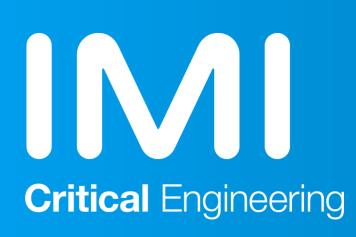
Actuation and Control systems for Petrochemical process valves Best practice and new trends

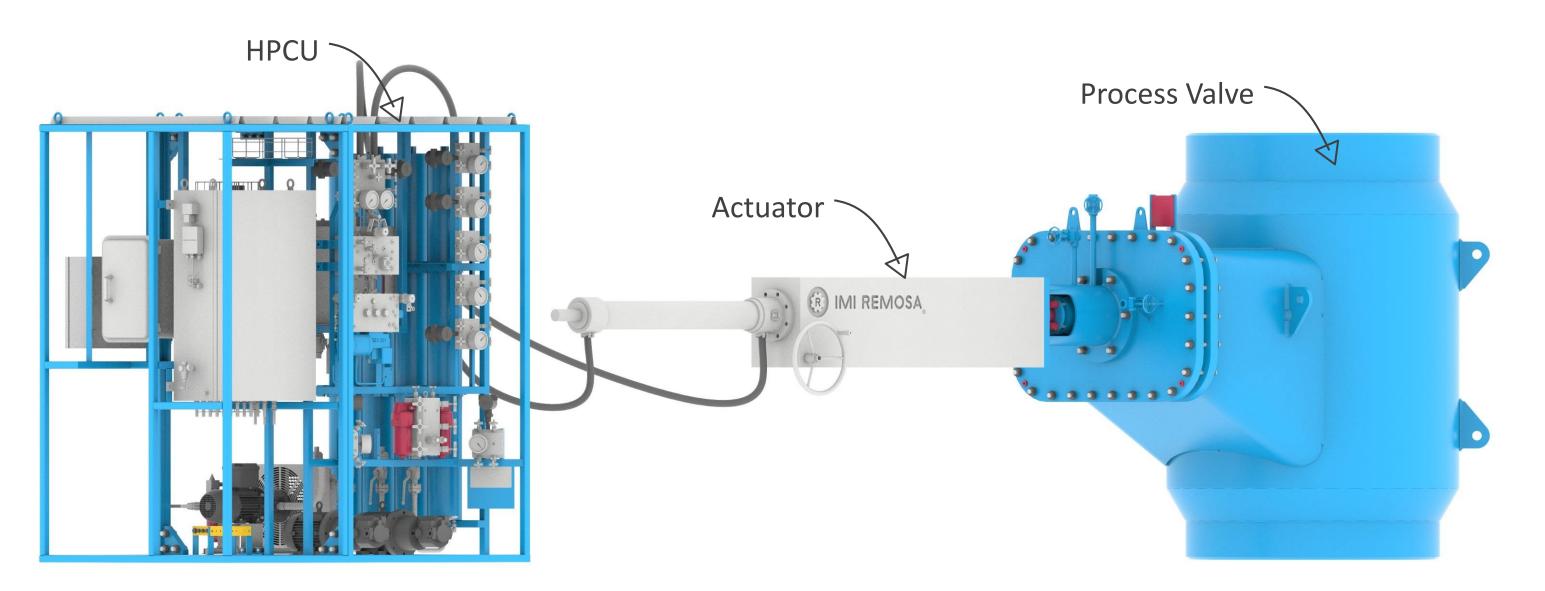
Alberto Pedrini IMI REMOSA

Actuation and Controls Engineering Manager





Actuating system for process valve



- HPCU provides accurate valve positioning control for process through hydraulic valve directed by a control system.
- The system should provide full redundancy of the most critical items and functionalities in order to guarantee high reliability during normal and emergency operation





Hydraulic Units description

HPCU: Hydraulic Power Control Unit

• Power

HPU transforms electric energy supplied to pump motors, into the hydraulic pressure needed for valve operation. Furthermore, it ensures oil cleanliness and temperature control

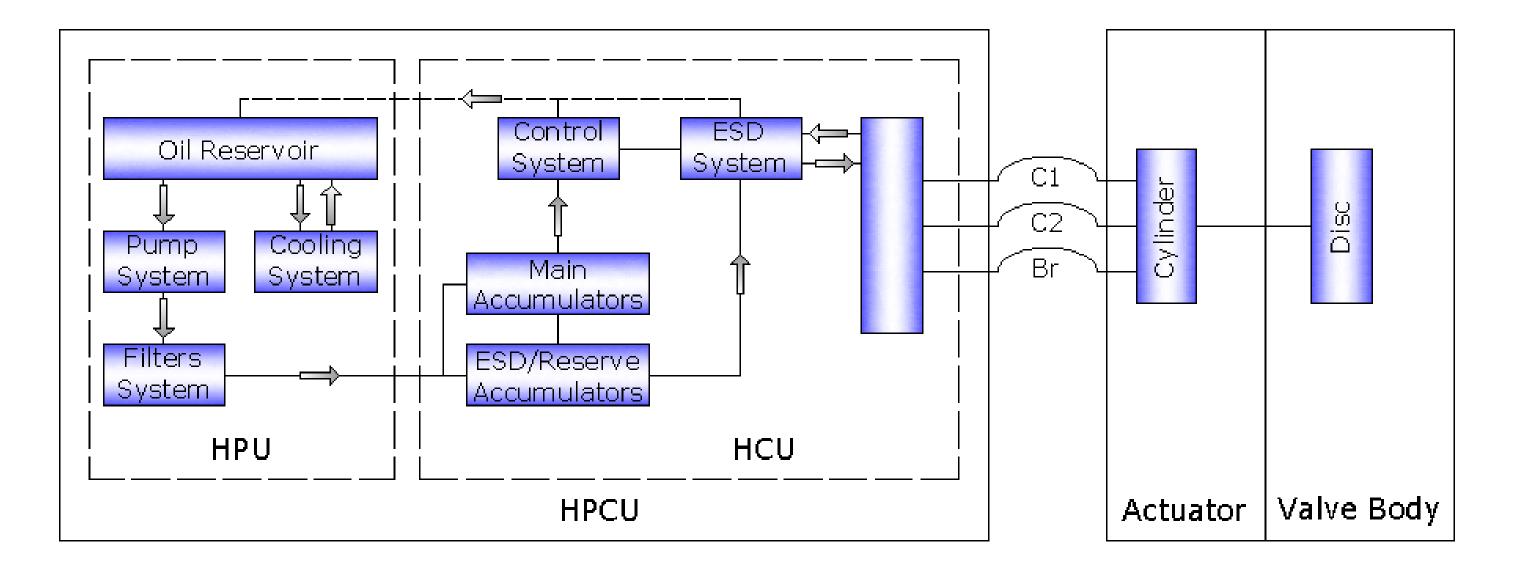
Control Π

Hydraulic power (pressurized oil) is stored in the accumulators, and directed to the hydraulic cylinder to change the slide value disc position. This position can be changed automatically (DCS and PLC control system) or manually by the field operator.



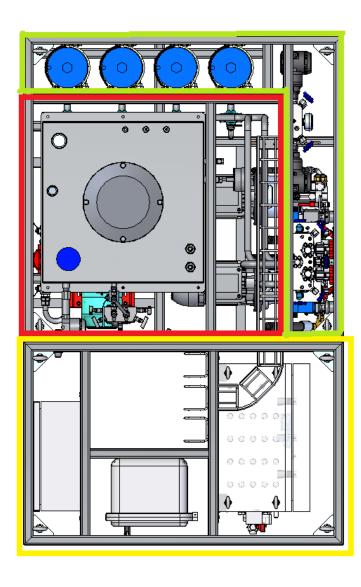
Hydraulic unit description

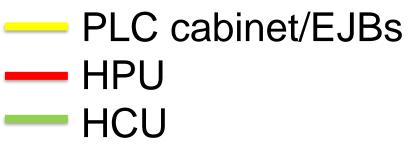
HPCU: Block Diagram





HPCU layout Current state – integrated HPCU







PLC cabinet

HPU+HCU



Especially old installations are based on integrated layout Each valve has its own control system, HPU and HCU

Advantages

- Commissioning
- □ Logistics

Disadvantages

- Ex-proof installation (Exd Exp)
- Dimension of HPCU
- □ Limited Choices

HPCU layout Alternative and new trends – Splitted HPCU

New installation prefers to have control system splitted to hydraulics and installed in safe area

This solution is applied especially when a package with more than 4 value is provided

Disadvantages

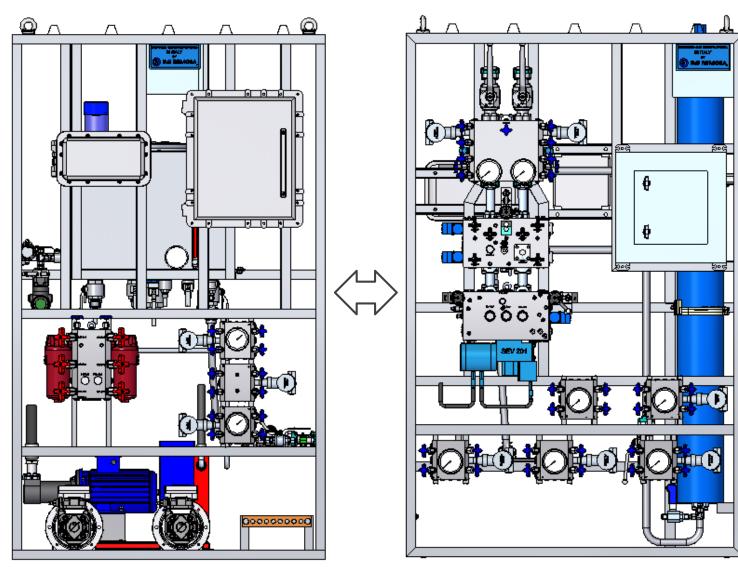
- Commissioning
- Logistics

Advantages

- No Ex-proof Π
- Dimension of HPCU
- Numerous Choices



PLC cabinet rack Installed in safe area



HPU Installed on ground or with HCU



HCU Installed on platform

Control system – From Old to New Technology

Available Features:

- Valve positioning control
- Monitoring HPCU by means of analog transmitters and digital switches
- Management of main equipment (pumps, reservoir, accumulators)
- Generating alarms
- High performance valve positioning control and advanced system management
- Providing user with detailed informations about HPCU status
- Dealing with faults and abnormal events by actively adjusting HPCU operation in real time
- **Touch screen HMI**
- **Increased diagnostics and remote assistance**

Analog controller

PLC





PLC vs analog controller

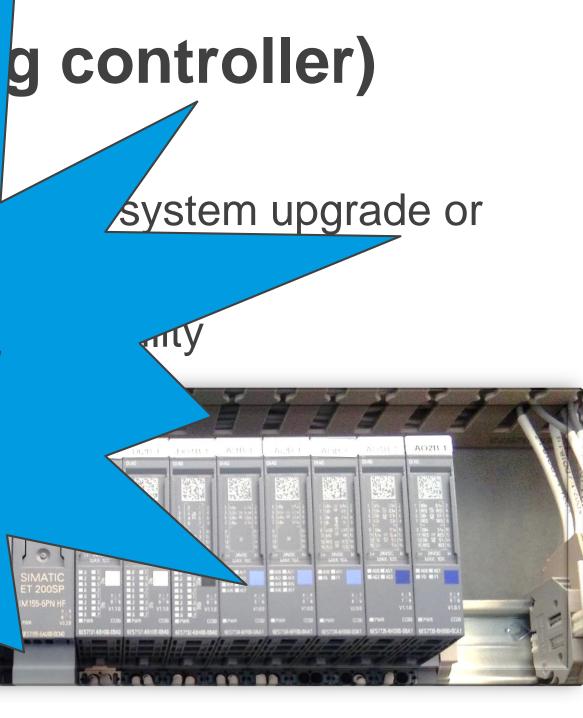
PLC System key features vs an

- Performance
- Easy reprogramming an optimization
- Interchangeab
- Easy Maintenance
- Low Power
- Small physical
- Several Commun
- Human Machine mone
- Communication module

PLC has become a MUST for HPCU control system

remotery monitor HPCU status!



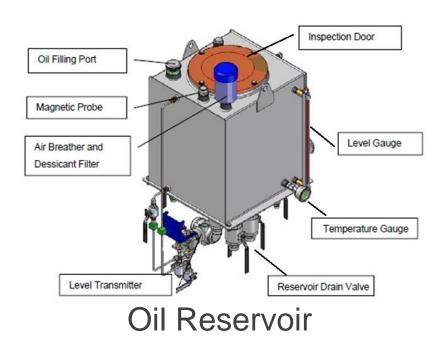


HPU – Current technology

Purposes

- □ Stores the hydraulic fluid and protects it against contamination particles and moisture
- Pressurizes the oil to be used in the HCU for valve positioning / ESD
- Controls the oil temperature

Main Elements:





Pressure pumps Variable displ. type



Filter-PSV manifold



ation particles and moisture oning / ESD



Cooling&Recirc. system

HPU – Alternative and new trends

Increase the system pressure

- In the past normal hydraulic pressure was 100-120 barg.
- E.g. Some licensors still require system pressure <125barg in its specs
- System pressure can be increased up to 160 bar without any negative impact and with the following benefits:
 - Smaller cylinder (means small flow rate)

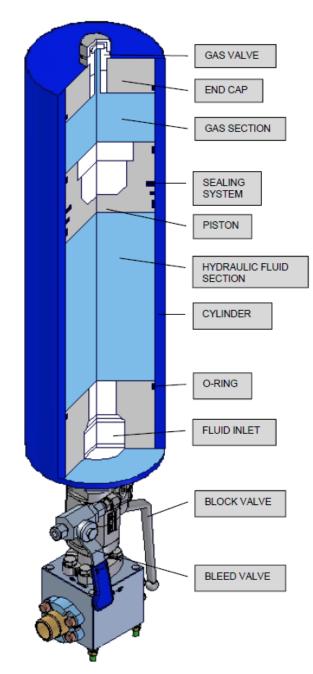


- Smaller components in general (servo, accumulators, valves, etc)
 - HPCU are smaller and more standardized



HCU – Accumulators



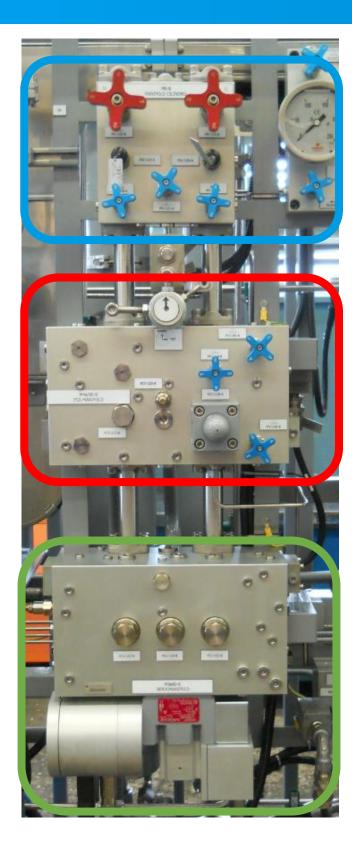


Accumulators:

- Store energy (in the form of pressurized oil), to give required operating performance (valve closing time in operation or ESD, strokes in case of pump failure, etc.) according to Licensor specification
- Piston Type Oil/Nitrogen Accumulator
- Main (or reserve) accumulator battery is connected to the main hydraulic system
- Emergency accumulator battery is connected to the ESD hydraulic system
- Accumulators sized for min. 2 full strokes @ normal operating thrust, with Safety Factor 2
- Dedicated isolation and bleed valve
- Can be equipped with ultrasonic position switch or position or N2 pressure transmitter upon request



HCU – Manifolds



Cylinder I/F manifold

- Provide interface connection to the actuator cylinder
- Equipped with block and bleed of the main cylinder hydraulic line Π

ESD Manifold

- Solenoid operated, fail to close, ESD action.
- Solenoid valve poppet type. possible configuration in 1001, 1002, 2002, 2004
- SOV powered by Emergency Interlock System or independent power source
- Manual ESD Test Valve
- Design ESD closing time is normally less than 2 secs for SV

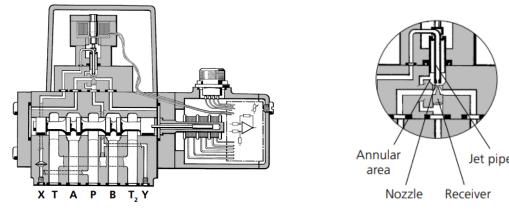
Control Manifold

- The "heart" of the HPCU, transforming the electrical command into oil flow Π regulation to the actuator
- The control is provided by a servovalve
- Manual Operator 3-Position Valve (Open-Auto-Close)
- Solenoid Valve for lock in position and energy saving mode



HCU – Alternative and new trends

Servovalve vs Proportional Valve



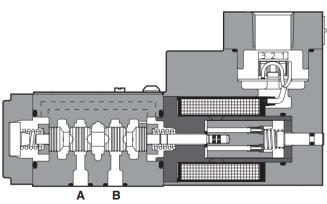
There is no clear distinction between servovalve and proportional valve. Different vendors tend to give different definition

The spool is hydraulically piloted by a jet pipe or similar	Solenoid is used to
Existing from 1940s	It is required dedic
Zero overlap	
Response time < 18ms	R
Max current 300mA	
Hysteresis 0.5-3%	
High sensibility to oil contamination	Less ser

The answer is yes! Are you asking if proportional valves are suitable for FCC control valve application?







o provide infinite positioning of the spool

icated electronics to drive the solenoid

Positive overlap

Response time < 60ms

Max current 2.5 A

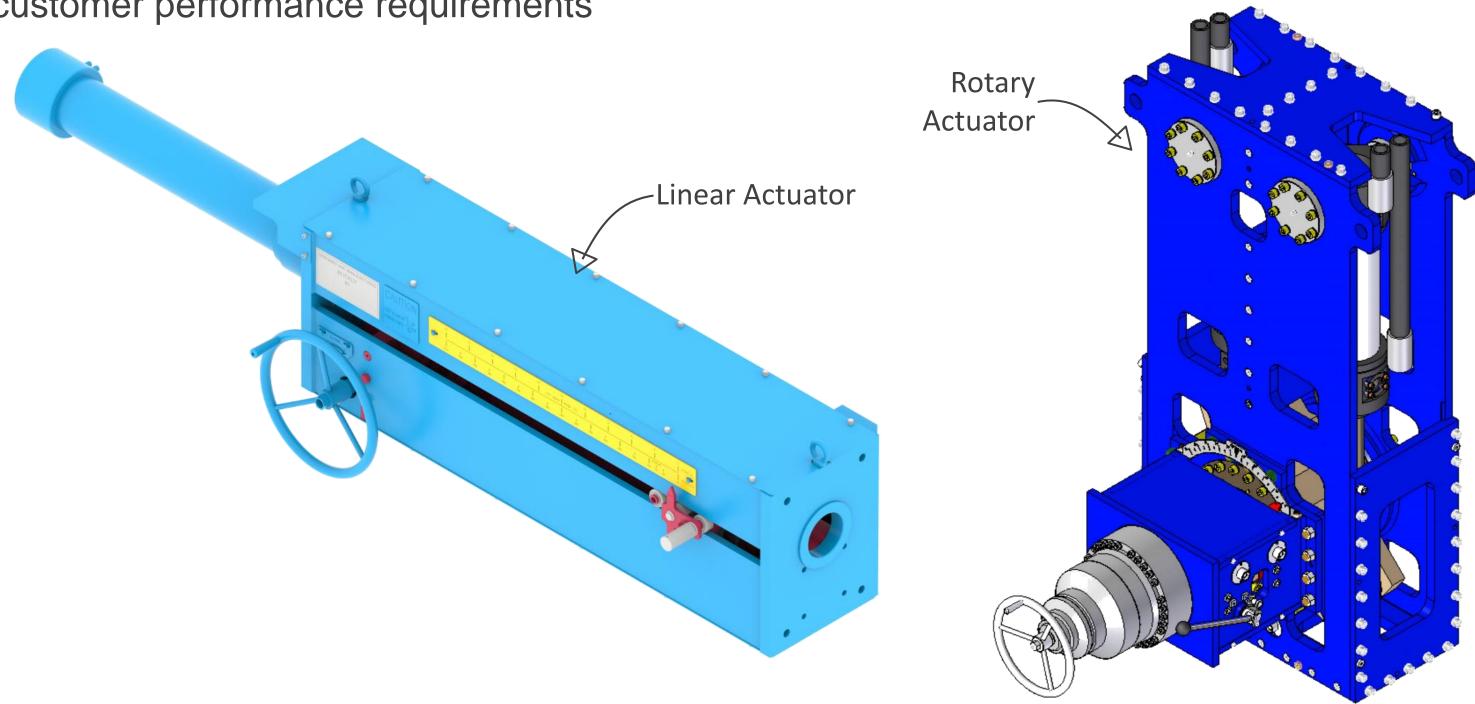
Hysteresis < 5%

ensibility to oil contamtination

Actuator – Current Technology

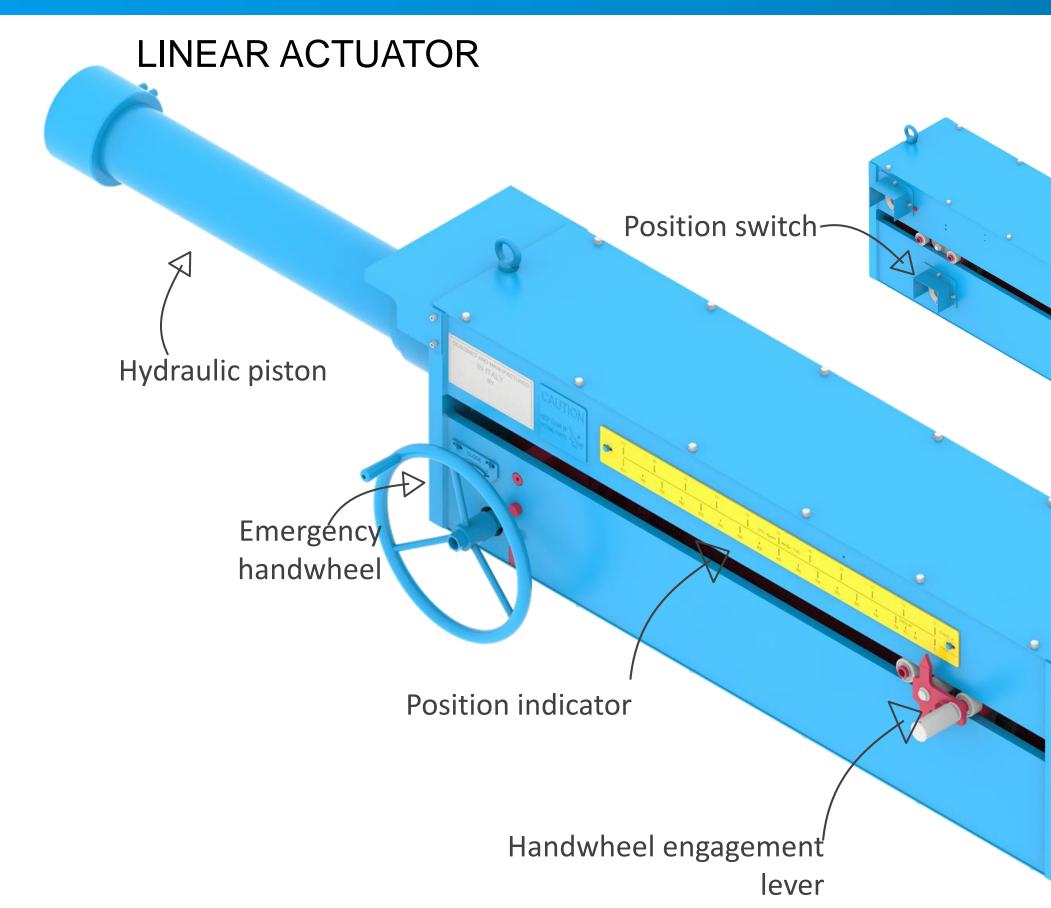
Slide valve and butterfly valve are equipped respectively with linear and rotary actuator.

IMI Remosa designs and manufactures several sizes of actuator in order to meet the most stringent customer performance requirements





Actuator – Current Technology





Redundant Position transmitters

Actuator – New trends

Although hydraulics is still the best solution for providing high force at high speed, the technology of electrical cylinder is growing fast.



Main concerns remain:

- Force vs speed
- Accumulation method for emergency function (big batteries needed!)
- High current to be provided very close to the FCC valve



Servo-motor

Actuation & Control Systems - Common Issues

19%

Component Malfunctioning

21%

- Fluid Cleanliness ** HPCU Malfunctioning \checkmark Limited functionality of the HPCU Shortened lifetime of Equipment **Component Malfunctioning** HPCU Malfunctioning **No Spare Parts** No OEM Spare Parts on Stock Hydraulic Leakage HPCU Malfunctioning Fire Risk **Erosion Corrosion** HPCU Malfunctioning Fire Risk
- Other 6)

17

1)

3)

4)

5)

** fluid cleanliness level of ISO 17/14/11, 85% of all types of hydraulic system failures are a direct consequence of fluid contamination.



IMI Remosa Statistics of last 5 Years (based on Customer Emergency Field Service calls) Leakages **Erosion**/ 13% Corrosion 12% Other 10% **Oil Not Clean** 25%

Control Systems - Common Issues





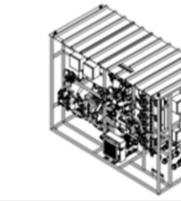
Defective / Worn Out of HPCU Equipment & Hoses/Pipes





Hydraulic Leakages

	REMOSA									Critical Engineering				
Reason Prajeal		-		BPC	Required 5	tide Walter		P 161		EPCE/A-I		5	· Parl Li	
Refiners	RFCC, LTB, PRB BBITS PETROBAS			T	1311-TCT-248			Page				1		
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TCV2481-582A	,													
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TCV2481-5820				· ·		•	2	_		•				
TCV2481-5820 TCV2481-581	COOLER MILTER CARTORIGE	1	H.	· · ·	CRTISIUM	·	2		z		2			
TCV2481-5820 TCV2481-581 H.A. 1311-PSV-2468; 1311-	COOLER FILTER CARTORIGE	1	H H	· · ·	CRT16000001	• 	2		2	•	2			
TCV2484-582D TCV2484-584 H.A. 1311-P5V-24681 1311-P5V-24681 1311-P5V-24481 P5V-2468 P5V-2468	COOLER FILTER CARTORIGE FLUSHING KIT RELIEF VALVE PRESSURE RELIEF VALVE PRESSURE RELIEF VALVE	1 2 2 1	H. H. H. H.	· · ·	CRT46000001 PLUSHKITSLOU VHAXPED420410 VHAX00014000 VD400002000	•	2		2 1 2 2 1	•	2 1 2			
TCV2484-5820 TCV2484-581 H.A. 1311-P5V-2468;1311- P5V-2443;1311- P5V-2443;1311- P5V-2443 P5V-2443 P5V-2448 P5V-2448	COOLER FILTER CARTORIGE FLUSHING KIT RELIEF VALVE PRESSURE RELIEF VALVE PRESSURE RELIEF VALVE FLEXIBLE HOSE	1 2 2 1 2 1 2	N. N. N. N. N.	•	CRT45000000 PLUSHKITSLOO VHAXPE0420400 VHAX00004000 VD0000002000 TUP45H004330	•	2	•	2 1 2 2 1 2	•	2 1 2 1 2			
TCV2481-5820 TCV2481-581 H.A. 1311-P5V-2468; 1311- P5V-2463; 1311- P5V-2463; 1311- P5V-2468 P5V-2468 P5V-2468 P5V-2468 P5V-2468 P5V-2468 P5V-2468	COOLER FILTER CARTORIGE FUUSHING KIT RELIEF VALVE PRESSURE RELIEF VALVE PRESSURE RELIEF VALVE FLEXIDLE HOSE FLEXIDLE HOSE	1 2 2 1 2 1 2 2 2 1 2 2 2 2 2 2 2 2 2 2	He. He. He. He. He.	· ·	CRT45000001 FLUSHKITSLOU VHAXPED470400 VHAXIIII VD6100000000 TU745H001330 TU745H001300		2	•	2 1 2 2 1 2 2 2 2	•	2 1 2 1 2 2			
TCV2484-582D TCV2484-584 H.A. 1314-P5V-2468; 1314- P5V-2468 1314-P5V-2468; 1314- P5V-2468 P5V-248 P5V-248 P5V-248 P5V-248 P5V-248 P5V-248 P5V-248 P5V-248 P5	COOLER FILTER CARTORIGE FUUSHING KIT RELIEF VALVE PRESSURE RELIEF VALVE PRESSURE RELIEF VALVE FLEXIDLE NOSE FLEXIDLE NOSE FLEXIDLE NOSE	1 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	20 20 20 20 20 20 20 20 20 20 20 20 20 2	· · ·	CRT46000001 FLUSHKITSLOU VHAXPED470400 VHAXIIII VD60000000000 TU745H000000 TU745H0000000 TU745H0000000		2	· · ·	2 1 2 2 1 2 2 2	•	2 1 2 2 2			
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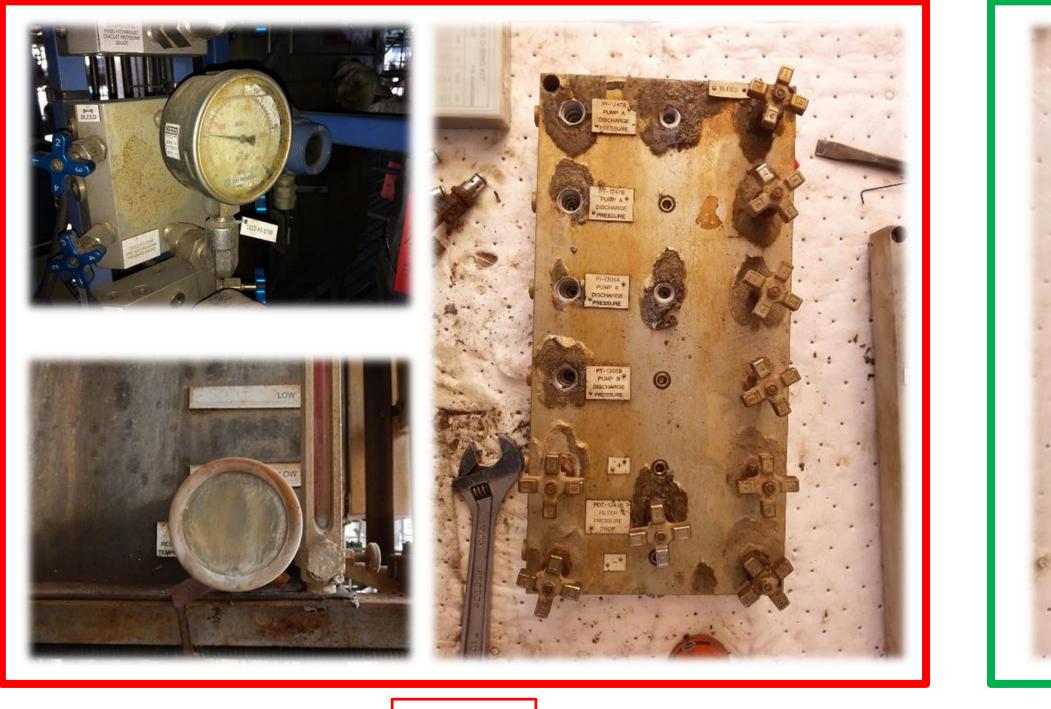


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1311-PSV-2468; 1311-	PLUSHING KIT	•	H.,		PLUSHKITSLOBE		• 	•	2	•	2			
1311-PSV-2468; 1311- PSV-2461 1311-PSV-2443; 1311- PSV-2458 PSV-2448	PLUSHING KIT RELIEF VALVE PRESSURE RELIEF VALVE PRESSURE RELIEF VALVE	2 2 1	H. H. H.	· · · · · · · · · · · · · · · · · · ·	PLUSHKITSLOH VHAXPED471411 VHAXIIIII4411 VD4141412411		•	-	2 1 2 2 2	•	2 1 2			
1911-PSV-2468; 1911- PSV-2461 1911-PSV-2443; 1911- PSV-2468 PSV-2468 PHH1C1-1; PHH1C2-1	PLUSHING KIT RELIEF VALVE PRESSURE RELIEF VALVE PRESSURE RELIEF VALVE FLEXIPLE HOSE	1 2 1 2	H. H. H. H.	•	PLUSHKITSLOH VMAXPED171111 VMAXIIIIIIII VDD111112111 TUP4SH111331		• 	- - - -	2 1 2 2 1 2	•	2 1 2 1 2			
1911-PSV-2468; 1911- PSV-2461 1911-PSV-2443; 1911- PSV-2468 PSV-2468 PHH1C1-1; PHH1C2-1 PHH1C1-1; PHH1C2-1;	PLUSHING KIT RELIEF VALVE PRESSURE RELIEF VALVE PRESSURE RELIEF VALVE FLEXIPLE HOSE FLEXIPLE HOSE	1 2 1 2 2	H H H H	· · · · · · · · · · · · · · · · · · ·	PLUSHKITSLOH VMAXPED178111 VMAXIMI1111 VD5111112111 TUP4SH111331 TUP4SH1112111		• 	· · ·	2 1 2 2 1 2 2 2 2	•	2 1 2 1 2 2			
1911-Р5V-2461; 1911- Р5V-2461 1911-Р5V-2443; 1911- Р5V-2443 Р5V-2443 РКИ-С1-1; ГКИ-С2-1 РКА-С1-1; ГКИ-С2-1; ГКИ-10R-1; ГКА-10R-1;	PLUSHING KIT RELIEF VALVE PRESSURE RELIEF VALVE PRESSURE RELIEF VALVE FLEXIPLE HOSE FLEXIPLE HOSE FLEXIPLE HOSE	1 2 1 2 2 2 2 2 2	N	· · · · · · · · · · · · · · · · · · ·	PLUSHKITSLOH VMAXPED178111 VMAXIMI1111 VD6111112111 TUP4SH111331 TUP4SH1112111 TUP4SH1112111		•	- - - - - -	2 1 2 2 1 2 2 2 2 2 2	•	2 1 2 2 2			
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1311-PSV-2468; 1311- PSV-2463; 1311-PSV-2443; 1311- PSV-2468 PSV-2468 PHH1C1-1; PHH1C2-1 PHH1C1-1; PHH1C2-1; PHH1DR-1; PHH1DR-1; PHPAOUT-1; PHPAOUT-1;	PLUSHING KIT RELIEF VALVE PRESSURE RELIEF VALVE PRESSURE RELIEF VALVE PLEXIPLE HOSE FLEXIPLE HOSE FLEXIPLE HOSE FLEXIPLE HOSE FLEXIPLE HOSE	1 2 2 2 2 2 1 1 1	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	•	PLUSHKITSLOH VMAXPED178111 VMAXITE1111 VD4211112111 TUP45H1112111 TUP45H111211 TUP45H111211 TUP7211111127 TUP7211111121		•	- - - - - - - - - -	2 1 2 2 1 2 2 2 2 1 1 1	•	2 1 2 2 2 1 1			
1311-PSV-2468; 1311- PSV-2463; 1311-PSV-2443; 1311- PSV-2468; PSV-2468; PNH1C1-1; PNH1C2-1 PNH1C1-1; PNH1C2-1; PNH1DR-1; PNH1DR-1; PNPAOUT-1; PNPAOUT-1; PNPAOUT-1;	PLUSHING KIT RELIEF VALVE PRESSURE RELIEF VALVE PRESSURE RELIEF VALVE PLEXIPLE HOSE FLEXIPLE HOSE FLEXIPLE HOSE FLEXIPLE HOSE FLEXIPLE HOSE		R. R. R. R. R. R. R. R. R.	· · · ·	PLUSHKITSLOH VMAXPED178111 VMAXIPED178111 VMAXIPED178111 VD41111211 TUP4SH111211 TUP4SH111211 TUP4SH111211 TUP4SH111211 TUP4SH111211 TUPASH111211 TUPASH11121 TUPASH11121 TUPASH1121 TUPASH1121		•	- - - - - - - -	2 1 2 2 1 2 2 2 1 1 1 1	• • • • •	2 1 2 2 2 1 1 1			
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1311-PSV-24E8; 1311- PSV-24E3 1311-PSV-2443; 1311- PSV-2453 PSV-2453 PHH1C1-1; PHH1C2-1 PHH1C1-1; PHH1C2-1; PHH1DR-1; PHH1DR-1; PHPA0UT-1; PHPB0R-1; PHPB0R-1; PHPB0R-1; PHPA1H-1;	PLUSHING KIT RELIEF VALVE PRESSURE RELIEF VALVE PRESSURE RELIEF VALVE PLEXIPLE NOSE PLEXIPLE NOSE PLEXIPLE NOSE PLEXIPLE NOSE PLEXIPLE NOSE PLEXIPLE NOSE PLEXIPLE NOSE			· · · · ·	PLUSHKITSLOH VMAXPED178111 VMAXPED178111 VMAXPED178111 VD5111112111 TUP4SH1112111 TUP4SH1112111 TUP4SH1112111 TUP4SH1112111 TUP4SH1112111 TUP4SH111211 TUPASH111211 TUPASH111211 TUPASH11211 TUPASH11211 TUPASH11213 TUPASH112142 TUPASH112142 TUPASH112142 TUPASH112142 TUPASH121423 TUPASH121423			- - - - - - - - - - - - - - - - - - -	2 1 2 2 1 2 2 2 1 1 1 1 1 1 1	• • • • • • • • •	2 1 2 2 2 1 1 1 1			
1511-PSV-2468; 1511- PSV-2461 1511-PSV-2443; 1511- PSV-2468 PSV-2468 PNR1C-1-1; PNR1C2-1; PNR1C-1-1; PNR1C2-1; PNR1DR-1; PNR1DR-1; PNPR0UT-1; PNPR0UT-1; PNPDR01-1; PNPDR-1; PNC0UT-1;	PLUSHING KIT RELIEF VALVE PRESSURE RELIEF VALVE PRESSURE RELIEF VALVE PLEXIPLE NOSE FLEXIPLE NOSE FLEXIPLE NOSE FLEXIPLE NOSE FLEXIPLE NOSE FLEXIPLE NOSE			· · · ·	PLUSHKITSLOH VMAXPED178111 VMAXIPED178111 VMAXIPED178111 VD5111112111 TUP4SH1112111 TUP4SH1112111 TUP4SH1112111 TUP4SH1112111 TUPASH111211 TUPASH111211 TUPASH111211 TUPASH11121 TUPASH11121 TUPASH11121 TUPASH11121 TUPASH11121 TUPASH11121 TUPASH11121			- - - - - - - - - - - - - -	2 1 2 2 1 2 2 2 1 1 1 1 1 1	• • • • • • • •	2 1 2 1 2 2 1 1 1 1			



No Spare Parts on Stock in Refinery

Defective / Worn Out Equipment



Before





After

5) Erosions & Corrosions

«Cilinder Bellow», a Special Solution for Severe Service





Before



After

Typical maintenance schedule

PERIODIC CHECK DESCRIPTION

Visual inspection for major leaks	
Start for 1 minute the back-up main pump to verify functionality	
Start for 1-minute back-up recirculation pump to verify functionality	
Start for 1-minute back-up heater to verify functionality	
Verify accumulator nitrogen pre-charge pressure.	
(This check shall be performed isolating one accumulator from the other in order to	
maintain the system in operation)	
Replace oil tank breather	
Replace filter (high pressure, return line, recirculation line)	Eve
Hydraulic oil analysis	Every
Replace all Flexible hoses	
Replace hydraulic system O-rings	
Replace solenoids, control valve	Eve



FREQUENCY

Every month

Every month

Every month

Every month

Every 3 months or every TA

(whatever occurs before)

When silica gel become "pink"

ry TA or with "High" alarm for filter differential pressure

(whatever occurs before)

2 months or when new oil is introduced in the system

(whatever occurs before)

Every TA or 4 years

(whatever occurs before)

When leakage occurs

Or every TA

Or every 4 years

(whatever occurs before)

ry 2 TA or 10 years (whatever occurs before)



Thank You!

