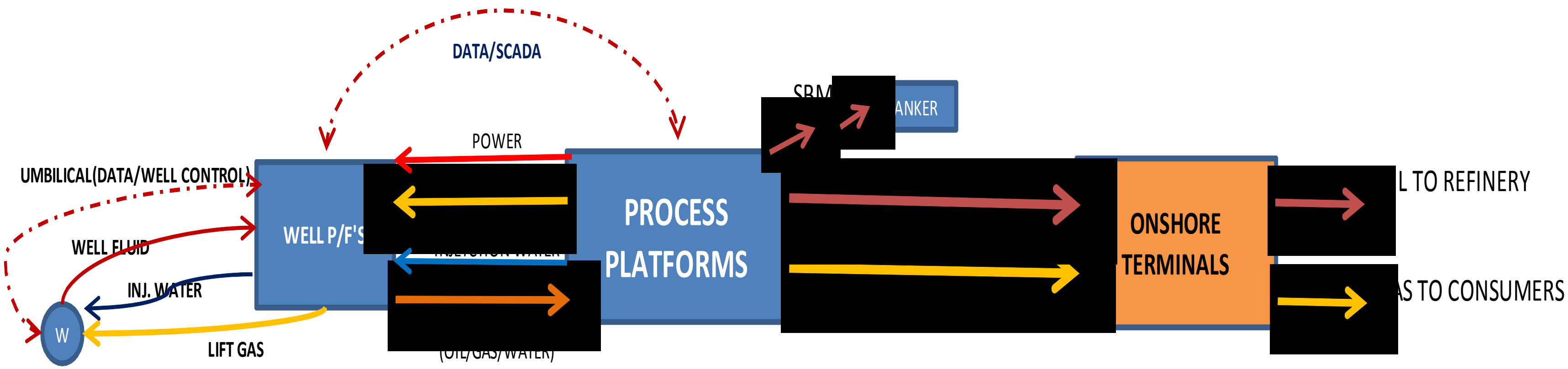
Offshore Oil and Gas Production Systems

OFFSHORE PRODUCTION SYSTEM- A SCHEMATIC



WELLS

- OIL PRODUCERS
- GAS PRODUCERS
- INJECTION WELLS

- WELLS
- WELL TESTING
- PRODN OPTIMIZATION
- WELL CONTROL
- WELL SERVICING
- TELEMETRY / SCADA

- WELLS/CONNECTED WELL P/F
- SEPARATION MODULE- OIL/GAS/WATER
- GAS COMPRESSION AND DEHYDRATION MODULE
- SEA WATER TREATMENT FOR WATER INJECTION
- PRODUCED WATER TREATEMENT MODULE
- POWER GENERATION
- UTILITIES - WATER/SUPPLIES
- LIVING QUARTERS
- DRILLING/WELL SERVICING RIG MODULE

THE MAJOR ELEMENTS OF OFFSHORE PRODUCTION SYSTEM

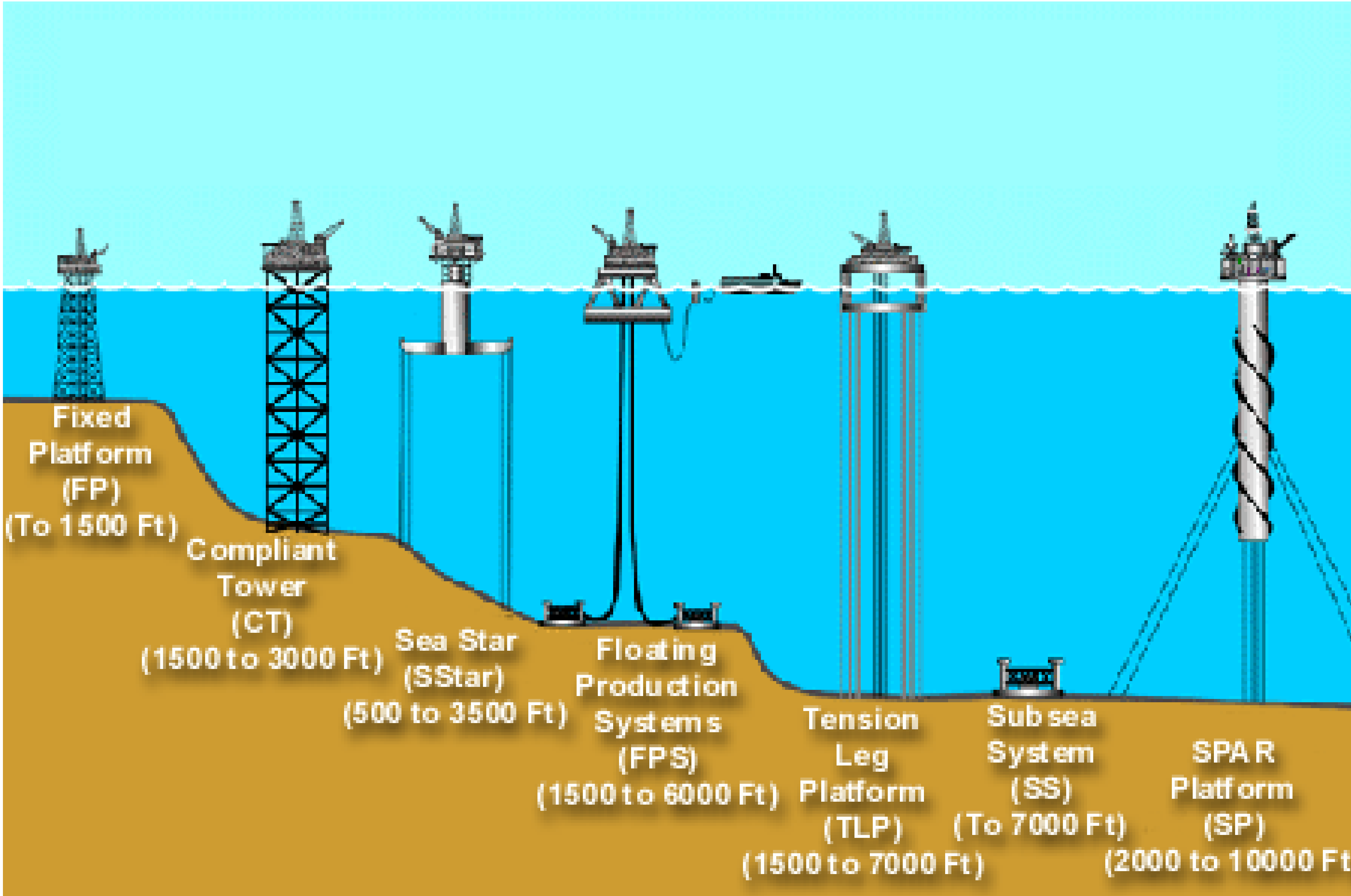
- **WELLS (SUBSEA/PLATFORM WELLS)**
- **WELL PLATFORMS/WELL SERVICING RIGS**
- **FEEDER SUBSEA PIPELINES**
- **PROCESSING PLATFORMS**
- **EXPORT PIPELINES FOR OIL/GAS**
- **TANKERS FOR EVACUATION OF OIL.**

We shall discuss about…

- PLATFORMS
- WELLHEAD PLATFORMS
- WELLS
- PROCESSING SYSTEM
- NEW TECHNOLOGIES

TYPES OF OFFSHORE PLATFORMS

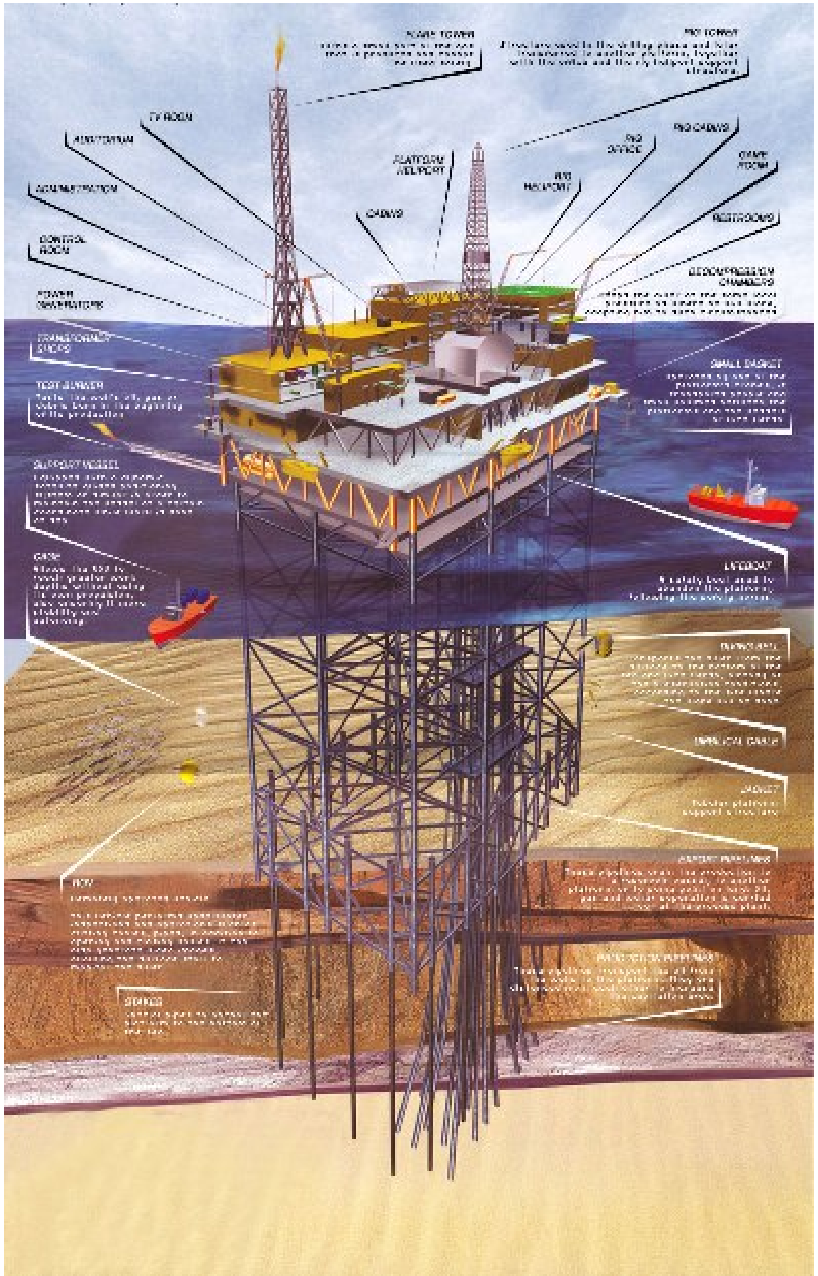
WATER DEPTH AND TYPE OF PLATFORM



Oil platforms

- An oil platform or oil rig is a large structure used to house workers and machinery needed to drill and/or extract oil and natural gas through wells in the ocean bed.
- Depending on the circumstances, the platform may be attached to the ocean floor, consist of an artificial island, or be floating.
- Generally, oil platforms are located on the continental shelf, though as technology improves, drilling and production in deeper waters becomes both feasible and profitable.
- A typical platform may have around thirty wellheads located on the platform and directional drilling allows reservoirs to be accessed at both different depths and at remote positions up to 5 miles (8 kilometres) from the platform.
- Many platforms also have remote wellheads attached by umbilical connections, these may be single wells or a manifold centre for multiple wells.

FIXED PLATFORMS



These platforms are built on concrete and/or steel legs anchored directly onto the seabed, supporting a deck with space for drilling rigs, production facilities and crew quarters.

Such platforms are, by virtue of their immobility, designed for very long term use.

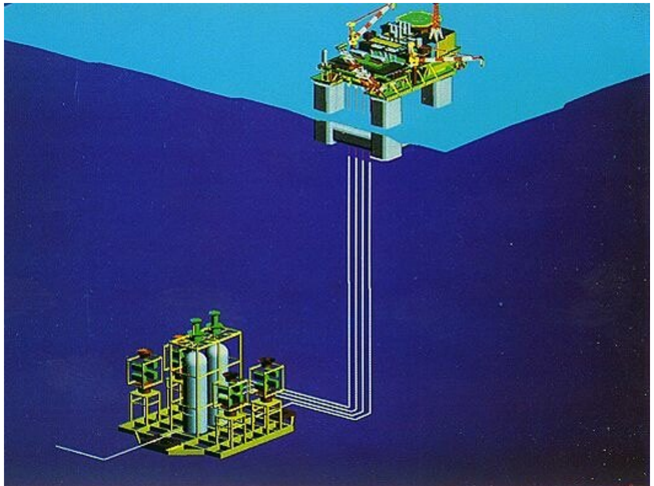
Various types of structure are used, steel jacket, concrete caisson, floating steel and even floating concrete.

Steel jackets are vertical sections made of tubular steel members, and are usually piled into the seabed. Concrete caisson structures, often have in-built oil storage in tanks below the sea surface and these tanks were often used as a flotation capability, allowing them to be built close to shore and then floated to their final position where they are sunk to the seabed.

Fixed platforms are economically feasible for installation in water depths up to about 1,700 feet (520 m).

Fixed Platform

Semi-submersible Platform



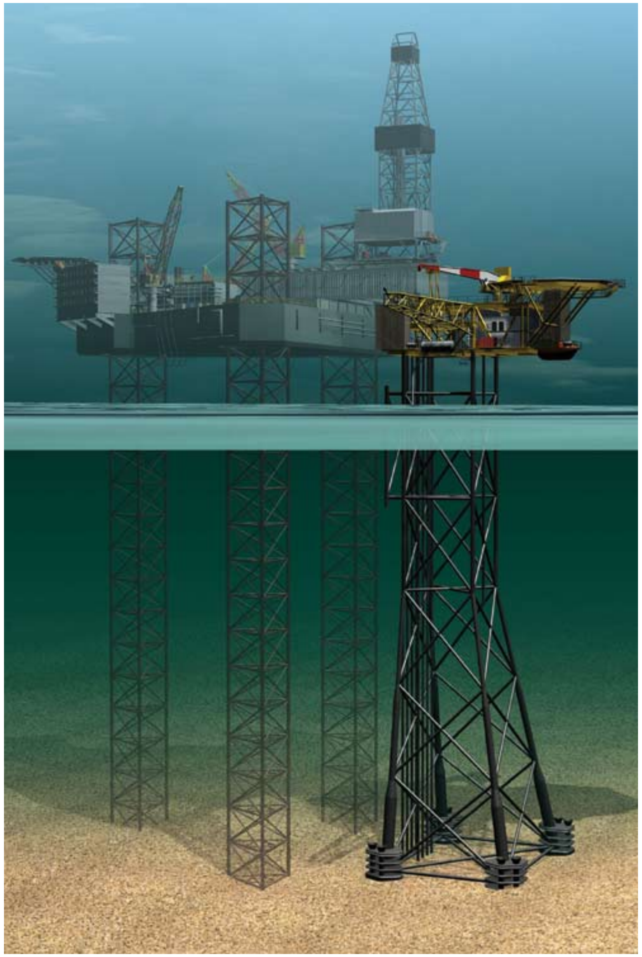
These platforms have legs of sufficient buoyancy to cause the structure to float, but of weight sufficient to keep the structure upright.

Semi-submersible rigs can be moved from place to place; can be ballasted up or down by altering the amount of flooding in buoyancy tanks;

They are generally anchored by with chain, wire rope and/or polyester rope during drilling operations, though they can also be kept in place by the use of dynamic positioning.

Semi-submersibles can be used in water depths from 200 to 10,000 feet (60 to 3,050 m).

Jack-up Platforms

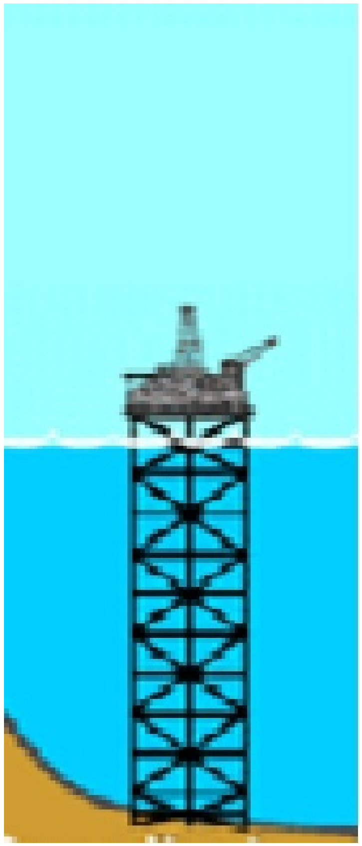


Jackups, as the name suggests, are platforms that can be jacked up above the sea using legs which can be lowered like jacks.

These platforms are typically used in water depths up to 400 feet, although some designs can go to 550 feet depth.

They are designed to move from place to place, and then anchor themselves by deploying the legs to the ocean bottom using a rack and pinion gear system on each leg.

Compliant Towers

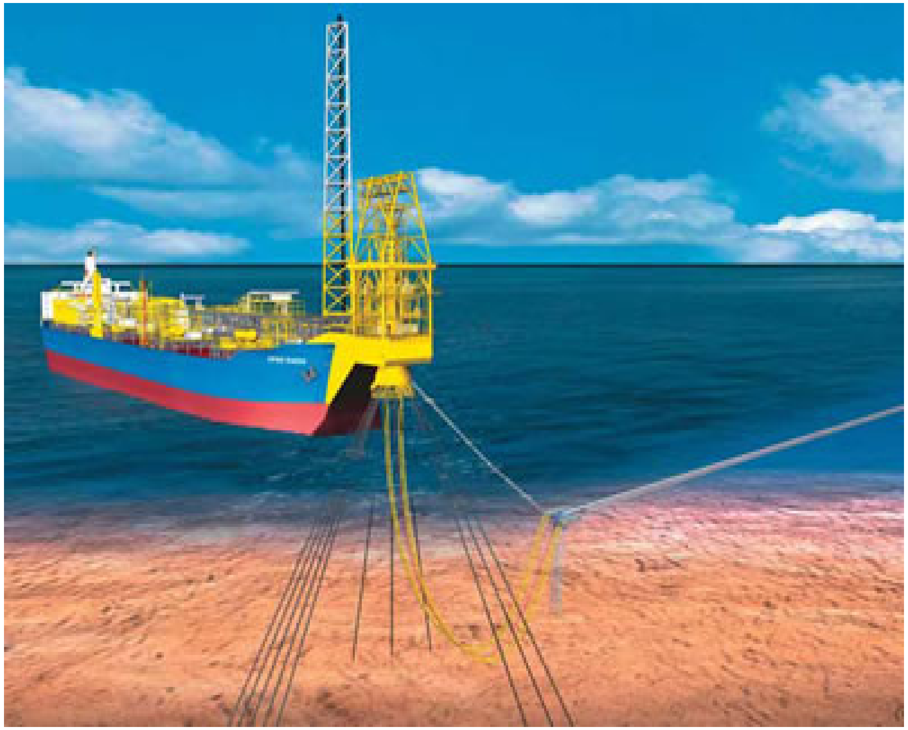


- These platforms consist of narrow, flexible towers and a piled foundation supporting a conventional deck for drilling and production operations. Compliant towers are designed to sustain significant lateral deflections and forces, and are typically used in water depths ranging from 1,500 and 3,000 feet (450 and 900 m).

Drillships

A drillship is a maritime vessel that has been fitted with drilling apparatus. It is most often used for exploratory drilling of new oil or gas wells in deep water but can also be used for scientific drilling. Early versions were built on a modified tanker hull, but purpose-built designs are used today. Most drillships are outfitted with a dynamic positioning system to maintain position over the well. They can drill in water depths up to 12,000 feet (3,660 m).

Floating production systems



FPSOs are large ships equipped with processing facilities and moored to a location for a long period.

The main types of floating production systems are:

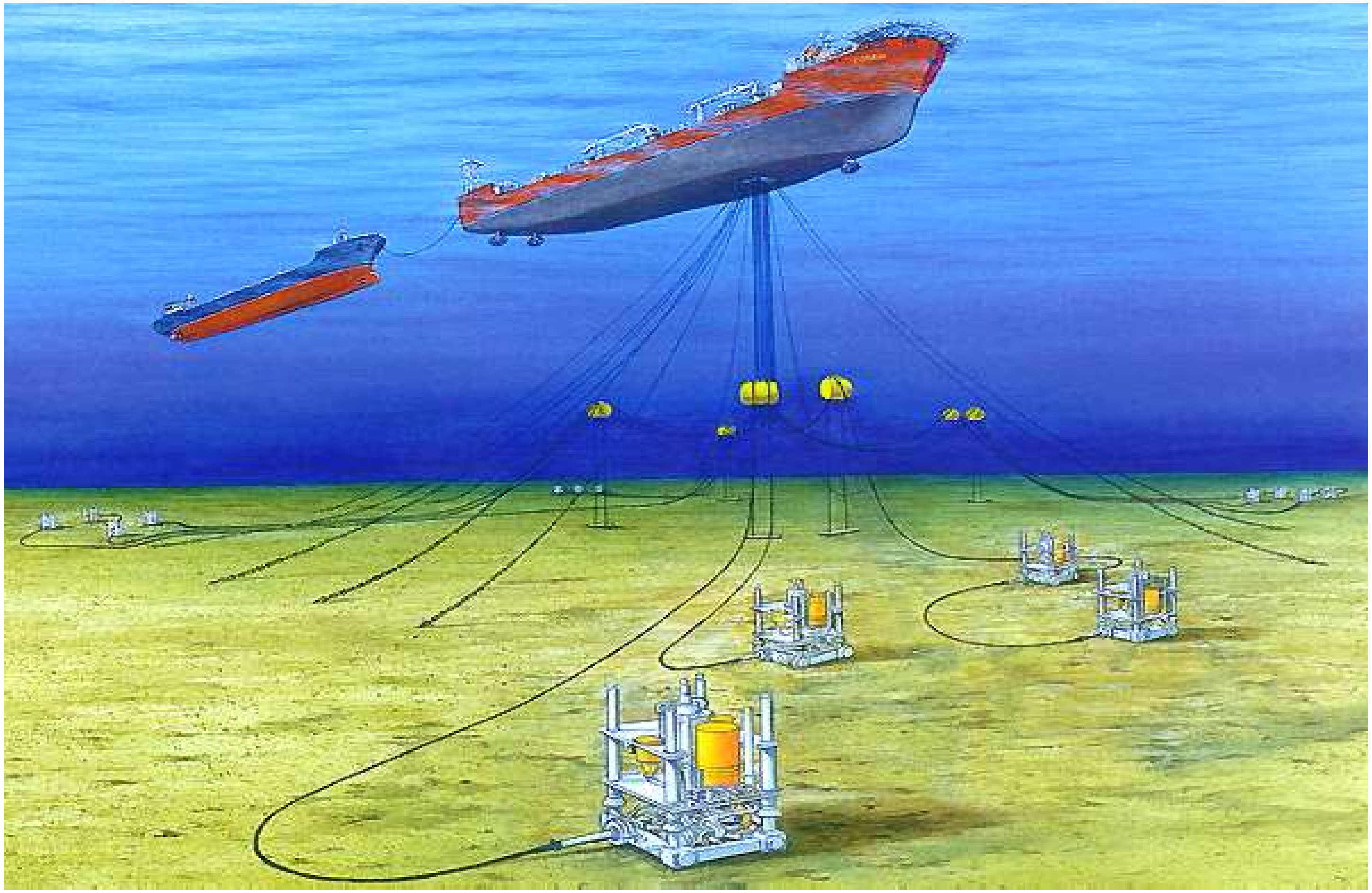
FPSO (floating production, storage, and offloading system),

FSO (floating storage and offloading system), and

FSU (floating storage unit).

These ships do not actually drill for oil or gas.

FPSO AND SUBSEA WELLS



Tension-leg platform

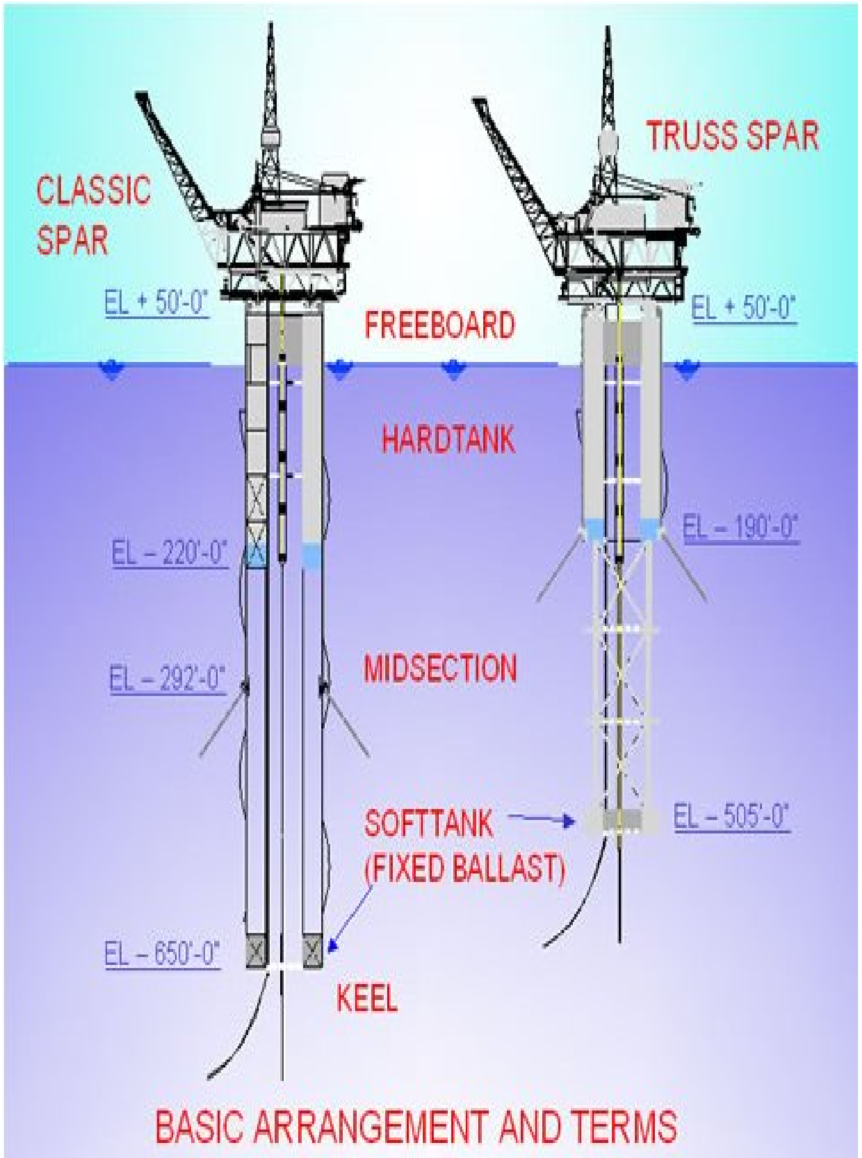
TLPs consist of floating rigs tethered to the seabed in a manner that eliminates most of the vertical movement of the structure.

TLPS are used in water depths up to about 6,000 feet (2,000 m). The "conventional" TLP is a 4-column design which looks similar to a semisubmersible.

Proprietary versions include the Seastar and MOSES mini TLPs; they are relatively low cost, used in water depths between 600 and 4,300 feet (200 and 1,300 m).

Mini TLPs can also be used as utility, satellite or early production platforms for larger deepwater discoveries.

SPAR Platforms



Spars are moored to the seabed like the TLP, but whereas the TLP has vertical tension tethers the Spar has more conventional mooring lines.

Spars have been designed in three configurations: the "conventional" one-piece cylindrical hull, the "truss spar" where the midsection is composed of truss elements connecting the upper buoyant hull (called a hard tank) with the bottom soft tank containing permanent ballast, and the "cell spar" which is built from multiple vertical cylinders.

The Spar may be more economical to build for small and medium sized rigs than the TLP, and has more inherent stability than a TLP since it has a large counterweight at the bottom and does not depend on the mooring to hold it upright.

It also has the ability, by use of chain-jacks attached to the mooring lines, to move horizontally over the oil field.

World’s deepest spar: Eni's Devil's Tower is located in 5,610 feet (1,710 m) of water, in the Gulf of Mexico; however, when Shell's Perdido Spar is installed, it will be the deepest at 8,000 feet (2,438 m

Maintenance and supply

- A typical oil production platform is self-sufficient in energy and water needs, housing electrical generation, water desalinators and all of the equipment necessary to process oil and gas such that it can be either delivered directly onshore by pipeline or to a Floating Storage Unit and/or tanker loading facility.
- Elements in the oil/gas production process include wellhead, production manifold, Production separator, glycol process to dry gas, gas compressors, water injection pumps, oil/gas export metering and main oil line pumps.
- All production facilities are designed to have minimal environmental impact.
- Larger platforms are assisted by smaller ESVs (emergency support vessels) that are summoned when something has gone wrong, e.g. when a search and rescue operation is required.
- During normal operations, PSVs (platform supply vessels) keep the platforms provisioned and supplied, and AHTS vessels can also supply them, as well as tow them to location and serve as standby rescue and fire fighting vessels.

Crew

- The size and composition of the crew of an offshore installation will vary greatly from platform to platform.

- Because of the cost intensive nature of operating an offshore platform, it is important to maximise productivity by ensuring work continues 24 hours a day.

- This means that there are essentially two complete crews on board at a time, one for day shift and the other for night shift. Crews will also change out at regular intervals, nominally two weeks.

Essential personnel

- Not all of these personnel are present on every platform, on smaller platforms workers will be responsible for several areas. The names shown are not industry-wide.

  * OIM (offshore installation manager) is the ultimate authority during his/her shift and makes the essential decisions regarding the operation of the platform.
  * Operations Team Leader (OTL)
  * Offshore Operations Engineer (OOE) is the senior technical authority on the platform
  * PSTL or Operations coordinator for managing crew changes
  * Dynamic Positioning Operator, navigation, ship or vessel maneuvering (MODU), station keeping, fire and gas systems operations in the event of incident
  * 2nd Mate - Meets manning requirements of flag state, operates Fast Rescue craft, cargo ops, fire team leader.
  * 3rd Mate - Meets manning requirements of flag state, operates Fast Rescue craft, cargo ops, fire team leader
  * Ballast Control Operator _ also fire and gas systems operator
  * Crane operators to operate the cranes for lifting cargo around the platform and between boats.
  * Scaffolders to rig up scaffolding for when it is required for workers to work at height.
  * Coxwains for maintaining the lifeboats and manning them if necessary.
  * Control room operators - Especially FPSO or Production platforms.
  * Catering crew will include people tasked with performing essential functions such as cooking, laundry and cleaning the accommodation.
  * Production techs for running the production plant
  * Helicopter Pilot(s) live on some platforms that have a helicopter based offshore. The helicopter flight crew transports workers to other platforms or to shore on crew changes.
  * maintenance technicians (instrument ,electrical ,mechanical)

Essential personnel – ONGC System

MANAGERS:

- OFFSHORE INATALLATION MANAGER
- PROCESS MANAGER
- MAINTENANCE MANAGER
- WELL PLATFORM MANAGER
- HSE MANAGER

TEAMS

- Process control room operators
- Mechanical/Electrical/Instrumentation team
- Static Equipment maintenance team
- Wellhead teams
- Pipeline maintenance team
- Skilled and Unskilled technicians

Incidental personnel

* **Drill crew** will be on board if the installation is performing drilling operations. A drill crew will normally comprise:

  - o Toolpusher
  - o Roughnecks
  - o Roustabouts
  - o Company man
  - o Mud engineer
  - o Derrickhand
  - o Geologist

* **Well services crew** will be on board for well work. The crew will normally comprise:

  - o Well services supervisor
  - o Wireline or coiled tubing operators
  - o Pump operator

Risks

- The nature of their operation — extraction of volatile substances sometimes under extreme pressure in a hostile environment — has risk and accidents and tragedies occasionally occur. In July 1988, 167 people died when Occidental Petroleum's Piper Alpha offshore production platform, on the Piper field in the North Sea, exploded after a gas leak. The accident greatly accelerated the practice of providing living accommodations on separate rigs, away from those used for extraction.

  However, this was, in itself, a hazardous environment. In March 1980, the 'flotel' (floating hotel) platform Alexander Kielland capsized in a storm in the North Sea with the loss of 123 lives.

  Given the number of grievances and conspiracy theories that involve the oil business, and the importance of gas/oil platforms to the economy, platforms are believed to be potential terrorist targets. Agencies and military units responsible for maritime Security often train for platform raids.

Ecological effects

- **In British waters, the cost of removing all platform rig structures entirely was estimated in 1995 at $345 billion, and the cost of removing all structures including pipelines — a so-called "clean sea" approach — at $621 billion.**

- **Further effects are the leaching of heavy metals that accumulate in buoyancy tanks into water; and risks associated with their disposal.**

- **There has been concern expressed at the practice of partially demolishing offshore rigs to the point that ships can traverse across their site; there have been instances of fishery vessels snagging nets on the remaining structures.**

- **Proposals for the disposal at sea of the Brent Spar, a 449 ft tall storage buoy , was for a time in 1996 an environmental cause célèbre in the UK after Greenpeace occupied the floating structure. The event led to a reconsideration of disposal policy in the UK and Europe.**

- **In the United States, Marine Biologist Milton Love has proposed that oil platforms off the California coast be retained as artificial reefs, instead of being dismantled (at great cost), because he has found them to be havens for many of the species of fish which are otherwise declining in the region, in the course of 11 years of research. Love is funded mainly by government agencies, but also in small part by the California Artificial Reef Enhancement Program.**
- **In the Gulf of Mexico, more than 200 platforms have been similarly converted.**

Un-manned Platforms

Normally unmanned installations….

- These installations (called Wellhead Platforms), are small platforms, consisting of little more than a well bay, helipad and emergency shelter.
- They are designed to operate remotely under normal operations, only to be visited occasionally for routine maintenance or well work.

WELLHEAD PLATFORMS

- Generally 4 legged unmanned platforms
- Consists of 4 decks, spider deck, cellar deck, main deck and helideck
- Personnel visit the platform for Well testing and other maintenance activities.
- May have 3 to 32 wells (Producers and Injectors), one vertical well and others directional and reaching out in different direction up to 6 km from the platform.
- Wells are drilled normally by Jack up Rigs that dock with the platform.
- Well servicing (workover) is done either by Jack up rigs or by Modular Rigs that are assembled over the platform.

Facilities in Well Platforms

- Wells
- Production Manifold to receive well fluid from all the wells
- Lift gas Manifold for feeding lift gas to well along with Injection gas regulation/Control and measurement system.
- WI manifold for feeding injection water to WI wells along with metering system.
- Test manifold and Test separator and associated measurement system for Oil, Gas and Water.
- Well control Panel (SDP)
- Instrument gas system
- RTU and SCADA
- Battery pack, Solar power panel.
- Subsea lines carry well fluid from the platform to the Process platform
- Also, Lift gas and Injection water is brought in by subsea lines from Process Platform.
- Emergency Gen-set.
- Fire water pumps and Fire fighting system.
- HC Gas detectors
- ESD/FSD system
- Crane.

SDP

- **Pneumatic control panels are designed to monitor crucial wellhead safety parameters. They provide sequential start up and safe shutdown of production wells.**
- **In remote unmanned well-head platforms produced gas is used as the medium inside the control panel. Easy availability of pneumatic power source makes pneumatic controls a desirable choice.**

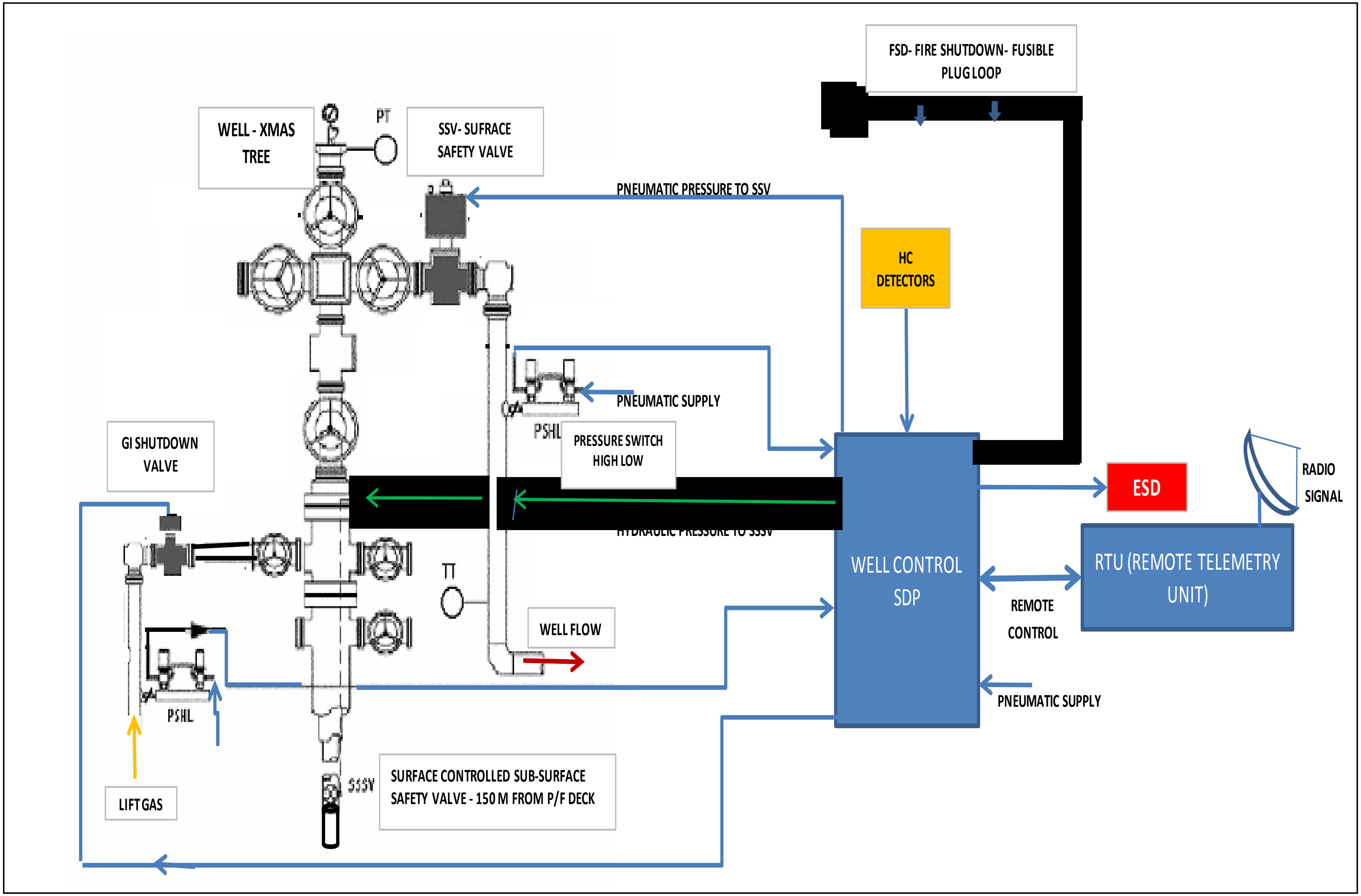
The pneumatic shutdown panel is designed as a central protection unit for overall protection of the installation. Three levels of protection for personnel, production wells and surface facilities are envisaged. Thus a panel consists of;

a) Fire and gas leakage protection system: Any gas leakage is automatically detected and appropriate shutdown action initiated to prevent formation of combustible mixture. All sources of ignition are also shutdown. Any eruption of fire is detected and appropriate shutdown and suppression action initiated.

b) Surface Facility Protection: A safety analysis or hazardous operability (HAZOP) analysis of surface facilities including rotary and process equipments is carried out. All possible hazards, interrelation between various parameters are identified and listed. The functional chart thus evolved is the SAFE (Safety Analysis and Function Evaluation) chart. The SAFE chart forms the basis for design of panel in surface safety protection.

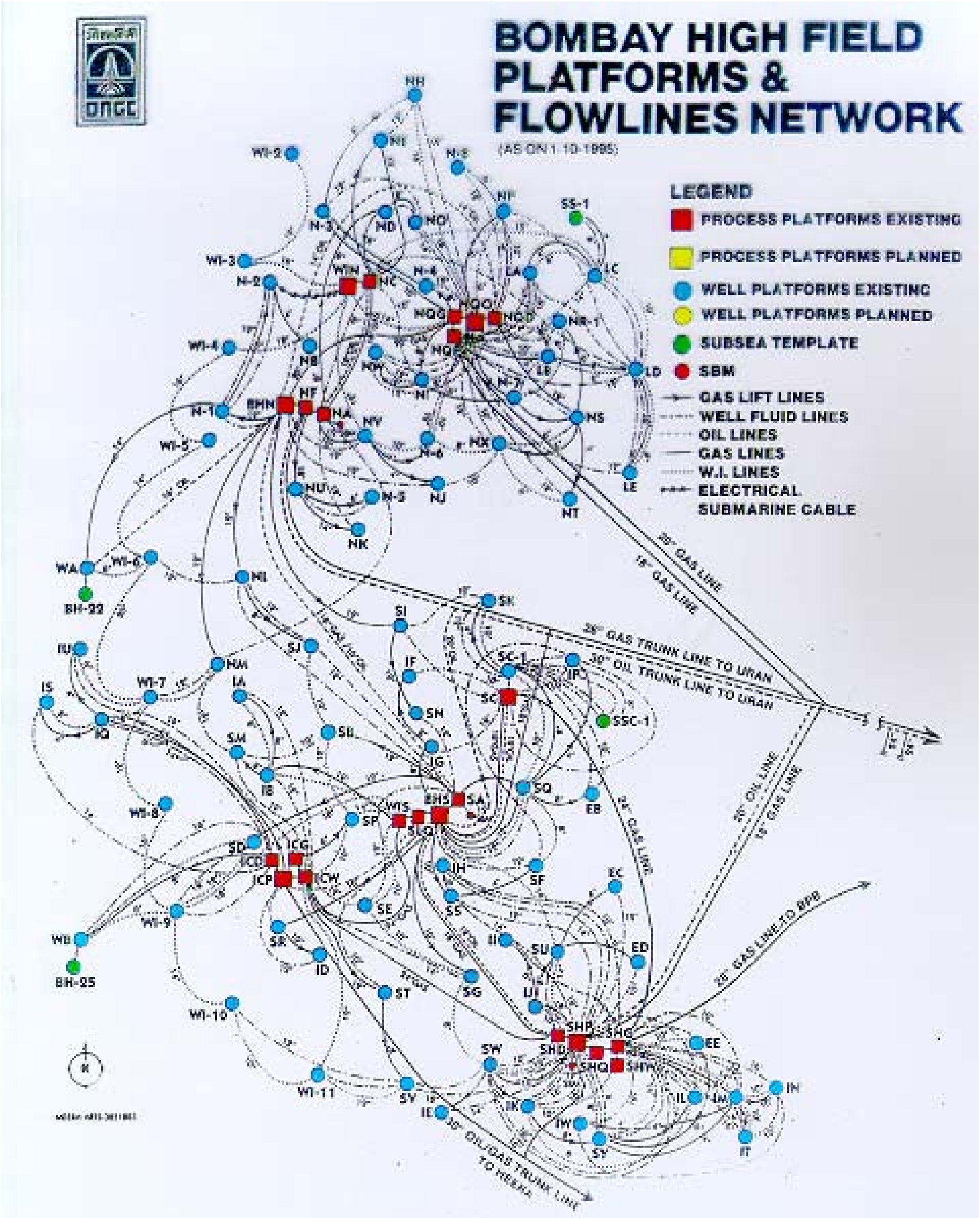
c) Well control & Protection: A major function of the wellhead shutdown panel is to control the well through the surface and sub surface safety valves. The interrelations between various valves are well defined and their sequential operation established.

WELL CONTROL-SCHEMATIC



WELL CONTROL

- Wells close by SSV (Surface Safety Valve) and SSSV (Sub-surface Safety Valve) when abnormal conditions exists.
- Abnormal conditions may be Higher Pressures in the flow lines, Fire.
- Wells can also be closed remotely from Process platforms/Shore through SCADA with the help of RTU.


BOMBAY HIGH FIELD PLATFORMS & FLOWLINES NETWORK
(AS ON 1-10-1995)
LEGEND
PROCESS PLATFORMS EXISTING
PROCESS PLATFORMS PLANNED
WELL PLATFORMS EXISTING
WELL PLATFORMS PLANNED
SUBSEA TEMPLATE
SBM
GAS LIFT LINES
WELL FLUID LINES
OIL LINES
GAS LINES
W.I. LINES
ELECTRICAL SUBMARINE CABLE
ONGC
26" GAS TRUNK LINE TO URAN
30" OIL TRUNK LINE TO URAN
30" OIL/GAS TRUNK LINE TO HEERA
26" GAS LINE TO BPB
20" GAS LINE
18" GAS LINE
20" OIL LINE
16" GAS LINE
24" OIL LINE

SMART WELLHEAD PLATFORMS

- Provides Well head real time data.
- Provide Real time Monitoring and Control of Unmanned Platforms and wells.
- Provides minimum Human Intervention in day to day operations
- Provide Stabilised production and Transportations process along with Optimisations
- Provide real time data Consolidation, Recording and storage for the analysis for future evaluations.
- Reduce the delay in decision making via online measurements of critical parameters such as Water cut, Gas Rates etc.

Major Elements of SMART platform

- Instrumentation on well head.
- Automated Well testing using Remotely Operated Multi Selector Valve in well platform.
- Automation system to Monitor and Optimise Production.
- Remote Lift Gas optimization.
- Integration of different automation system to ensure data consolidation at central facilities.
- WAN Communication: Radio, V- sat at offshore wellhead platform.

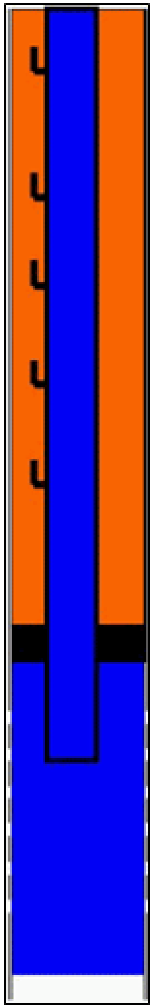
WELLS

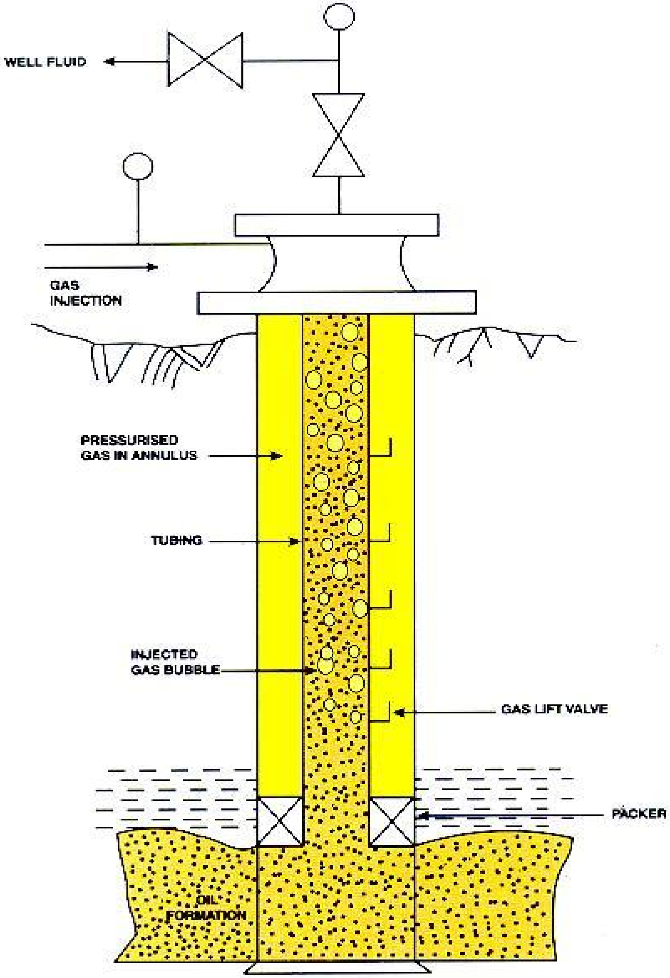
- Producers

  Self flow, Gas lifted and ESP.
- Injectors
- Subsea wells :

  Dry Tree, Wet Tree wells.
- Directional wells
- Horizontal wells
- ERD Wells
- Multilateral wells
- Intelligent wells

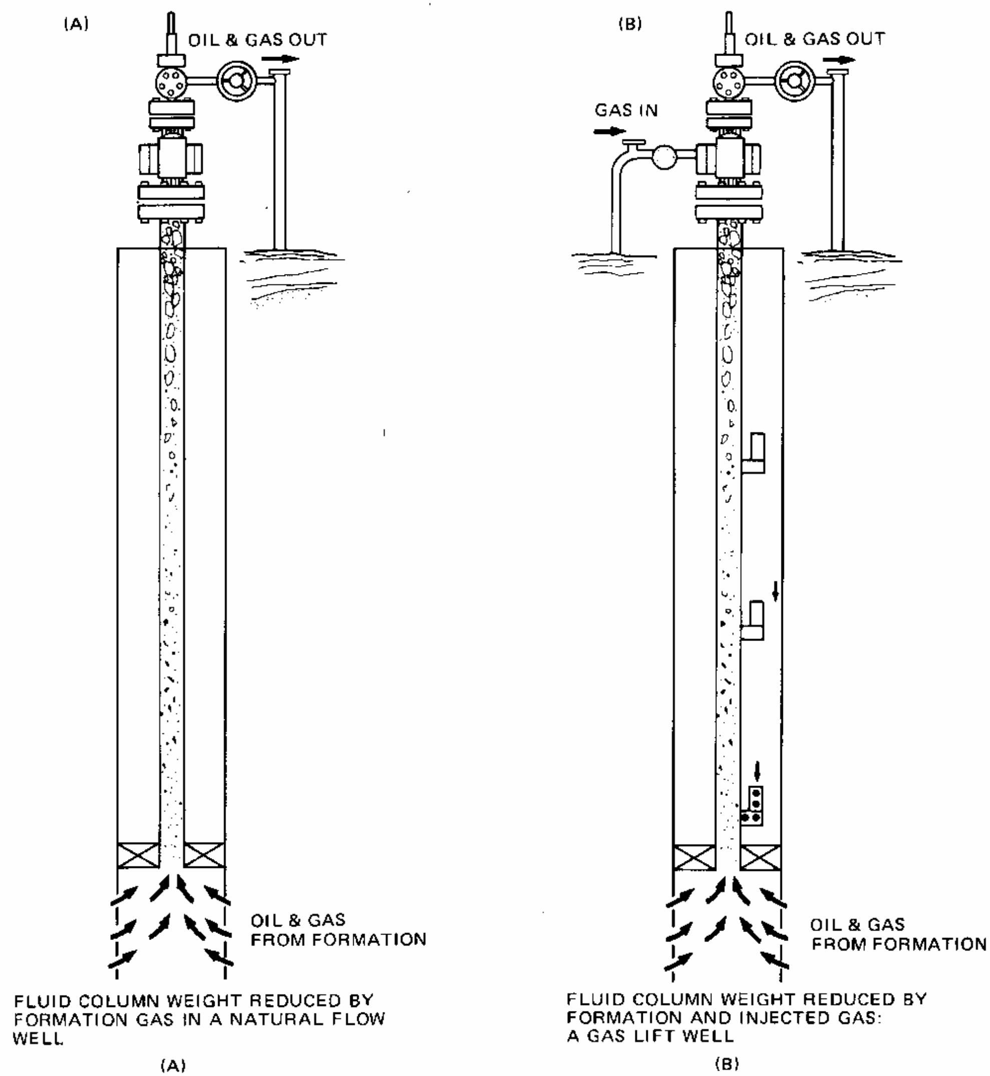
Gas Lifted wells



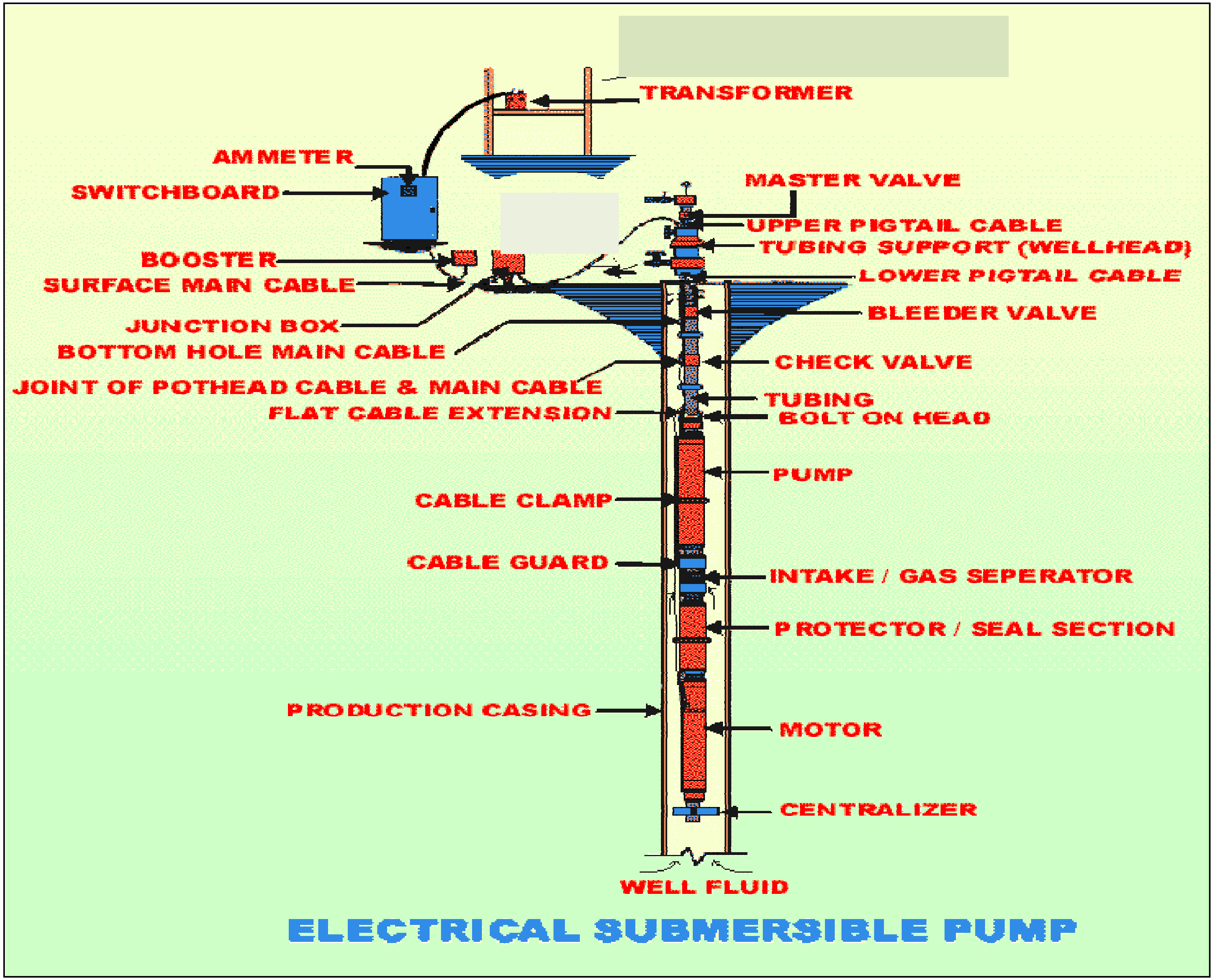


Well on Gas Lift : Gas injected in the tubing to lighten the liquid column. JAN' 99

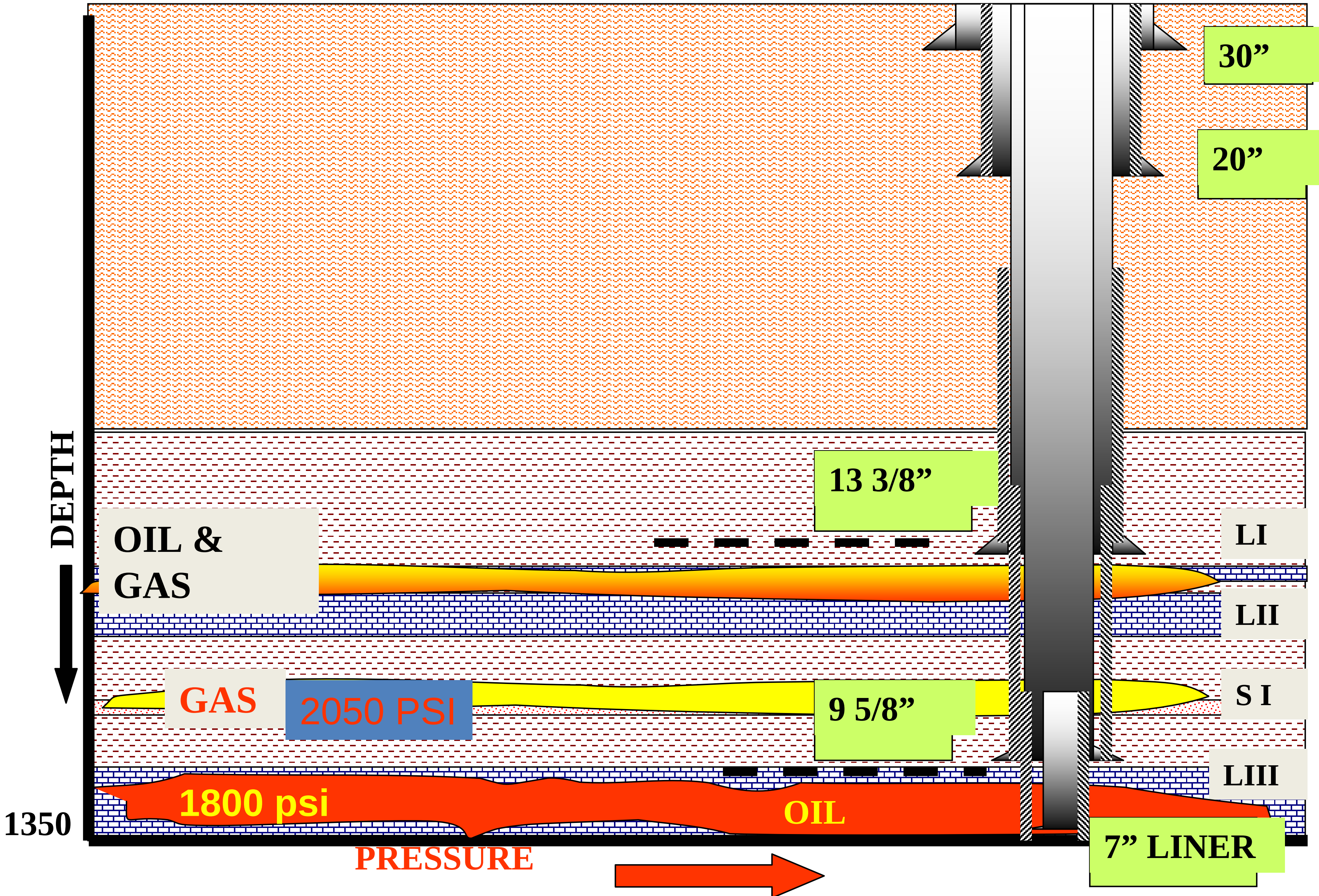
SELF FLOWING AND GAS LIFTED WELLS



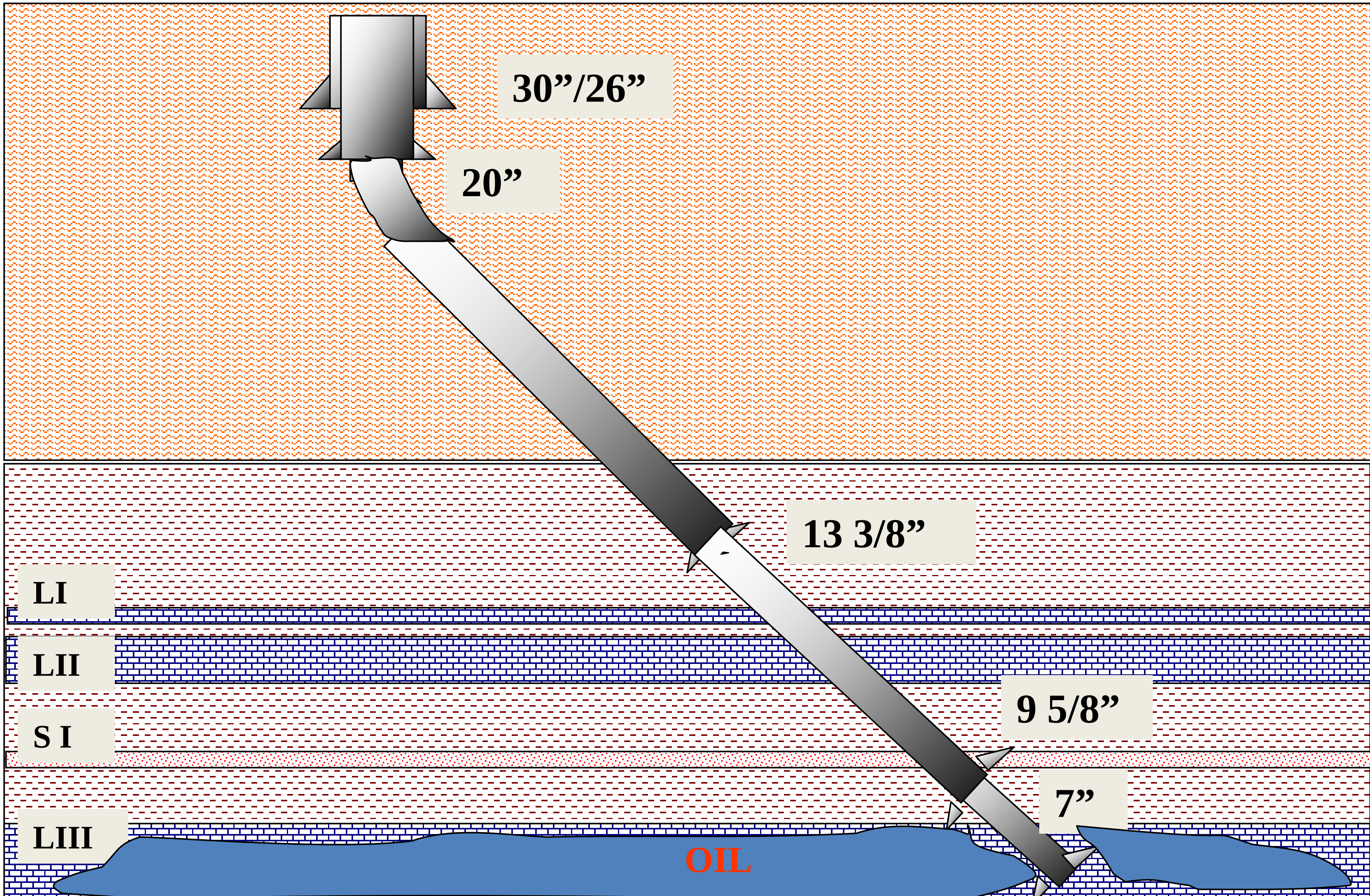
ELECTRICAL SUBMERISBLE PUMPS (ESP) WELLS



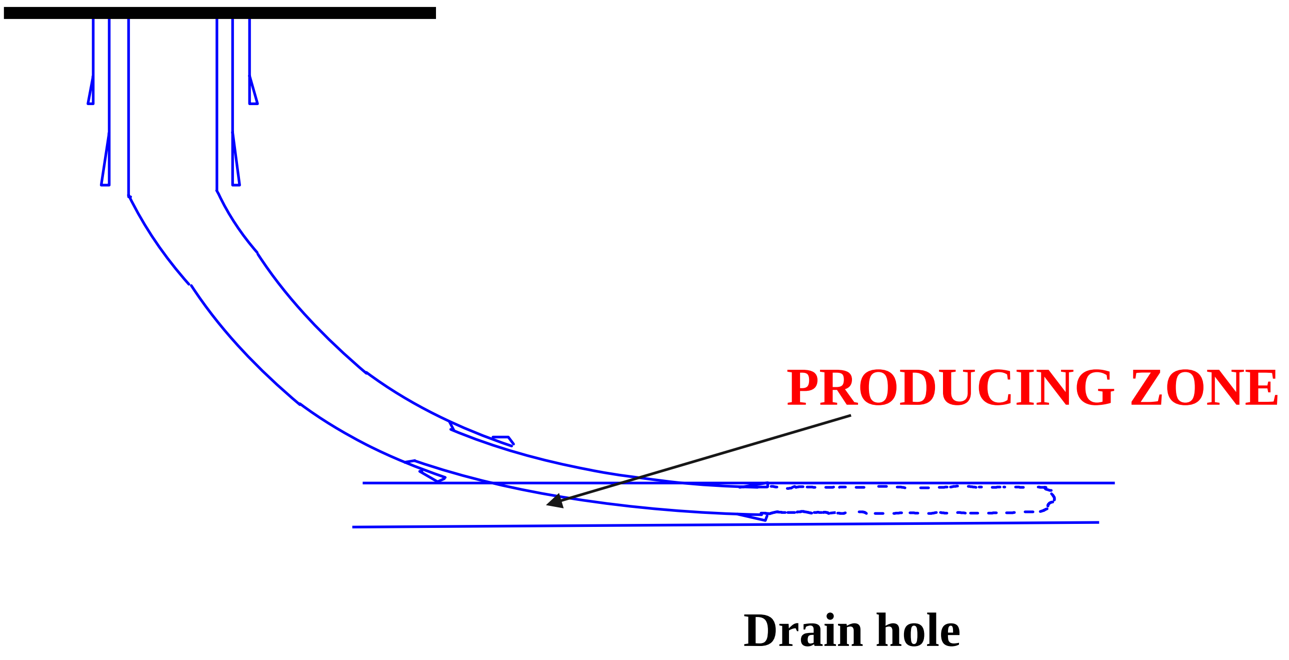
VERTICAL WELL



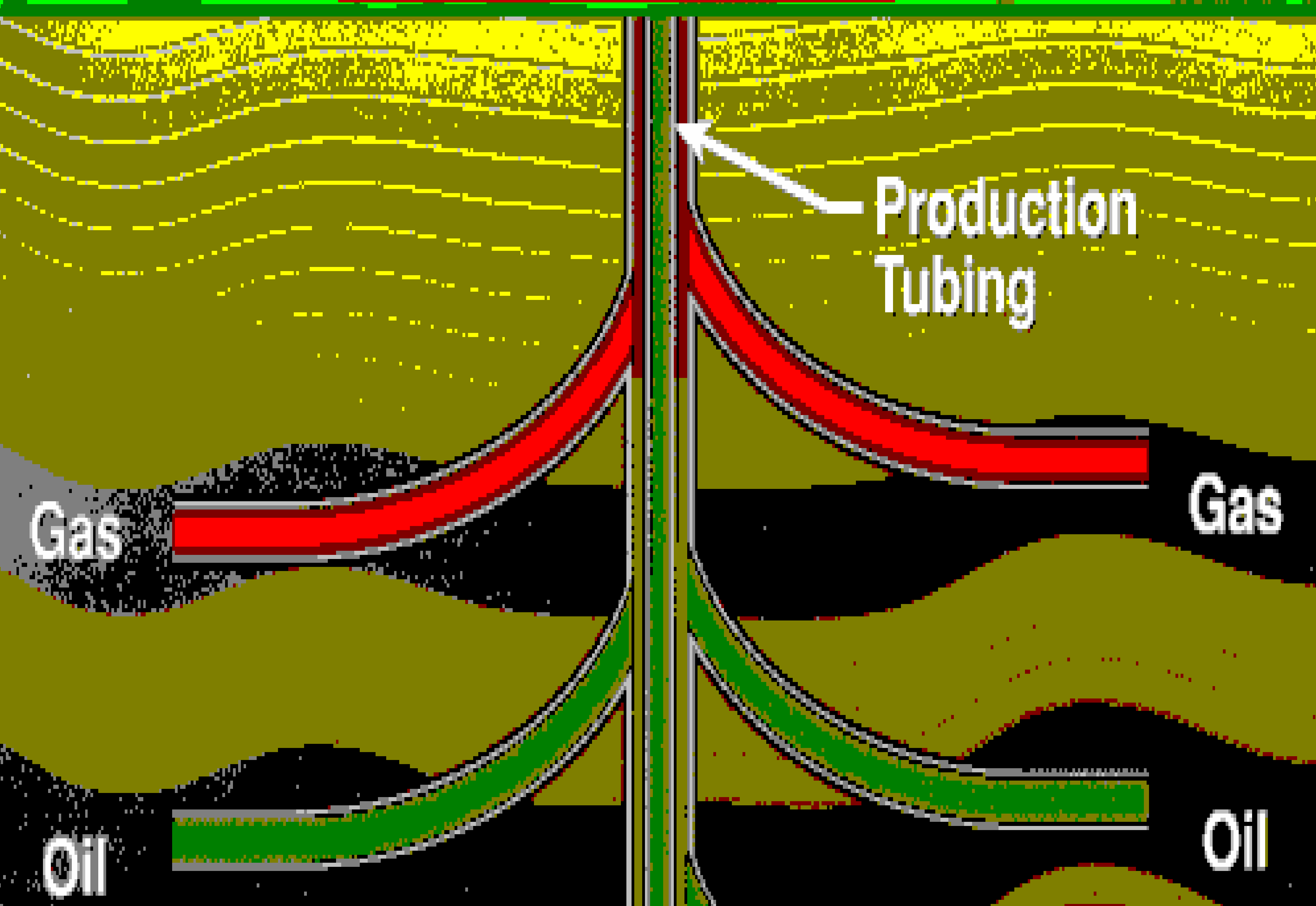
DIRECTIONAL WELL



HORIZONTAL WELLS

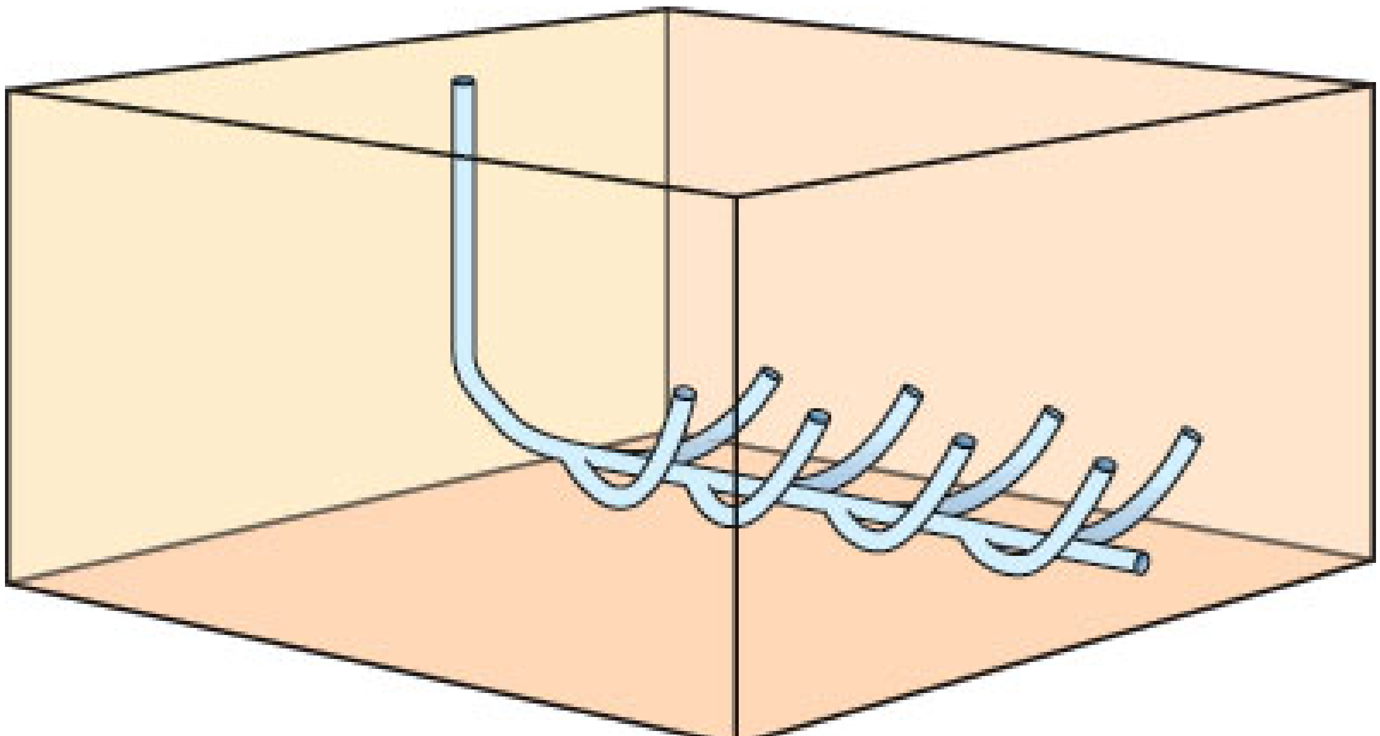


MULTI LATERAL WELL



FISHBONE MULTI LATERAL WELL

Many ribs branch off the main wellbore. The path of oil to the well is shorter through a rib than through the rock, both in homogeneous sands and even more in heterogeneous sands with barriers and baffles. Ribs can be added to any lateral.

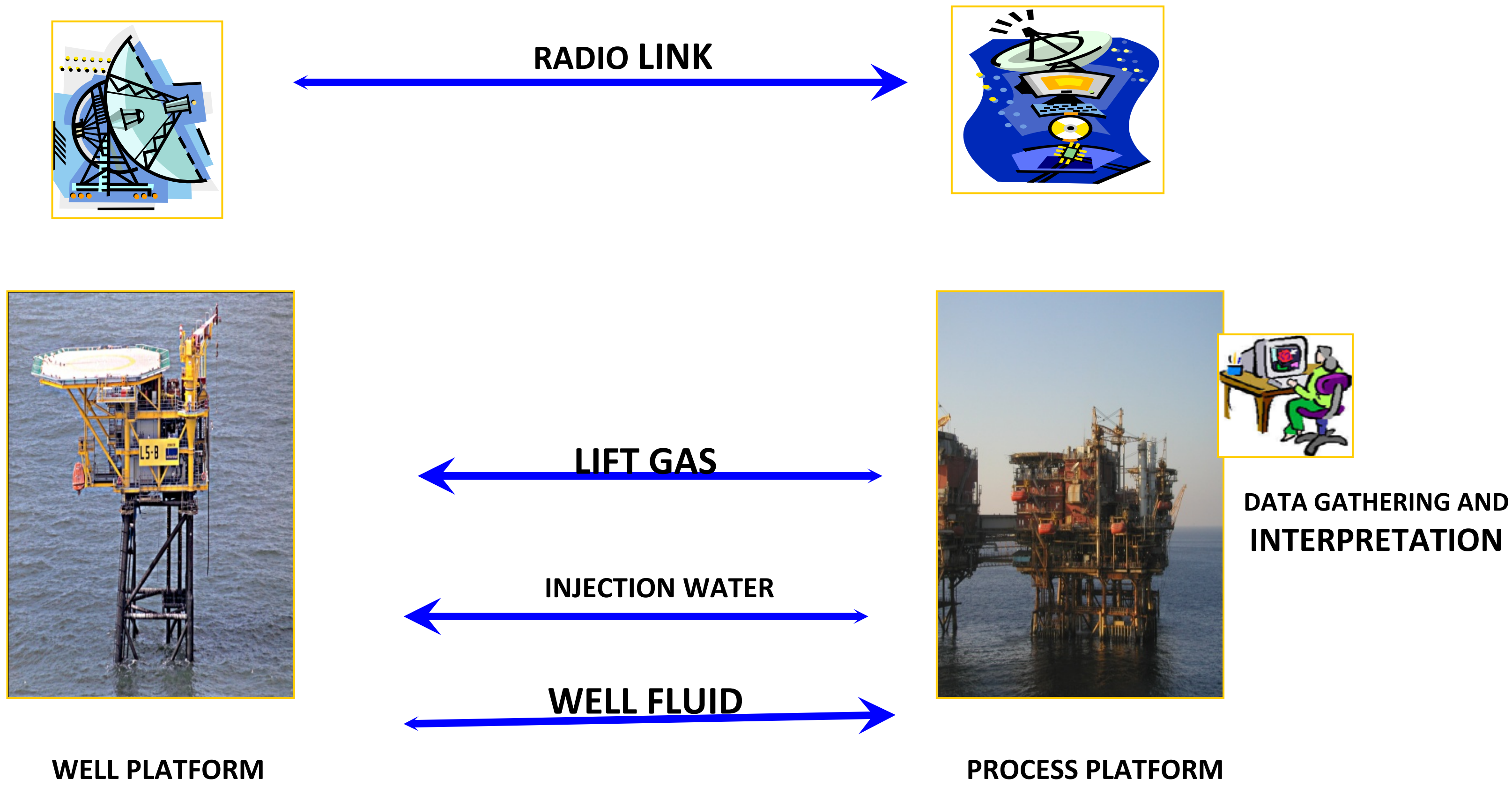


WELL MONITORING AND CONTROL RTU/SCADA

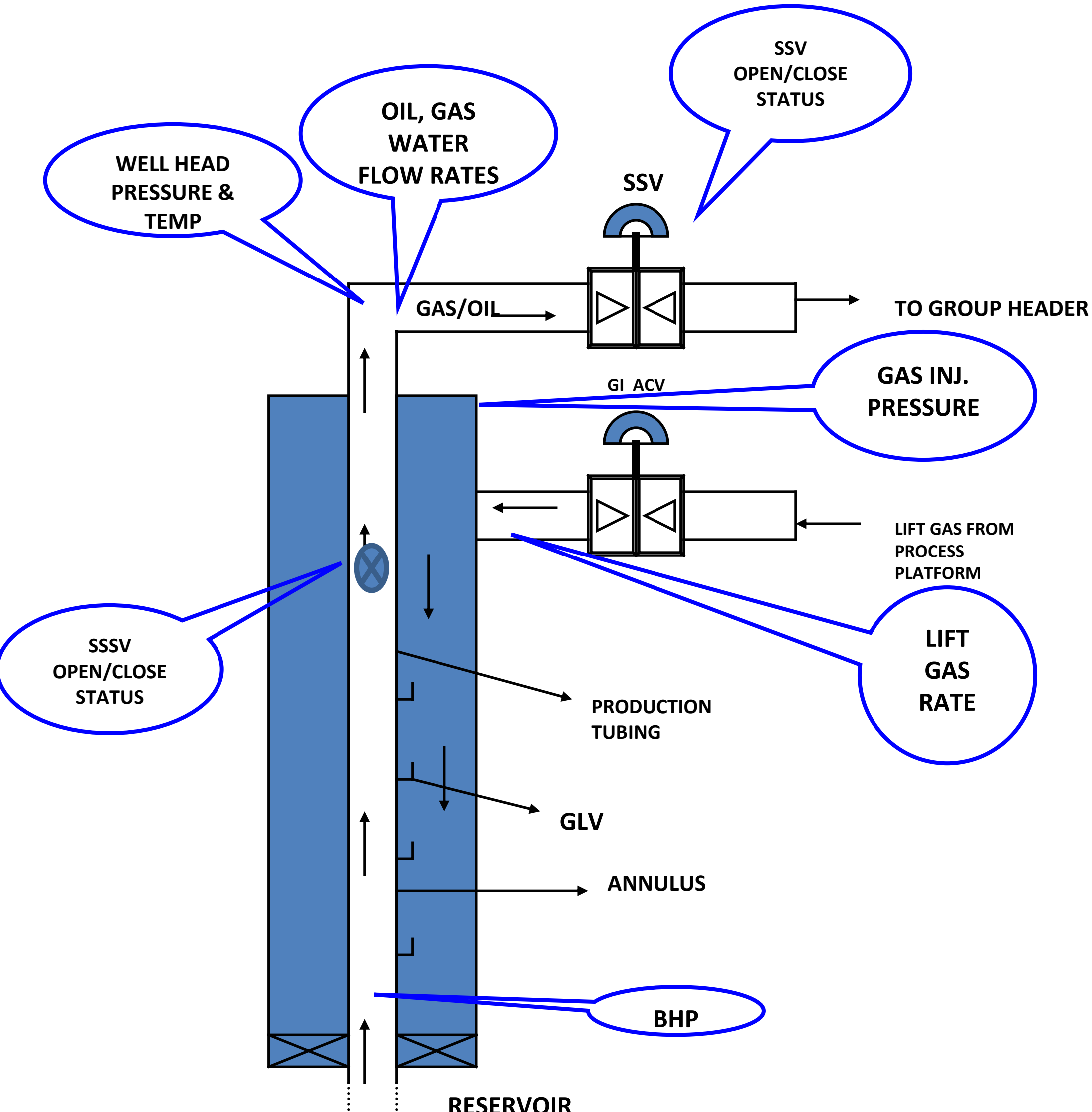
SCADA – FOR WELL MONITORING, CONTROL AND PRODUCTION OPTIMIZATION

- SUPERVISORY CONTROL AND DATA ACQUISITION
- Gather necessary DATA from a REMOTELY LOCATED Oil/Gas well and Well Platform with the help of Field Transmitters & RTU and send it to the DATA GATHERING & ANALYSIS point.

SCADA- OVERVIEW

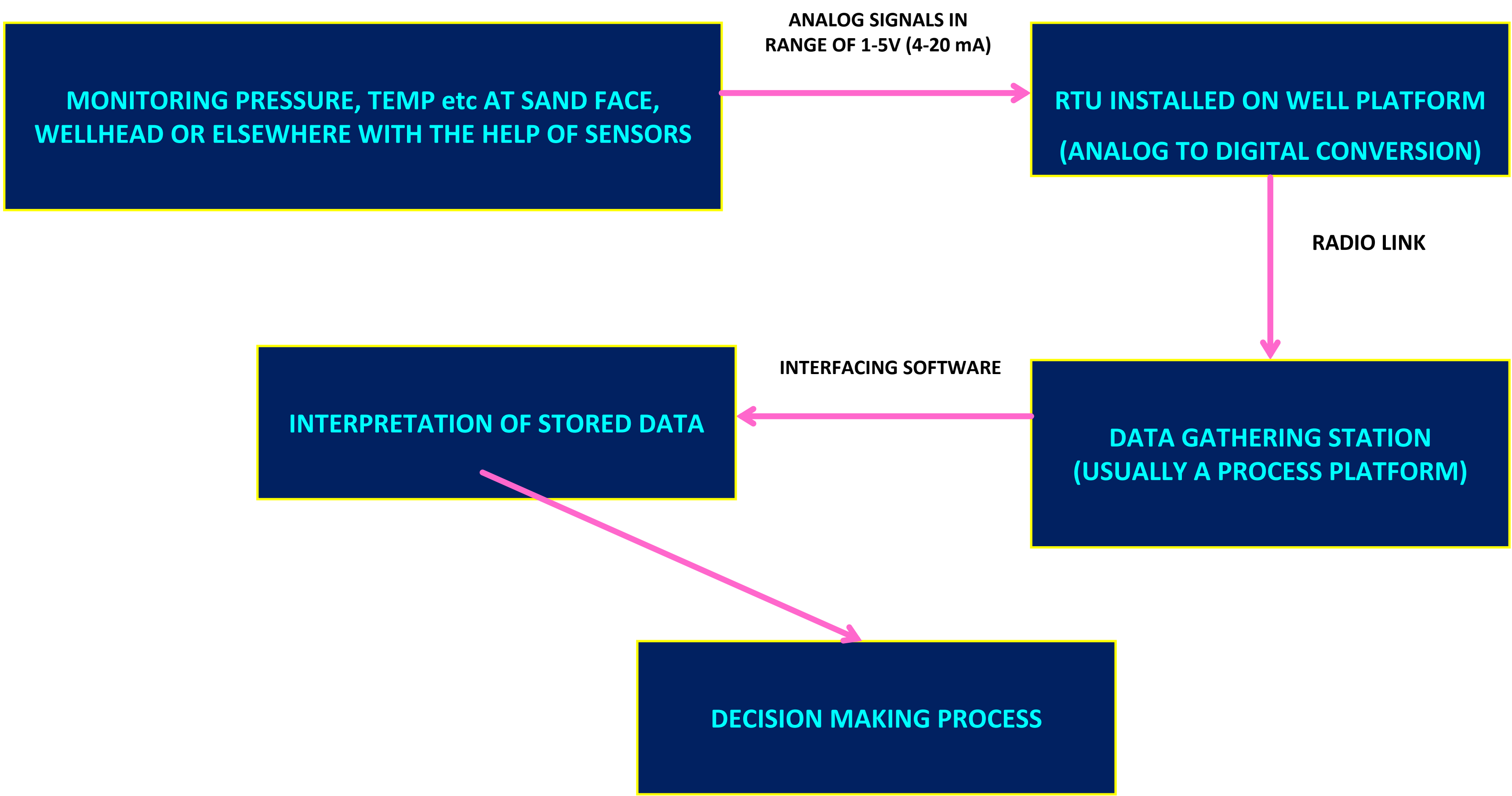


SCADA -METHODOLOGY



PARAMETERS AVAILABLE FOR MEASUREMENT IN AN OIL WELL ON GAS LIFT

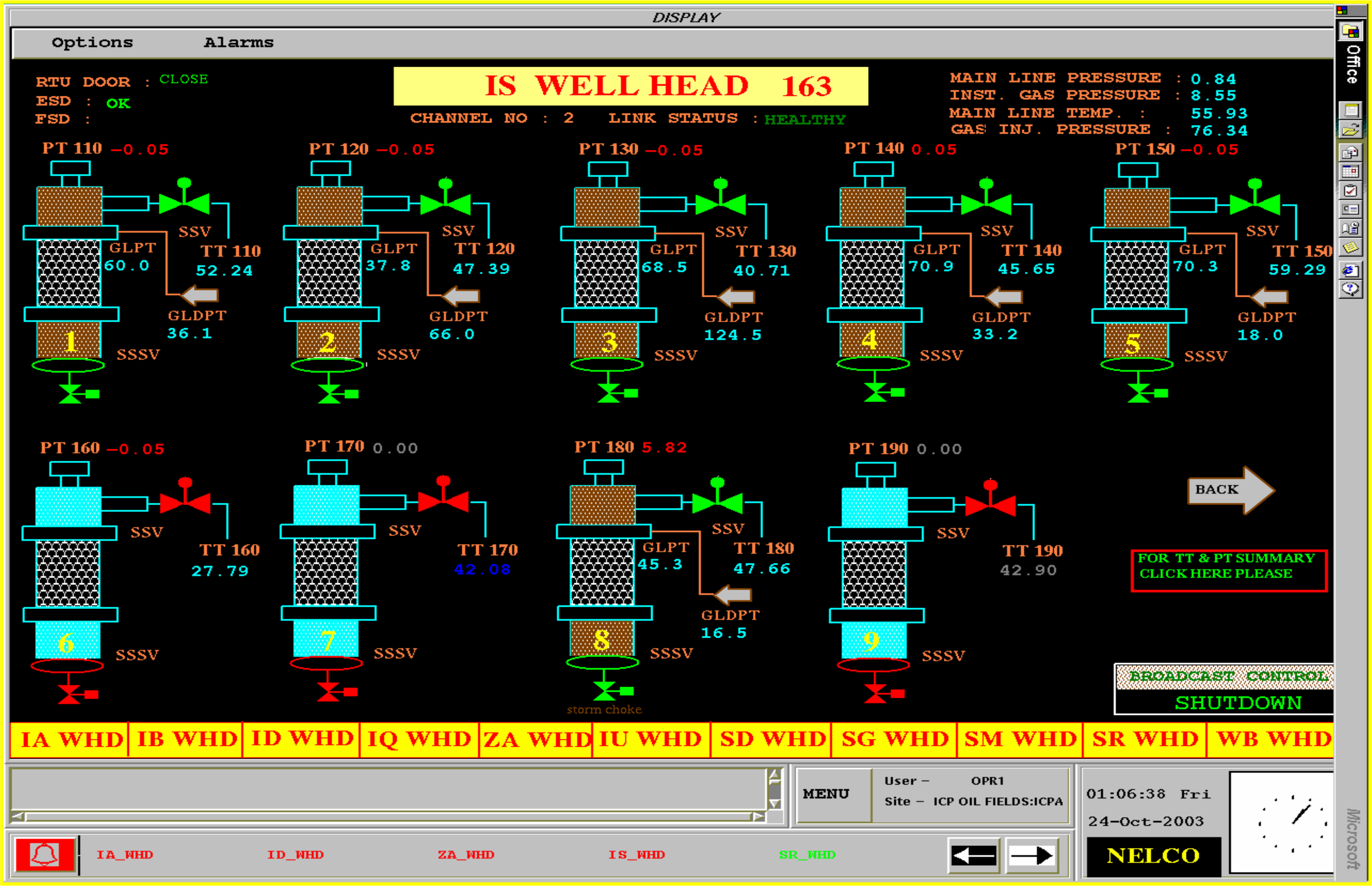
SCADA- A SCHEMATIC



MAJOR BENEFITS OF SCADA

- **24 hrs online monitoring of well status and flow, lift parameters from Process Complex as well as from onshore control centre.**
- **Historical Data and trending helps in Troubleshooting.**
- **Ability to close wells remotely during emergency.**
- **Better Production optimization of individual wells**
- **Instant alerts in case of Well closures, ESD, FSD and control panel failure**
- **Optimum utilization of Manpower for attending to well problems**
- **Reduction in number of physical visits to well platforms resulting in optimization of Helicopter sorties.**
- **To observe slugging in pipelines.**
- **Lift gas allocation for each well.**

MONITORING OF WELL PLATFORM USING SCADA – THIS IS ACCESSIBLE FROM ANY DESKTOP COMPUTER IN ONGC LAN NETWORK.



MIMIC DISPLAY

MONITORING OF WELL PLATFORM USING SCADA

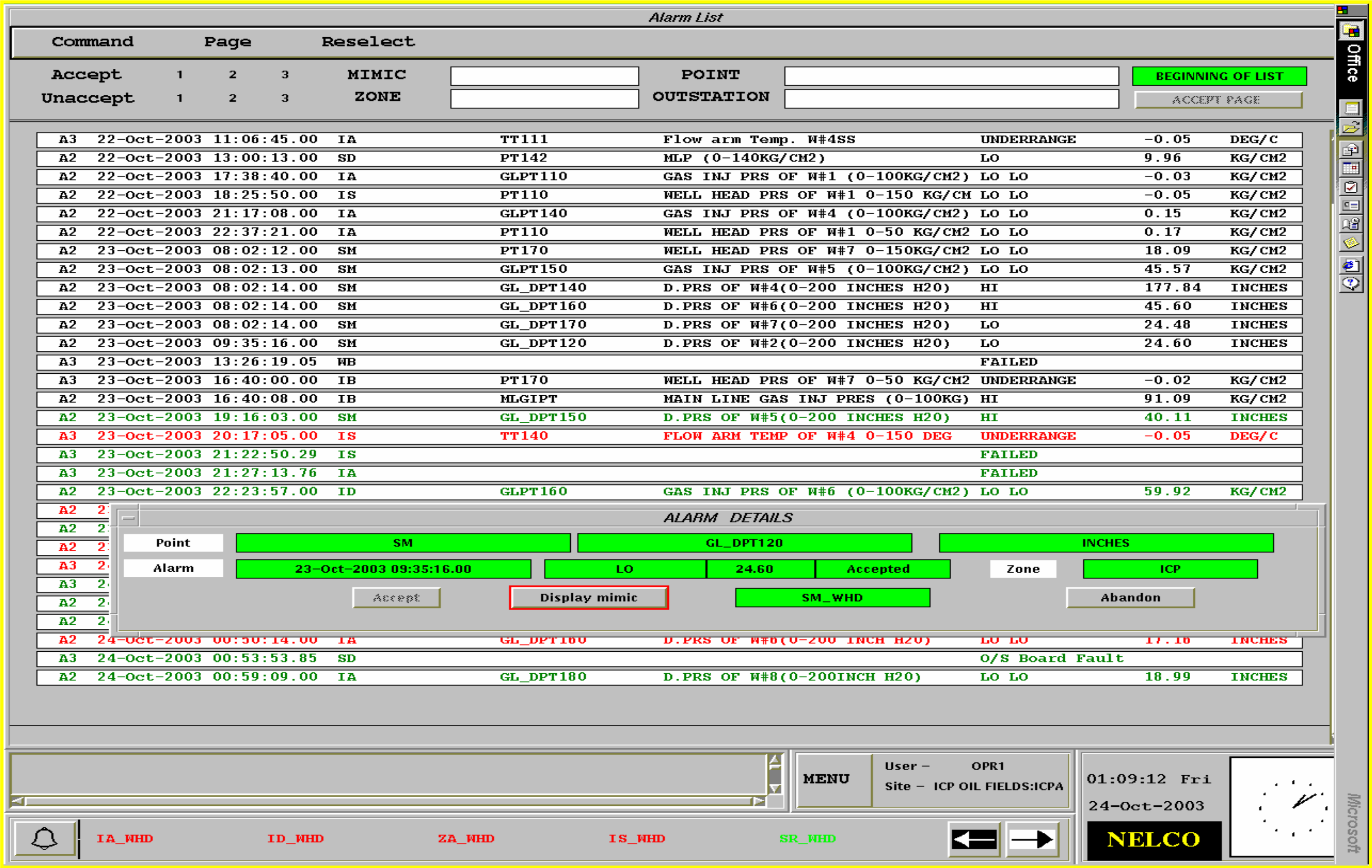
	WELL#1	WELL#2	WELL#3	WELL#4	WELL#5	WELL#6	WELL#7	WELL#8	WELL#9
SSV	OPEN	OPEN	OPEN	OPEN	OPEN	CLOSED	CLOSED	OPEN	CLOSED
SSSV	OPEN	OPEN	OPEN	OPEN	OPEN	CLOSED	CLOSED	OPEN	CLOSED
PT's	-0.05	-0.05	-0.05	0.05	-0.05	-0.05	0.00	5.82	0.00
TT's	52.24	47.39	40.71	45.65	59.29	27.79	42.08	47.66	42.90
GLDPT	36.08	66.00	124.48	33.15	18.01			16.54	
Inj PT	60.04	37.76	68.53	70.91	70.30			45.27	
O.D	1.000	1.000	0.750	0.538	1.000			0.984	
P.D	1.503	1.503	1.503	1.503	1.503			1.503	
Vol.F	38817	53073	23432	7912	24994			45520	

FT630B	-0.05
FT630C	149.95
TELBAT	20.60
SOLARC	99.24

BATCHR	23.35
LODCUR	9.89
GDSBAT	14.72
NAVBAT	0.00

STATUS DISPLAY

MONITORING DIFFERENT ALARMS WITH THE HELP OF SCADA



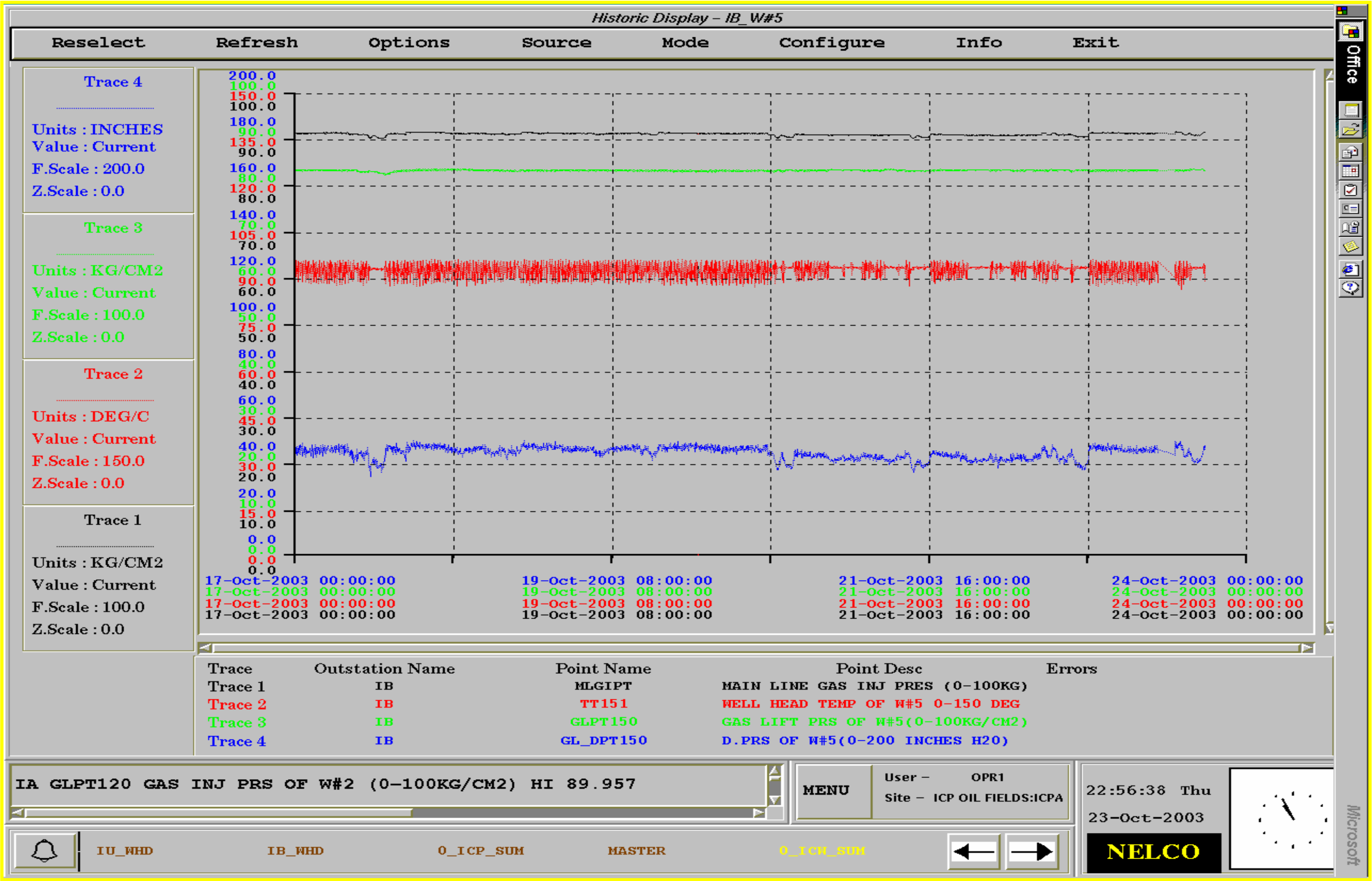
SCADA HELPS IN LIFT GAS ALLOCATION / PRODUCTION ALLOCATION

DAILY AVERAGE GAS FLOW RATE ON 01-Oct-2003 00:10:00

	WELL-1	WELL-2	WELL-3	WELL-4	WELL-5	WELL-6	WELL-7	WELL-8	WELL-9
IA	82442	27137	91318	49975	64257	70057	52551	33232	
IB	69805	WI	70508	61718	59248	53655	35511		
ID	43134	41425	23963	46960	99489	76943	0		
IQ	20713	9020	48649	33925	WI	21645	61956	16424	45694
IS	38875	53252	22862	7699	25218	WI	WI	45331	
IU	494	44432	41173	9785	WI	1012	2038	45615	WI
SD	42942	92691	62187	30903	WI	66032	60455	WI	
SG		39216			50430				
SM	WI	42144	WI	89997	34184	37073	60991	46230	
SR	79513	0	33791	43146	18308	WI	30529	32978	
WB	1695	26537	44602	31297	45005	31676	45189	58909	0
ICD	72906	53501	WI	23356	50110	28207	23152	39255	33323

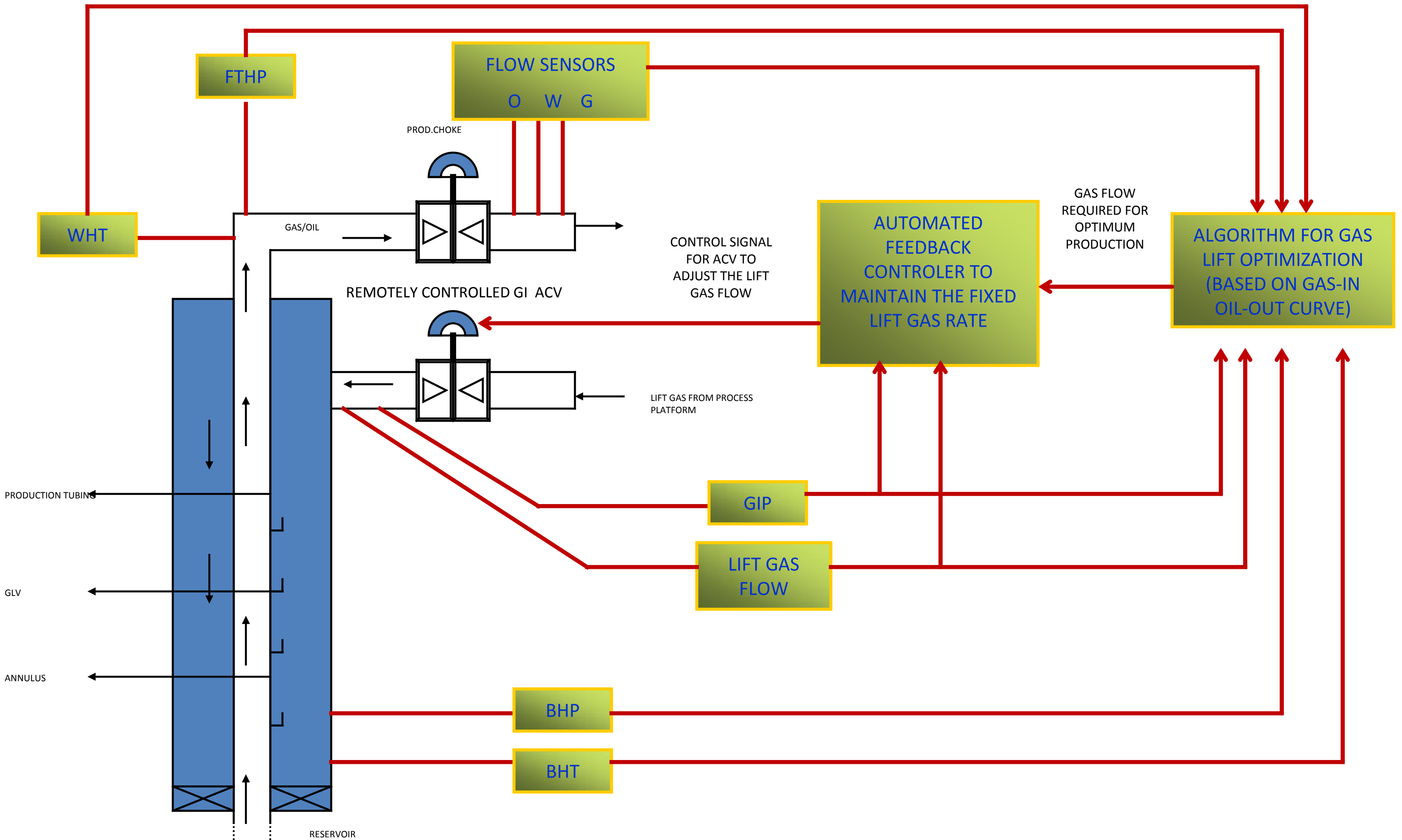
– 1 –

TRENDING OF GI PRESSURE, MLGIP, TEMPERATURE, LIFT GAS RATE HELPS IN KEEPING WELLS FLOWING AT ITS OPTIMUM 24x7

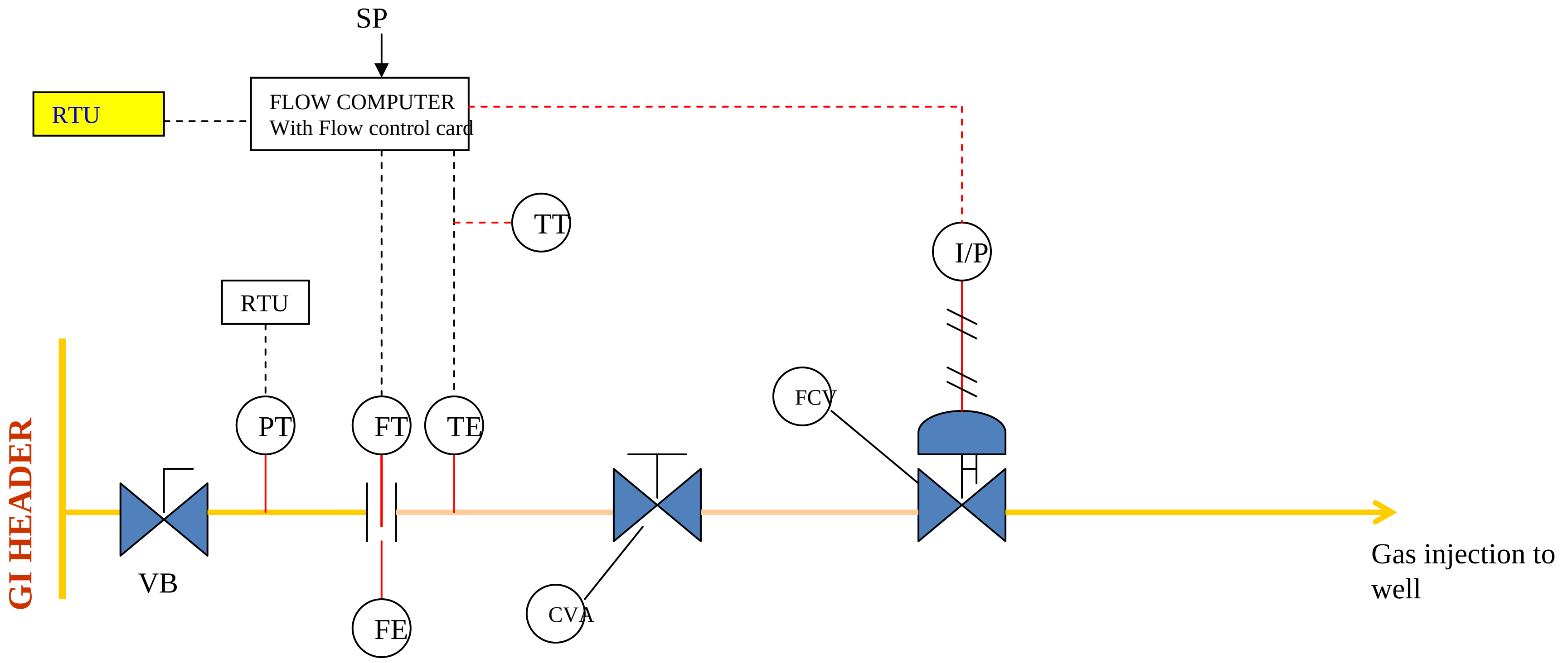


WELL AUTOMATION

DESIGN FOR AUTOMATED CONTROL SYSTEM FOR GL OPTIMIZATION

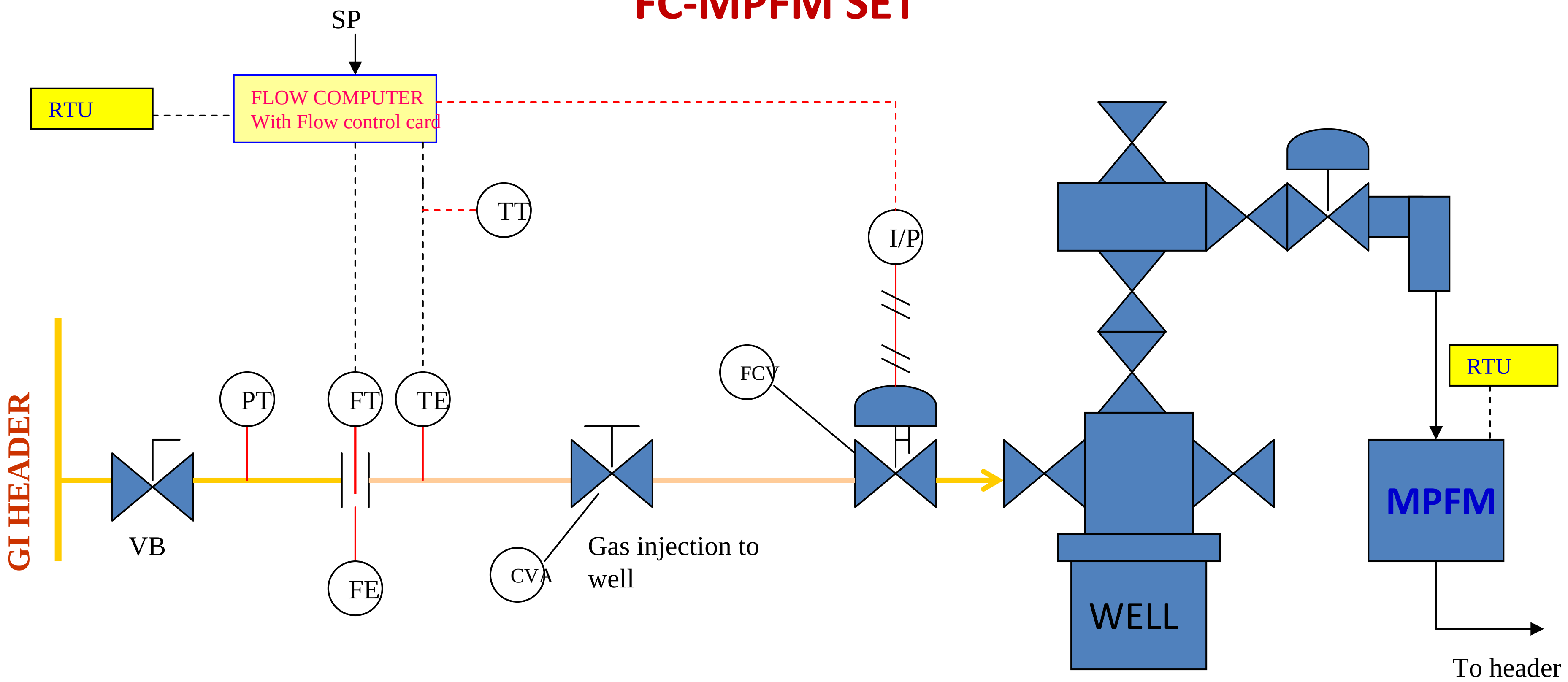


Online Monitoring and Remote control of Injection Gas



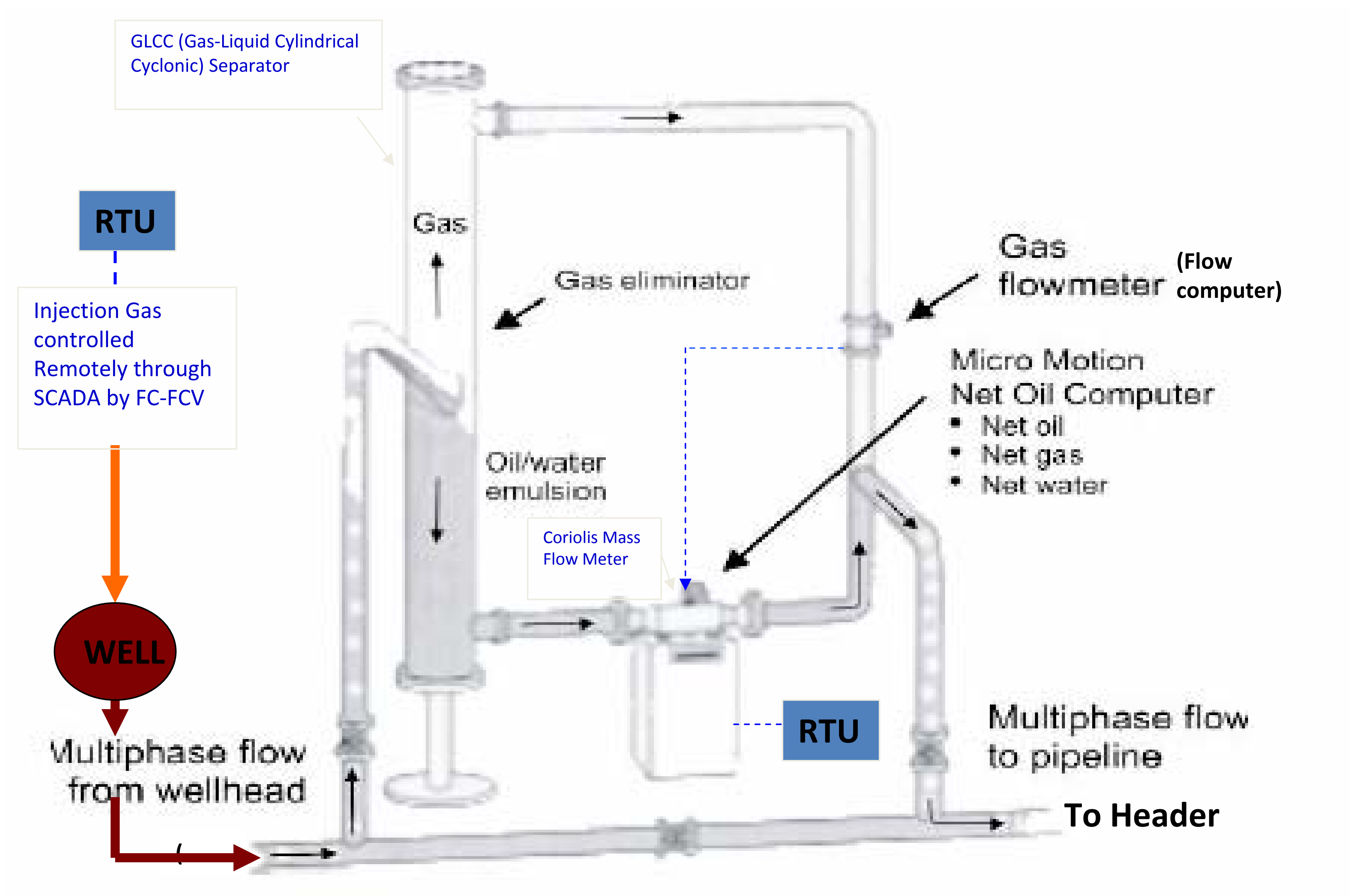
FC is accessed via SCADA from the process complex and Injection gas Rate is monitored and adjusted, if required, remotely.

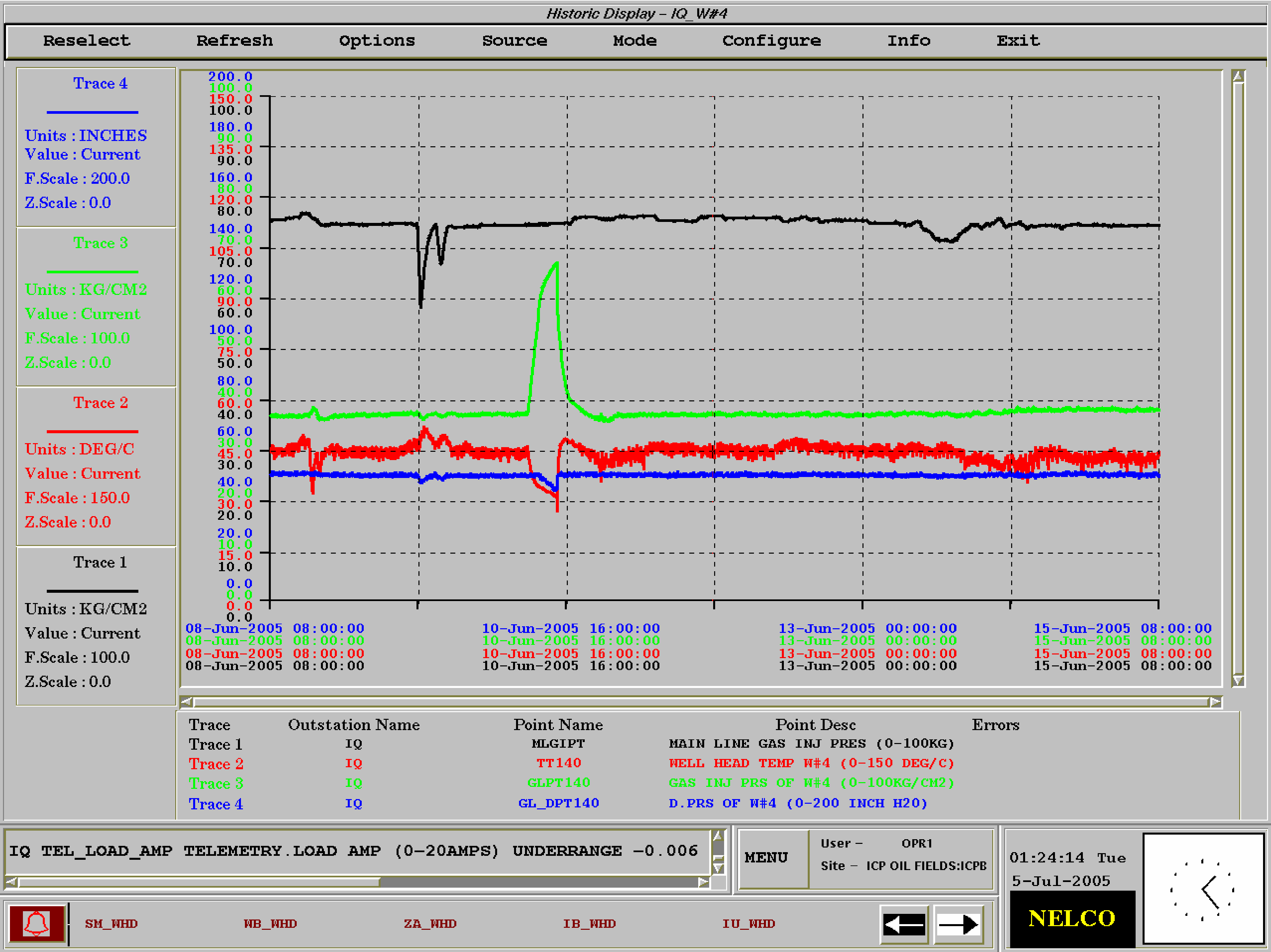
REMOTE OPTIMIZATION OF WELL USING FC-MPFM SET



- Injection gas is remotely monitored, controlled via RTU-FC-FCV through SCADA
- One well is diverted via MPFM and Production rates available through SCADA at Process PF.
- Well can be tested and Optimized REMOTELY for different Injection gas rates by changing the set point in FC-I/P-FCV Loops via SCADA.

SMART online 24 x 7 monitoring and Optimization of each well Using "Gas Flow Computer- Compact GLCC Separator- Coriolis Mass flow Meter" Set.




Historic Display – IQ_W#4
Reselect
Refresh
Options
Source
Mode
Configure
Info
Exit
Trace 4
Units : INCHES
Value : Current
F.Scale : 200.0
Z.Scale : 0.0
Trace 3
Units : KG/CM2
Value : Current
F.Scale : 100.0
Z.Scale : 0.0
Trace 2
Units : DEG/C
Value : Current
F.Scale : 150.0
Z.Scale : 0.0
Trace 1
Units : KG/CM2
Value : Current
F.Scale : 100.0
Z.Scale : 0.0
08-Jun-2005 08:00:00
10-Jun-2005 16:00:00
13-Jun-2005 00:00:00
15-Jun-2005 08:00:00
Trace
Outstation Name
Point Name
Point Desc
Errors
Trace 1 IQ MLGIPT MAIN LINE GAS INJ PRES (0-100KG)
Trace 2 IQ TT140 WELL HEAD TEMP W#4 (0-150 DEG/C)
Trace 3 IQ GLPT140 GAS INJ PRS OF W#4 (0-100KG/CM2)
Trace 4 IQ GL_DPT140 D.PRS OF W#4 (0-200 INCH H20)
IQ TEL_LOAD_AMP TELEMETRY.LOAD AMP (0-20AMPS) UNDERRANGE -0.006
MENU
User – OPR1
Site – ICP OIL FIELDS:ICPB
01:24:14 Tue
5-Jul-2005
NELCO
SM_WHD
WB_WHD
ZA_WHD
IB_WHD
IU_WHD

PROCESSING IN OFFSHORE PROCESS PLATFORMS

PROCESSES

3-Phase well fluid is received from Wells/Well Platforms and processed at Large Process Platforms generally consisting of the following four Major Processing Modules

- **Separation (Oil, Gas and Produced water) & Oil dispatch**
- **Gas Compression & dehydration**
- **Produced Water Conditioning**
- **Sea water processing & injection system**

These process complexes will also have the following:

- **Fire detection & Suppression system**
- **Power Generation**
- **Well services/drilling Modules**
- **Water Maker/Utilities/Sewage Treatment**
- **Living Quarters**

SEPARATION

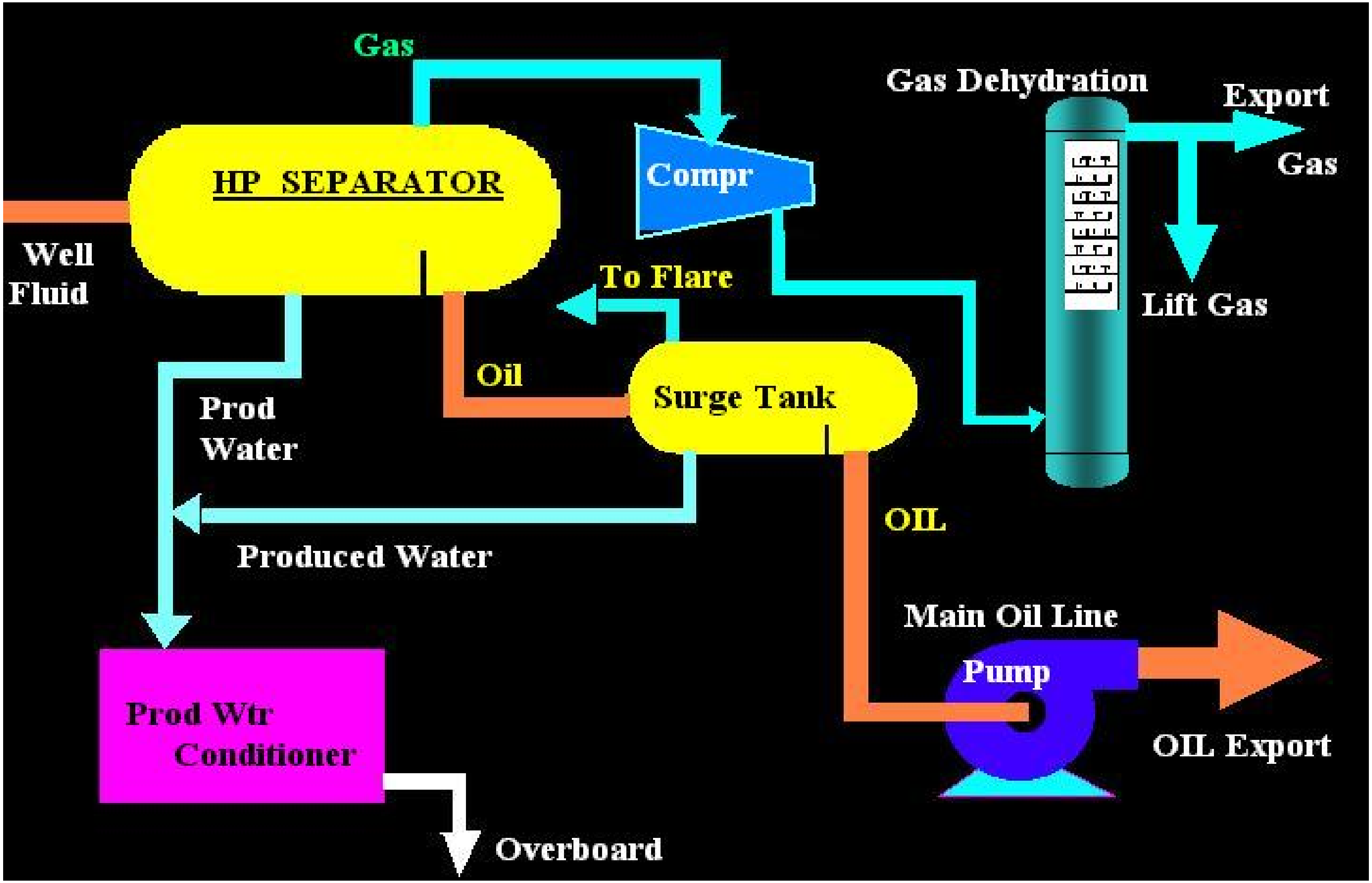
SEPARATION

- Oil , Gas and Water is separated from the Wellfluid.
- Well Fluid from various Wells/ Well Platforms / Subsea Manifold reaches the process complex via subsea pipelines and risers and is further processed in more than one train.
- Each Train will normally consist of a Production Manifold , Well fluid heater, Inlet Separator, Crude oil Manifold, Crude oil heater, Surge Tanks and MOL Pumps.
- Well Fluid is received in the Production Manifold . Demulsifier Chemical is dozed in Production manifold to promote breaking up of Water-Oil emulsion
- Then it is heated in well fluid heater with Hot oil Flowing in Shell Side and well fluid in tube side. This heating enables better separation of oil and water in Inlet Separator.
- The Well Fluid from Well fluid heater reaches Inlet Separator.

Inlet Separator – First Stage Separation

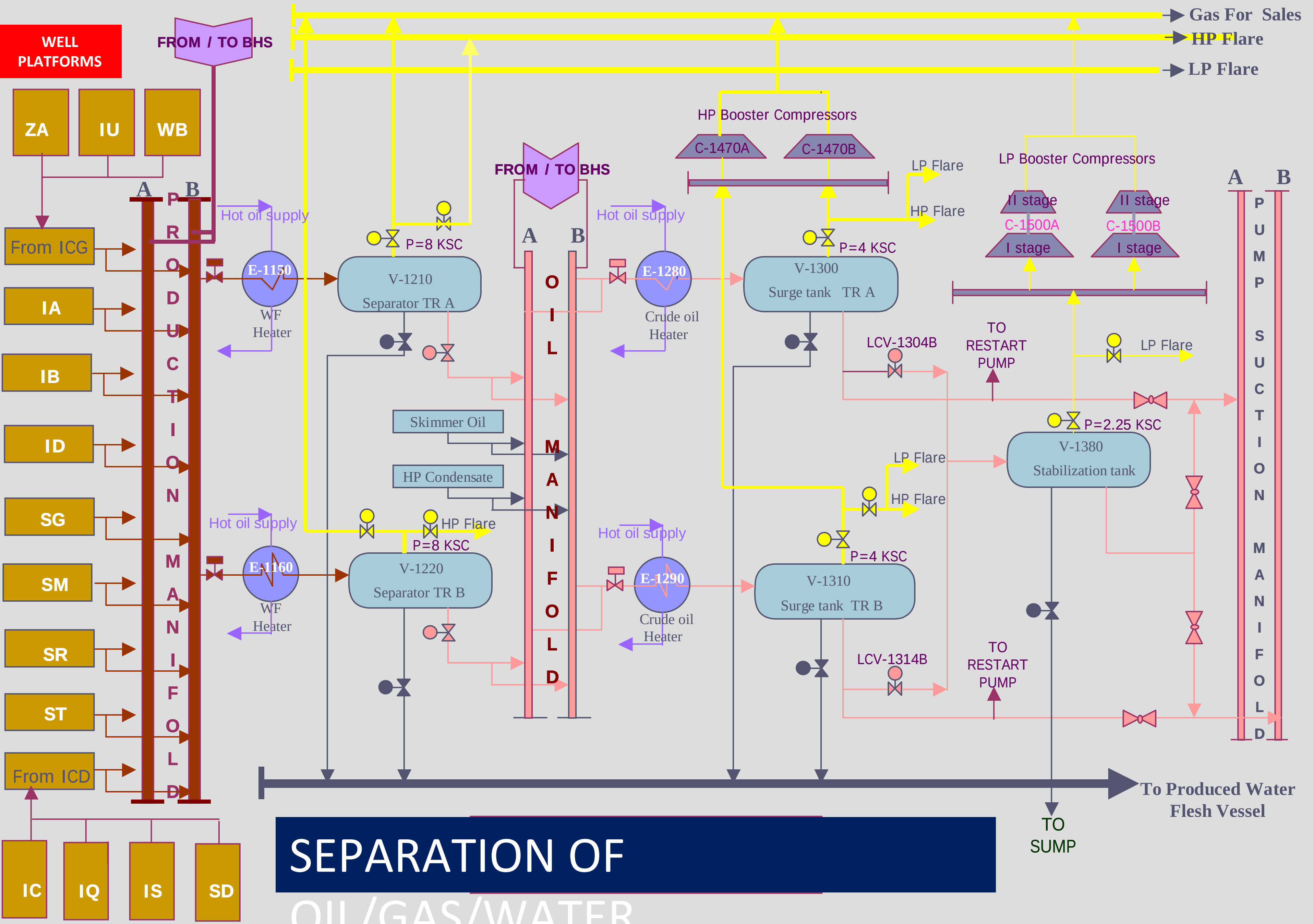
- Inlet Separator is a vessel in which 3 phase separation of well fluid into Oil, Gas and Water occurs.
- Separation is by gravity mainly assisted by chemical and heat. Residence time in the vessel is an important criteria for better separation.
- Separated Gas is routed to Gas compression and dehydration Module.
- Compressed gas is sent to the Lift gas network for lifting the producers and excess gas is exported via pipelines to shore.
- Separated oil flows to the oil manifold.
- Separated water flows to Produced water conditioning unit.
- From oil manifold crude oil flows to crude oil heater in which crude oil is heated with hot oil. This enhances the separation of oil & water in Surge Tanks (second stage separation).
- Demulsifier chemical dozed in oil manifold further promotes the breaking of water-Oil emulsion.

PFD- OIL,GAS,WATER SEPARATION

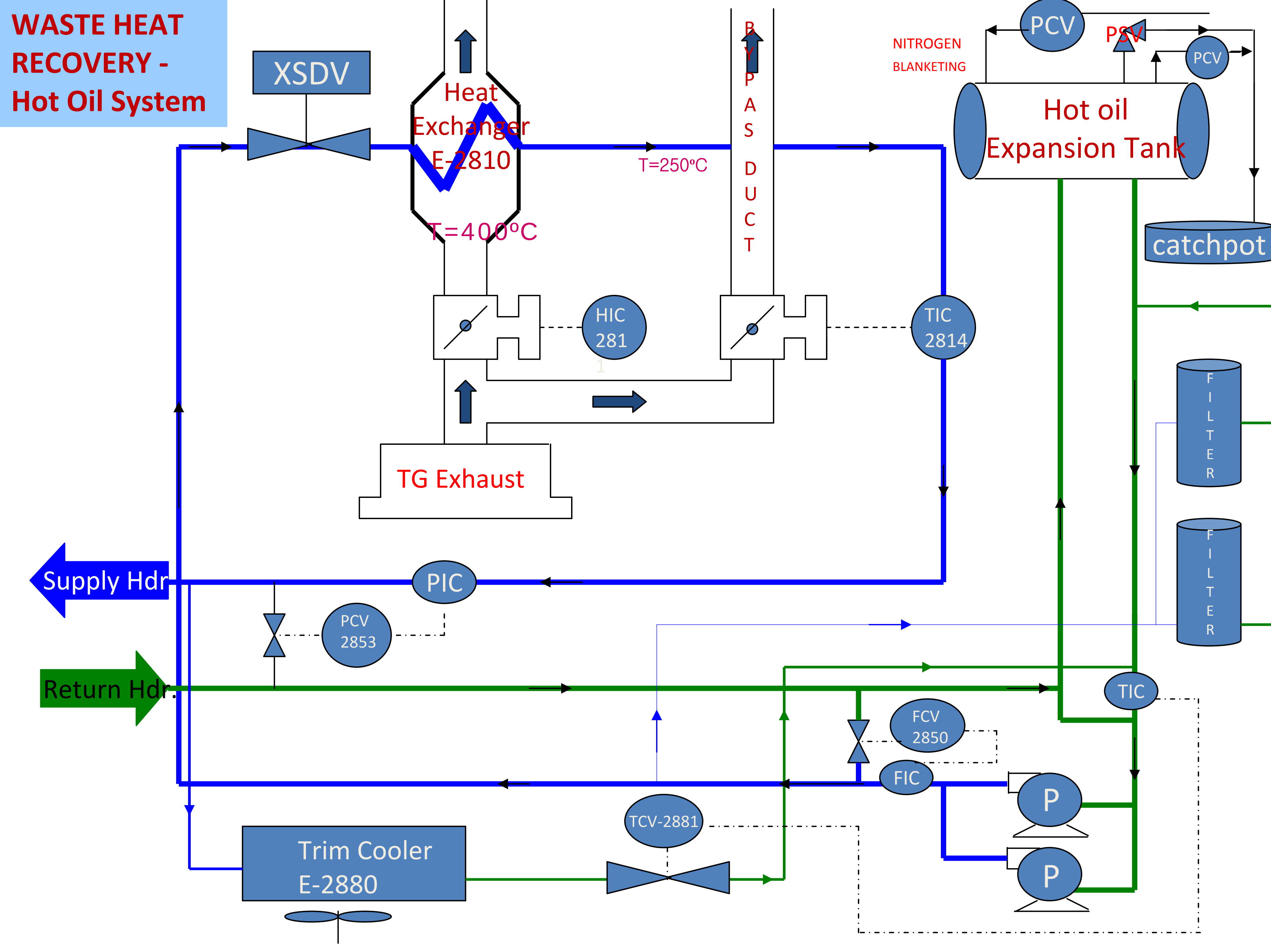


Surge Tank – Second Stage Separation

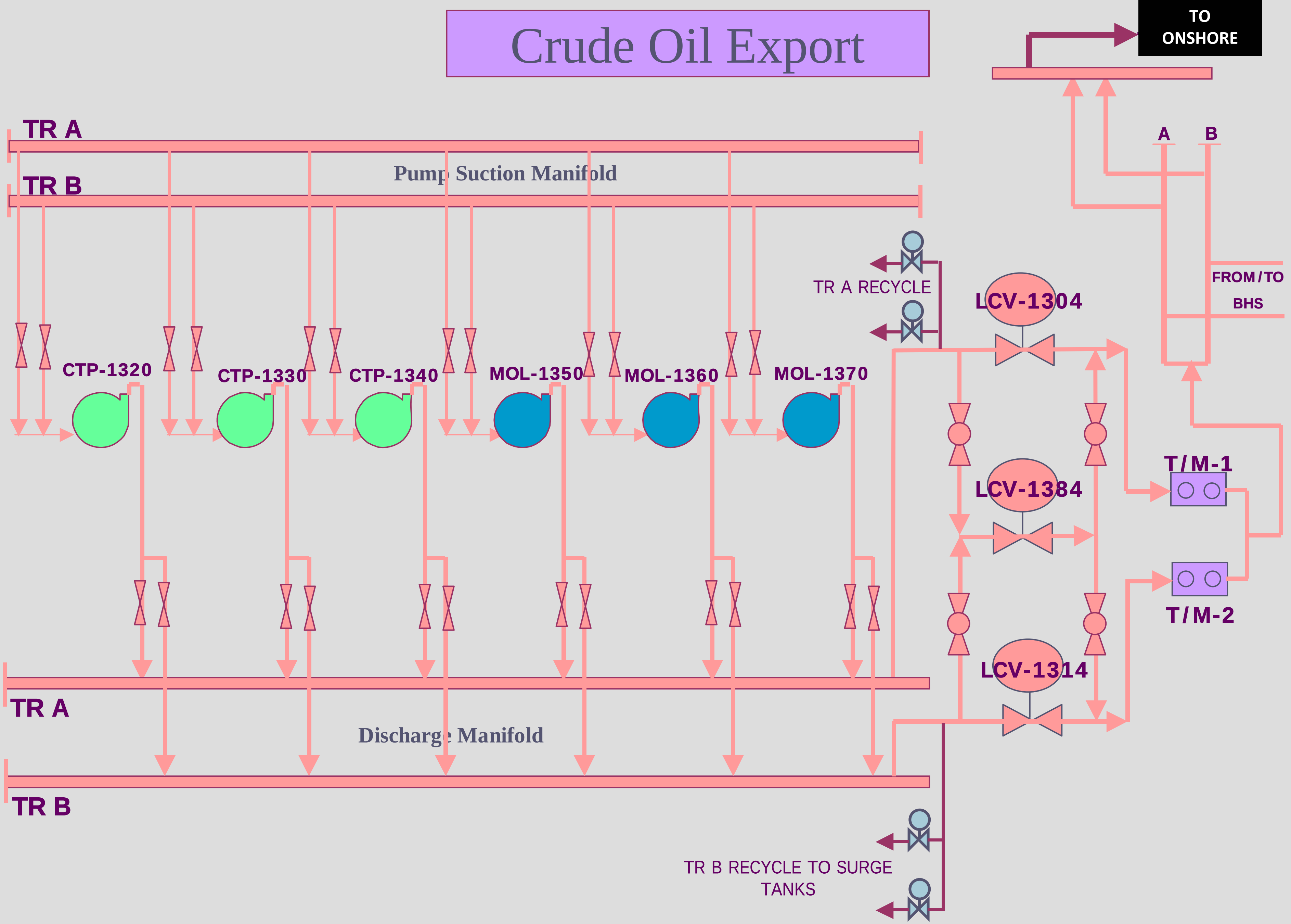
- **Surge tank is maintained at a lower pressure to stabilize crude i.e. to remove maximum of associated gas from the crude oil.**
- **Oil from surge tanks can be either pumped directly with MOL pumps or can be diverted to third stage separators (Surge tank-3).**
- **Separated crude oil is pumped with CTP / MOL pumps to export trunk lines.**
- **Separated Gas is diverted to Gas compression module after boosting the pressure LP booster compressor.**
- **Separated Water is diverted to Produced water conditioning Unit.**



SEPARATION OF OIL/GAS/WATER


WASTE HEAT RECOVERY - Hot Oil System
XSDV
Heat Exchanger E-2810
T=400°C
T=250°C
BYPASS DUCT
NITROGEN BLANKETING
PCV
PSV
PCV
Hot oil Expansion Tank
catchpot
HIC 281
TIC 2814
TG Exhaust
FILTER
FILTER
Supply Hdr
PIC
PCV 2853
Return Hdr.
TIC
FCV 2850
FIC
P
P
TCV-2881
Trim Cooler E-2880

Crude Oil Export



CRUDE EVACUATION BY SBM AND TANKER

GAS COMPRESSION, DEHYDRATION AND EXPORT

Gas Compression.

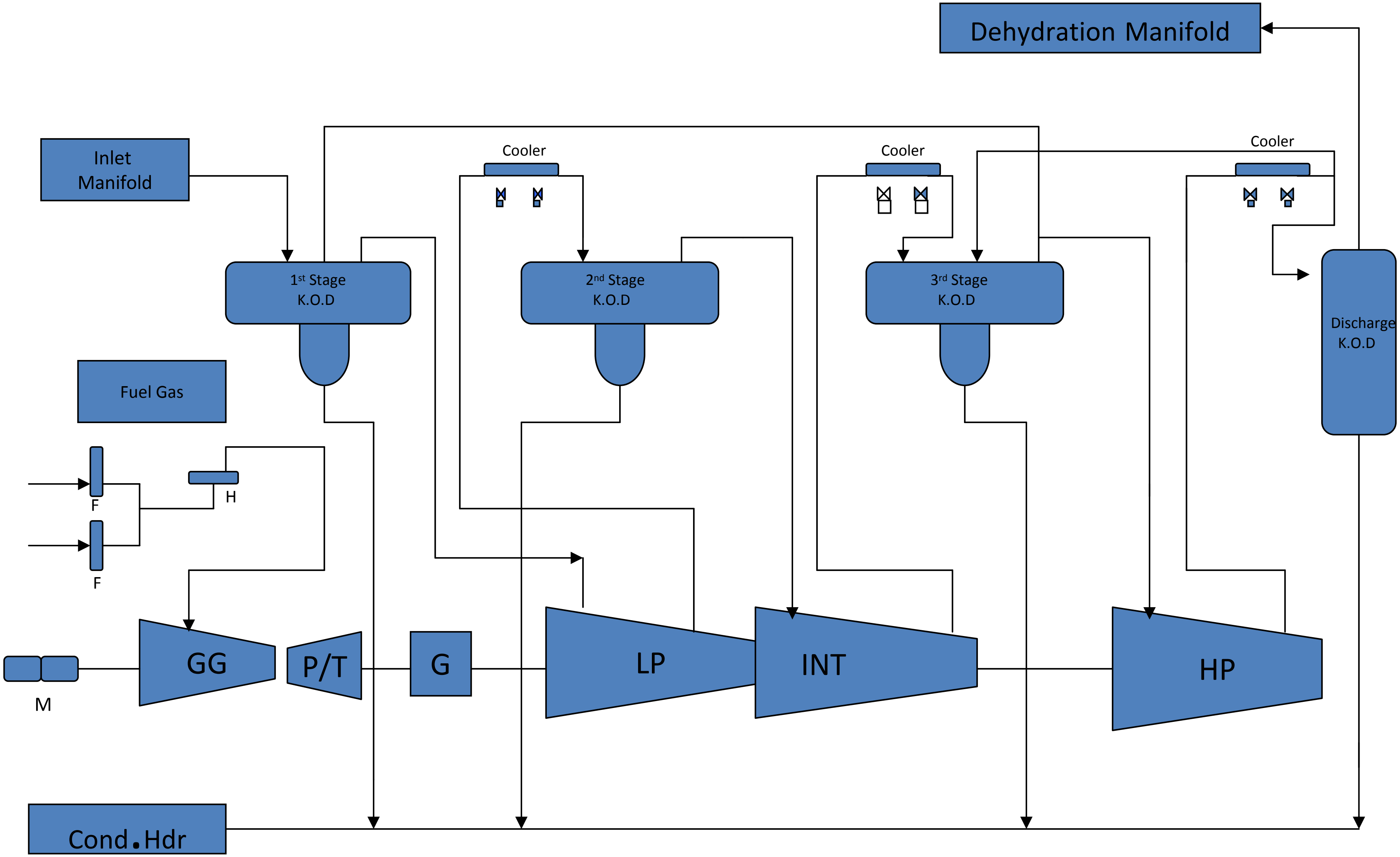
- Gas from Separators ,Surge Tanks and export gases if any from other process platforms are compressed to about 90-100 kg/cm2 pressure as per the field gas lift requirement.

- Normally Gas turbine driven Centrifugal compressors (PGC's- Process Gas Compressors) are used.

- Gases compressed in PGC's is dehydrated to prevent formation of GAS HYDRATES. Gas hydrates are formed at low temperatures when moisture is present in Hydrocarbon gases. These gas hydrates are ice like substance which prevent the smooth flow or block the flow of gases in gas flow lines.

- Gas Hydrates can be formed in Adjustable Choke Valves ,PCV's & GLV's in GI Lines where Throttling of gases give rise to low temperatures.(Joule Thomson effect).This can affect production phenomenally from Gas lift wells.

GAS COLLECTION AND COMPRESSION



Gas Dehydration

- Compressed Gas is dehydrated in a Glycol contactor with Tri Ethylene Glycol(TEG)as an absorbent for moisture from compressed gas.

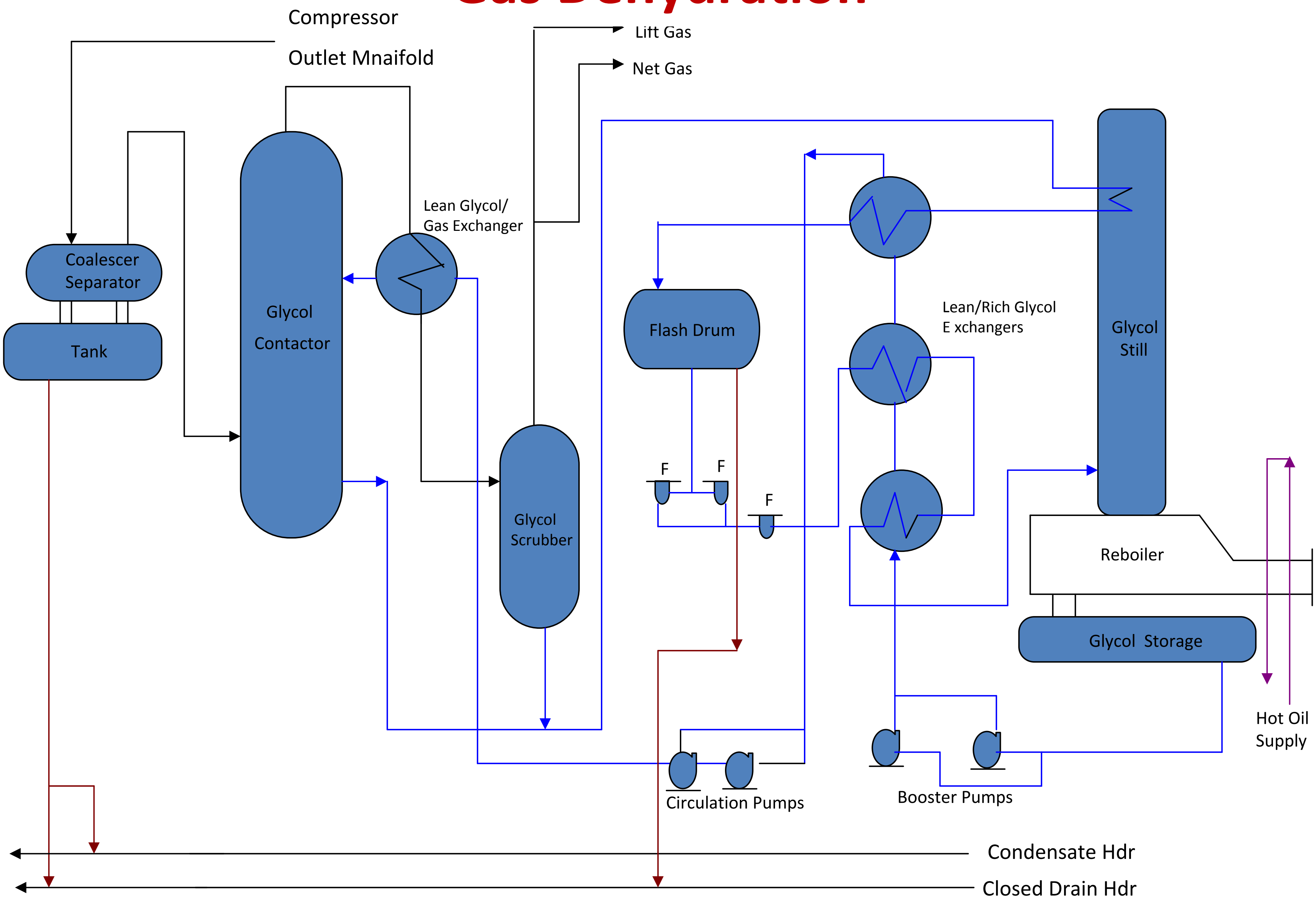
- Glycol contactor is bubble cap tray column with many bubble cap trays. TEG flows counter current with compressed gas from the top of the column.

- TEG coming in contact with compressed gas in the bubble cap trays selectively absorbs the moisture from the gas and dehydrates it.

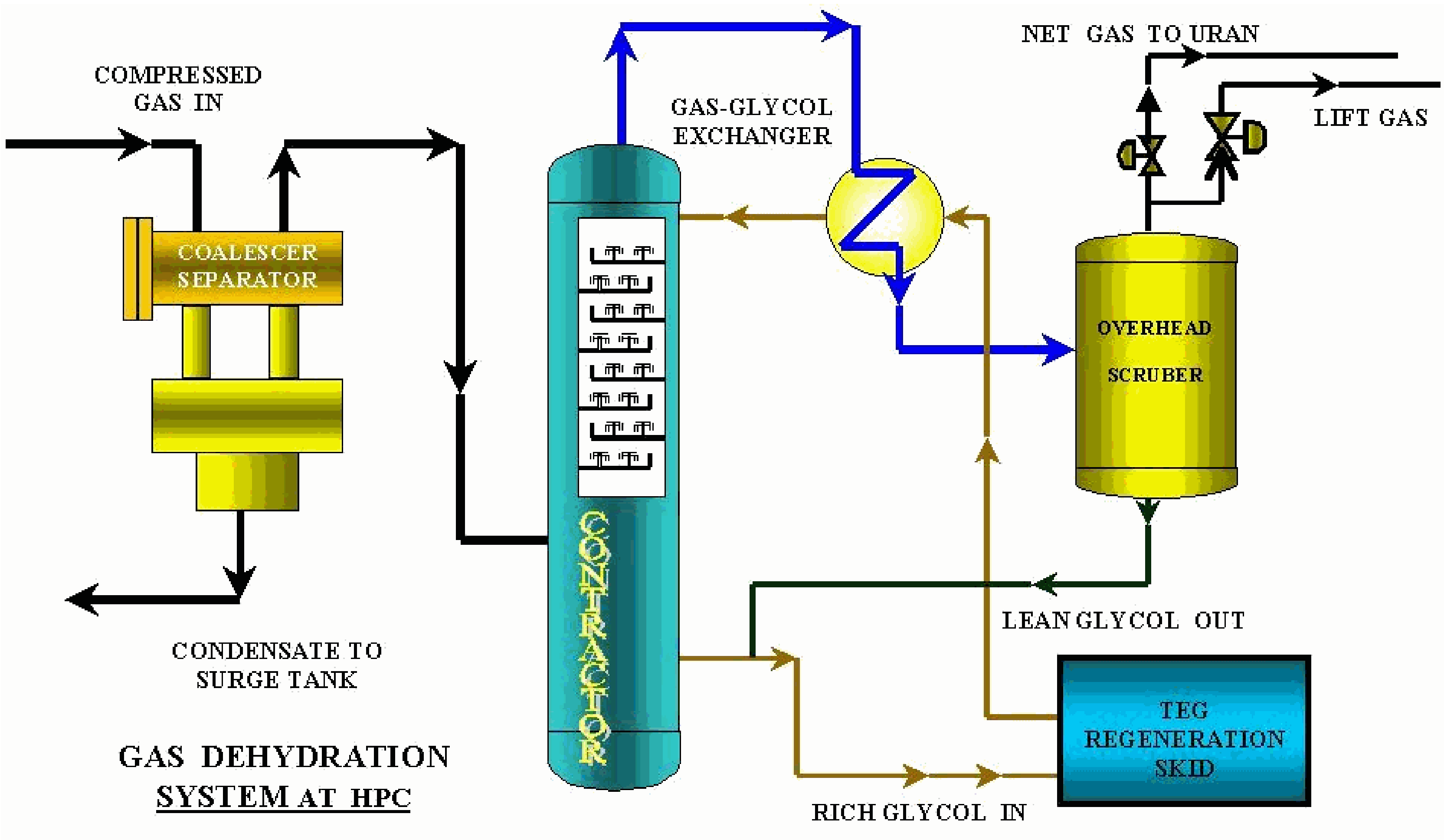
- The dehydrated gas is sent to feed gas lift wells in priority basis and remaining to export gas line.

- The TEG rich in moisture is sent for re-concentration , converted to Lean glycol and recycled back to contactor for dehydration.

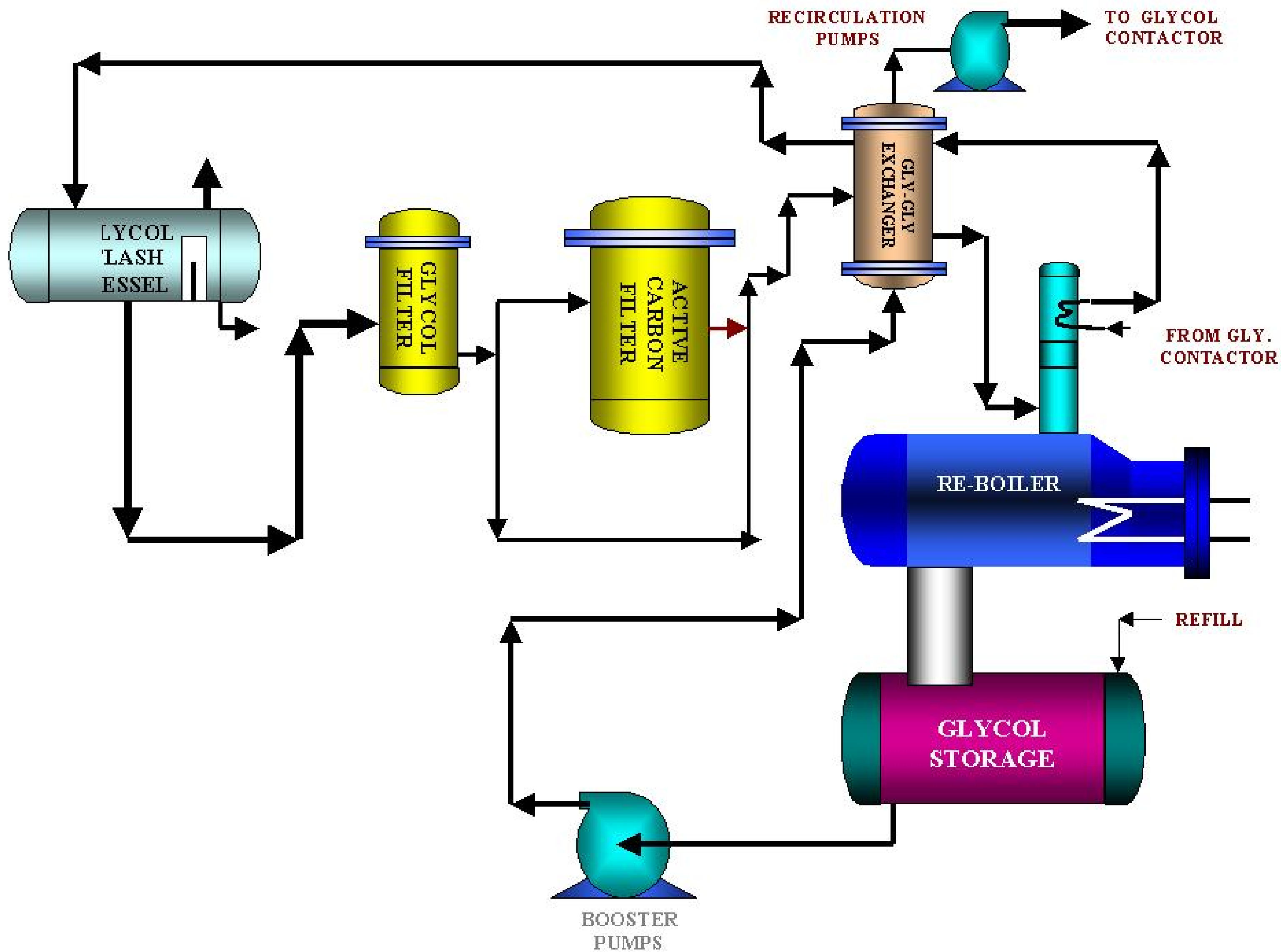
Gas Dehydration



GAS DEHYDRATION – GAS GLYCOL EXCHANGER



REGENERATION OF GLYCOL



PRODUCED WATER TREATMENT

Produced Water Conditioning

- **The water produced along with Oil and Gas from the wells is to be treated to within acceptable levels of quality in terms of oil ppm before it is discharged in to the sea.**

- **Produced Water Conditioning unit normally consists of Flash Vessel ,CPI Separators, IGF (induced Gas floatation Unit) and Sump caisson**.

Flash Vessel

Receives water from Both Inlet Separators and Surge tanks .It is maintained at 0.8 kg pressure. In flash Vessel most of the dissolved gases in the produced water flashes out which is routed to LP flare header. Associated Oil from the produced water in the flash vessel is routed to closed drain header and is collected in the sump caisson.

CPI separators

Water from the flash vessel flows to many **CPI separators** (corrugated plate interceptor) in parallel. Oil from CPI Separator is collected in a tank from which it is pumped to oil manifold. Gas goes to LP Flare header.

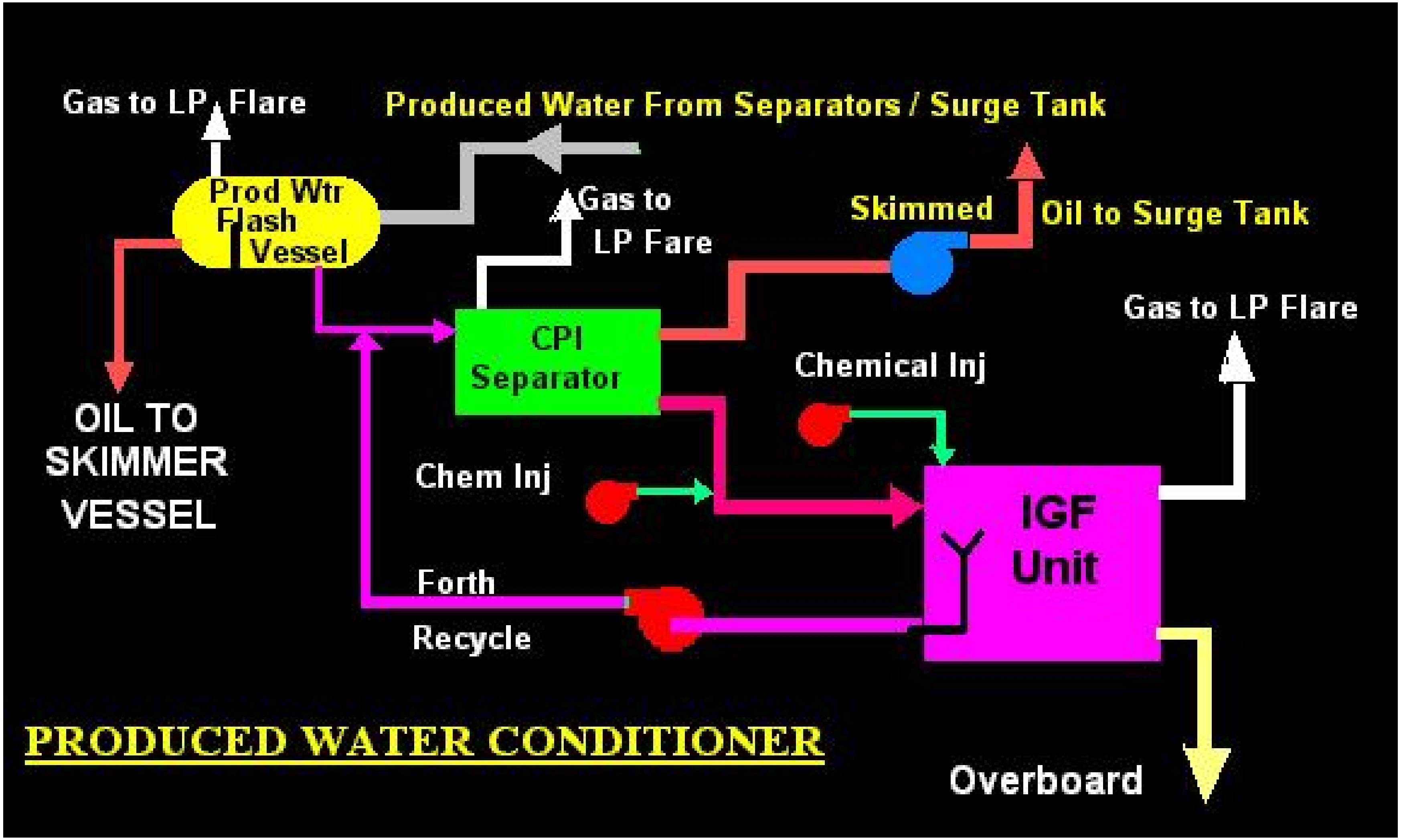
IGF unit

•Water from CPI Separator Flows to **IGF unit**. IGF is a tank in which gas bubbles are aerated with motor driven agitators. This bubbles float the oil droplets to surface .This collected oil is pumped to CPI separators.

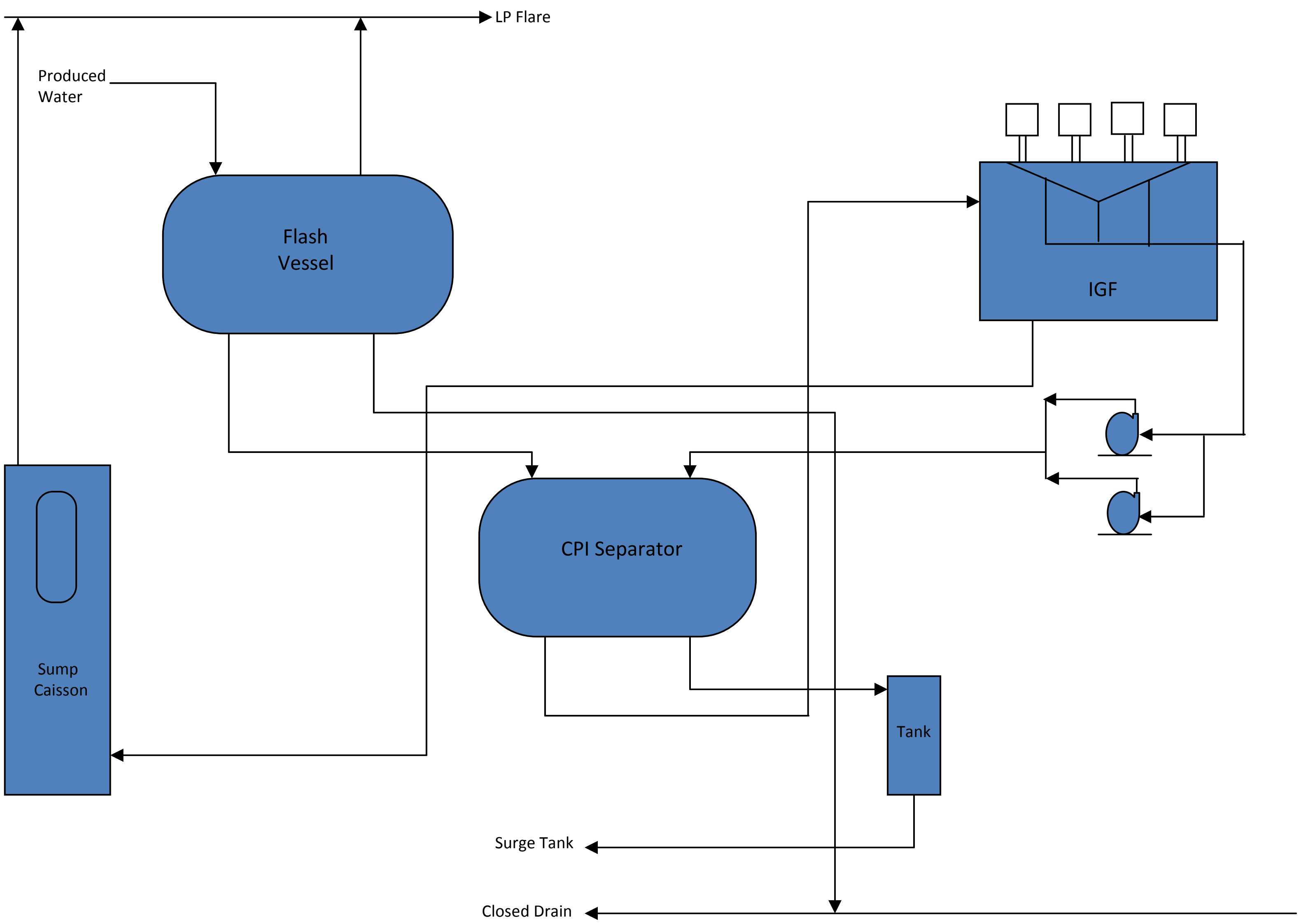
Sump Caisson

Water from IGF is routed to **Sump Caisson** which is a vessel with bottom end open through which water continuously drains into the sea. Oil floating in the surface of the sump caisson is collected in the blow caisson and lifted up and flown into the skimmer with gas injection.

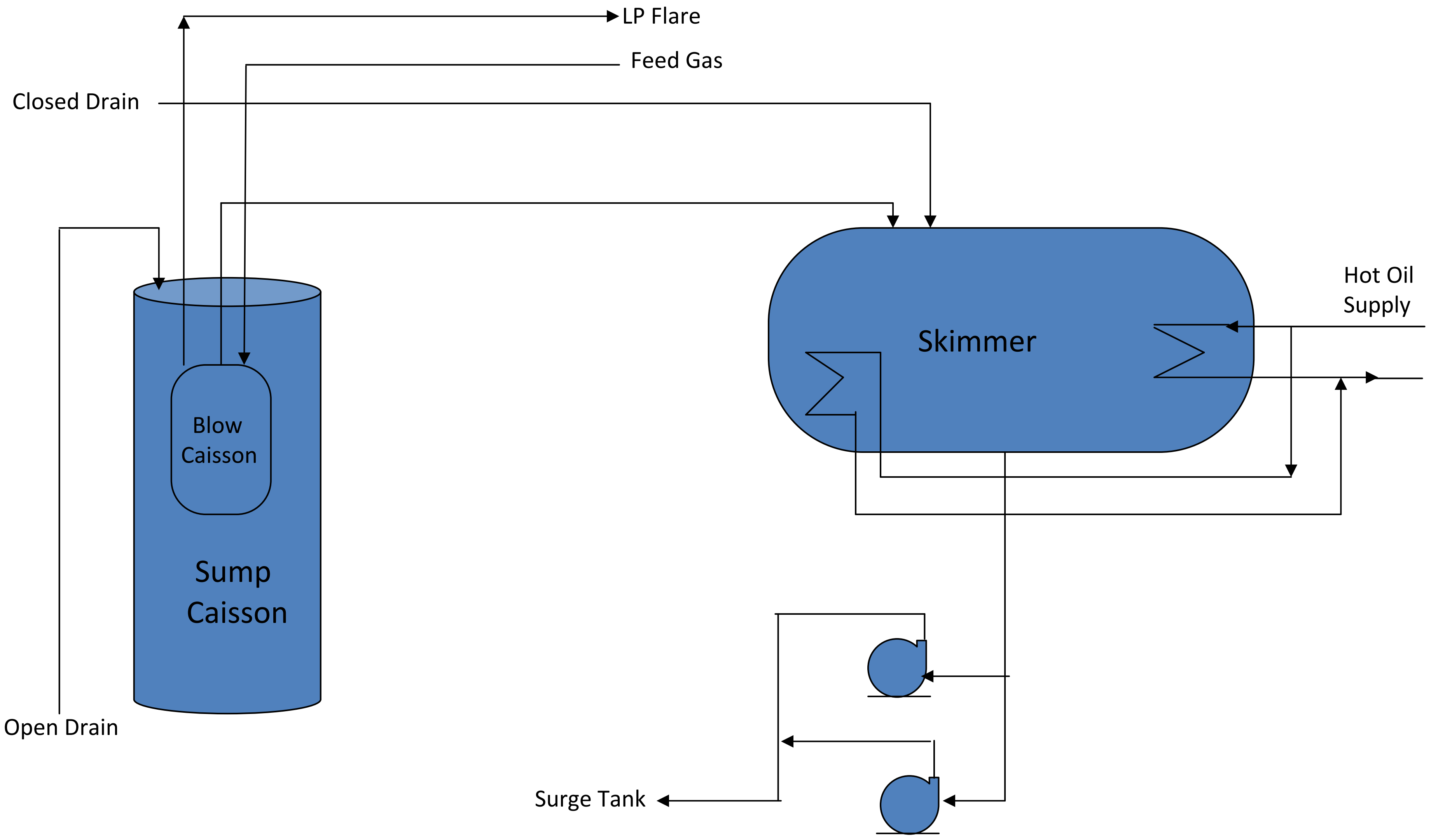
PFD- PRODUCED WATER CONDITIONING



Produced Water Conditioning



Skimmer


LP Flare
Feed Gas
Closed Drain
Hot Oil
Supply
Skimmer
Blow
Caisson
Sump
Caisson
Open Drain
Surge Tank

WATER INJECTION

Water Injection

- Water Injection is done to maintain Reservoir pressure as well as Water flooding.

- To prevent damage to the Reservoir the quality of water injected is strictly complied with. Also, the health of the pipelines carrying the injection water to the wells and well platforms is taken care of by dozing chemicals to prevent corrosion and generation of H2S by SRB colonies.

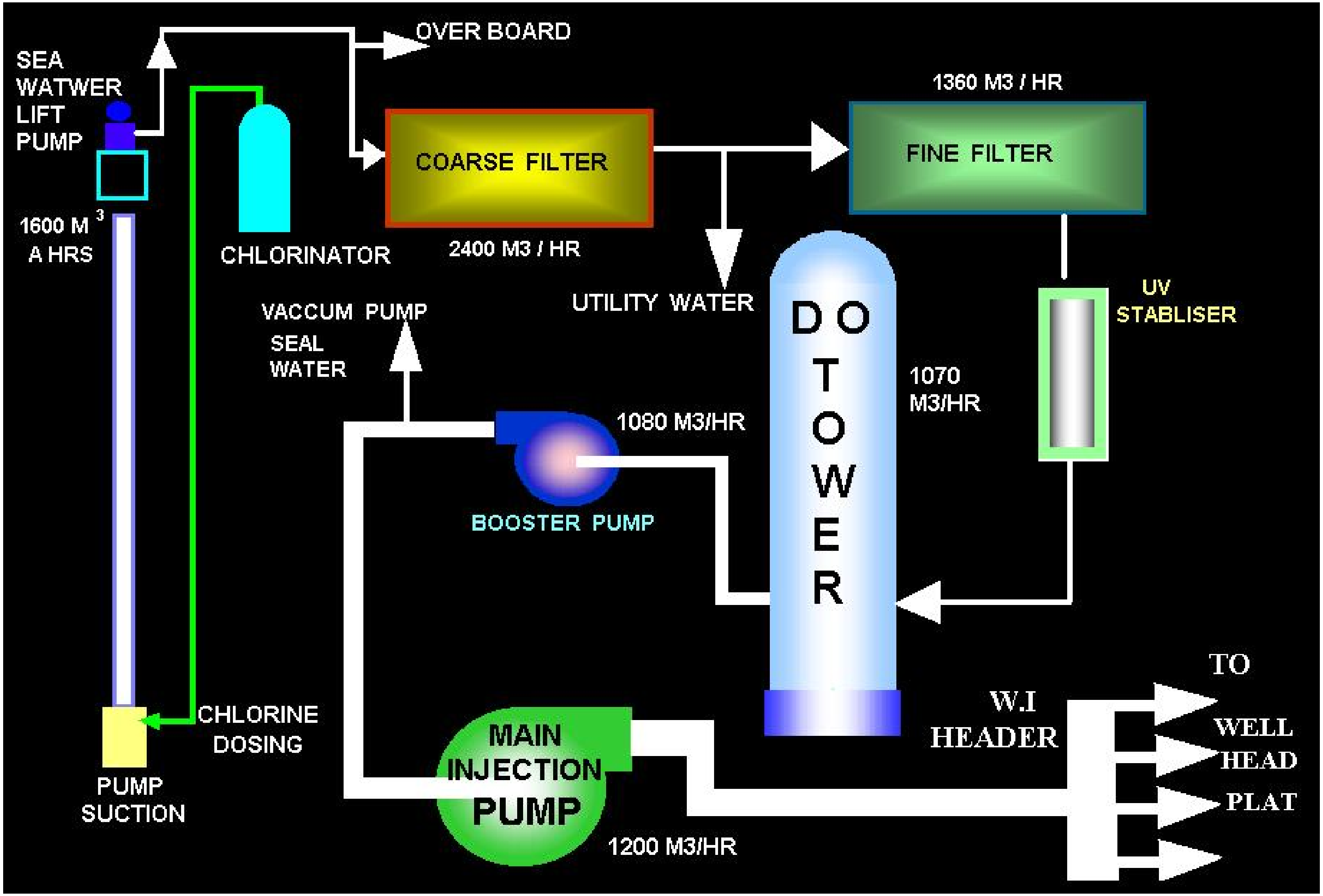
The Major components of Water Injection systems are:

SEA WATER LIFT PUMPS
COARSE FILTERS
FINE FILTERS
DEOXYGENATION TOWERS
BOOSTERS PUMPS
MAIN INJECTION PUMPS
CHEMICAL DOSING SYSTEM

CHEMICAL DOZING SYSTEM

FLOCCULANT
SCALE INHIBITOR
CORROSION INHIBITIOR
CHLORINATION
BACTERICIDE
OXYGEN SCAVENGER

SEA WATER TREATMENT FOR WATER INJECTION



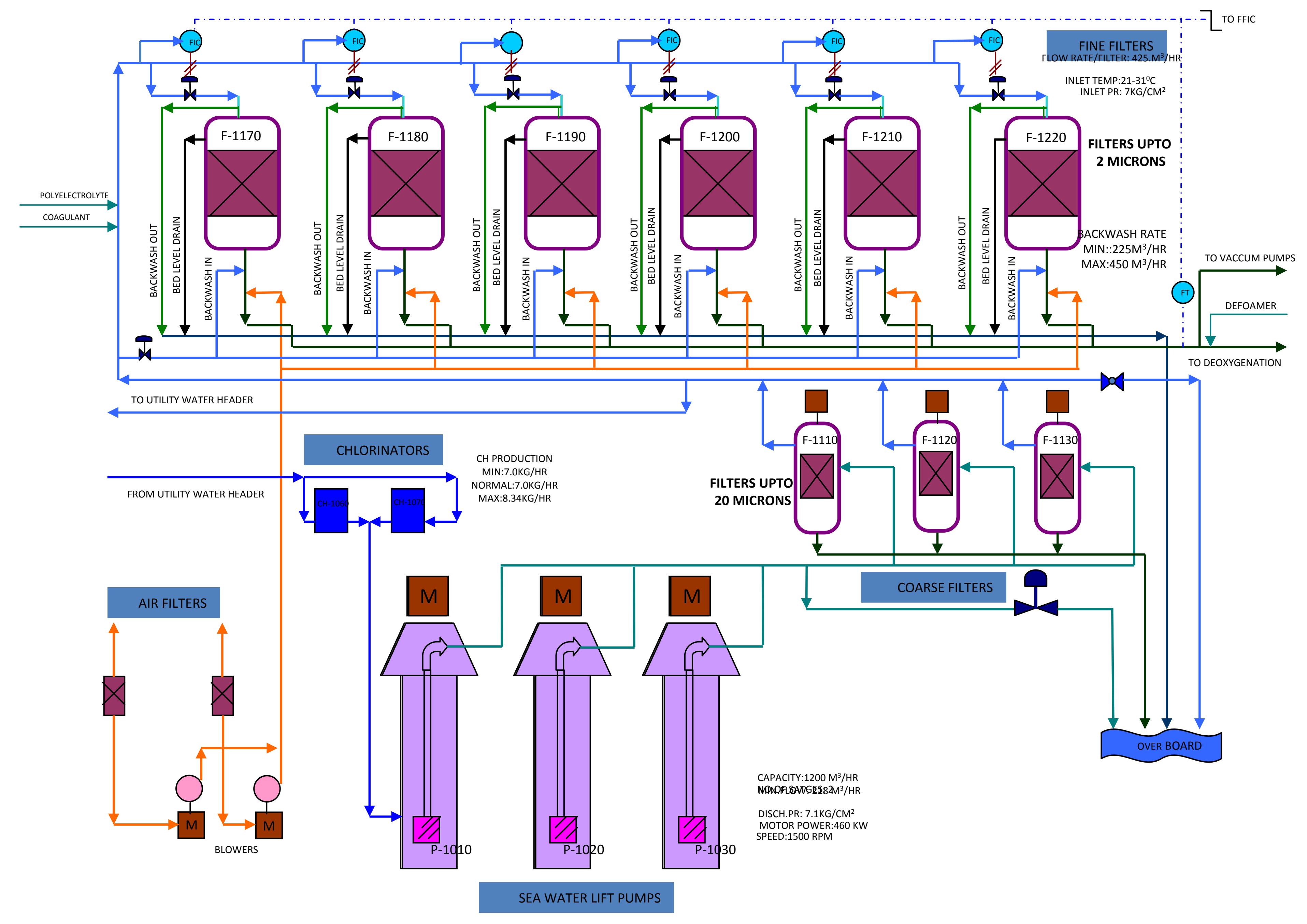
SEA WATER LIFTING AND FILTERING

- Water from sea is Lifted with seawater lift pumps and fed to Coarse Filters and fine filters for filtering.

- Coarse filters the particles are filtered to 20 microns
- Fine filters the particles are filtered up to 2 microns.

- Poly electrolyte and coagulants are added in sea water lift pump discharge to promote coagulation of suspended particles.

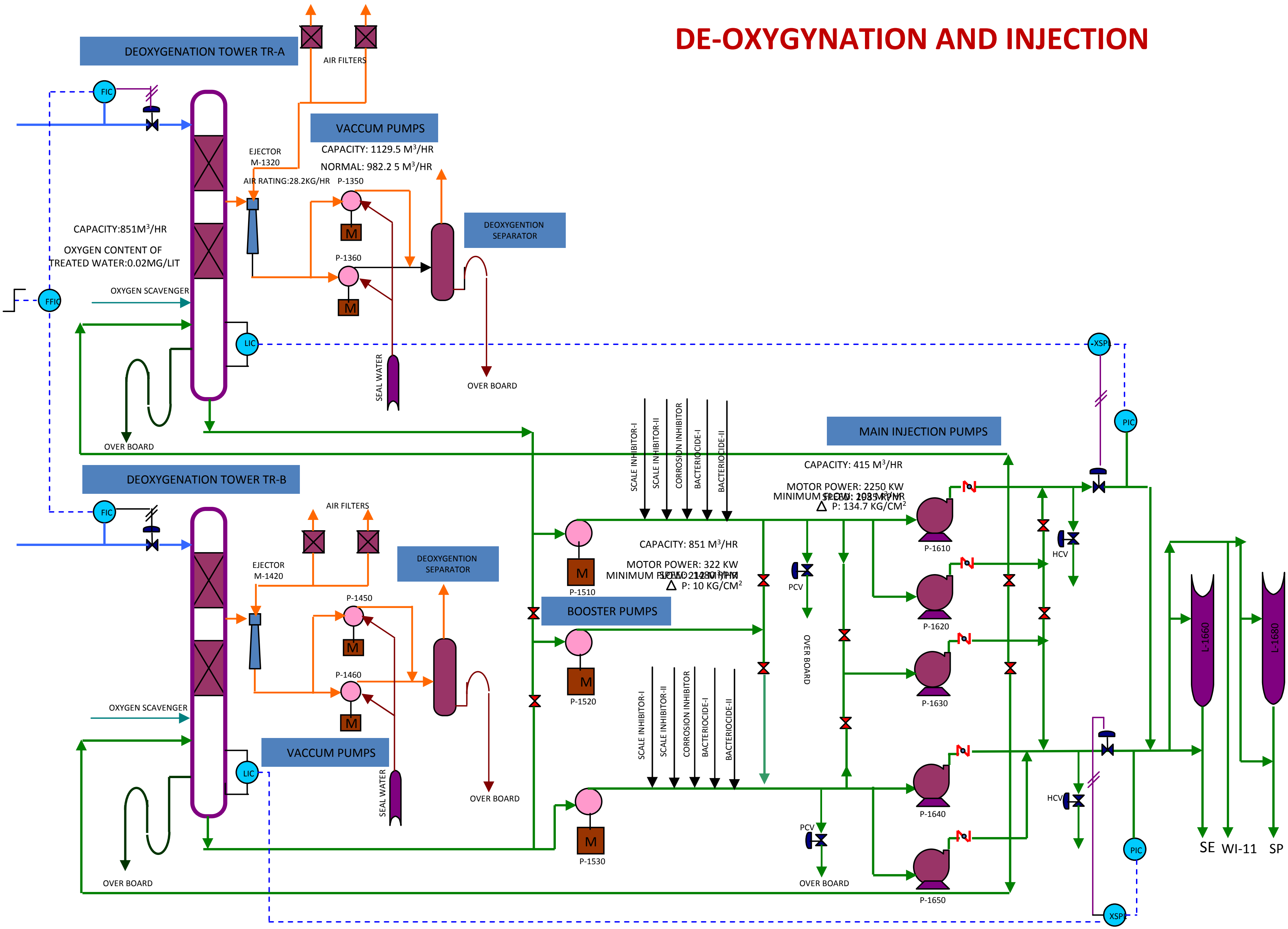
SEA WATER LIFTING - FILTERATION



DE-OXYGYNATION AND PUMPING

- The filtered water flows to Deoxygenating towers for removal of oxygen.
- Deoxygenation prevents formation of aerobic bacterial colonies(sulfur reducing bacteria) in the WI flow lines. Vacuum pumps and Oxygen scavenger chemical dozed facilitates oxygen removal in the towers.
- Booster Pumps take suction from De-oxygenation Towers and feed Main Injection Pumps.
- Scale inhibitors, Bactericide and corrosion inhibitor chemicals are dozed in the discharge of booster pumps.
- MIP's discharge the treated water to Water Injection subsea pipelines to wells and well platforms for injecting in to water injection Wells.

DE-OXYGYNATION AND INJECTION



Fire Detection & Suppression System

Detection System

- Gas Detection
- Fusible Plug
- Fire Detection
- Smoke Detection
- Heat Detection

Suppression System

- FIRE WATER PUMPS
- Water Sprinkler
- Dry Chemical
- FM-200
- CO_2 Extinguisher
- AFFF SYSTEM

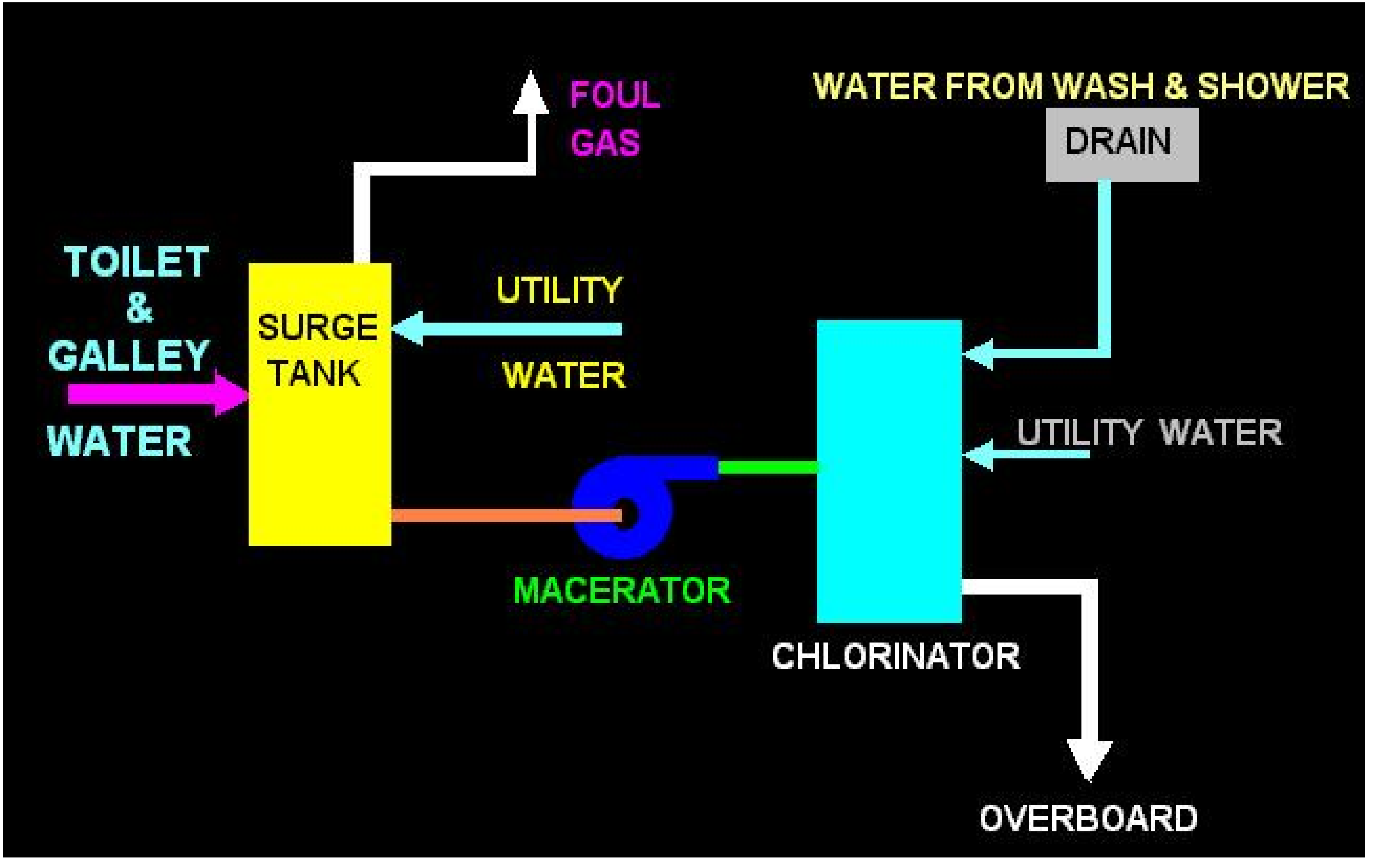
Escape / Abandon

- Escape Ladder
- Scramble Net
- Life Ring
- Life Raft
- Life Boat
- Jumping Rope

UTILITIES

- POWER GENEARTION – GAS TURBINE DRIVEN GEBERATORS
- WATER MAKERS- RO WATER MAKERS
- LIVING QUARTERS AND ASSOCIATED REQUIREMNETS LIKE LAUNDRY, GALLEY
- EMERGENCY DIESEL GENERATORS
- COMMUNICATION SYSTEMS

SEWAGE TREATMENT



NEW TECHNOLOGIES

Intelligent wells

DIGITAL OIL FIELD

MULTIPHASE PUMPING

SUBSEA SEPARATION AND RE-INJECTION

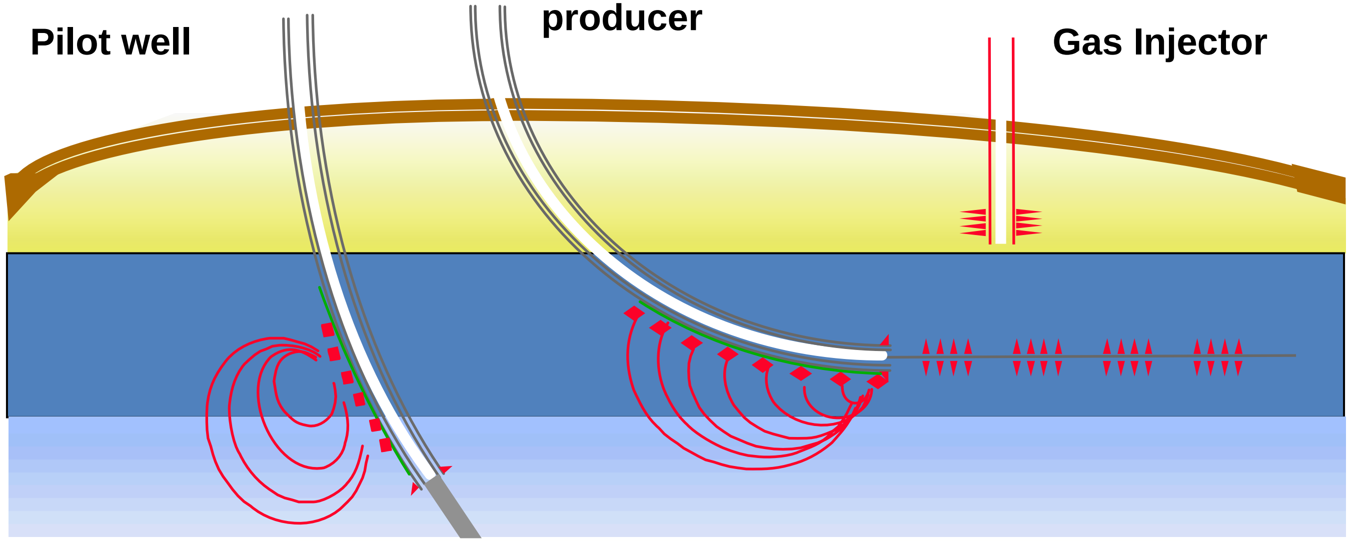
GAS TO WIRE

Intelligent Wells

Wells Equipped at Completion with Downhole Controls and Sensors

Proactive Remediation of Fluid Inflow

- **Remote controlled Downhole zonal control valves**
- **Implement reservoir decisions without intervention**



Continuous data from wells

Pressure Performance

Inflow Distribution

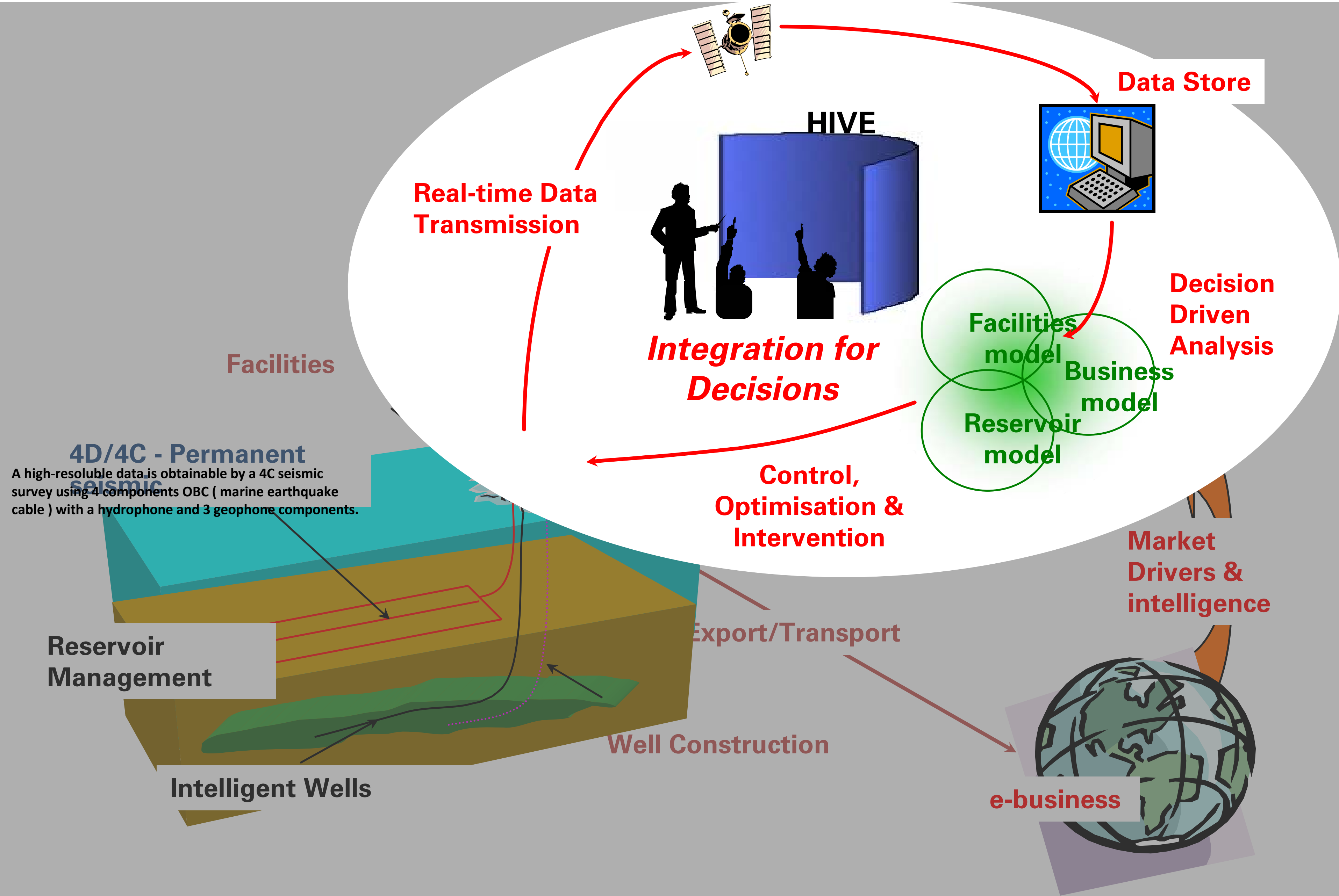
Flowing Phase

Downhole Seismic

Reservoir Saturation

- Optical Pressure Gauge
- Optical Distributed Temperature Gauge.
- Data is transmitted up the wellbore via fibre optics.

DIGITAL OILFIELD



MULTI PHASE PUMPING

Multiphase production systems require the transportation of a mixture of oil, water and gas, often for many miles from the producing well to a distant processing facility.

This represents a significant departure from conventional production operations in which fluids are separated before being pumped and compressed through separate pipelines. By eliminating this equipment, the cost of a multiphase pumping facility is about 70% that of a conventional facility and significantly more savings can be realized if the need for an offshore structure is eliminated altogether.

However, multiphase pumps do operate less efficiently (30-50%, depending on Gas volume fraction and other factors) than conventional pumps (60- 70%) and compressors (70-90%).

Still, a number of advantages in using multiphase pumps can be realized, including:
1)Increased production through lowering backpressure on wells;
2)Elimination of vapor recovery systems;
3)Reduced permitting needs;
4)Reduction in capital equipment costs; and,
5)Reduction in “footprint” of operations .

CONVENTIONAL AND MULTIPHASE PUMPING

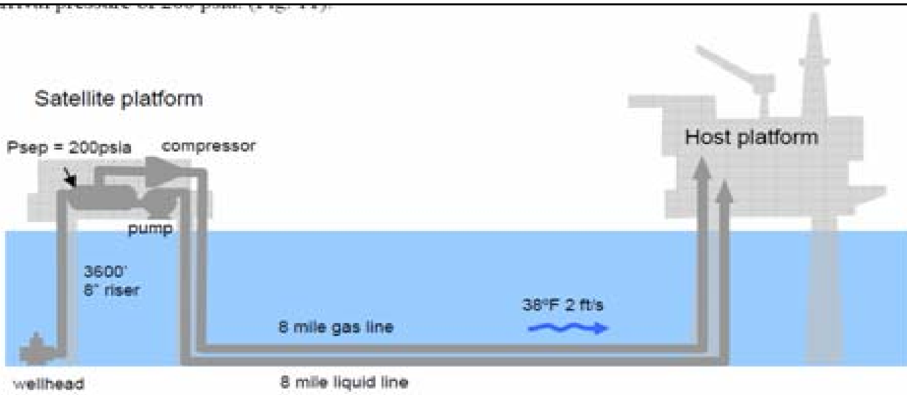


Figure 10: Schematic of Production System using satellite platform

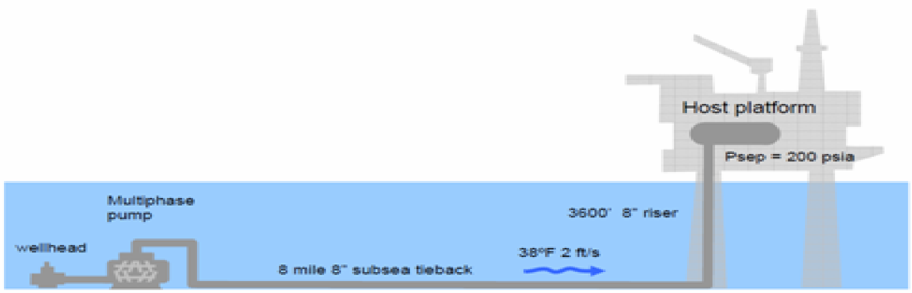


Figure 11: Schematic of Production System using subsea multiphase pump

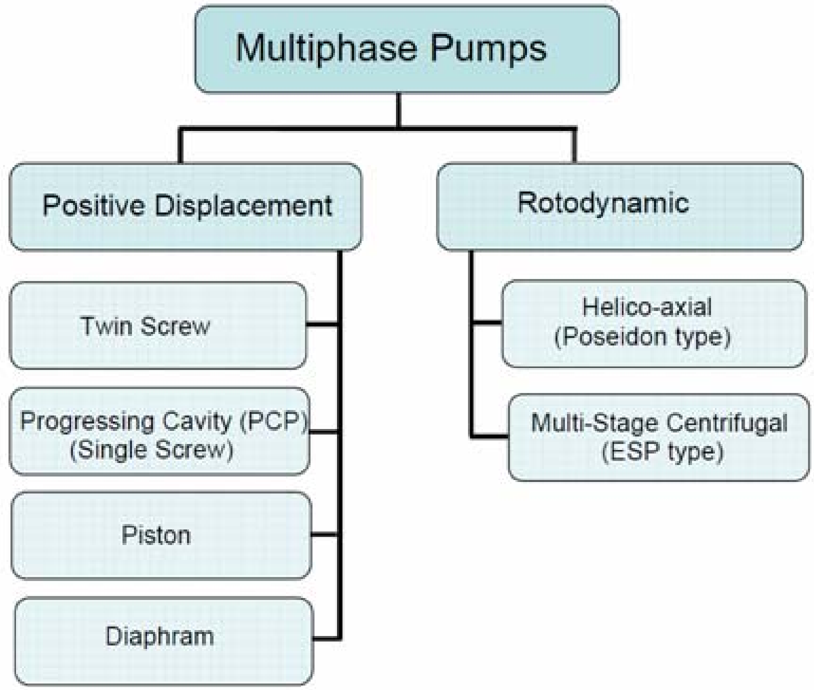
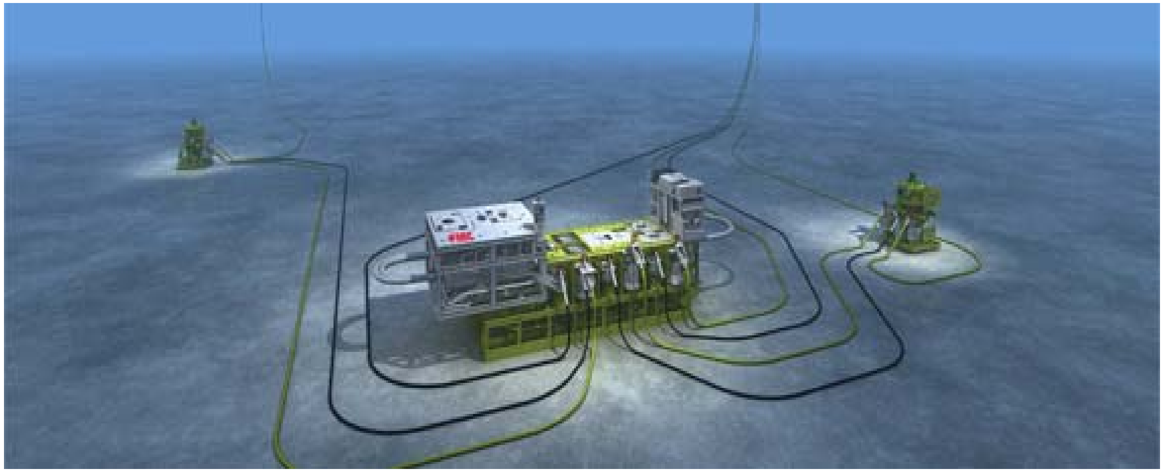


Figure 1: Types of Multiphase Pumps

- **Multiphase pumping is a relatively new technology and acceptance has been hampered by a lack of engineering design tools.**
- **Recently, pipeline simulation codes have incorporated the ability to model multiphase pump performance as part of the overall multiphase production system**

SUBSEA PROCESSING

- Normally used in deepwater
- Separation of heavy oil and water
- Reinjection of water to boost production in a mature field development.
- The separation system may also includes cyclone modules that will perform water treatment before reinjection the water back into the reservoir.



"a true subsea development is very environmentally friendly."

THANKS