which is generally referred to as Flow Induced Vibration (FIV).

Main FIV excitation mechanism:

- Flow Induced Pulsation
- High Frequency Excitation
- Flow induced Turbulence
- Surge

**FEDDO GROUP** have developed in-house models based on both impedance and transient methods to evaluate flow induced vibrations and mitigation methods.

## 4.0 Software Solution

FEDDO GROUP offers a range of software solutions:

- FIELD OPTIONS
- QUICK SURGE
- GAS RELEASE
- FLARE STACK
- GASNET
- LIQNET
- TRANSGAS
- PIPESIM
- PIPELINE, STUDIO, FLOWMASTER, STONE etc
- OLGA
- HYSYS

### 4.1 FIELD OPTIONS

#### Description of Function

Integrated Reservoir, Wells, Flowlines and Riser Multiphase analysis.

- **Deliverables**
  - Assess Reservoir Development Technology Options
  - Costs of Developments
  - Systems sizing
  - Flow Assurance Risk Analysis.

### 4.2 QUICK SURGE

#### Description of Function

Surge analysis for horizontal liquid pipeline systems.

##### Deliverables:

- Pressures, Flow rates, Velocities, Versus Time and Distance.
- Max. and Min. Pressures resulting from Valve closure.

### 4.3 GAS RELEASE

#### Description of Function

Assess the pollutant concentration levels in the local atmosphere by performing plume rise and air dispersion calculations as well as predicting the location and quantity of gas in explosive range.

- **Deliverables:**
  - Predict Pollutant concentration levels in the local atmosphere arising due to the gaseous emissions of these pollutants from chimney (or other sources) stacks.



- Predicting the location and quantity of gas in explosive range.

#### 4.4 FLARE STACK

##### Description of Function

Calculate radiation levels in the atmosphere as a result of flaring or accidental release of gas from stacks or other sources.

- **Deliverables:**
  - Design of flare stacks (diameter, height, flow rate etc.) to comply with the prevailing safety regulations.

#### 4.5 GAS NET

##### Description of Function

Simulate the thermo-hydraulics of a diverging network or a single pipe transporting dry gas.

- **Deliverables:**
  - Prediction of pressure and temperatures along each pipe.
  - Size pipeline internal diameter.
  - Assess the adequacy of the pipeline insulation.
  - What if analysis.
  - Predict compressor power requirements.
  - Prediction erosion conditions in each pipe.

#### 4.6 LIQNET

##### Description of Functions

Simulate the thermo-hydraulics of a diverging network or a single pipe transporting liquids.

- **Deliverable:**
  - Prediction of pressure and temperatures along each pipe.
  - Size pipeline internal diameter.
  - Assess the adequacy of the pipeline insulation.
  - What if analysis.
  - Predict pumping power requirements.
  - Prediction erosion conditions in each pipe.

#### 4.7 TRANSGAS

##### Description of Function

Predict the effects of transient pressure and flow variations due to closing or opening of downstream valves at demand points.

- **Deliverables:**
  - Study the effects of gas demand rate changes.
  - Study the effects of closing /opening control valves.
  - Investigate operating philosophy.
  - Investigate stability analysis.

- Investigate design alternatives.
- Investigate line pack utilization.

#### COMMERCIAL SOFTWARE

- PIPESIM

##### Description of Function.

Design and analysis of steady state multiphase systems. Pressures, velocities, liquid hold-up, slug characteristics and fluid properties.

- PIPELINE, STUDIO, FLOWMASTER, STUDIO etc

##### Description of Function.

Transient gas of liquid pipeline network analysis program Pressures, velocities, with distance and time.

- OLGA

##### Description of Function.

Transient multiphase pipeline analysis program Pressure, velocities, liquid hold-up, sweep-out, slug characteristics and fluid properties.

- HYSYS

##### Description of Function.

Process unit simulator for refinery modeling and limited pipe flow analysis (separators, compression, fractionation, columns, etc. Thermal, mass and energy balance analysis – can be modified for novel applications modelling.

## 5.0 FEDDO GROUP Personnel Flow Assurance Experience

FEDDO's senior technical team consists of industry experts with extensive international knowledge and expertise in challenging environments. Members of this team have worked on some of the most innovative projects of their time.

For Further information:

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