



Field Development / Facilities Engineering

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Field Development / Facilities Engineering

Issues Covered

- ／What are “**reservoir fluids**”?
- ／What oil and gas facilities **do**?
- ／How these facilities are **designed**?
- ／How do they **work**?
- ／What are the main **challenges**?



What Are Reservoir Fluids

- ✓ Reservoir fluids are a mixture of
 - Oil
 - Water
 - Gas
 - Sand
 - Other contaminants (e.g. wax, scale, salt...)
- ✓ The nature of the reservoir fluids will be a significant factor in the design of the facilities
- ✓ Product specifications impact facility design and can vary significantly
- ✓ There is usually uncertainty in the composition and flowrate of the reservoir fluids

Heavy oil

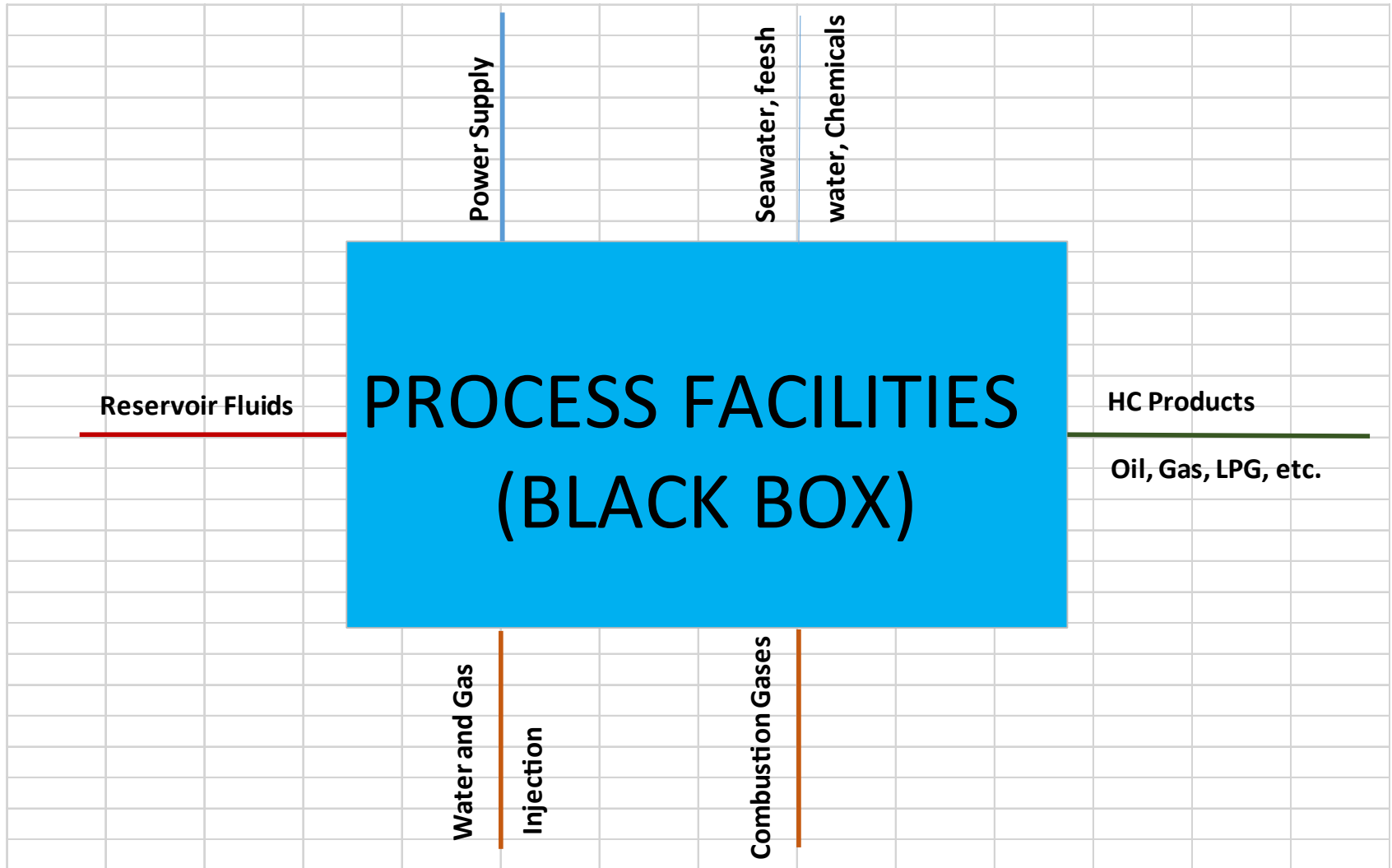


Produced water



Sand

What Oil and Gas Facilities Do



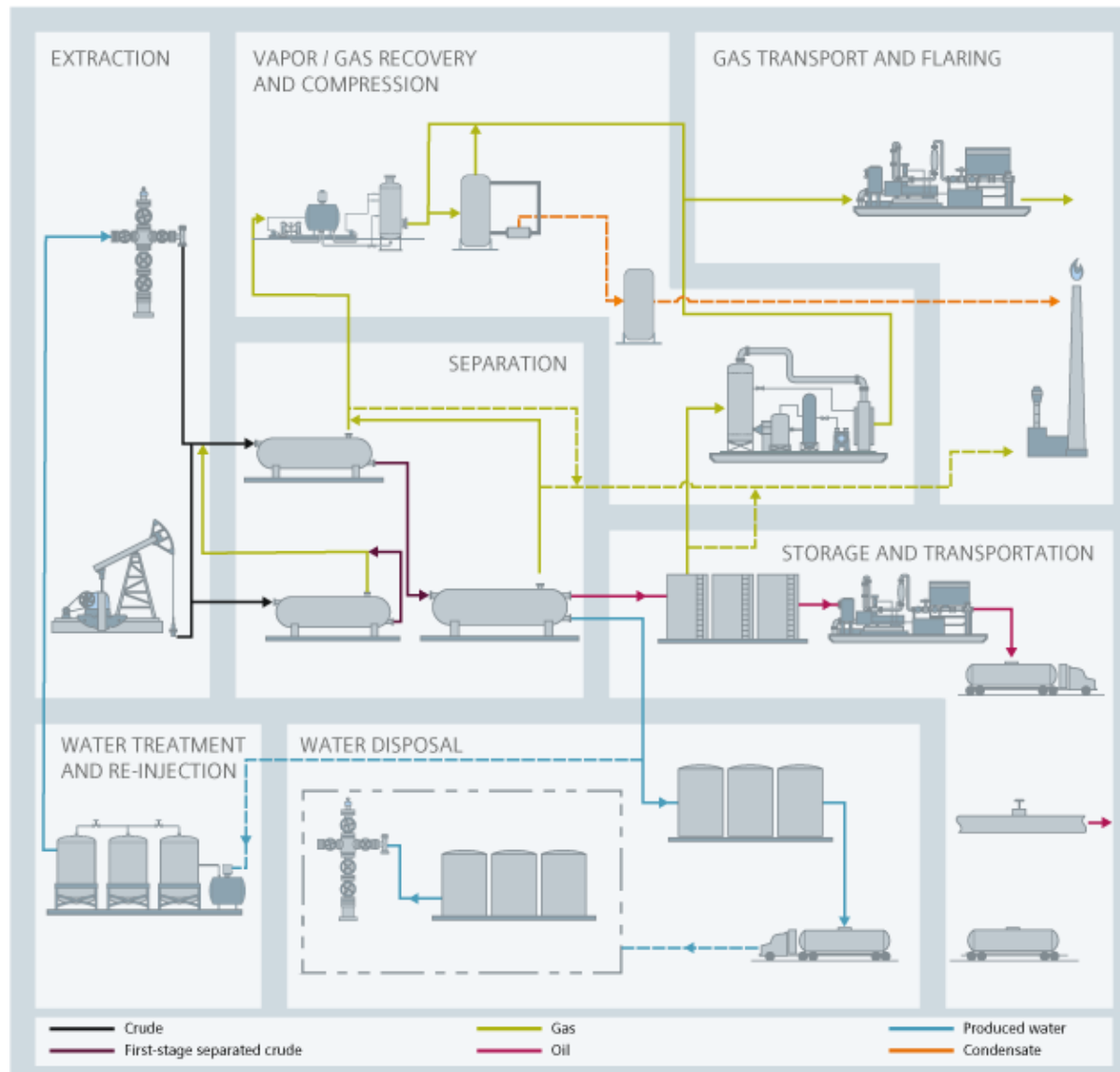
What Oil and Gas Facilities Do

- ✓ **Transport** well fluids from the well to a processing facility
- ✓ **Separate** products (oil and gas) from waste streams (water, sand & other contaminants)
- ✓ **Treat** oil and gas to meet the sales requirements
- ✓ **Treat** waste streams to meet the disposal requirements (environmental)
- ✓ **Deliver** products to the shore/market



What Oil and Gas Facilities Do

Overall Process Flow Diagram



What Oil and Gas Facilities Do

Transport Reservoir Fluids (oil / gas / water)

Typically by pipeline (may be onshore or underwater) to the processing Facilities

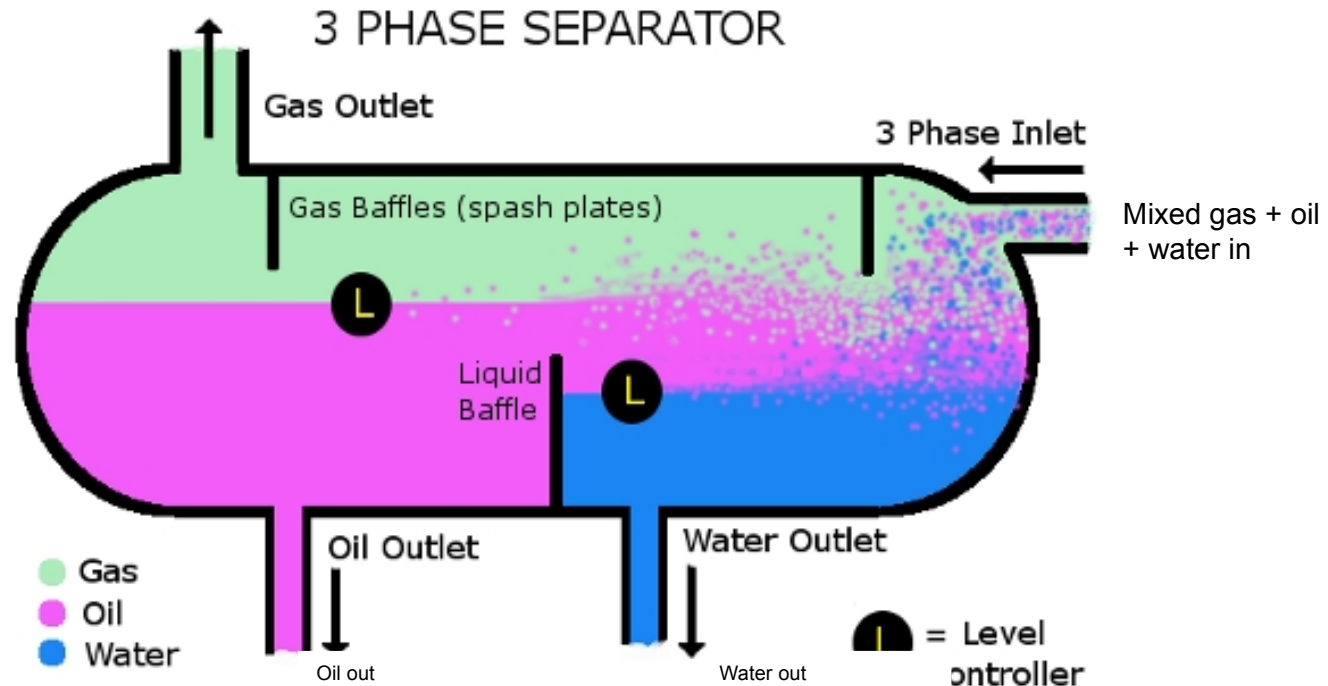
- ✓ Pipelines
- ✓ Land access (ROW)
- ✓ Societal & Environmental impact
- ✓ Construction impact
- ✓ Flow assurance
 - Hydrates
 - Scales
 - Wax
 - Chemical injection / insulation



What Oil and Gas Facilities Do

Separate products from waste streams

✓ A gravity separator (horizontal steel vessel)



✓ Other types of separator include:

- Electrostatic
- Centrifugal

What Oil and Gas Facilities Do

Separate products from waste streams

- ✓ After simple separation products will still contain impurities
- ✓ Some well fluids are difficult to separate and require additional processing (e.g. heating / chemicals)
- ✓ Waste streams (water / sand) typically contaminated with oil
- ✓ Typical Oil specifications include:
 - BS&W (Basic sediment and water) <1%
 - Salt Content < 10 ptb
 - Pour Point
 - Flash Point, vapour Pressure

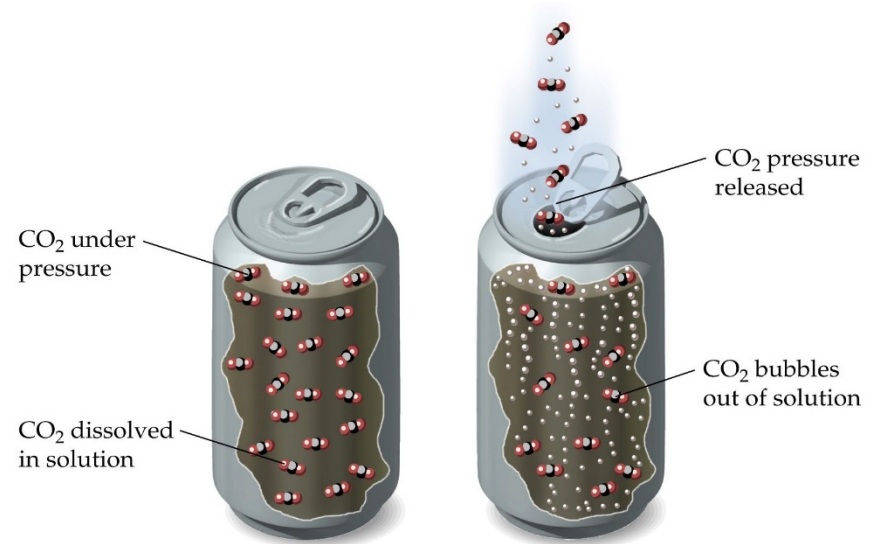


Mud slop wastes

What Oil and Gas Facilities Do

Treat Oil : Stabilise

- ✓ Oil can contain gas or light HC components which may be released if the pressure or temperature changes
- ✓ The stabilization process is a form of partial distillation which reduces vapour pressure, thereby making the crude oil safe for storage and shipment in tankers.



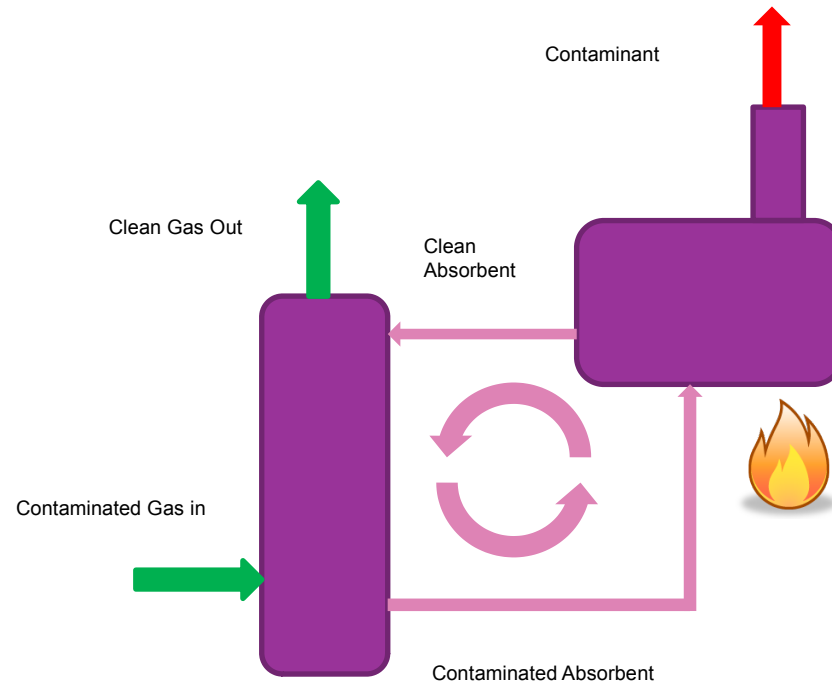
What Oil and Gas Facilities Do

Treat Gas : remove contaminants (simplified)

- ✓ Separated / wellhead gas may contain contaminants
- ✓ Water, “Sour” or “Acid” gases e.g.
 - ✓ Hydrogen Sulphide
 - ✓ Carbon Dioxide

Typical (simplified) continuous contaminant removal process

- Gas is mixed with absorbent
(Glycol for water)
(Amine for H_2S / CO_2)
- Contaminant is absorbed
- Gas is cleaned
- Absorbent is “regenerated”
– typically by heating



What Oil and Gas Facilities Do

Gas Treatment

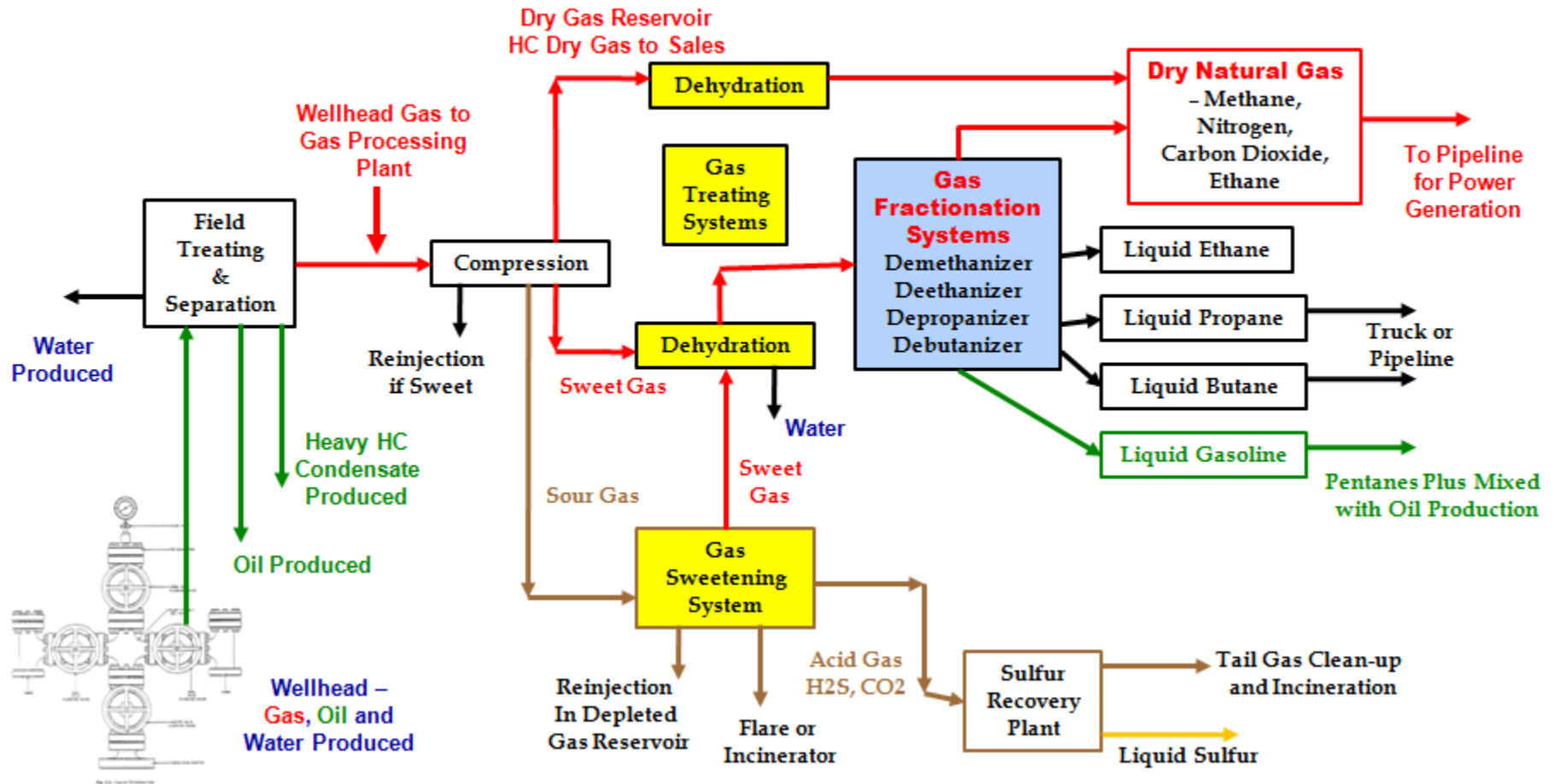
- ✓ Gas is usually burned as a fuel
- ✓ Sold on “heating value” i.e. How much energy it contains
- ✓ Export gas needs to be in the correct heating value (HV) range
 - If HV too low - remove inert gases, e.g. nitrogen, CO₂
 - If HV too high - reduce LPG content
- ✓ Other specifications include:
 - Maximum H₂S < 4 ppm for the national grid
 - CO₂ content <3%mol
 - Dew point to avoid both water and HC condensation



Gas Processing Plant

What Oil and Gas Facilities Do

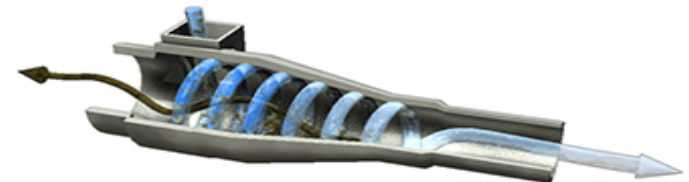
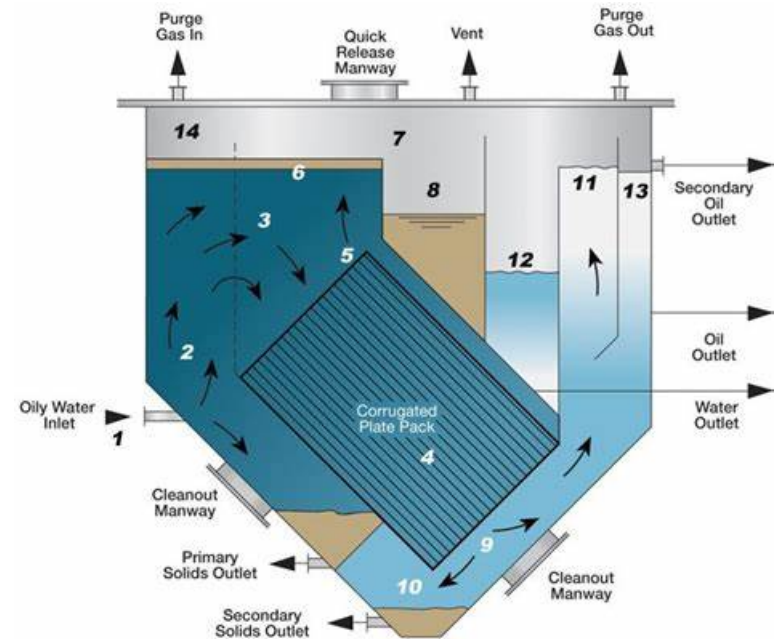
Natural Gas Processing Plant - NGPP



What Oil and Gas Facilities Do

Treat waste streams – produced water

- ✓ Disposal requirements
- ✓ Environmental permitting
- ✓ Quality constraints – reinjection
- ✓ Quantity – can be multiples of oil production
- ✓ Oil removal
- ✓ Separators, Centrifuges, cyclones, stripping columns, membranes, chemicals
- ✓ Scale formation
- ✓ Saltwater can be difficult to dispose onshore



What Oil and Gas Facilities Do

Deliver products to the market

Oil

- Pipeline
- Tanker
- Rail
- Road
- Power generation



Gas

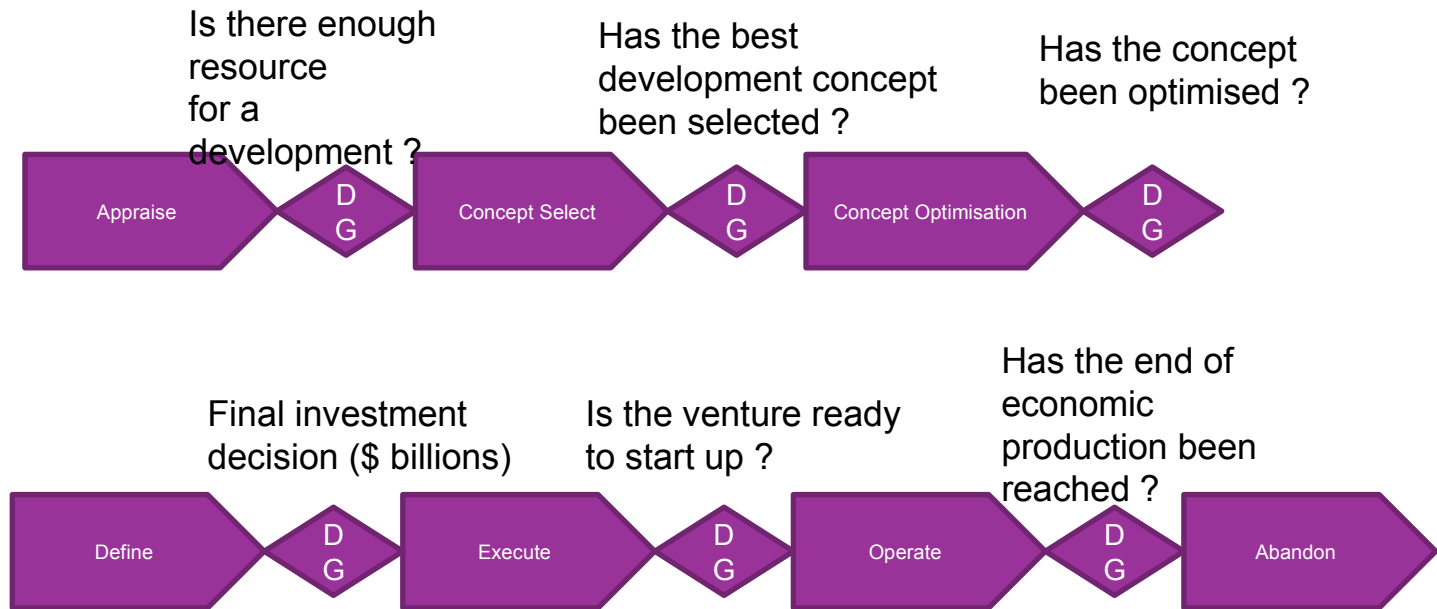
- Pipeline
- Power generation
- LNG



Field Development

The field development process

- ✓ Staged process with “decision gates” between each stage
- ✓ Maximise value from the sub-surface



Field Development

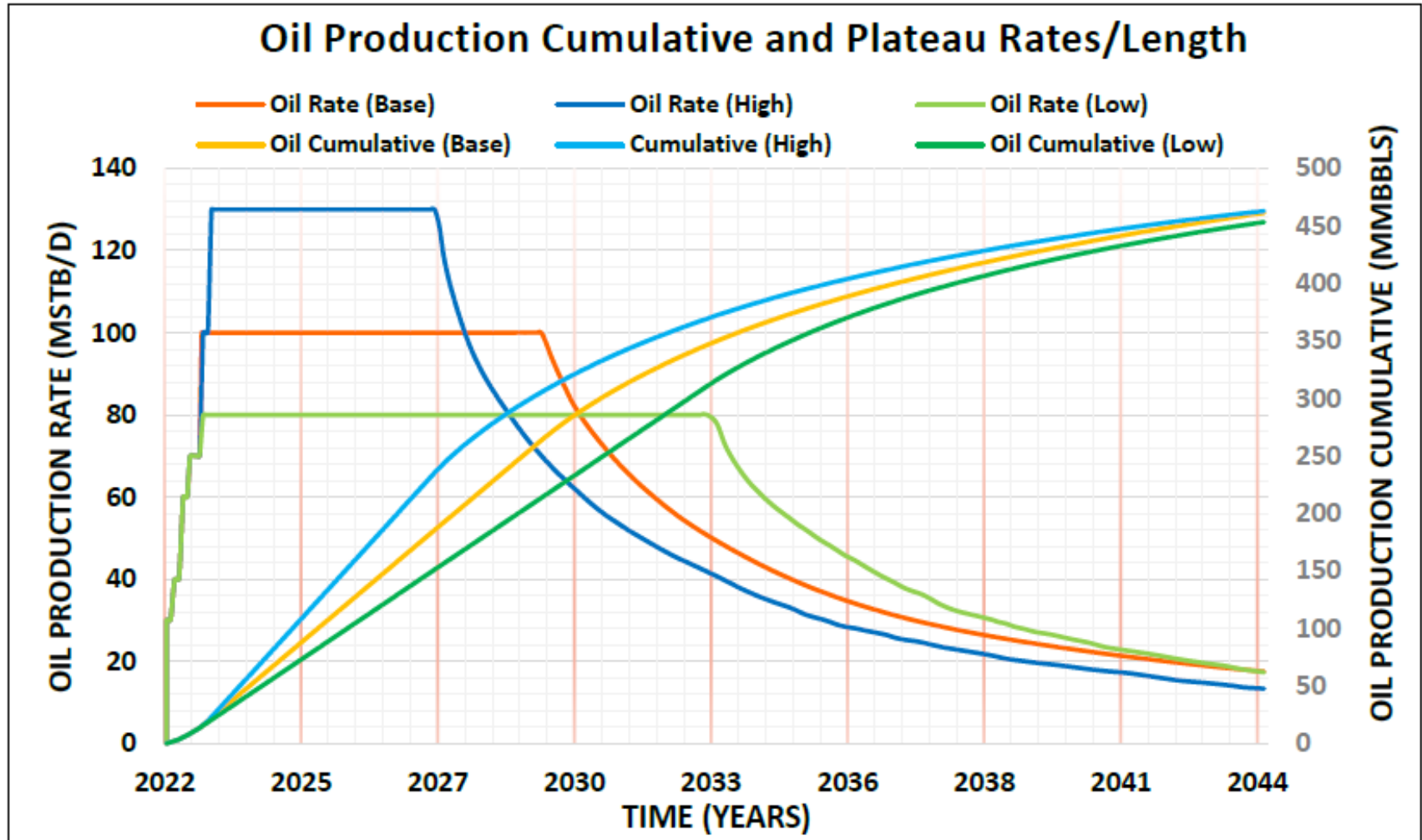
Understanding a development

- ✓ Facility interface with reservoir
 - Production profiles
 - Drawdown constraints
 - Pressure support requirements
 - Number and type of wells
- ✓ Market size and location
- ✓ Export routes
- ✓ Gas and water constraints
- ✓ Schedule / Timing (early production potential)
- ✓ Economics



Production Profiles

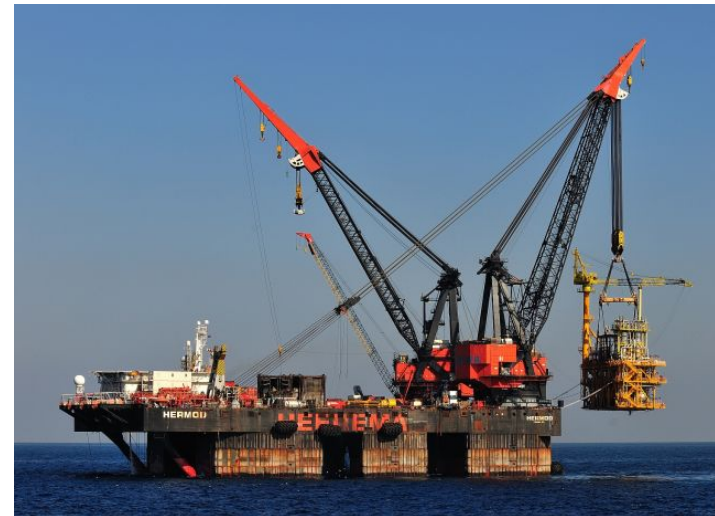
Design Cases: Maximum Oil, Gas, Water and Liquid Flows, High Viscosity



Development Engineering Considerations

How will it be built (and abandoned)

- ✓ Local skills
- ✓ Training
- ✓ Local content
- ✓ Safety standards
- ✓ Labour relations
- ✓ Offshore issues
- ✓ Fabrication location
- ✓ Operations support / supply base



Development Options - Technical

Typical decisions required

- ✓ Facility location(s)
- ✓ Number and type of wells
- ✓ Process selection
- ✓ Capacity
- ✓ Number of trains
- ✓ Future expansion provision
- ✓ Operating / maintenance philosophies
- ✓ Provision for future abandonment
- ✓ All the time *maximising value*

Construction & Decommissioning Vessel “Pioneering Spirit”



Development Engineering

Key Behaviours

- ✓ No harm to people, no harm to environment
- ✓ Understand the uncertainty in the sub-surface data
 - Design for a range of scenarios
 - Iteration often required
- ✓ Make decisions
- ✓ Understand the nature and scale of the development
- ✓ Consider all the options, not just the preferred base case
- ✓ Engage and manage all key stakeholders



Thank you

Questions are very welcome