Actuation solutions for unmanned off-shore platforms.

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BACKGROUND

These last few years are characterized by low oil prices and this fact is having a strong impact on the strategies of Oil & Gas companies.

Oil & Gas companies are also experiencing high costs of off-shore personnel, one of the reasons is the decreased number of skilled personnel available.

As a result of the above, we see a trend within our customers to evaluate how to limit as much as possible the installation and maintenance costs while refurbishing existing off-shore installations or install new platforms.

In this scenario also valve actuator manufacturers are required to propose effective solutions to Oil & Gas companies in order to:

1. Limit the installation costs.
2. Limit the maintenance costs
3. Limit the need of personnel working in the off-shore installation

THE SOLUTIONS NOW AVAILABLE

One of the first points for our customers, it is to study the possibility to avoid the installation of a pneumatic supply network in the platform, with compressors, dehydrating units, filters, piping, etc…

As a consequence of this, equipment with pneumatic supply cannot be considered, therefore pneumatic actuators cannot be installed: the possible alternatives are hydraulic or electric actuators.

Obviously the solution of hydraulic actuators with common HPU (Hydraulic Power Unit: it is a centralized skid with electric motors, pumps and related accessories to produce hydraulic supply for all hydraulic actuators) cannot be considered because the installation and maintenance costs are similar or higher when compared with the pneumatic actuators with pneumatic supply network.

Considering all the above the obvious solution is to use electrically powered actuators for all actuated valves, in next pages we will analyze challenging points and details.

The technical challenge of electric actuators is how to realize the required fail-safe action (valve emergency operation to close or open) even when electric power supply is not available (in case of a blackout).

"Traditional" pneumatic actuators or hydraulic actuators with common HPU can be in spring return execution, the energy for the fail-safe action is stored in the spring: this solution has generally given good results in terms of reliability and safety in the last years: let's remember that reliability and safety are key factors in off-shore installations.

For electrically powered actuators it is possible to consider UPS systems for all actuators, alternatively we can use batteries or supercapacitors on board of each actuator, but these solutions may need significant activities in terms of regular and accurate inspection & maintenance, furthermore they are not yet perceived to offer the same level of reliability and safety of the springs used now with pneumatic actuators or hydraulic actuators.

With the above in mind, the solution is to keep using spring return execution even with electrically powered actuators.

Therefore:

- In a platform some valves are not critical and they can be electrically operated by electric actuator as usual, without any need of fail-safe action
- Some valves are critical and they are required to be fail-safe (and with assessed SIL, with Partial Stroke Test possibility, etc...):
    - If they are linear valves, we need to use electric linear spring return actuators (now available on the market, refer for instance to Bettis RTS)
    - If they are quarter-turn valves, we need to use electric quarter-turn spring return actuators (available on the market since some yeras, Bettis RTS, Biffi EFS etc…).

Some details regarding electric fail-safe:

- Electric spring return actuators are often based on epicyclic gears and there must be a system to control and limit the speed of the spring stroke.

  These elements introduce some complexity, as a result electric spring return actuators are suitable to cover up to a certain size of valves: they normally operate quarter turn valves

not bigger than 10”- 20” according to valve design and differential pressure, for linear valves there are even more limitations.

- In order to overcome the limitations given by electric spring return actuators for bigger valves, actuator manufacturers can propose electrohydraulic actuators which are electrically powered (same power source as electric actuators):
    - they are standard quarter-turn scotch yoke spring return actuators or linear hydraulic spring return actuators with an integral HPU (installation is incomparably simpler than for common HPU: no hydraulic piping to the actuator, no cleaning & flushing of hydraulic lines…).
    - they present a smart electronic control unit (similar to smart control of electric actuators) which controls the integral HPU & the valve operation, monitoring valve position, generating diagnostic data, the smart control can have also communication protocols like electric actuators.

      At the end of the day, from the control room of the plant, these electrohydraulic actuators look like a smart electric actuator.

In the next page, as an example, we will consider the valves of a typical gas injection platform with valves up to 18”/1500 and differential pressure up to 190 barg.

The available electric power supply is: 400 Volt, 3ph, 50 Hz.

There are “fail in last position” valves, “fail-safe to open” valves (anti-surge) and “fail-safe to close” valves (HIPPS, ESDV/SDV): in all cases electrically powered actuators can present reasonable operating times for normal operation and for fail-safe operation.

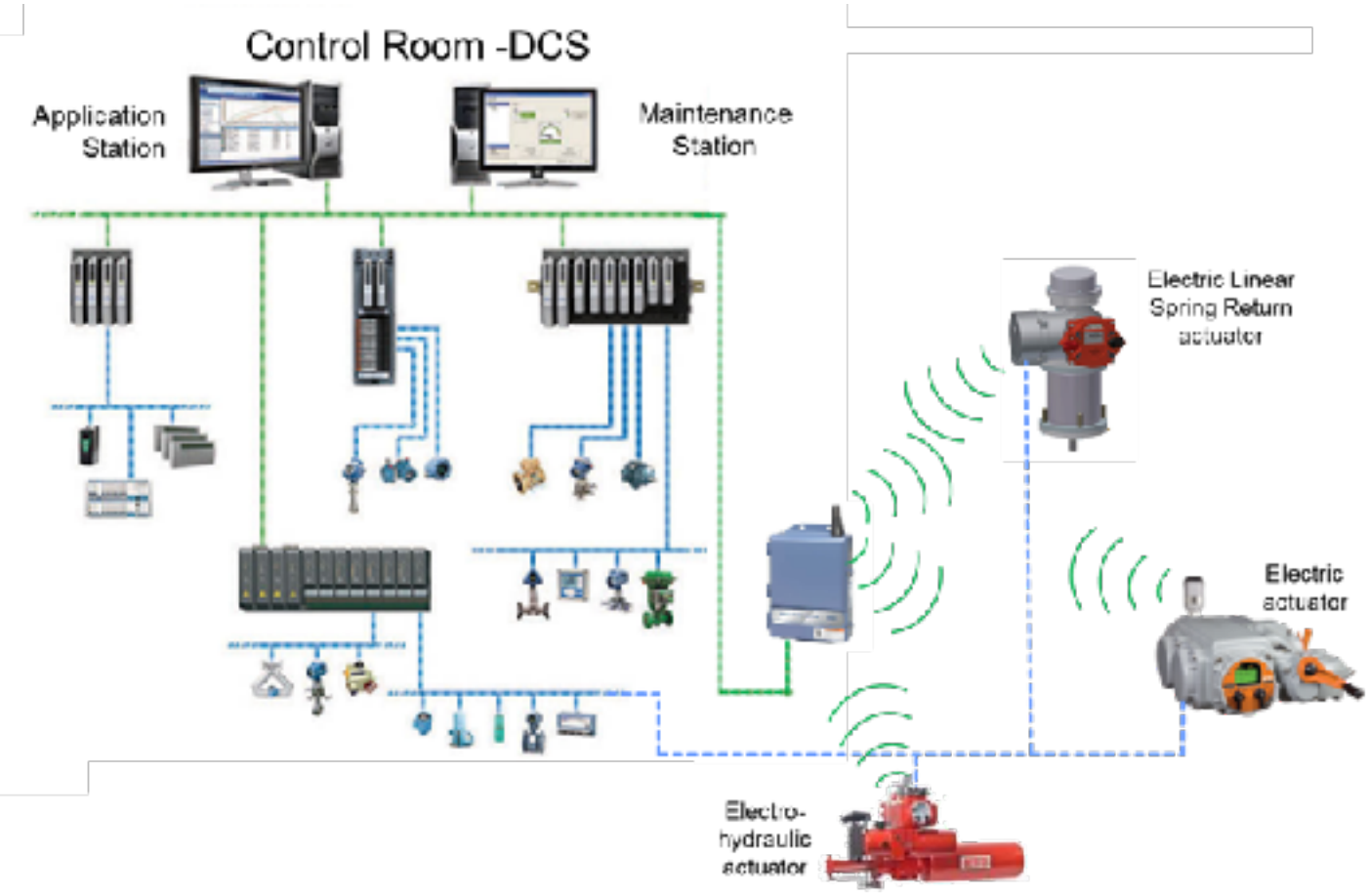
Description	Pipe Dia. (in)	Pipe Dia. (mm)	Pipe Class	Max operating Pressure (bar)	Max DP (bar)	Control Valve (size in)	Control Valve (type)	ESV	BSV	HIPPS	HV/XV	Act Type	Fail position	Required Operating Time in Normal conditions (sec)	Required Operating Time in Fail conditions (sec)	Operating Time in Normal conditions (Sec)	Operating Time in fail conditions (Sec)	KW	Run (15 min) (amps)	Peak current (amps)	Weight per unit (Kg)
Wet Gas	16	406,4	CL1500	60	60				Ball			SCHD	Fail Close	60	13	24-540	3,8-200	0,7	2,10		435
Wet Gas	16	406,4	CL1500	60	60						Gate	TDCE	Fail Last	60	90	120		13	43	316	558
Wet Gas	12	304,8	CL1500	60	60				Ball			SCHD	Fail Close	60	14	20-540	1,7-200	0,7	2,10		345
Wet Gas	12	304,8	CL1500	60	60						Gate	TDCE	Fail Last	60	90	106		13	44	316	550
Oil	4	101,6	CL1500	60	60	4			Ball			RTS	Fail Close	30	8	14-150	3-8	0,28	0,51	0,42	43
Oil	4	101,6	CL1500	60	60	4	Globe				Gate	TDCE	Fail lock in last	30	10	31		5,6	13,4	60,5	178
Wet Gas	12	406,4	CL1500	100	10				Ball			SCHD	Fail Close	60	14	20-540	1,7-200	0,7	2,10		345
Wet Gas	16	406,4	CL1500	100	10						Gate	TDCE	Fail last	60	90	106		15	45	316	551
Dry Gas	2	50,8	CL1500	100	10	2		Ball	Ball			RTS	Fail Close	30	4	14-430	3-8	0,28	0,14	0,42	43
Dry Gas	2	50,8	CL1500	100	10	2	Globe				Gate	TDCE	Fail lock in last	30	10	4,6		1	2,5	2,5	10
Wet Gas	10	254	CL1500	100	10				Ball			RTS	Fail Close	50	10	30-650	3-30	0,20	0,32	1,2	300
Wet Gas	10	254	CL1500	100	10						Gate	TDCE	Fail last	50	30	72		9,9	28,3	315	300
Dry Gas	10	254	CL1500	100	10				Ball			RTS	Fail Close	50	10	30-650	3-30	0,20	0,32	1,2	300
Dry Gas (Gas lift)	4	101,6	CL1500	100	100			Ball	Ball			RTS	Fail Close	30	4	30-650	3-30	0,20	0,32	1,2	300
Dry Gas (Gas lift)	4	101,6	CL1500	100	100						Gate	TDCE	Fail lock in last	30	10	31		5,6	13,2	60,5	180
Dry Gas (Gas lift)	5	127	CL1500	100	100			Ball	Ball			SCHD	Fail Close	35	16	20-540	1,7-200	0,7	2,10		345
Dry Gas (Gas lift)	5	127	CL1500	100	100						Gate	TDCE	Fail lock in last	35	18	35,6		9,9	28,6	318	390
Dry Gas (Gas lift)	5	127	CL1500	100	100			Ball	Ball			SCHD	Fail Close	35	16	20-540	1,7-200	0,7	2,10		345
Dry Gas (Gas lift)	5	127	CL1500	100	100						Gate	TDCE	Fail lock in last	35	18	35,6		9,9	28,6	318	390
Liquid line from [illegible]	2	50,8	TBA	?	?	2			Ball			RTS	Fail Close	30	3	14-430	3-6	0,28	0,14	0,42	43
Dry Gas	18	457,2	CL1500	100	100			Ball	Ball			SCHD	Fail Close	50	16	54-1000	13-500	1,1	3,44		834
Liquid export	11,5	292,1	CL1500	60	60			Ball	Ball			SCHD	Fail Close	57,5	13	20-540	1,7-200	0,7	2,10		345
Multiphase liquid	11,5	292,1	CL1500	60	60			Ball				SCHD	Fail Close	57,5	13	20-540	1,7-200	0,7	2,10		345
Multiphase liquid	11,5	292,1	CL1500	60	60			Ball				SCHD	Fail Close	57,5	13	20-540	1,7-200	0,7	2,10		345
Multiphase liquid	11,5	292,1	CL1500	60	60			Ball				SCHD	Fail Close	57,5	13	20-540	1,7-200	0,7	2,10		345
Methanol	3	76,2	CL1500	TBA	60	3		Ball				RTS	Fail Close	15	5	14-420	1-6	0,25	0,13	0,42	43
Multiphase liquid	11,5	292,1	CL1500	60	60					Ball		SCHD	Fail Close	57,5	13	20-540	1,7-200	0,7	2,10		345
Multiphase liquid	11,5	292,1	CL1500	60	60					Ball		SCHD	Fail Close	57,5	13	20-540	1,7-200	0,7	2,10		345
Multiphase liquid	11,5	292,1	CL1500	60	60					Ball		SCHD	Fail Close	57,5	13	20-540	1,7-200	0,7	2,10		345
Seawater common line	10	273,1	CL150	low	low	10			Ball			RTS	Fail Close	50	10	30-150	3-30	0,28	0,32	1,2	300
Seawater and cooler	8	219,1	CL150	low	low	8	Globe or Butterfly				Globe	RTS	Fail lock in last	40	40	11-154		0,25	0,29	1,25	36
Seawater and cooler	8	219,1	CL150	low	low	8					Butterfly	SCHD	Fail Close	40	16	24-540	3,8-200	0,7	2,10		345
Oil	4	101,6	CL1500	60	60	4	Globe					RTS CL	Fail lock in last	30	8	8-206		0,35	0,13	0,6	12,5
Dry Gas	2	50,8	CL1500	100	10	2	Globe					RTS CL	Fail lock in last	30	4	8-204		0,25	0,29	1,25	36
TEG (Glycol)	2	50,8	CL1500	100	10	2	Globe					RTS CL	Fail lock in last	30	3	8-204		0,28	0,28	1,28	36
Wet Gas (Anti Surge)	12	304,8	CL1500	100	60	10-12	Globe					RTS MS	Fail Open	60	2	10-300	3-6	0,25	0,58	0,82	168
Dry Gas (Anti Surge)	10	254	CL1500	100	50	10-12	Globe					RTS MS	Fail Open	50	2	20-300	3-8	0,25	0,58	0,82	168
Liquid line from [illegible]	2	50,8	CL1500	?	?	2	Globe					RTS CL	Fail lock in last	30	3	7-101		0,25	0,14	0,6	12,5
Methanol	3	76,2	CL1500	?	107	3	Globe					RTS CL	Fail lock in last	15	5	7-101		0,25	0,13	0,6	12,5
Seawater cooler	10	273,1	CL150	low	147	8	Globe					RTS CL	Fail lock in last	40	16	11-154		0,25	0,29	1,25	36

Another point to limit maintenance costs and the need of skilled personnel off-shore is to have a superior level of integration between all electrically powered actuators and the control room where plant control system (DCS) and the Asset Management System are placed (it can be on-shore or in a nearby platform), this higher level of integration take the form of the following advantages:

- Full access to actuator diagnostic data from AMS (Asset Management System) in control room (valve signature download, real time monitoring of actuators etc..).
- Possibility of advanced actuator set-up from AMS (Asset Management System) in control room.
- Possibility to get warnings/alerts from the actuators in control room (at DCS/AMS level) before a failure happens.

All the above possibilities allow a drastic reduction of inspections on site, allow predictive maintenance from control room with positive impact not only on maintenance cost & personnel reduction, but also on reliability of the valve + actuator package.

The access to actuator diagnostic from control room (with possibility of warnings/alerts before failures and possibility to change actuator set-up) can be via wired protocol or wireless protocol (wireless Hart): obviously the network can be dedicated just to actuators, but can be shared also with other instruments or equipment.


Control Room -DCS
Application Station
Maintenance Station
Electric Linear Spring Return actuator
Electric actuator
Electro-hydraulic actuator

Stefano Belletti has a master degree in mechanical engineering from the Politecnico of Milano.

He started as valve actuator sales engineer in 1991 at Biffi, then he worked in various sales position; for 2 years he has been responsible for the Global After Sales Services of Biffi and in 2007-2009 he was the Global Marketing Mgr. for Automation & Controls in Tyco Flow Control.

Stefano then has been the Commercial Mgr. resident in Kazakhstan of Bonatti (an Italian EPC active on Kashagan, Karachaganak and Tengiz fields, specialized in maintenance services)

In Emerson, Stefano is now the Business Development Mgr. in Europe for Bettis Electric actuators.