Masoneilan

a Baker Hughes business

78X00 Series LincolnLog™ angle design

Control valves designed for cavitating water systems

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Introduction to cavitation in water applications

Cavitation is a common and damaging phenomenon in power plant and upstream applications, occurring when local pressure drops below the liquid's vapor pressure, causing vapor bubbles to form and then violently collapse as pressure recovers. In power plants, cavitation is frequently encountered in high-pressure water services such as boiler feedwater, condensate, heater drains, and recirculation systems, while in upstream oil and gas it appears in produced water handling, injection systems, and high-deltaP liquid letdown services.

These rapid bubble collapses generate intense localized forces that can lead to noise, vibration, erosion, and accelerated valve and piping damage, while also degrading control stability.

Cavitation is particularly difficult to manage because it shifts with load, temperature, pressure, and valve position, often appearing only during transient operating conditions.

While complete elimination of cavitation is not always practical, its impact can be significantly reduced through proper valve selection and sizing, use of angle-pattern bodies, cavitation-resistant or axial multi-stage trims, controlled pressure recovery, and careful actuator and positioner matching.

When cavitation is deliberately managed rather than ignored, **Masoneilan™ LincolnLog™ control valves** can maintain stable control and long service life even in demanding, high-energy liquid applications.

Masoneilan LincolnLog design has over 20 years of proven field performance as the industry's first high-pressure liquid letdown solution.

Power generation

Water applications in power plants are notoriously difficult to control for both pressure drop and flow rate because the operating conditions combine high energy levels, rapid transients, and fluid behavior that changes dramatically with small pressure or temperature variations. Unlike many industrial services, these challenges are inherent to how power plants operate.

In power-plant water services, cavitation behaves like a moving target rather than a fixed condition. As plant load changes, pressure and temperature shift, and operating points move across the valve stroke, cavitation can relocate, intensify, or disappear altogether.

This makes predicting damage locations difficult, renders sizing based on Cv alone insufficient, and can lead to unstable or unpredictable control performance if cavitation is not deliberately managed.

Compounding this challenge, power plants spend much of their operating life in transient conditions experiencing rapid load changes, unit trips and restarts, pump transitions, and heater level disturbances.

Each event introduces fast pressure-drop swings, sudden flow reversals, and momentary flashing or cavitation. Valves must therefore deliver reliable, stable control not only at steady state, but during these dynamic events, which is why power plant water valves are often designed to manage and withstand cavitation safely over a long period of time, and with the right selection of trim, materials and knowledge cavitation can be eliminated entirely.

Feature	Benefit
Side inlet	Uniform flow into trim
Bottom outlet	Directs cavitation damage away from seat
Gravity-assisted discharge	Helps remove vapor quickly
No downstream elbow required	Reduces erosion and vibration
Easy drainage	Important during shutdown and outages

Managing extreme pressure drop and wide operating range

In power plant water services, extremely high-pressure drops are a normal part of operation rather than an exception. Applications such as boiler feedwater letdown, startup and low-load operation, heater drain and recirculation frequently experience pressure reductions of 50–90% across a single control valve. These conditions generate very high velocities at the trim, making valves highly susceptible to cavitation, erosion, and sensitivity to even small pressure fluctuations—challenging stable control across the full operating range.

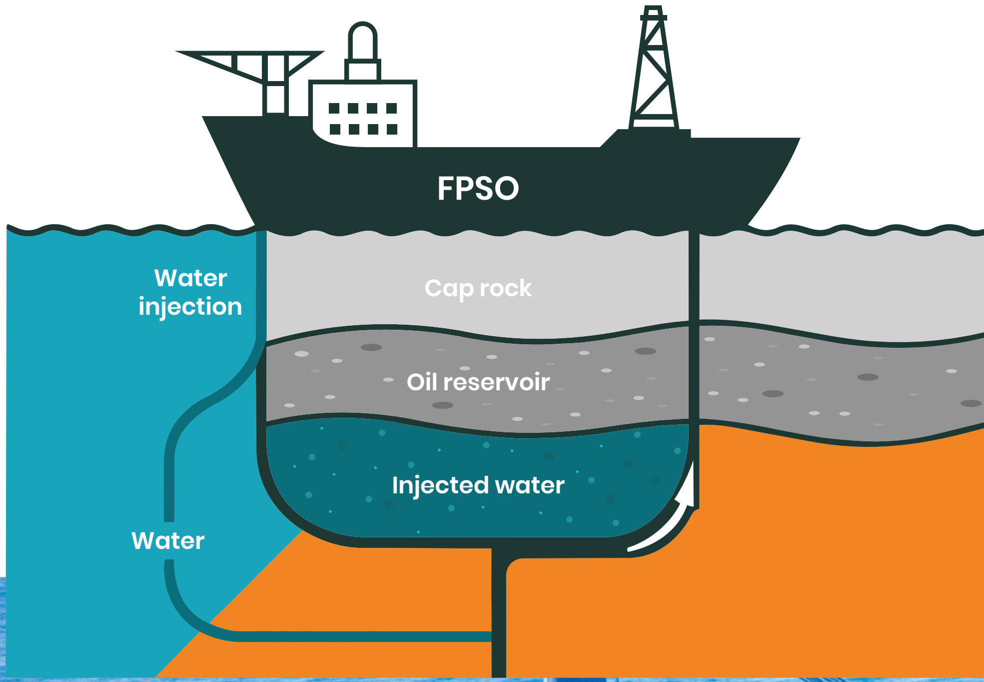
Compounding this challenge, power plants rarely operate at steady state. The same valve must perform reliably from cold startup through minimum load, base load, and continuous load-following operation. This wide operating envelope demands a large Cv turndown while maintaining precise control at low flow and stability at high flow. Without a valve designed for these extremes, plants can experience poor resolution during startup, excessive noise or vibration at higher loads, and reduced controllability overall.

Water injection

Water injection is a technique used in oil production that is critical for maintaining and enhancing reservoir pressure and hydrocarbon output.

Water injection involves pumping water into an oil reservoir to:

- **Maintain reservoir pressure:** As oil is extracted, pressure drops. Injecting water helps sustain pressure, which is essential for continued production.
- **Displace oil:** Water pushes oil toward production wells, improving recovery.
- **Improve sweep efficiency:** It helps move oil from less accessible parts of the reservoir.



Equipment selection

The water is treated and injected into the reservoir to maintain pressure and enhance oil recovery (EOR), all integrated within the rig or floating production, storage and offloading (FPSO) platform's topside processing facilities.

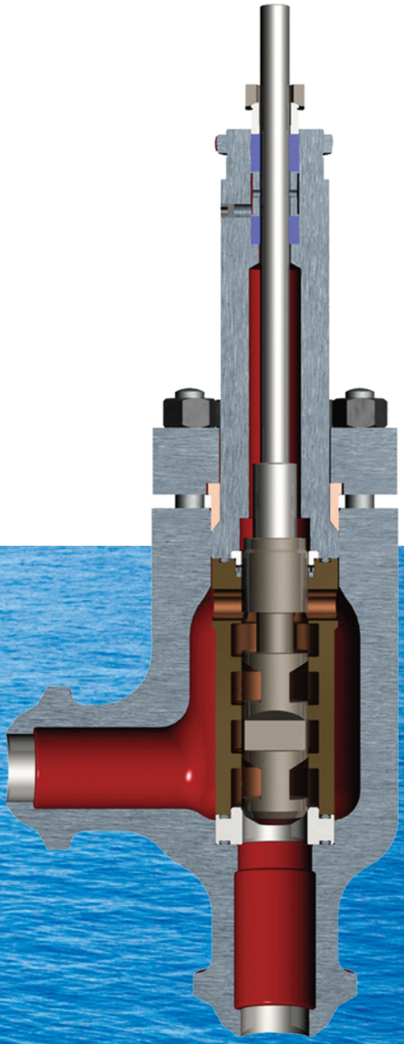
Without water injection, the reservoir pressure drops, reducing the energy available to push oil toward production wells that means less oil reaches the wellbore, leading to a sharp decline in output. Likely resulting in gas break out of solution and migrate to the wellbore, causing gas coning and reducing oil flow.

Sudden changes in fluid composition (more gas or water) can strain topside processing systems on platforms or FPSOs with well Integrity being put at risks through changes in pressure drop that can destabilize wellbores or cause sand production in unconsolidated formations.

The results in operating costs is significant as injection rates directly influence output and impacts on well life.

Selecting the right equipment for water injection systems iscrucial to maintain and increase OPEX, reliability and safety. The Masoneilan 18X00/78X00 Series LincolnLog valve is a premier solution for high-pressure liquid letdown applications, especially in produced water injection systems.

Designed to eliminate cavitation and withstand erosive conditions, it ensures long-term reliability in the harshest environments.



Why LincolnLog?

Axial flow LincolnLog design utilizes a tortuous path to distribute pressure drop along the axis of the plug. The axial stages throttle in unison as the plug strokes, maintaining staging ratios at all lift points. Velocity and pressure drop are controlled, thus eliminating cavitation and the resulting trim damage.

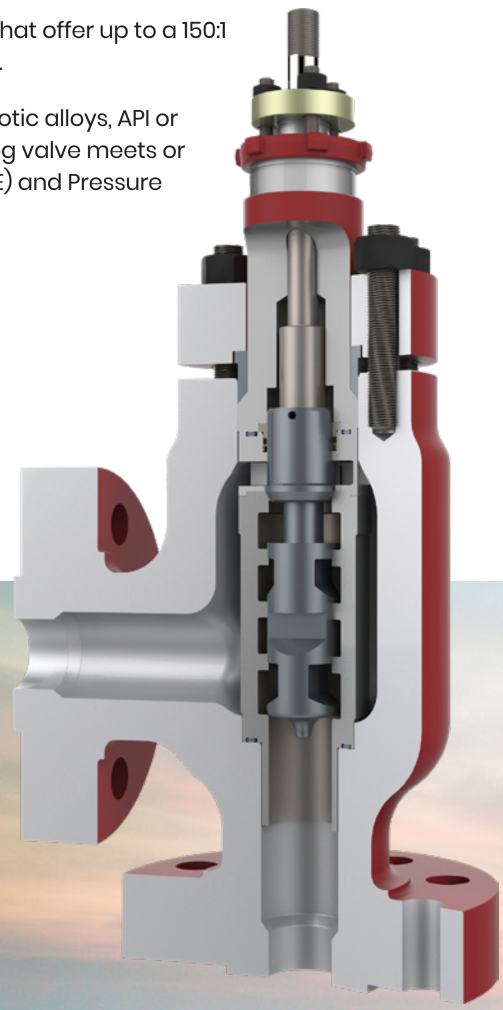
The axial flow design of the LincolnLog valve offers reliable performance throughout the entire range of plug travel with direction available with flow in the side or in the bottom out the side (SIBO).

By throttling at all stages in unison, the LincolnLog valve reduces short-circuiting of any pressure-reduction stage, decreasing wear along the leading and controlling edge of the plug.

The axial flow technology of the LincolnLog valve helps eliminate damage to any controlling surface (plug, cage or seat) by not exposing any one stage to excessive velocity or the full pressure drop.

The wide variety of trim designs in the LincolnLog valve includes options that offer up to a 150:1 turndown ratio, enabling response to a wide range of process conditions.

With several combinations of forged or cast valve bodies, standard or exotic alloys, API or ANSI-rated construction, and globe or angle configurations, the LincolnLog valve meets or exceeds exacting industry specifications such as corrosive service (NACE) and Pressure Equipment Directive (PED) compliance.



- Proven performance in thousands of severe service installations world-wide
- Custom-engineered for extreme pressure drops (up to 8000 psi/550 bar)
- Compliant with NACE MR0103, ISO 15156 and PED standards

LincolnLog overview

Size
- 1" through 8" (25 mm through 300 mm)

ASME B16.34 Rating and Connection
- Flanged or RTJ: ASME 600 – 2500

Optional Rating
- UNI-DIN 100 – 400
- Welded: butt-welded (BW) or socket welded (SW)

Pressure Rating
- API6A 10K or 15K in sizes 1" through 6"

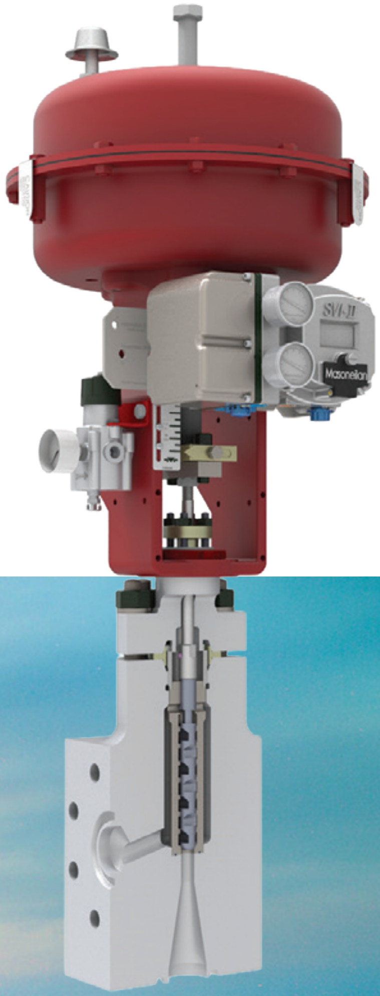
Temperature Range
- -20ºF to 600ºF (-29ºC to 316ºC)

Body Materials
- Carbon Steel, Stainless Steel, Chrome-Moly
- Options: F6NM Martensitic Stainless Steel, F51 Duplex Stainless Steel, F55 Duplex Stainless Steel and Nickel-Alloy Inconel 718

Trim
- Axial flow technology, multi-stage, cage-guided, anti-cavitation trim style C, Class VI available on request
- Options for flow in the side and out the bottom (SIBO) or flow in the bottom and out the side (BISO)

Inherent Characteristics
- Linear

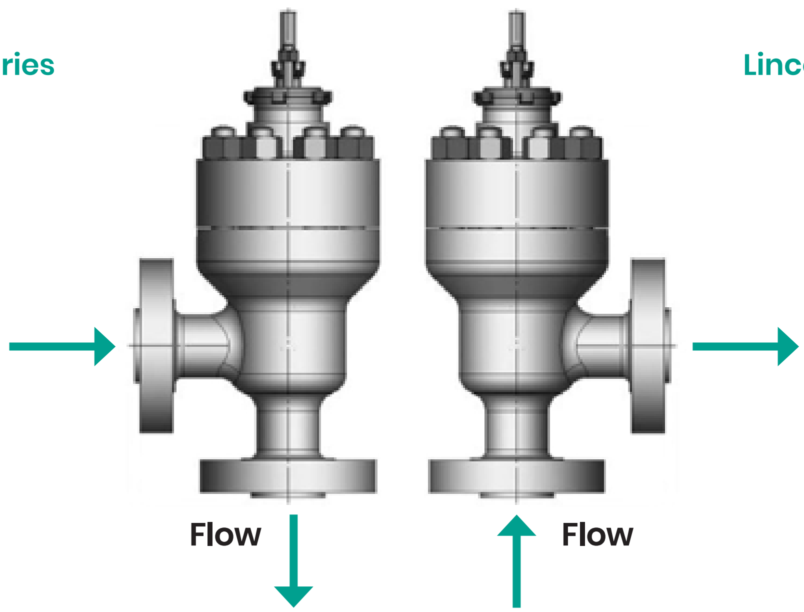
Actuators
- Model 51/52/53 pneumatic piston cylinder
- Model 87/88 multi-spring-opposed diaphragm



Applications

LincolnLog 78500 Series
Flow-to-Close (FTC)
Flow in the Side and
Out the Bottom (SIBO)

LincolnLog 78400 Series
Flow-to-Open (FTO)
Flow in the Bottom and
Out the Side (BISO)



The LincolnLog angle pattern valve trim provided flexible flow capability, enabling installation in either vertical or horizontal orientations. This design flexibility supports integration into modular system architectures and facilitates direct replacement of existing valve configurations without requiring major piping modifications.

Maintaining long-term shutoff is critical in high-pressure liquid service, as high-pressure differential leakage may lead to wire drawing, cavitation, or flashing damage to the valve, downstream piping, or other equipment.

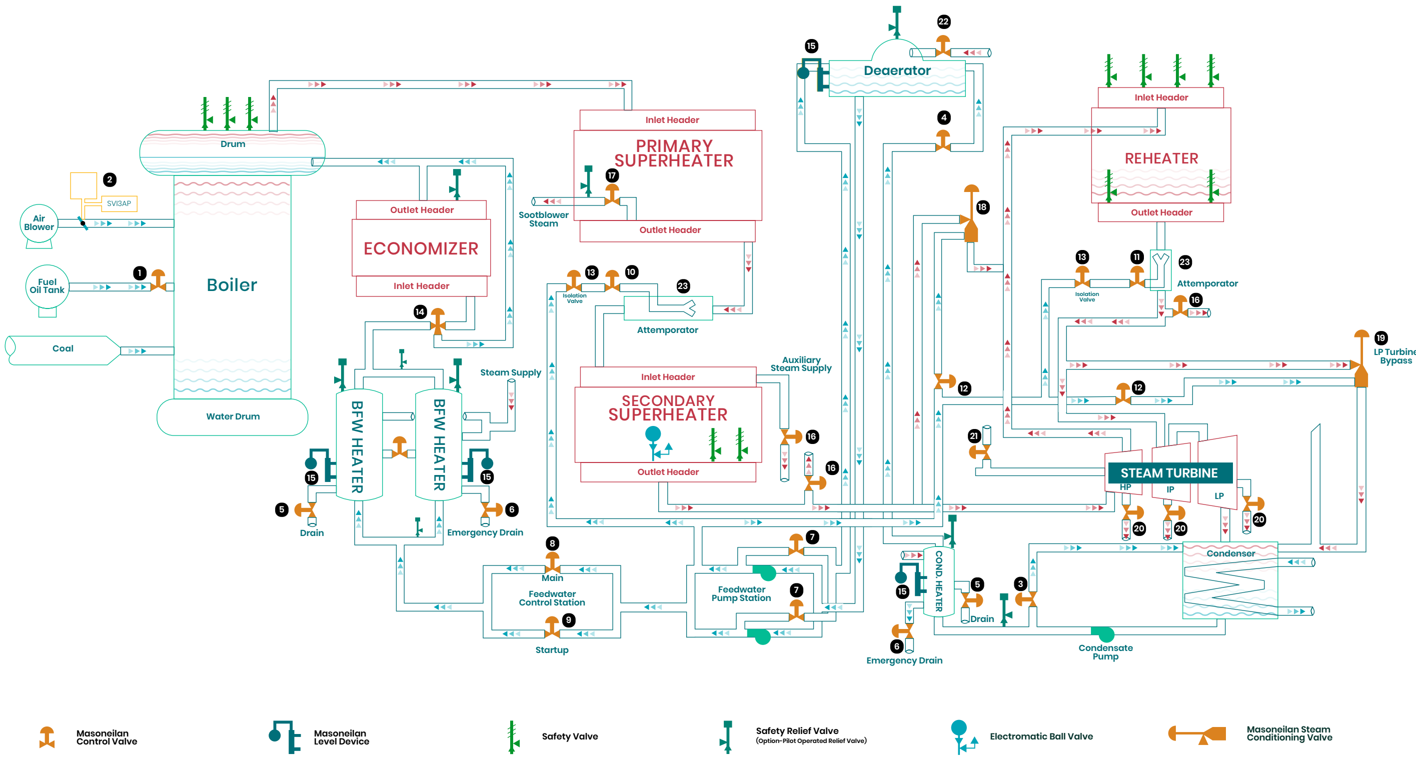
Upstream oil and gas industry:

- Pump recirculation
- Produced water injection
- High pressure separator

Power generation industry:

- Boiler feedwater control
- Feedwater recirculation (minimum flow)
- Attemperator spray water
- Condensate dump and heater drain control
- Startup and transient letdown services

Typical coal/oil power plant system



1. Fuel oil control	13. Spraywater isolation valves
2. Air damper positioner	14. HP economizer/FW preheater bypass
3. Condensate recirculation	15. Level controler
4. Deaerator level control	16. Auxiliary steam
5. Condensate/Boiler FW continuous heater drain	17. Soot blower
6. Condensate/Boiler FW emergency heater drain	18. HP turbine bypass
7. Boiler feedpump recirculation (LincolnLog)	19. LP turbine bypass
8. Main feedwater regulator (LincolnLog)	20. Main/reheat steam and turbine drains
9. Start up feedwater regulator (LincolnLog)	21. Turbine seal pressure
10. Superheater attemperator spray	22. Deaerator pegging steam
11. Reheater attemperator spray	23. SH/RH attemperator
12. HP/LP turbine bypass attemperator spray	

FW = feed water, HP = high pressure, LP = low pressure, SH = superheater, RH = reheater

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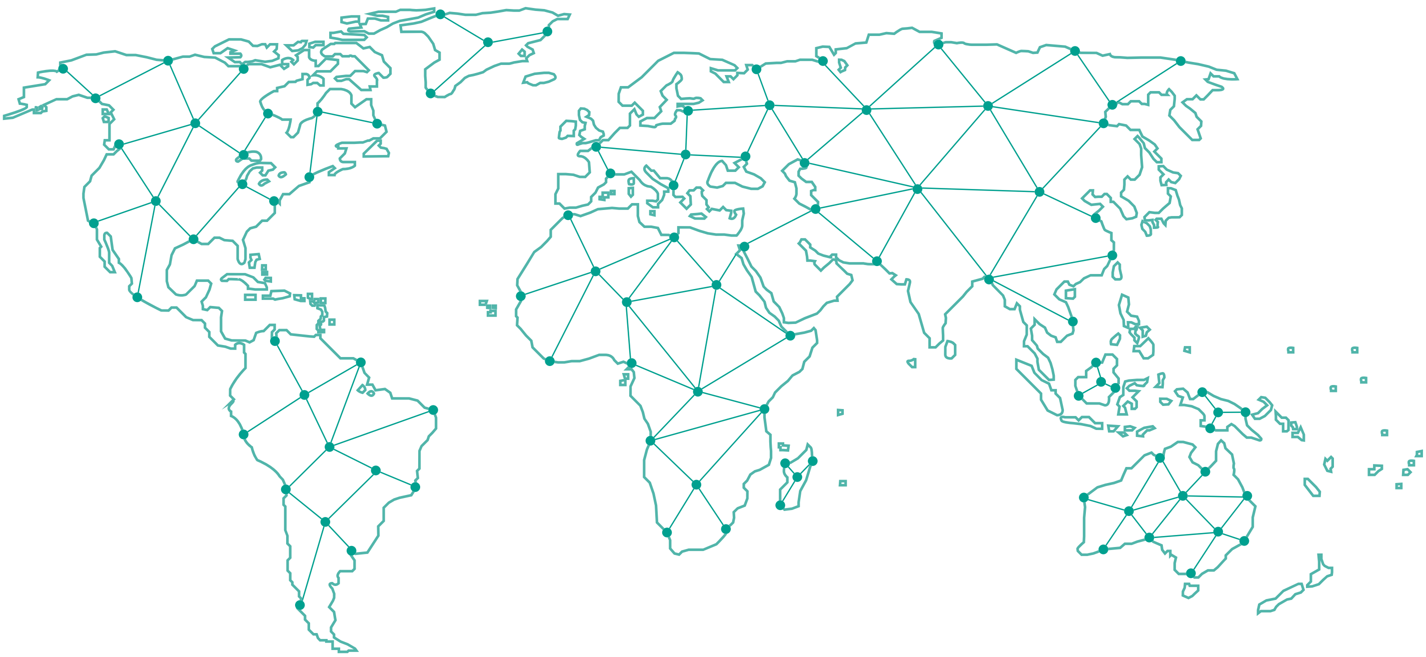

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