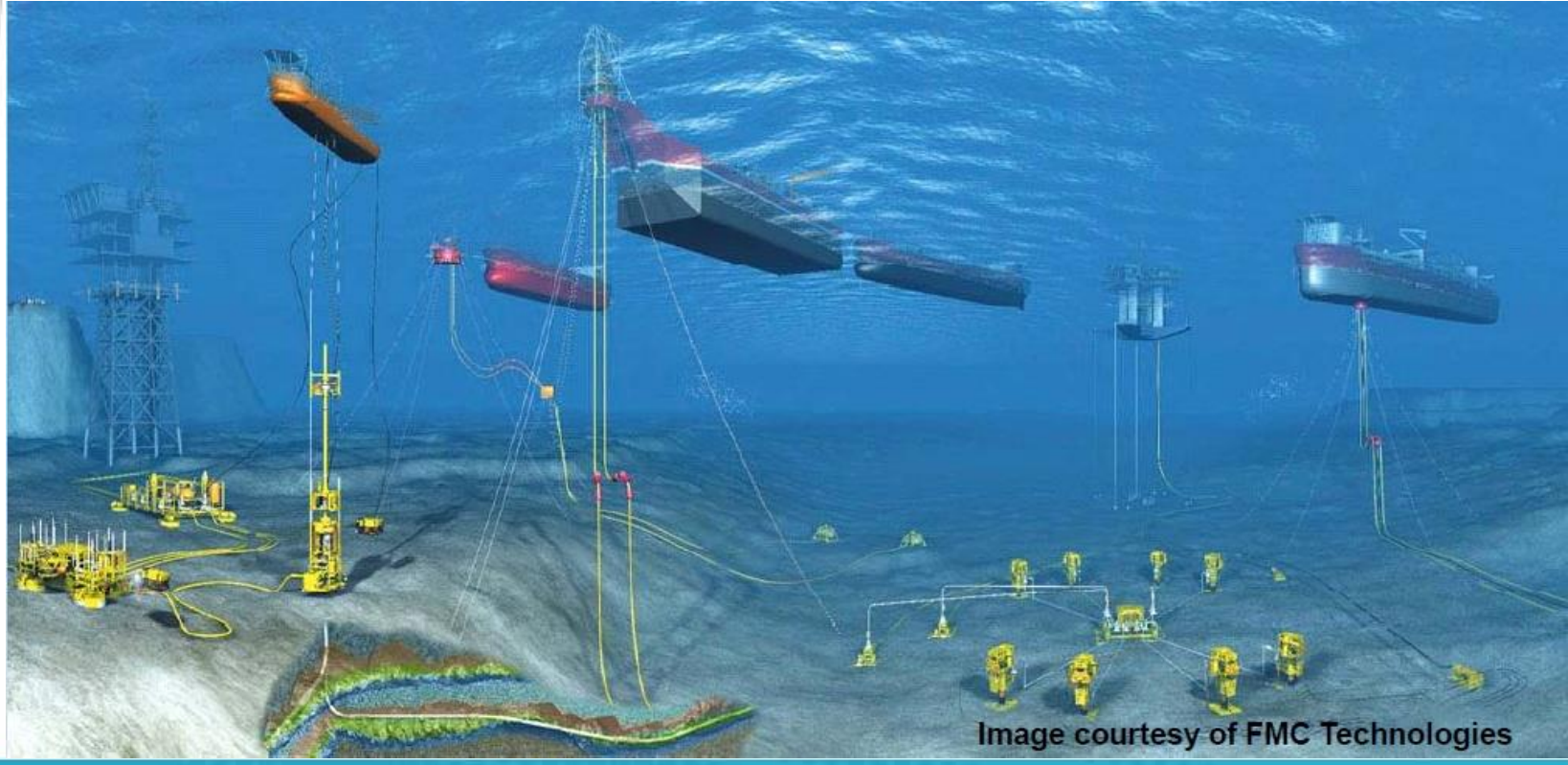


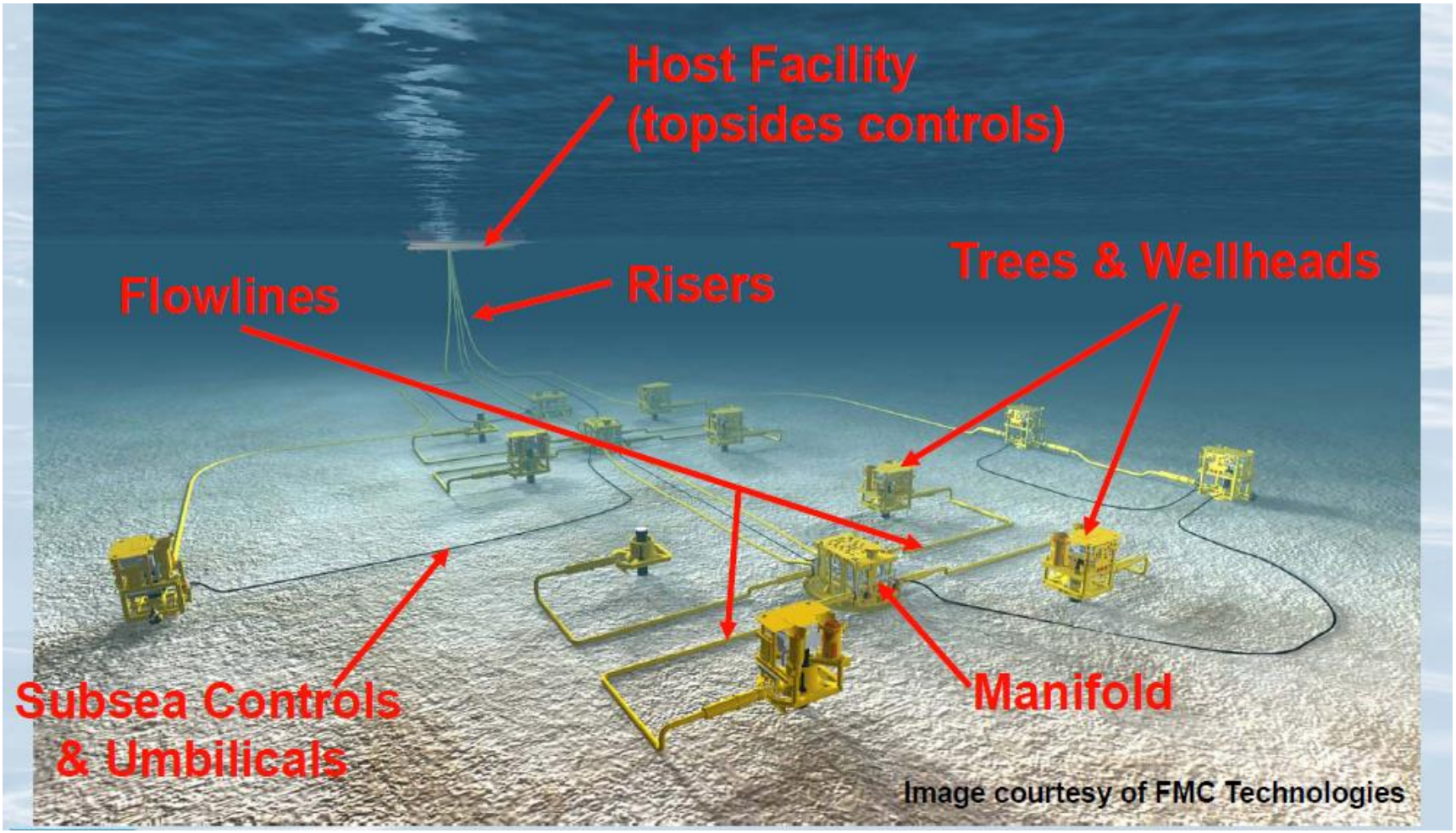
Offshore Equipment

Yutaek Seo

Lecture Plan

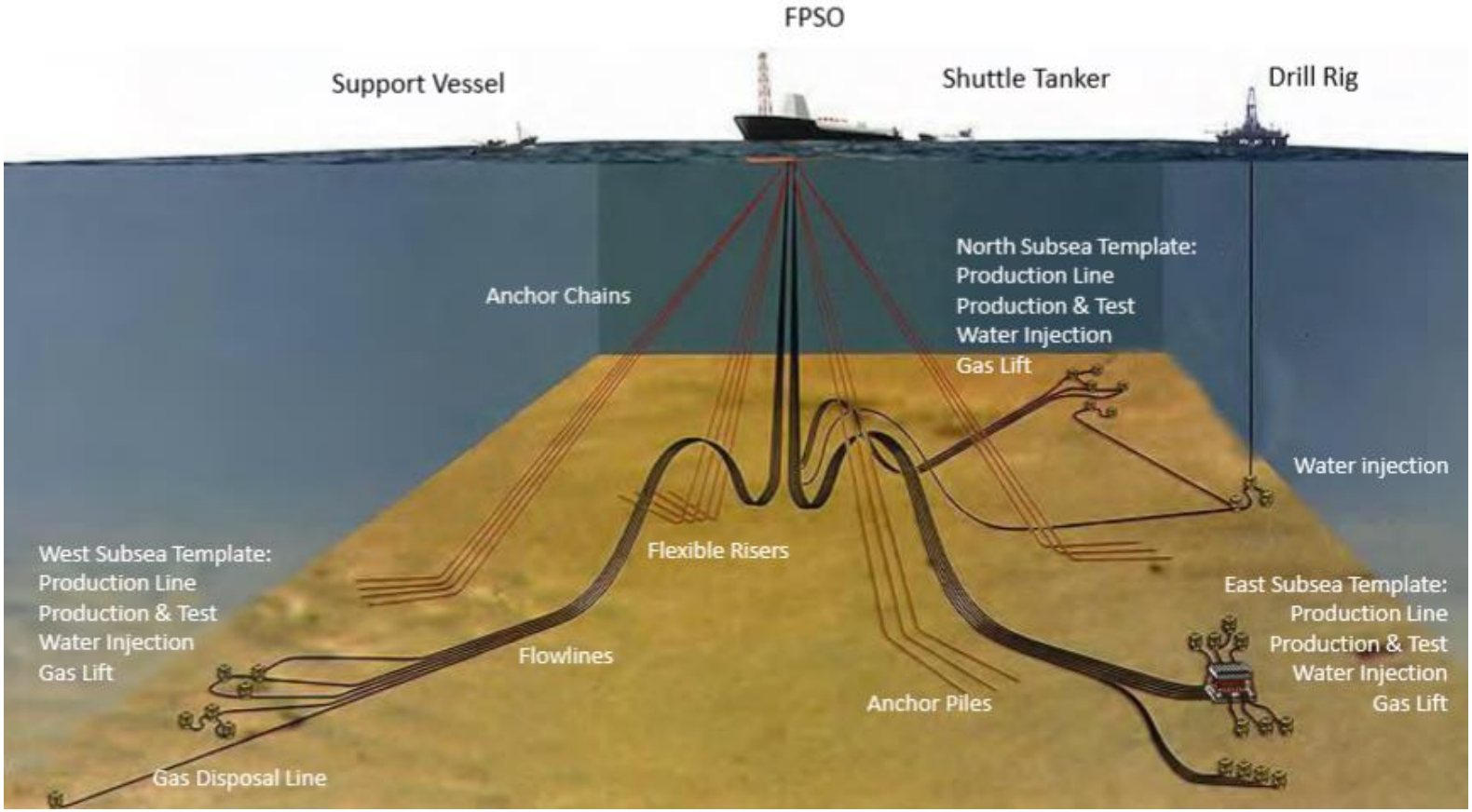
1	Offshore projects with various equipment
2	Offshore pipeline design
3	Production facility
4	Process selection
5	Mechanical design of pressure vessels
6	Two phase oil and gas separation
7	Valve, Fitting, and Piping details
8	Compressors
9	Reciprocating compressors
10	Topside process design – gas processing system
Text book	- Printed materials: Topic 1, 2, 10 - Surface production operations, Vol. 2 (Gas-Handling): Topic 7, 8, 9 - Surface production operations, Vol. 1 (Oil-Handling): 3, 4, 5, 6
Rating	- Homework, Quiz 20% (March, May) - Midterm 30% (April) - Final 40% (June) - Attendance 10%

Typical Field Layout



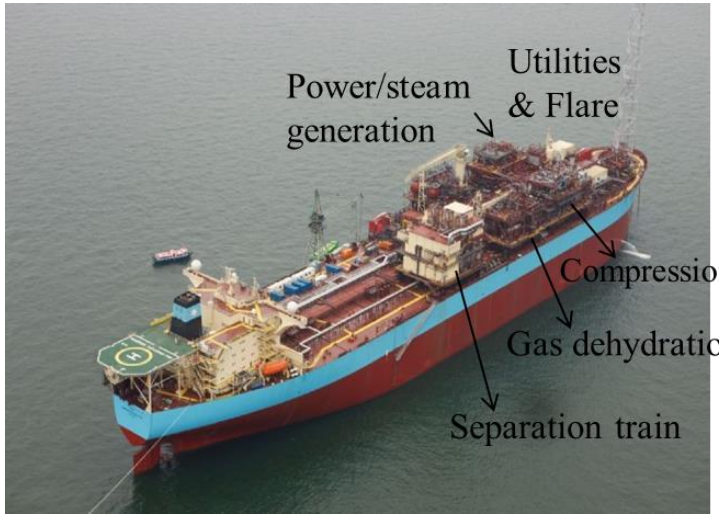
Oil FPSO

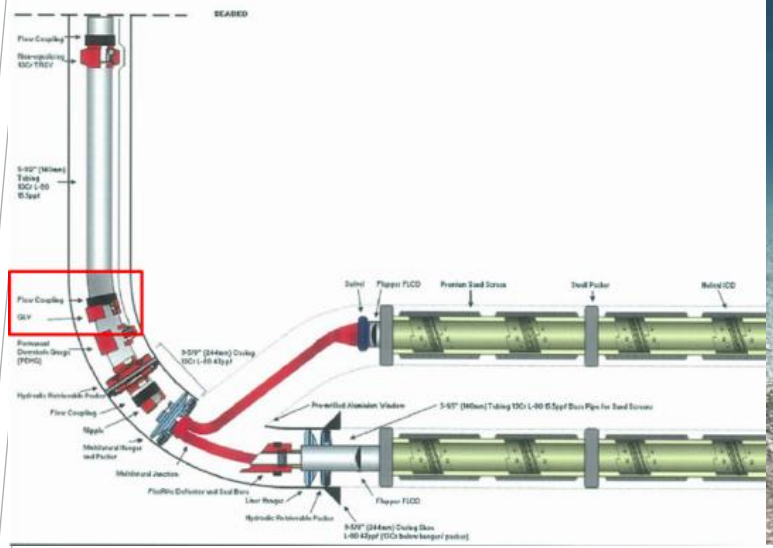
- Processes hydrocarbons from subsea template into oil, LPG, sales gas, etc.
- A converted tanker or purpose built vessel – may be ship shaped
- Eliminate the need for costly long-distance pipelines, which is effective in remote or deep water developments

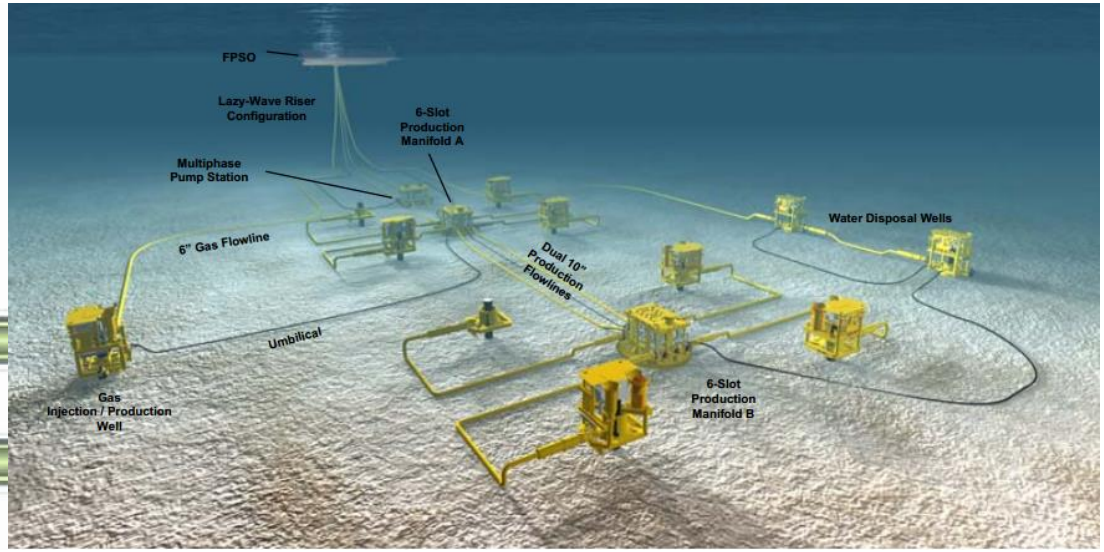


FPSO in Western Australia

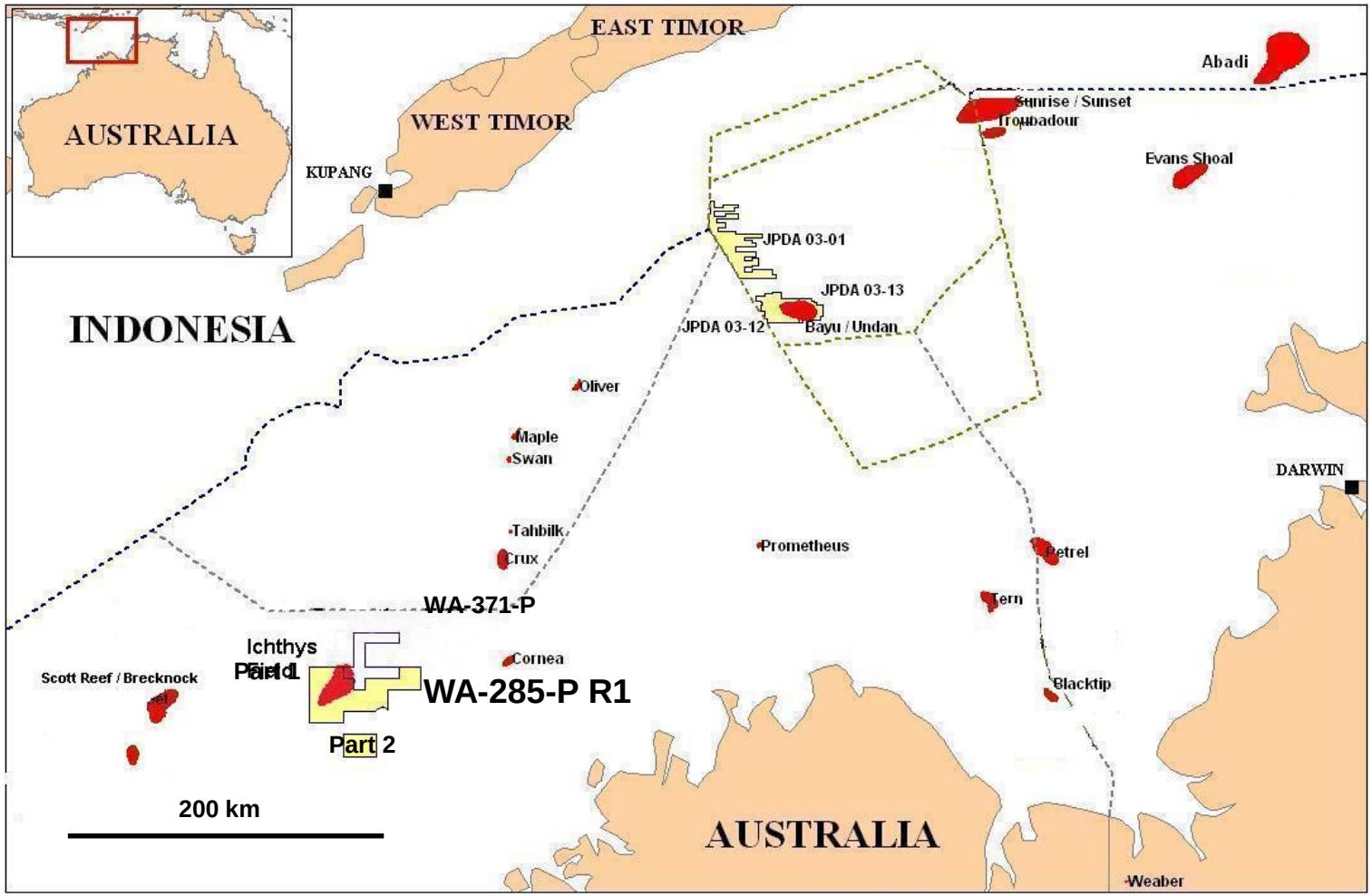
- **Vincent oil field**
  : Located offshore Exmouth in Western Australia
  : Water depth 350m, 17^{o} API crude from 8 wells
  : Oil column thickness 8.5 ~ 19.0 m
  : Total Liquid processing capacity 120,000 b/d with total storage capacity of 1.2 million barrels of oil
  : Water (150,000 b/d) & Gas (80 MMscf/d) Injection
  : Dual sided hull and disconnectable mooring





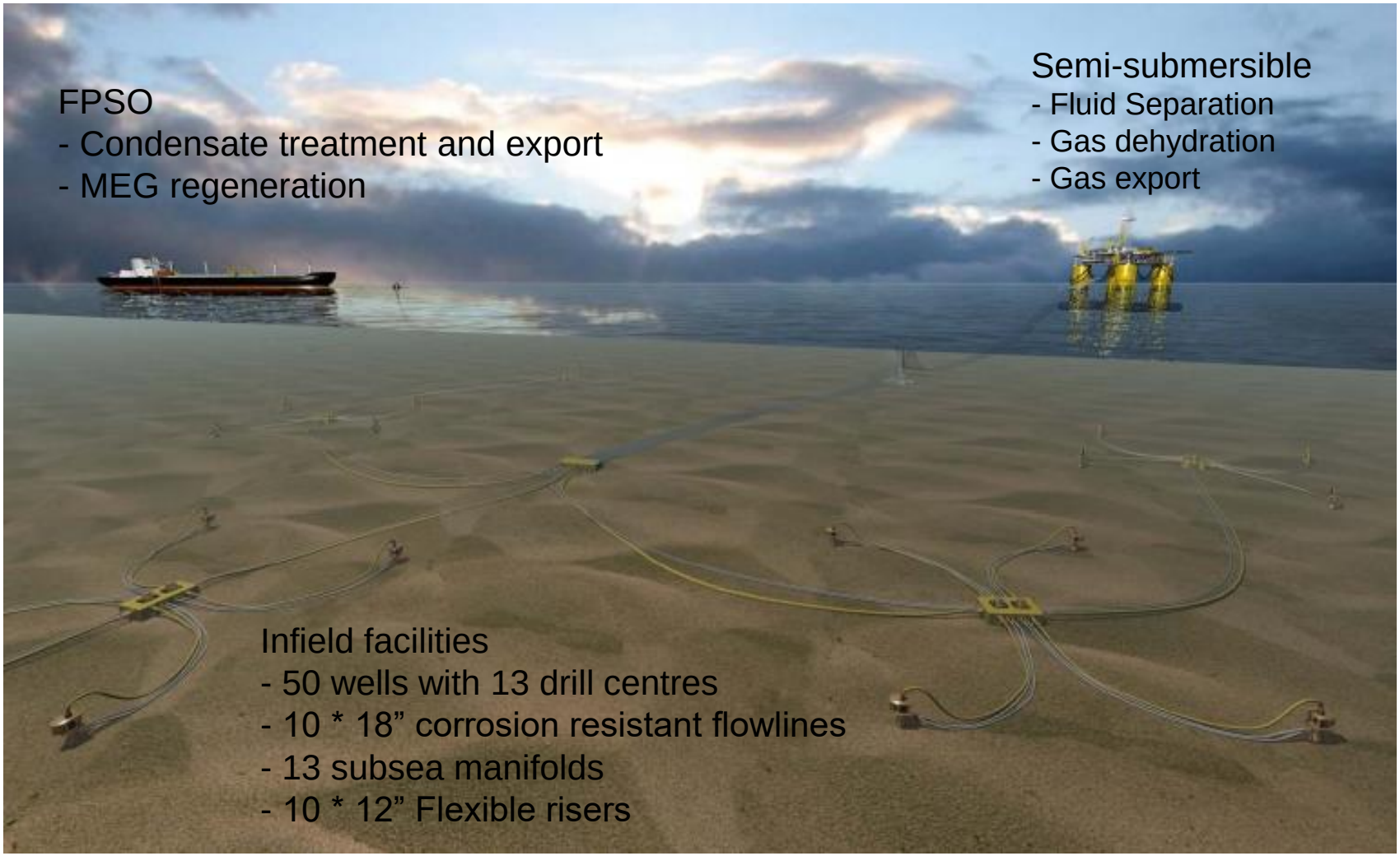


INPEX - Ichthys Field

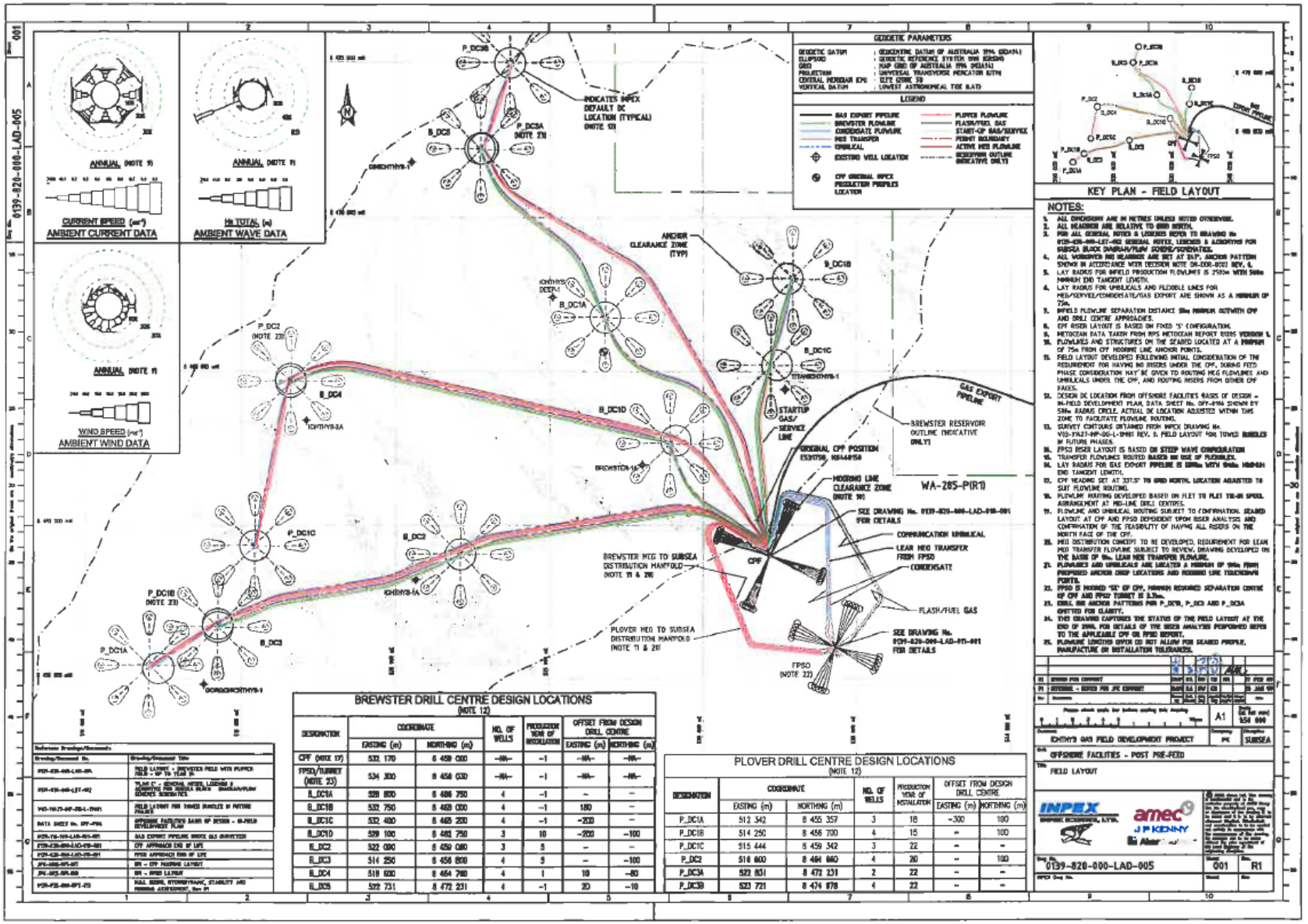


- Approximately 200 km from the mainland
- 250–270 m water depth

Field Development Plan



Field Architecture



BREWSTER DRILL CENTRE DESIGN LOCATIONS (NOTE 12)

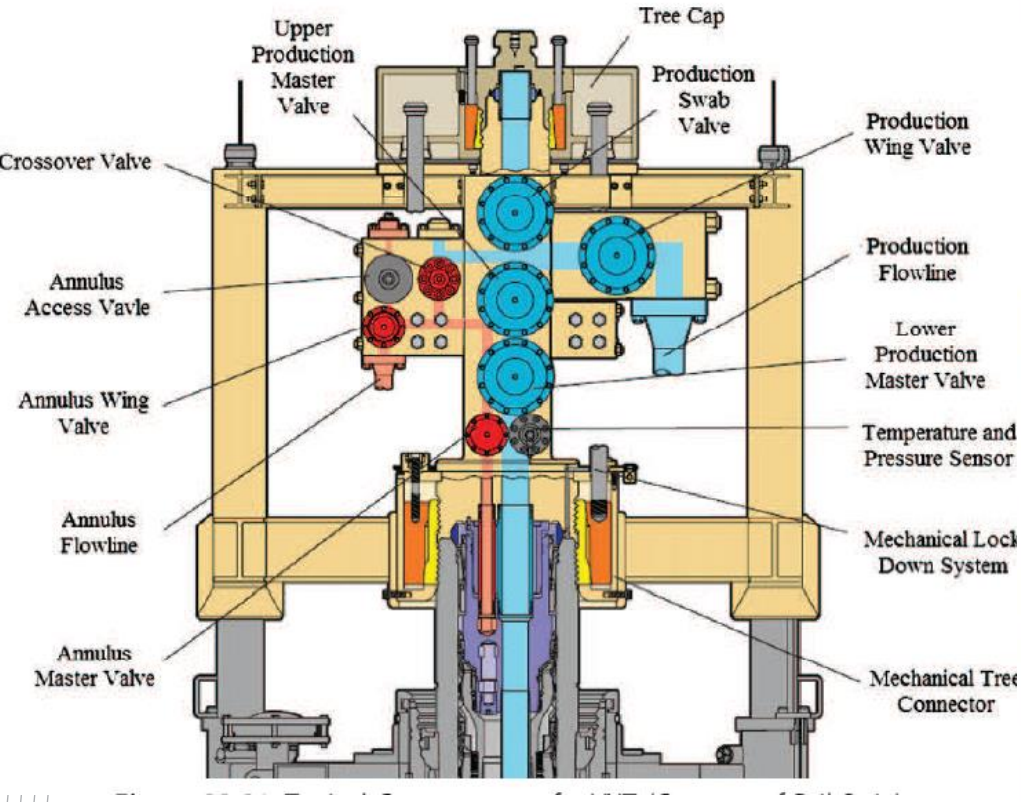
DESIGNATION	COORDINATE EASTING (m)	COORDINATE NORTHING (m)	NO. OF WELLS	PRODUCTION YEAR OF INSTALLATION	OFFSET FROM DESIGN DRILL CENTRE EASTING (m)	OFFSET FROM DESIGN DRILL CENTRE NORTHING (m)
CPF (NOTE 17)	532 170	8 459 000	-N/A-	-1	-N/A-	-N/A-
FPSO/TURRET (NOTE 23)	534 300	8 458 030	-N/A-	-1	-N/A-	-N/A-
B_DC1A	529 800	8 466 750	4	-1	-	-
B_DC1B	532 750	8 468 000	4	-1	180	-
B_DC1C	532 400	8 465 200	4	-1	-200	-
B_DC1D	529 100	8 462 750	3	10	-200	-100
B_DC2	522 090	8 459 080	3	5	-	-
B_DC3	514 250	8 458 800	4	5	-	-100
B_DC4	518 600	8 464 780	4	1	10	-80
B_DC5	522 731	8 472 231	4	-1	20	-10

PLOVER DRILL CENTRE DESIGN LOCATIONS (NOTE 12)

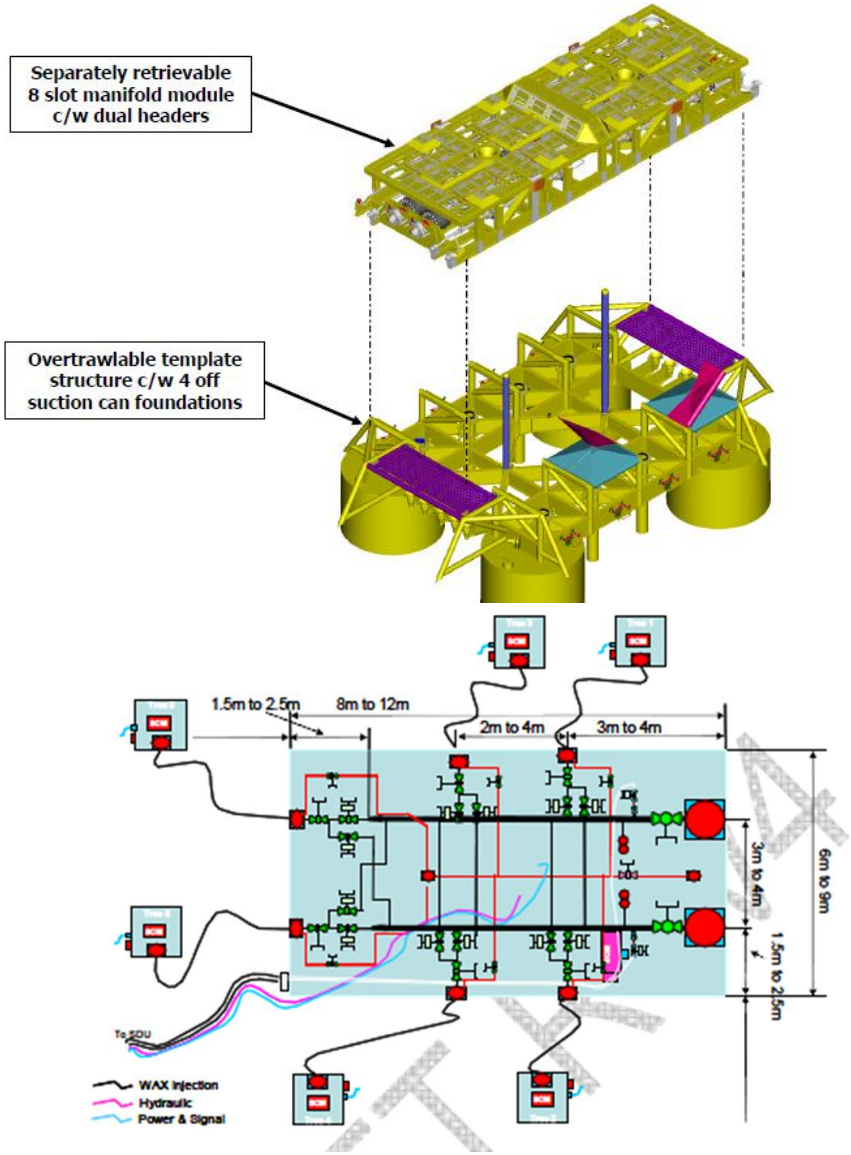
DESIGNATION	COORDINATE EASTING (m)	COORDINATE NORTHING (m)	NO. OF WELLS	PRODUCTION YEAR OF INSTALLATION	OFFSET FROM DESIGN DRILL CENTRE EASTING (m)	OFFSET FROM DESIGN DRILL CENTRE NORTHING (m)
P_DC1A	512 342	8 455 357	3	18	-300	100
P_DC1B	514 250	8 456 700	4	15	"	100
P_DC1C	515 444	8 459 342	3	22	"	-
P_DC2	518 800	8 464 660	4	20	"	100
P_DC3A	522 851	8 472 231	2	22	"	-
P_DC3B	523 721	8 474 878	4	22	"	-

Subsea Tree

- Primary production and safety device for a well
- Essentially consists of a number of valves to regulate flow and isolate the tree from the well, and monitor the production fluids



Manifold/Template

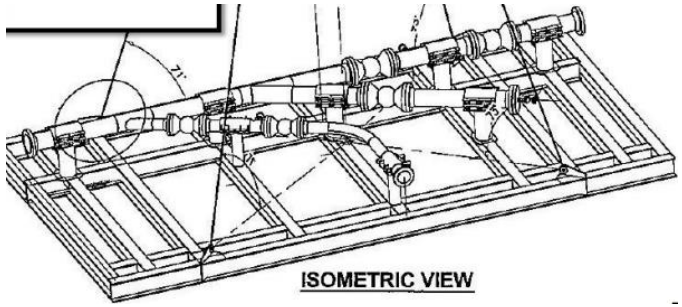


- A template is a seabed founded structure that provides a guide for other equipment
- A manifold is a system of piping and associated equipment used to gather produced fluids. Associated equipments may include
  - : Isolation valves
  - : Flowline connectors
  - : Xmas tree connectors
  - : Flow control chokes
  - : Umbilical termination and distribution

PLEM/PLET

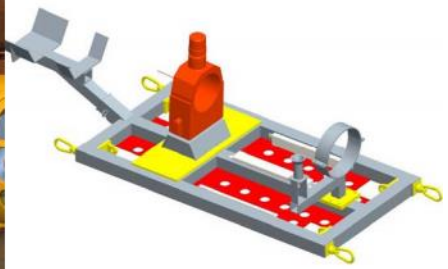
- PLEM (Pipeline End Manifold)

  : Used to comingle 2 or more pipelines together and eliminate the need for additional risers



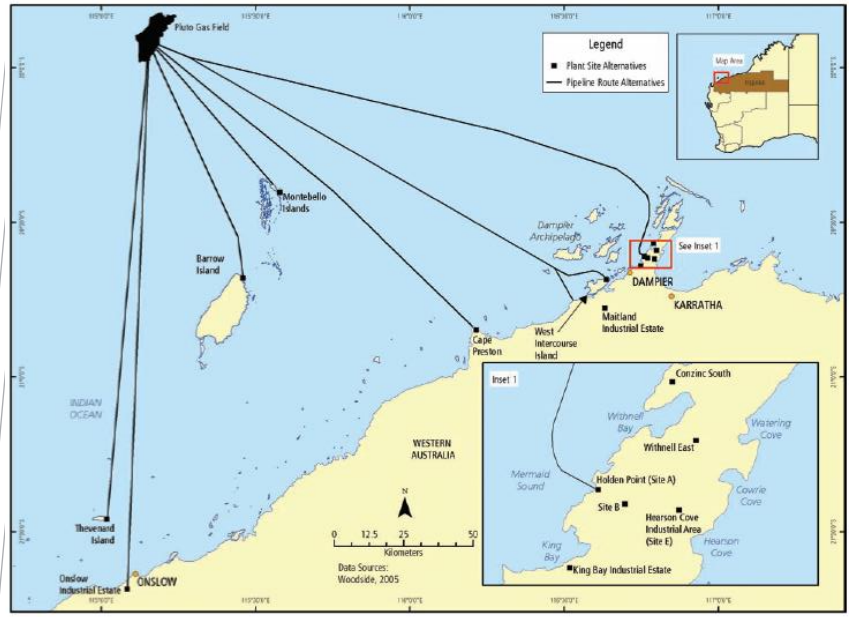
- PLET (Pipeline End Termination)

  : Used to link manifold to the production pipeline



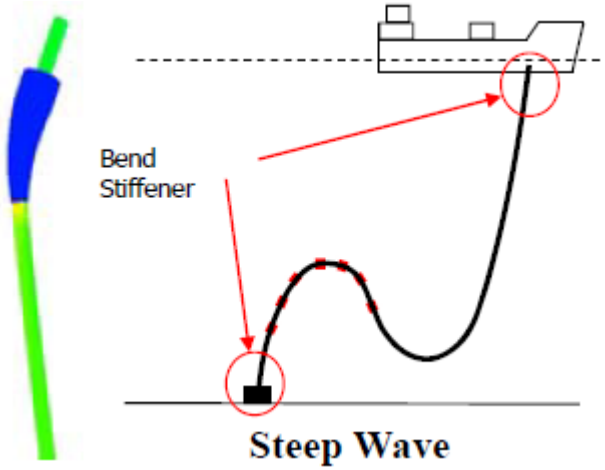
Flowline

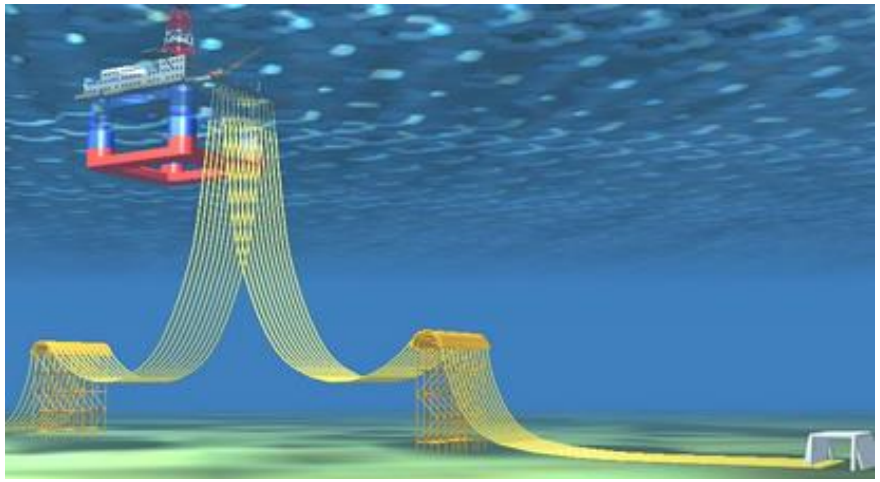
- Transport reservoir fluid to processing facilities
- Pipelines
  : horizontal transfer from wellhead
  : these may be very long
  : may be rigid or flexible pipe
  : commonly called flowlines



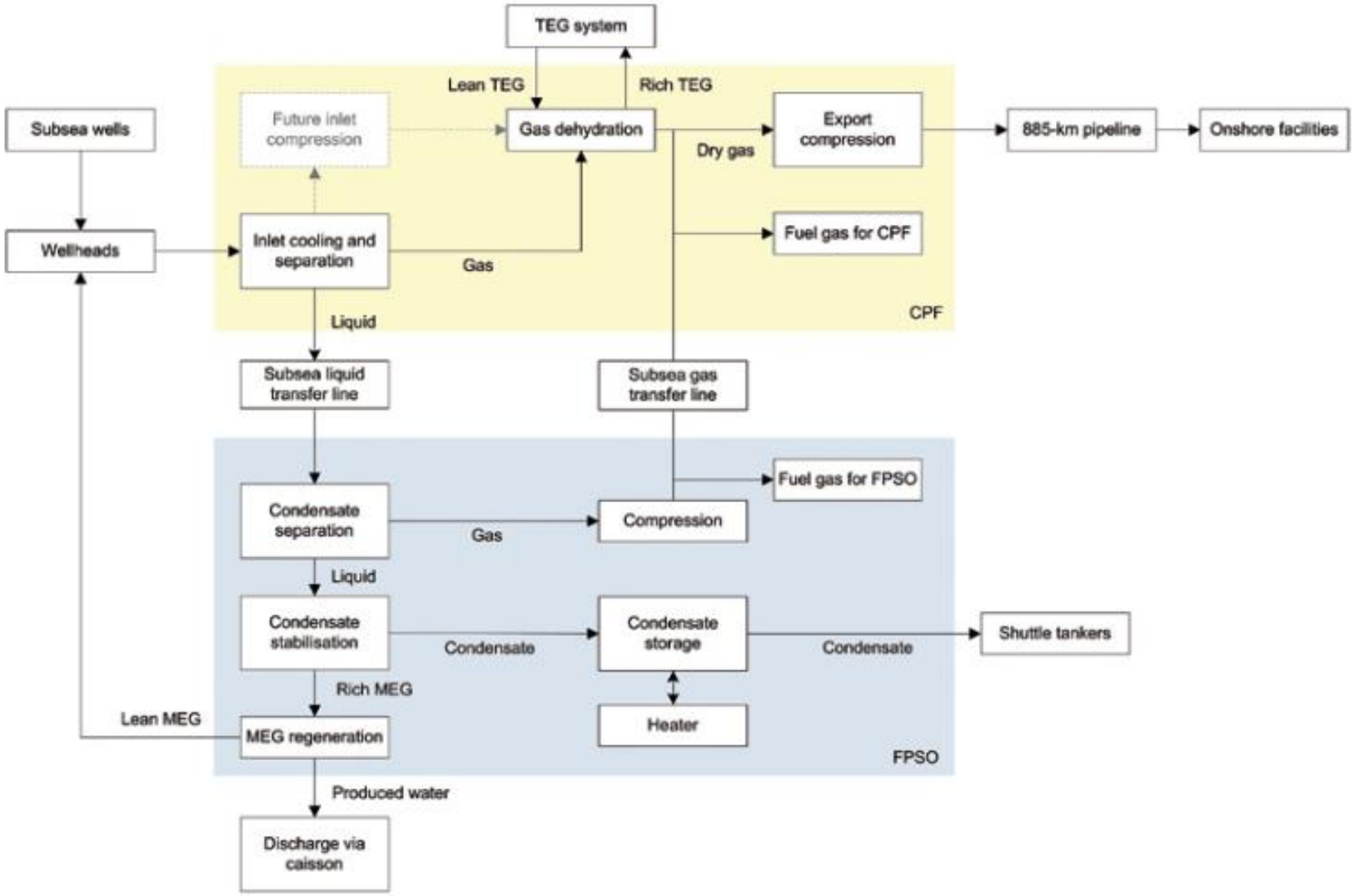
Riser

- Vertical transfer to above surface processing facilities
- Either Rigid or Flexible
- Rigid risers normally for fixed platforms
  : pre-installed inside jacket frame
  : cost effective and added riser protection
- Flexible risers mainly for floating production system
  : Flexibility and reliability
  : Easy and rapid installation





Offshore Process Flow Diagram



CPF (Central Processing Facility)

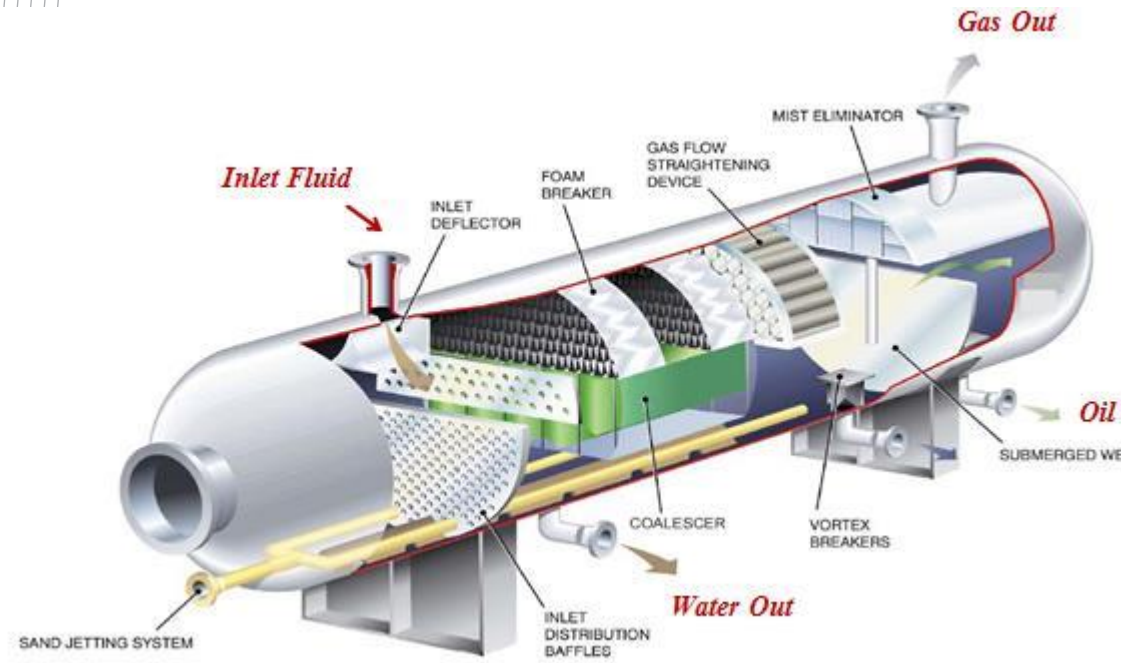
- Design capacity of 1657 MMscf/d export gas
- 4 leg semi-submersible hull structure
- 4 group * 7 mooring legs (28 total mooring legs)
- Inlet flow control and manifolding
  : Each riser will have a topside choke
  : Flowlines are connected by manifolds to three production trains
- Inlet separation system
  : Inlet surge vessel to separate bulk liquids
- TEG gas dehydration
- Gas export compression
  : Four trains of export compression (each sized for 33% of total throughput)
  : Discharge at ~20 500 kPa to maintain export flow
- Inlet booster compression – Future option
- Condensate export to the FPSO
- Accommodation – 150 beds
- Utilities
  : Chemical injection package, TEG regeneration, etc
  (Antifoam, Wax inhibitor, Methanol, Scale inhibitor, MEG, TEG, Subsea hydraulic fluid)

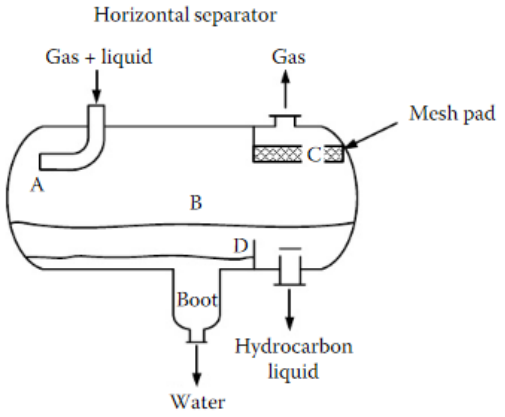
FPSO (Floating Production Storage and Offtake

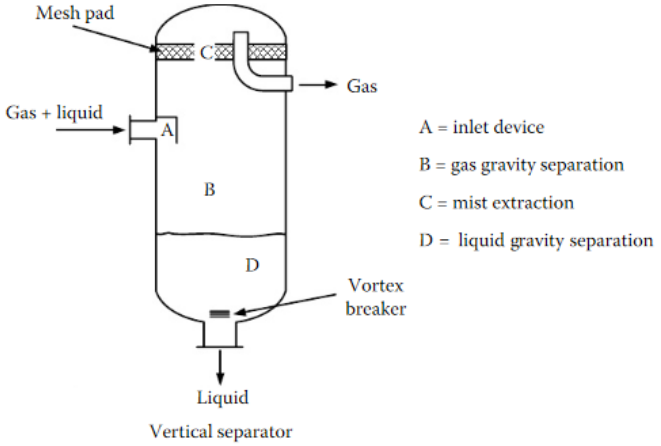
- Weather veining turret mooring
  : 3 group * 7 mooring legs (21 total)
- 12 path swivel
- Product storage of 1.2 million barrels
- Condensate treatment and stabilization
  : Series of 3-phase separators, coalescers, and heat exchanger to stabilize the condensate up to 85 000 bpd
  : Main tank capacity – 150 000 m3
- Mercury removal from condensate and water
- Flash gas compression
- MEG regeneration unit
  : 2 * 50% MEG regeneration plants
  : Max. lean MEG injection of 100 m3/hr
  : MEG storage tank capacity – 13 500 m3
- Produced water treatment facilities
- Condensate export system to shuttle tankers

Inlet separation

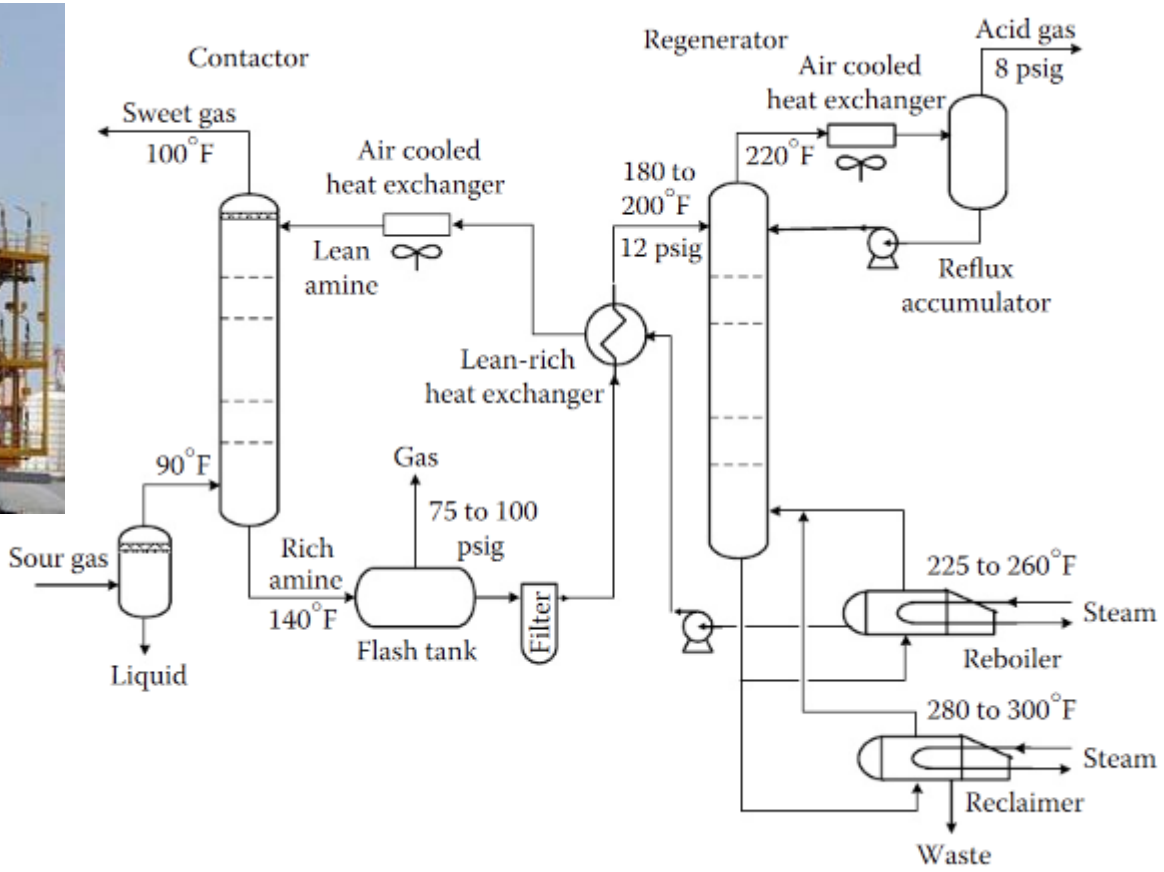
- Following figure shows a schematic of gas-liquid separators and indicates the four types of separation:
- Primary separation
- Gravity settling
- Coalescing
- Liquid collecting







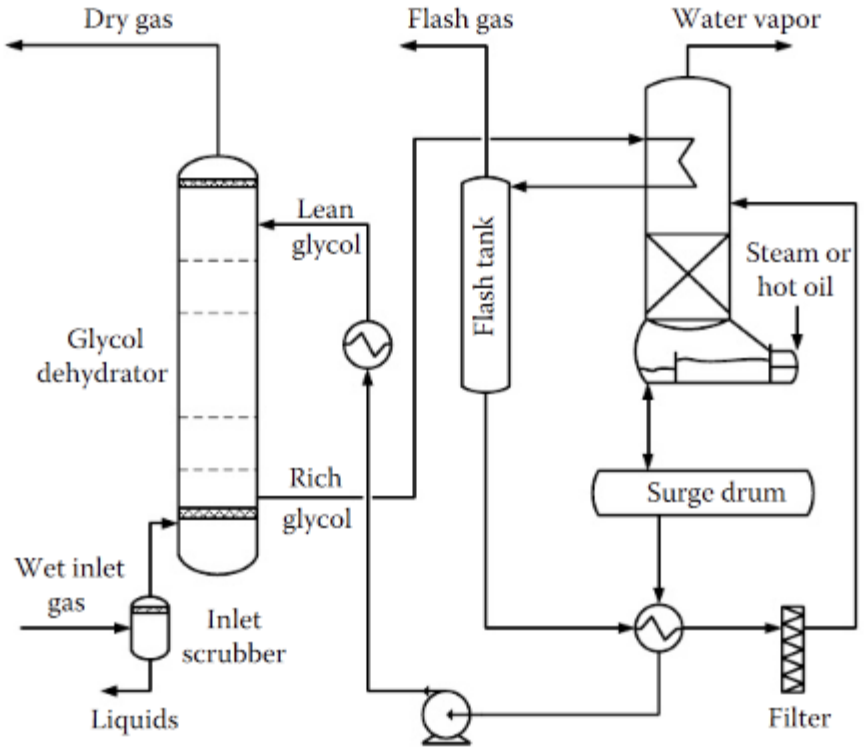
Acid gas removal with MEA



PFD of MEA treating process.
: Contactor operates at pressure up to 70 bar. Flow rates to reclaimer are 1 ~ 3 % of amine circulate rate

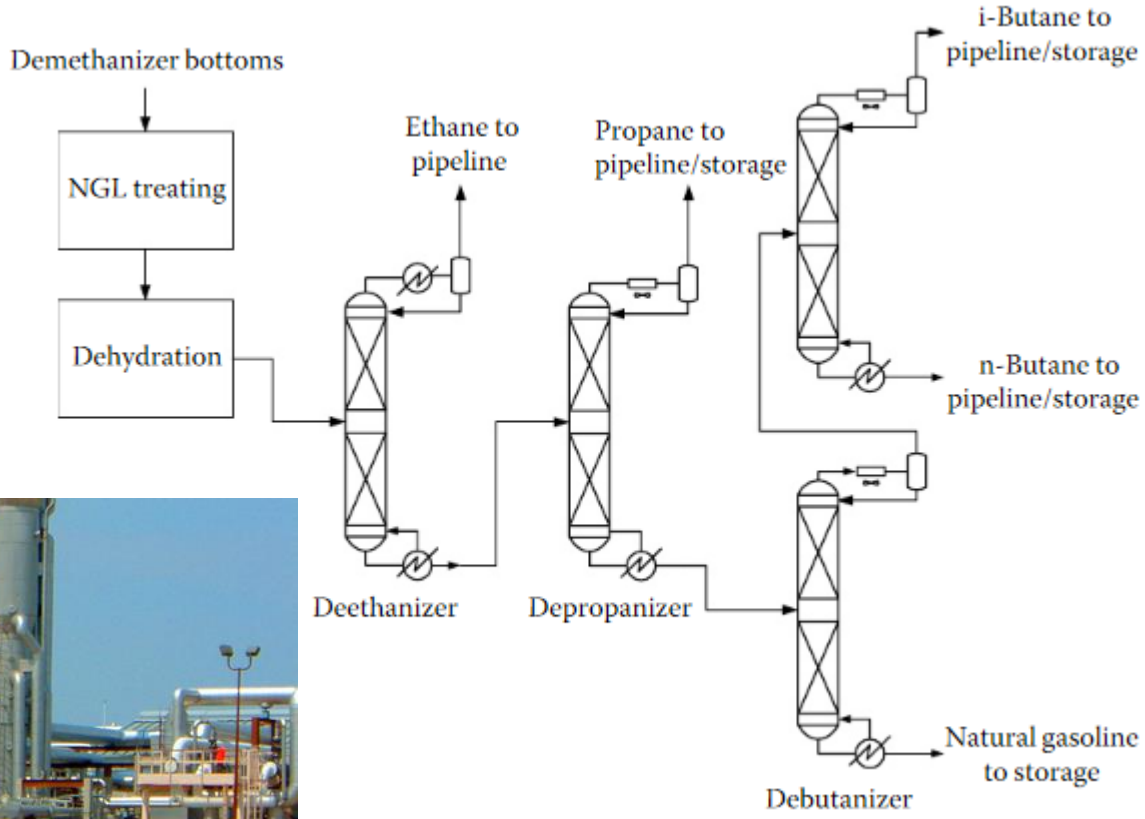
Gas dehydration using TEG

- A typical, simplified flow sheet for a glycol absorption unit

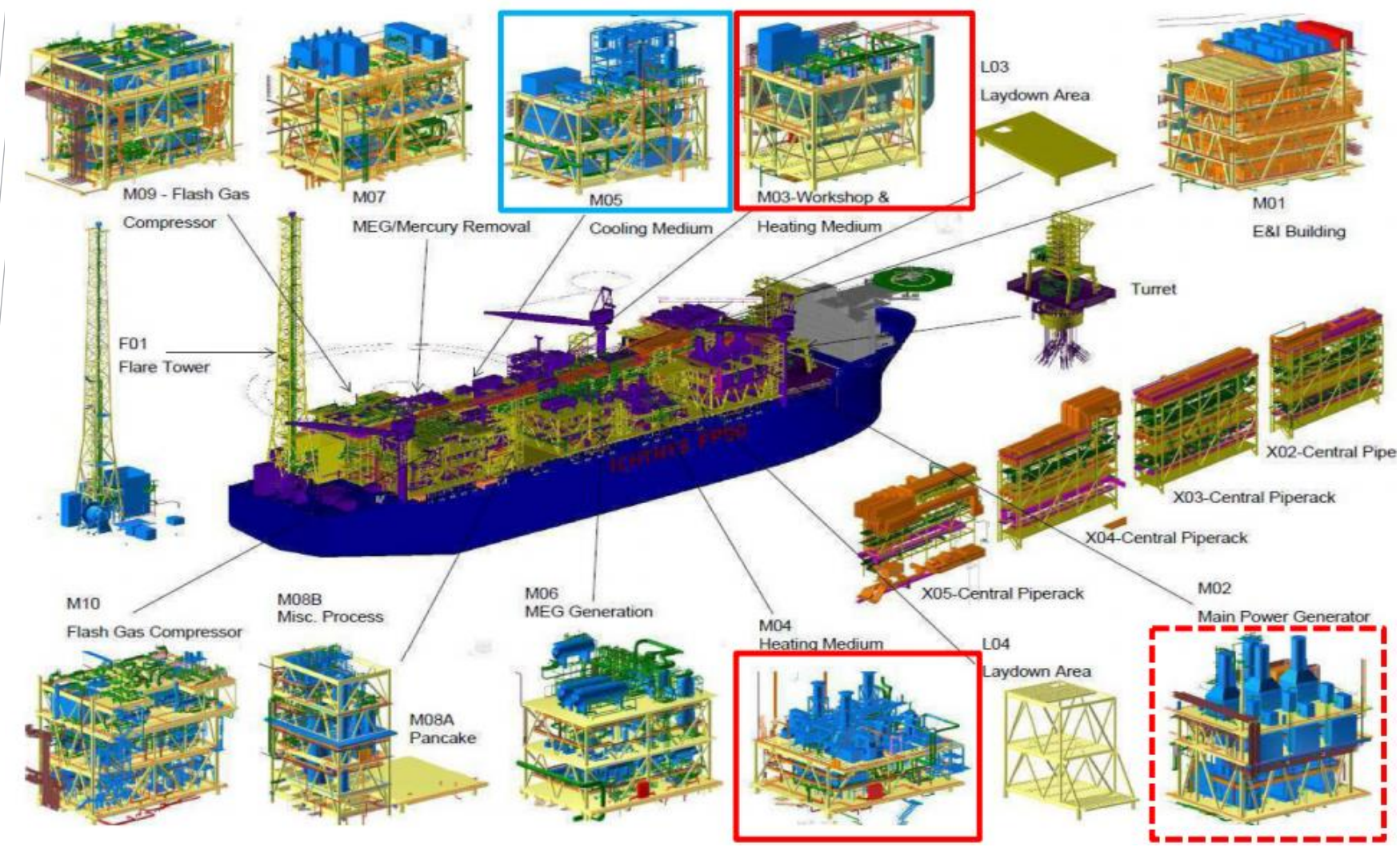


NGL recovery

- Extensive fractionation of NGL



Offshore facilities on topside



Thank you!