Wellhead Safety Control Panel

WELLHEAD SAFETY CONTROL SYSTEM

Three power options; one safety objective.



Gas-over-Oil Type · Wellhead Gas Self-Sourcing | Gas-over-Oil Type · Clean Nitrogen Cylinder Supply | Electro-Hydraulic Type · Stored-Energy Electric

For onshore gas wells, sour gas fields, multi-well cluster pads, unattended well sites, gas storage facilities and retrofit of existing wellheads

DAUME (Shanghai) Control Technology Co., Ltd.

API 6A | NACE MR0175 | IEC 61508 (SIL2) | Ex d IIC T5 | IP67

About DAUME

DAUME (Shanghai) Control Technology Co., Ltd. focuses on wellhead safety control and fluid-control actuators for oil and gas wells. Addressing the safety-interlock requirements across the "wellhead — pipeline — station" scope, the company provides integrated services covering scheme design, system integration, complete-unit manufacturing, factory testing and site commissioning.

The company's wellhead control products cover three technology routes: gas-over-oil control panels powered by wellhead natural gas, gas-over-oil control panels using nitrogen cylinder banks as a clean gas source, and electro-hydraulic control panels that require no gas source at all and drive surface wing valves by means of a stored-energy multifunctional electric emergency shutdown device. All three routes share the same safety logic and quality standards, and are selected according to site conditions in terms of gas source, power supply, gas quality and operation and maintenance.

In the electro-hydraulic field, DAUME integrates permanent magnet brushless DC (BLDC) variable-speed technology, energy-storage technology and hydraulic control technology within a single control panel. A dual energy-storage architecture—"electric storage + hydraulic storage"—replaces conventional pneumatic control circuits, reducing the gas-treatment chain and routine maintenance items while supporting partial-stroke testing and remote control without production shutdown, thus serving unattended and intelligent well sites.

Business Segment	Main Scope
Gas-over-Oil Control	Wellhead gas self-sourcing type and clean nitrogen cylinder supply type → Wellhead Control Panel
Electro-Hydraulic Control	Stored-energy multifunctional electric emergency shutdown device → Electro-Hydraulic Control Panel
Actuation & Valves	Permanent magnet brushless DC (BLDC) actuator → high-precision, frequent modulation of choke valves and associated valve packages
Engineering & Services	Scheme design, FAT/SAT, retrofit of existing installations, O&M and spare parts

Draw gas from the well to safeguard the well; only by not being bound to the gas source lies the lasting solution.

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1 Product Portfolio and Technology Roadmap

1.1 Three Technology Routes

The task of a wellhead safety control panel remains unchanged: it receives trigger signals from the wellhead, pipeline, fire and gas system and central control, drives the subsurface safety valve (SCSSV) and surface safety valves (MSSV, WSSV) according to preset logic, and executes an emergency well shutdown when an abnormality occurs. The difference among the three products lies not in "whether to shut in the well" but in "with what energy the well is shut in".

The gas-over-oil Type I (wellhead gas self-sourcing) uses wellhead-produced natural gas as its sole power source: the gas is tapped, filtered, de-liquefied, flame-arrested and pressure-regulated to form pilot gas; one branch directly actuates the surface safety valve, while the other is converted by a pneumatic booster pump into hydraulic pressure to actuate the subsurface safety valve. Its advantage is that it operates even during a power failure; its drawback is that reliability rests on wellhead gas quality and pressure—when gas quality is poor, with liquid and sulphur content, or when pressure is too low or the well has been shut in, the protection capability is weakened.

The gas-over-oil Type II (clean nitrogen cylinder supply) replaces the power source with bottled nitrogen: nitrogen is dry, clean and inert, free of condensate, water and hydrogen sulphide, so wear and blockage of pilot valves and booster pumps are significantly reduced. At the same time it no longer depends on wellhead gas production, so pressure can be built up even when the well is shut in, under low yield, or during well testing or workover. Its constraint is the limited capacity of the cylinder bank, which must be sized on the number of shutdowns and accompanied by sound refill and changeover management.

The electro-hydraulic type uses no gas source at all: the surface wing valve WSSV is actuated by a stored-energy multifunctional electric emergency shutdown device, while the subsurface safety valve and master valve are controlled by a hydraulic power unit. Normal operation is powered by a 220 V mains supply or low-power solar power, and emergency shutdown is accomplished respectively by the device's internal energy storage and the hydraulic accumulator. It eliminates the entire gas-treatment chain, with fewer components and less maintenance, and provides partial-stroke testing, parameterised shutdown curves and

remote diagnostics, representing the development direction towards electrification and unattended operation of wellhead control panels.

1.2 Overview of Technology Routes

As shown in Figure 1 below, the three routes start from different power sources but ultimately converge on the same safety logic of "isolating the wellbore first, then shutting the surface valves". The electro-hydraulic route in the third column contains no gas-source stage whatsoever, which is the most fundamental difference from the other two routes.

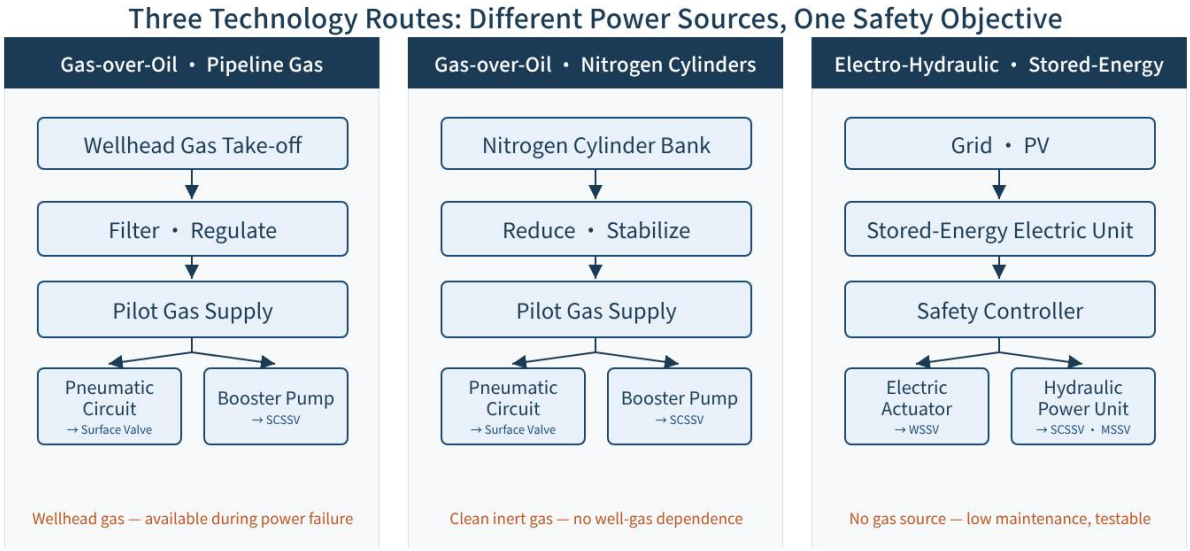


Figure 1 Overview of three wellhead control technology routes

1.3 Comparison of the Three Solutions

Table 1 below compares the three solutions horizontally across six dimensions: power source, actuation method, dependency conditions, O&M and functions. It should be noted that the columns "dependence on external power" and "behaviour on power loss" do not constitute an advantage of the gas-over-oil solution: the electro-hydraulic solution accomplishes shutdown on power loss by means of its own energy storage; both solutions can shut in the well, only via different energy paths.

Table 1 Comparison of three wellhead control solutions

Comparison Dimension	Gas-over-Oil (Pipeline Gas)	Gas-over-Oil (Nitrogen Cylinder)	Electro-Hydraulic
Power Source	Wellhead natural gas	High-pressure nitrogen cylinder bank	Electric power + energy storage + hydraulics

Comparison Dimension	Gas-over-Oil (Pipeline Gas)	Gas-over-Oil (Nitrogen Cylinder)	Electro-Hydraulic
Surface Valve WSSV Actuation	Pneumatic actuator	Pneumatic actuator	Electric (stored-energy driven)
Subsurface Valve and Master Valve	Pneumatic pump + accumulator → SCSSV/MSSV	Pneumatic pump + accumulator → SCSSV/MSSV	Hydraulic power unit + accumulator → SCSSV/MSSV
Gas Source Dependency	Depends on wellhead gas production; loss of gas means loss of power	Depends on nitrogen; gas failure means loss of power	None; no gas used at all
Dependence on External Power	No	No	Required in normal operation, not required for emergency shutdown
Behaviour on Gas Loss	Accumulator sustains, then shuts down at preset thresholds	Multiple shutdowns possible before cylinder bank is depleted	Not applicable (no gas source)
Behaviour on Power Loss	No impact	No impact	FC FO FL optional
Gas Quality Sensitivity	High; requires filtration, de-liquefaction, flame arrest and pressure regulation	Low; clean inert gas	None
Adjustable Shutdown Time	Yes; requires replacement/setting of throttling elements	Same as left	Yes; parameterised setting
Partial-Stroke Test	Not supported; requires production shutdown for testing	Not supported	Supported; verification without production shutdown
Routine Maintenance	Filter elements, de-liquefaction, draining, pilot valves	Cylinder bank refill, pressure regulators, pilot valves	Energy-storage health, hydraulic oil, accumulator
Typical Scenarios	Conventional wells with stable gas source and controllable gas quality	No gas source, low-yield wells, well testing and workover	Unattended, sour-gas and intelligent well sites

1.4 Selection Guidance

For older well sites with stable wellhead pressure, good gas quality and mature gas-treatment facilities, the wellhead gas self-sourcing type has the lowest investment and the most proven structure and is preferred. Where wellhead yield is low, shut-ins are frequent, gas quality carries heavy liquid and sulphur content, or the well is in testing, workover or temporary production, the nitrogen cylinder type can build pressure independently of wellhead gas and is more robust.

For well sites with mains power or the option of photovoltaic plus energy storage, requiring minimal staffing and needing remote diagnostics and testing without production shutdown — especially in sour-gas and offshore or nearshore environments — the electro-hydraulic type is recommended. For older wells with existing gas-over-oil panels, the original pneumatic WSSV circuit can be replaced by a stored-energy electric emergency shutdown device while retaining the hydraulic section, forming a "electric drive + hydraulics" hybrid retrofit at lower investment than complete replacement.

2 Gas-over-Oil Control Panel: Wellhead Gas Self-Sourcing Type

2.1 Working Principle

Wellhead natural gas is tapped from the christmas tree production line and pressure-regulated to 0.4 – 0.7 MPa after passing through a pressure-tap ball valve, filter, liquid separator and flame arrester, forming a stable pilot gas source. The pilot gas splits into two branches: one enters the pneumatic control circuit and controls the surface safety valves via high- and low-pressure pilot valves, a shuttle valve and a quick exhaust valve; the other enters the pneumatic booster pump, converting low-pressure gas into high-pressure hydraulic oil, which is stored in the accumulator and then drives the subsurface safety valve through the hydraulic control valve package.

As shown in Figure 2 below, the blowdown paths of the two branches are independent: the pneumatic branch blows down through the quick exhaust valve to a safe vent area, while the hydraulic branch returns oil to the tank through the valve package. When any interlock is triggered, both branches depressurise simultaneously, and the WSSV, MSSV and SCSSV close by spring return. A hand pump serves as a backup means of building pressure when the gas source fails or during commissioning, and is connected into the hydraulic circuit.

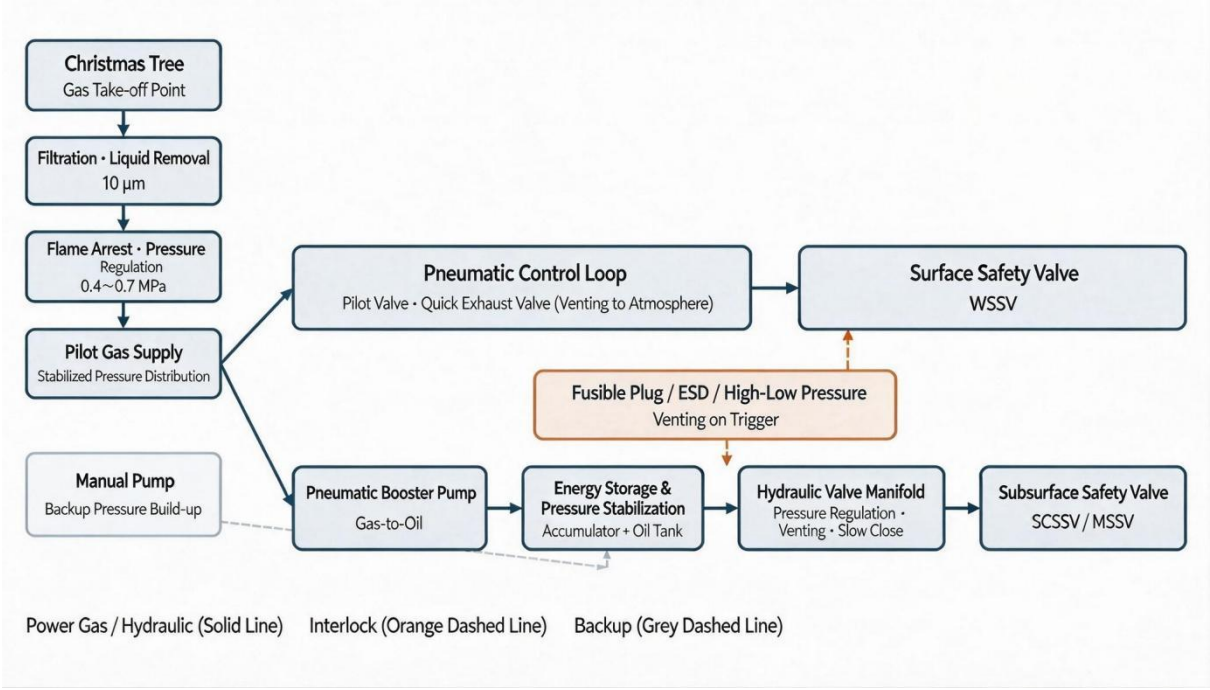


Figure 2 System flow of the gas-over-oil control panel (wellhead gas self-sourcing type)

2.2 Gas Source Pretreatment Chain

The pretreatment chain consists of six stages: filtration, de-liquefaction, flame arrest, pressure regulation, safety relief and draining. The filter is selected at 5 – 10 μm precision; the liquid separator removes condensate and free water; the flame arrester is arranged upstream of the pressure regulator to prevent flashback from propagating along the pipeline back to the wellhead.

This chain determines the failure modes of the entire unit. Condensate swells rubber seals and contaminates pilot valve spools, while free water forms hydrates at low temperature that block instrument tubing; both lead to a "failure to close when required". Therefore this product makes filtration, de-liquefaction and draining independent units, with differential-pressure indication on the filter element and drain points concentrated at the lower part of the cabinet for shift-based operation.

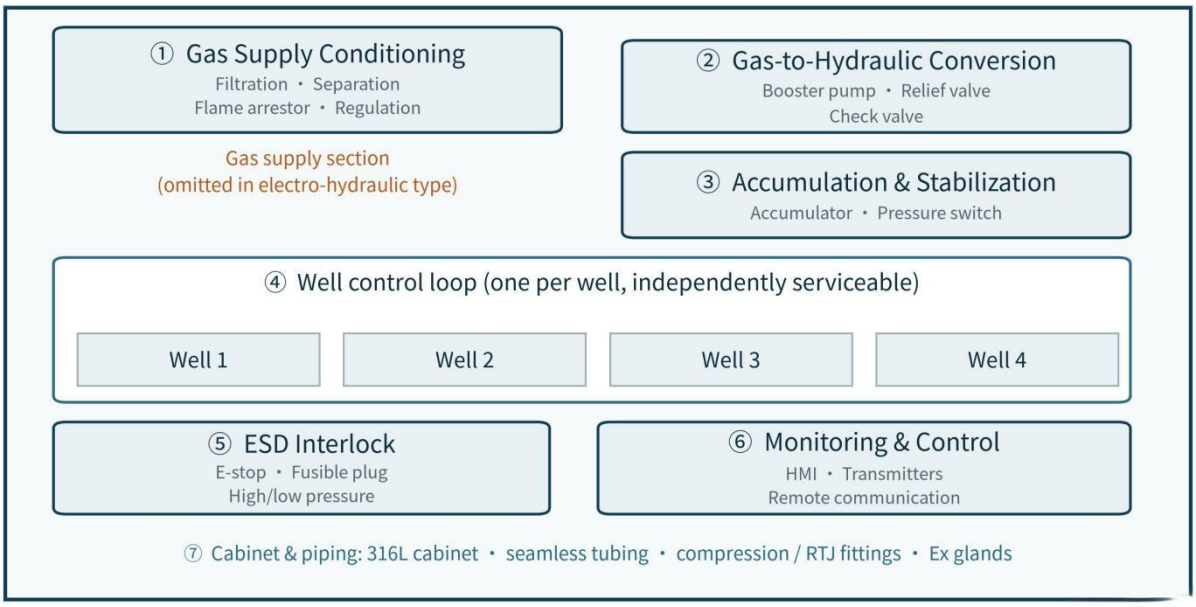


Figure 3 Functional unit composition of the gas-over-oil control panel (front view of cabinet)

① Gas source pretreatment: pressure-tap ball valve, filter, liquid separator, flame arrester, pressure regulator, safety valve and drain valve, removing condensate, free water and solid impurities and stabilising pilot pressure. ② Gas-over-oil conversion: a pneumatically driven booster pump converts low-pressure gas into high-pressure hydraulic oil, equipped with a relief valve and a non-return valve to prevent overpressure and backflow. ③ Accumulation and pressure stabilisation: a bladder-type accumulator with pressure switch and blowdown valve package maintains control pressure during gas-source fluctuation or brief gas loss,

enabling multiple well shutdowns. ④ Single-well control circuit: one set per well, independently serviceable, including pilot regulation, shuttle valve, quick exhaust valve, controllable throttled soft-close assembly and valve position feedback. ⑤ ESD interlock: local emergency stop, fusible-plug fire circuit, high- and low-pressure pilots and remote ESD solenoid valve, all fail-closed on gas loss. ⑥ Monitoring and electrical control: explosion-proof touch screen, digital pressure display, audible and visual alarm and signal isolation, with 4–20 mA and passive dry contacts uploaded to RTU/DCS. ⑦ Cabinet and piping: 316L cabinet, seamless stainless steel tubing, compression or RTJ connections and explosion-proof glands.

As shown in Figure 3, gas treatment, gas-over-oil conversion, accumulation/pressure stabilisation and the single-well circuits are arranged in separate zones inside the cabinet; the gas-source section is exclusive to the gas-over-oil type and is entirely eliminated in the electro-hydraulic type. Figure 4 shows the corresponding internal cabinet view, where the relative positions of the stainless steel tubing, booster pump, accumulator and rows of pilot valves can be seen.



Figure 4 Typical internal layout of the gas-over-oil control panel

2.3 Pneumatic Control Branch and Surface Safety Valves

The pneumatic branch consists of high- and low-pressure pilot valves, a shuttle valve, a quick exhaust valve and a pressure switch. The high-pressure pilot senses line overpressure and the low-pressure pilot senses underpressure; either one actuation opens the blowdown

port. The shuttle valve selects between local and remote signals, ensuring the higher pressure takes priority; the quick exhaust valve establishes a high-flow blowdown path at the instant of triggering, causing the WSSV to lose pressure rapidly and close.

The control pressure of the surface safety valve is taken directly from the pilot gas source without boosting, so shutdown response is fast and the structure is simple. The trade-off is that gas source pressure must be stable: if pilot pressure is insufficient, the valve may not close fully, which is why this product provides low pilot-pressure alarm and delayed shutdown.

2.4 Gas-over-Oil Conversion and Energy Storage

The pneumatic booster pump converts pilot gas into high-pressure hydraulic oil at a fixed intensification ratio, with output pressure set according to the rated control pressure of the subsurface safety valve. A relief valve limits maximum output and a non-return valve prevents backflow after the pump stops. The pump is started and stopped by an accumulator pressure switch and does not run during normal pressure holding, so gas consumption and wear are concentrated in the short pressure make-up periods.

The accumulator is of bladder type, with nitrogen pre-charge pressure set according to the manufacturer's specification (typically 70% – 90% of the minimum working pressure), and capacity calculated on the worst-case condition, i.e. the required number of well shutdowns can still be completed after the gas source is cut off. The accumulator also absorbs pressure pulsation, keeping the control pressure of the SCSSV/MSSV stable.

2.5 Interlocks and Blowdown Paths

The pipeline-gas type is configured with ten categories of interlock (see Chapter 5); the most commonly used on site are high pressure, low pressure, fusible-plug fire circuit, local emergency stop and remote ESD. Except for low gas source pressure, which is an alarm followed by delayed shutdown, all interlocks are "trigger-and-blowdown" and do not rely on software judgement; a fusible plug must be replaced after actuation and cannot be reset for continued service.

The design of blowdown ports is often overlooked: pneumatic blowdown contains natural gas and must be routed to a safe vent area, away from ignition sources and operating walkways; hydraulic blowdown returns to the oil tank, where excessive backpressure must be avoided so as not to affect shutdown speed. The cabinet arranges the two types of blowdown port separately and labels them to prevent incorrect field connection.

2.6 Applicable Conditions and Limits

The pipeline-gas type is best suited to conventional gas wells and multi-well cluster pads with a stable gas source, controllable gas quality and existing gas-treatment experience. If wellhead pressure falls below the lower regulation limit, gas quality with liquid and sulphur content significantly exceeds the standard configuration, or the well is shut in for a long period, the nitrogen cylinder type or electro-hydraulic type should be used instead.

Table 2 Comparison of two gas-over-oil gas source solutions

Comparison Item	Wellhead Gas Self-Sourcing	Clean Nitrogen Cylinder Supply
Gas Source	Wellhead production pipeline	High-pressure nitrogen cylinder bank
Gas Quality	Contains condensate, water and hydrogen sulphide; requires treatment	Dry, clean and inert; no treatment required
Dependence on Wellhead Gas Production	Yes	No
Continuous Gas Supply Capability	Continuous as long as the well is producing	Limited by cylinder bank capacity; refill required
Main Maintenance	Filter elements, de-liquefaction, draining, pilot valves	Cylinder pressure check, refill, pressure regulator
Typical Scenarios	Conventional production wells, multi-well cluster pads	Low-yield wells, shut-in wells, well testing/workover, wells with no gas source
Investment Level	Low	Moderate, increasing with cylinder bank capacity

3 Gas-over-Oil Control Panel: Clean Nitrogen Cylinder Supply Type (Common Solution)

3.1 Why Use a Clean Nitrogen Cylinder Supply

Using wellhead natural gas directly as instrument gas is essentially "precision control with dirty gas". Even with filtration and de-liquefaction, pilot valves operating for long periods in media containing oil, water and sulphur inevitably suffer spool fouling, seal swelling and winter freeze blockage. A nitrogen cylinder bank provides a dry, clean and inert power source, eliminating such failures at the source.

The second reason is independence from wellhead gas production. When the well is shut in, at very low yield, or during well testing or workover, there is no pressure for pipeline gas tapping and the control panel cannot build pressure; a nitrogen cylinder bank can establish pilot pressure under any condition, completing valve opening, pressure holding and shutdown actions. The third reason is safety: nitrogen does not support combustion, so blowdown does not form a combustible cloud at the wellhead and venting requirements are lower than for natural gas.

3.2 System Composition and Flow

The nitrogen cylinder type shares all downstream circuits with the pipeline-gas type; the only difference is the gas-source section. The high-pressure nitrogen cylinder bank forms 0.4 – 0.7 MPa pilot gas through first-stage pressure reduction, filtration and stabilisation, which then enters the pneumatic control circuit and the pneumatic booster pump. The cylinder bank is equipped with low-pressure alarm and changeover valves, one bank in service and one on standby, with an alert for refill when pressure falls below the set value.

As shown in Figure 5, apart from the gas-source section, the configuration of pneumatic control, rapid blowdown, surface safety valves, pneumatic booster pump, accumulator, hydraulic control valve package and subsurface safety valve is identical to the pipeline-gas type. Consequently both gas-over-oil panels can use the same cabinet, the same spare parts and the same operating procedures, keeping field training and maintenance costs low.

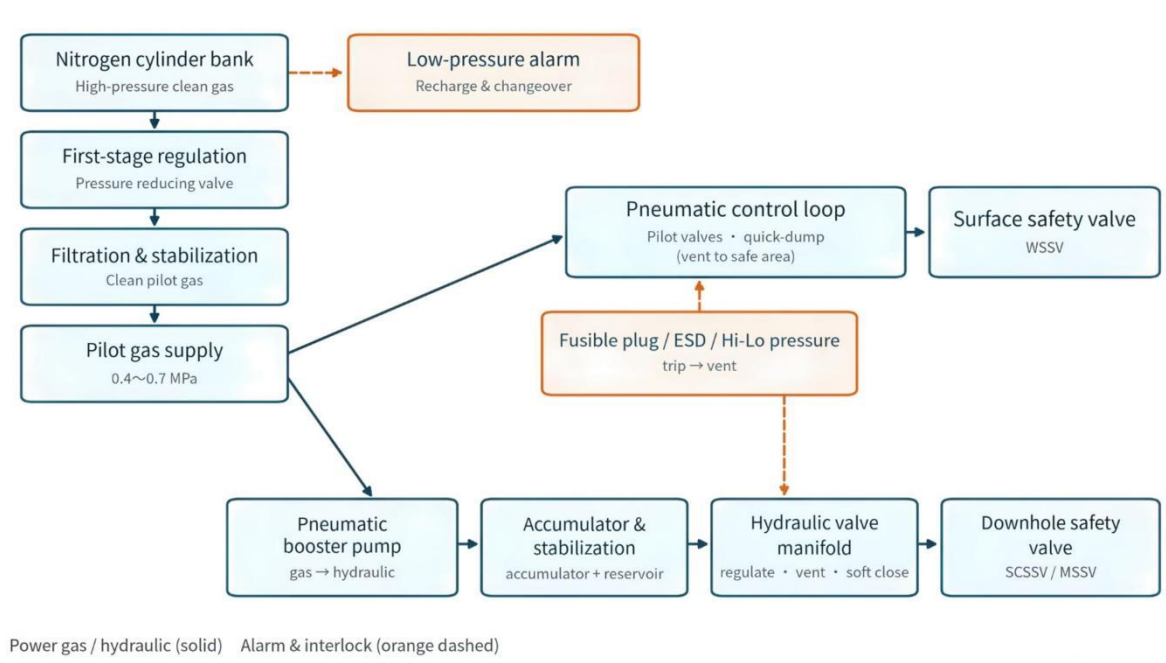


Figure 5 System flow of the gas-over-oil control panel (clean nitrogen cylinder supply type)

3.3 Cylinder Bank Capacity Calculation and Changeover

Cylinder bank capacity is calculated on three quantities: gas consumption per shutdown, the number of shutdowns that may occur during the unattended period, and a safety margin. Per-shutdown consumption includes pilot-circuit blowdown, booster-pump pressure make-up and actuator gas usage; the number of shutdowns is determined by the site inspection interval and historical abnormality frequency, generally not fewer than three; the safety margin is taken at approximately 1.3 times. The result determines the number of cylinders and the volume of each cylinder, as well as whether automatic changeover between two banks is required.

There are two changeover methods: manual changeover for manned or regularly inspected well sites, simple and low-cost; automatic changeover for unattended well sites, accomplished by a pressure switch and solenoid valve, with an alarm issued after changeover. Either way, the cylinder bank should be marked with filling date, pressure and next inspection time.

3.4 Operational Management Requirements

Nitrogen cylinders are pressure vessels, and their transport, storage and use must comply with relevant regulations: keep upright and secured, avoid exposure to sunlight and impact, and isolate from oil and grease; periodically leak-test the cylinder valve and pressure-

regulator connections; keep the cylinder room well ventilated to prevent accumulation of inert gas in low areas causing oxygen deficiency.

Daily checks focus mainly on cylinder pressure, supplemented by visual inspection and connection leak tests; refill is performed at the lower pressure limit, and "replace only when empty" is not recommended so as to avoid insufficient gas at shutdown. Standby cylinder banks should be periodically test-bled to confirm the cylinder valves can open normally.

3.5 Typical Application Scenarios

Low-yield and intermittent-production wells: the wellhead is often at low pressure or shut down, making pipeline gas tapping unreliable. Shut-in and sealed wells: monitoring and emergency shutdown capability must be maintained. Well testing, workover and temporary production: no fixed gas-source facilities are available, and the cylinder bank can be transported together with the skid. Wells with harsh gas quality: severe liquid, sulphur and water content — clean nitrogen avoids pilot valve failure at the source. Offshore or remote sites with no gas source: a cylinder bank is more economical than laying a gas-tapping pipeline.

4 Electro-Hydraulic Control Panel: Stored-Energy Electric Type (Development Direction)

4.1 Technical Positioning

The reliability of the gas-over-oil solution rests on one premise: the wellhead has gas, and the gas is clean enough. Once that premise fails, protection is compromised; meanwhile the gas-source chain itself brings a long list of components—filtration, de-liquefaction, flame arrest, pressure regulation, pilot valves—each a potential leak point and maintenance point.

The electro-hydraulic control panel replaces the power source entirely: the surface wing valve WSSV is directly actuated by a stored-energy multifunctional electric emergency shutdown device, while the subsurface safety valve SCSSV and master valve MSSV are controlled by a hydraulic power unit; the complete unit requires no gas source at all. Normal operation is powered by the grid or low-power photovoltaics, and emergency shutdown is accomplished by the device's internal energy storage and the hydraulic accumulator — independent of both external power and wellhead pressure.

> Dual energy-storage architecture: electric storage handles loaded shutdown of the surface wing valve, hydraulic storage handles shutdown of the subsurface safety valve and master valve; the two branches are configured and blow down independently, so servicing either side does not affect the protection capability of the other.

4.2 System Composition

The complete unit consists of four parts: the power supply unit, the stored-energy multifunctional electric emergency shutdown device, the hydraulic power unit and hydraulic control valve package, and the safety control and monitoring unit. As shown in Figure 6 below, the upper part is the electric drive branch and the lower part the hydraulic branch, with the SIL2 safety controller and explosion-proof control panel in the middle. ESD, fire and gas and pressure triggers are connected on the left, and status is uploaded to DCS/SCADA on the right.

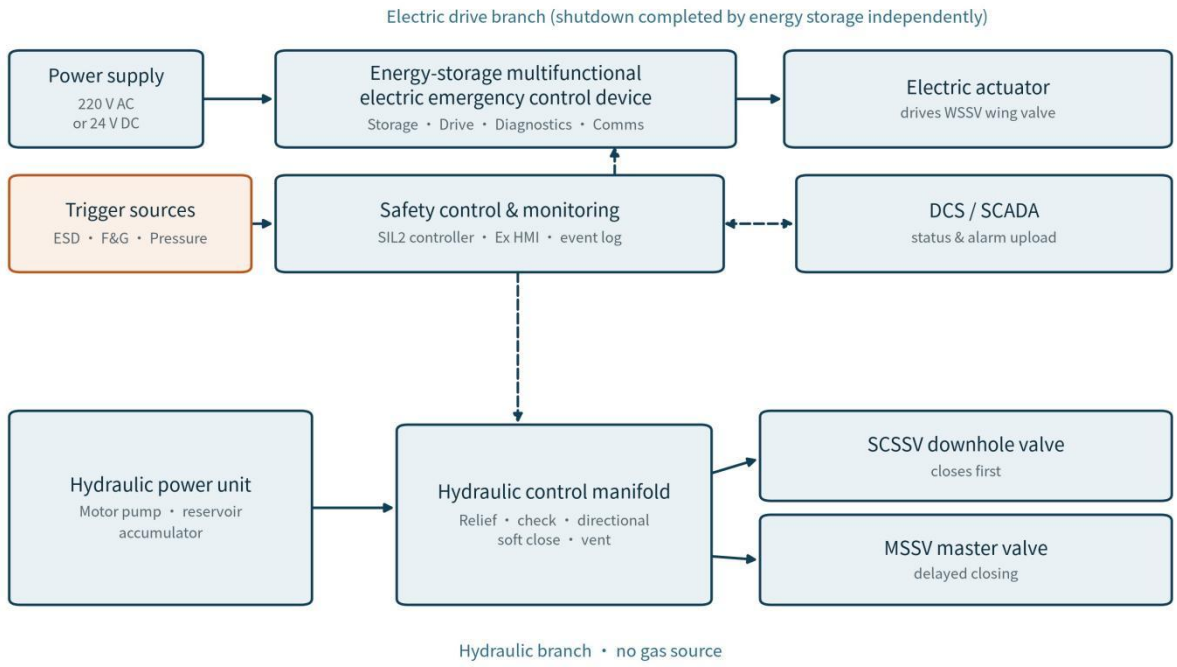


Figure 6 System composition and dual energy-storage architecture of the electro-hydraulic control panel

4.3 Stored-Energy Multifunctional Electric Emergency Shutdown Device

This is the core of the electro-hydraulic panel and its most essential difference from the gas-over-oil panel. It integrates energy storage, drive, control, diagnostics and communication within one device, forming a complete "shut in even on power loss" circuit of its own, with no need for an external gas source or central hydraulic power unit to provide power.

During normal operation the energy-storage unit is kept fully charged by the power supply unit and, after a power loss, actuates the mechanism for a set number of cycles. The drive unit employs a permanent magnet brushless DC motor with closed-loop control of both position and torque; on shutdown it first overcomes flow torque with the set torque, then seats smoothly to avoid high-speed impact on the valve seat. The control unit supports four trigger modes—local, remote, automatic and manual release—with the ESD hardwired signal taking priority over any software command.

The device also performs two functions beyond the reach of conventional gas-over-oil panels: first, the partial-stroke test (PST), which moves the valve a small distance and returns it to position without interrupting production, verifying "whether a valve that has not moved for a long time can actuate at the critical moment"; second, condition monitoring and self-diagnostics, continuously recording valve position, torque, current, temperature and energy-storage health, and issuing early alarms on abnormalities rather than exposing the problem only when shutdown fails.

Table 3 Functional configuration of the stored-energy multifunctional electric emergency shutdown device

Function	Implementation	Benefit to the User
Energy Storage & Power Supply	Wide-temperature battery pack or supercapacitor, maintained by the power supply unit during normal operation	Loaded shutdown still possible after power loss
Drive & Actuation	Permanent magnet brushless DC motor + closed-loop position/torque control	Controllable shutdown torque, avoiding impact and sticking
Trigger Modes	Local, remote, automatic, manual release	A usable shutdown means under any condition
Partial-Stroke Test	PST: small movement and reset without production shutdown	Solves the hidden problem of "not actuating at the critical moment"
Condition Monitoring	Valve position, torque, current, temperature, energy-storage health	Faults detected in normal times, reducing sudden failure to actuate
Communication & Recording	4–20 mA, dry contacts, Modbus, 4G; event log	Integration with DCS/RTU, traceable incidents
Protection & Adaptability	Ex d IIC T5, IP67, −40 to +70 °C	Suited to outdoor and harsh environments

4.4 Hydraulic Power Unit and SCSSV/MSSV Control

The hydraulic branch handles the subsurface safety valve and master valve: the motor-pump unit raises the hydraulic oil pressure and delivers it to the accumulator and valve package, providing stable control pressure for the SCSSV and MSSV. The pump unit is started and stopped by a pressure switch and does not run during normal pressure holding; the accumulator capacity is sized on the required number of shutdowns after power loss and constitutes the "energy storage" on the hydraulic side.

The hydraulic control valve package contains a relief valve, non-return valve, solenoid directional valve, throttled soft-close assembly and blowdown valve. On shutdown, blowdown follows the set sequence: the SCSSV loses pressure and closes first, isolating the wellbore; the MSSV then closes after a delay. The soft-close assembly controls the depressurisation rate so that the master valve closes smoothly, reducing impact on the pipeline and wellhead.

The hydraulic system operates fully sealed, with emphasis on oil cleanliness and accumulator pre-charge pressure. The tank is fitted with a level gauge and breather filter, and return oil is filtered; low-pour-point hydraulic oil is selected for low-temperature service, with electric tracing added where necessary.

4.5 Action Logic and Sequence

During normal production, energy storage is full and hydraulic pressure built up, with the WSSV, SCSSV and MSSV all in the open position and the panel performing monitoring only. Once any trigger acts, the safety controller records and locks the first-out cause and simultaneously issues shutdown commands to both branches: the electric device closes the WSSV along the set curve, the hydraulic valve package blows down so that the SCSSV closes first and the MSSV closes with a delay, and audible and visual alarms activate and are uploaded to central control.

Table 4 Typical action sequence of the electro-hydraulic control panel

Stage	Action	Time Setting	Description
1	Trigger and first-out recording	Instantaneous	Records the first trigger cause and locks subsequent alarms
2	SCSSV shutdown	≤2 s	Hydraulic blowdown, isolating the wellbore
3	MSSV shutdown	2 – 8 s adjustable	Delayed closing to avoid pressure build-up in the wellhead section
4	WSSV soft closing	5 – 15 s adjustable	Electric actuator closes along the curve, suppressing water hammer
5	Alarm and upload	Synchronous	Audible/visual alarm + DCS/SCADA status
6	Reset	After manual confirmation	Fault cleared, field confirmation, pressure rebuilt

Note: The times given are typical settings; actual values are set during commissioning according to well conditions and recorded in the commissioning log and on the nameplate.

Figure 7 below shows two shutdown characteristics: rapid shutdown applies to emergencies such as loss of wellhead control or fire-and-gas triggering, where control pressure drops in a step and the valve closes immediately; controllable throttled soft closing applies to planned conditions such as normal shutdown or changeover for maintenance, where control pressure falls along an S-shaped curve and the valve seats slowly, suppressing water hammer and pressure surges. The electro-hydraulic type switches between the two via parameterised curves, while the gas-over-oil type does so by replacing or setting throttling elements.

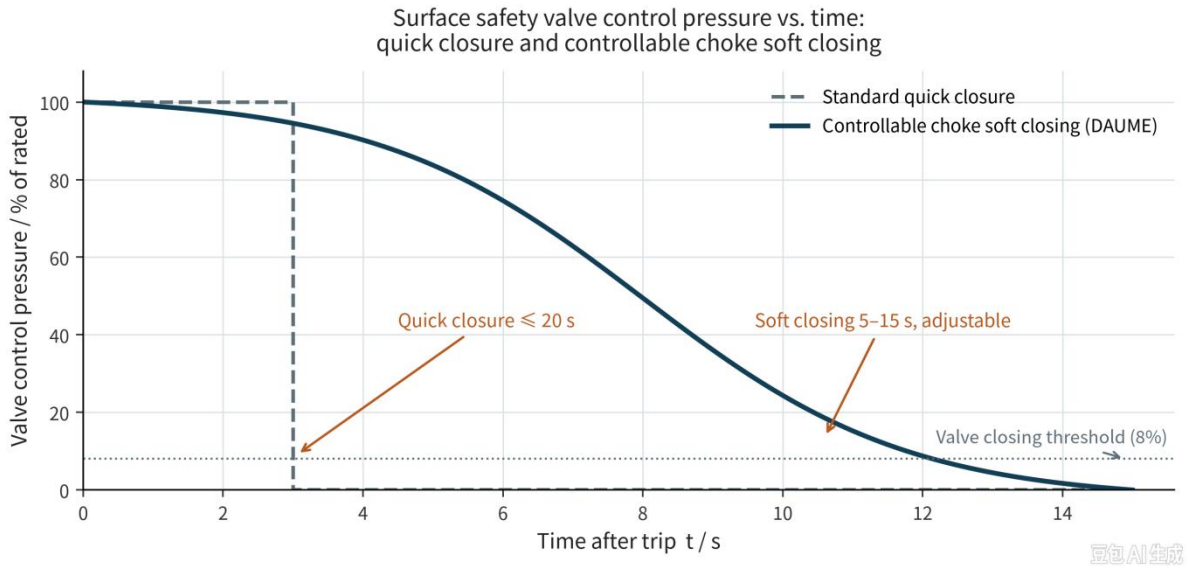


Figure 7 Shutdown characteristics of rapid shutdown and controllable throttled soft closing

4.6 Comparison with Gas-over-Oil Solutions

Both solutions can shut in the well; the difference lies in the energy path, maintenance structure and verifiability. Table 5 below compares them from the perspectives of O&M and functions to facilitate item-by-item discussion during scheme review.

Table 5 Comparison of electro-hydraulic and gas-over-oil solutions

Comparison Item	Gas-over-Oil Solution	Electro-Hydraulic Solution
Gas Treatment Chain	Required: filtration, de-liquefaction, flame arrest, pressure regulation, pilot valves	Not required; the entire chain is eliminated
Routine Maintenance Items	Filter elements, de-liquefaction, draining, pilot valves, gas leak checks	Energy-storage health, hydraulic oil, accumulator pre-charge
Energy for a Single Shutdown	Wellhead gas + accumulator	Electric storage + hydraulic accumulator
Testability	Requires production shutdown for action testing	PST verification without production shutdown
Emissions	Natural gas blown down, requiring venting	No gas blowdown
Functional Extensibility	Limited by pneumatic components	Parameterised curves, remote diagnostics, data upload
Wear and Service Life	Pilot valves act frequently, seals age readily	Electric control has no continuous gas consumption and a long service life
Initial Investment	Low	Higher, but with an exceptionally long life cycle and maintenance-free operation

4.7 Origin of Maintenance-Free Operation and Long Service Life

"Maintenance-free" does not mean zero maintenance; it means shifting maintenance from "frequent and experience-dependent" to "minimal and monitorable". The electro-

hydraulic panel eliminates the gas-line filter elements, liquid separator, drain valves and rows of pilot valves, so draining, element replacement and valve cleaning are no longer needed in routine service (only return-oil filtration remains on the hydraulic side); the energy-storage unit is managed by the energy-storage device or a capacitor balancing circuit, and the hydraulic system is fully sealed with monitorable oil. Only three inspection items remain: energy-storage health, hydraulic oil cleanliness and accumulator pre-charge pressure.

Long service life comes from two design orientations: first, the electric control device acts only during valve opening, valve closing and PST, with no continuous gas consumption or frequent pilot action; second, shutdown uses closed-loop control of torque and position, so valve seating impact is small and the valve seat and seals wear slowly. This advantage is especially marked for frequently operated wells that actuate many times a day.

4.8 Complete Unit and Factory Verification

Figure 8 below shows the complete electro-hydraulic control panel. The front of the cabinet is an explosion-proof control box integrating buttons, indicator lights, local/remote switchover and emergency stop; behind the cabinet are the vertical accumulator bottle bank and the stainless steel hydraulic oil tank, on the side are the motor-pump unit and high-pressure hoses, and the level gauge and pressure gauges are positioned for easy observation.



Figure 8 Complete electro-hydraulic control panel (explosion-proof control box, accumulator bank, motor-pump unit and stainless steel oil tank)

Five verifications are completed before shipment: hydraulic strength and gas tightness, dual-branch action, loaded shutdown on stored energy, PST action and reset, and point-to-point communication with central control. The stored-energy shutdown test is performed with external power disconnected, recording the number of shutdowns, time and torque curves as part of the delivery documentation.

4.9 Applicable Conditions and Limits

The electro-hydraulic panel requires normal power supply, or an independent photovoltaic plus energy-storage supply scheme; storage capacity is configured on the basis of "completing N shutdowns after power loss and holding for the specified time". In severe cold regions (below −40 ° C), low-temperature capacitor performance and cabinet tracing

must be considered; in sour-gas and offshore environments, the corrosion-protection class of electrical equipment must be upgraded, and hazardous-area classification determines the explosion-proof form.

For extremely remote well sites with neither a reliable power supply nor a requirement for long-term unpowered operation, the gas-over-oil solution retains a cost advantage; for well sites with power or the possibility of photovoltaics and requiring low maintenance and intelligence, the electro-hydraulic solution has a lower overall cost. The two are not substitutes but divide the work according to site conditions.

5 Common Safety Design

5.1 Interlock Protection List

All three routes share the same interlock list and action principles: except for low gas source pressure, which is "alarm followed by delayed shutdown", any trigger executes the full shutdown sequence; there is no half-measure protection of "alarm only, no action". The only difference is whether the actuating elements are pneumatically or electrically/hydraulically driven.

Table 6 List of safety interlock protection functions

No.	Protection Function	Triggering Element	Actuated Object
1	Local Emergency Shutdown (ESD)	Explosion-proof emergency stop button	SCSSV, MSSV, WSSV
2	Remote Emergency Shutdown (ESD)	Dry contact from DCS or RTU	SCSSV, MSSV, WSSV
3	Line High-Pressure Overpressure	High-pressure pilot valve / pressure transmitter	SCSSV, MSSV, WSSV
4	Line Low-Pressure Underpressure	Low-pressure pilot valve / pressure transmitter	SCSSV, MSSV, WSSV
5	Fire Protection	Fusible plug (71 ° C / 100 ° C) or fire and gas signal	SCSSV, MSSV, WSSV
6	Combustible Gas Excess	External detector dry contact	SCSSV, MSSV, WSSV
7	Hydrogen Sulphide Excess	External detector dry contact	SCSSV, MSSV, WSSV
8	Low Gas Source Pressure	Pilot pressure switch (gas-over-oil type)	Alarm, shutdown after delay
9	Low Control Pressure	Hydraulic / energy-storage pressure switch	Corresponding actuated object alarms and shuts down
10	Abnormal Valve Position	Valve position feedback switch	Alarm and upload

Note: Item 8, "low gas source pressure", applies only to the gas-over-oil type; the electro-hydraulic type has no gas source, and the corresponding monitored items are the charge level of the energy-storage unit and the hydraulic pressure.

5.2 Interlock Architecture

As shown in Figure 9 below, trigger signals enter the logic unit via hardwiring, and the logic unit drives three channels: the SCSSV, the surface valves and alarm upload. The three channels are separated in logic and power supply: failure of alarm or upload does not affect shutdown, and shutdown action is not delayed by communication interruption. The electro-

hydraulic type adds two inputs—energy-storage status and actuator diagnostics—to determine "whether shutdown capability is intact".

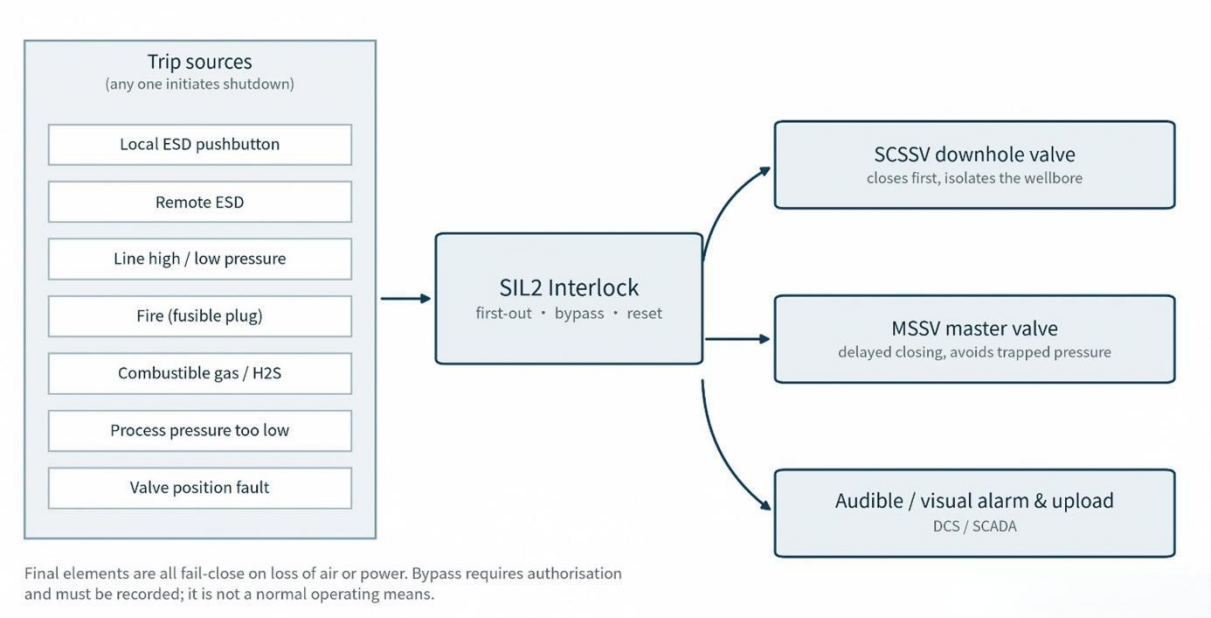


Figure 9 Safety interlock architecture: triggers, logic unit and actuating elements

5.3 First-Out, Bypass and Access Authority

When multiple conditions trigger simultaneously, the logic unit records only the executed cause, with subsequent alarms as consequences and not masking the origin. Bypass, where required, is used for commissioning and maintenance and must be operated by key or password, with a time limit set, bypass status permanently displayed on screen and written into the log; no interlock may be in bypass during production.

Inhibition is riskier than bypass and is permitted only briefly after confirming detector failure and adopting alternative monitoring measures. Both operations must be performed by authorised personnel, with the reason and restoration time stated in the shift-handover record.

6 Main Technical Parameters

6.1 Gas-over-Oil Control Panel

The gas-over-oil type is divided into pipeline-gas and nitrogen-cylinder configurations according to gas source, with identical downstream circuits. The table below gives general parameters; differences between the two gas-source sections are given in Table 2.

Table 7 Main technical parameters of the gas-over-oil control panel

Item	Parameters and Description
Product Series	DM-WHCP gas-over-oil type (P: pipeline gas source / N: nitrogen cylinder gas source)
Number of Wells Controlled	1 / 2 / 3 / 4 / 6 wells, extendable for cluster wells
Gas Source	Pipeline gas: wellhead natural gas; nitrogen cylinder: high-pressure nitrogen cylinder bank (two banks switchable)
Pilot Gas Source Pressure	0.4 – 0.7 MPa, adjustable
Gas Quality Requirement	Pipeline gas: 5 – 10 μm filtration, de-liquefaction and flame arrest; nitrogen: dry, clean gas
SCSSV Hydraulic Output	Up to 69 MPa (10,000 psi), determined by valve type and well depth
Surface Safety Valve Actuation	Pneumatic, 0.4 – 0.7 MPa
Shutdown Mode	Sequential shutdown / controllable throttled soft closing / two-stage blowdown
Shutdown Time	SCSSV ≤2 s (rapid mode ≤1 s); surface valves 5 – 15 s, set according to valve type
Safety Integrity Level	SIL2 (IEC 61508)
Explosion-Proof Rating	Ex d IIC T5 Gb; optional Ex d IIB T5
Ingress Protection Rating	IP67
Ambient / Medium Temperature	−40 to +60 °C / −20 to +80 °C (customisable for high temperature)
Cabinet and Piping	316L stainless steel cabinet 3 mm; 316L seamless tubing, 316SS / 4130 valve bodies
Accumulator	Bladder type, nitrogen pre-charged, capacity sized on the number of well shutdowns
Signal Output	4 – 20 mA, passive dry contacts, valve position feedback; optional RS485
Applicable Standards	API 6A (valves and materials), NACE MR0175/ISO 15156, IEC 61508, GB 3836

6.2 Electro-Hydraulic Control Panel

The electro-hydraulic type eliminates the gas-source section and adds parameters for power supply, energy storage and electric drive. The table below gives the main parameters of the complete unit; storage capacity and actuator torque are configured per project.

Table 8 Main technical parameters of the electro-hydraulic control panel

Item	Parameters and Description
Product Series	DM-WHCP electro-hydraulic type (E series)
Control Objects	WSSV (electric actuator); SCSSV, MSSV (hydraulic)
Gas Source Required	No
Power Supply	220 V AC, 24/48 V DC; optional photovoltaic + battery
Energy Storage Form	Wide-temperature battery pack or supercapacitor module, sized on the number of shutdowns
Emergency Shutdown Capability	Completes N loaded shutdowns after power loss (N determined per project, typically ≥ 1)
Electric Control Device	Permanent magnet brushless DC, closed-loop position/torque control, adjustable opening/closing time
Hydraulic Output	Up to 69 MPa (as required); hydraulic power unit flow configured by number of circuits
Hydraulic Power Unit	Single/dual motor-pump set + stainless steel oil tank + bladder accumulator + pressure/level monitoring
Control Core	SIL2 safety controller + explosion-proof operating buttons + event log
Test Function	Partial-stroke test (PST), verification without production shutdown
Communication	4–20 mA, passive dry contacts, Modbus 485/RTU/TCP (optional), 4G
Explosion-Proof / Ingress Protection	Ex d IIC T5 Gb; IP67
Ambient Temperature	−40 to +70 °C (electric tracing required below −40 °C)
Cabinet Material	316L stainless steel, 3 mm plate
Applicable Standards	API 6A (valves and materials), IEC 61508, GB 3836, NACE MR0175/ISO 15156

7 Materials, Corrosion Protection and Certification

7.1 Material Configuration

Materials are selected on the basis of medium, pressure class and environment. The standard configuration is primarily 316L stainless steel, balancing corrosion resistance and weldability; sour-service conditions use materials resistant to sulphide stress cracking per NACE MR0175 with controlled hardness. The electro-hydraulic type additionally requires corrosion protection and sealing for the battery compartment, cables and electrical components.

Table 9 Material configuration of main parts

Part	Material / Configuration	Description
Cabinet and Door Panel	316L stainless steel, 3 mm	Overall pickling and passivation for long-term outdoor use
Process and Instrument Piping	316L seamless stainless steel tubing	Instrument and power lines routed separately to reduce interference
High-Pressure Hydraulic Piping	316L cold-drawn precision tubing	RTJ flanges or high-pressure compression fittings at the high-pressure section
Valve Bodies	316SS / 4130 forgings	Sour-resistant material, hardness per NACE MR0175
Seals	Fluorocarbon rubber / PTFE	Perfluoroelastomer optional for high-sulphur or low-temperature service
Fasteners	Stainless steel A4-70	Anti-galling, easy field assembly and disassembly
Skid Base	Powder-coated or hot-dip galvanised carbon steel	Orange-red marking, with lifting lugs and grounding terminal
Electro-Hydraulic Specific	Isolated battery compartment, flame-retardant cables, corrosion-resistant glands	Independent protection for battery and electrical components

7.2 Corrosion Protection and Environmental Protection

Pickling and passivation are completed before final assembly, with special attention to welds and heat-affected zones to prevent pitting from initiating at the weld. A rain and sun canopy can be added outdoors to lower cabinet temperature; offshore and nearshore environments use a heavy-duty corrosion-protection coating system, with the number of coats increased according to the salt-spray class.

Cold regions are equipped with heat tracing and dehumidification to prevent instrument tubing from icing and hydrate formation; the electro-hydraulic type requires insulation and

heating for the battery compartment to ensure discharge capability at low temperature. In high-humidity areas, anti-condensation heaters are fitted to keep the cabinet temperature above the dew point.

7.3 Certification and Factory Testing

The panel is designed and manufactured per API 6A (valves and materials), NACE MR0175/ISO 15156, IEC 61508 and GB 3836, and is delivered with material certificates, explosion-proof certificates, SIL assessment or certification documents (per project), pressure test reports and factory inspection reports. Pressure-containing parts are traceable to heat numbers, and key valves and actuators retain original manufacturer certificates.

Factory tests cover hydrostatic strength, gas tightness, hydraulic circuits, interlock action, sequence setting, valve position and signal verification; the electro-hydraulic type additionally undergoes power-off stored-energy shutdown and PST verification. All test records are delivered with the unit as the baseline for site acceptance and periodic verification.

8 Skid-Mounted Configurations and Optional Features

8.1 Three Skid-Mounted Configurations

The wall-mounted single-well panel is compact with a small footprint, suited to single-well sites with limited space; the integrated skid-mount combines the control cabinet, gas source or hydraulic power unit, cylinder bank and manifold on a single skid, positioned in one lift, with only energy interfaces, hydraulic lines and signal cables to be connected on site; the multi-well cluster skid arranges the control cabinet and energy-storage/cylinder bank in separate zones for centralised management of multiple wells.

For the electro-hydraulic skid, the key point is the arrangement of the power supply: the battery compartment is separated from the hydraulic power unit to avoid oil contamination and high-temperature effects; photovoltaic panels can be folded and fixed above the skid and stowed during transport. The skid interfaces of all three routes are standardised, facilitating phased expansion or retrofit replacement at the same well site.



Figure 10 Multi-well cluster control panel skid unit

8.2 Optional Features

Optional features are selected according to risk and operating mode; indiscriminate selection of all options is not recommended. Common options are listed below, of which solar

power supplies only the monitoring and communication loads and does not enter the safety circuit.

Table 10 Common optional features

Optional Feature	Applicable Scenario	Description
High-Pressure Nitrogen Backup Cylinder Bank	Well sites at high risk of gas-source interruption	One active, one standby, sustaining multiple shutdowns after gas loss
Dual Accumulator Sets	High-yield wells, multiple wells sharing a hydraulic circuit	One active, one standby, switchable for online servicing
Dual Energy-Storage Units	Unattended sites requiring high availability	Main/standby switchover, servicing one side without production shutdown
Photovoltaic + Energy-Storage Supply	Well sites without grid power (electro-hydraulic type)	Supplies monitoring and communication; emergency shutdown is completed by the local energy storage
Explosion-Proof Touch Screen Upgrade	Where trends and event logs are required	Pressure curves and playback of operation records
RTU / Wireless Remote Transmission	Unattended well sites	4G/5G or optical fibre connection to central control
Hydrogen Sulphide and Combustible Gas Detectors	Sour wells, centrally arranged well sites	Dry contacts connected into the interlock
Cabinet Heat Tracing and Dehumidification	Cold and high-humidity regions	Prevention of freeze blockage and condensation
Offshore Heavy-Duty Corrosion Coating	Offshore platforms, nearshore wells	Longer service life in salt-spray environments

9 Installation, Commissioning and O&M

9.1 Installation Requirements

The panel is installed to the side of the christmas tree, on the upwind side of the prevailing wind, away from blowout outlets, pressure-relief points and open-flame work areas, and maintains the code-required safety distance from the wellhead. The skid base is fixed on a level foundation, and cabinet verticality and grounding resistance meet site requirements.

The gas-over-oil type is connected to the gas tap, hydraulic lines and signal cables; the nitrogen cylinder type additionally requires securing the cylinder bank, connecting pressure regulators and checking cylinder pressure; the electro-hydraulic type requires verification of power capacity, phase sequence and grounding, with insulation and battery status confirmed before first energisation of the energy-storage device. All interfaces are leak-tested point by point and phase-checked before gas or power is admitted.

9.2 Commissioning and Acceptance

Factory commissioning covers pressure calibration, interlock action, shutdown sequence, soft-close time, valve position feedback and the communication point list, forming the FAT record. Site commissioning is carried out after gas tightness or electrical safety is qualified, completing in sequence energy pressure build-up, single-circuit action, interlock linkage, point-to-point verification with central control, and finally one complete shutdown test.

The electro-hydraulic type adds two items: the power-off stored-energy shutdown test, recording the number and time of shutdowns; and the PST test, confirming the valve can move and return accurately to position. On completion of commissioning, set values, shutdown times, bypass records and the point list are written into the report and marked on the nameplate and module panels.

9.3 Operation and Maintenance

The gas-over-oil type requires daily attention to pilot pressure, hydraulic oil level, filter differential pressure and leakage, with draining performed per shift; the nitrogen cylinder type focuses on cylinder pressure and changeover status; the electro-hydraulic type focuses on energy-storage health, hydraulic oil cleanliness, accumulator pre-charge pressure and actuator diagnostic information.

Periodic maintenance follows set intervals: filter element replacement, fusible plug replacement, accumulator verification, pilot valve or actuator action testing, interlock linkage, and SIL periodic verification. The electro-hydraulic type's battery pack undergoes capacity verification per the manufacturer's recommendation, and the hydraulic oil is replaced based on cleanliness test results.

9.4 Prohibited Practices

The following practices directly compromise safety functions and should be enforced as site prohibitions, emphasised repeatedly in training and shift handovers.

Table 11 Prohibited practices during installation and operation

Prohibited Practice	Consequence
Short-circuiting or removing an interlock circuit	Trigger condition is masked, preventing shutdown on abnormality
Operating above the nameplate set pressure	Overpressure of valves and piping, possible leakage or rupture
Using non-sour-resistant valves in sour wells	Sulphide stress cracking and sudden valve body failure
Disassembling piping or modules under pressure	High-pressure gas or hydraulic oil spray causing injury
Keeping a bypass engaged for extended periods	Protection exists only in name
Not checking energy storage after power loss on the electro-hydraulic type	Loaded shutdown cannot be completed on power loss
Changing set values without authorisation and without record	Sequence mismatch and no traceability of incidents

10 Application Scenarios

The three routes each emphasise different well conditions. Configuration varies with the well condition, but the core logic is consistent: isolate the wellbore first, then shut the surface valves, with a controllable and verifiable process.

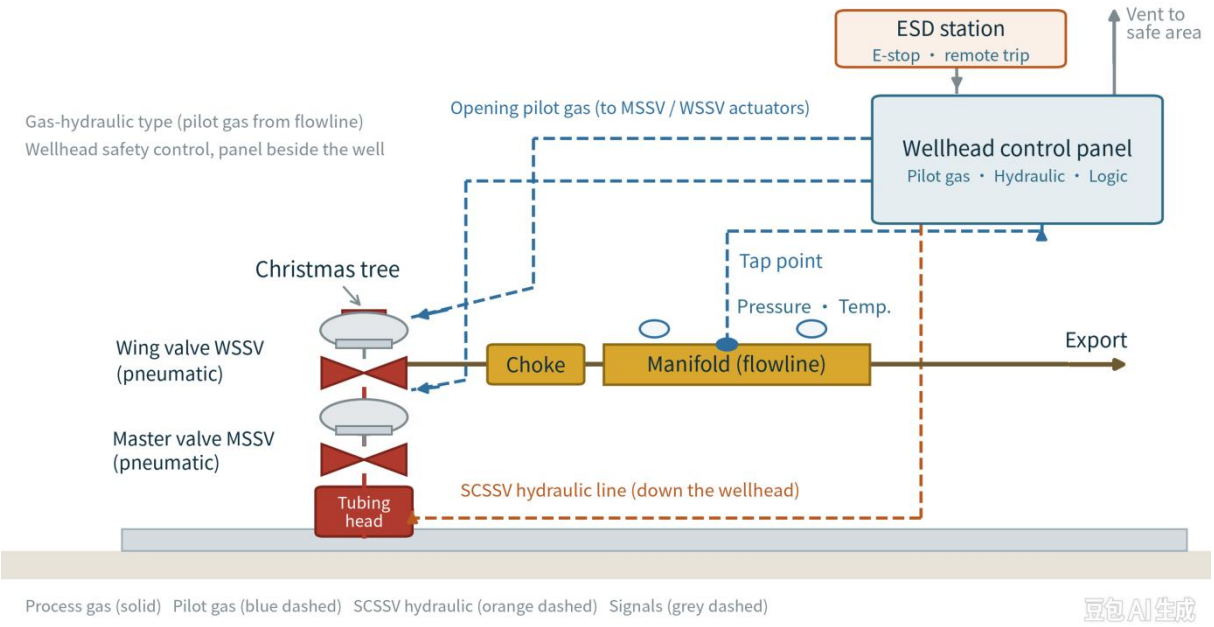


Figure 11 Gas-over-oil wellhead safety control system configuration (drawn to the actual field wellhead arrangement)

The figure above is drawn to the actual arrangement of the field wellhead installation and can be read along four paths: the solid brown line is the process gas flow—natural gas passes from the tubing head through the master valve MSSV, wing valve WSSV and choke valve into the yellow manifold, is metered and then exported; the blue dashed line is the pilot gas, tapped from the manifold downstream of the wing valve and upstream of the choke, regulated in the control panel and returned to the pneumatic diaphragms of the MSSV and WSSV to establish the valve-opening pressure; the orange dashed line is the SCSSV hydraulic control line, running from the control panel down along the wellhead to the subsurface safety valve, providing opening pressure and closing on depressurisation; the grey dashed line carries signals and commands, connecting the ESD station, venting and the internal logic of the panel. The three medium paths are mutually independent, and on any pressure abnormality or

command trigger the panel depresses and shuts down in the order "subsurface first, then surface".

The difference from common schematics is that the pilot gas tap must be located upstream of the choke valve; otherwise pressure after throttling is insufficient and cannot reflect the true wellhead pressure before shut-in. The actuators of the surface safety valves are pneumatic diaphragms that close on loss of gas, requiring no separate spring-return mechanism. The control panel is installed to one side of the wellhead platform, with the hydraulic and pilot lines led out from the bottom of the panel to avoid piping crossing the manifold.



Figure 12 Field view: christmas tree, yellow manifold, pneumatic diaphragm actuators and local instrumentation

10.1 Conventional Production Gas Wells

With a stable gas source and controllable gas quality, the wellhead gas self-sourcing type is preferred. Single- or dual-well configuration is sufficient, with emphasis on tap-point selection, winter insulation and drain management.

10.2 Low-Yield, Shut-in and Well-Testing/Workover Wells

When the wellhead has no gas or insufficient pressure, pipeline gas tapping fails, whereas the nitrogen cylinder type can build pressure under any well condition; the cylinder bank is transported with the skid, suited to well testing, workover and temporary production.

10.3 Unattended and Intelligent Well Sites

The electro-hydraulic type, combined with photovoltaics and wireless remote transmission, relies mainly on remote monitoring in daily operation; PST and self-diagnostics make "unattended" mean not merely that no one is present, but that status can be judged and capability verified.

10.4 Sour Gas Fields

The gas-over-oil type requires sour-resistant materials per NACE MR0175 and enhanced de-liquefaction and draining; the electro-hydraulic type eliminates the gas chain, avoiding corrosion of pilot elements by sour gas at the source and, combined with corrosion-resistant electrical configuration, is more suitable.

10.5 Gas Storage Injection/Withdrawal Wells

Pressure and flow vary widely, so controllable throttled soft closing is recommended and accumulator or energy-storage capacity should be verified against the maximum injection/withdrawal condition; parameters may be set separately for the injection and withdrawal periods, with changeovers recorded in the commissioning log.

10.6 Offshore Platforms and Nearshore Wells

Space is limited, making wall-mounted or compact skid-mounted configurations suitable, with offshore heavy-duty corrosion protection; the electro-hydraulic type produces no gas blowdown, which is advantageous on enclosed platforms. Lifting and fixing must meet platform structural requirements.

11 Quality Assurance and Technical Services

11.1 Quality Assurance

The panel is subject to full-process control from design and procurement through integration and testing: key valves and actuators are traced by brand and model, pressure-containing parts retain material certificates, assembly undergoes process inspection, and the complete unit undergoes FAT before shipment. Documentation supplied includes general assembly drawings, piping diagrams, electrical schematics, operation and maintenance manuals, a certificate compilation and a spare parts list.

The warranty period of the complete unit is as stipulated in the contract; failures due to manufacturing quality during the warranty period are repaired or replaced free of charge. Consumables such as fusible plugs, filter elements and seals are excluded from warranty, but long-term supply is guaranteed.

11.2 Retrofit of Existing Wellheads

For older wells with existing gas-over-oil panels, a retrofit approach of "retaining the hydraulics and replacing the pneumatic control" can be adopted: replace the original pneumatic WSSV circuit with a stored-energy multifunctional electric emergency shutdown device and the original pneumatic booster pump with an electric hydraulic pump set, while retaining the accumulator, hydraulic valve package and SCSSV/MSSV circuits and eliminating the entire gas-treatment chain. After retrofit, independence from wellhead gas quality is achieved, maintenance items are significantly reduced, and PST and remote diagnostics are available.

The retrofit follows a "test first, switch over later" approach: the new device is commissioned independently and monitored in parallel with the original system, and only after confirming that actions and signals are consistent is the original pneumatic circuit removed. A single-well retrofit can generally be completed within a planned shut-in window without affecting production from adjacent wells.

11.3 Technical Service Scope

Services cover pre-sales schemes, supply, site commissioning, training, spare parts and periodic verification, and can be combined to suit the project.

Table 12 Technical service scope

Service Stage	Main Scope
Pre-Sales Support	Condition calculation, scheme comparison, sequence design, bid technical documents and deviation lists
System Supply	Complete skid-mounted unit, associated piping and valve packages, spare parts kit, drawings, manuals and certificates
Site Service	Installation supervision, pressure build-up and interlock commissioning, point-to-point verification with DCS/RTU
Retrofit Service	Replacement of existing pneumatic circuits, parallel commissioning and changeover
Training	Training in operation, inspection, emergency response and reset procedures
After-Sales & Spare Parts	Periodic follow-up, spare parts supply, replacement of consumables, SIL periodic verification

There is no room for "good enough" in wellhead safety. The value of the three routes lies not in stacking components but in linking energy, logic, actuation and records into a verifiable chain: quiet in normal times, acting decisively when an abnormality occurs, and able to explain afterwards why it acted. DAUME is willing to explain this chain in detail and to configure it to suit the site conditions.

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Draw gas from the well to safeguard the well; only by not being bound to the gas source lies the lasting solution.

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