WHITECASTLE ENGINEERING LIMITED

www.whitecastle-eng.com

Whitecastle Engineering Ltd

Independent Specialist Engineering Consultancy

Business Overview

Project Lifecycle Capabilities

Whitecastle at a glance

WHITECASTLE ENGINEERING LIMITED

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- Independent Engineering Consultancy
- Highly experienced and specialist consultants
- Working in the Oil&Gas, Petrochemical, Power and Insurance industries
- With decades of experience from working for major turbomachinery OEMs in the Oil&Gas and Power industries
- *We've been there, done that. And will do it again.*

Industries and Expertise

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INSURANCE

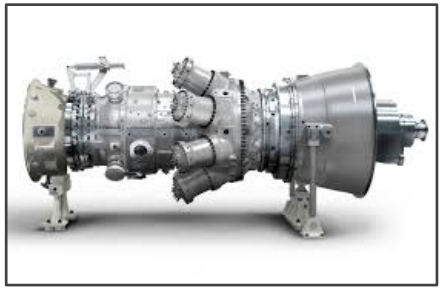
POWER

OIL&GAS

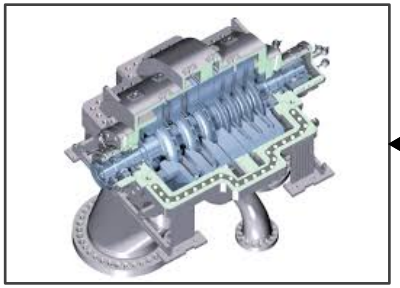
PETROCHEMICAL

STEAM TURBINES

GAS TURBINES



COMPRESSORS



DIESEL

PUMPS

Services and Solutions

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WEL offers a wide range of services and solutions based on 40+ years of expertise and experience

Equipment

- Steam turbines
- Gas Turbines
- Gas Compressors
- Expanders
- Diesel engines
- Pumps

... including auxiliary equipment.

Engineering services

- Oil&Gas production systems
- Power Generation systems
- Troubleshooting and Debottlenecking
- Aerodynamic design
- Rotodynamics and Vibration
- Spare Stocking, Storage and Maintenance
- Energy efficiency and emissions
- Loss Adjusting evaluation
- Root Cause Analysis
- Forensic Engineering
- Mechanical and fluid analysis
- RAM analysis

... based on various technologies.

Project life cycle solutions

- Conceptual design engineering
- Technical specification and Tendering management
- Technical bid management
- Project management
- Front End Engineering Design (FEED) technical audit
- Detailed engineering technical audit
- Factory and Site Acceptance Testing (FAT and SAT)
- Service Agreement management
- Expert witness
- Owner's engineer
- Technical Authority

...for different type of facilities.

Value proposition – 5 Forces

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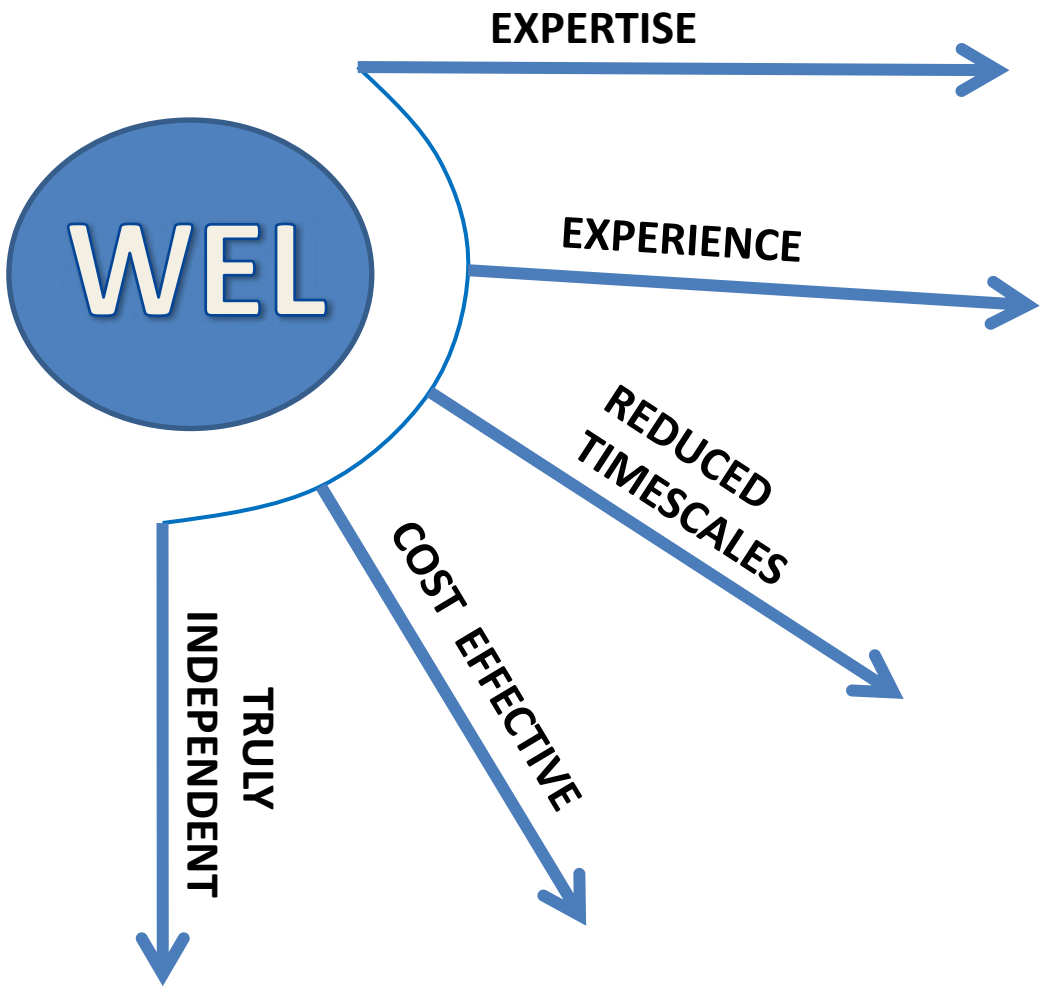

WEL Project Lifecycle Capabilities

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WEL has the capabilities to deliver engineering solutions over the THREE main project phases

Appraise Select	Field Development Technology assessment Pre-FEED	Concept development Integrated Asset Modelling Preliminary/budget cost estimation Feasibility study RAM study Selection
Define	FEED Detailed cost estimating Execution planning	Technical and functional specifications Bidding evaluation Detailed cost estimation Contracting management Execution planning
Execute	Detailed Engineering Commissioning Delivery	Procurement Attributes & assurance Risk assessment (HAZOP) Inspection of deliveries Test witness (FAT and SAT) Commissioning/ Start-up

WEL Recent Projects & Results

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No.	Brief project description	Location	Client company	Contract Period Dates
1	**Air Compressor System reliability and root cause analysis study.** Collect data, analyse root cause, evaluate reliability, identify bad actors, evaluate maintainability and obsolescence issues. Assess current maintenance strategy.	Scotland	ExxonMobil	4 months 2018
2	**Gas turbine air filtering system upgrade feasibility study,** Analysis of current system performance, design, operational and maintenance conditions, GAP analysis on filtration system against latest technology, vendor liaison, benefit quantification analysis, selection recommendation.	Scotland	ExxonMobil	3 months 2018
3	**Technical specification support for a compressor-expander module at on-shore gas processing facility,** **Scope**: Conducted a technical audit of the original technical specification document as issued by process engineering house. **Results**: Improved technical specification of the machinery: seals, bearings, testing, etc. **Follow-up**: Whitecastle to be involved in the Bid Evaluation phase of the project	DUBAI	DPC	3 months 2016
4	**Root Cause Analysis of Emergency Fire Pump failure during start-up.** When planned testing as required for as an emergency critical machine the pump driver would fail to achieve full speed and trip on engine overload. Gathered performance data to evaluate power tracking of pump vs engine demand on run-up. Analysed changes to installation since commissioning. Provided system modification recommendations.	Offshore North Sea	BP	4 months 2015
5	**Oil production improvement and reliability recovery.** Consisted of data gathering for performance modelling to identify process bottlenecks. Investigation of maintenance routines process and practice along with warehouse stocks levels and obsolescence.	Oman	Production Developments Oman	6 months 2016
6	**Gas compressor reliability and root cause analysis study.** High incidents of premature wear plus high vibration trips. Investigated compressor to turbine alignment changes due to external influence (heat from the flare). Resulted in a regular maintenance routine of work plus definition of maintenance spares and consumable kits.	Offshore North Sea	BP UK Exploration	4 months 1985
7	**Refrigeration compressor integrity assessment and root cause analysis.** Investigation of vibration induced plant trips. Investigation instigated following a short run period after the OEM overhauled the compressor.	Qatar	QVC	6 weeks 2015
8	**Wellhead gas lift compressor and driver breakdown low availability study, as part of a Total responsibility Healthcare Maintenance Contract.** Major refurbishment of failed engines and compressors as well as plant vessels valves, control systems and electrical distribution on 12 Gas Lift oil field wellhead stations in the Niger delta region.. Following refurbishment a structured planned maintenance and spares regime was introduced. Improvement followed the analysis of the group failure of machine type, each had bespoke resulting maintenance and operating regimes. . Availability improved to 99%. Total healthcare contract value US$ 24 million	Nigeria	Shell Production Development Company	3 years 1988-2001

PLUSPETROL – CAMISEA COMPRESSION SYSTEM DEVELOPMENT

PlusPetrol – Camisea Compression

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- **Description:** Gas compression system development for existing facility producing gas from 3 clusters of Block 88, Peru, South America.
- **Main achievements:** Reduced project CAPEX in aprox. US$ 700m by concept optimisation,

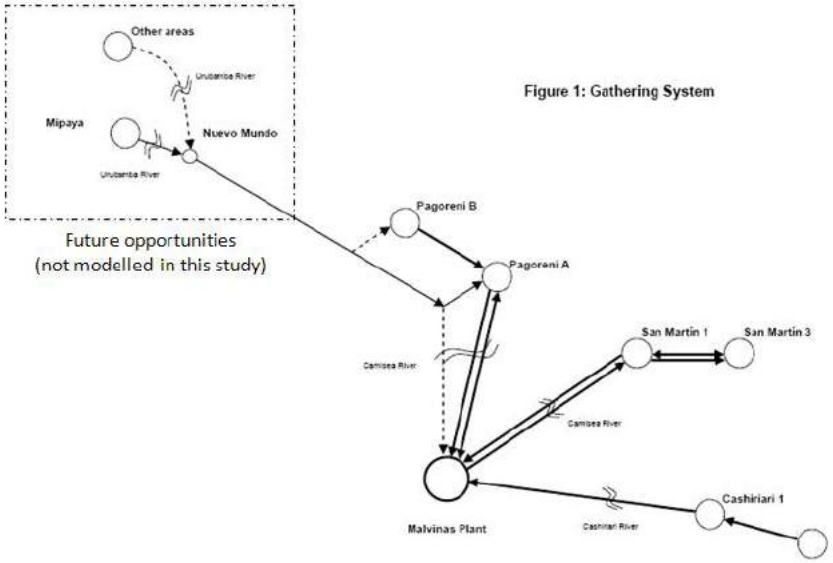

Figure 1: Gathering System

PlusPetrol – Camisea Compression

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PlusPetrol – Camisea Compression

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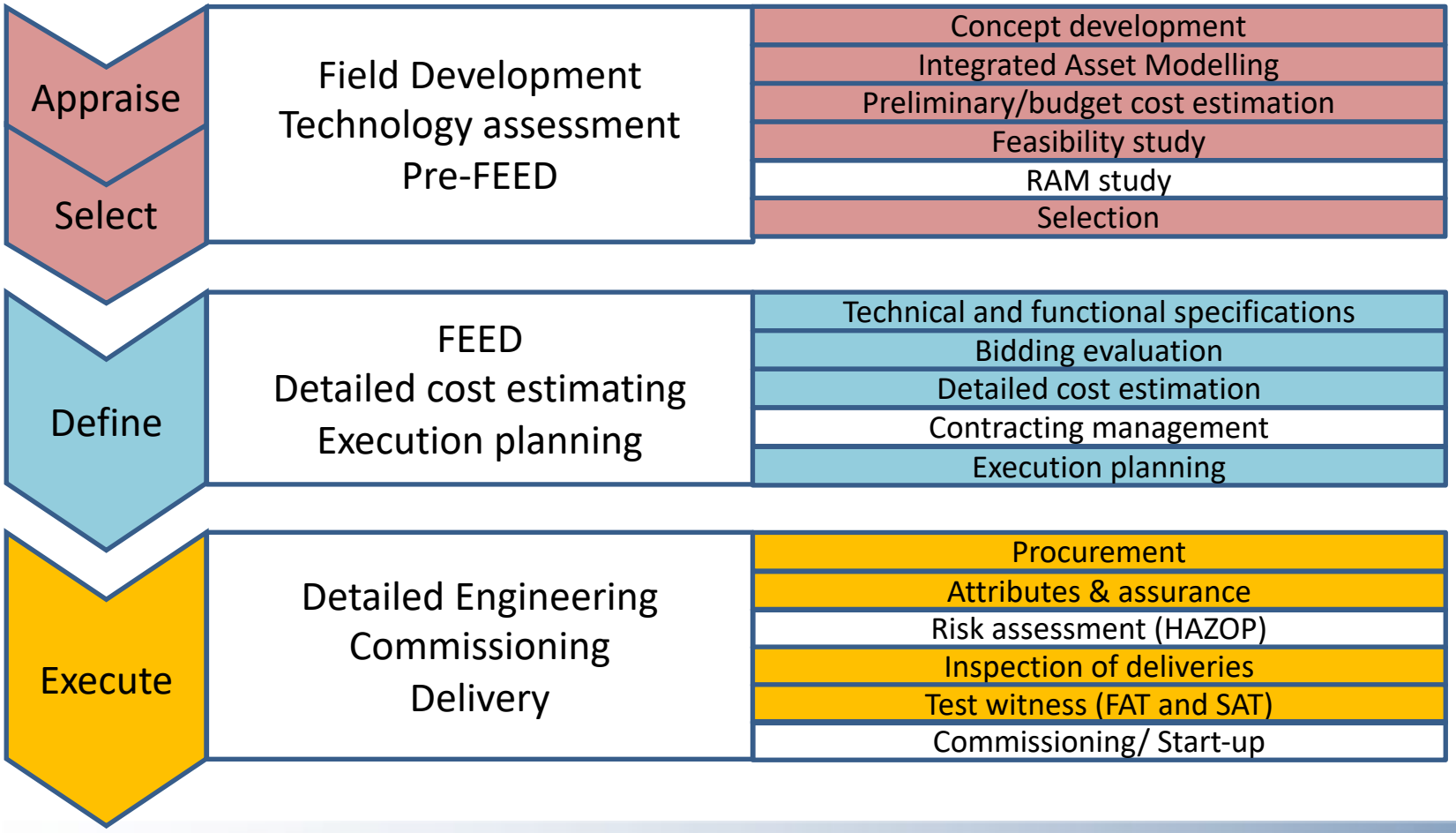
- **Scope:**



PlusPetrol – Camisea Compression

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- **Duration:**

15 Weeks - Appraise + Select
12 Weeks - Define
18 months - Execute

- **Contract type:**

Appraise + Select + Part of Define = Lump sum
Part of Define + Execute = Reimbursable

- **Organisation**:

Project Director
Project Manager/ Technical Authority
Principal rotating engineer
Concept study manager
Mechanical engineer
Process engineer
Electrical engineer consultant
Process and multiphase pipeline consultant

RWE/DEA – BREAGH COMPRESSION SYSTEM DEVELOPMENT

RWE/DEA – Breagh A compression

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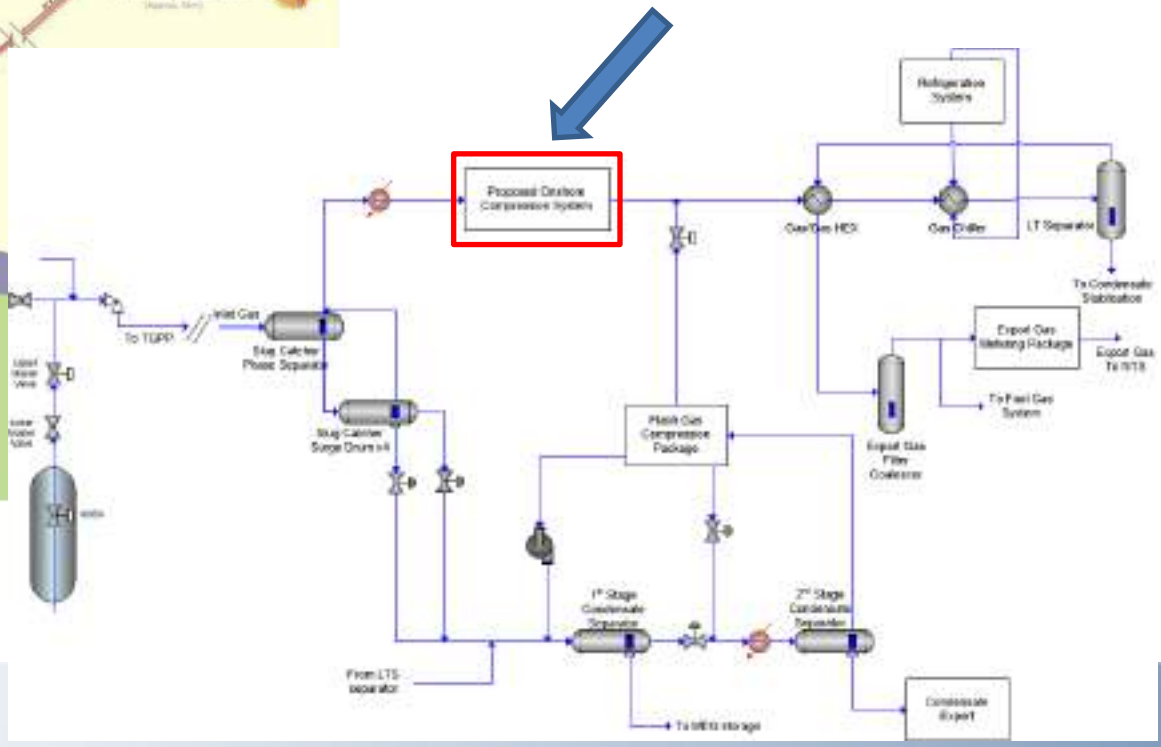
- **Description:** Compression system for Breagh field development
- **Main achievements:** Reduced project CAPEX in £30m by optimised driver selection and design conditions.



RWE/DEA – Breagh compression

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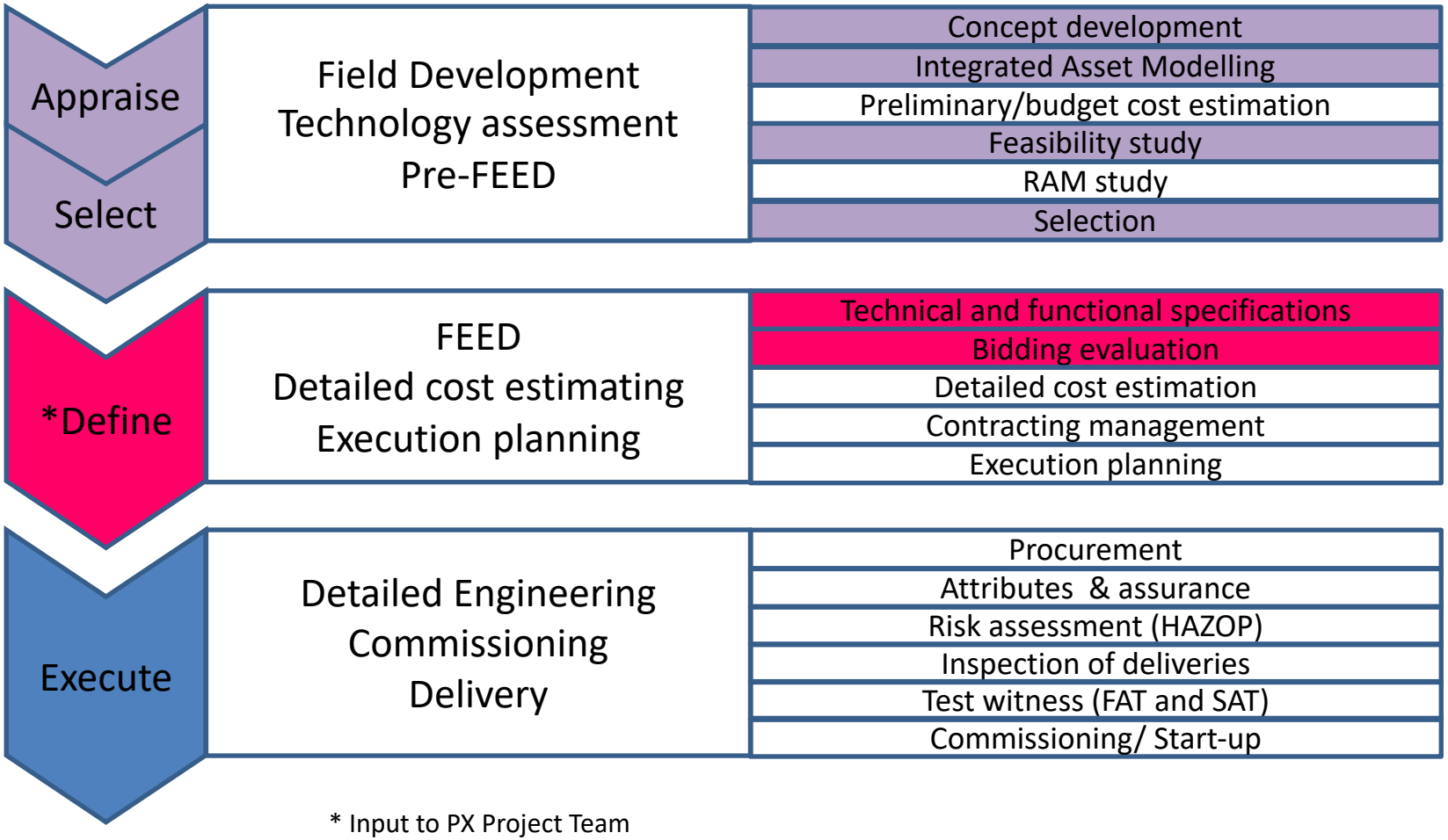
- **Scope:**



* Input to PX Project Team

RWE/DEA - Compression

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- **Duration (Timing):**

16 Weeks (12 Months) – Appraise + Select
12 Weeks – Define

- **Indicative Cost:**

Appraise + Select + Define = Reimbursable

- **Organisation**:

Project Director
Study Manager/ Technical Authority
Principal rotating engineer
Mechanical engineer
Process engineer
Subsurface and pipeline consultant

TAQA – CLADHAN ON TERN COMPRESSION SYSTEM REDESIGN

TAQA – Cladhan on Tern

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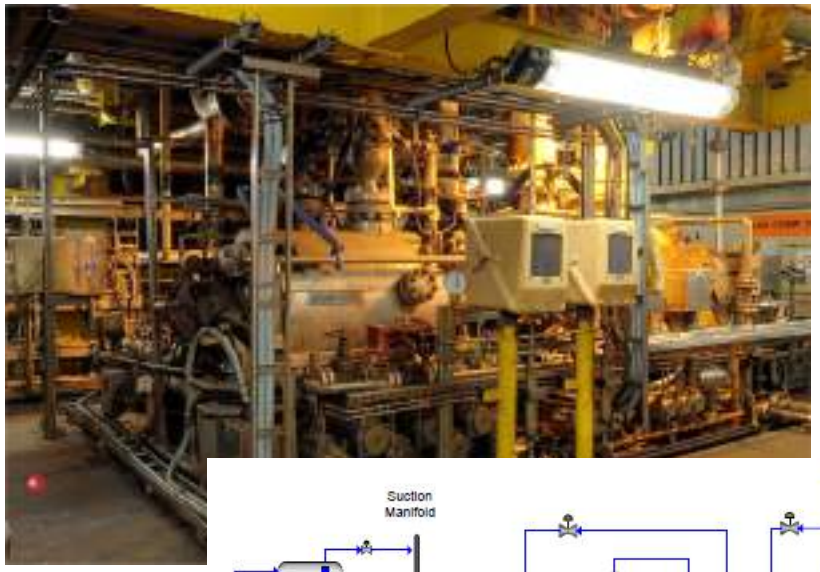
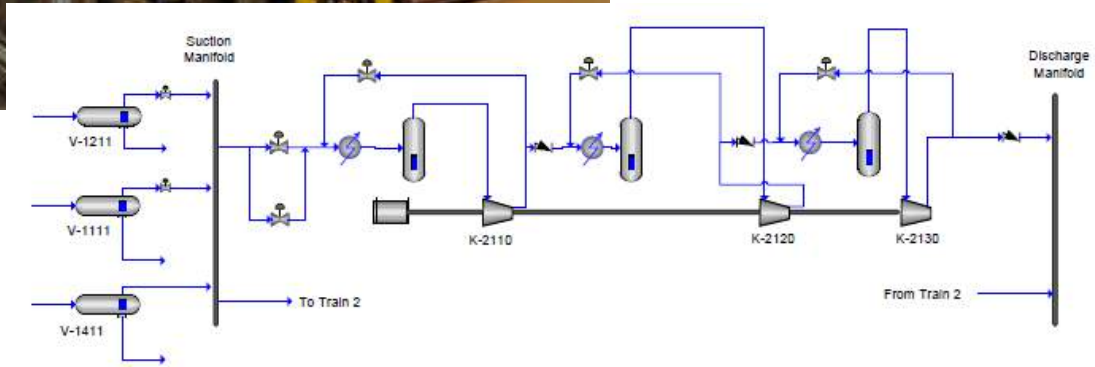
- **Description:** Compression system re-design for satellite field development, United Kingdom.
- **Main achievements**: Reduction in construction costs through optimised design and planning, improved technical assurance of design.





TAQA – Cladhan on Tern

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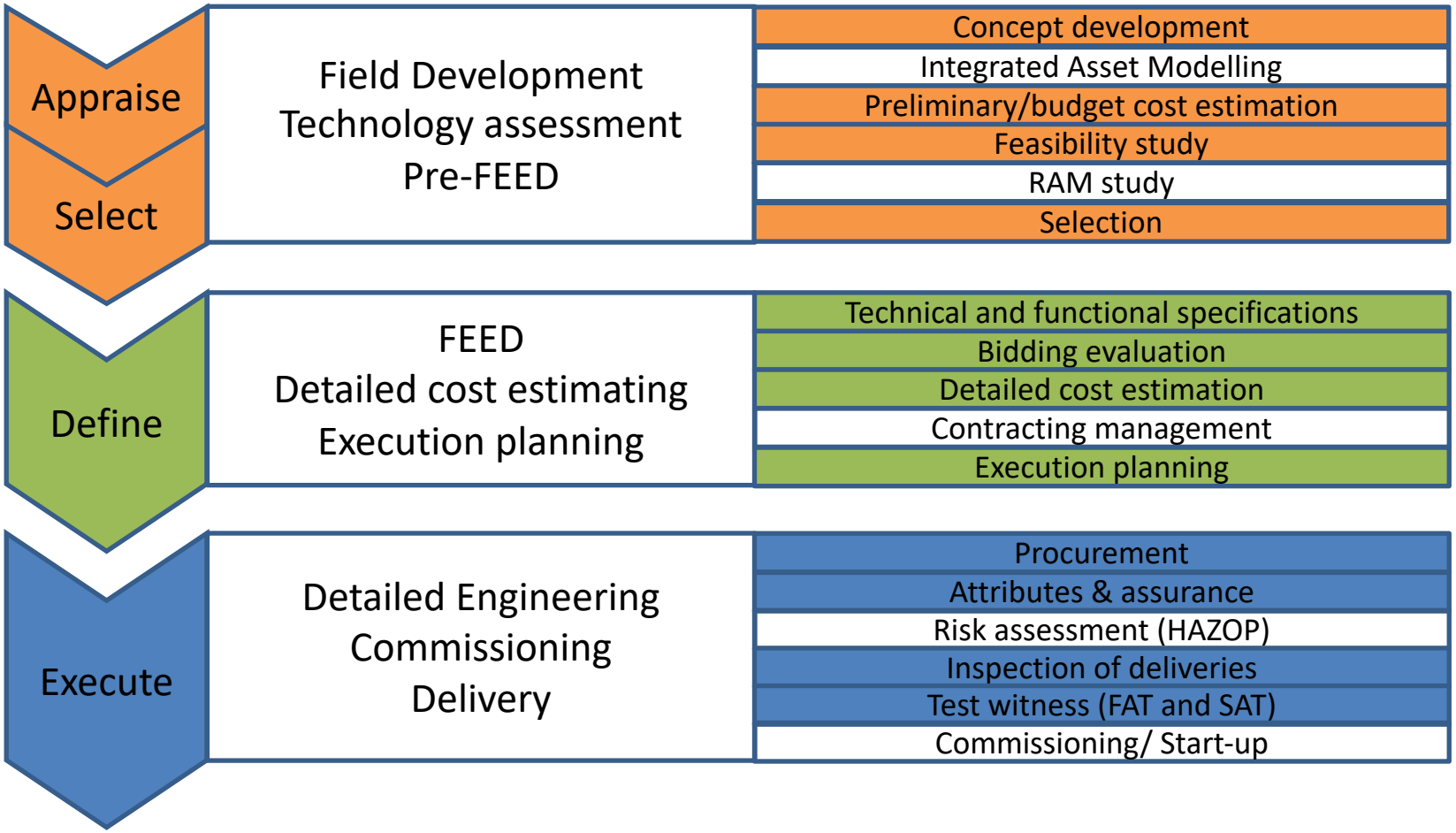
- **Scope:**



TAQA – Cladhan on Tern

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- **Duration:**

14 Weeks (Appraise + Select)
12 Weeks (Define)
24 months (Execute)

- **Indicative Cost:**

Appraise + Select + Part of Define = Lump sum
Part of Define + Execute = Reimbursable

- **Organisation**:

Project Director
Study Manager/ Technical Authority
Principal rotating engineer
Mechanical engineer
Process engineer