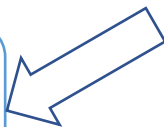




FEDDO
GROUP

Growing Reliable Partnership

**Subsea Pipelines
Capability Statement**



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

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1.0 Introduction

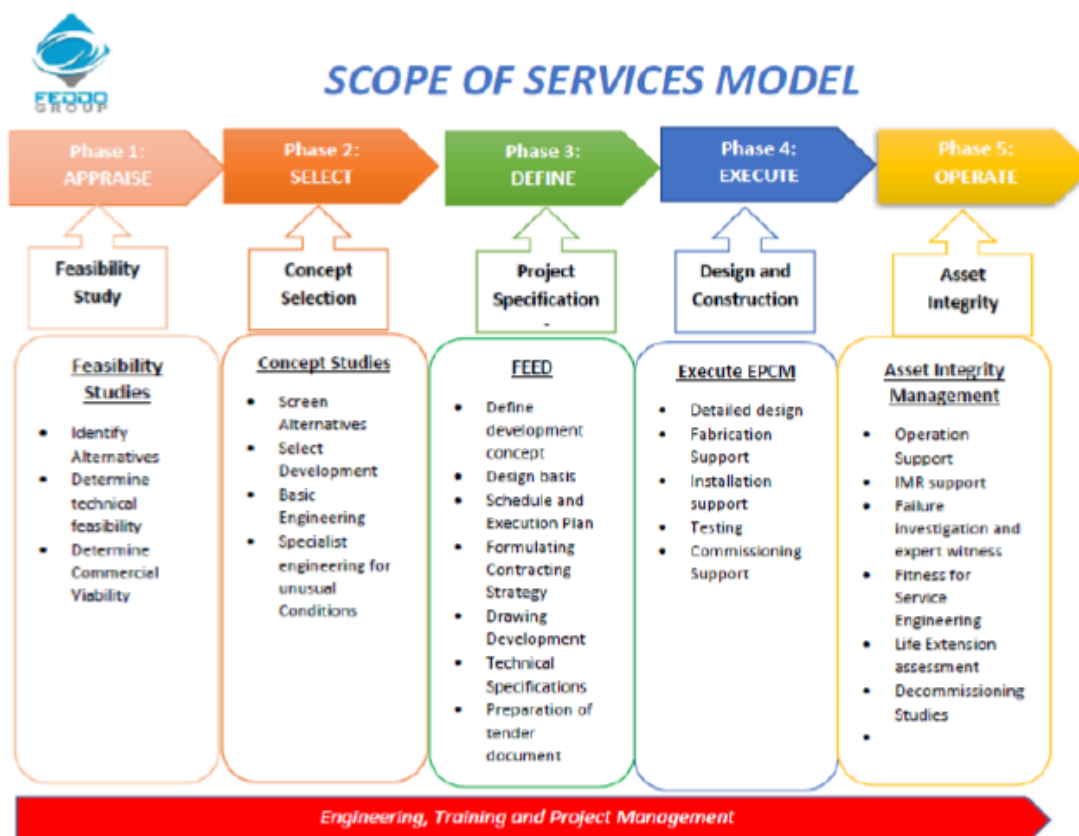
FEDDO Group was established in 2013 as a Global company, registered and headquartered in Australia (Perth)

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.

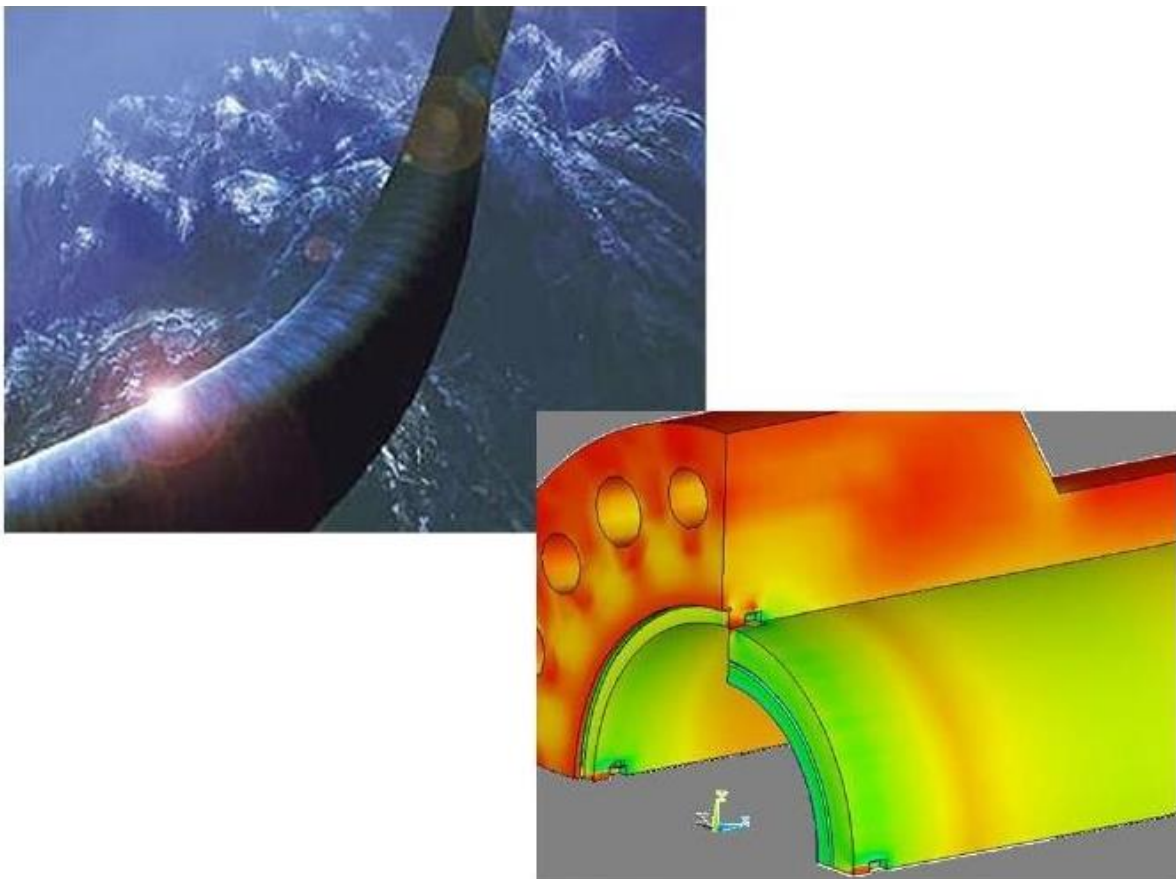
It is our practice to work with client to turn complex situations into positive practical results, by bringing professional insight to support critical business decisions. We work in all phases of project development from appraise, select, define to execute and operate.



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.

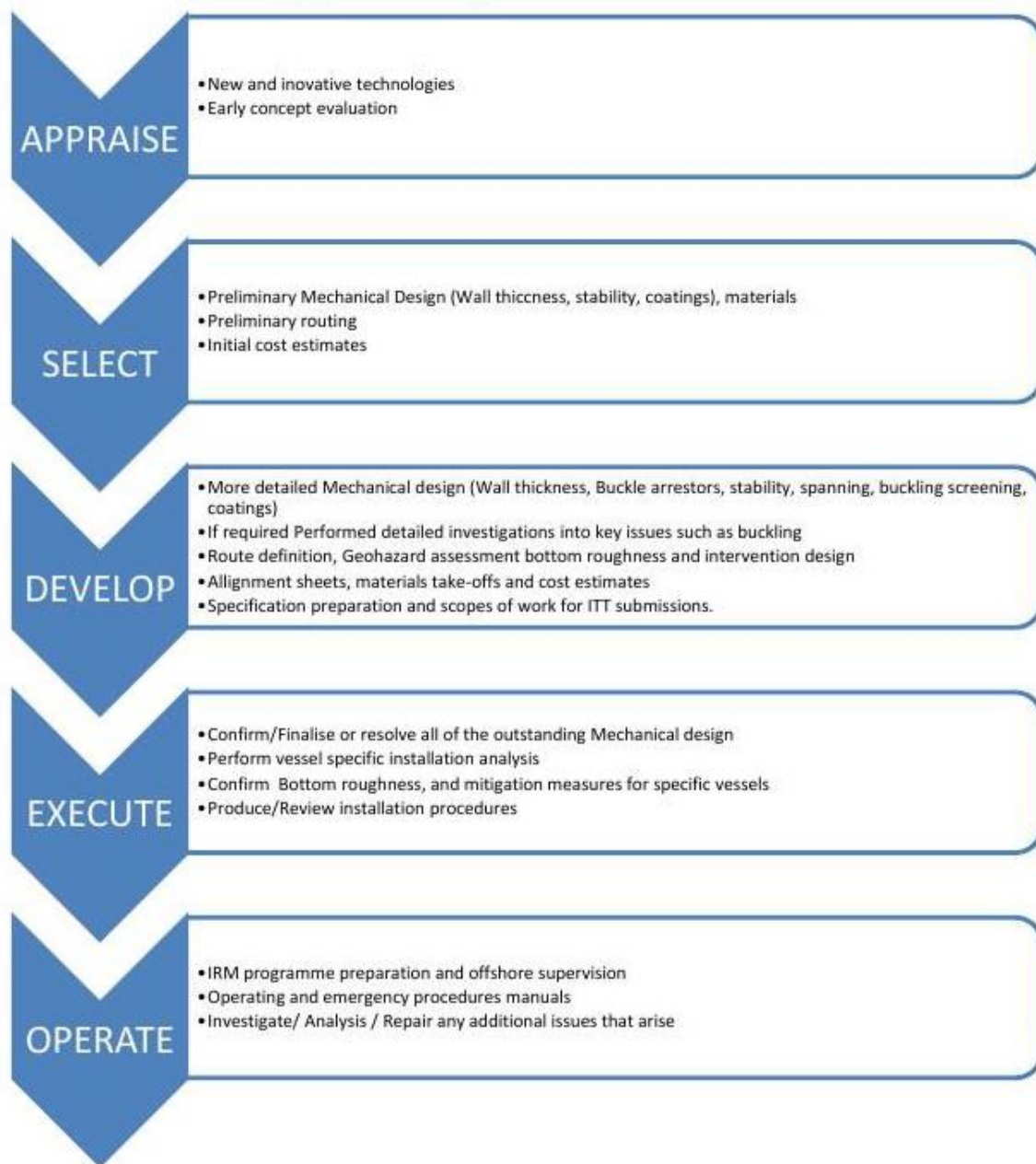
This document provides details of our capabilities in **Subsea Pipelines** design



2.0 Subsea Pipelines Capabilities

For many field developments and challenging export and transportation system projects, the pipelines play a vital link and can have a large impact on the feasibility and practicality of the project. FEDDO GROUP has in-depth knowledge and extensive experience in dealing with the most complex pipeline design, installation, operation and decommissioning problems.

Typically, the pipeline work undertaken by FEDDO GROUP covers all design engineering phases and can be described broadly by the following activities:



Within a typical pipeline design the following elements are normally required, the level of work required depends on both the stage of the project whether concept selection through to detailed design or the environment and type of product:

- Pipeline sizing, wall thickness and steel grade
- Pipeline route selection
- Stability analysis, weight coat and /or trenching
- Bottom roughness assessment including spanning analysis
- Pipeline installation assessment
- Material Selection and Specifications
- Landfall design
- Tie-in design (risers and subsea facilities)

In addition and/or based on the findings above some aspects of pipeline design can require a more detailed investigation such as:

- Buckling assessment
- Geohazard analysis
- Risk study considering other external influences and definition of remedial measures

FEDDO GROUP assists Clients in the development of EPIC documentation such as:

- Invitation to Bid (ITB) Documents
- Materials, fabrication and Construction Specifications

3.0 Pipeline Design Experience

Subsea pipelines are a safe and reliable way to transport energy from offshore fields to onshore terminals and further on to end users. As energy consumption increases worldwide, offshore exploration moves towards even deeper reservoir pockets and the need for improving the design of high pressure/high temperature (HPHT) pipelines is evident.

FEDDO GROUP's staff extensive project experience includes practical design and installation knowledge required for cost effective completion and operation of marine pipeline facilities in all environments.

3.1 Skills Required

FEDDO GROUP's personnel have the skill sets required to perform the engineering tasks for subsea Pipelines design and operation across the entire field cycle, summarised as follows:

General understanding of, and ability to engage meaningfully with specialist practitioners in the areas of:

- Technical and feasibility studies
- Survey management and route selection and visualization

- Preliminary and detailed design
- Field development engineering
- HP/HT pipeline engineering
- Arctic pipeline engineering
- Insulated pipe-in-pipe engineering
- Deepwater flowline and pipeline engineering
- Pipeline repair engineering
- Materials and NDT engineering
- Project and construction management
- Owner's engineering
- Asset Integrity Management and operation support
- Flow assurance assessment

Sound detailed working knowledge and experience of the following areas:

- Wall Thickness Sizing
- Materials Selections
- Design Code and Acceptance Criteria
- Cathodic Protection Design
- Freespan Design
- Expansion
- Bottom Roughness
- Routing
- Spool Piece Design
- HP/HT Design
- Pipe-Soil interactions
- Lateral Buckling Design, Mitigation and Operation
- Upheaval Buckling and Mitigation
- Geohazard pipeline interaction
- Flexible pipelines
- Conventional Steel Risers
- Bundle Design
- Landfall Design
- Bulkhead Design
- J-lay Collar Design
- Buckle Arrestor Design
- Slugging Design
- Ice Interaction
- Engineering Criticality Assessment
- Reliability
- Specification Preparation
- Cost Estimation
- Installation Procedures and Manuals Preparation
- Operation and Maintenance Procedures and manuals Preparation
- Emergency Procedures manuals
- Pipeline Decommissioning, Abandonments and Recovery Design
- Installation and construction Hazard identification

3.2 Tools Required

The principal tools required to perform subsea pipelines work are human and intellectual, viz technical understanding, experience, skill, know-how and the ability to analyse and decide between competing approaches.

Certain software tools are available to assist the intellectual effort, being analytical tools, and administrative or management tools.

Examples of the analytical tools used by FEDDO GROUP are as follows:

- OFFPIPE
- ORCAFLEX
- AGA
- AutoPIPE
- DNV tools e.g FATFREE, STABLELINES etc
- ANSYS
- SAGE Profile
- PLUSONE
- AutoCAD
- ABAQUS
- CEASAR II
- BUCKFAST AND SAFEBUCK
- In-house developed MATHCAD Calculation Programs
- In-house Excel programs

4.0 Subsea Pipelines Engineering Services

4.1 Conventional Pipeline Design

Preliminary and/or detailed submarine pipeline design generally includes design basis document, safety schematic, pipeline flow assurance and line sizing, pipeline route selection, geohazard analysis, pipeline route alignment drawings, on-bottom stability analysis and determination of weight coating and/or trenching requirements. FEDDO GROUP also determines wall thickness and steel grade using traditional or limit state design criteria and associated mechanical design. Other services include; pipe spanning analysis and determination of pipe support requirements and design, risk study and definition of remedial measures as well as pipeline installation studies to verify alternative installation options.

4.2 Pipeline Shore Crossing Design

The shore crossing design for a pipeline system is a combination of site selection and design activities required to maintain pipeline stability and integrity while minimizing impact to environmentally sensitive areas and adjacent property or facilities. Key activities include site selection, design basis definition, pipeline stability analyses, operational requirements and construction methods. A thorough and rigorous degree of engineering is often warranted in view of the potential for significant construction cost reduction and operational reliability of the pipeline

system. FEDDO GROUP's staff technical expertise and involvement in a wide range of shore crossing designs provide the basis for implementing a cost-effective design.

4.3 Long Distance and Deepwater Pipeline Design

The design of long distance and deepwater pipelines encompasses most of the fundamentals of conventional pipeline design. However, several additional aspects warrant a thorough and rigorous level of engineering. The design of long distance and deepwater pipelines require particular attention to flow assurance to maintain deliverability and to prevent or mitigate the formation of hydrates, paraffin and/or asphaltenes. Furthermore, the system design effort must consider the capabilities and requirements for all parts of the system throughout the entire service life.

Pipeline routing is a major factor that can directly influence the cost and feasibility of a pipeline project. Design of large-diameter, deep water pipelines requires intimate knowledge of the relevant failure mechanisms, material behaviour, pipe fabrication processes and installation limitations. FEDDO GROUP staff has extensive experience to lead the industry to extend the limits of pipeline design for deep water through extensive full-scale testing programs and close cooperation with the code developers, pipe mills and construction contractors.

4.4 Production Flowline Design

There are several important issues related specifically to (HT/HP) field developments. These include thermal expansion, pipeline/flowline lateral or upheaval buckling, stress/strain localization, corrosion protection systems, flowline and component material selection and flow assurance. As many of these issues are interdependent, a clear understanding of the limitations, interaction and interdependency is required to develop a robust and reliable system design.

FEDDO GROUP's Staff experience and understanding of the issues and solutions provides a cost effective, fit-for purpose design. FEDDO GROUP staff has extensive expertise in the design of flowline systems for HP/HT applications including Pipe-in-Pipe and Bundled Flowlines, Externally Insulated Flowlines and Flexible Pipe Flowlines.

4.5 Pipeline Shore Approaches

FEDDO GROUP staff has extensive experience in the design and construction of pipeline shore approaches. Our design approach extends well beyond the basic mechanical design of the shore approach and includes geotechnical engineering and marine geology aspects as well. As a world leader in pipeline design and construction management, FEDDO GROUP senior staff has had the opportunity to showcase this experience on a number of challenging projects for which shore approach studies, design and/or construction was a part.

4.6 Shore Crossing Construction Methods

Different construction methods are evaluated to define the resultant trench cross sections. Dredging (hydraulic and conventional), directional drilling, drilling and blasting, mechanical trenching, jetting and plowing techniques are considered in conjunction with seabed soils data to determine method suitability. Shore crossing installation methods and equipment, including pipe pull, pipelay, horizontal directional drilling and/or a combination of these methods, may be evaluated. Pipe weight, stiffness, pulling requirements, bathymetry and shore crossing length are considered for each installation method. In addition, selection of the optimum construction methods and, the

availability of the required construction equipment must also be considered. In some cases the preferred method may not be cost effective due to lack of availability and/or high mobilization costs. Vessel draft limitations in the shore approach may also limit the type of trenching/dredging and pipeline construction equipment which can be used.

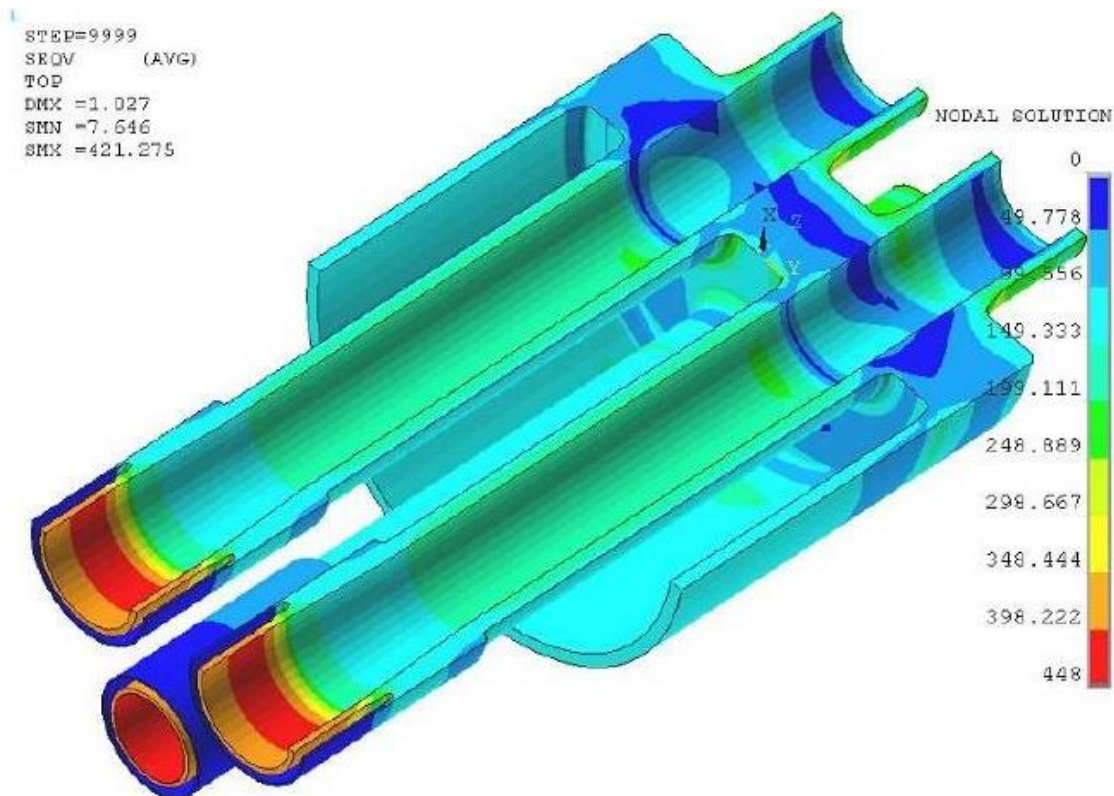
5.0 Subsea Pipelines Design Experience

FEDDO GROUP vision is to perform projects located in remote, hostile and Deepwater environments. To achieve this FEDDO GROUP has developed capabilities and a team of experienced people in a global network who have experience with a broad variety of subsea pipelines design.

Experience has been gained working on projects located in extreme environments such as the Arctic, Caspian Sea, Timor Sea as well as in ultra-Deepwater of the Gulf of Mexico and West Africa Coast.

FEDDO GROUP personnel have experience with application of the principal industry codes relevant to design and operation of subsea pipelines such as:

- Relevant DNV Codes and standards
- Relevant ISO/PD standards
- API 1111
- ASME B31:4 and B31.8
- Relevant Australian Standards etc



For Further information:

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