

**BERNARD[®]
CONTROLS**

//////////////////// Invest in Confidence //////////////////////

Nuclear Actuators



INVEST IN CONFIDENCE

**BERNARD CONTROLS BRINGS TOGETHER 75+ YEARS
OF EXPERTISE AND 50+ YEARS OF CONTINUOUS
EXPERIENCE IN THE NUCLEAR INDUSTRY.**

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invest in confidence

Reliability and Safety

Actuator construction requires both electrical and mechanical components. Once installed in the heart of the nuclear power plant, they must retain their integrity and remain available, not only during the decades of normal service in the containment area (in presence of ionising radiations) but also in case of severe accidental circumstances when their correct operation becomes absolutely necessary.

Applications Experience

BERNARD CONTROLS actuators have been chosen to equip more than 120 reactors throughout the world: in Belgium, Bulgaria, China, France (all reactors in operation), Germany, India, Lithuania, South Korea, Spain, Sweden, Ukraine... as well as in new generation EPR plants (France, Finland, China).

Based on our experience in the nuclear industry, BERNARD CONTROLS has designed a full range of actuators for use inside and outside nuclear power plants containment. We also propose actuation solutions for other nuclear sites such as waste treatment and uranium enrichment plants or nuclear submarines which carry small nuclear reactor on board. In this last application, compactness is of critical importance.

International Standards

These environmental conditions have been precisely defined by the various safety standards for instance RCC-E (French standard), IEEE (American standard) or KTA (German standard). Accidental circumstances include earthquakes and conditions linked to a loss of coolant.

Certification

BERNARD CONTROLS appreciates the importance of quality at all stages of the production process, and has put in place and maintains a Quality Management System in accordance with ISO 9001 (certification ISO 9001: 2008 n°1997/8657.6). BERNARD CONTROLS also maintains the nuclear quality in accordance with 50C/SG-Q-IAEA codes and RCCE. The quality of BERNARD CONTROLS products has been approved and recognized by a number of international certifying bodies, including ABS, BUREAU VERITAS, CSA, Germanischer Lloyd, EAC, INERIS and others.

50+ years of continuous experience
in the Nuclear industry.

BERNARD CONTROLS actuators chosen
for more than **120+ reactors**
throughout the world.



EXPERTISE & STRONG CUSTOMER SUPPORT FOR THE NUCLEAR INDUSTRY

For more than 50 years, BERNARD CONTROLS has been continuously designing electric actuation solutions for the Nuclear market in close partnership with its customers and all key players of this industry.

Strong Customer Support has been a commitment since the beginning and results in processes & teams focused on customers' needs. Thus, a special sales team is dedicated to nuclear projects and customers. In addition, Project Managers from our R&D Department are available to accompany clients in all their needs and coordinate Projects amongst all involved company Departments in order to design new products, adapt standard ranges to customer needs, prepare a new product qualifications...

Our engineers are also available to validate design of sites or solve customers' on-site issues thanks to:

- > Test bench to simulate valve operation,
- > Calculation tools & calculation experts to estimate resistance of materials or evaluate over torques due to switch-off delay and valve stiffness, etc.



Nuclear Classification

BERNARD CONTROLS range of electric actuators for nuclear plant has been designed and qualified according to RCC-E standard published by AFCEN (French association for the rules of design and construction of components used in nuclear power plants) and to IEEE.

The RCC-E and IEEE documents specify the rules for design, qualification and construction of electrical materials for nuclear power plants.

Three main levels of requirements and qualification exist depending on the type of application. Please note that these three types of application exist in all standards but may be named differently.

The three levels of requirements are:

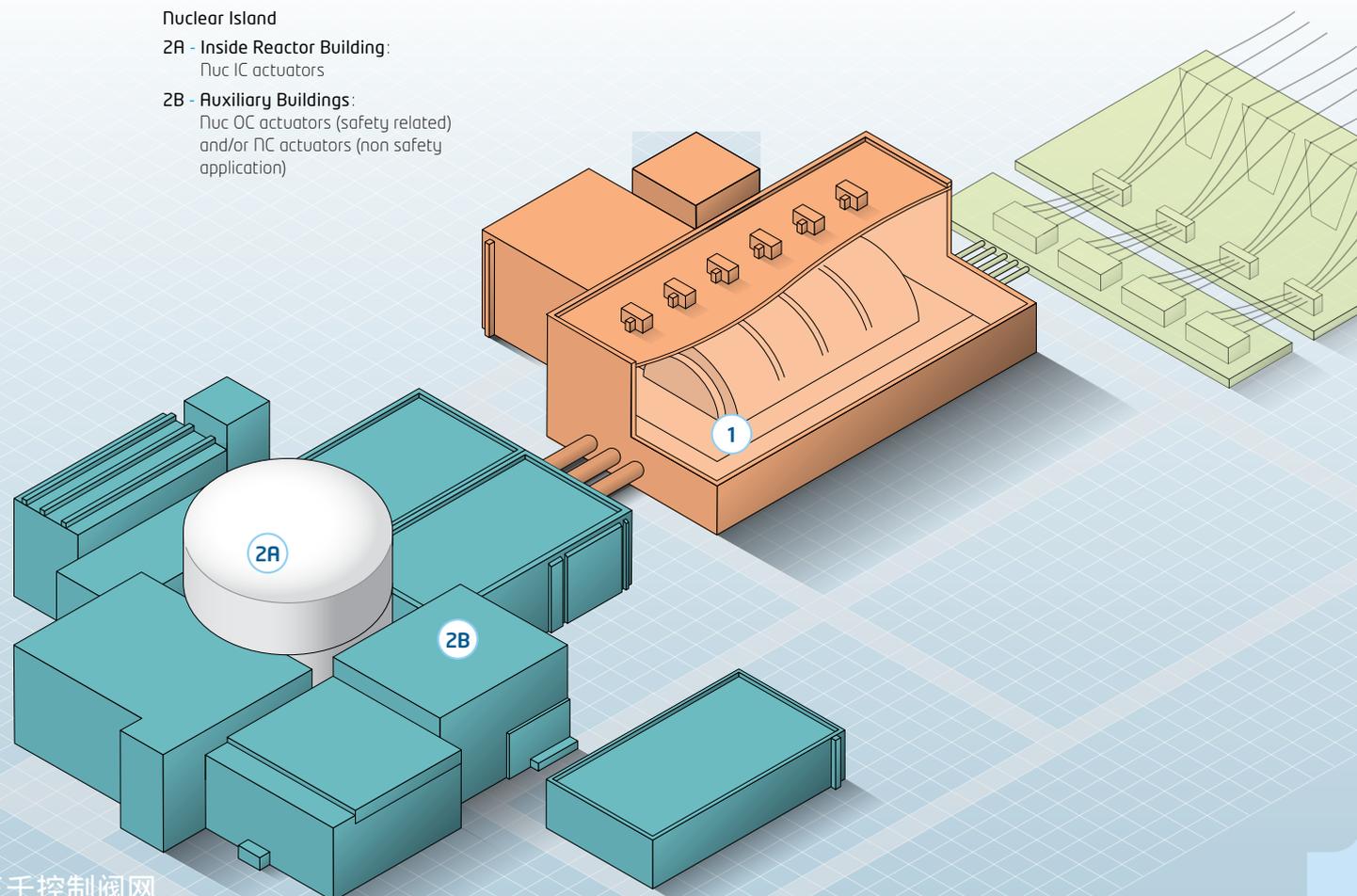
- **Commercial grade (NC):** actuators designed for operation in normal environment for 30 years (referred as "NC" type in the RCC-E standard)
- **Safety requirements outside containment (Nuc OC):** actuators designed for operation in normal environment for 30 years and during seismic accidents (referred as "K3" type in the RCC-E standard)
- **Safety requirements inside containment (Nuc IC):** actuators designed for operation during 40 years in ionizing environment and remaining operational in case of seismic accidents and LOCA, Loss of Coolant Accident (referred as "K1" type in the RCC-E standard)

1 - Conventional island (Turbin, BOP..)
NC actuators (Non safety related equipment)

Nuclear Island

2A - Inside Reactor Building:
Nuc IC actuators

2B - Auxiliary Buildings:
Nuc OC actuators (safety related) and/or NC actuators (non safety application)



> Nuclear Classification of electric actuators

	Actuators	Modulating class		Electronic control	Commercial grade equipment NC	Safety related equipment	
						Nuc O.C Outside Containment qualification (aging & seism)	Nuc I.C Inside Containment qualification (aging seism & LOCA)
MULTI-TURN	 SN	ON/OFF		- INTEGRAL+	● (2) ● (1)	● (2) ● (1)	●
		Class III		- POSIGAM+	● (2) ● (1)	● (2) ● (1)	●
	 ST	ON/OFF		- INTEGRAL+ INTELLI+®	● ● ●	● ●	
		Class III		- POSIGAM+ INTELLI+®	● ● ●	● ●	
	 MA MB	Class II		- MODUGAM+ INTELLI+®	● ● ●	● (3) ● (3)	
		Class I		- INTELLI+®	● ●		
QUARTER-TURN	 SQN	ON/OFF		- INTEGRAL+	● (2) ● (1)	● (2) ● (1)	●
		Class III		- POSIGAM+	● (2) ● (1)	● (2) ● (1)	●
	 OA No torque limiter Up to 150 N.m	ON/OFF		- INTEGRAL+ INTELLI+®	● ● ●	● ●	
		Class III		- POSIGAM+ INTELLI+®	● ● ●	● ●	
	 AS/BS Torque limiter Up to 1200 N.m	ON/OFF		- INTEGRAL+ INTELLI+®	● ● ●	● ●	
		Class III		- POSIGAM+ INTELLI+®	● ● ●	● ●	
FAIL SAFE	 FQ	ON/OFF		- INTEGRAL+	● ● (1)	● ●	●
		Class III		- POSIGAM+	● ● (1)		
GEARBOXES		Multi-turn			●	●	●
		Quarter-turn			●	●	●
		Manual			●	●	●

Linear thrust units are also available

(1): separated box only

(2): due to the qualification for inside containment, actuator is automatically qualified for outside containment and non safety related area

(3): Westinghouse actuator qualification and BERNARD CONTROLS electronic qualification with separated control box



Type of operation

> What are the classes of modulating?

A modulating actuator has to be fully adapted to the operating duty of the modulating loop. Two points are important for enhancing the reliability of the actuator:

- The lifetime of equipment is related to the number of operations (motor, mechanism, electronic...) or to the change of positions,
- The motor must stand up to overheating.

Although the electric motor is important, it is not the only one element to take into account when choosing an actuator. Therefore, BERNARD CONTROLS proposes a classification of actuators according to four types of operations named MODULATING CLASSES. It has deeply inspired the classification used in the European electric actuator standard EN 15714-2.



Type of operation	Modulating class
 <p>Open or close the full stroke, on average 20 to 30 times / day 360 motor starts / h maxi (peak) Motor duty cycle: S4 - 30 % or 40 %</p>	On-Off
 <p>Select intermediate positions (inching), with good precision (better than 2 %) on average 360 times/day. 1200 motor starts / h maxi (peak) Motor duty cycle: S4 - 50 %</p>	CLASS III modulating
 <p>Select intermediate positions (inching), with high precision (better than 1 %) on a permanent basis every 2 or 3 seconds. 1800 motor starts / h maxi (peak) Motor duty cycle: S4 - 100 %</p>	CLASS II modulating
 <p>Fast positioning (continuous movement) with an excellent precision (0.5 % or better) No limit of motor starts Motor duty cycle: S4 - 100 %</p>	CLASS I modulating

The choice of a type of operation determines the selection of a motor for each function. Based on the CEI34 Standard defining the electric motors standard duty cycles, BERNARD CONTROLS has chosen the S4 duty rating, because it is the most representative duty cycle for actuators operations.

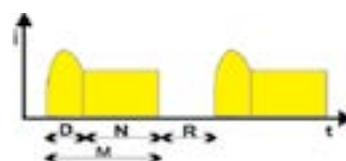
IEC 60034 STANDARD - S4 MOTOR DUTY CYCLE

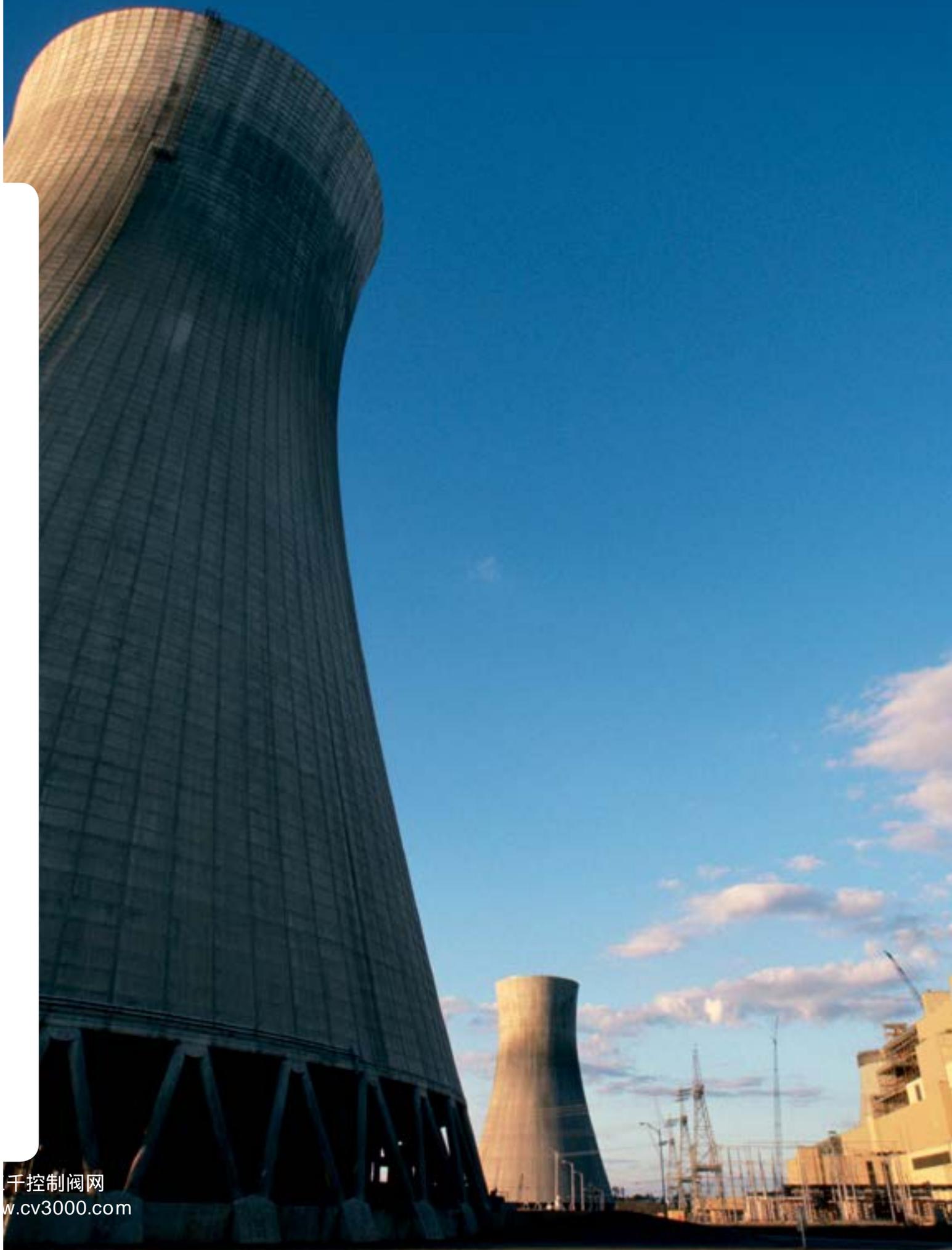
S4 INTERMITTENT DUTY WITH STARTING

Repetition of cycles including:

- starting period D
- period of constant speed N
- rest period R

To be followed by the duty factor in %, as well as the number of starts per hour.







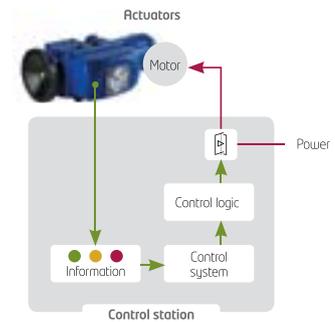
Wide choice of controls

You can decide on local or remote control to meet the requirements of your particular system and the environment in which the actuators are to be used. BERNARD CONTROLS' wide range of control systems enables you to choose the best solution for your needs.

> Standard control

The customer provides the control logic to handle all the data received from the actuator electric contacts. The reversing starters are housed in the customer's own enclosure.

Qualification: inside or outside containment, or Non Safety Related Area

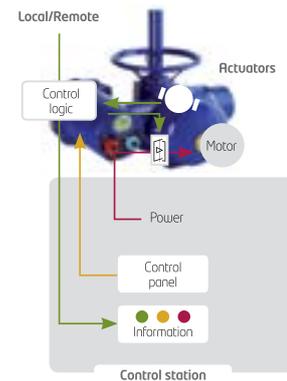


Standard control

> INTEGRAL+ control

The INTEGRAL+ control system is fully configurable and can perform all actuator control functions, including production of status reports, fault handling, protection systems and command processing. Local controls can be disabled either locally or from a remote location. The reversing starters are incorporated in the control unit.

Qualification: outside containment or Non Safety Related Area



INTEGRAL+ control / INTELLI+® control

> INTELLI+® control

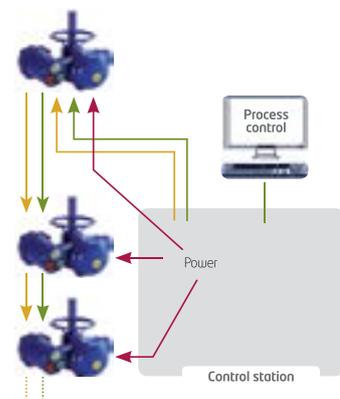
As well as the functions offered by INTEGRAL+, the INTELLI+® system also allows the system to be set up and programmed without opening the unit. It includes an LCD screen plus tools for preventative maintenance.

Qualification: Non Safety Related Area

> Fieldbus control

Fieldbus systems are compatible with BERNARD CONTROLS integrated controls and allow you to control a large number of actuators or other devices and transmit/receive a great deal of data over a single two-wire serial link.

Qualification: Non Safety Related Area



Fieldbus control



Benefits of integrated control systems

- **Simple:** ready-to-use turnkey solution.
- **Safe:** proven system incorporating many safety features.
- **Economical:** saves time and money at the design and installation stages.
- **Intelligent:** remote management of a large volume of data and optimized preventative maintenance using our digital solutions in conjunction with the fieldbus.

		INTEGRAL+	INTELLI+®
QUALIFICATION	Non Safety Related Area	•	•
	Outside containment (Nuc O.C.)	•	
	Inside containment (Nuc I.C.)		
MODULATING CLASS	ON/OFF	INTEGRAL+	INTELLI+®
	Modulating class III	POSIGAM+	INTELLI+®
REMOTE CONTROL	Pulse command	•	•
	Maintained signal	•	•
	ESD (Emergency ShutDown)	•	•
	Auxiliary (Overrides local command)	•	2 commands 9 options
	Timer	Option	•
	Analogue control	Option (standard on POSIGAM+)	Option
LOCAL COMMANDS	Lockable selector knobs	•	•
	Digital display		•
	Indicator lights	Option	•
INTERNAL PROTECTION	Fuses	•	•
	Automatic phase monitoring (3-phase)	•	•
	Motor thermal cut-out	•	•
	Torque limiter protection	•	•
SIGNALING	Number of signal relays	4 + 3 (option)	4 + 3 (option)
	Data items	16	23
	Number of fault relay	1	1
	Number of listed faults	8	12
	Analogue position feedback	Option (Std on POSIGAM+)	Option
CONFIGURATION	Configuration setting	Internal (with jumpers)	External - Local command knob - Fieldbus - Pocket PC - Laptop
	Torque/position setting method	Mechanical	Digital
	Travel limit stop	On position – On torque	On position – On torque
	Full configuration upload		Via: Fieldbus - Pocket PC Laptop
MONITORING	Self-diagnostics		•
	Torque/position curve		•
	Actuator operating log		•
	Partial stroking		•
FIELDBUS	Profibus DP (single or redundant)	Option	Option
	Foundation fieldbus		Option
	Modbus RTU		Option



Full information
about
BERNARD CONTROLS
nuclear qualified
actuators on request



Failsafe actuators

FQ actuators are widely used in Oil & Gas markets but also in new generation of Nuclear power plant as for ventilation application. It can be used for On-Off or Modulating Class III applications.

- Failsafe with reliable spring-return technology
- Fast and shock-free valve travel during emergency operation
- Maintenance-free
- IP67 as standard - IP68 on request
- Explosionproof versions (ATEX-ΠEMA)
- Nuc IC and Nuc OC versions have been qualified. Please contact us .

MODEL	MAX. TORQUE
FQ4	40 Nm
FQ8	80 Nm
FQ12	120 Nm
FQ18	180 Nm
FQ30	300 Nm
FQ50	500 Nm



What is Fail Safe?

The activation of an emergency signal triggers the immediate opening or closing of the backup device, without the need of any external power source.

This signal can be activated following:

- an abnormal event (fire, overflow ...)
- an automatic control
- an operator's action
- or the lack of power supply

Examples of applications: storage and distribution of gas and dangerous liquids, fire protection systems, protection of chemical facilities, air conditioning and ventilation of hazardous areas.

➤ Technical solution

Spring return actuator

Under normal conditions, the actuator operates electrically. Its motor simultaneously drives the valve or damper as well as a high resistance spiral spring.

A solenoid which is continuously power supplied releases the device and spring assembly when its power supply is interrupted, for whatever reason.

When power is restored, the actuator automatically returns to its position, according to the commands received.



TYPE TYP **FG12**

Moteur - Motor

0.03 KW **230** V **1** Ph

30 % **0.5** A **50** Hz

Actionneur - Antrieb - Actuator

120 Nm ⁰/₀ **120** Nm ^F/₅₀

0.16 ^{1/min} ^{1/min} **0.25** ^{1/min} ^{1/min}

N° **09C08363 001**

MADE IN FRANCE **CE**



Mounting flange specifications

> ISO5210 types of drive forms

	option TYPE A STEM NUT	option TYPE B1-B2 LARGE DIA.	option TYPE B3-B4 SMALL DIA	standard TYPE C CLAW COUPLING
actuator side				
	Thrust accepted	Thrust not accepted	Thrust not accepted	Thrust not accepted

> ISO 5210 max. torque / max. thrust / bolting guidelines

Flange	Actuator Max torque	Max. thrust with stem nut	Mounting bolts
F10	100 N.m	40 000 N	4 x M10 / d = 102 mm
F14	400 N.m	100 000 N	4 x M16 / d = 140 mm
F16	700 N.m	150 000 N	4 x M20 / d = 165 mm
F25	1 200 N.m	200 000 N	8 x M16 / d = 254 mm
F30	2 500 N.m	325 000 N	8 x M20 / d = 298 mm
F40	10 000 N.m	1 100 000 N	8 x M36 / d = 406 mm

For other flanges, please consult BERNARD CONTROLS.

> ISO 5211 max. torque / bolting guidelines

Flange	Actuator Max torque	Mounting bolts
F05	125 N.m	4 x M6 / d = 50 mm
F07	250 N.m	4 x M8 / d = 70 mm
F10	500 N.m	4 x M10 / d = 102 mm
F12	1 000 N.m	4 x M12 / d = 125 mm

Flange	Actuator Max torque	Mounting bolts
F14	2 000 N.m	4 x M16 / d = 140 mm
F16	4 000 N.m	4 x M20 / d = 165 mm
F25	8 000 N.m	8 x M16 / d = 254 mm
F30	16 000 N.m	8 x M20 / d = 298 mm
F35	32 000 N.m	8 x M30 / d = 356 mm

For other flanges, please consult BERNARD CONTROLS.

Other actuation solutions for nuclear power plants

High Duty Modulating

- 100 % duty service
- Different models suitable for use as:
 - Class II modulating: moderate speed, high resolution
 - Class I modulating: high speed, very high resolution
- Quarter-turn, linear, multi-turn and lever movements
- Specific turnkey electronic control solutions available

Conventional actuators

- A complete range of non-qualified actuators for:
 - Steam valves
 - Cooling towers
 - Dampers & fans, etc
- For On-Off up to Class I positioning duty
- Available with INTELLI+® non-intrusive controls

Gearboxes & Thrust units

- Large choice of gearboxes and thrust units from low to very high torques:
 - multi-turn applications
 - quarter-turn applications
 - linear applications
- Gearboxes and thrust units exist in commercial grade and in Nuclear qualified version

