CHH100 Series

Medium Voltage Drive

Innovation, Value, Teamwork

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CHH100 Series Medium Voltage Drive

As a new generation of medium voltage variable frequency speed regulating devices developed and produced by INVT, CHH100 series medium voltage drive adopts a mature power unit tandem technique and therefore have stable and reliable work. The control system is designed with multiprocessing control architecture and use DSP + FPGA.

So its control accuracy and response speed are improved significantly. The output side uses the phase-shifting multiple pulse width modulation (PWM) technology, so it has an extremely low harmonic content and may be adapted to on-site motors without output filter. CHH100 series medium voltage drive consist of strictly selected parts and are therefore reliable in quality. The human-machine interface is friendly and convenient for operations. Since their launch on the market, CHH100 series medium voltage drive have been extensively used in multiple industries like electric power, metallurgy, mines, cement and petrochemical industry, contributed a lot to the energy saving, consumption reduction and process improvement of enterprises and well accepted by customers.

Applications of CHH100 series medium voltage drive

Thermal Power Generation
Dedusting fans, slurry pumps, boiler blowers, draft fans of boilers, primary air fans of boilers, circulating water pumps, condensation pumps and feed pumps;

Mine
Main drainage pumps, main exhaust fans, medium pumps, water-isolated slurry pumps at sand pump stations, ore crushers, mine ventilators, air compressors, belt conveyors and excavators;

Metallurgy
Dedusting fans, blast-furnace blowers, cold circulating pumps, slag flushing pumps, primary air fans of inverter, secondary air fans of inverter and refining dedusting fans;

Petrochemical Industry
Main pipeline pumps, pumping units, molecular sieve adsorption pumps, medium pumps, extruders, circulating pumps, water injection pumps, slurry pumps, boiler feed pumps, electric submersible pumps, brine pumps, draft fans and descaling pumps;

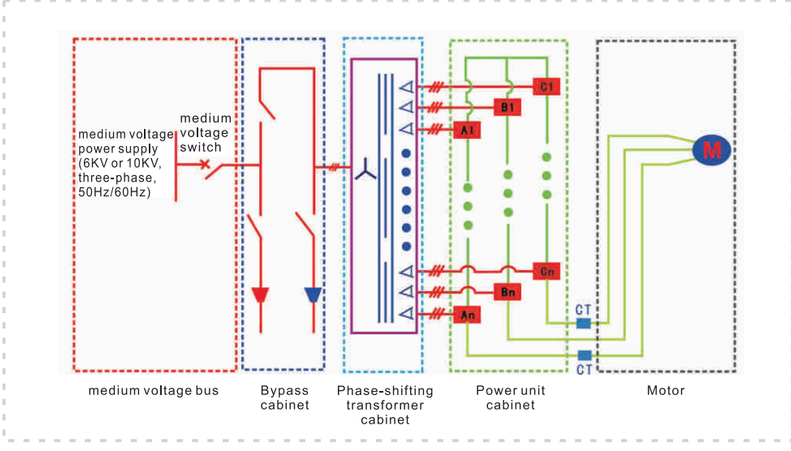
Chemical Industry
Air compressors, circulating pumps, desulphurization fans, air blowers, ammonia compressors, CO2 compressors, nitrogen compressors, gas fans and other medium compressors;

Building Materials
Kiln draft fans, forced draft fans, cooler suction fans, high-temperature fans, raw material mills, air supply fans of kilns, blowers of coolers, fans of separators and main dedusting fans;

Municipal Works
Clean water pumps, sewage pumps, purifying pumps, mixed-flow pumps and oxygen blowers, etc.;

Other Industries
The fans and water pumps, etc. used in the industries such as pharmacy, paper making, and wind turbine, etc.

Principle of speed regulation of CHH100 series medium voltage drive



Control principle of CHH100 medium voltage drive

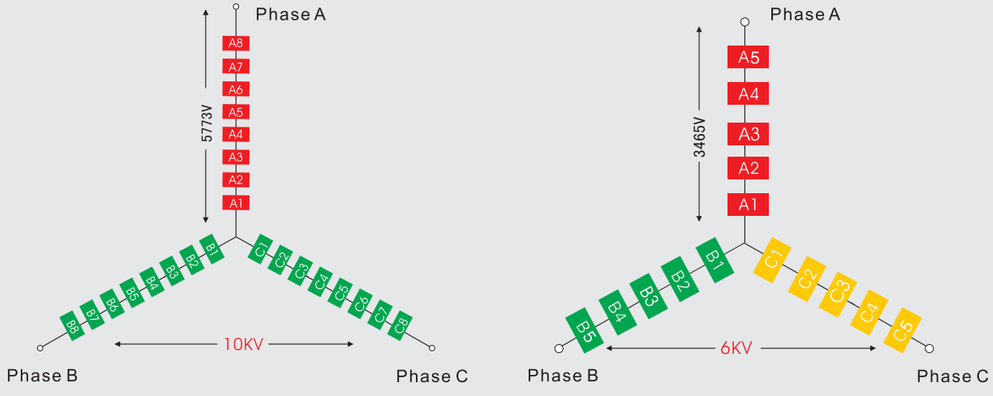
(1)Input Terminal: Each power unit of a medium voltage drive is electrified by a secondary winding of a phase-shifting transformer. Different secondary windings have a certain phase difference (20°for 3kV, 12°for 6kV and 7.5°for 10kV), thus eliminating the harmonic current generated by the rectification part of the power units, alleviating the interference of the medium voltage drive in the line side and improving the power factor of the system.

(2)Output Terminal: It has an electric structure with serial power units, adopts the multi-level phase-shifting SPWM technology and realizes (2n+1) multi-level voltage output, namely 7-level (3kV), 11-level (6kV) and 17-level (10kV). As a result, the harmonic content of the voltage at the output end is reduced and the waveform of the output voltage approximates to a sinusoidal waveform.

(3)The control system adopts the DSP and FPGA digital processing technologies. Consequently, the extremely high processing speed enhances the real-time property of system control and improves system performance and control accuracy.

(4)The control system and the medium voltage part employ optical fiber isolation technology, which improves the anti-interference capability and reliability of the system.

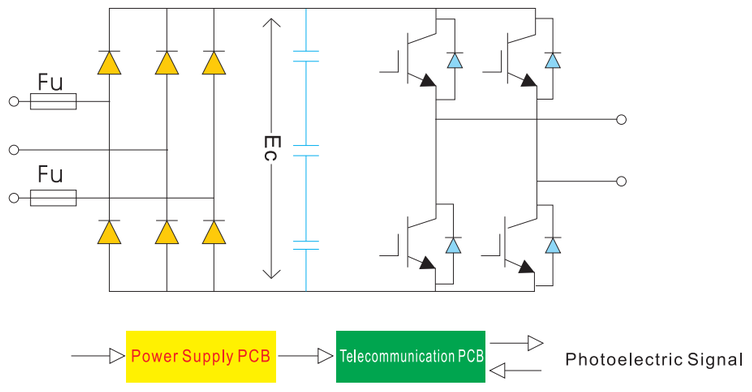
● Converter Circuit Topology



(1)Three-level power unit phase shifting superposition, five-level power unit phase shifting superposition and eight-level power unit phase shifting superposition are used for 3kV, 6kV and 10kV respectively; the power units are subject to modular design; and the modules have a bypass function, making the medium voltage drive more stable and reliable.

(2)The multi-level power units adopt the phase-shifting technology, thus ensuring an almost perfect sinusoidal waveform.

● Principle Of Power Units



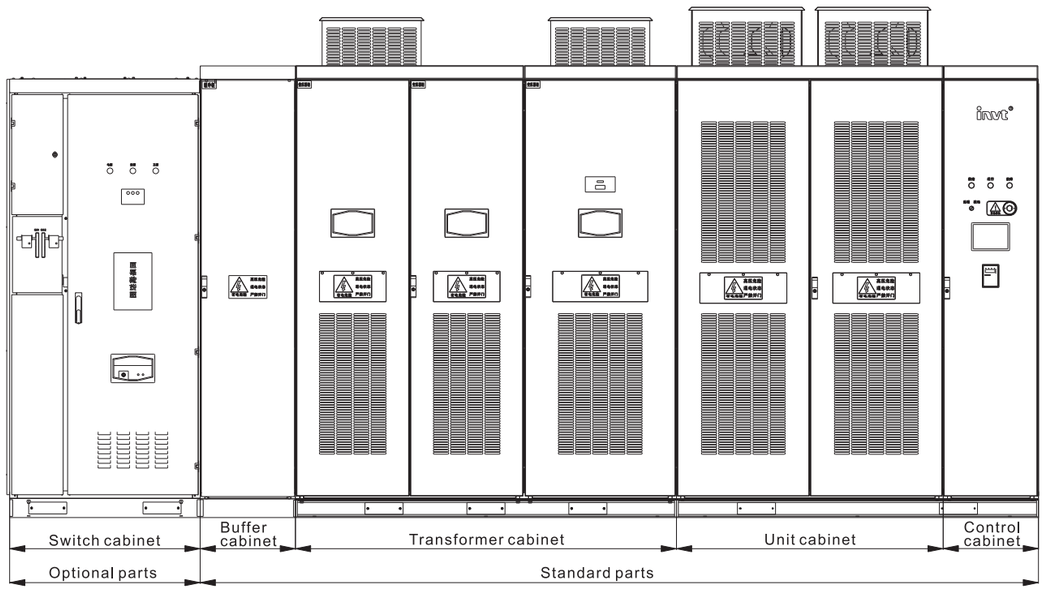
(1)The low-voltage input (690V) on the secondary side of the rectifier transformer reaches the power units through fuses. The system adopts 6n pulse full-bridge rectification, namely 18-pulse (3kV), 30-pulse (6kV) and 48-pulse (10kV). The direct current obtained will first go through a capacitor filter and be then turned into a PWM modulated alternating current by an H-bridge converter for output.

(2)The power units have consistent electric performance and are therefore interchangeable.

(3)If one power unit fails, it can bypass automatically and the medium voltage drive can operate continually. Consequently, the losses caused by shutdown are avoided and the reliability of the medium voltage drive is improved.

Composition of CHH100 series medium voltage drive

A CHH100 series medium voltage drive consists essentially of a switch cabinet (optional), a buffer cabinet (if the power is large), a transformer cabinet, a power unit cabinet and a control cabinet.



Transformer Cabinet

The transformer cabinet holds a dry type medium voltage phase-shifting isolation transformer. On the primary side of the phase-shifting isolation transformer, the current waveform after the superposition of the converted currents on the secondary side is very close to a sinusoidal waveform. Consequently, the harmonic interference in the power grid is very small and fully meets the requirements of all the related national standards (such as GB/T14549-93) and international standards (such as IEEE 519-1992).Meanwhile, if the medium voltage drive fails, its temperature monitoring and controlling device will feed back the information to the control cabinet immediately, which ensures reliable operation for the medium voltage drive.

Power Unit Cabinet

The power unit cabinet is a core part of the main power circuit of a medium voltage drive. It consists of multiple completely similar power units.
The output voltages of the power units undergo a series connection and superposition, and are then changed into a three-phase voltage output to a medium voltage motor. An optimized PWM control technology with a proprietary intellectual property rights is used. Consequently, the voltage waveform output to the medium voltage motor is very close to a sinusoidal waveform; both the harmonic content and the dv/dt value are small; the voltage obtained may be directly output to an ordinary asynchronous motor while no extra filter is used; and there is no requirement for the length of the cable between the medium voltage drive to the motor.

Control Cabinet

The control cabinet is the core of the entire speed regulation system of the medium voltage drive. It uses the DSP and FPGA digital processing technologies that can improve the control accuracies and response speeds of devices. It acquires the voltage and current analog quantities and switching values of a system and executes logic operation and processing according to the local or remote operations and settings by a user. It controls the motions of power units and drives a motor for operation.

Switch Cabinet

The switch cabinet is an optional device. If a user needs to switch between a power frequency state and a variable frequency state, an automatic switch cabinet, a manual bypass cabinet or an isolation switch may be selected; otherwise, the user may not select this optional device.
On the one hand, a switch cabinet provides an isolation switch between a phase-shifting transformer cabinet and a power distribution system on the power distribution side; on the other hand, it provides the function of switching between a power frequency state and a variable frequency state and related supporting electric protection measures.

Buffer Cabinet

A medium voltage drive has a large power, both the exciting current obtained at the moment the phase-shifting transformer in the main circuit is electrified and the charging current of the DC capacitor in the unit main circuit are large, which makes the quick break protection device of the power cabinet of higher level. Thus, buffer cabinets are standard accessories for CHH100 series medium voltage drive with a voltage of 6kV (1800kW～4000kW) or 10kV (3150kW～7100kW).
Each buffer cabinet is provided with a starting resistor that can reduce the impulse current toward the power grid during electrification greatly. After start, make the starting resistor shorted through a vacuum contactor following the set program.

Internal structure of CHH100 series medium voltage drive

Below is a picture of an 10kV (630kW) medium voltage drive consisting of a transformer cabinet, a power unit cabinet and a control cabinet.

The control cabinet is the core of a speed regulation system of the medium voltage drive.
It executes logic processing and computation, controls the motions of the power units and drives the motor for operation.

There is a dry type medium voltage phase -shifting isolation transformer in the transformer cabinet. It can significantly improve the voltage waveform on the line side, effectively restrain harmonics and greatly improve the operation reliability of the medium voltage drive.

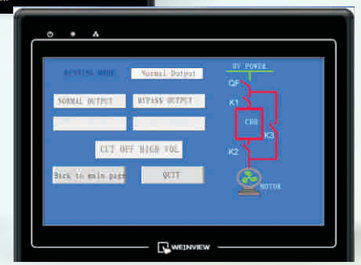
The power unit cabinet consists of multiple completely same power units. With functions like rectification, filtering and PWM onversion, it is a core component of a medium voltage drive. The IGBT can be tolerated 1700 V

The dry-type medium voltage isolation phase-shifting transformer is installed in the transformer cabinet, which can greatly improve the voltage waveform on grid side, efficiently suppress the harmonics and markedly enhance the reliability of the frequency inverter.
The function unit cabinet composed of multiple same function units is used to realize rectification, filtration and PWM inversion mainly. As the core component of the frequency inverter, it adopts 1700V high IGBT as its power device.
The control cabinet, as the core of the medium voltage frequency conversion and speed adjusting system, is to perform the logical processing and calculation, control the operation of various power units and drive the running of the motor.

Control interfaces of CHH100 series medium voltage drive

Main Parameter Setting Interface

Main interface for running statement monitoring



Main interface for displaying the current operation mode

Main Interface of Start /Stop Function Setup

Main Interface of Operation Log

Main interface of Storage and Display Setup

Performance indexes of CHH100 series medium voltage drive

Input	Voltage/frequency of the main circuit	Three-phase 3kV, 6kV, 10Kv ; 50Hz/60Hz
	Control circuit	Single-phase 220V
	Permissible fluctuation	Voltage: + 10%, – 15%; voltage unbalance rate: <3%; frequency: 50Hz/60Hz ±10%
	Input power factor	> 0.97 (with the rated load)
	Applicable motor power (kW)	185 ~ 4000(6kV) 220 ~ 7100(10kV)
Output	Rated capacity (kVA)	236 ~ 5000(6kV) 295 ~ 9000(10kV)
	Rated voltage (three-phase)	3kV, 6kV, 10kV
	Current overload capacity	120% of the rated current for 120s;150% of the rated current for 5s;instant protection for 200％ of the rated current
	Output frequency	0~120Hz
	Efficiency of the medium voltage drive	> 0.96 (with the rated load)
Operation Control Characteristics	Control characteristic	V/F control, multiple V/F curves for selection
	Control interfaces	Touch screen, keypad
	Highest frequency	120Hz
	Fundamental frequency	60Hz
	Frequency of starting	0~10Hz
	Frequency resolution	0.01Hz
	Acceleration/ deceleration time	0.1~3600s
	Frequency setup	Keypad, terminals, upper computer communication, multi-speed setup, PID, etc.
	Grade of protection	IP20, other grades of protection are customizable
Structure	Overall structure	Multi-cabinet type
	Cooling method	Forced air cooling by the fan at top
Signal input and output	On-off input	16-circuit digital input
	On-off output	8-circuit relay output
	Analog input	3-circuit analog input: AI1, AI2: 0～10V/0 ~ 20mA; AI3: -10V ~ 10V
	Analog output	4-circuit analog output: AO1, AO2: 0 ~ 10V; AO3, AO4: 0 ~ 10V/0 ~ 20mA
	High-speed pulse input	1-circuit input: input range: 0 ~ 50kHz
	High-speed pulse output	1-cricuit output: output range: 0 ~ 50kHz
Noise Level	<75 dB	
Protection	Input overvoltage, undervoltage and overcurrent protection of the medium voltage drive, output short circuit protection, overheat protection of the input transformer, DC overvoltage, undervoltage and overtemperature protection of power units, communication failure protection of power units, overvoltage and overcurrent stall protection of the medium voltage drive, fault protection of the control power supply, etc.	
Service Environment	Installation position: Indoor Ambient temperature: -10℃ ~ +40℃ Storage temperature: -40℃ ~ +70℃ Relative humidity: 5% ~ 95% (without condensation) Elevation: < 1000m (derated operation if the elevation is higher than 1000m)	
Safety Specification	The medium voltage drive should be reliably grounded; the metallic parts and shell grounding point that may be touched should have a resistance equal to or smaller than 0.1Ω and be able to bear the impacts by a short circuit current (larger than 40kA) calculated according to the corresponding switch; there should be a grounding symbol on the grounding point. Protective facilities against electric shocks (such as shielded enclosure) should be installed in the cabinets of each medium voltage drive.	

Technical advantage of CHH100 series medium voltage drive

(1)High Reliability

Thanks to their high integration and fully digital control systems, CHH100 medium voltage drive have great anti-interference capability.
With dual redundant power supply design for the control systems, CHH100 medium voltage drive have higher reliability.
CHH100 medium voltage drive have abundant power unit monitoring functions covering the temperatures of all power units and the voltages of all DC bus. They can make adjustments for systems in advance as per the monitored data to avoid faults.
CHH100 medium voltage drive have a power unit bypass function. After a power unit of a variable frequency speed regulation system fails, this function can bypass the failed power unit and make the medium voltage drive continue running.

(2) Powerful Functions

Each medium voltage drive has more than 300 function codes and can realize different settings for its starting characteristic and operation mode according to the site conditions;
Each medium voltage drive has a standard RS485 communication interface (adopting the standard Modbus communication protocol) and it can be connected with a DCS via the RS485 communication interface or through hard wiring;
medium voltage drive have abundant terminal functions that are programmable, ensuring excellent expandability of systems.

(3) Perfect Protection Functions

The power units of a medium voltage drive have 11 kinds of fault protection;
The electric part of a medium voltage drive does comprehensive detections for the output voltage, output current, input voltage and input current and has more than 20 kinds of super strong protection like overvoltage protection, overcurrent protection, undervoltage protection and temperature protection for both the motor and the power source of the medium voltage drive;
medium voltage drive can set constant values protected according to the site conditions. Furthermore, they have built-in lightning overcurrent protection devices and therefore have a better protection function for both equipment and systems.

(4) Comprehensive Parameter Records

medium voltage drive can detect and display multiple operation parameters (including the temperature of each module and the voltage of each bus), so they have functions of fault display, recording and self-diagnosis;
A medium voltage drive can upload all information to a DCS through its communication interface. In the case of any abnormality, the system will record the condition of the medium voltage drive comprehensively so that the related persons on site can solve the corresponding problems more accurately.

(5) Design with high efficiency and power factor and low harmonic

In the case of the rated load, a medium voltage drive has efficiency >96% and an input power factor equal to or higher than 0.96.
In the case of the rated load, the harmonic on the input side (the impact on the power grid) is lower than 2% and that on the output side (the impact on the motor) is lower than 2% too; a DSP control system optimizes the modulation waveform to ensure a perfect harmonic-free output waveform.

(6) Excellent energy-saving effect

Medium voltage drive have a function of energy-saving operation.
Under normal circumstances, the V/F value is normal. After a light-load operation is detected, a medium voltage drive can conduct automatic voltage modulation to ensure a better energy-saving effect.
There are multiple V/F curve designs for optimizing the output voltages corresponding to different loads.

(7) Design with the maximum voltage and current redundancy

Medium voltage drive use 1700V IGBTs and serial multi-level low-voltage power units and have a doubled voltage margin and high redundancy for the voltage safety design of power devices.
The current of each main power device doubles the margin, which ensures high reliability for systems.

(8) Processing technologies of system bypass and power unit bypass

Autobypass technology of power frequency and variable frequency: After a medium voltage drive fails, it can switch from a variable frequency state to a power frequency state automatically;
Autobypass technology of power units: A medium voltage drive is able to bypass a failed module within 200ms and takes long-term derated operation while waiting for a proper time for stop and maintenance.

(9) Automatic tracking of motor speed

The medium voltage drive adopt a motor speed tracking technology. When the bus of the main power source is electrified again after a power failure (within 10s), a medium voltage drive is able to track the motor speed and resume operation automatically and without any operations;
When switching from a power frequency state to a variable frequency state, a medium voltage drive does not need to stop but tracks the motor speed and realizes automatic operation to ensure quick switching.

(10) Great voltage fluctuation adaptability

Medium voltage drive are able to realize full-load outputswith a power grid voltage fluctuation range of ±10%;
In the case of a short-time power failure (30%) of the power grid, a medium voltage drive is able to take derated operation continually while providing no protection.

(11) The most effective electromagnetic interference solution

Viewed from the design of power unit modules, medium voltage drive have incoming and outgoing lines designed as per different current ranges and therefore have better anti-interference capability; viewed from structural design and electric design, medium voltage drive take comprehensive measures against electromagnetic interference to ensure their reliable operation most effectively.

Design standard of CHH100 series medium voltage drive

Q/INVT1000-2007	Enterprise Standard of Shenzhen INVT Electric Co., Ltd. for CHH100 Series medium voltage drive
IEC60632-1	Medium voltage motor starter
IEC60470	medium voltage alternating current contactors and contactor-based motor-starters
IEC60751	Industrial platinum resistance thermometer detector
IEC1000-4-2EMC	Anti-interference standard
IEC1000-4-3	EMC anti-interference standard
IEC1000-4-4	EMC anti-interference standard
IEC1000-4-5	EMC anti-interference standard
EN50082-2 Industry	EMC anti-interference standard
DL/T944-2006	Medium voltage drive used for the fans and pumps of thermal power plants (a standard of the electric power industry of the People's Republic of China)
GB/T10228	Specification and technical requirements for dry-type power transformers
GB/T14549	Quality of electric energy supply – Harmonics in public supply network
GB/T50150	Standard for hand-over test of electric equipment of electric equipment installation engineering

Model and instructions to model selection

CHH100 — 2000 — 06 — T U *

1 Product Series | 2 Power Range | 3 Voltage Class | 4 5 6 Management No.

Field	Symbol	Symbol Description	Example of Naming
Product Series	1	Product Series	CHH100 : Universal medium voltage drive
Power Range	2	Rated Power	2000: 2000kW
Voltage Class	3	Voltage Class	03: 3 kV 3A: 3.3 kV 06: 6kV 6A: 6.6 kV 10: 10 kV 11: 11 kV
Management No.	4	Type of motor	T: Synchronous Motor Y: Asynchronous Motor (default)
	5	Market management No.	U: Non–standard Machine S: Standard Machine (default)
	6	Extension Bit	Reserved

CHH100—10kV series

Model of Medium Voltage Drive	Motor Power (kW)	Rated Current (A)	Rated Capacity (kVA)	Power Units		Dimensions and Weight of the Medium Voltage Drive	
				Model	Qty.	Dimensions (W×D×H)	Weight (kg)
CHH100–0220–10	220	17	295	HU02	24	3500 × 1000 × 2690	2970
CHH100–0250–10	250	19	330				3070
CHH100–0280–10	280	21	360				3140
CHH100–0315–10	315	24	400				3200
CHH100–0355–10	355	27	450			3700 × 1000 × 2690	3295
CHH100–0400–10	400	30	500				3345
CHH100–0450–10	450	33	570				3405
CHH100–0500–10	500	37	630				3505
CHH100–0560–10	560	41	710				3575
CHH100–0630–10	630	46	800				3755
CHH100–0710–10	710	51	870	HU04F	24	4400 × 1200 × 2690	4350
CHH100–0800–10	800	57	980				4550
CHH100–0900–10	900	64	1100			4600 × 1200 × 2690	4885
CHH100–1000–10	1000	71	1200				5025
CHH100–1120–10	1120	79	1370				5245
CHH100–1250–10	1250	88	1500				5525
CHH100–1400–10	1400	98	1700				5775
CHH100–1600–10	1600	112	1900	HU10B	24	4800 × 1200 × 2690	6662
CHH100–1800–10	1800	127	2200			5000 × 1500 × 2690	7232
CHH100–2000–10	2000	141	2400				7552
CHH100–2240–10	2240	157	2700				7980
CHH100–2500–10	2500	175	3000				8130
CHH100–2800–10	2800	205	3600				8380
CHH100–3150–10	3150	230	4000	HU13	24	7100 × 1500 × 2940	10100
CHH100–3550–10	3550	260	4500				10830
CHH100–4000–10	4000	290	5000				11090
CHH100–4500–10	4500	326	5600				12000
CHH100–5000–10	5000	362	6300	HU15	24	8300 × 1500 × 2970	13390
CHH100–5600–10	5600	405	7000				13960
CHH100–6300–10	6300	456	8000			10800 × 1500 × 2970	17380
CHH100–7100–10	7100	512	9000				18840

Instructions to model selection:

1.The switch cabinet is optional. Content “Dimensions and weight of the medium voltage drive” in the model selection table above excludes a switch cabinet. If a switch cabinet is necessary, the user should make it clear when placing the order.
2.For a 10kV medium voltage drive, its power range is 3150kW to 7100kW; and its buffer cabinet is a standard accessory and is included in the content “Dimensions and weight of the medium voltage drive” in the model selection table above.
3.For a 6kV medium voltage drive, its power range is 1800kW to 4000kW; and its buffer cabinet is a standard accessory and is included in the content “Dimensions and weight of the medium voltage drive” in the model selection table above.

CHH100—6kV series

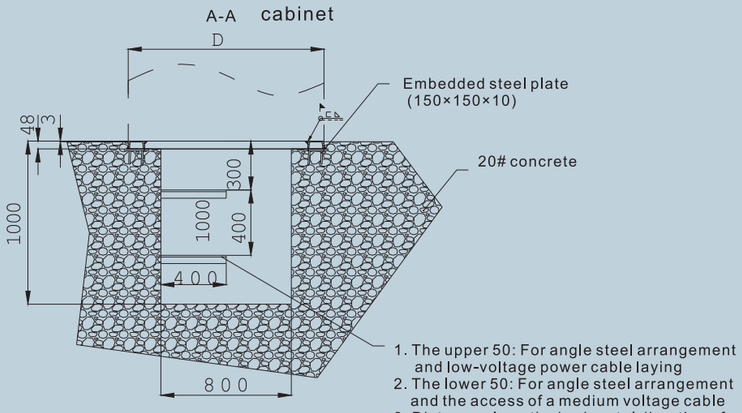
Model of Medium Voltage Drive	Motor Power (kW)	Rated Current (A)	Rated Capacity (kVA)	Power Units		Dimensions and Weight of the Medium Voltage Drive	
				Model	Qty.	Dimensions (W×D×H)	Weight (kg)
CHH100–0185–06	185	23	236	HU02	24	3000 × 1000 × 2690	2150
CHH100–0200–06	200	25	255				2160
CHH100–0220–06	220	27	280				2200
CHH100–0250–06	250	30	315				2280
CHH100–0280–06	280	33	350				2280
CHH100–0315–06	315	37	400				2280
CHH100–0355–06	355	42	440				2440
CHH100–0400–06	400	48	500				2510
CHH100–0450–06	450	54	560			3600 × 1200 × 2690	3250
CHH100–0500–06	500	60	600	HU04F	24		3350
CHH100–0560–06	560	67	690				3700
CHH100–0630–06	630	75	750				3850
CHH100–0710–06	710	84	880				4000
CHH100–0800–06	800	95	980				4150
CHH100–0900–06	900	106	1100	HU10B	24	3700 × 1200 × 2690	4720
CHH100–1000–06	1000	118	1250				5020
CHH100–1120–06	1120	132	1370			3900 × 1200 × 2690	5395
CHH100–1250–06	1250	146	1500				5495
CHH100–1400–06	1400	164	1700				5625
CHH100–1600–06	1600	185	1900				5675
CHH100–1800–06	1800	220	2000	HU13	24	5900 × 1200 × 2690	7160
CHH100–2000–06	2000	229	2400				7450
CHH100–2240–06	2240	261	2700				8010
CHH100–2500–06	2500	281	3000				8380
CHH100–2800–06	2800	324	3300				8760
CHH100–3150–06	3150	363	3700	HU15	24	7100 × 1200 × 2970	10070
CHH100–3550–06	3550	428	4500				10725
CHH100–4000–06	4000	482	5000				11475

4.For loads with large torque changes (such as compressors and vibration machines), the capacities of medium voltage drive should be appropriately increased during model selection according to the actual conditions.
5.The rated currents of the motors of submersible water pumps and submersible oil pumps are larger than the rated currents of ordinary motors, so the rated currents of medium voltage drive should be larger than the rated currents of the said motors during model selection.
6.For asynchronous motors with many poles, the capacities of medium voltage drive should be correspondingly increased during model selection according to the rated currents of asynchronous motors during model selection.
7.For loads with large starting currents (such as Roots blower), the rated currents of medium voltage drive should be correspondingly increased during model selection.
8.When a “one-driving-multiple” solution is adopted and one medium voltage drive is used for driving multiple paralleled motors, the rated current of the medium voltage drive should be correspondingly Increased one or two grade during model selection.
9.If a medium voltage drive is installed at a place at an elevation higher than 1000m, it should be made clear during ordering; the medium voltage drive must have a phase-shifting transformer designed for plateaus and take derated operation.
10.For medium voltage drive with larger power not mentioned in the model selection table above, please contact our local offices.

Installation requirements for CHH100 series medium voltage drive

Installation foundation of a medium voltage drive

The medium voltage drive must be vertically installed on the concreted channel steel foundation. To meet the flatness requirement of the foundation, the allowance of every 1000mm is 1mm. The weight distribution of the medium voltage drive must be considered for the foundation. The foundation should be made of concrete and channel steel (specification: 10# at least).

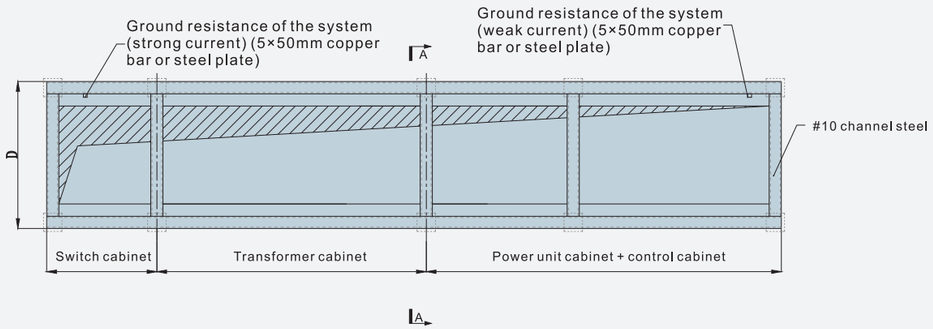


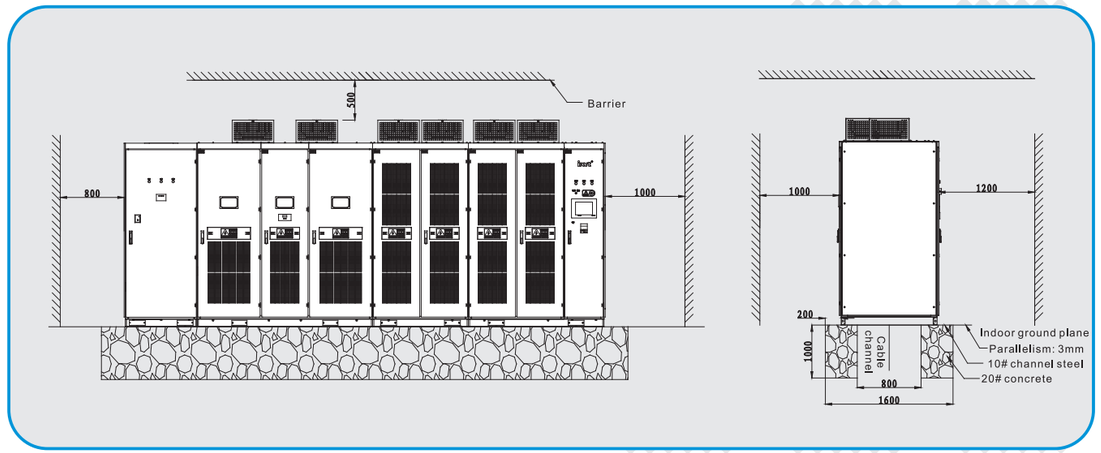
Technical Requirements

1. Take measures against flood, dust and vermin for the trench.
2. The 10# channel steel is used for the foundation. The installation plane should be flat. The permissible error for each meter is smaller than 1mm.
3. The channel steel used for the cabinet base of the medium voltage drive may be fixed with the foundation channel steel through welding on the site.
4. If the temperature is lower than 4℃, there should be indoor heating measures.
5. This foundation drawing is for the reference purposes during civil construction only.

Installation space of medium voltage drive

Please refer to the related engineering drawings for the external dimensions and installation drawing of the medium voltage drive. All the cabinets should be installed according to the related drawings. One or multiple medium voltage drive may be installed together according to the position condition on the site and the quantity of the medium voltage drive. The general rule of layout is that the operations and maintenance should be convenient.





Air Channel Installation

The speed regulation system of each CHH100 series medium voltage drive has an efficiency great than 96% and about 4% of energy is transformes into heat energy; it is therefore necessary to consider the cooling of the speed regulation system. If the ambient temperature on the site is high, it will be necessary to install a forced air cooling channel or an air conditioner. When a forced air cooling channel is used, it is suggested to make the air exhaust rate corresponding to each 200kW frequency inverter capacity larger than 1m3/s; if an air conditioner is used, it is suggested to make the configuration corresponding to each 200kW frequency inverter capacity larger than 4HP.

Interface cables of medium voltage drive

The interface cables of medium voltage drive may access via the tops or bottoms of medium voltage drive. Both the interface cables and the corresponding cable ducts must be made of flame retardant materials. Medium voltage cables should be armored cables and signal cables should be shielded cables. A single-end grounding mode should be adopted. Measures against moisture, dust and vermin should be taken for cable interfaces.

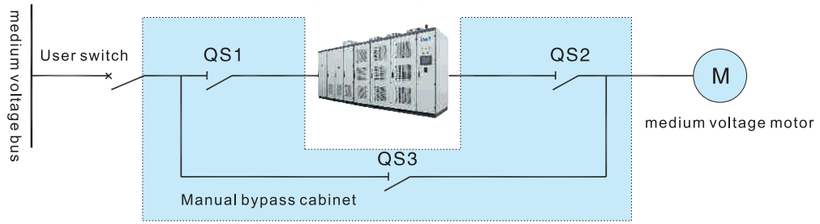
Precautions during installation of medium voltage drive

The speed regulation system of a medium voltage drive is composed of more than three cabinets (the specific quality of the cabinets depends on the power and the layout). On the installation site, one or several cabinets may be vertically placed on the foundation through a crane or forklift separately. The phase-shifting transformer cabinet must be installed separately. When each cabinet is installed, it must not incline by more than 10°.

Technical solutions for the speed regulation of CHH100 series medium voltage drive

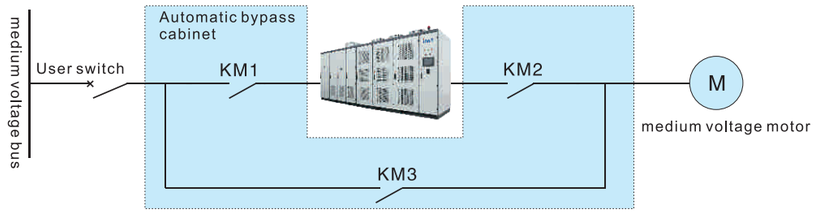
“one-driving-one” Manual Solution

This solution ensures manual switching between a power frequency state and a variable frequency state for loads. Furthermore, the medium voltage isolating switch has an apparent isolation point, which guarantees safe maintenance for the medium voltage drive.



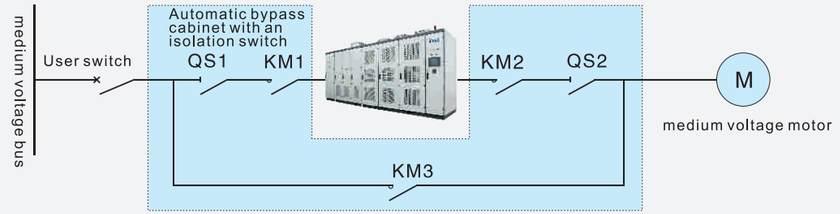
“one-driving-one” Automatic Solution

This solution ensures quick automatic switching between a power frequency state and a variable frequency state for loads. If the switching duration needed by a system is short and the motor may be stopped during maintenance of the medium voltage drive, it will be proper to select this bypass system.



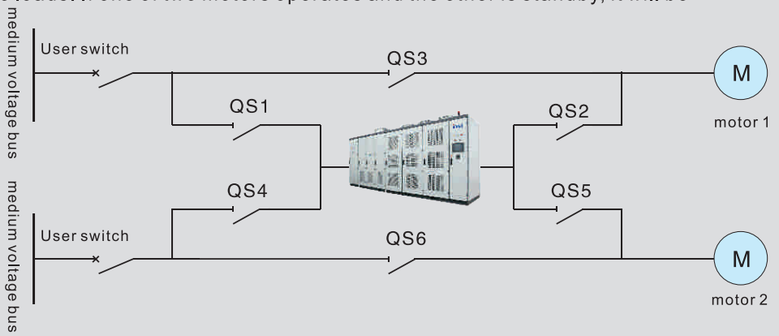
“one-driving-one” Automatic Solution With An Isolation Switch

This solution ensures quick automatic switching between a power frequency state and a variable frequency state for loads and safe maintenance for the medium voltage drive. If the switching duration needed by a system is short and power frequency operation is necessary during maintenance, it will be proper to select this solution.



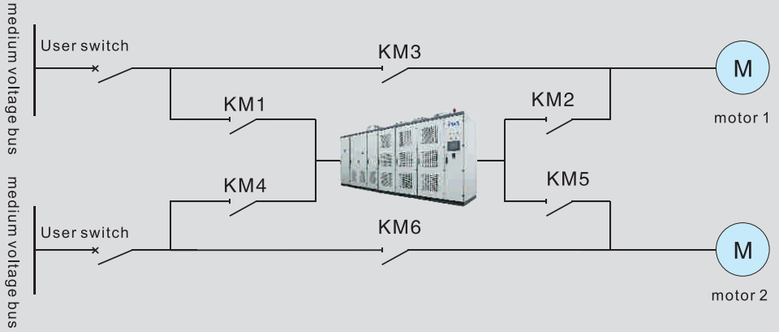
“one-driving-two” Solution

The “one-driving-two” manual bypass solution can realize manual switching for two loads and ensures periodic operation for the two loads. If one of two motors operates and the other is standby, it will be proper to select this bypass system.



“one-driving-two” Automatic Solution

A “one-driving-two” automatic bypass cabinet is able to realize quick automatic switching for two loads. If the switching duration needed by a system is short, it will be proper to select this bypass system.



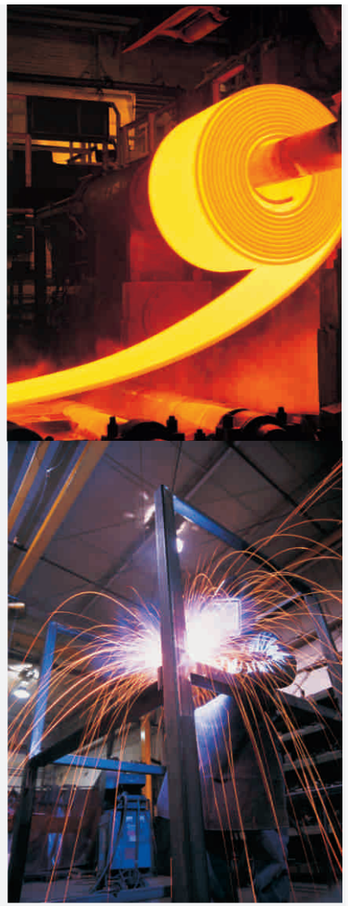
Benefits of medium voltage drive brought for customers

(1) Saving electric energy effectively

In production activities, fans and pumps are usually designed with their corresponding maximum duty and provided with larger margins based on the consideration of the efficiency reduction of equipment with time on. In practical production, motors work in power frequency and their flow and air volumes need to be adjusted by regulating the openings of valves and ventilation doors. As a result, a great deal of energy is consumed for overcoming the resistances of the valves, baffles and ventilation doors, causing a phenomenon of “a large horse pulling a small carriage”. After medium voltage drive are used for speed regulation, valves and ventilation doors are fully opened and motors are driven by medium voltage drive to operate with low frequencies, thus lowering the speeds of motors and saving electric energy significantly.

(2) Increasing the power factor on grid power

When a motor is operating with the power frequency and full load, its power factor is about 0.84, but the actual operating power factor is much lower than 0.8. If it is driven by a medium voltage drive, its power factor on the power supply side may be higher than 0.9. Consequently, the reactive power can be reduced obviously without a reactive power compensation device, the requirement of the power grid can be met and the operation costs of the upstream equipment can be further cut down.



(3) Cutting down the operation and maintenance costs of equipment

If variable frequency regulation is done and the load is small, the speeds of motors and fans will both reduce, motors and the loaded equipment will have less serious wear, lower fault rates and longer service lives and maintenance periods than before; after variable frequency reconstruction, valves will be completely opened and the maintenance load of baffles will be significantly reduced; when the medium voltage drive are operating, it is only necessary to dedust them at regular intervals without shutdown, thus ensuring continuous production.

(4) Prolonging the service lives of equipment

With a medium voltage drive, a motor can realize soft start with a current no larger than 1.2 times its rated current while generating no impact to itself and the power grid; in the entire operation range, the motor can operate stably and has less loss; a piece of loaded equipment can start with very low noise and starting current and without any abnormal vibrations or noise. So the service lives of equipment like motors, fans and water pumps can be significantly prolonged.

(5) Ensuring safe operation for equipment

medium voltage drive have multiple protection functions, such as overcurrent protection, short circuit protection, overvoltage protection, undervoltage protection, phase lose protection, and temperature rise protection, and can therefore protect power grids and motors better. Medium voltage drive have great capacity to adapt to the voltage fluctuations of power grids, in other words, they have wide operating voltage ranges and can operate continuously and reliably even if the voltage fluctuation ranges of power grids are ±10%.

Application of CHH100 series medium voltage drive on dedusting fans in iron and steel works

Project Overview

An iron and steel company in Hebei Province that is a Sino-foreign joint venture now has four medium-sized rolled steel production lines (one 800# rolling mill production line, one 650# rolling mill production line and two 500# rolling mill production lines) and three dedusting systems in all. The three dedusting systems have large capacities and serve as the main dedusting equipment in production. The power and supply voltage of the motors of the dedusting fans are 2240kW and 10kV respectively. According to the original design, dampers are used for air volume adjustment. However, it is discovered after some time of operation that this air volume adjustment method has serious limitations mainly embodied in the following aspects:

(1)The dampers must be adjusted manually and are therefore inconvenient in use and usually remain unchanged under any conditions, which causes a huge waste;

(2)The air is consumed by the dampers, resulting in a large pressure difference between the front and back sides of the dampers and easy wear of the ventilation doors;

(3)Fans and motors run with full speeds, resulting in serious vibrations, loud noise, large loss and serious bearing wear;

(4)The adjustment accuracy is low, the linearity is poor and the response speed is slow;

(5)Motors have large starting currents, which affects the power grid stability.

In order to solve the limitations above, respond to the energy saving and emission reduction policies and guidelines of the state and improve its operation level and core competitiveness in a comprehensive way, the iron and steel company decided to carry out variable frequency energy-saving reconstruction for its 3# dedusting system and invited us to undertake the reconstruction according to the operation data and actual technological requirements on the site.

Solution of reconstruction with the help of the speed regulation system of a medium voltage drive

Our technical engineers have configured a CHH100 series 10kV/2500kW medium voltage drive for the customer according to the parameters and technological requirements of the site equipment. The main technical parameters of the medium voltage drive are in the table below.

No.	Item	Parameter
1	Model of medium voltage drive	CHH100-2500-10
2	Rated Capacity	3150kVA
3	Rated Voltage	10kV
4	Rated Current	175A
5	Applicable Motor Power	2500kW
6	Form Of Bypass System	“One-driving-one” manual bypass system

After the CHH100 medium voltage drive is installed and debugged, the following key test data were obtained during commissioning.

No.	Power Frequency Operation			Variable Frequency Operation		
	Damper Opening	Input Voltage	Input Current	Input Voltage	Running Frequency	Input Current
1	30%	10.04kV	52.4A	10.04kV	20Hz	23.4A
2	60%	10.04kV	104.2A	10.04kV	20Hz	55.5A
3	90%	10.04kV	135.8A	10.04kV	20Hz	102.3A

The table below shows the electricity consumed by the dedusting fans in the power frequency operation state and the variable frequency operation state calculated according to the test data above.

No.	Air Volume Needed	Electric energy consumed in the power frequency operation state	Electric energy consumed in the variable frequency operation state	Electricity Saved	Rate Of Electricity Saving
1	30%	765.41kW	394.70kW	370.71kW	48.43%
2	60%	1522.05kW	936.15kW	585.90kW	38.49%
3	90%	1980.63kW	1720.56kW	260.07kW	13.13%

Economic Benefit Analysis

According to the actual operation, there are about 15 minutes of high-speed operation, about 25 minutes of middle-speed operation, and about 15 minutes of low-speed operation, so the overall rate of electricity saving is:

Rate of electricity saving of the system:

{（370.71×15+585.90×25+260.07×15）/（765.41×15+1522.05×25+1980.63×15）}×100%=30.42%

Electricity saved by the system:

{765.41×（15/55）+1522.05×（25/55）+1980.63×（15/55）}×30.42%=438.35kW

Electricity saved each day:

438.35 kW×24h = 10520.57kW.h

Rough electricity cost saved each year:

If the electricity price is RMB0.35/kW.h and the average annual operation period of equipment is 330 days, the rough electricity cost will be:

10520.57kW.h×330×RMB0.35/ kW.h = RMB1,215,100

Conclusion:

Operational practice has proved that the CHH100 series medium voltage drive produced by INVT Electric Co., Ltd. are stable and reliable. After reconstruction based on application of CHH100 medium voltage drive, motors can start stably, have significantly reduced vibrations and noise, greatly improve the operation conditions of equipment and realize the expected energy-saving purpose.

Application of CHH100 series medium voltage drive on the circulating pumps of boilers

Project Overview

The generator units of the Harbin Jieneng Thermal Power Plant Co., Ltd. adopt a closed circulating water system. Each generator unit is equipped with two circulating water pumps with a motor power of 500kW and a supply voltage of 10kV. The butterfly valve at the outlet of each circulating water pump has two positions only; namely, a fully opened position and a fully closed position. The flow of the cooling water is controlled and adjusted by changing the quantity of the circulating water pumps started. Due to season changes and the temperature differences between day and night, there is often a phenomenon that the flow is insufficient if only one circulating water pump is started or excessive if two circulating water pumps are started. This flow adjustment method is technologically backward and easy to result in unsteady vacuum of steam turbines and cannot ensure steady and economical operation for steam turbines. Meanwhile, it wastes a lot of electric energy and water resources and results in an excessively high rate of electricity use and a higher power generation cost of the plant.To improve the situation, adapt to the electric power system characterized by separation of plants and grids and interconnection to grids based on price bidding, save energy sources, reduce the rate of electricity use by the plant, protect the environment, simplify the operation mode and alleviate the mechanical wear of rotating equipment, the Harbin Jieneng Thermal Power Plant Co., Ltd. decided to conduct variable frequency energy-saving reconstruction for the circulating water pumps of its generator units.

Solution of reconstruction with the help of the speed regulation system of a medium voltage drive

After overall surveys and comparisons, the Harbin Jieneng Thermal Power Plant Co., Ltd. finally decided to use the CHH100 series medium voltage drive produced by us. Through the cooperation of the technical personnel of the Harbin Jieneng Thermal Power Plant Co., Ltd. and our company, a variable frequency reconstruction solution was worked out for the circulating water pumps of the 3# generator unit. According to the solution, one of the two circulating water pumps operates with a power frequency and the other with a variable frequency. The technical solution is as follows:

No.	Item	Parameter
1	Model of medium voltage drive	CHH100-500-10
2	Rated Capacity	630kVA
3	Rated Voltage	10kV
4	Rated Current	37A
5	Applicable Motor Power	500kW
6	Form Of Bypass System	“One-driving-one” manual bypass system

Main parameters of motors

Supporting medium voltage motors for water pumps					
Model Of Motor	Y5602-6	Rated Power	500kw	Rated Voltage	10kv
Rated Current	34A	Power Factor	0.85	Number of poles of motor	4

On December 26, 2008, measurements were done on the site through measuring instruments and meters. The following are the data obtained.

Adjustment Method	Input Current	Input Voltage	Input Power Factor	Operating Power	Daily Electricity Consumption
Valve Adjustment	27.23A	10030A	0.76	359.51kW	8628.22kW.h
Variable Frequency Adjustment	12.9A	10030A	0.97	217.37kW	5217kW.h

Economic Benefit Analysis

The energy-saving effect of two 500kW/10kV boiler circulating water pumps based on variable frequency adjustment is as follows: (Compared with the situation based on valve adjustment)

Rate of electricity saving: {(8628.22−5217)/8628.22}×100% =39.53%

Daily electricity saved: 8628.22−5217=3411.22 kW.h

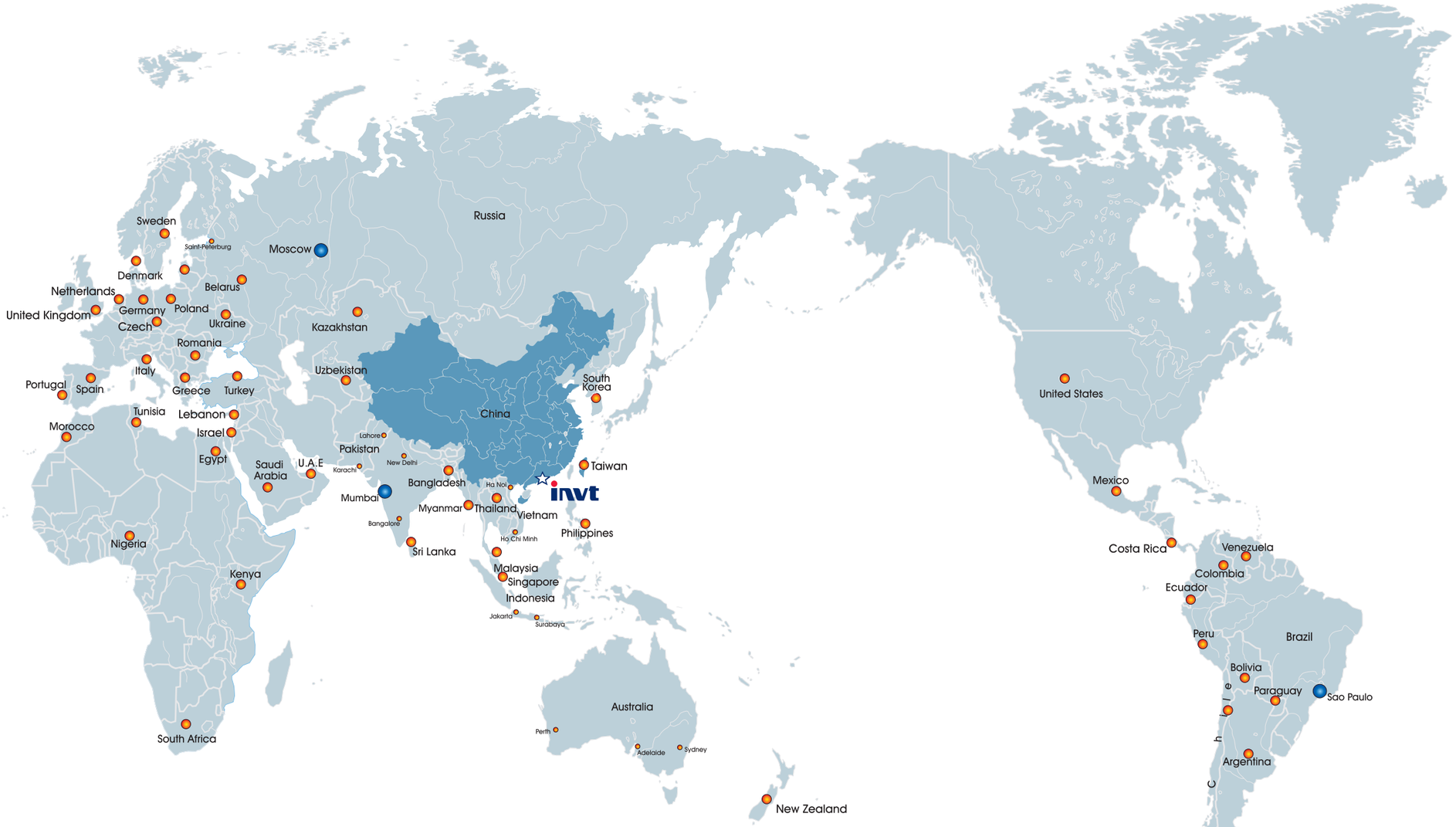
Rough electricity cost saved each year (if the electricity price is RMB0.35/kW.h):

3411.22 kW.h×365×RMB0.35/ kW.h = RMB435,800

Conclusion:

After the variable frequency reconstruction done for the boiler circulating water pumps of the Harbin Jieneng Thermal Power Plant Co., Ltd., the energy-saving effect is obvious. The application of the variable frequency speed regulation technology has realized the soft start of motors, prolonged the service lives of motors and decreased the vibration and wear of pipelines. The operational practice has proved that the application of the 10kV/500 kW CHH100 series medium voltage drive in the circulating water pump system of the generator unit #3 of the Harbin Jieneng Thermal Power Plant Co., Ltd. is successful.

Sales Network



- India subsidiary company in Mumbai
- Russia representative office in Moscow
- Brazil representative office in Sao Paulo
- Exported to more than 60 countries and regions