Supplementary Loading System

LESER

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Overview of the advantages of the Supplementary Loading System (SLS)

Table of contents

The LESER Supplementary Loading System (SLS) is an accessory that can be installed on new safety valves or on safety valves already in operation (retrofit). It serves to improve the operating characteristics of the safety valve.

The main applications for the SLS in the pulp and paper industry are:
- the protection of the drying cylinders
- the protection of the steam boiler

The use of the SLS leads to:
- **Higher process productivity** by operating the protected system closer to the Maximum Allowable Working Pressure (MAWP) (up to 97%).
- **Less loss of media** when the safety valve opens and closes. Both the opening and closing times are shortened.
- **Shorter duration of noise emission** to the environment because the opening and closing times of the safety valve are shortened.
- **Fully tight** up to the set pressure. The safety valve also remains tight during pressure spikes which happen below the set pressure.
- **Less wear** on the safety valve because there is no simmering before the safety valve responds.

All this results in:
- a higher degree of plant efficiency.
- a longer lifetime of the installed safety valve.

The SLS amortizes itself in 3–6 months.

How the Supplementary Loading System works
Components

The LESER SLS is a so-called controlled safety pressure relief system (CSPRS) according to ISO 4126-5. It supports the opening and closing of a safety valve.

The Supplementary Loading System consists of the following components:

- Pneumatic actuator Type 702 (1) transfers opening and closing forces to the spindle of the safety valve.
- Control unit Type 712 (2) controls the supply of pressurized air of the actuator by de-/ pressurizing the actuator.
- Safety Valve (3), equipped with pneumatic actuator.

Requirements for installation

For installation in the plant, the following requirements must be met:

- Installation of the safety valve in the plant (standard).
- Three pressure tapping lines (4) connects the system to be protected with the control unit. Three pressure lines ensure safety redundancy (acc. to ISO 4126-5).
- Connection pipes between the control unit and actuator (5).
- Installation space for the control unit: 1000 mm × 800 mm × 800 mm

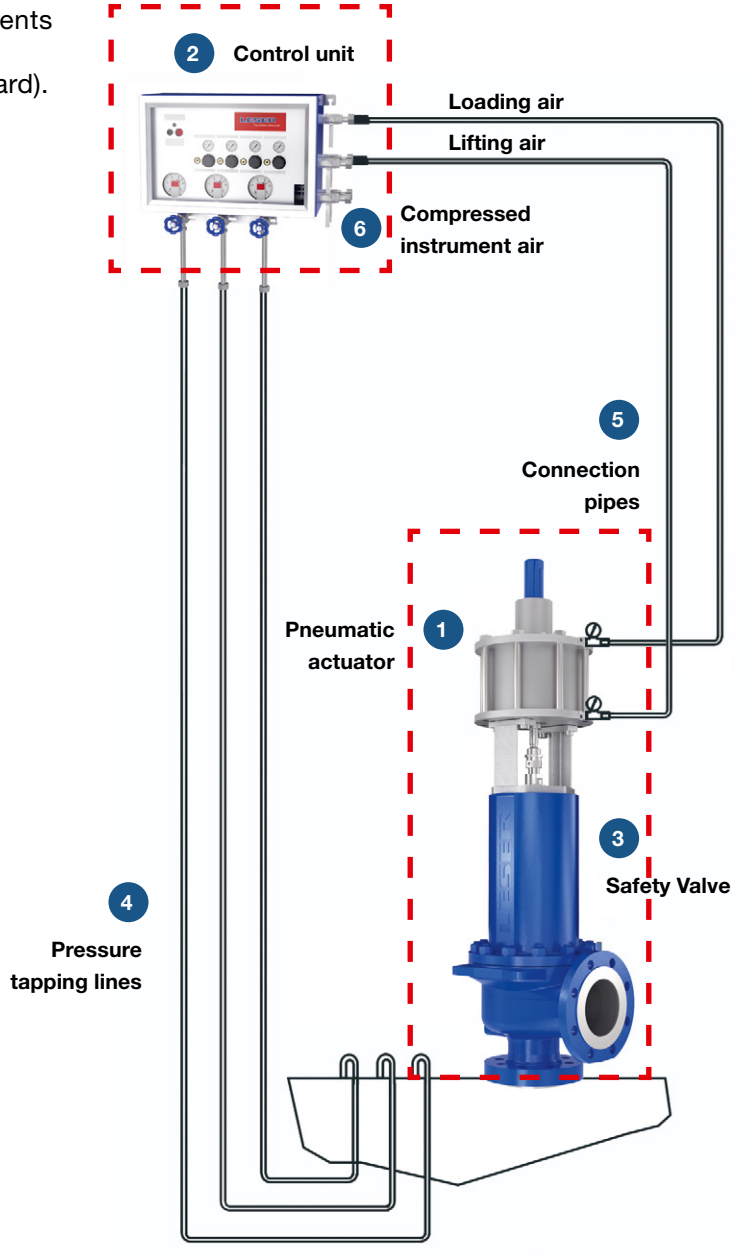
Requirements for air supply

In order to operate the SLS, the following pneumatic requirements must be met:

- Compressed instrument air (6)
  - Dry
  - Oil and dust-free
  - The continuous standard consumption of the control unit is 0,07 Nm³/h. The recommended discharge capacity of the compressor is 12 Nm³/h.

Requirements for Maintenance and Service

- Annual maintenance, which shall be carried out by LESER.



LESER Scope of Supply

How Supplementary Loading System works
Explanation of the Function

The function of the SLS can be described in three different phases:

Phase 1
Normal operating condition

Under normal operating conditions of the protected system, the SLS typically operates up to 97% of MAWP; instead of the 85–90% of MAWP that is typical for a conventional safety valve for steam and gas service.
The safety valve remains tight until the set pressure is reached.

Phase 2
Pop opening

When the operating pressure increases up to the set pressure of the safety valve, the control unit depressurizes the actuator. The safety valve opens immediately with a pop-action supported by lifting air.

Phase 3
Closing phase

As soon as the system pressure drops below the set pressure, the actuator supports the closing by applying an additional load. The safety valve closes at 98% of the set pressure (2% blowdown).

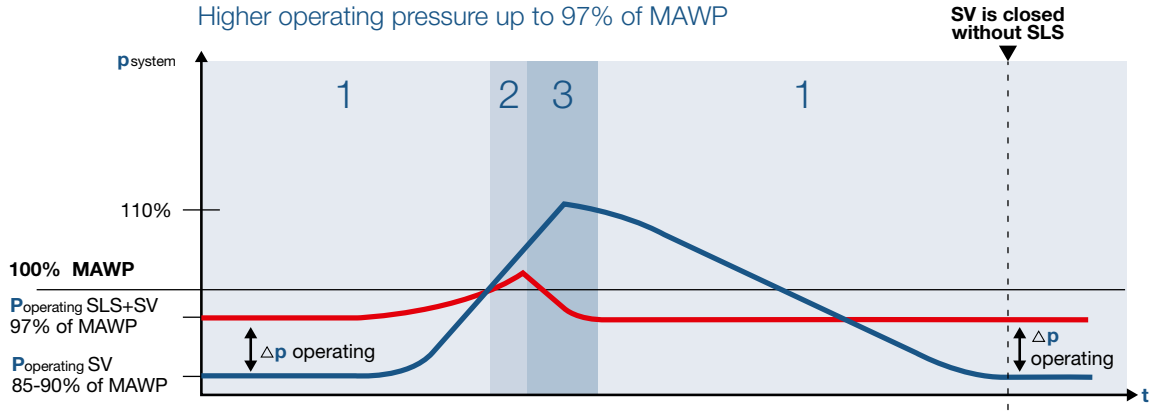
Fail-safe design
If the pneumatic supply fails, the safety valve will still work as a normal spring-loaded safety valve.

Operating characteristics according to codes and standards

Info Box	Safety Valve conventional	Safety Valve with SLS
Typical operating pressure of MAWP	85%	97%
Overpressure (Completely open)	Max. 3 % ASME I Max. 10% ASME VIII Max. 10% Full lift PED	<1%
Blowdown	Max. 4% ASME I Max. 7% ASME VIII Max. 15% Full lift PED	Approx. 2%

Effects of the SLS on plant operation
Showing the advantages compared to a conventional safety valve

Higher operating pressure up to 97% of MAWP



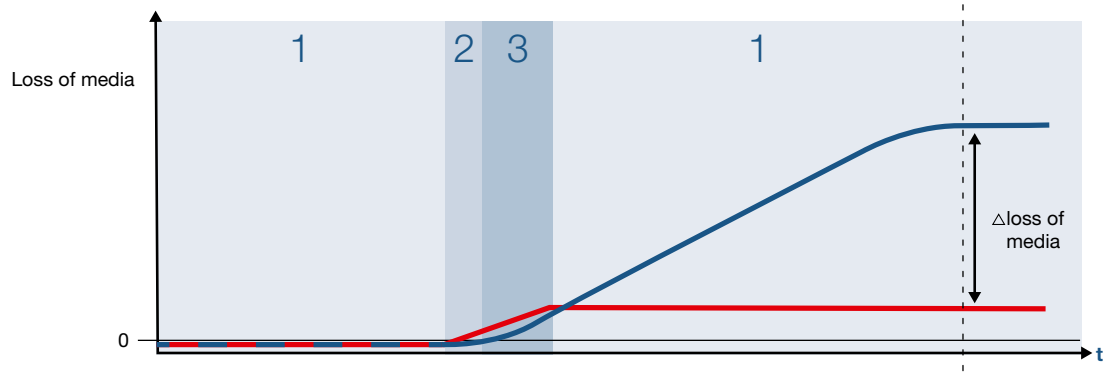
SLS
Conventional valve

1 Phase 1 normal operating

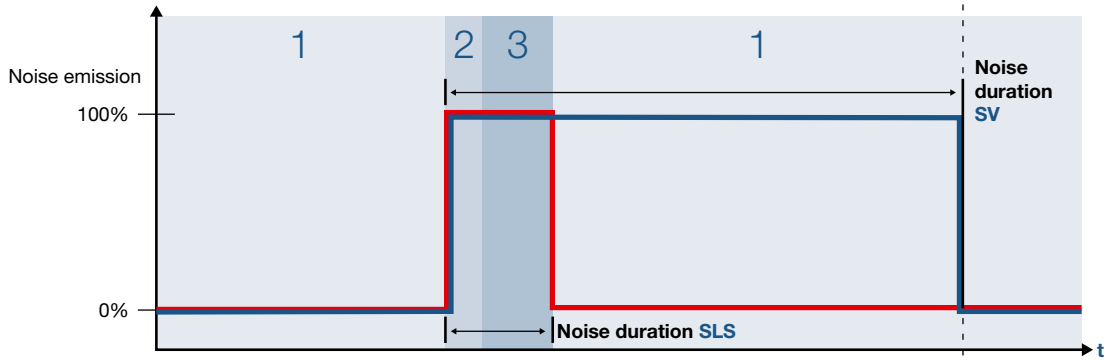
2 Phase 2 Pop opening

3 Phase 3 Closing Phase

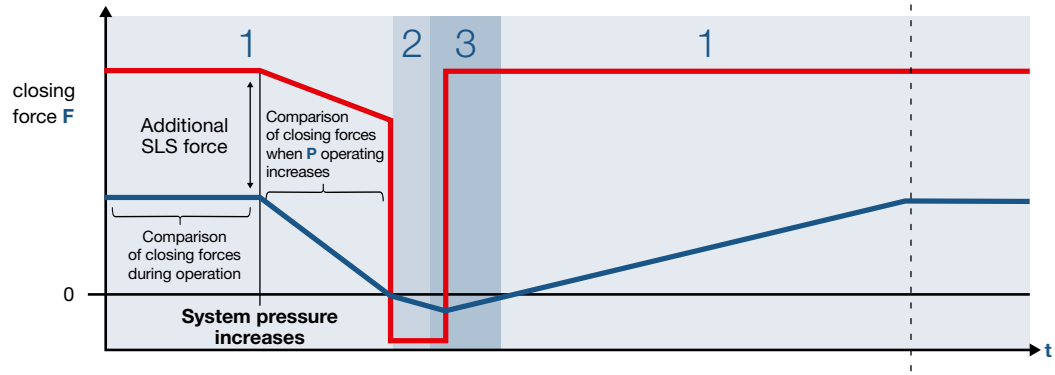
Less loss of media



Duration of noise emission



Fully tight up to the set pressure



closing force =
$F_{load} + F_{spring} - F_{lift} - F_{pressure}$

closing force > 0 = valve closed
closing force < 0 = valve opened

This shows that the increasing system pressure only slightly reduces the closing force when the SLS is used. As a result, the SV is tight up to the set pressure.

Benefits in the pulp and paper industry
SLS in the drying section

The table below shows the operating condition of the drying cylinders in a paper mill, comparing overpressure protection with a conventional safety valve with the use of an SLS. By using an SLS to protect the drying cylinders, it is possible to increase the drying temperature, which leads to the following increase in plant efficiency:

		Safety Valve conventional (SVC)	Safety Valve with SLS
10	**MAWP = Set Pressure**	4 bar-g	
20	**Typical operation pressure level**	85%...90%	97%
30	**Operational steam pressure under condition (20)**	3,4…3,6 bar-g	3,88 bar-g
40	**Temperature sat. steam at operating pressure under condition (30)**	147,1…148,7°C	150,9°C
50	**Temp. of pulp before drying (cooling limit temperature)**	40…80°C	40…80°C
60	**Driving temperature difference (60 = 40 - 50)**	67,1…108,7°C	70,9…110,9°C
70	**Absolute temperature difference ΔT=(60 SLS – 60 SV)**	2,2…3,8°C	
80	**Relative temperature difference ΔT=((60 SLS / 60 SV) -1)**	2,02...5,66%	

The operating pressure increase (line 30) in the drying cylinder leads to a higher steam temperature (line 40). This temperature difference (line 80) compared to the conventional safety valve leads to a higher production velocity by the same factor. This results in a 2% to 5,7% increase in production output and higher profit.

Photo: MinttuFin - stock.adobe.com

SLS – References
A well-established system

LESER has supplied 900 SLS until 2022, and 50 more are installed every year. Thus, the SLS has become a common technology in Europe. There are many different applications where the benefits of the SLS help to improve process efficiency. In the pulp and paper industry, they are installed either on the boiler or the drying cylinders. The following list shows a selection of applications of the SLS.

Supplementary Loading System – Pulp and Paper

Customer	Date	Country	Application	Set pressure
Klabin	21.03.2002	Brazil	Recovery boiler	96 bar
Valmet / Norske Skog	17.06.2020	Austria / Brück	Boiler mainstream and drum	47 bar-g
Smurfit Kappa	29.01.2014	Germany	Boiler mainstream and drum	77 bar-g
Stora Enso	17.07.2021	Finland	Drying cylinder	8,5 bar-g
Schoellershammer	23.04.1997	Germany	Drying cylinder	5,2 bar-g
Nettingsdorfer paper mill	07.06.1999	Germany	Drying cylinder	5 bar-g

Supplementary Loading System – Boiler OEM

Customer	Date	Country	Application	Set pressure
VKK Standardkessel	24.05.2004	Germany	Boiler systems	43 bar-g
Duro Dakovic Termoenergetska	10.10.2000	Croatia	Boiler systems	78 bar-g
Baumgarte Boiler Systems GmbH	23.07.2003	Germany	Power plants	44,5 bar-g
Richard Kablitz GmbH	14.02.2003	Germany	Biomass & Waste to Energy	79 bar-g
Valmet / Salzburg AG	04.01.2022	Austria	Power plant	71 bar-g

Approval

The LESER supplementary loading system is type-tested and complies with national and international regulatory requirements, such as:

- European Pressure Equipment Directive (PED) 2014/68/EU
- ISO 4126-5
- AD 2000 A2

The LESER supplementary loading system is CE marked and approved in all EU countries.
The main application of the supplementary loading system is steam service where it is primarily used for two purposes:

	US Rule	European Rule
Protection of steam drum and superheater of boiler MAWP typically > 1 bar.	ASME I	PED
Protection of steam heated equipment for drying purposes such as a drying cylinder. MAWP > 10 bar	ASME VIII	PED

The PED allows the use of supplementary loading systems in both applications.
The ASME code authorizes power-actuated relief systems under ASME I and ASME VIII.
LESER has decades of experience in steam applications and can meet ASME requirements but has not yet been certified. We are in the process of applying for ASME approval for the SLS.

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