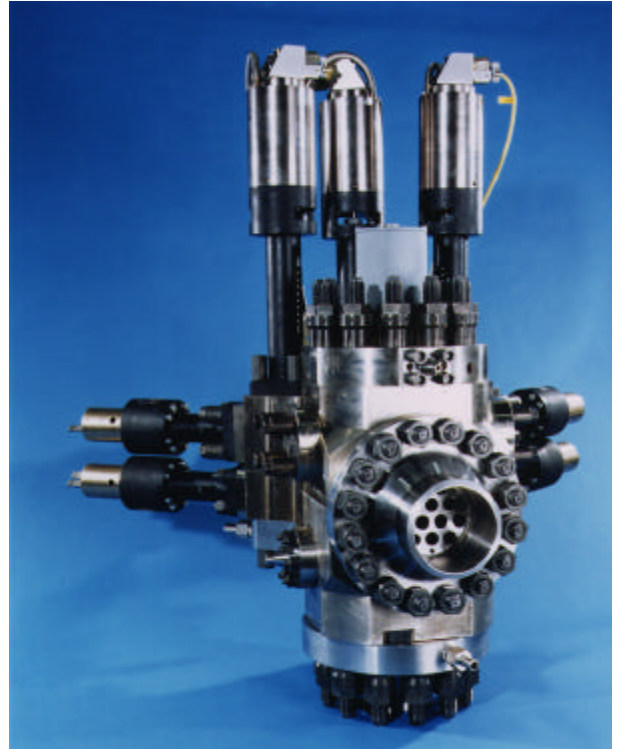


- **System medium operated**
- **High actuating force for opening and closing**
- **Application as pressurizer safety valve, relief valve or main steam safety valve**
- **ATWS qualified by NSS system supplier for various medium conditions: steam, water, hydrogen and for multi-phase flow and transients**
- **Electrical equipment (MV, MOV) qualified to KTA and IEEE**
- **Linear stroking characteristic, unaffected by media phase changes**
- **Pressure retaining parts made from forged steel**
- **Pilot valves mounted directly on the main valve with internal bores to the main valve cylinder**



Application

The purpose of the SV as a pressuriser safety valve is to protect the primary loop of a pressurized water reactor against over-pressure. At a given set pressure the safety valves open and releases medium (steam, water, hydrogen) from the pressurizer to the flash tank.

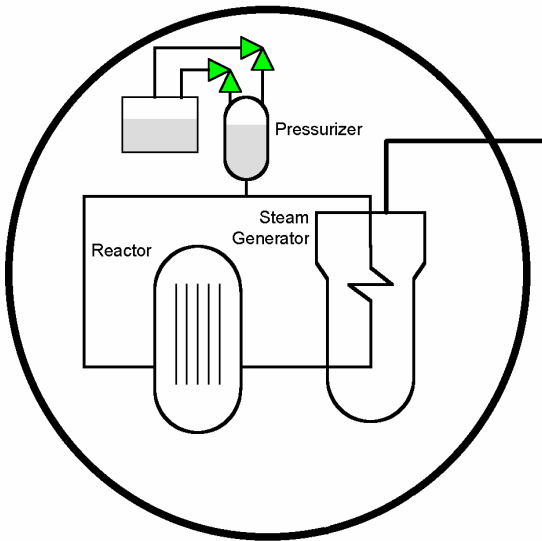
The SV can also be used as a pressurizer relief valve to relieve pressure from the primary loop of a pressurized water reactor. At a given pressure, below the set pressure of the safety valves also installed, the relief valve is opened and releases steam from the pressurizer to the flash tank.

On the main steam system, the SV can also be used as a main steam safety valve to protect the steam generator from overpressure.

Design

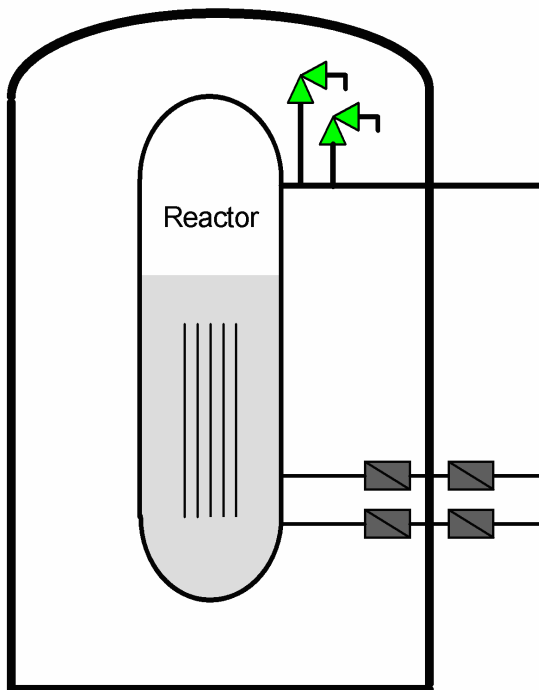
- High opening and closing reliability due to very high force reserves
- High tightness because pressure in pressurizer (full Δp) acts in closing direction
- Lower stem guide shields the stem head from pressure peaks when opening and provides damping
- Compression spring for keeping closed when primary loop is pressureless. The spring is not required for closing during operation
- No penetrations through the pressure boundary, completely tight to the outside
- Double sealing of all connections under system pressure during normal operation
- Cobalt free design
- Permanent discharging of hydrogen, if required (pressurizer safety valve application)

PWR Containment, diagram



The SV as Pressurizer Relief and Pressurizer Safety Valves on a PWR

BWR Containment, diagram



The SV as Main Steam Safety Valves on a BWR

Operating Principle

The valve consists of one main SV valve and one or more pilot valves. Three different pilot valve designs are available, STV, MV and MOV. The main pilot valve is the spring-loaded STV which opens the SV valve at the set pressure. The STV can be fitted with an additional solenoid loading device to improve the closing force. The other pilot valves can be solenoid operated (MV) for quick pressure release, or motor operated (MOV) for the bleed function.

The main valves and pilot valves are designed and qualified to operate with hydrogen, saturated steam and saturated water, sub-cooled water as well as during phase transitions.

In normal operation, the main valve and pilot valves are closed and the whole inner space of the SV is connected to the relief tank. The stem is forced into the valve seat by the system pressure in the inlet nozzle.

To open the SV the upper piston chamber is charged with system medium by one of the pilot valves attached to the main valve.

Opening the SV using the STV

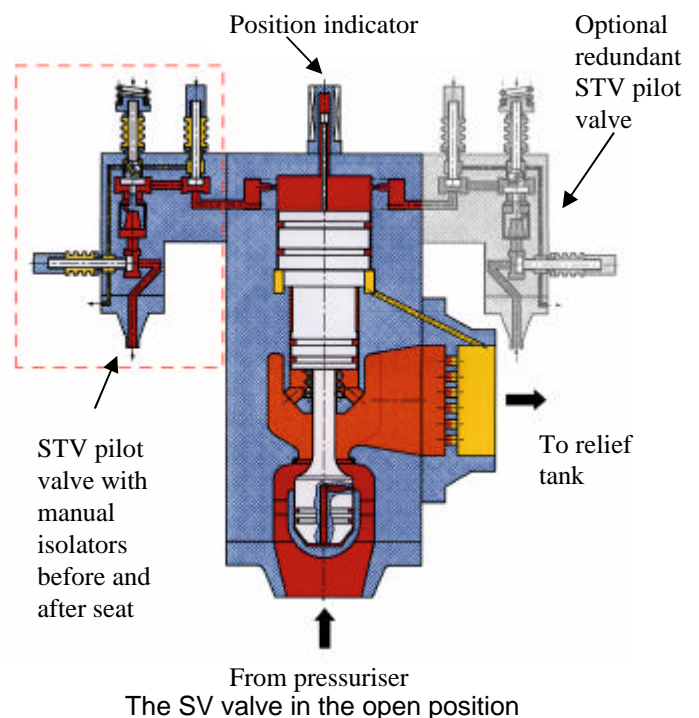
The system pressure acts on the STV. Once the STV set pressure is reached, the additional load solenoid (if installed) is switched off, and the STV opens in one step thanks to the "powerlift" feature. No oscillation of the STV trim can occur.

Opening the SV using the MV

When the MV receives the signal to open the solenoid is energised and the stem lifts against the spring.

Opening the SV using the MOV

Like the MV, the MOV opens when it receives a signal. The el. motor actuator is LOCA qualified, and stays open even if the power supply fails (bleed operation possible). Therefore the main SV also stays open.



Opening with the MV or MOV is possible at any system pressure > 8 bar. Once in the open position the SV will remain open unless the system pressure is < 1.5 bar g. After one of the pilot valves has opened, the system medium flows into the upper piston chamber of the main valve through the pilot valve, pressurizing the upper piston chamber with system medium and opening the main SV safety valve.

Closing the pilot valves interrupts the feed to the upper piston chamber. As soon as the pressure in the upper piston compartment has decreased to approx. 40% of system pressure the main valve starts to close. When the upper piston compartment is completely depressurised, a high closing force margin ensures reliable and tight closing.

Qualification & Testing

The SV safety valve has been fully ATWS qualified in 1:1 scale Blowdown testing on the Siemens Karlstein, Large Valve Testbed in Germany. Correct and stable valve functioning was proved in a whole series of exhaustive tests. The media that the valve was tested with were hydrogen, saturated steam, saturated water and sub-cooled water, and all phase transitions of these varying media. The testing was completely satisfactory, and the SV valve and its pilots were in perfect condition afterwards.

All the SV valves that are delivered are tested on the CCI Works Testbed, using saturated steam at plant operating pressure and temperature, with low flow, to demonstrate all functional modes, before delivery.

The SV valves have been installed in many plants since 1991 and have many reactor years of operational experience.

Extensive testing was also done during the development of the SV. The testing, also on the CCI Works Testbed, involved thousands of valve strokes under all conditions, including an endurance test with more than 1000 consecutive strokes. This process proved the valve's functional design and the material pairings. The electrical equipment that can be used with the SV valve is also fully qualified.

- The inductive position indicators are tested and qualified for LOCA conditions, and are certified to IEEE and KTA.
- The solenoids that activate the MV pilot valves, and those used on the STV pilot valves to provide an additional loading, are also qualified to IEEE and KTA.
- When the SV valve is used as a pressuriser safety valve with "bleed" function, the MOV motor-operated pilot is used, actuated by an electric motor. This application requires qualified actuators, and CCI uses actuators that are LOCA compatible and qualified to KTA.

Technical Specification, SV Pressuriser Safety Valve

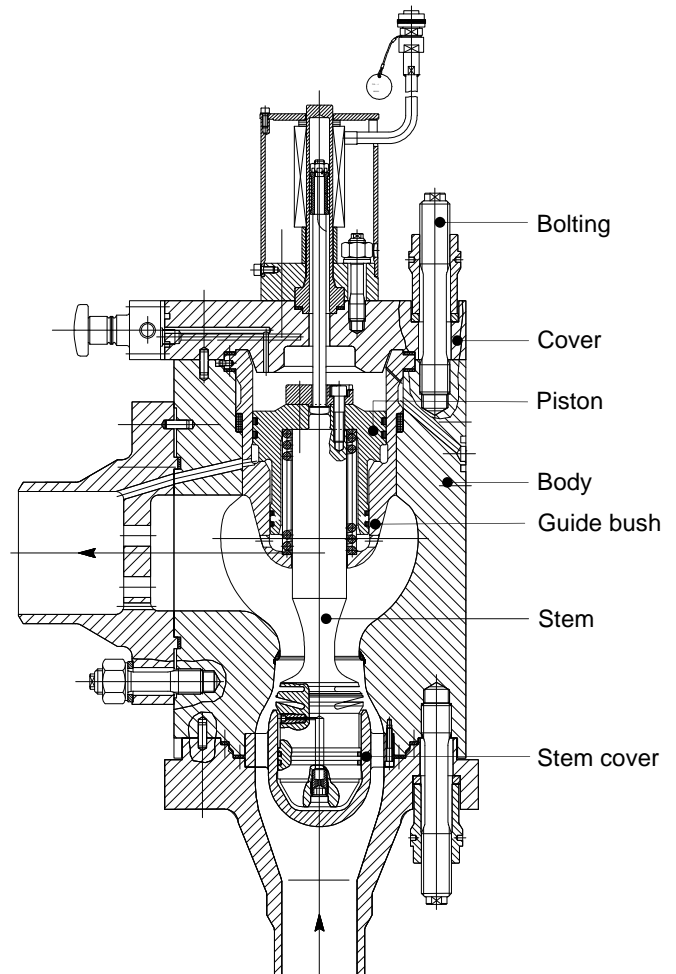
| | |
|------------------------|--|
| Body style | Angle type, flow-to-close valve |
| Pipe connection | Flange connection or butt weld ends, according to customer's requirement |
| Steam data range | Temperature: up to 360°C / 680°F |
| Inlet | Pressure: up to 200 bar / 2800 psi |
| Seat-/stem tightness | DIN 3230, rate 1 / MSS-SP61 |
| Actuation | By system medium |
| Typical stroking time* | Opening: 0.5 sec; closing: 0.5 – 1.0 sec |
| Serviceability | Replacable stem/plug/(and seat when SV welded in) |
| Options | Position indication for main and pilot valves |
| | Redundant pilot valves for operating the SV |
| | Spring (STV) operated, solenoid (MV) or motor (MOV) pilot valves |
| | Hand valves to isolate STV pilot valve |
| Installation position | Any stem orientation possible. Directly attached to pressuriser (preferred), relief tank, or in line. No loop seal required. |

* with steam

Typical Materials

| Standard | ASME | DIN |
|-----------------------|--------------|-------------|
| Inlet / Outlet flange | *SA182F316LN | *1.4550 |
| Body /Cover | *SA182F316LN | *1.4550 |
| Piston | *see DIN | *1.4057 |
| Stem | *see DIN | *1.4057 |
| Seat hard-facing | Cobalt-free | Cobalt-free |
| Guide bush | *see DIN | *1.4122 |
| Stem cover | *see DIN | *1.4057 |
| Bolting | SA193B16 | *1.7709 |
| | SA194GR7 | *1.7254 |

* or according to customer specification



Typical scope of supply *

| | |
|--------------------------|--|
| | Pressuriser safety valve |
| Pressuriser safety valve | SV 100 |
| Pilot valves, redundant | 2 x STV, 1 x MV, 1 x MOV |
| Position indication | 1 x linear position indicator on SV Limit switches for pilot valves |

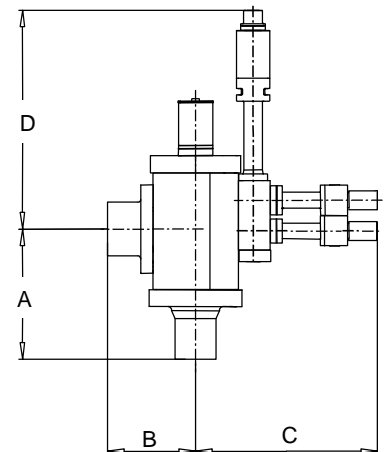
* or according to customer specification

Dimensional Information

| Valve Dimensions | Type* | Seat mm | A mm | B mm | C mm | D mm |
|------------------|----------|---------|------|------|------|------|
| | SV 50 | 50 | 370 | 340 | 760 | 820 |
| | SV 100 | 100 | 520 | 360 | 800 | 900 |
| | SV 125 | 125 | 630 | 440 | 830 | 960 |
| | **SV 280 | 280 | 890 | 600 | 1175 | 1110 |

* contact CCI for valve sizes outside this range

** SV 280 supplied as Main Steam Safety Valve with differing pilot valve configuration and overall dimensions



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