## BUSINESS CASE SPARE RELIEF VALVE INSTALLATIONS

What to note in practice when selecting spare relief valve installations.









# INTRO

Safety equipment in the process industry is sub-But what should be done if the safety valve must ject to strict rules and standards, resulting in be removed due to unplanned service? In this case, planned downtime, usually every five years. Howthe safety of the system is no longer guaranteed ever industry requirements are moving towards and the plant must be shut down. That's because it is mandatory to permanently ensure overpressure even longer maintenance intervals to further increase efficiency. But if safety equipment has to be relief in conformity with regulations. The same overhauled or exchanged due to malfunctions or applies when a safety valve must be removed for leakage, unplanned downtime may occur between maintenance or service. But to shut down all or part these intervals. To improve the cost efficiency of of the process plant would be economically untenplants these unplanned or even planned downtime able. For this purpose, there are various solutions needs to be avoided or reduced as much possible. on the market to create the required redundancy.

## 2 SOME SOLUTIONS -MANY CHALLENGES

Such a spare valve installation can be solved in different ways. Possibilities include three-way plug valves, interlocking systems combined with shut-off valves or change-over valves. All three installations are part of the supply line to the safety valve. Their design and associated piping must ensure a stable function of the safety valve, taking into account a maximum allowable inlet pressure loss of 3% of the safety valve set pressure.

Many spare valve installations available on the market must be adapted to the piping systems installed in the customer's plant. Often these installations use complex and extensive piping, making it difficult to calculate the inlet pressure drop. However, a correct and accurate calculation of the inlet pressure drop is essential for efficient and safe plant protection. Incorrect calcu-

lation can affect the stable function of the safety valve, which in the worst case can compromise the safety of the entire plant. In addition, some installations do not allow safe switching between the installed safety valves. For example, the two inlet shut-off valves could be closed simultaneously without a (mechanical) interlock, leaving the pressure system unprotected. In the event of an inadmissible increase in overpressure, the system is no longer protected and serious injuries to plant personnel and damage to the environment may occur. Moreover, the operation of some spare relief valve installations is demanding and requires thorough staff training.

## 3 INVESTMENT COMPARISON OF DIFFERENT RELIEF VALVE INSTALLATION METHODS

	Change-over valve solutio (LESER design)	on	Change-over valve soluti (Shuttle type)	on	Change-over valve soluti (Rotor type)	ion	Gate valves on one pipe nozzle		Gate valves and key interlocking on one pipe nozzle	g system	Gate valves on two pipe nozzles		Gate valves and key interlocking on two pipe nozzles	system
	Component	Cost	Component	Cost	Component	Cost	Component	Cost	Component	Cost	Component	Cost	Component	Cost
	Change-over valve 1" CL300	631€	Change-over valve 1" CL300	533€	Change-over valve 1" CL300	2.554 €	2x Welding neck flange 1" CL300	100€	2x Welding neck flange 1" CL300	100€	2x Welding neck flange 1" CL300	100€	2x Welding neck flange 1" CL300	100€
	Welding neck flange 1" CL300	50€	Welding neck flange 1" CL300	50€	Welding neck flange 1" CL300	50€	2x Welding seam	54 €	2x Welding seam	54 €	2x Welding seam	54€	2x Welding seam	54 €
	Welding seam	27€	Welding seam	27€	Welding seam	27€	2x Pipe 1" SCH40 (5xDN = 125 mm)	4€	2x Pipe 1" SCH40 (5xDN = 125 mm)	4€	2x Pipe 1" SCH40 (5xDN = 125mm)	4€	2x Pipe 1" SCH40 (5xDN = 125 mm)	4€
	Pipe 1" SCH40 (5xDN = 125mm)	2€	Pipe 1" SCH40 (5xDN = 125 mm)	2€	Pipe 1" SCH40 (5xDN = 125 mm)	2€	2x Welding seam	54 €	2x Welding seam	54 €	2x Welding seam	54€	2x Welding seam	54€
	Welding seam	27€	Welding seam	27€	Welding seam	27€	2x Welding neck flange 1" CL300	100€	2x Welding neck flange 1" CL300	100€	2x Welding neck flange 1" CL300	100€	2x Welding neck flange 1" CL300	100€
EXAMPLE 1							2x gate valve 1" CL300	400€	2x gate valve 1" CL300	400€	2x gate valve 1" CL300	400€	2x gate valve 1" CL300	400€
Safety valve							2x Welding neck flange 1" CL300	100€	2x Key interlocking system	3.000€	2x Welding neck flange 1" CL300	100€	2x Key interlocking system	3.000€
Type 526 1D2 in							2x Welding seam	54€	2x Welding neck flange 1" CL300	100€	2x Welding seam	54€	2x Welding neck flange 1" CL300	100€
							2x pipe bend 1"	110€	2x Welding seam	54€	2x Pipe 1" SCH40 (5xDN = 125 mm)	4€	2x Welding seam	54€
carbon steel							2x Welding seam	54 €	2x pipe bend 1"	110€	2x Welding seam	54€	2x Pipe 1" SCH40 (5xDN = 125 mm)	4 ŧ
								140 E	2x Weiding seam	04 E	2x Welding neck flange 1 CL300	100 €	2x Welding search flange 1" CL 200	04 E
							2x Wolding pock flango 1" CL300	27 E	1x Wolding soam	27 €	2x Welding neck liange 1 CLSOO	54 E	2x Welding neck flange 1" CL300	100 €
							1x Welding seam	27 €	2x Welding neck flange 1" CL 300	50 E	2x Pipe 1" SCH40 (5xDN - 125 mm)	04 C 4 E	2x Welding seam	54 E
							1x Pine 1" SCH40 (5xDN - 125 mm)	21 C	1x Welding seam	27 €	2x Welding seam	4 C 54 €	2x Pine 1" SCH40 (5xDN - 125 mm)	4 €
							1x Welding seam	27€	1x Pipe 1" SCH40 (5xDN - 125 mm)	2 €		04 0	2x Welding seam	54 €
								21 0	1x Welding seam	27€				010
	Sum	737 €	Sum	639 €	Sum	2.660 €	Sum	1.303 €	Sum	4.303 €	Sum	1.236 €	Sum	4.236 €
	Change-over valve 3" CL300	1.977€	Change-over valve 3" CL300	1.669€	Change-over valve 3" CL300	4.947€	2 2x Welding neck flange 3" CL300	240€	2x Welding neck flange 3" CL300	240€	2x Welding neck flange 3" CL300	240€	2x Welding neck flange 3" CL300	240€
	Welding neck flange 3" CL300	120€	Welding neck flange 3" CL300	120€	Welding neck flange 3" CL300	120€	2x Welding seam	160€	2x Welding seam	160€	2x Welding seam	160€	2x Welding seam	160€
	Welding seam	80€	Welding seam	80€	Welding seam	80€	2x Pipe 3" SCH40 (5xDN = 400mm)	20€	2x Pipe 3" SCH40 (5xDN = 400 mm)	20€	2x Pipe 3" SCH40 (5xDN = 400 mm)	20€	2x Pipe 3" SCH40 (5xDN = 400mm)	20€
	Pipe 3" SCH40 (5xDN = 400 mm)	10€	Pipe 3" SCH40 (5xDN = 400 mm)	10€	Pipe 3" SCH40 (5xDN = 400mm)	10€	2x Welding seam	160€	2x Welding seam	160€	2x Welding seam	160€	2x Welding seam	160€
	Welding seam	80€	Welding seam	80€	Welding seam	80€	2x Welding neck flange 3" CL300	240€	2x Welding neck flange 3" CL300	240€	2x Welding neck flange 3" CL300	240€	2x Welding neck flange 3" CL300	240€
							2x gate valve 3" CL300	1.000€	2x gate valve 3" CL300	1.000€	2x gate valve 3" CL300	1.000€	2x gate valve 3" CL300	1.000€
EXAMPLE 2							2x Welding neck flange 3" CL300	240€	2x Key interlocking system	3.000€	2x Welding neck flange 3" CL300	240€	2x Key interlocking system	3.000€
Safety valve							2x Welding seam	160€	2x Welding neck flange 3" CL300	240€	2x Welding seam	160€	2x Welding neck flange 3" CL300	240€
Type 526 3.14 in							2x pipe bend 3"	150€	2x Welding seam	160€	2x Pipe 3" SCH40 (5xDN = 400mm)	20€	2x Welding seam	160€
							2x Welding seam	160€	2x pipe bend 3"	150€	2x Welding seam	160€	2x Pipe 3" SCH40 (5xDN = 400mm)	20€
Carbon Steel							1x Tee 3"	215€	2x Welding seam	160€	2x Welding neck flange 3" CL300	240€	2x Welding seam	160€
							1x Welding seam	€ 08	1x Tee 3"	215€	2x Welding neck flange 3" CL300	240€	2x Welding neck flange 3" CL300	240€
							2x Welding neck flange 3" CL300	240€	1x Welding seam	80€	2x Welding seam	160€	2x Welding neck flange 3" CL300	240€
							1x Welding seam	80€ 10.0	2x Welding neck flange 3" GL300	240€	2x Pipe 3" SCH40 (5xDN = 400mm)	20€	2x Welding seam	160€
							1x Molding accm	10 E	1x Vielaing searn	80 E	2x weiding seam	160 £	2x Molding coom	20 E
							Tx weiding seam	OU E	1x Molding soam	80 €			2X Weiding seam	100 E
	Sum	2 267 €	Sum	1 050 €	Sum	5 237 €	Sum	3 235 €	Sum	6 235 €	Sum	3 220 €	Sum	6 220 €
	Change-over valve 8" CL 300	6.849€	Change-over valve 8" CL 300	5 781 €	Change-over valve 8" CL 300	16.324 €	2 2x Welding neck flange 3" CL 300	1.300 €	2x Welding neck flange 3" CL 300	1,300 €	2x Welding neck flange 3" CL 300	1 300 €	2x Welding neck flange 3" CL300	1.300€
	Welding neck flange 8" CL300	650€	Welding neck flange 8" CL300	650 €	Welding neck flange 8" CL300	650€	2x Welding seam	500€	2x Welding seam	500€	2x Welding seam	500 €	2x Welding seam	500€
	Welding seam	250€	Welding seam	250€	Welding seam	250€	2x Pipe 3" SCH40 (5xDN = 1000mm)	200€	2x Pipe 3" SCH40 (5xDN = 1000 mm)	200€	2x Pipe 3" SCH40 (5xDN = 1000 mm)	200€	2x Pipe 3" SCH40 (5xDN = 1000 mm)	200€
	Pipe 8" SCH40 (5xDN = 1000mm)	100€	Pipe 8" SCH40 (5xDN = 1000mm)	100€	Pipe 8" SCH40 (5xDN = 1000 mm)	100€	2x Welding seam	500€	2x Welding seam	500€	2x Welding seam	500€	2x Welding seam	500€
	Welding seam	250€	Welding seam	250 €	Welding seam	250€	2x Welding neck flange 3" CL300	1.300€	2x Welding neck flange 3" CL300	1.300€	2x Welding neck flange 3" CL300	1.300€	2x Welding neck flange 3" CL300	1.300€
							2x gate valve 8" CL300	2.000€	2x gate valve 8" CL300	2.000€	2x gate valve 8" CL300	2.000€	2x gate valve 8" CL300	2.000€
							2x Welding neck flange 3" CL300	1.300€	2x Key interlocking system	3.000€	2x Welding neck flange 3" CL300	1.300€	2x Key interlocking system	3.000€
EXAMPLE 3							2x Welding seam	500€	2x Welding neck flange 3" CL300	1.300€	2x Welding seam	500€	2x Welding neck flange 3" CL300	1.300€
Safety valve							2x pipe bend 3"	600€	2x Welding seam	500€	2x Pipe 3" SCH40 (5xDN = 1000 mm)	200€	2x Welding seam	500€
Type 526 8T10 in							2x Welding seam	500€	2x pipe bend 3"	600€	2x Welding seam	500€	2x Pipe 3" SCH40 (5xDN = 1000 mm)	200€
carbon steel							1x lee 3"	900€	2x Welding seam	500€	2x Welding neck flange 3" CL300	1.300€	2x Welding seam	500€
							1x Welding seam	250€	1x lee 3"	900€	2x Welding neck flange 3" CL300	1.300€	2x Welding neck flange 3" CL300	1.300€
							2x Welding neck tlange 3" CL300	1.300€	IX welding seam	250€	2X Welding seam	500€	2x vvelding neck tiange 3" CL300	1.300€
							1x Welding Seam	250€	2x weiging neck liange 3° CL300	1.300€	2x mpe 3 SCH40 (SXDIN = 1000mm)	200€	2x vvelding seam	3000€
							1x Welding scam	100 E	1x Pine 3" SCH40 (5vDN - 1000 mm)	200€	2x weiding seam	300€	$2x \text{ Hpc} = 300 \text{ H} \text{ (000 \text{ mm})}$	200€ 500€
							IN WEIGHTY SEATT	200€	1x Welding seam	250 E				500€
	Sum	8.099.€	Sum	7.031.€	Sum	17.574.€	Sum	11.750 €	Sum	14.750.€	Sum	12,100.€	Sum	15,100.€

### TECHNICAL COMPARISON AND SUMMARY

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	Change-over valve solution (LESER design)	Change-over valve solution (Shuttle type)	Change-over valve solution (Shuttle type)	Gate valves on one pipe nozzle	Gate valves and key interlocking system on one pipe nozzle	Gate valves on two pipe nozzles	Gate valves and key interlocking system on two pipe nozzles	
Cost comparison summary	Always close to the solution with the lowest investment	Always solution with the lowest investment	Always most expensive solution	Third best solution in terms of costs but not safe	Most expensive solution in the market	Third best solution in terms of costs but not safe	Most expensive solution in the market	
Technical comparison								
INLET PRESSURE LOSS	Low inlet pressure loss due to the flow opti- mized design of the CoV	High inlet pressure loss due to 2x90° bends over the CoV	Lowest pressure loss in the market	High inlet pressure losses due to compari- bly long piping, sharp edges in the tee, 90° bends and flow coefficients of isolation valves	High inlet pressure losses due to compari- bly long piping, sharp edges in the tee, 90° bends and flow coefficients of isolation valves	Inlet pressure loss mainly caused by the used isolation valve, straight inlet pipe causes only low pressure losses	Inlet pressure loss mainly caused by the used isolation valve, straight inlet pipe causes only low pressure losses	
SAFE OPERATION	Easy operation by using the handwheel	Easy operation by using the handwheel	Complex switch over with 3 steps	Risk of closing both sides at the same time	Complex switch-over by using different keys -> clear work instruction and trained personell is required	Risk of closing both sides at the same time	Complex switch-over by using different keys -> clear work instruction and trained personell is required	
DESIGN AND SEALING	Metal to metal sealing for a robust and durable design.	Metal to metal sealing for a robust and durable design	Soft sealing design	With standard isolation valves state of the art tightness level can be reached	Corrosion on key interlocks lead to malfunctioning	With standard isolation valves state of the art tightness level can be reached	Corrosion on key interlocks lead to malfunctioning	
SPACE REQUIREMENTS	Very low	Very low	Very low	Comparibly large space needed	Comparibly large space needed. Additional accessability to key interlockings must be given	Two pipe nozzles on the vessel are required	Two pipe nozzles on the vessel are required. Additional accessability to key interlockings must be given	
AVAILABILITY / DELIVERY TIMES	Short delivery times. Standard change-over valves: 4 weeks	Always order related manufacturing leads to long lead times (>20 weeks)	Always order related manufacturing leads to long lead times (>20 weeks)	Short delivery times for standard isolation valves	Retrofitting isolation valves with key inter- locking systems: 10 weeks	Short delivery times for standard isolation valves.	Retrofitting isolation valves with key inter- locking systems: 10 weeks	
COORDINATION EFFORT	Low coordination effort with only one supplier for safety valves and change-over valves	Comparibly high coordination effort with different manufacturers necessary as many shuttly type CoV manufacturers don't have SV in their portfolio	Low coordination effort with only one supplier for safety valves and change-over valves	Comparibly high coordination effort with different manufacturers necessary	Highest coordination effort with different manufacturers necessary	Comparibly high coordination effort with different manufacturers necessary	Highest coordination effort with different manufacturers necessary	
SUMMARY	Most economical solution with easy operation by considering the max. inlet pressure drop of 3%	Economical solution but only for in- stallations without high requirements on inlet pressure loss	Expensive solution with complex oper- ation but perfectly flow optimized	No safe solution with high inlet pres- sure losses and risk of isolating both sides at the same time	Safe solution in terms of operation but high inlet pressure losses and invest- ment costs	No safe solution with high inlet pres- sure losses and risk of isolating both sides at the same time	Safe solution in terms of operation but high investment costs	

### ASSUMPTIONS FOR THE COST COMPARISON

Vessel and safety valves are not considered in the cost comparison as they are equal in all systems. Not included as well are required bolts and nuts as well as gaskets between flanges!

For the alternative systems only gate valves which are the cheapest solution in the market were considered. The use of ball valves etc. would be even more expensive. Prices for CoV expressed as consumer net prices. All cost assumptions are based on carbon steel installations only.



The LESER change-over valve offers an economic solution for safe and efficient plant availability, 24/7. With the help of extensive flow tests and CFD simulations, a flow-optimised design with minimal pressure drop was developed. Every configuration of these change-over valves has a defined resistant coefficient that enables

reliable and precise calculation of the inlet pressure drop. Change-over valves with a pendulum design are easy to operate and, when combined with safety valves, provide permanent protection for plants. Because of their durable design and extensive lifecycle tests, these change-over valves are maintenance-free.



### CHANGE-OVER VALVES WITH A PENDULUM DESIGN GUARANTEE

- Low pressure drop when the safety valve is blowing off (3% criterion)
- Opening of the full orifice area in every position during the changeover procedure
- The economic solution, because an optimal choice can be made for every application
- Simple changeover while the plant is in operation

The change-over valve is the result of LESER's experience and focus on the design, production and testing of safety valves. LESER is one of the

leading companies in the industry. It's the largest safety valve manufacturer in Europe and an international market leader for safety valves.





### PUBLISHER

LESER GmbH & Co. KG D-20537 Hamburg, Wendenstraße 133-135 D-20506 Hamburg, P.O.Box 26 16 51 Fon +49 (40) 251 65-100 Fax +49 (40) 251 65-500 E-Mail: sales@leser.com

The new change-over valve is the result of LESER's extensive experience and exclusive focus on the design, production and testing of safety valves. LESER is one of the leading companies in the industry. It's the largest safety valve manufacturer in Europe and an international market leader for safety valves.