Upstream Oil and Gas
The Role of Facilities Engineers

Presentation Outline

- Introduction
- Simple Business Flow / simplified schematics
- Why treating – Oil, Gas and Water
- What do engineers do ?
- Oil & Gas Processing Facilities - Flowstations, Gas Plants, Terminals, SPMs, etc
  - Simplified schematics to explain processing required and typical installed facilities
- Typical Costs and Schedules
- Regulations and Standards
- Safety

Me

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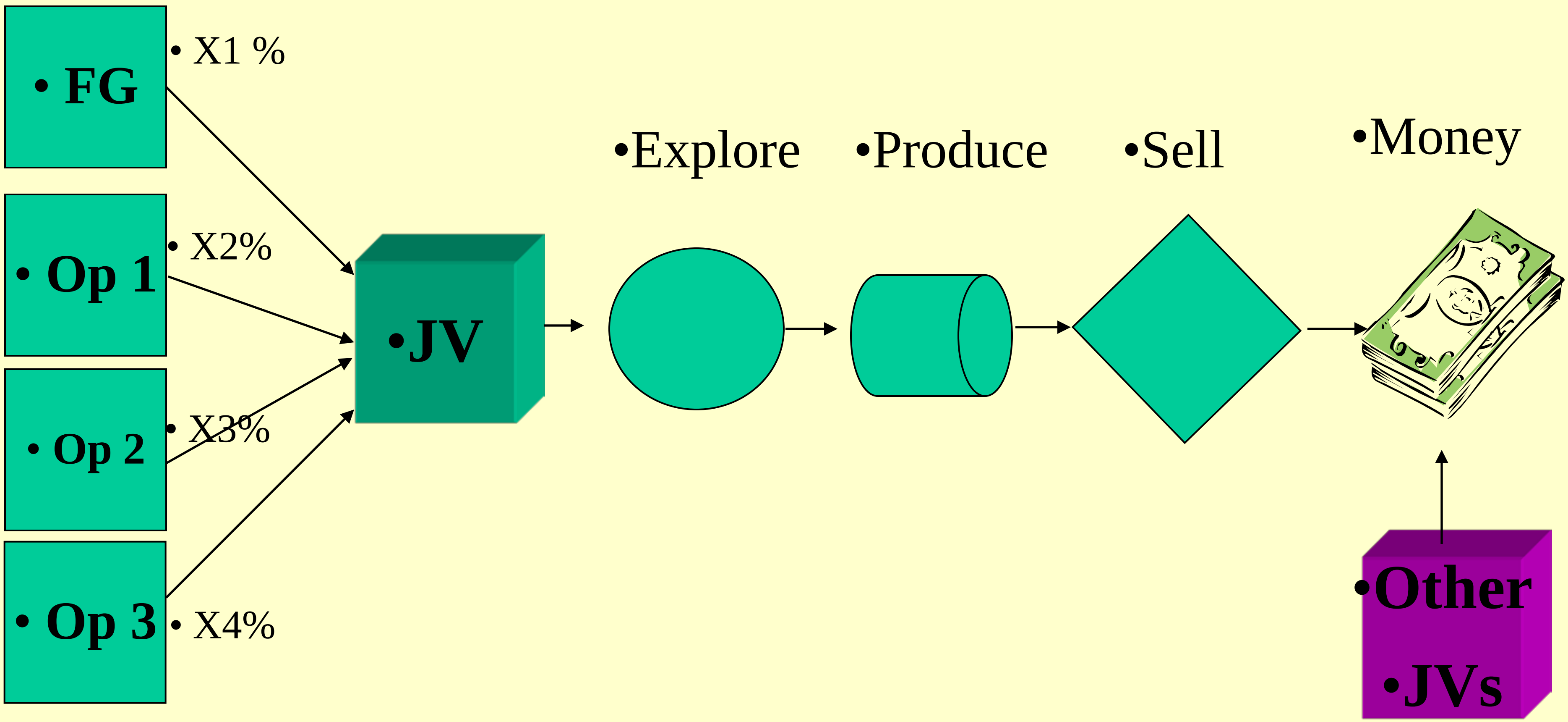
  - **B.Sc. (Hons) Chemical Engineering, Unilag, 1982.**
  - **Worked in Upstream Oil & Gas, etc 1984 – 2014.**
  - **Fellow, NSChE.**
  - **MNSE.**
  - **Married with Children.**

Industry Structure

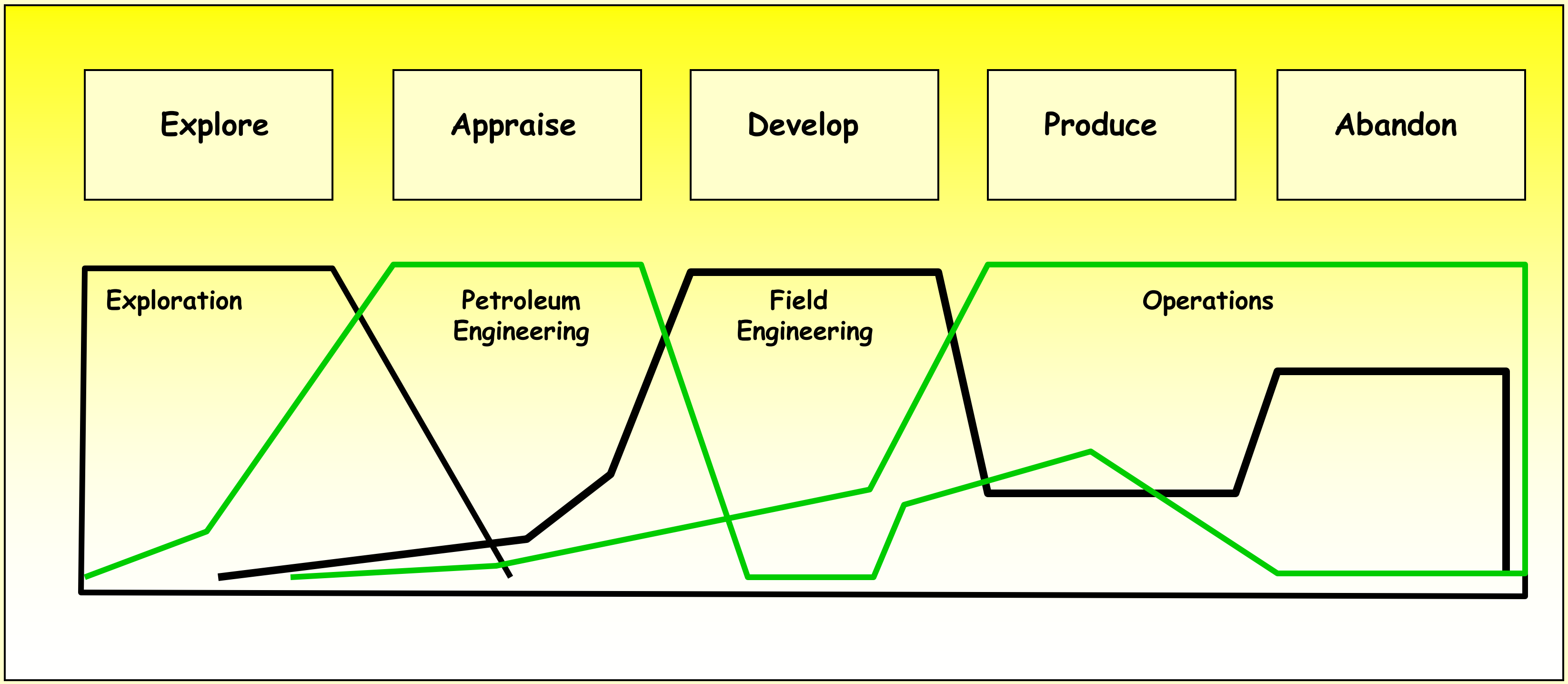
- **Upstream**
  - **Exploration, Develop oil & gas, oil & gas production, etc**
- **Midstream**
  - **Refining, Petrochemicals, Gas & Power, LNG**
- **Downstream**
  - **Distribution, Marketing, Retailing, Storage**

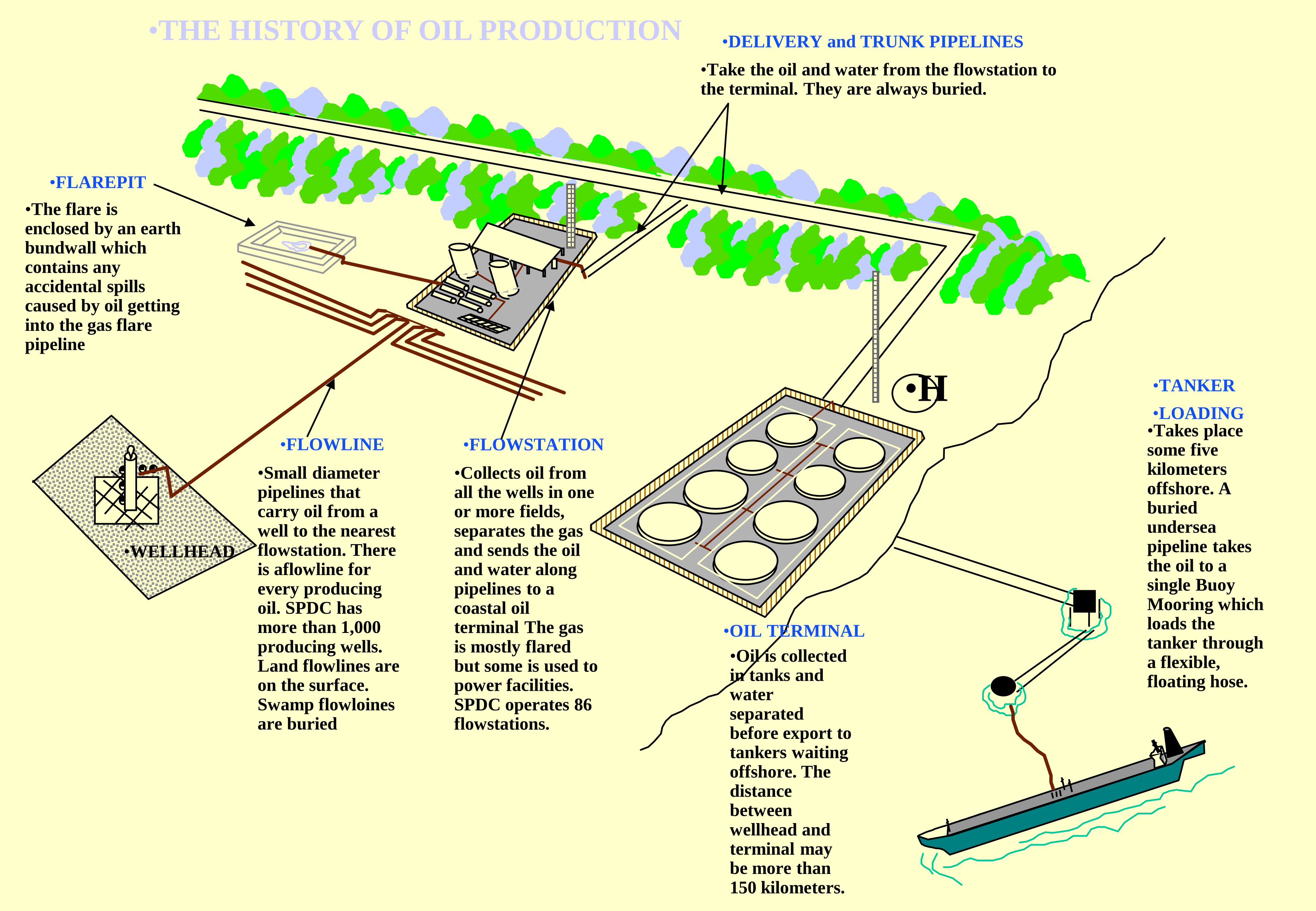
Upstream Simple Business Flow



- Other models exist, e.g. PSC

PETROLEUM RESOURCE LIFE CYCLE
RELATIVE ACTIVITY




•THE HISTORY OF OIL PRODUCTION
•DELIVERY and TRUNK PIPELINES
•Take the oil and water from the flowstation to the terminal. They are always buried.
•FLAREPIT
•The flare is enclosed by an earth bundwall which contains any accidental spills caused by oil getting into the gas flare pipeline
•H
•WELLHEAD
•FLOWLINE
•Small diameter pipelines that carry oil from a well to the nearest flowstation. There is aflowline for every producing oil. SPDC has more than 1,000 producing wells. Land flowlines are on the surface. Swamp flowloines are buried
•FLOWSTATION
•Collects oil from all the wells in one or more fields, separates the gas and sends the oil and water along pipelines to a coastal oil terminal The gas is mostly flared but some is used to power facilities. SPDC operates 86 flowstations.
•OIL TERMINAL
•Oil is collected in tanks and water separated before export to tankers waiting offshore. The distance between wellhead and terminal may be more than 150 kilometers.
•TANKER
•LOADING
•Takes place some five kilometers offshore. A buried undersea pipeline takes the oil to a single Buoy Mooring which loads the tanker through a flexible, floating hose.

We need to treat oil, gas and water to meet required specifications before they are used or disposed off.

Why Process the Wellstream ?

- **Oil and Gas need separate transport**
- **Oil and Gas have different Customers**
- **Different Customers have different specifications**
- **Handling requirements:**
  - » **HSE**
  - » **Transport and Logistical**

Oil Specification

- **For Transport :**
  - Allowed gas content (Vapour Pressure)
    - » **Different for Pipeline, Terminal, Tanker**
  - Allowed water content

- **For Customer :**
  - Allowed water content
  - Allowed ‘Blend’ / API grade
  - Allowed ‘Contaminants’

Gas Specification

- **For Transport in pipeline :**
  - Pressure
  - Temperature
  - Hydrocarbon Dewpoint
  - Water Dewpoint

- **Customer :**
  - All above +
  - Compositional Specification
  - Energy content (Heating Value)
  - Quantities at specific times (Swing factor)

Typical Gas Specification

Customer's Gas Specification							
H2O Dewpoint Spec			15 Degrees C at pressures from 45 to 60 Barg				
HC Dewpoint			15 Degrees C at pressures from 45 to 60 Barg				
Delivery Pressure			45 - 60	barg			
Delivery Temperature			20 - 50	Deg C			
Gross Heating Value			37.6 MJ/sm3 (1010 BTU/scf)				
Composition			Min %	Max %			
	C1		86	97			
	C2		1	4			
	C3		0.5	2			
	C4		0.1	1.5			
	C5		0.1	0.6			
	C6+		0.2	1			
	Total Inert			4			
	CO2			2			
	H2S			6 ppm			
	Total Sulphur			9 ppm			
	Particles			10 Micron			

So to meet the specs, we need to do the following:

- **Customer requirements:**
  - Delivery P and T.
  - Composition.
  - Energy content.
  - When and Where.
- **Handling requirements:**
  - HSE.
  - Transport & Logistical.
  - Legislation.

- **Thus we must:**
  - Dehydrate.
  - Compress.
  - Sweeten.
  - Remove CO_2.
  - Recover liquids.
  - Store.
  - Fractionate.
  - etc....

•ROLE OF FACILITIES ENGINEER

• Facilities Engineers' role is to plan, design, construct and maintain the **surface facilities** required directly or indirectly for hydrocarbon prospecting, production and evacuation. It covers both Oil & Gas and Non Oil and Gas facilities eg

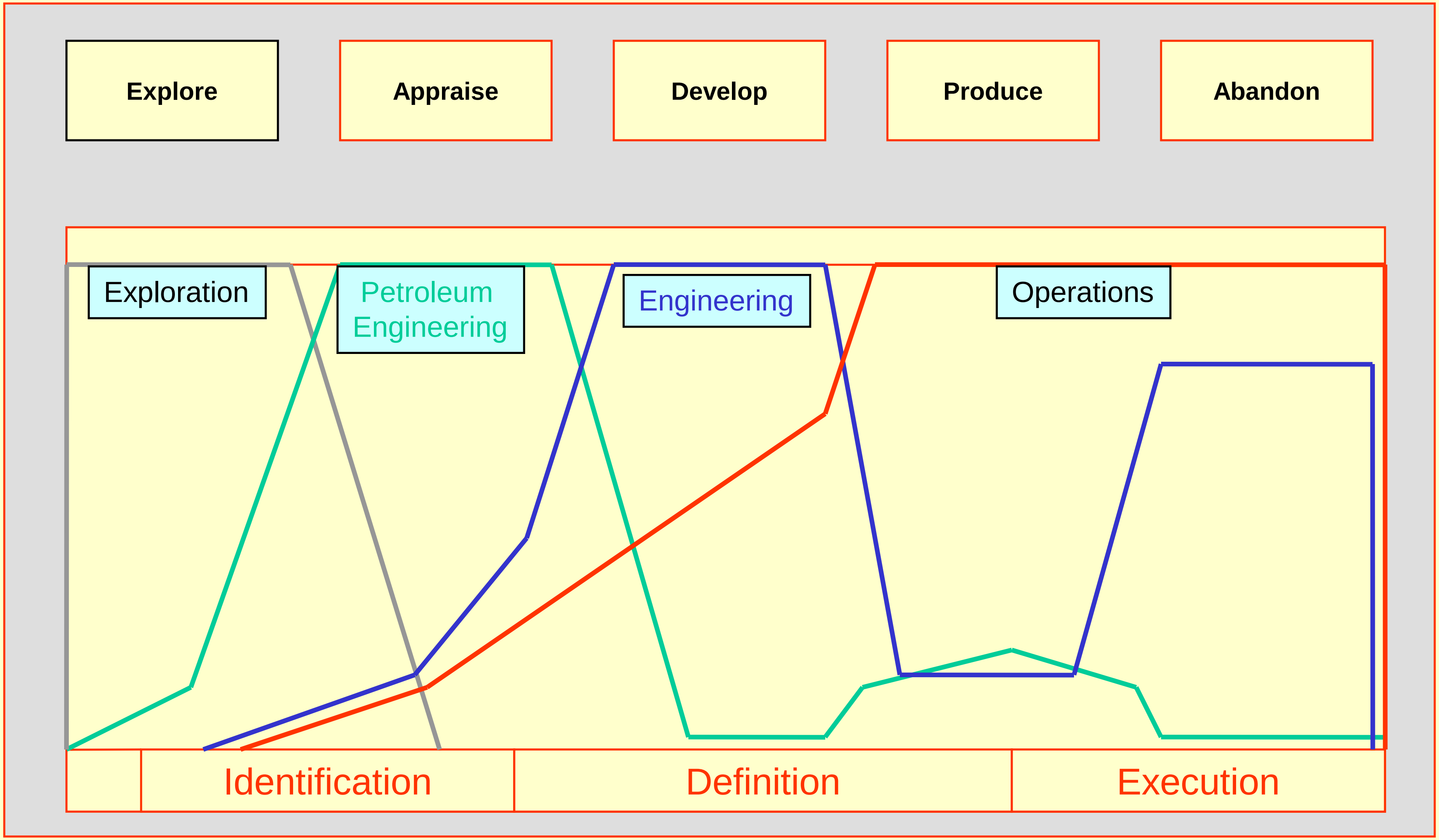
•Oil and Gas Infrastructures:

- ✓ Flowstations
- ✓ Gasplants
- ✓ Flowlines /pipelines with manifolds.
- ✓Terminals, including tanks, CLPs, SPMs, etc

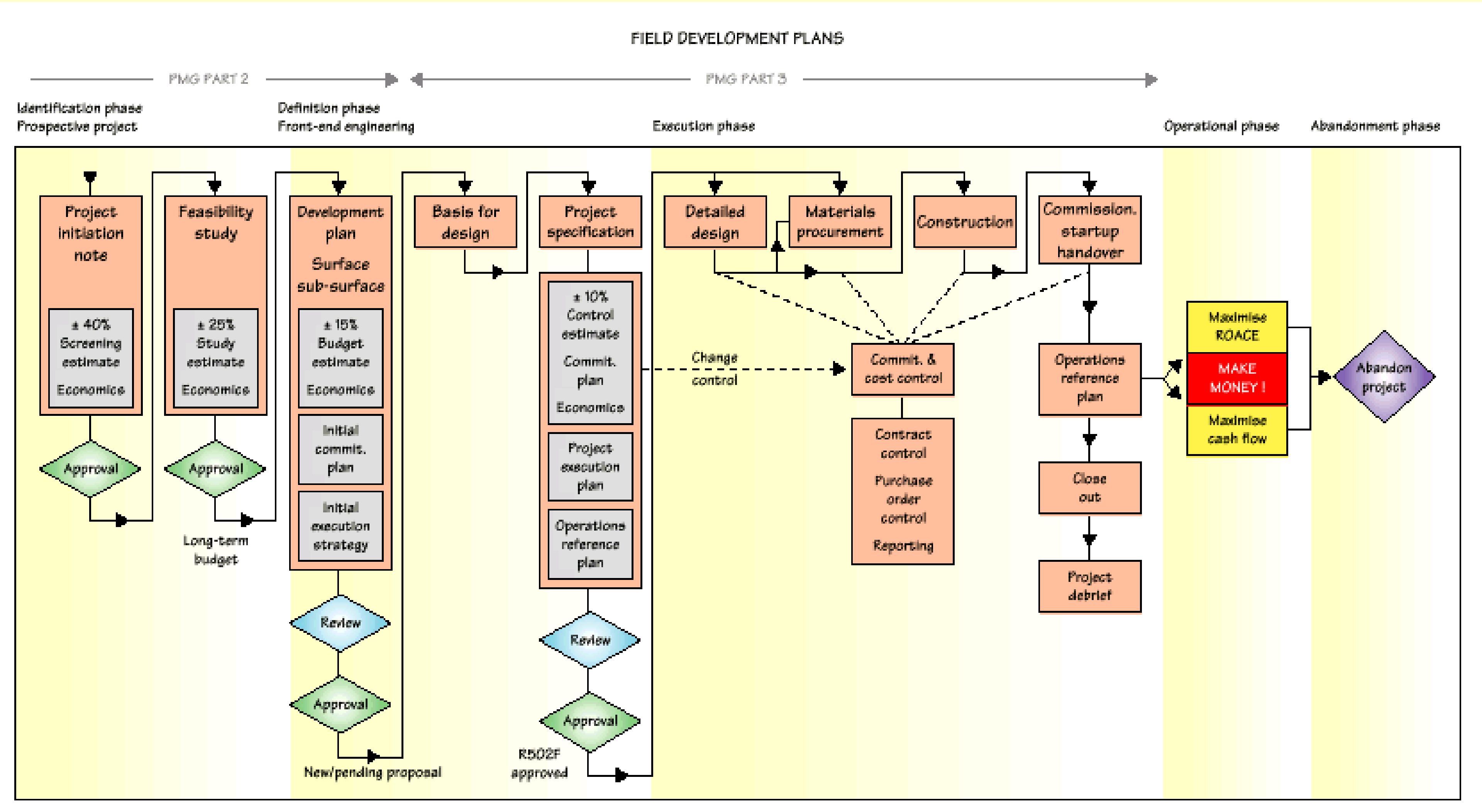
✓Non oil & Gas infrastructures:

•Roads and hardstands, Drilling Locations for land rigs, Dredging slots for swamp rigs, Jetties and quaywalls, Helipads and runways, Office and residential buildings, etc.

PROJECT ACTIVITY LIFECYCLE



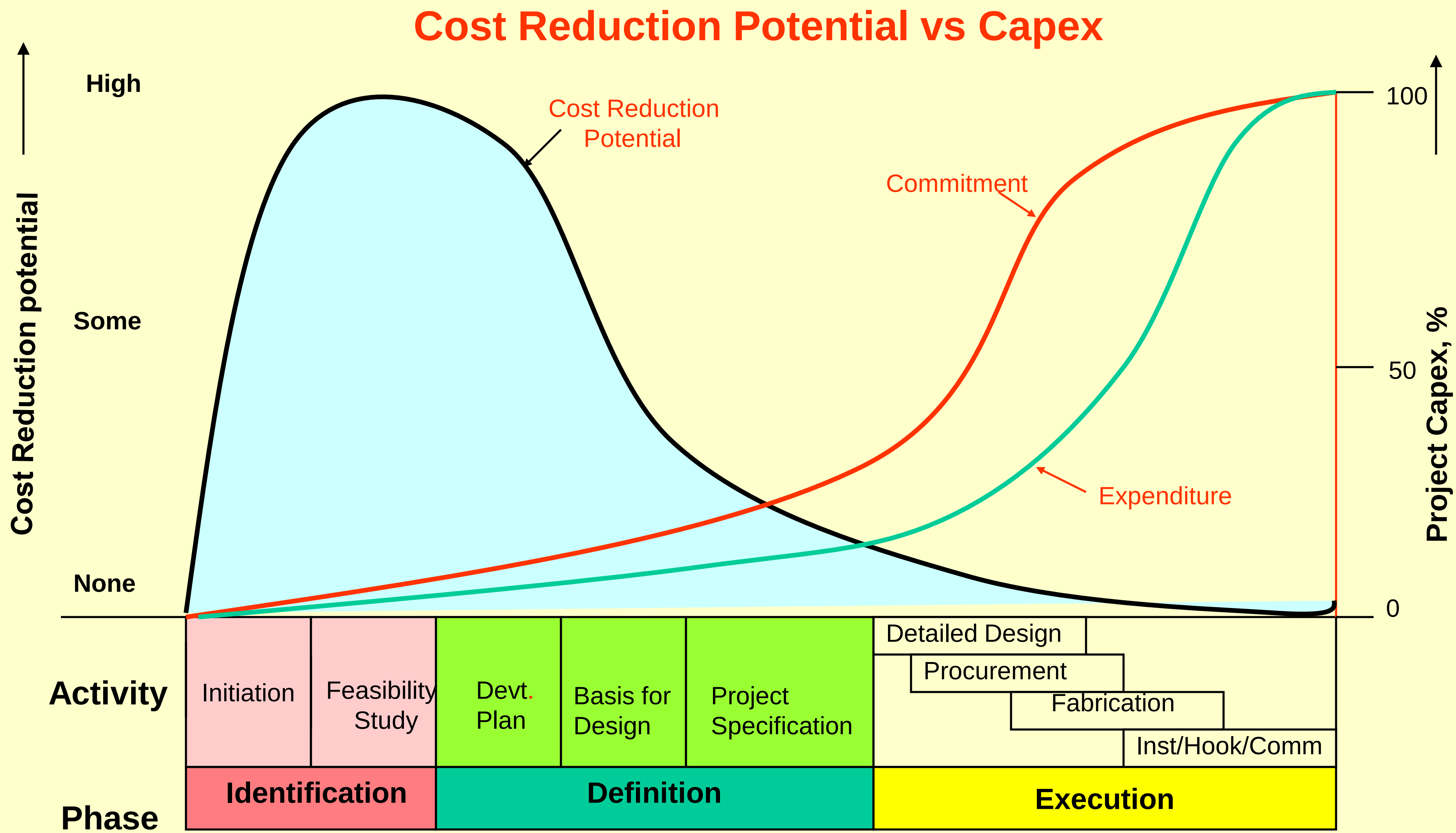
PROJECT DEVELOPMENT PHASES



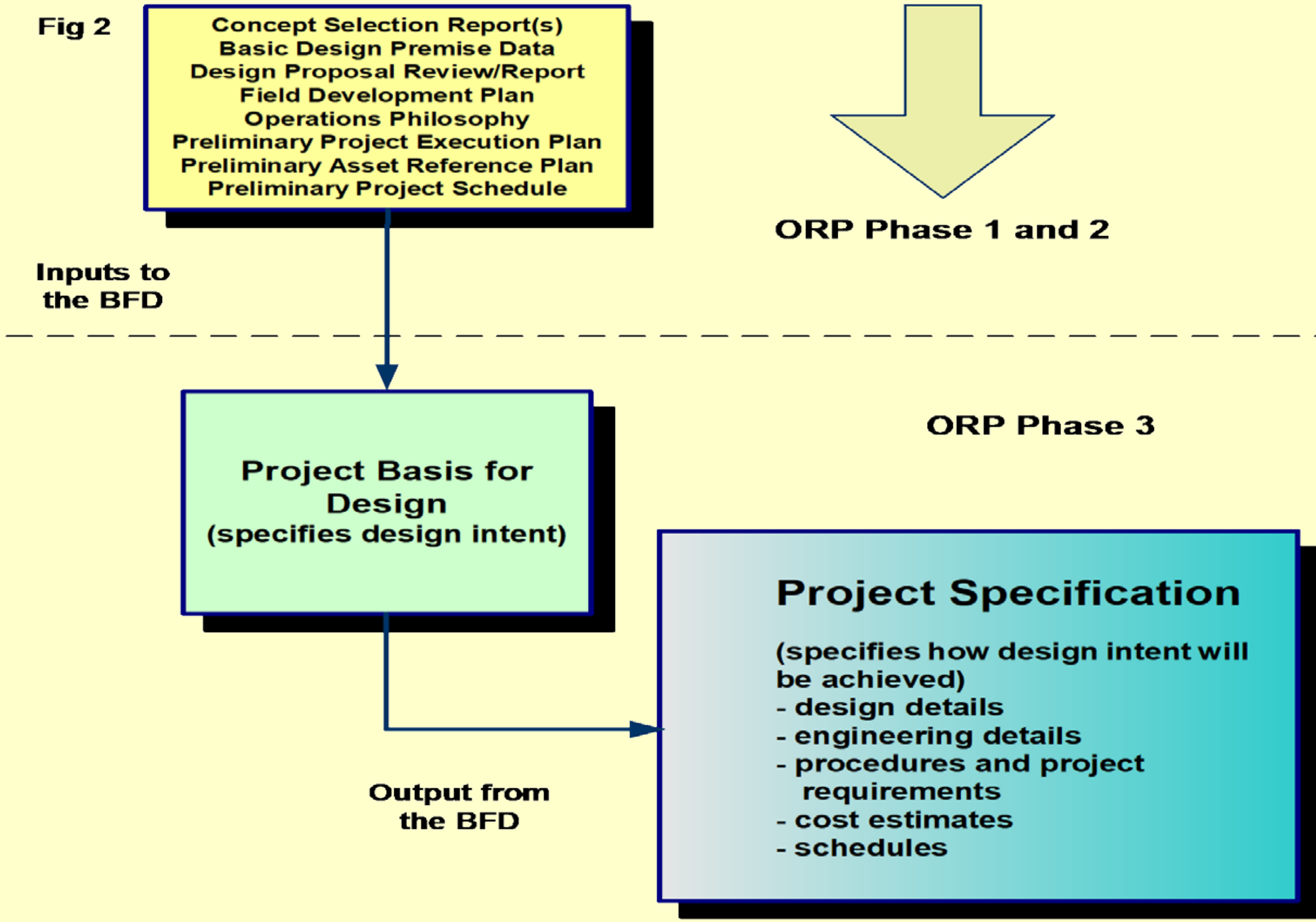
•ROLE OF FACILITIES ENGINEER

FE roles span the entire phases

PROJECT PHASES

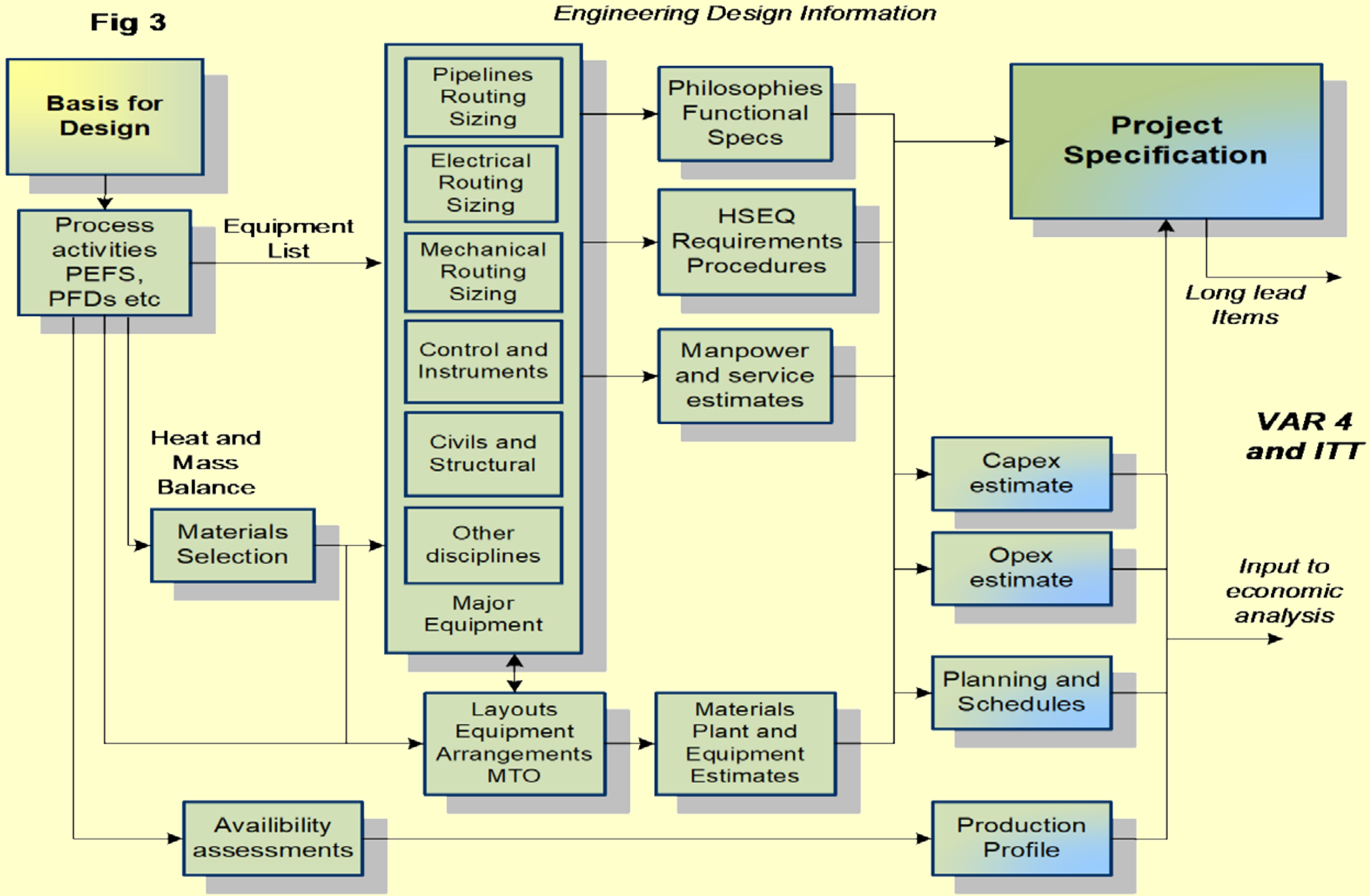


Concept Selection, Basis for Design & Project Specifications



Project Specification in relation to the Basis for Design

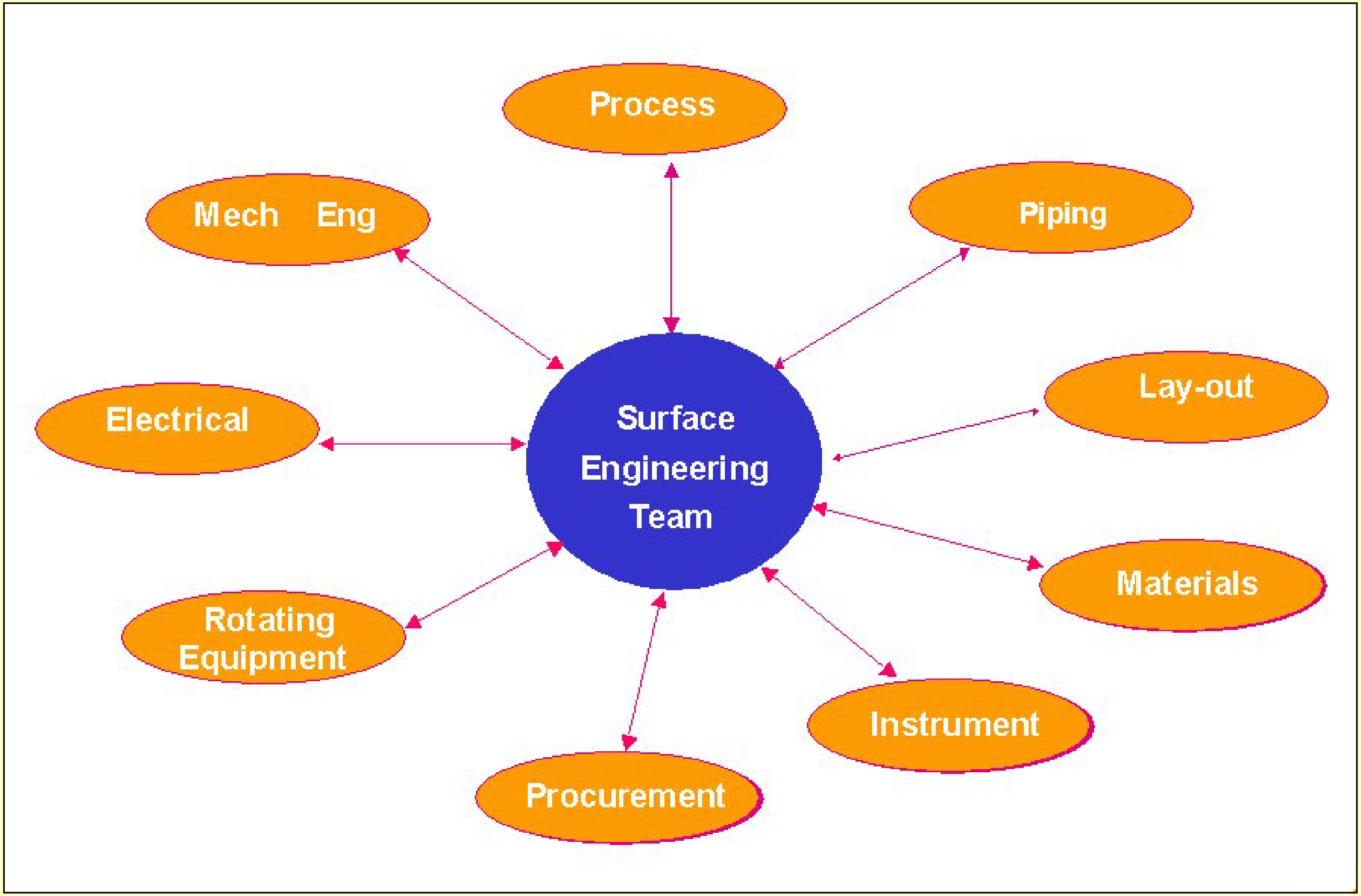
Fig 3



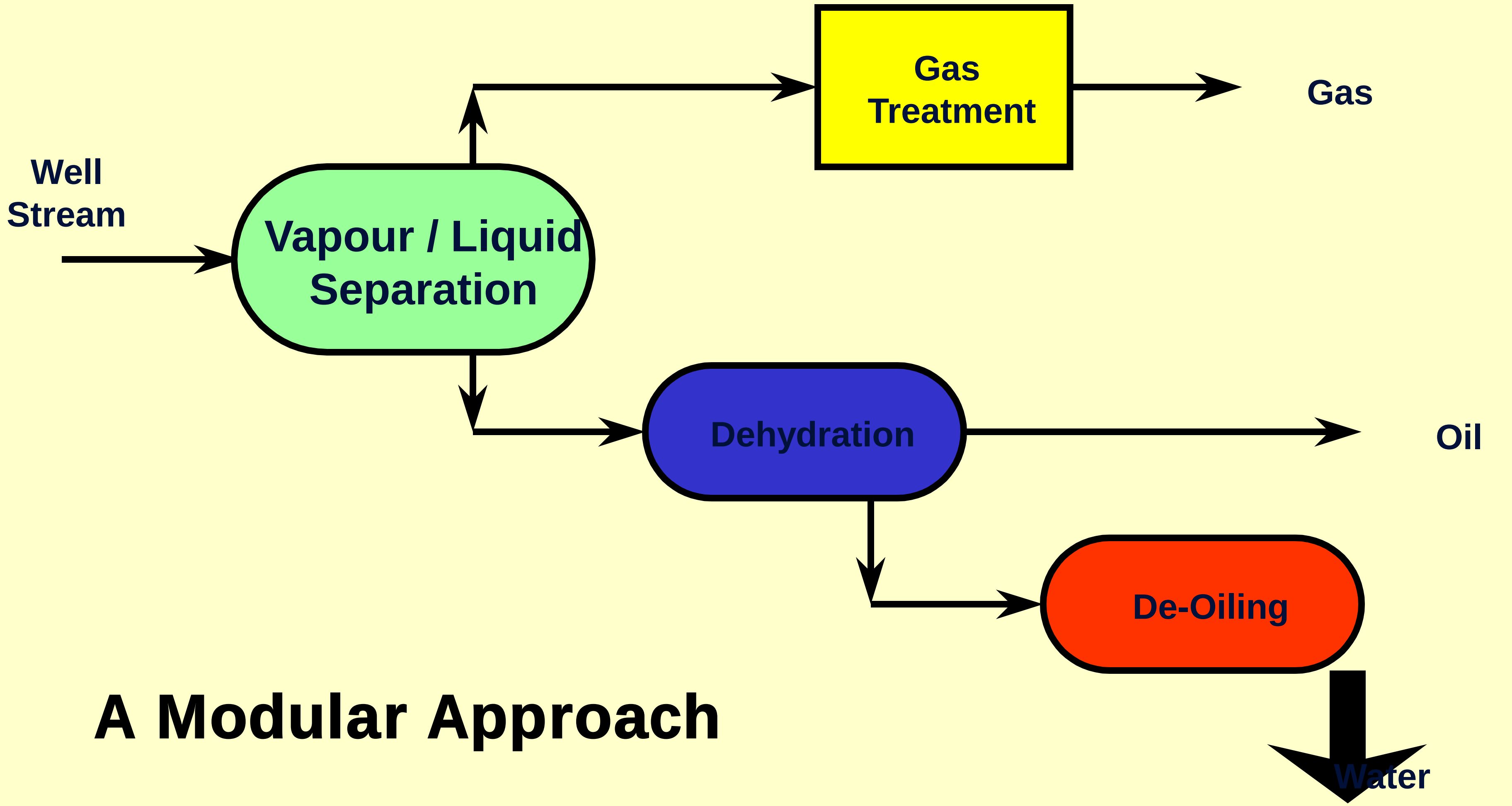
Development of the Project Specification

Typical Construction Sites

A Team work, various disciplines

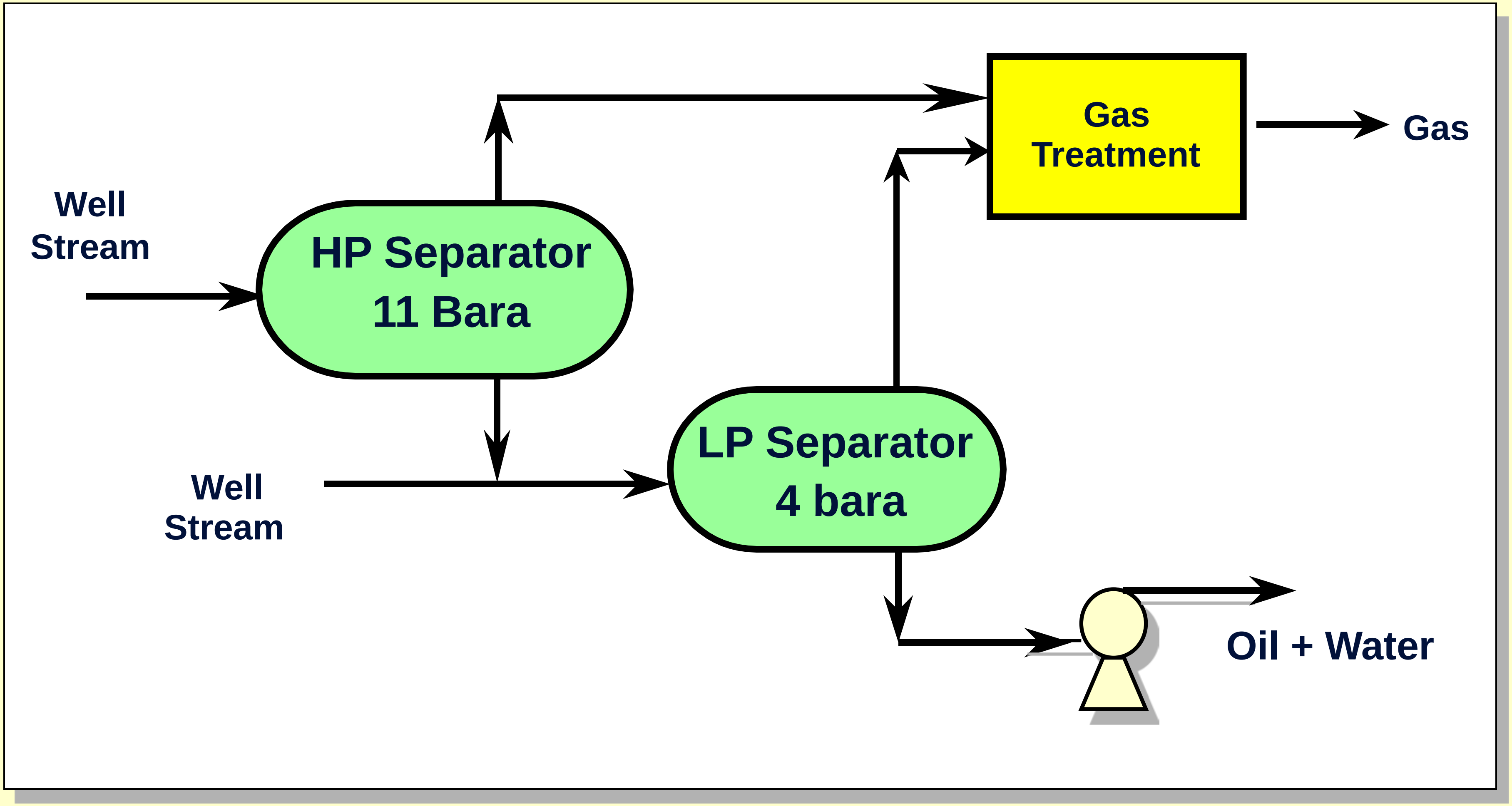


Process Flow Schemes

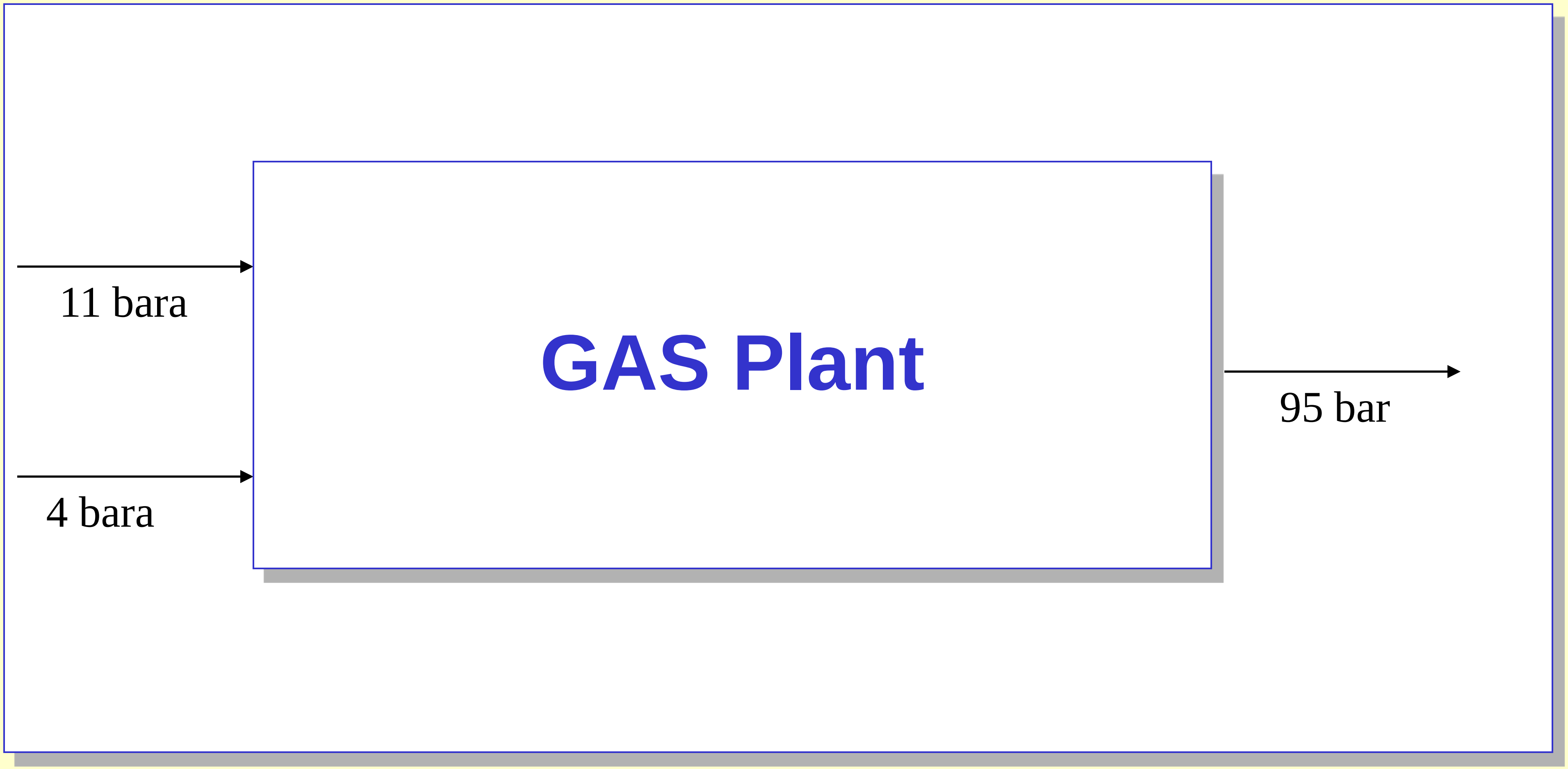


A Modular Approach

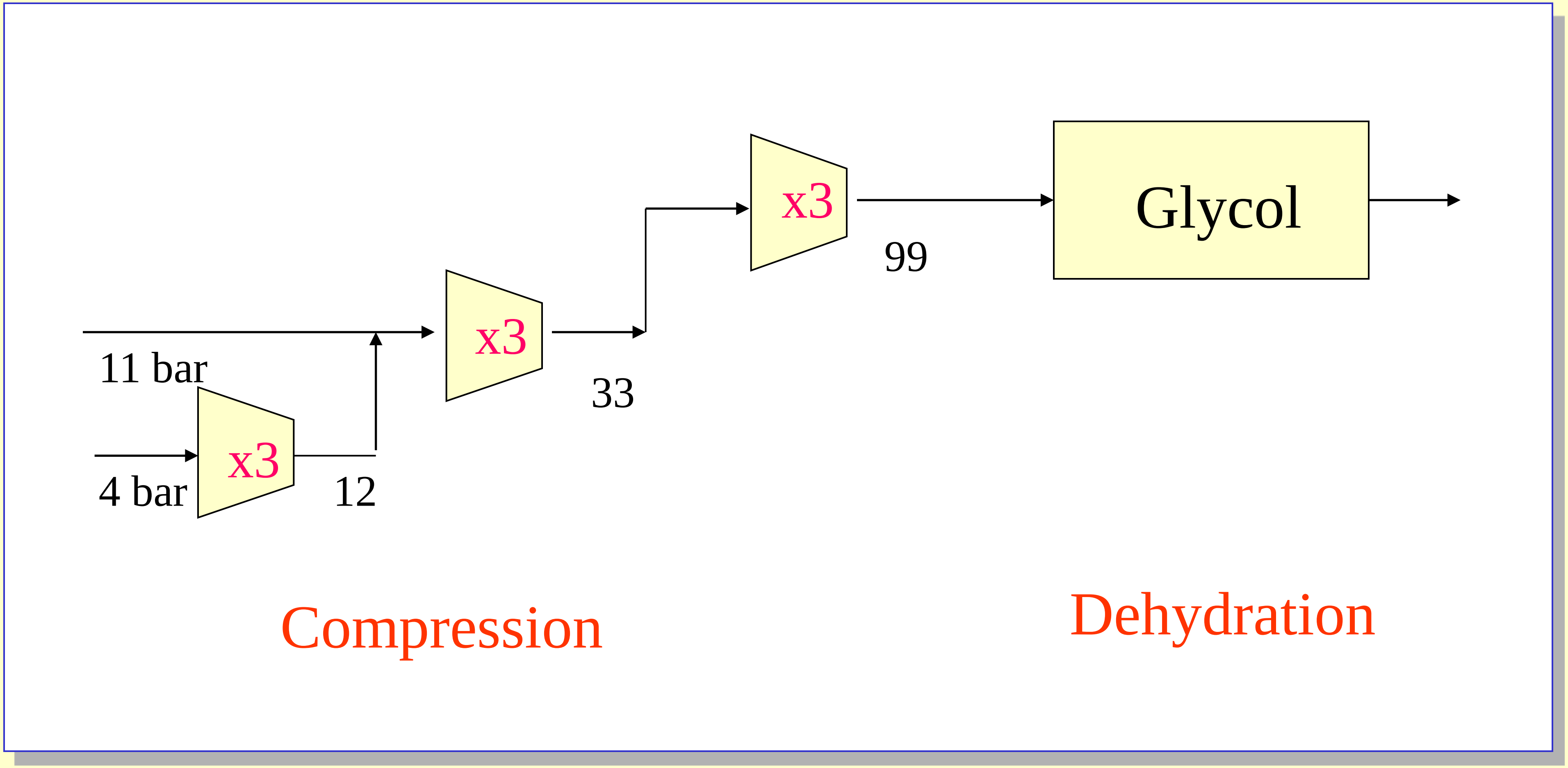
Typical Standard Flowstation



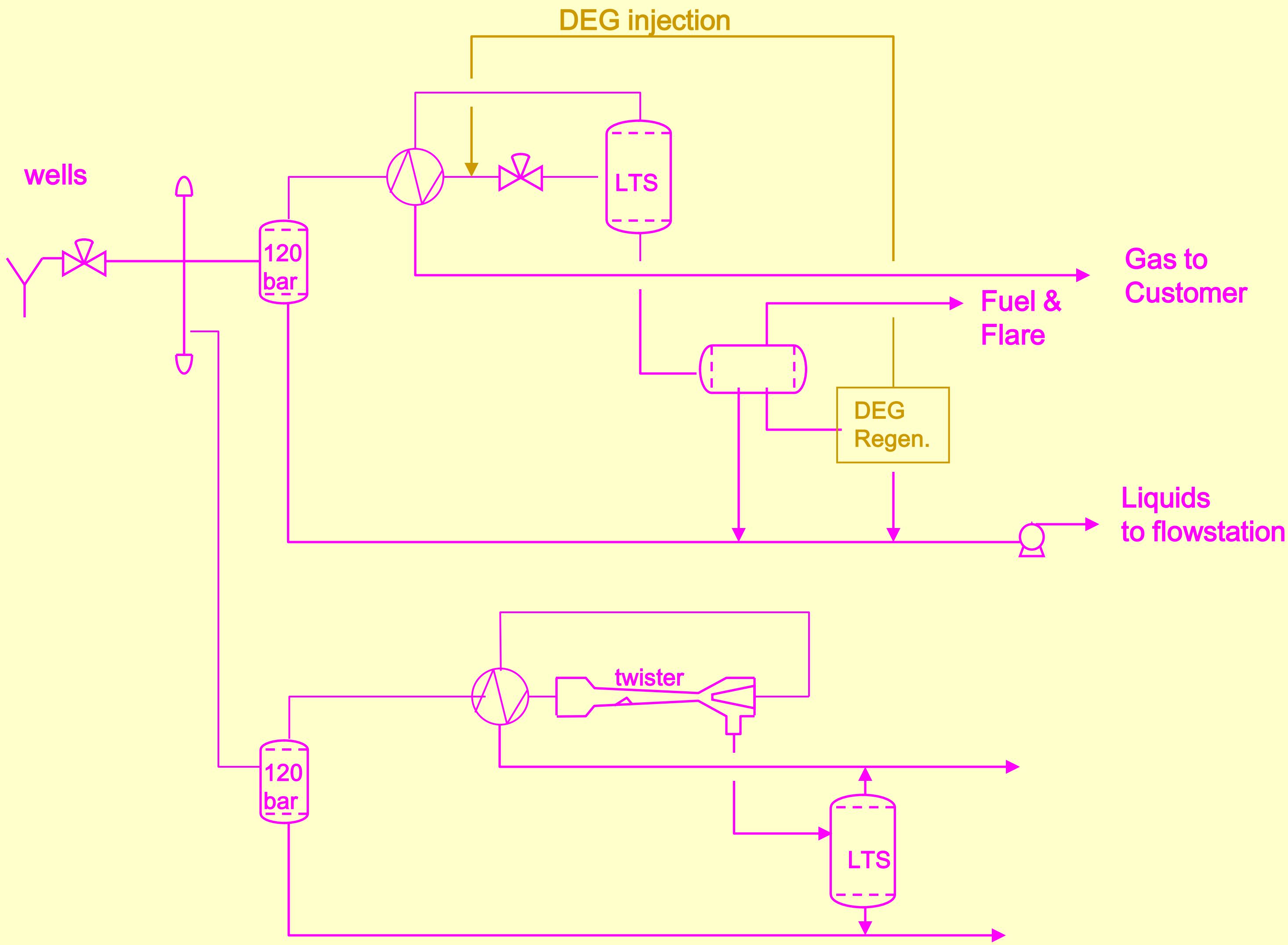
Associated Gas Plant Design



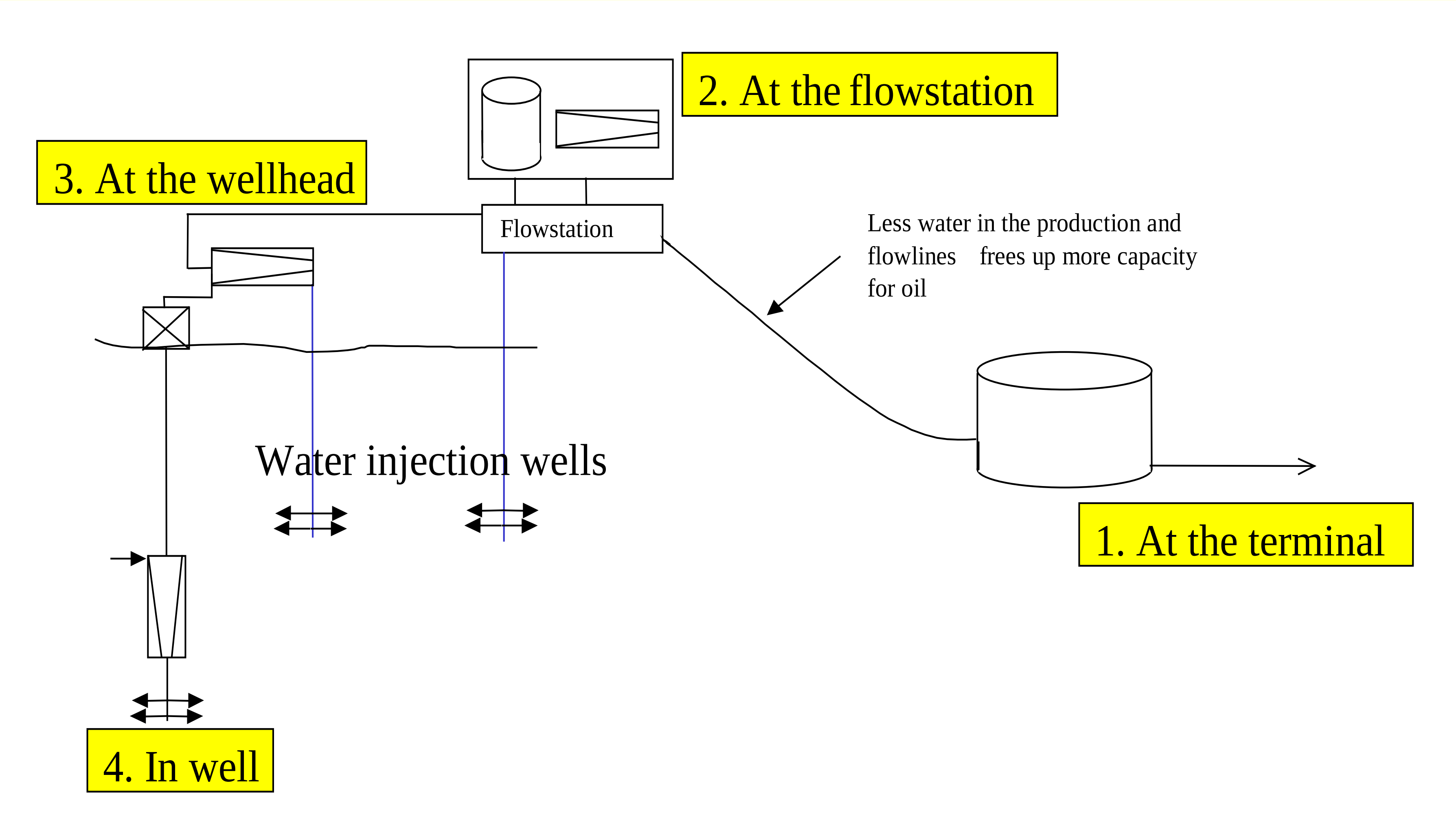
Associated Gas Plant



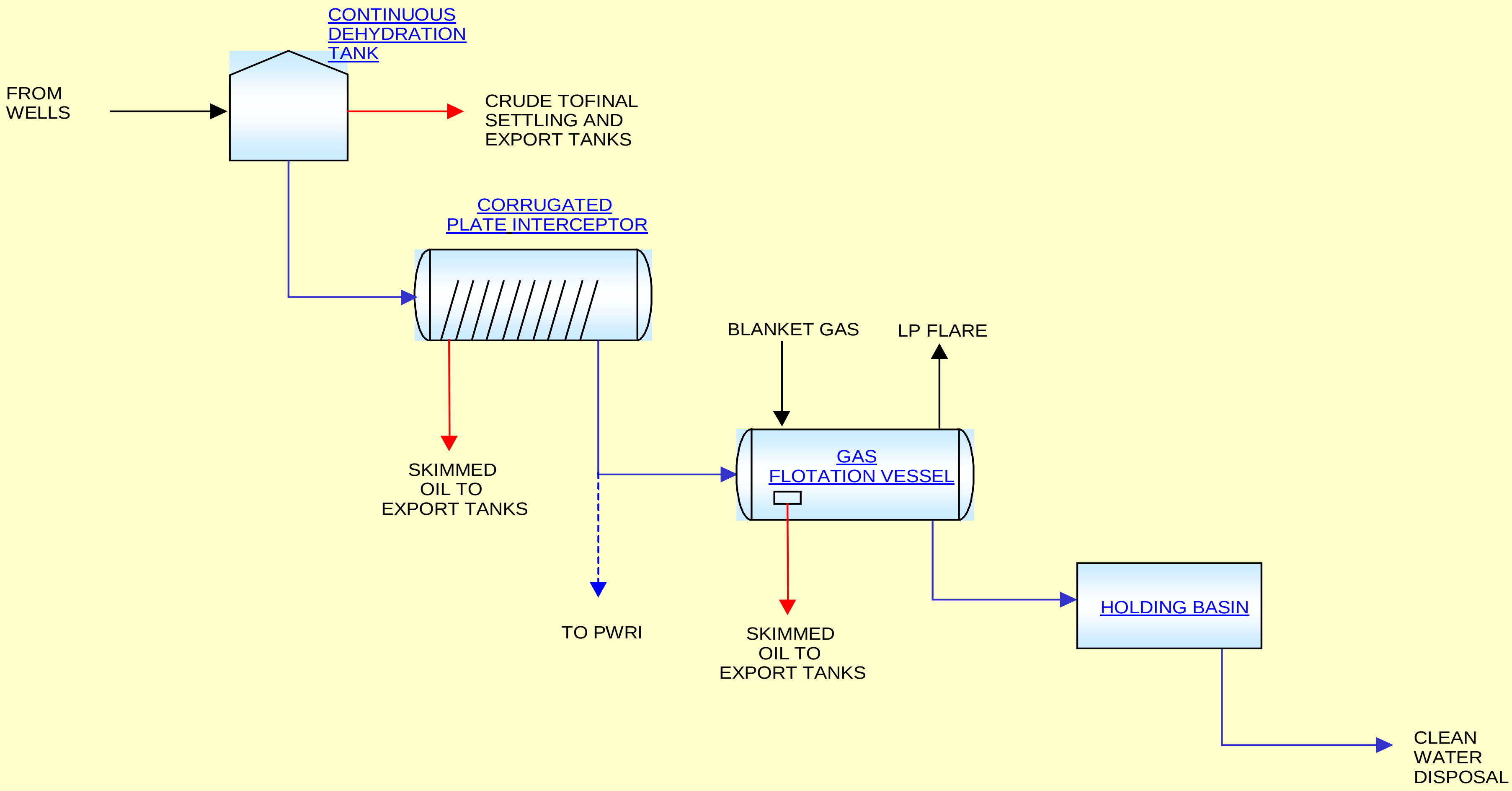
Typical NAG Plant



WATER INJECTION SCHEMES



TYPICAL ONSHORE WATER TREATMENT SCHEME



Typical Land Flowstation

Typical Land Flowstation

Typical Swamp Flowstation

Typical Swamp Flowstation

Typical Swamp Flowstation

Typical Offshore Wellhead Jacket

Typical Land Pipeline

Typical Swamp Pipeline

Typical Pipeline Manifold

Typical Gas Plant

Typical Offshore Platform

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CENTRAL PIPE
SWIVEL
TURNTABLE
FIXED
FLOATING
BUOY
MOORING
HAWSER
FLOATING
HOSE
PIPELINE
PLEM
SUBMARINE
HOSE
ANCHOR
CHAIN LEG

Typical Costs and Schedule

Rules of Thumb for Major Projects :

Costs :

- A 60,000 bbl/d Flowstation costs 30 Mln US$
- A 100 mmscfd AG plant costs 100 mln US$

Manpower for a 100 Mln $ Project :

- During FDP you need One Multidiscipline Facilities Engineer
- During Conceptual Design (FEED) you need 5 Facilities Engineers
- For Detailed Design of a 100 mln $ plant a Contractor needs 100 Designers
- For Construction of a 100 mln US$ plant I need 1000 Construction staff (on land)

- A 30 MW Power Generator consumes 10 MMscfd Fuelgas

Regulations & Standards

STANDARDS:

- **NATIONAL**
- **COMPANY STANDARDS**
- **INDUSTRY STANDARDS**

- **Summary of bad experiences & good practices.**
- **Important to understand and use them**
- **Establish a Technical Change Control system to manage deviations.**

SOME KEY EXTERNAL APPROVALS REQUIRED

Approval, license or Permit type	Responsible External Agency
Contract Awards	NAPIMS
Annual JV Budget and Expenditure	NAPIMS
Asset Development Plan / Field Development Plan	DPR
Environment Impact Assessment Permit to survey	Department of Petroleum Resources (DPR), Federal Ministry of the Environmental (FMENV) DPR
Co-ordinates of Marine structures	DPR obtains clearances from other agencies
Road crossings	(Federal) Ministry of Transport
River Crossings	(Federal) Ministry of Transport and In-Land Waterways
Permit to Dredge	(Federal) Ministry of Transport and In-Land Waterways
Oil Pipeline License	DPR
Conceptual Design	DPR
Detailed Design / Start of Fabrication an Construction	DPR
Fabrication of Construction stages	DPR, (DPR Procedure Guide needs clarification)
Start of Commissioning	DPR
Start Up	DPR
Hydrocarbon Custody Transfer Meterin Facilities	DPR
Tank Calibration	DPR
Permit to generate own power	(Federal) Ministry of Mines and Power/NEPA PLC

Why must we follow standards ?

Because we want to prevent major incidents like these

- **THANK YOU FOR LISTENING**

- **DISCUSSIONS**