Turbine Bypass Valve Supplier Profiles

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McILVAINE

- A-T
  Arca
  Bellino
  DFT
  Emerson
  GE
  IMI
  SPX
  Trimteck
  Valvtechnologies
  Weir

McILVAINE

- Bellino

Bellino is now manufacturing valves for any service in power generation.

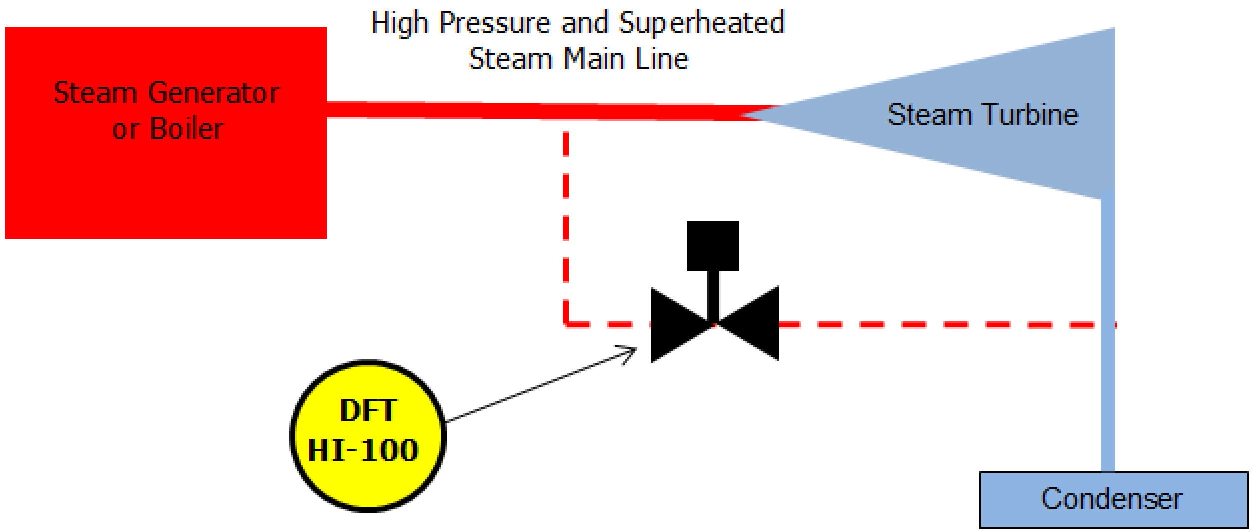
The range includes let down station desuperhater, bypass turbine for high medium and low pressure and is focused on several services, starting from steam desuperheating to boiler valves.

Thanks to a peculiar body profile of the valve, as well as to special steels and specialized machining it is possible to obtain constant thickness that reduces the effects coming from mechanical and thermal stress.

The range of products covers all the needs in terms of steam desuperheating.

- DFT

DFT®, formerly known as Durabla® Fluid Technology, has been making in-line check valves and severe service control valves for over 70 years. It started with a customer's need for a small metal-seated check valve that could be installed in any position while providing tight shut-off. The Basic-Check® valve was developed to satisfy that need. Over the following decades, other customers' needs led to the development of the ALC®, BNC®, DLC®, DSV®, Excalibur®, FBC™, GLC®, GPV™, PDC®, SCV® , TLW® and WLC® styles of in-line silent axial flow check valves. Each of these DFT® in-line check valves addresses the particular needs of today's customer.



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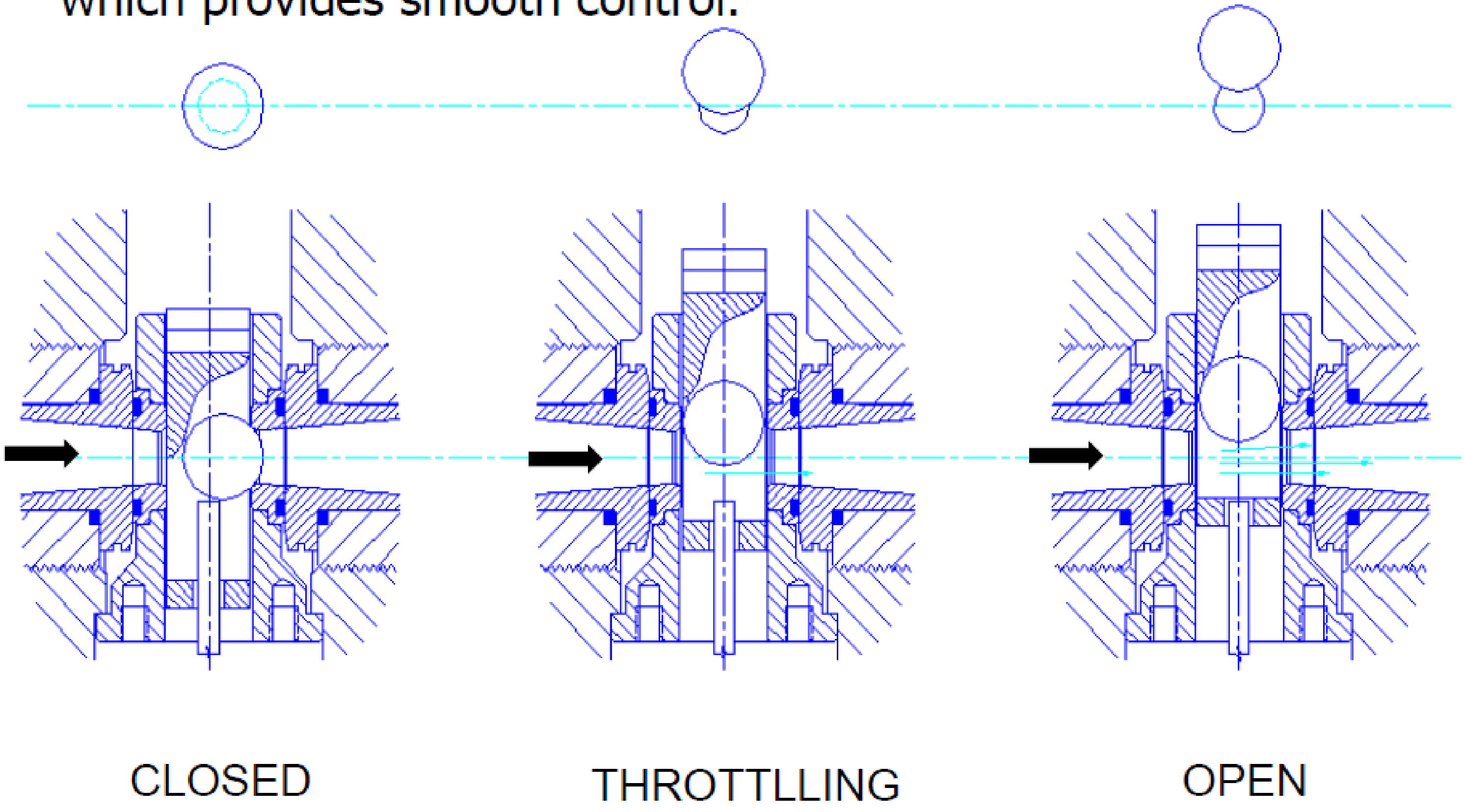
DFT Control Valves - Flow Characteristics

Fluid is controlled by moving the Ball in and out of the flow stream. The moving Ball creates a variable eclipsed orifice which provides smooth control.



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DFT INC

- Emerson

By combining new advances in control technology, the TBX offers enhanced pressure reduction capabilities with highly efficient and more accurate steam conditioning performance, all within a single unit. The result: tighter pressure control, lower operating noise levels, extended service life and improved temperature maintenance.

Efficient Temperature Control: The TBX utilizes variable geometry spray nozzles to inject a fine mist into the downstream flow pattern. The nozzles are strategically placed around the valve’s outlet to ensure a complete mixing and rapid vaporization of spray water for efficient and effective temperature control.

Meeting Stringent Noise Limits: The TBX steam conditioning valve utilizes Fisher’s unique Whisper technology to provide noise attenuation as much as 40 dB greater than what other quiet valve designs offer. It’s a difference that proves to be a significant operating advantage when faced with strict fence line noise limits.

McILVAINE

The rugged cage-guide design of the Fisher TBX enables it to handle full main steam pressure drops, while Whisper Trim™ technology eliminates the risk of excessive noise and vibration, which could cause structural damage and performance degradation. The valve’s proven and well-established Whisper Trim III cages and WhisperFlo trims help to attenuate noise by up to 40 dBA.

The Fisher TBX uses a thermally compensated hung trim design which accommodates rapid changes in temperature – as experienced during a turbine trip – to enable smooth, continuous operation. The cage is hardened for maximum life and can expand freely during thermal excursions. This prevents the valve plug from sticking and therefore avoids delays in turbine start-up. To prevent leakages affecting steam production when the turbine is operating, the Fisher TBX uses Fisher Bore Seal Trim technology, which achieves tighter shut-off.

MCILVAINE

Bypass valves play a major role in the turbine bypass system. The valves used in a 480 megawatt power plant had sticking and leakage problems for several years, requiring frequent maintenance and repair. Sticking valves would cause delays in turbine startup and steam leaking into the condenser was wasting energy and lowering condenser efficiency. It was thought that the leakage rate through these valves was exceeding Class II shutoff. Emerson engineers recommended that their new bore seal technology trim be installed in the bypass valves and that larger actuators be installed on three of the valves to increase the thrust for higher seat loads to meet Class V shutoff. Closure of the plug compresses the seal ring into a reduced bore in the cage, which is also above the flow ports. The compressed seal creates radial sealing forces that prevent flow between the plug and cage. Converting the turbine bypass valves to the new bore seal design achieves a Class V rating with the expectation that they would not degrade below a Class IV rating for at least three years. Using a typical market rate of $100 per MW-hr and running 330 days per year, estimated energy savings from using the bore seal trim is $425,000 per year.

McILVAINE

- GE

In 2010, Crystal River, an 860 MWE pressurized water nuclear reactor in operation since 1977, was undergoing an extended power upgrade that included a 20 percent power increase and 180 MWE of additional capacity. After a detailed technical comparison and evaluation, Dresser Masoneilan was selected to provide the valves for the turbine bypass system.

The company's differentiated technologies, such as the SVI II AP digital positioner, form the ideal control valve solution for general service through severe service applications. Dresser Masoneilan is also able to provide customers with technical expertise and support at the local level through its global network of fully equipped aftermarket centers.

McILVAINE

Unit 2A, A B Hopkins Generating Station
Commercial operating date: June 2008
EPC contractor: BE&K Inc
Owner's engineer: Sargent & Lundy
Type of plant: Combined cycle
Key personnel
Manager of power production: Robert E McGarrah
Plant manager: Triveni Singh
Asst plant manager: Clark K Sheehan

Manufacturer: GE Energy
Number of machines: 1
Model: 7FA+e (7241)
Control system: Mark VI
Combustion system: DLN 2.6
Fuel: Dual fuel (natural gas and distillate)
Control system: Emerson Process Management (Ovation)
Attemperator: CCI-Control Components Inc
Duct burner: John Zink Co
SCR: Vector Systems Inc
Catalyst supplier: Cormetech Inc
Steam-turbine bypass valve/desuperheater: Dresser Inc (Masoneilan)
Water treatment

A workshop on optimization of steam-turbine bypass systems at the 2018 meeting of the Australasian Boiler and HRSG Users Group, led by Bob Anderson, Competitive Power Resources Corp, covered the arrangement, purpose, and methods for operating and maintaining this equipment.

Vibrant discussion followed presentations by Anderson, Justin Goodwin of Emerson/Fisher, Ory Selzer of IMI CCI, and Sanjay Sherikar of Nihon Koso Co Ltd.

Problems include

- Leakage
- Sticking valve plugs
- Noise

MCILVAINE

- IMI

IMI Supplies Valves from 4” to 32”

SIRA BHL

A high pressure turbine bypass valve is used to divert some or all of the steam flowing from the main boiler away from the turbine and into the cold reheater line. The valve reduces both the pressure and temperature so the steam can be safely transferred between these two systems.

Sizes	DN 100 to DN 800	4" to 32"
Set pressures	max. 330 bar	
Materials	1.7335	SA 182 Gr. F12
	1.7383	SA 182 Gr. F22
	1.4903	SA 182 Gr. F91
	1.4901	SA 182 Gr. F92

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The HP-Bypass Valve Type ARS is a steam conditioning valve. It is used for steam throttling with very high pressure drop combined with in-body desuperheating through spraywater injection. Its prime area of application is high pressure bypass systems for fossil-fired power plants with subcritical as well as supercritical steam conditions. With the range of body materials available, the ARS valve can be applied for main steam pressures and temperatures of today’s most advanced thermal power plants. The valve is specially designed for the cyclic operation of bypass systems. Equipped with a hydraulic actuator and the necessary safety control devices the valve can be used as a combined HP-Bypass and superheater safety valve in accordance with EN4126-5 (TRD 421). The complete system has a type approval for this application.

ARS High Pressure-Utility

Compact, robust design

Bonnet and bolting on low pressure side

Optimized body shape for minimal thermal stress

Multi-function contoured cage eliminates thermal shocks

Wing type stem

Tight shut-off (EN 12266-1 Cl. B or MSSSP61 or ANSI/FCI 70.2 Cl. V)

Wide installed base

Integral desuperheating; water injection in area of highest turbulence ensures:

- Optimal mixing of steam and water
- Very short necessary straight pipe length after the valve (approx. 1m)

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In 2015 IMI Critical Engineering, manufactured a turbine bypass valve for a 1,050-MW supercritical thermal power plant, the first of its kind ever produced in India.

IMI CCI Japan, part of IMI Critical Engineering, was approached by a Japanese engineering, procurement, and construction (EPC) company to work on the project. The contract required IMI CCI Japan to supply eight sets of low-pressure turbine bypass isolation and control valves, each with a capacity of 1,050-MW.

While the assembly and testing of the turbine bypass valves was undertaken at IMI CCI Japan, IMI CCI Sri City was chosen as the manufacturing facility for the valve body (including all welding and de-superheater), fully machined internals, and the bonnet. The project was successfully delivered to an exacting client specification.

AB6350 for CHP plants

IMI CCI Japan has over 40 years of experience to deliver integrated control valves and desuperheaters for turbine bypass and steam conditioning valves. In total, they have delivered more than 1,500 units of AB6000 series all over the world.

AB6350 is a new design model of the AB6300 series for small Combined Heat and Power (CHP) applications. The AB6350 is designed to perfectly match power plants like incineration power plants, biomass power plants, and other small co-generation power plants.

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In order to achieve the most sophisticated design of the integrated turbine bypass system, AB6350 has the following key features.

Actuator
- Multi-spring diaphragm
- Piston
- Electric
- Hydraulic

Cage, trim and seat
- Multi-hole cage
- Balanced trim with graphite balance seal
- Quick change seat with graphite seal

Desuperheater
- Steam atomizing

Accessories
- A full range of accessories are available to meet requirements

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IMI Turbine Bypass Valves for Smaller Power Plants

	Plant Capacity	Applications	Valve size	Rating
Incineration Power plant	3-40MW	Turbine Bypass	3-8 inch	300-900
CDQ power Plant Process Steam	10-60MW	Turbine Bypass Steam Conditioning	6-8 inch	300-4500
Power Plant Desalination Plant	10-150MW	Turbine Bypass Steam Conditioning	6-8 inch	1500-2500
Process Steam Pulp & Paper, Chemical, O&G, Sugar, Cement, etc.	10-100MW	Steam Conditioning	3-8 inch	300-2500

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SPX : Copes Vulcan

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The Copes-Vulcan Pressure Reducing and Desuperheating Valve known as the DSCV-SA, is of angle style construction with the steam inlet through the branch connection and the steam outlet through the in-line connection. The connections can be either flanged or butt welded depending upon the customer preference.

The units are manufactured in two parts to allow for greater customer flexibility. The high pressure side of the unit is of cast or forged construction with the lower pressure outlet section being of fabricated construction. The valve is provided with a bolted bonnet closure for pressure ratings up to and including ANSI 900# and a pressure seal closure for ratings ANSI 1500# up to and including ANSI 4500# rating.

The valve can be fitted with single stage HUSH, multi stage HUSH or Copes-Vulcan RAVEN trim technology depending upon the pressure drop and to meet the requirements of specific noise levels. The valve is provided with high pressure balancing, single seat trim construction utilizing a tandem trim pilot operated concept ensuring tight and repeatable class V shutoff per ANSI/FCI 70-2.

The DSCV-SA is available in an almost infinite range of sizes as each valve is tailored to suit a particular customer's requests and requirements. Additional Noise Attenuation can be performed by utilizing a specifically engineered RAVEN multi-labyrinth trim design utilizing upon 18 stages of pressure reduction.

Pressure Ratings: The DSCV-SA valve can be fully or split rated design and available in standard, special or intermediate class. Standard classes are available up to and including ANSI 4500#, intermediate and special class designs can be accommodated were required.

Maintenance: The DSCV-SA is not a high maintenance valve. However, the complete trim is a 'Quick-Change' style with no welded in components or large internal threaded parts. The whole trim assembly is held in compression by either a compression ring or the bonnet. By simply removing the compression ring or bonnet the whole trim merely slides out of the top of the valve.

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Copes-Vulcan

Steam Turbine Bypass

SPX

Section From The Turbine Bypass Valve Redesign Project

Engineering Job #[redacted] Cost Code[redacted]
Engineering Managerial Responsibility: [redacted]
Job Cost Responsibility: [redacted]
Project Start Date[redacted] Required Project Completion Date[redacted]

ENGINEERING PROJECT: TBV RE-DESIGN & UPGRADE

DESIGN BRIEF

Summary:

To review marketing feedback and design a competitive turbine bypass valve that can be clearly demonstrated to technically address all the significant key factors as received from our existing and potentially future customers and end users. Where possible the new design should be available for existing plant upgrade.

Key Design Features:

The following design features are listed in a 'weighted' order as received back from marketing following questionnaires issued. The weighting is based on the number of 'hits' each itemised detail received with the highest being at the top of the list. The EPC and End User columns reflect the position of that particular feature in their respective levels of importance.

Both EPCs & End Users Prioritise Reliability

	Critical Design Feature	EPC	End User
1	100% Reliability (also includes 'fit for purpose')	1	1
2	Repeatable tight shut off (also includes high cyclic operation)	---	2
3	Wide rangeability (also includes good temperature control)	3	6
4	Low Maintenance (also includes no special tools or engineers)	---	3
5	Flexible Installation	4	---
6	Low Noise Trim Options (**ACTIVE** multi stage pressure drops)	7	---
7	No Thermal Shocks (remove dependency for thermal liners)	---	5
8	Price Competitive	5	---

Is the Valve Supplier Market Actually Aligned For Todays Requirements

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Copes-Vulcan

SPX

DSCV-SA Turbine Bypass valve
HP to Cold Reheat (or Condenser)
Hot Reheat to Condenser
LP to Condenser

- Repeatable class V tight shutoff
- High pressure balanced
- Full plug guiding with anti-rotation
- Steam atomisation of the cooling water
- Low coolant pressure required
- High water capacity for large cooling duties
- High turndown ration for both steam and water
- Noise attenuating trim options
    - Single stage HUSH
    - Multi stage HUSH
    - Multi Disc Labyrinth RAVEN
- Fast acting pneumatic or hydraulic actuation
- Extremely flexible
    - Flanged or butt weld connections
    - ANSI 150 – 4500, standard, intermediate and split classes
    - Minimum straight line lengths required
- Low maintenance; with 'Quick-Change' trim design no special tools

Steam Turbine Bypass

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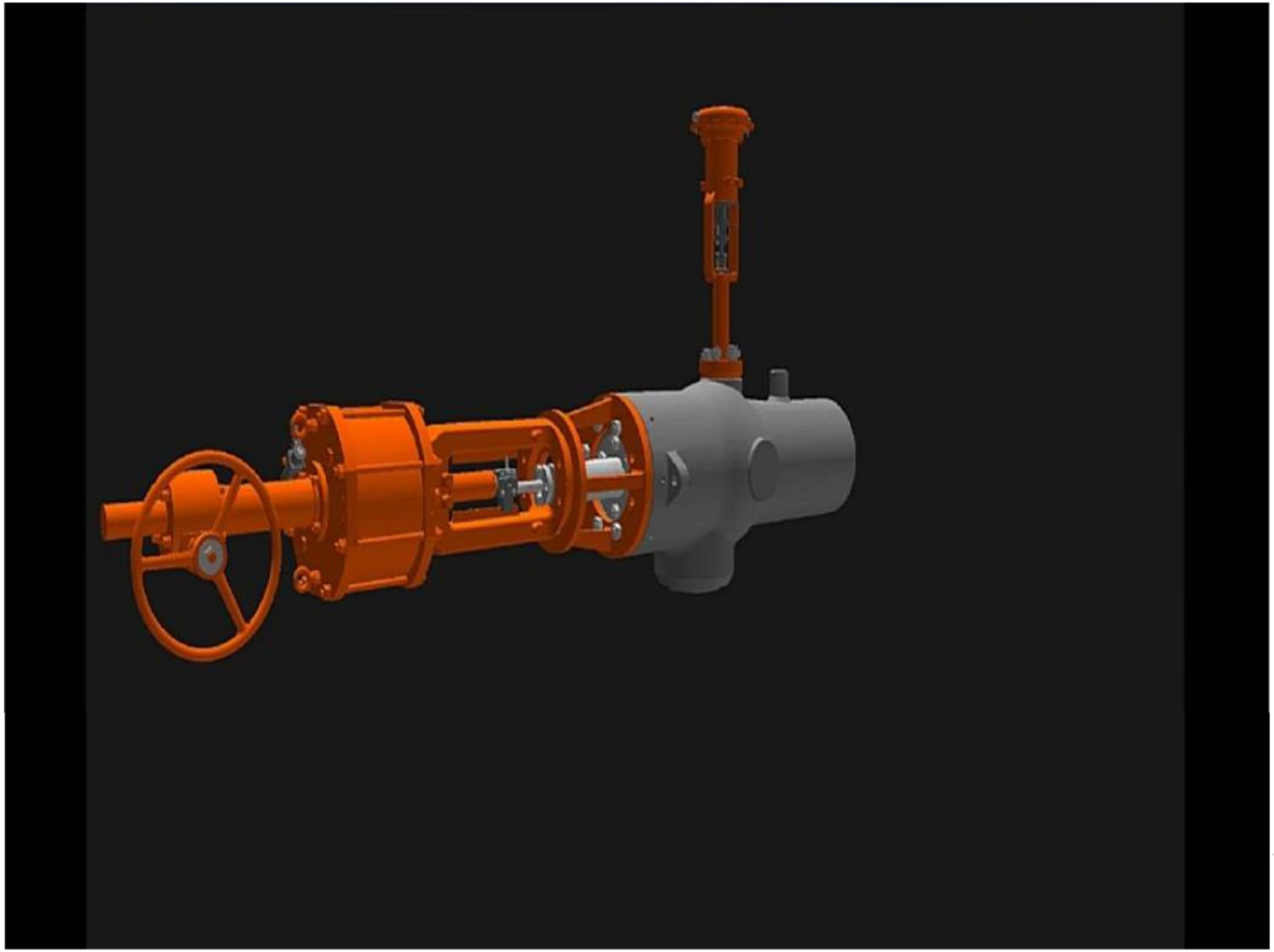

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WHAT IS ACTUALLY REQUIRED

- Change In Power Plant Operating Regimes
  - Combined Cycle Plants
  - ‘Two Shifting Operation’ & ‘Peak Shaving’
    - Up to 700+ Operations a year
    - Simple Cycle Operation For Flexibility
  - Solar Plants –
    - Similarly Twice a day operation

Is the Valve Supplier Market Actually Aligned For Today’s Requirements?

DSCV-SA: Modern Turbine Bypass Valve Addressing the Problems

- Very Tight Repeatable Shut Off (thermal efficiency)
- 100% reliability (High Pressure Balancing – Working With The Steam Dynamics)
- Guaranteed Concentric Plug Guiding (Modular Trim Design)
- No Thermal Shocks (No Mechanical Spray Nozzles Mounted On the Pressure Boundary)
  - Steam Atomisation – Preheated and introduced into the center of the steam flow)
- Flexible installation (Replace Existing Valves Matching Pipe Sizes and Distances)
- Low Maintenance (No Piston Rings or Special Balancing Systems)
- Easy In-Line Servicing (No Special Tools or Specialist Engineers)

ELIMINATE THE RISK BY DESIGN

Tight Repeatable Shut-Off

There are two forms of seat ware;

- Insufficient Seat Contact load leading to steam cut (wire drawing)
- Seat Throttling at low lifts.

DSCV-SA

Seat Contact Load

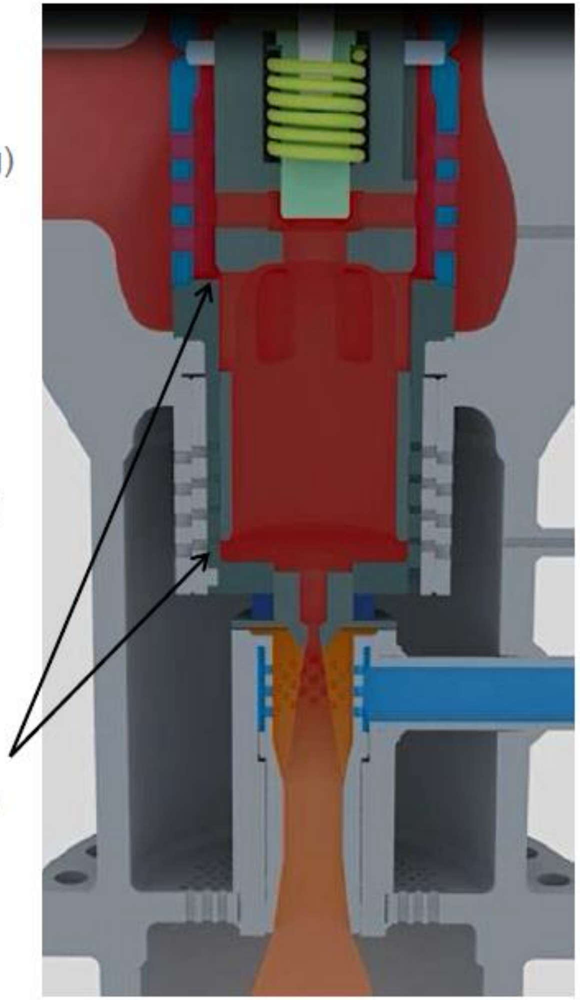
- Actuator sized for ANSI FCI 70-2 Class V seat contact load

Plus

- Fully unbalanced when closed so large augmented seat contact loads. Example a standard size HP Bypass at 1500 PSIG inlet pressure will have an additional 80,000 lbf of seat contact load.

Seat Throttling

- The trim is designed so that the plug seat lifts well clear of the cage seat **BEFORE** the first cage hole is uncovered. The steam forward feed area is approximately 5 times the cage area thus guaranteeing no seat throttling



High Maintenance Removed By Design

All Bypass Valve Trims Are Balanced Due To Physical Size

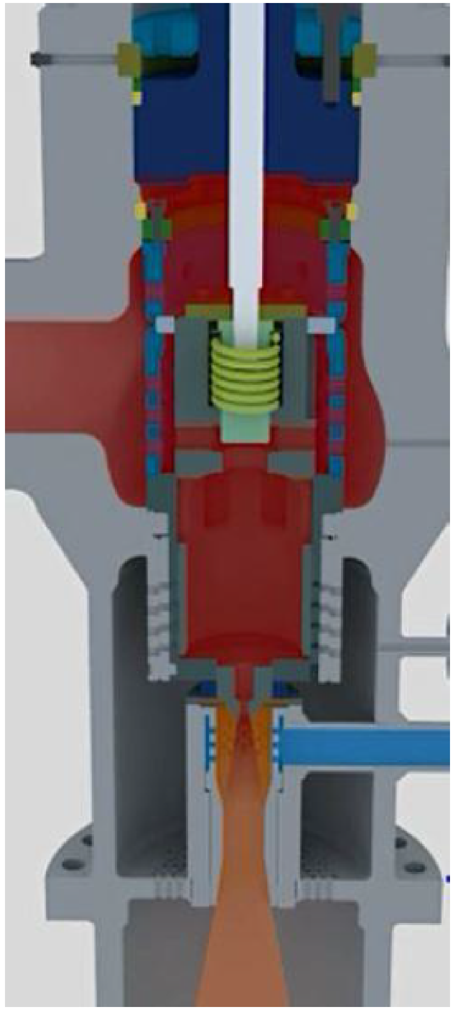
There are two forms of trim balancing;

- **Low Pressure Balancing**: The pilot plug evacuates the pressure above the plug to the lower pressure below the plug. This method is fully dependant on piston rings and finely machined, close tolerance balancing cylinders. This the system is always fighting the dynamics of the steam.

- **High Pressure Balancing**: Encourages the steam to flow to both the upper and lower part of the plug. Removing closer tolerance balancing cylinders, piston rings and any other flow restriction devices.

DSCV-SA

- Only employs high pressure balancing for all applications; Main Steam Bypass, Hot ReHeat to Condenser & LP to Condenser.

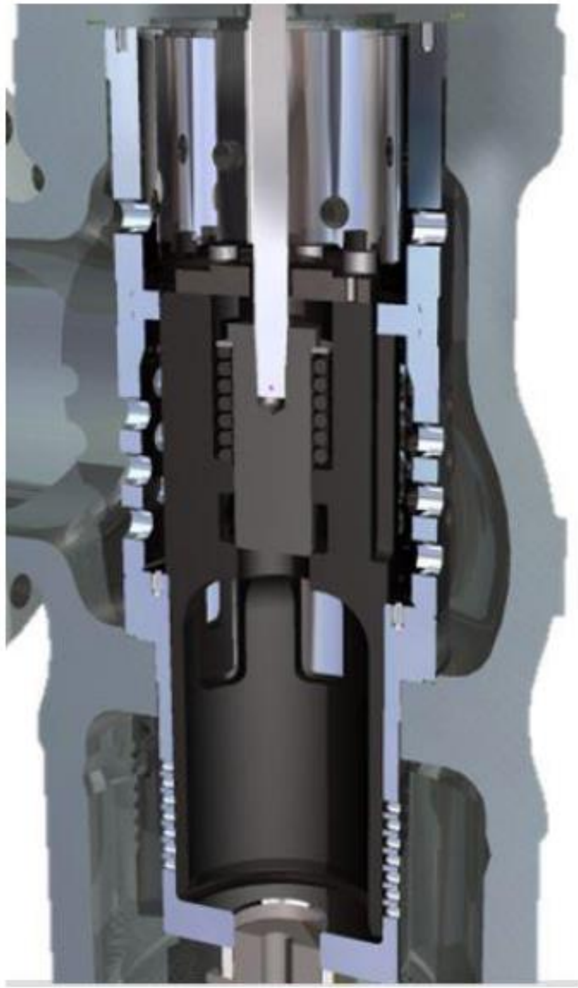


Working in Harmony With The Steam Rather Than in Constant Battle

Modular Trim Design

DSCV-SA

- The complete trim is a modular cartridge and is removed by simply sliding out the through the bonnet. No seat welding, no special tools.
- The modular design ensures accurate concentricity even on the largest of trims.
- Fully guided throughout the length of the cage.
- Upper guided via the unique E-A Ring which incorporates plug anti-rotation.
- Heavy duty spacer allows for bends to be welded directly to the DSCV-SA inlet connection.



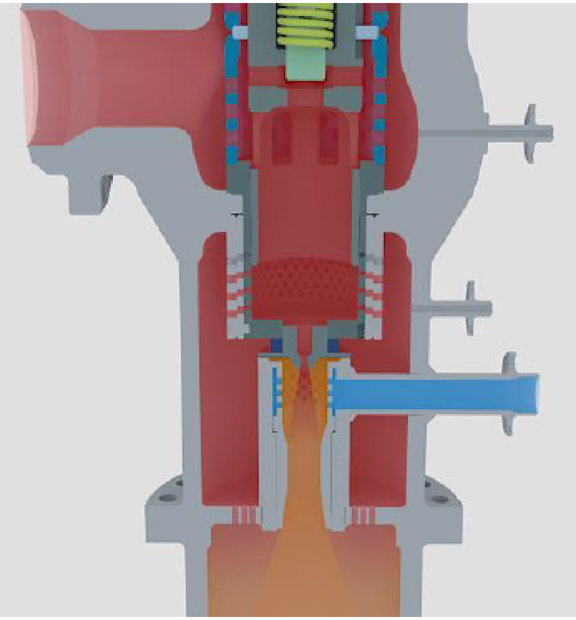
Stability With Full Guiding & Anti-Rotation

Integral Steam Atomisation

DSCV-SA

- The DSCV-SA does not use mechanical spring loaded nozzles for several reasons;

1. Steam atomisation dramatically reduces the mean average water droplet size of the incoming cooling water compared to mechanical water nozzles.
2. The steam pre-heats the cooling water in the converging-diverging venturi.
3. The combination of steam atomisation and water preheating via the converging/diverging venturi increases the evaporation rate reducing the downstream straight line lengths.
4. Mechanical spray nozzles have limited effective turndown as effective atomisation reduces with lower flows and pressure differentials. Steam atomisation actually increases with turndown.



Mean Time To Full Evaporation Minimised

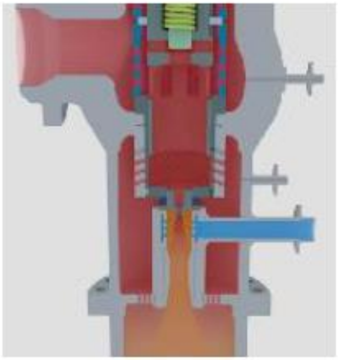
No Thermal Shocks

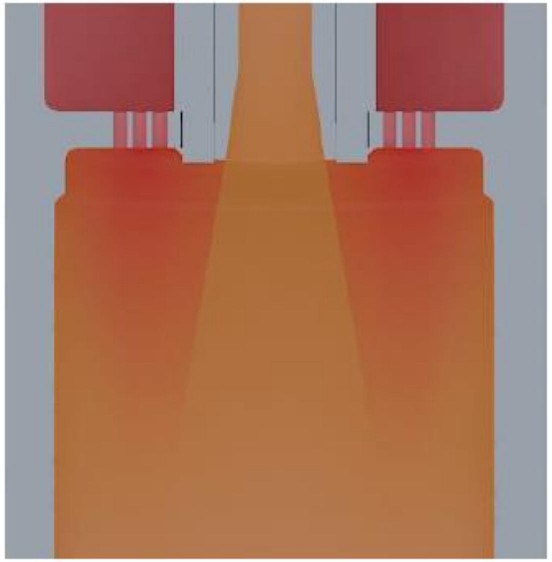
Integral Steam Atomisation – Introduced into the Centre of the Steam

DSCV-SA

- The DSCV-SA introduces the cooling water into the centre of the steam flow, not from the periphery such as spray nozzles.

1. The main steam flow passes through the outlet diffuser or flow guide.
2. Importantly with steam atomisation the atomised spray water which is pre-heated enters the main body of steam at the centre
3. The diffuser or flow guide produce a 360^0 annulus that shrouds the atomised pre-heated cooling water thus producing a thermal shield with no need for mechanical thermal liners.
4. Therefore no mechanical thermal liners are required to protect the valve body or downstream pipework from thermal shock due to the temperature differential between the steam inlet temperature and the cooling water temperature.



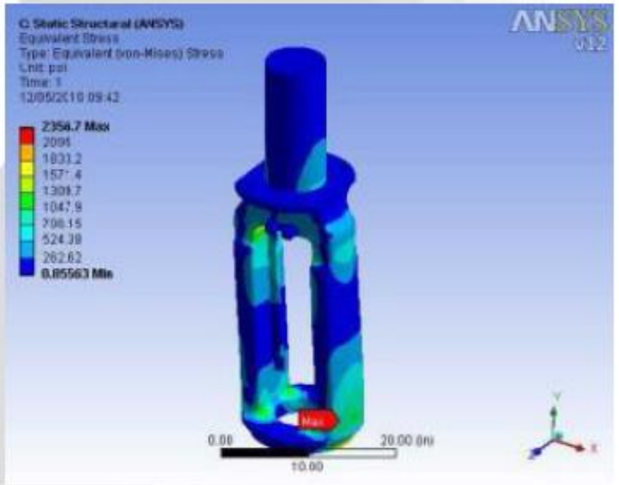


No Mechanical Thermal Liners Required – Steam Shrouding

Tailored To Fit

DSCV-SA

- The DSCV-SA turbine bypass valve has been design for full flexibility.
- Steam atomisation provides rapid water evaporation and thus shorter downstream lengths.
- Heavy duty inlet spacer with E-A Ring Guiding and integral anti-rotation allows bends to be welded to the inlet.
- Cartridge trim, no piston rings or balancing cylinders and actuator yokes designed to 7G acceleration allows for trouble free horizontal installation.
- Steam inlet, outlet and water connections can be any size and material transitions.
- Integral warming valves and drainage connections
- Hydro, Steam blow out or thru and chemical clean trims available.



Multiple Options For The Most Arduous Plant Designs

DSCV-SA

- A wide range of sizes to suit small Energy From Waste power plants, through conventional combined cycle & coal to large solar plants.

DSCV-SA CAPACITIES	
Size	Capacity Cv
00	103
0	248
1	501
2	850
3	1329
4	2333
5	3479
6	8520

Comprehensive Range Of Sizes For Types Of Power Plants

- Trimteck

Main Steam System Valves

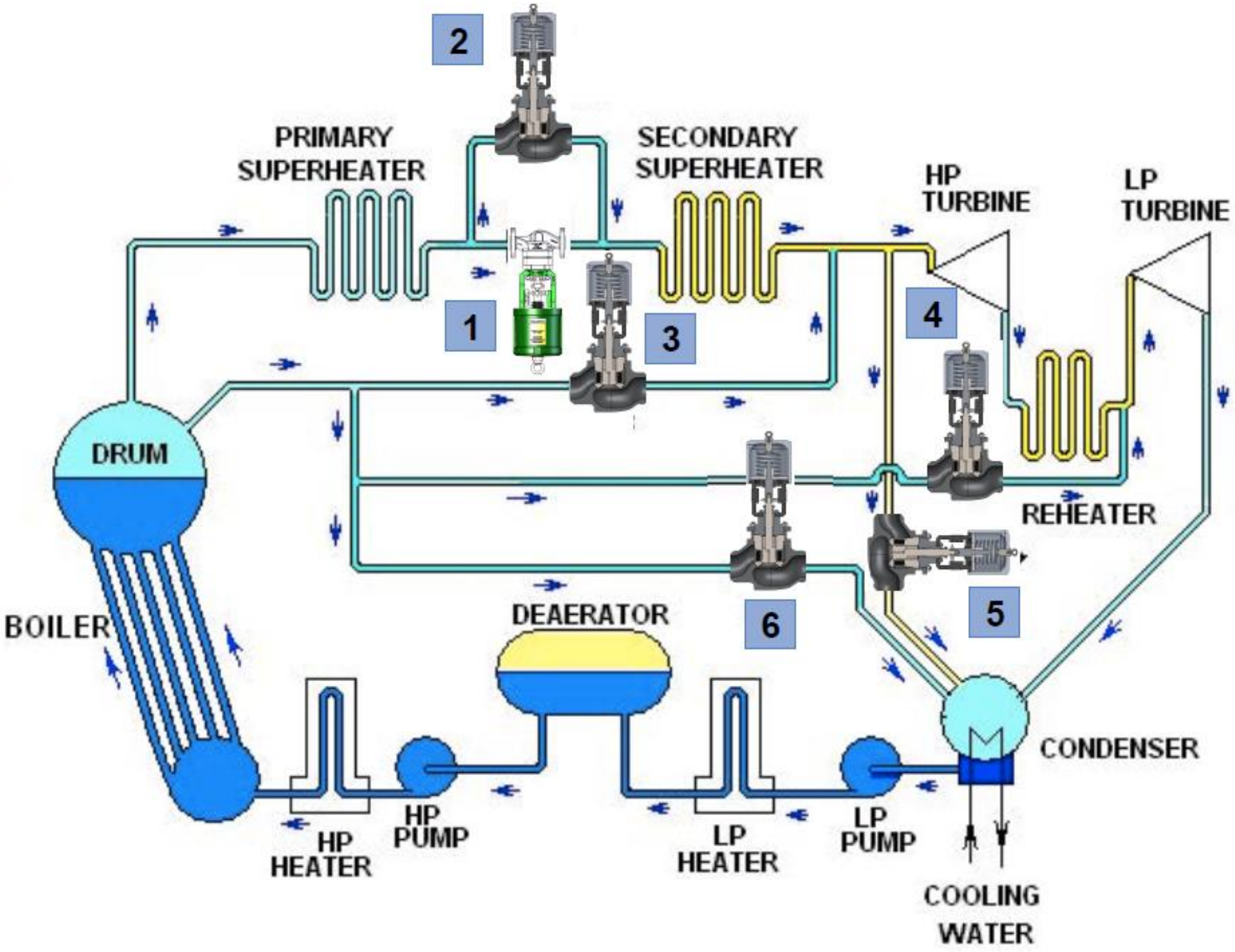
1. & 2. *Superheater valves*: Maintain boiler pressure below 70%; and modulate pressure to the turbine

3. *Main Steam Attemperator Valve*: Controls HP Turbine Temperature at 15% Load

4. *Reheater Attemperator Valve*: Controls LP Turbine Temperature at 15% Load

5. *Turbine Bypass Valve*

6. *Superheater Bypass Valve*



Case Study 5 – Rocky River WWHR

TRIMTECK® OPTIMUX™

Turbine Bypass and Steam Attemperation

End User	Water & Sewer Authority of Cabarrus Country 2MW Biomass Plant
Location	Concord, NC, USA
Requirements	Main steam bypass valve along with spray water attemperator valve and desuperheater
Trimteck Solution	Turbine Bypass: 3" CL900 OpGL-XT ST-3 Globe Control Valve with Noise Abatement Trim Backpressure Aid: 6" CL900 ST-3D In-Line Diffuser Spray Water Attemperator Valve: 1" CL 150 OpGL Desuperheater Nozzle: OpDSH Varifix

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Additional Trimteck Users – Power Industry

TRIMTECK® OPTIMUX™

- Abengoa Hidrogeno – Spain
- AES – Argentina
- Almussaib Thermal – Iraq
- Cal Energy – USA
- Calpine – Canada
- Covanta Energy – USA
- Dominion Virginia Power – USA
- Echogen Power Systems – USA
- ENELVEN – Venezuela
- Pacific Gas & Electric – USA
- PREPA – Puerto Rico
- Rio Nogales Power Company – USA
- Florida Power & Light – USA
- GE-Hitachi Nuclear – USA
- GE Energy – USA
- La Paloma – USA
- Minnesota Power – USA
- Mt. Poso Cogeneration – USA
- Niagara Generation – USA
- Northern California Power Agency – USA
- Tennessee Valley Authority – USA
- Termocolon – Panama
- Termoflores – Colombia
- Xcel Energy – USA

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Weir
Turbine Bypass Valves

The Weir BV995 Turbine Bypass Valve is a highly sophisticated engineered control device. Conceptually, it is required to accurately control multiple operational variables, provide system protection to both upstream and downstream plant components, and sometimes perform these tasks all in a fraction of a second. Depending on the overall system size, bypass mode of operation and customer preference, there is almost an endless selection of options and configurations that can be applied to the BV995 bypass valve construction. The Weir BV995 Turbine Bypass Valve design can be varied to accommodate the particular plant design, size, and application. It is available in a range of options and configurations to assure optimum performance regardless of the mode of operation.

The high pressure (HP) bypass valves are subject to some of the highest pressures and temperatures. They may be utilized in either a Parallel or Cascading Bypass System. If the plant is configured in a Parallel arrangement, the HP Bypass Valve will direct the outlet steam flow to the condenser. If the plant is configured as a Cascading system (the most common in today's plants) the steam will be directed to the Cold Reheat section of the boiler or steam generator. Regardless, these valves will warrant the highest pressure ratings which may go as high as ASME 4500. The valves are commonly manufactured from forged materials which allow for higher strength and ductility when compared to the equivalent cast material. The additional strength of the forged materials also provide greater manufacturing flexibility which allows for optimized contours and shapes that can result in thinner wall sections being applied to the valve body design. This helps in reducing the effect of thermal gradient stress across the body caused by the rapid and sudden opening of the valve during a turbine trip sequence

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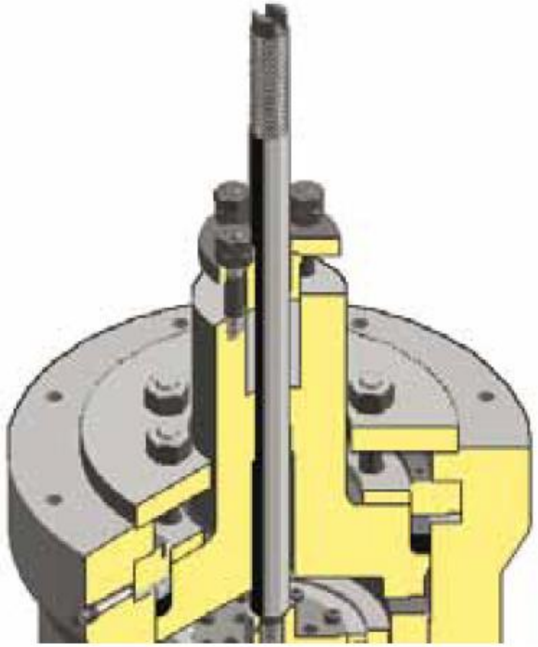
The Hot Reheat (HRH) bypass valves (sometimes referred to as Intermediate or Medium Pressure) are used to bypass steam to the condenser regardless of whether the bypass system is configured as parallel or cascading. The required flow coefficient, Cv, for these valves is often the largest in the system due to the combination of lower steam pressures and higher temperatures emanating from the re-heater. They are used to convert the HRH steam to conditions more acceptable for admission into the condenser. As a result of the high steam temperatures entering these valves, they normally require a significant amount of desuperheating flow to reduce the outlet enthalpy to acceptable condenser inlet conditions.

The low pressure bypass valve is used to bypass the LP section of the turbine and also directs its steam discharge to the condenser. The low pressure valves are not subject to extremes of heat and pressure in the same way as the HP and HRH bypass valves. They are therefore mostly made from lower grade cast materials such as ASTM/ASME SA216 WCB or carbon steel forgings such as ASTM/ASME SA A105. Due to the lower inlet pressures and temperatures, the LP bypass design criteria are not as difficult and there are many possible valve solutions and configurations for this application.

Spray Nozzles For turbine bypass applications, the most common nozzle used with the Weir Bypass valves is the BV984-VG (Variable Geometry) nozzle. It is a back pressure activated, variable geometry injection device. Depending on the spray water requirements, a number of nozzles are located radially around the outlet pipe. Selecting the right number of nozzles with a suitable pressure drop across each nozzle is crucial to obtaining an efficient spray injection pattern in the valve outlet. The number and location of the nozzles is critical to assure good spray penetration, complete flow area coverage, and minimize the formation of thermal stratification, a problem particularly prone in large diameter pipelines

Bonnents: In the design of any pressure vessel, there will always be a requirement to allow access to the inside of the component via the penetration of the pressure retaining boundary. In the case of a turbine bypass valve, this is usually facilitated by the valves bonnet. Under pressurized or operational conditions, the bonnet serves the same purpose as the vessel wall in securely containing the pressure and flow. However, when it is time for inspection or maintenance, the bonnet can be removed and access to the valve trim and seat can be afforded. Depending on the system pressures, valve size, and customer preference there are two main bonnet designs that are quite typical for turbine bypass valves. These are:

- Bolted Mechanical Bonnet
- Pressure Seal or Pressure Assisted Bonnet



Pressure seal bonnet design

Typical bolted bonnet

Weir Bonnet Options

Valve Materials of Construction

Part No.	Description	Material Standard	Comments
1	Valve Stem	AISI 616	Surface Hardened
2	Packing Hardware	AISI 420	
3	Packing	Graphite	
4	Segment/Spacer Ring	SA182-F22/F91/F92	
5	Pressure Seal Gasket	Graphite	SST Reinforced
6	Bonnet	SA105/SA182-F11,F22,F91/F92	
7	Valve Body	SA105/SA182-F11,F22,F91/F92	
8	Control Plug	SA182-F22/F91/F92	Alloy 6 Overlay
9	Seat Ring	SA182-F22/F91/F92	Alloy 6 Overlay
10	Pressure Reduction Stages	SA182-F22/F91/F92	
11	Outlet	SA106/SA335-P11,P22,P91	
12	VG Nozzle	AISI 410	

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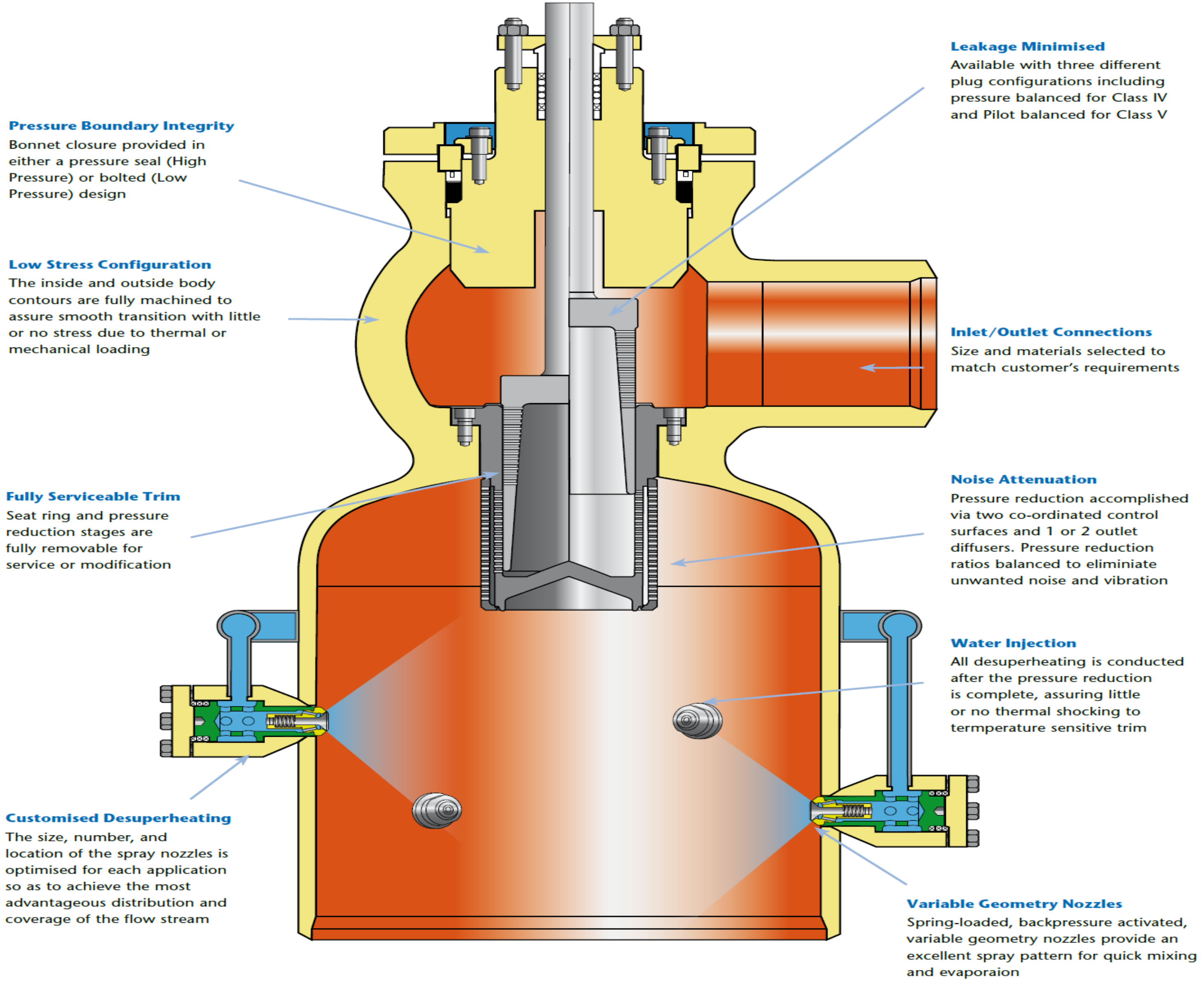
Weir Blake Borough Turbine Bypass Valve Features



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