**PRODUCT DATA SHEET** 



FILLSAFE POWER CONTROLLER

Banlaw FillSafe<sup>™</sup> Power

**Overfill Protection System Gen 4** 

Thank you for purchasing this high quality Banlaw product. Please read through and understand the information in this Product Data Sheet before installation or operation to avoid potential health safety and environment (HS&E) risks or equipment damage.



Figure 1 - Banlaw FillSafe<sup>™</sup> Power G4 Controller

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# 1 Warning, Caution and Note Usage

The terms Warning, Caution and Note may be used in this document in the following context:

WARNING DANGER	Information given with the WARNING icon must be considered to avoid serious injury.
	Information given with the CAUTION icon must be considered to avoid damage to equipment and possible injury.
Note:	Information given with the NOTE icon is highlighted to assist with a process or action. It may emphasise or add to other text in the document

# 2 Glossary Of Acronyms

The following acronyms are used in this document:

Acronym	Meaning
НМІ	Human Machine Interface
OFP	Over Fill Protection
SFL	Safe Fill Level
Smart TLS	Tank level switch with the functionality to detect wiring faults
Conventional TLS	Tank Level Switch

# **3** Reference Documents

Drawing	Description
BFSZP-01-E-	FillSafe Dlug And Dlay Termination Diagram
0001.PDF	FiliSale Plug-Aliu -Play Termination Diagram
FILLSAFE POWER	Papie Smort System Wiring Diagram Schematic, Covers M20, Doutsch and
SYSTEM BASIC	Milence
SCHEMATIC.PDF	

# 4 Banlaw FillSafe<sup>tm</sup> Power Gen-4 Product Overview

Banlaw FillSafe<sup>TM</sup> Power Gen 4 (4<sup>th</sup> generation) is an automatic tank fill cut-off system. The control unit provides the operator Fill/Stop buttons with back-lit LEDs. The purpose of the FillSafe Power Gen 4 system is to provide a reliable means to prevent the overfilling of a fluid storage tank.

The Generation 4 controller embraces all the features of the previous Generation 3 FillSafe Controller plus the optional ability to obtain device status from a suitably specified level switch and/or a suitably specified actuated ball valve. The status information allows the Generation 4 Controller to receive positional feedback from the ball valve and detect fault conditions in the wiring harness that connects to the Tank Level Switch. The Generation 4 controller may be setup to use either the smart TLS or the Actuated Ball Valve with feedback or both.

#### 4.1 Introduction

The FillSafe Power system automatically terminates the inflow of the fluid to the tank once the elected Safe Fill Level (SFL) has been reached.

The FillSafe Power System consists of 4 components, all connected by an electrical Wiring Harness:

- FillSafe Power Controller Gen 4
- Actuated Valve
- Fluid Level Switch (Level Sensor)
- Wiring Harness

**Figure 2** below, illustrates a basic arrangement of a FillSafe Power system. The example shown includes the use of a Banlaw dry-break diesel refuelling system (i.e. Nozzle, Receiver and Vent), although other styles of fluid connectors/couplings etc. may be used with the FillSafe Overfill Protection system.



#### Figure 2 General arrangement of FillSafe Power Gen-4 system

The system is simple in its architecture and compatible with a wide variety of tank filling applications. The degree of operator intervention for the system is low. The status LEDs on the Controller allow the operator to readily identify the system state.

# 4.2 FillSafe Power System – Features and Benefits

Features and benefits of the system include:

- Effective, safe, and reliable overfill protection (OFP) for the tank.
- No internal tank pressurisation is required for the operation of the FillSafe system.
- Simple to operate, with little intervention required by the operator.
- Suitable for use with non-flammable incompressible fluids, e.g. diesel fuels, oils, coolant, waste fluids, water, etc.
- Lowest pressure drop pressure-less refuelling system available on the market to prevent pressure drop.
- Can be designed for ultra-low and ultra-high flow rates.
- Visual indicator that the tank has been filled and provides visual feedback of valve operating condition as well as system faults.
- Can be configured with a high-high redundant float level, which gives an opportunity for a second pressure-less shut off level unlike mechanical overfill protection systems that fall back on tank back pressure to shut off the nozzle.

The only Banlaw proprietary component of the system is the Controller. The actuated valve and Level Switch are selected/configured based on specific client requirements, allowing a wide variety of applications to be catered for, including the refilling of a fluid storage tank via fluid connectors/couplings.

The FillSafe Power (BFSP2R series) controller is available with either a M20x1.5(F) conduit thread, a MIL-spec receptacle or a DT series Deutsch style receptacle. The plugged options assist with preventing fluid ingress from a compromised conduit, as well as simpler installation and maintenance.

The FillSafe Power system is not limited by either minimum or maximum fluid flowrates or fluid pressures. The style and size of the actuated valve are selected to cater to such specifications as fluid type, flow rate and pressures.

The system can incorporate a wide variety of actuated (automated) valves, including:

- Double-acting (power to open, power to close) electrically actuated valves.
- Single-acting (power to open, mechanical return to close) electrically or pneumatically actuated valves.
- Solenoid style valves.
- Certified fire-safe (e.g. API 607) valves, providing protection against the discharge of fluid from the tank in the event of a fire on-board the plant equipment or within the area adjacent to the tank.
- Valves with a manual override feature; useful in the event the FillSafe system is inoperable and the tank requires refilling, with alternative means used to terminate the inflow of fluid at the SFL.
- As an alternative to the use of an actuated valve, the controller can also be configured to control the operation of a pump(s) supplying fluid to the tank.
- The selection of the level switch is determined by requirements of the application. Configurations may include:
  - "Vertical mount", i.e. mounted through top of tank.
  - "Horizontal mount", i.e. mounted through the side of tank.
  - Threaded or flanged connection with tank port.
  - Variety of terminal heads, including tamper-evident styles.
  - Multiple float switches on a common level switch:
    - This feature allows the operator to nominate one of several fluid levels within the tank, typically via a key-switch, where the Controller will sense only the selected float switch and linked High-High float.
    - Smart TLS, this allows FillSafe Power GEN-4 recognize and manage TLS faults.

The FillSafe system is designed to be non-intrusive, i.e. the operation of FillSafe is configured to integrate seamlessly with an existing fluid transfer, tank refilling and diesel refuelling system. For example, a common combination is the integration of FillSafe<sup>™</sup> into a dry-break diesel refuelling system where the safe and proper operation of the refuelling system is not affected by the autonomous operation of FillSafe. The FillSafe System is the primary means for automatically terminating the flow of diesel into the tank, and in the unlikely event of a fault with FillSafe, the dry-break system acts as a secondary redundant system to prevent overfilling of the tank.



The dry break nozzle provides a level of redundancy in reducing the risk of overfill or spillage. For any redundant system to reduce the risk of overfilling of the tank, it is imperative this system is *configured, maintained* and *operated* in accordance with the approved site procedures. This caution issued to ensure users of the FillSafe<sup>™</sup> system maintain the system integrity. Forcibly overriding the automatic shut-off mechanism of a dry-break nozzle during refuelling is in breach of Banlaw's recommended operating procedure and will remove the redundancy provided by the dry-break refuelling system.

The FillSafe Power (BFSP2R series) controller is robustly constructed to withstand harsh operating environments. The cast aluminium enclosure is anodised to provide increased corrosion resistance, whilst the front fascia (HMI) incorporates a Gedakop<sup>™</sup> plaque and high quality, impact-resistant piezo-electric pushbuttons for superior sealing against environmental elements, including high-pressure wash-down water.

The system will fail to a safe state only if all parts in the FillSafe Power system are designed to do so. The FillSafe Power GEN-4 controller will instruct the actuated valve to close when the controller detects the following failures in the system:

- If the wiring between the controller and tank level switch has failed (Only if optional Smart TLS is fitted),
- unexpected actuated valve position (Only if optional Actuated ball Valve with position feedback is fitted), and
- over-temperature detection.

Note that loss of power to the system will only result in the closure of the actuated valve to a closed state if the actuated valve is designed to close automatically under such a condition. An example of such actuated valves are; normally closed spring rewind electric actuators and single acting pneumatic valves.

The BFSP2R GEN-4 series controller incorporates improved electrical protection against irregular input power  $(11 \sim 32V_{DC})$  including:

- Reverse polarity protection.
- Surge and ESD protection.
- Under and overvoltage protection.
- AC blocking.
- Overcurrent protection.
- Inrush current protection.
- ESD protection using piezo-electric pushbuttons.



This document contains content that is specific to the current generation of the Banlaw FillSafe Power system (formerly known simply as Banlaw FillSafe<sup>™</sup>). Users of earlier generation FillSafe systems are advised to contact Banlaw for information specifically related to the system in use. Please refer to APPENDIX A - Previous Obsolete Versions – FillSafe Controllers for the means to distinguish the various generations of the Banlaw FillSafe systems. The Banlaw Gen4 FillSafe Power System is backward compatible with all

actuated valves and level switches/sensors used in generations 1, 2 and 3 of FillSafe controllers.

# 5 Product Specifications

# 5.1 FillSafe Power BFSP2R (Series) Controller Unit

Material properties	Aluminium cast	body, EPDM gas	ket
Operating temperature (°C / °F)	-40°C (-40°F) < T <sub>amb</sub> < +75°C (167 °F)		
Nominal supply voltage	11 ~ 32V <sub>DC</sub>		
Under voltage protection	10 VDC		
Over voltage protection	33 VDC		
Maximum reverse voltage protection level	38 Volts DC		
AC blocking	50/60 Hz		
Connection type	M20x1.5P Conduit Entry	12 pin DT Series Deutsch Plug	MIL Spec 10 Pin Plug
IP (Ingress Protection) * Gland IP rating shall be of IP66 to meet product IP rating;	IP 66* IP64 IP66		IP66
Relay maximum contact current and voltage rating	8 Amps @ 440Vac or 8 Amps @ 300Vdc		
Over-current protection	Power input cable protection fuse:		
	Trip current – 4A		
	Board protection self-resettable fuse:		
	The nominal trip current of 0.5A		
Mounting orientation	Left or Right		
Maximum insulation test voltage (FillSafe   38 Volts dc     Terminals)   38 Volts dc			
Nominal mass of FillSafe Power controller	1 Kg		
Maximum Level Switch Input Voltage	5V		
# Fill time setting (watchdog timer in minutes)	A = 15min, B = 30 min, C = 45min, D = 60 min		
# Smart Level Switch (0 = NO)	Tank Level Sensing		
* Smart Level Switch (1 = YES)	Tank Levels Sensing plus BFSPLS Series Level Switch functions		S Series Level
# Ball Valve Feedback (N = NO)	Feedback (N = NO) Operates Ball Valve		
# Ball Valve Feedback (Y = YES)	Call Valve Feedback (Y = YES)Operates Ball Valve plus provides Feedback valve position and wiring integrity.		s Feedback on y.

Table 1: Product Specification Table

# Configured at manufacture.

PCB Pin#	Description	Designation	Deutsch Plug	Mil-Spec Plug	M20x1.5(F) Thread
1	Ball valve open feedback	BV OPN STS	1	A	1
2	Ball valve close feedback	BV CLS STS	2	В	2
3	Ball valve relay N/O negative contact	BV N/O	3	С	3
4	Ball valve relay N/C negative contact	BV N/C	4	D	4
5	Main power input +V	24V IN	5	E	5
6	Ball valve +V	BV 24V	6	F	6
7	Main power 0V	OV IN	7	G	7
8	Ball valve 0V	BV OV	8	Н	8
9	Smart level sensor signal (5V) Conventional level Switch excitation (5V) out	LEVEL +	9	J	9
10	Smart level sensor 0V Conventional Level Switch excitation in (5V)	LEVEL -	10	К	10
-	Not in use, seal plug if applicable	n/a	11	-	-
-	Not in use, seal plug if applicable	n/a	12	-	-

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#### Table 2:Deutsch Plug, MIL Spec Plug and M20x1.5 (F) Conduit Connections

5.2 Product Families and Part Numbering Convention



# Figure 3 - Part Numbering Convention (how to order your Banlaw FillSafe<sup>™</sup> Power Controller)

The part number code is based upon the options that are activated for the chosen product.

Example 1:	BFSP2R1 <b>MB</b> LY	BFSP2R Banlaw FillSafe <sup><math>M</math></sup> Power Controller, MIL Spec Plug Connection ( <b>M</b> ), with Level Switch ( <b>1</b> ), Timer setting 30 min ( <b>B</b> ), Left Mounting ( <b>L</b> ) and Ball Valve Feedback ( <b>Y</b> ).
Example 2:	BFSP2R1DCR N	BFSP2R Banlaw FillSafe <sup>™</sup> Power Controller, Deutsch Plug Connection ( <b>D</b> ), with Level Switch ( <b>1</b> ), Timer setting 45 min ( <b>C</b> ), Right Mounting ( <b>R</b> ) and NIL Ball Valve Feedback ( <b>N</b> ).

# 5.3 Options

Options available must be specified when ordering the FillSafe Power Controller.

#### 5.3.1 Smart Level Switch

This option lets Banlaw know what type of level switch is to be used. A Smart Level Switch provides diagnostic feedback to the Power Controller this feedback will flag errors on the Power Controller HMI, this aids in fault diagnosis and will alert operators to fault conditions prior to dispensing fuel. A standard Level Switch has no diagnostic capability.



The Controller supplies a 5 Volt signal for its operation. Do not apply any voltage to pin 9. Doing so may damage the Controller or render it inoperable.

# 5.3.2 Plug Type

Specify the plug type most suited to your installation. The options are:

- 12 pin DT Series Deutsch Receptacle. Note: Gen 3 controllers have 8 Pin Receptacles. See Appendix D.
- M20x1.5(P) suitable for conduit threaded entry.
- MIL-SPEC Style connector 10 Pin.

#### 5.3.3 Watchdog timer setting

The watchdog timer is started when the Fill button is pressed. This timer will automatically close the actuated valve once the present time option has elapsed, irrespective if the tank has been filled or not. Time options are given in the Product Specifications section. This ensures the valve is only open during refuelling and will be normally closed otherwise.

#### 5.3.4 Mounting orientation

The options are for right-hand or left-hand connection. This option is so that the cover plate will be in a readable state and not display the text upside down.

#### 5.3.5 Ball Valve Feedback

This option specifies the type of Actuated Valve that is installed. An Actuated Valve with Feedback provides diagnostic feedback to the Power Controller. This feedback will flag errors on the Power Controller HMI, which aids in fault diagnosis and will alert operators to fault conditions prior to dispensing fuel.

#### 6 The FillSafe Power OFP System Operation

# 6.1 Human Machine Interface (HMI)

The front control panel (HMI) of the Controller incorporates:

- "STOP" piezo-electric style push button with integrated RED LED.
- "FILL" piezo-electric style push button with integrated GREEN LED.



Figure 4 - Front Panel (HMI) of Controller

The purpose of each HMI component is:

#### STOP push button:

- When pressed will prompt the Actuated Valve to close during tank refilling prior to activation of the Level Switch.
- When pressed and held for at least 5 seconds, forces a reset of the Controller in the event of a malfunction which can be rectified by a reset.

#### **RED** LED:

- "OFF" (unlit) when power is off. The system is inoperable.
- "ON" (lit) when power is available to the Controller.

#### FILL push button

- When pressed will command the Actuated Valve to **open** whenever the fluid level remains below the activation level of the Tank level Sensor.
- When pressed, the watchdog timer starts.

GREEN LED:

- "OFF" (unlit) when power off, or when the fluid level is at or above the activation level of the TLS.
- "ON" (lit) when the fluid level is below the activation level of the Level Switch, and the Actuated Valve is closed or closing.
- "Flashing" (on and off) when power is available to the Controller, the fluid level is below the activation level of the Level Switch, and the Actuated Valve is open or opening.

# 6.2 Normal Operation

With the system installed and operating normally, the controller is monitoring the tank level switch continuously and will display via the front panel the system status. See **Table 3 HMI Indications**.

The operator will observe the RED and GREEN LEDs continuously lit if the tank can be filled i.e. power is applied and the tank level is below the TLS Trip Level. In the event the fluid level is below the Level Switch, the operator should determine the actual fluid level within the tank using a separate tank gauging system and decide whether to refill the tank.

To initiate filling the operator presses the **FILL** button. When the button is pressed the following occur:

- The watchdog time starts,
- The actuated ball valve is commanded to open,
- The GREEN LED begins flashing,
- The TLS is continuously monitored for tank full indication.

When the TLS detects the tank is full the following occur:

- The GREEN LED goes out,
- The actuated ball Valve is commanded to close.

The filling operation is complete.

# 6.3 Abnormal Operation

**Over Temperature.** The FillSafe Controller continuously monitors temperature in the controller. If the temperature in the controller exceeds 75°C then the controller will enter a failed state and the following will occur:

- The actuated Ball Valve will be commanded closed,
- The RED and GREED LEDs will flash simultaneously at once a second.

The system will remain in this condition until the Stop button is pressed. When the Stop button is pressed the system will remain inoperable until the temperature in the controller reduces to 60° C.

**Tank Level Switch Failure**. If the optional Smart TLS has been included in the system, the FillSafe Controller continuously monitors the Harness connection between the Controller and TLS. If a fault is detected:

• The actuated Ball Valve will be commanded to close. Note, due to fault it may not close.

• The **RED** and **GREED** LEDs will flash alternately at once per second.

The system will remain in this condition until the stop button is pressed and fault rectified.

**Actuated Ball Valve Failure.** If the optional ball valve actuator with position feedback has been included in the system and a position error is detected:

- The actuated Ball Valve will be commanded closed,
- The **RED** and **GREED** LEDs will flash alternately at ten times a second.

The system will remain in this condition the stop button is pressed.

# 6.4 Safety Features Description

The following paragraphs explain the operation of the safety features of the FillSafe Power Controller.

# 6.4.1 FillSafe Controller – Watchdog Timer

The "watchdog" timer is a feature of the Controller whereby an individual Controller is factory pre-set with a nominated setting, i.e. either 15 (default), 30, 45 or 60mins. This timer is activated once the "FILL" push-button is pressed, and in the event the actuated valve has not *already* been closed, the Controller will prompt the valve to automatically close once the timer period has elapsed.

Section 0 details the part numbering convention of the FillSafe Power Controllers. Each Controller purchased using this convention will have the watchdog timer pre-set by Banlaw during manufacture.

In the event the watchdog timer for a specific Controller has been incorrectly selected prior to purchase, the controller must be returned to the pace of purchase and sent back to Banlaw for reconfiguration.

If the watchdog timer feature closes the Actuated Valve prior to the tank being filled – i.e. prior to activation of the FillSafe Level Switch – the Controller can be reset to allow the tank refilling process to resume by either:

- Waiting for a period of approx. 2 seconds after the watchdog timer has elapsed, until the **GREEN** LED comes back on (is lit) on the Controller.
- Pressing and holding the "STOP" button on the Controller for approx. 5 seconds to force a Controller reset.



Resuming filling of a tank can only occur:

- The RED LED is Lit
- The FillSafe Level Switch has *not* been activated.
- The **GREEN** LED is lit (on).
  - The "FILL" button is pressed, after which:
    - The **GREEN** LED starts to flash.
    - The Actuated Valve opens.

# 6.4.2 Actuated Valve Feedback Monitoring (optional feature)

The FillSafe Power GEN-4 controller monitors the position of the optional actuated valve with position feedback and will fail the system if the actuated valve:

- Does not start open/close the valve within 3 seconds of command,
- Does not stop open/close valve within 30 seconds command, and
- Does not open/close entirely

The GEN-4 controller monitors actuated valve position (open/close/transition) and will command a valve to close when a failure is discovered. This fault notification is displayed until the "STOP" button is pressed.

The FillSafe Power GEN-4 controller is backward compatible with previous generations of the FillSafe Power series. This allows GEN-4 controller to replace previous generations of FillSafe controllers without the need to replace level switch or actuated valve. Banlaw recommends using an actuated ball valve with feedback for improved system reliability and security. Note that the level switch power circuit must not exceed 5VDC.

Section 0 details the part numbering convention of the FillSafe<sup>™</sup> Power controllers. Each controller purchased using this convention will have the actuated valve feedback monitoring pre-set by Banlaw during manufacture. Adjustment of the valve feedback monitoring setting by a customer is not recommended by Banlaw.

In the event the valve feedback monitoring for a specific controller has been incorrectly selected prior to purchase, please contact Banlaw or your nearest authorised Banlaw agent for instruction.

#### 6.4.3 Level Switch Operation

The Gen 4 controller can interface to two types of level sensor, a smart level sensor and a conventional level switch. The choice of level sensor is made at purchase and the controller is configured to interface with that level sensor at manufacture. The interface to both level sensor /switch is discussed below.

#### 6.4.3.1 Smart Level Sensor Feedback Monitoring (optional feature)

The Banlaw Smart Level Sensor<sup>™</sup> has the improved features over the previous level switch that brings improved data and safety to the GEN-4 controller and system:

- Response with the following information from FillSafe<sup>™</sup> Power controller query
  - Alive signal
  - CRC (optional, disabled as default factory setting)
  - Interface wire short or level switch damage report
- Low voltage operation (5V) reducing ignition risk.

The Controller communicates with the smart level sensor via a "one wire" interface where the communication and power for the sensor are supplied through pin 9 and the power supply common is supplied at pin 10. When the smart level switch option is selected use pins 9 and 10 as shown in the installation schematic.



TOP VIEW - PUCK

PIN No#	DESCRIPTION	
1	+LEVEL	
2	-LEVEL	
3	+FLOAT 1 (NO POLARITY	
4	-FLOAT 1 (NO POLARITY	
5	+FLOAT 2 (NO POLARITY	
6	-FLOAT 2 (NO POLARITY	

#### Figure 5: Smart Level Sensor Puck Wiring Terminations

#### 6.4.3.2 Use of a conventional Level Switch

When using a conventional level switch wire the contacts to the switch as shown in **Figure 6** below. This is the only configuration approved for use where the switch is excited by the Controller.



# Figure 6 Conventional Level Switch Installation

When a conventional level switch is used where the level switch uses an excitation supply other than 5V then the interface should be as shown in **Figure 7**.



# Figure 7 Convention Level Switch Interface

**Note:** Never apply voltages generated externally from the controller, this may lead to improper operation or system damage.

# 7 FillSafe System Installation

# 7.1 Pre-Installation Requirements

A critical pre-installation requirement for any Banlaw product, is to ensure the product complies with all necessary and regulatory requirements related to the use of the product within a country/region, and within a specific application. Critical issues to assess typically include:

- 1. Specific requirements related to the industry sector, e.g. mining, rail, marine, aviation, military, etc.
- 2. Specific regulatory requirements for the region or country, e.g. Australia, USA, Canada, Russia, EU, Indonesia, etc.
- 3. Specific requirements related to the proposed application e.g.:
  - a. Purpose, role and objectives of the product, i.e. the intended application(s) for the product.
  - b. How the product will be used, e.g. fluid types, fluid pressures, fluid flowrates, pressure relief etc.
  - c. For trade (custody transfer) use (if applicable).
  - d. Interaction or integration with other systems or products.
  - e. Where a product will be installed, e.g. within a workshop, on-board a mobile vehicle.
- 4. Specific requirements related to hazardous area (explosive atmosphere) classification.
- 5. Specific requirements related to the client or end-user, e.g. many international companies have their own specific Standards related to the safe and proper use of certain products.
- 6. Specific requirements related to the environmental conditions, e.g.:
  - a. Arctic (extreme cold).
  - b. Higher ambient temperatures.
  - c. Higher humidity.
  - d. Higher wind, e.g. cyclone/tornado areas.
  - e. Higher rainfall.
  - f. Higher levels of airborne dust and other elements.
  - g. Overly corrosive environments.
  - h. Higher structural loads.
  - i. Higher degrees of mechanical vibration
- 7. Where Banlaw personnel or persons managed by Banlaw are involved, persons undertaking a task must be competent to undertake each task.

All the above points must be considered, as new requirements within any of these points may constitute an "uncommon" (unfamiliar) product application. Each of the above points will have some bearing on the suitability of a Banlaw product for a given application.



Due to the pre installation requirements that apply to a Banlaw product, the client must liaise with Banlaw <u>prior</u> to the use of the product within an application that is deemed to be "uncommon".

Other pre-installation requirements specifically related to the Banlaw FillSafe Power system include:

 Ensuring the proposed application will be in accordance with the system specifications and requirements as noted in **Product Specifications**. The FillSafe system should not be considered for installation in the event these specifications cannot be met and maintained. 2. Appendix B – FillSafe Power level Switch Calculations.



Failing to adequately: identify, investigate, assess and conform with all necessary requirements for a Banlaw product application may result in hazardous situations.

# 7.1.1 System Actuated Valve Response Time – See also Appendix B

The time between the command to close and the time the valve closes is termed the actuation time. The Actuation Time of a specific FillSafe system will influence the specification of FillSafe system components, particularly the position, within the tank, at which the Level Switch is activated.



Prior to specifying a FillSafe Level Switch for an application, consideration must be given actuated valve *Times time* for "open to close" and for "closed to open", where each Times time may vary for specific types of valve actuators. For example:

- "Single acting" actuators: whether electrically or pneumatically actuated, only require external power (whether electrical or compressed/service air) to Times between *either* "open to closed" or "closed to open" valve positions. Examples of single acting actuated valves include: solenoid valves, and quarter-turn (0-90°) valves fitted with a single acting type actuator. As most FillSafe system actuated valves are configured as normally closed (N/C), external power is only required to Times the valve from "closed to open". In the event this power is isolated (cut) from the actuator, it will *automatically* Times from "open to closed" typically using an integral spring mechanism. The Actuation Times for most single acting valves will vary, specifically:
  - "Closed to open" (powered); *longer* Actuation Time.
  - "Open to closed" (unpowered); *shorter* Actuation Times.
- "Double acting" actuators; whether electrically or pneumatically actuated, double acting type actuators require energy (whether electrical or compressed/service air) to Times between *both* "open to closed", and "closed to open" valve positions. As most FillSafe system actuated valves are configured as normally closed (N/C), external power is required to both set the valve from "closed to open", *and* from "open to closed". In the event this power is isolated (cut) from the actuator, it's position will *remain stationery* (i.e. it's position shall remain unchanged). The times for most double acting valves are the same, i.e. the times for "open to closed" and "closed to open" valve positions are typically equal.

When the FillSafe Level Switch closes the Controller will command the Actuated Valve to close. The style of valve used will determine the time taken to fully close the valve. This period is the Actuation Time between activation of the Level Switch and (full) closure of the Actuated Valve. This time Lag must be considered when configuring a FillSafe system for **all** applications. Other application variables must also be considered:

- Incoming fluid flowrate into the tank.
- Dimensions of the tank, specifically the free surface area of the fluid at the "switching level" of the Level Switch.

In summary, the combination of the above FillSafe system variables will influence the switching level of the Level Switch relative to the SFL (or other required fill level) of the tank.

As an example, Figure 8 - Illustration of a Level Switch installed with a Banlaw Tank Vent, illustrates a FillSafe installation incorporating a Banlaw (or similar) dry-break diesel refuelling system, specifically a Banlaw Tank Vent. The time lag of the FillSafe system in this example influences the dimension " $\Delta$ H Buffer" – i.e. the vertical distance between the "switching" and "vent closed" fluid levels. Consideration of the necessary installation variables will determine the fluid level at which the Level Switch must "switch" to ensure subsequent complete closure of the Actuated Valve prior to the Banlaw tank vent closing. Termination of the inflow of fluid after closure of the vent will – in this example – cause internal pressurisation of the tank, and in some circumstances, overfilling of the tank, spillage of fluid from the vent(s), and the risk of over-pressurisation of the tank.



# Figure 8 - Illustration of a Level Switch installed with a Banlaw Tank Vent



Once a FillSafe system has been safely and properly configured after consideration of all necessary installation variables, an engineering assessment of the FillSafe system must be undertaken prior to *any change* to such a variable(s). For example, an increase in the tank refilling rate or a change in the SFL of the tank will require such an *assessment*.

For information related to evaluating the Absolute Level Switch Shutoff value refer to APPENDIX B - FillSafe Power Level Switch Calculations

# 7.1.2 Effect of Tank Gradient

This section outlines guidelines for mitigating risk when using the FillSafe Power system, specifically when a tank is refilled on a gradient.

Figure 9 - Five (5) Potential Tank Gradient Scenarios illustrates 5 possible scenarios (A to E) of refilling a tank on a gradient and illustrates the effect such a gradient has on the relative installed location of a FillSafe Level Switch and a tank vent – Banlaw tank vent shown.

- A) This scenario illustrates a proper installation with the tank on level ground.
- B) Scenario B illustrates an unacceptable installation where the level switch is installed quite some distance from the tank vent. The effect of the gradient in this case will cause the tank vent to close some time before the fluid reaches the level switch, by which time internal pressurisation of the tank will have occurred and likely fluid spillage from the vent.
- C) Scenario C depicts the correct proximity of the level switch to the vent, although the effect of the gradient in this case will reduce the volume of fluid stored in the tank i.e. the usable tank capacity once the level switch is activated.

- D) Scenario D illustrates the correct proximity of the level switch to the vent. The effect of the gradient in this case will <u>increase</u> the volume of fluid stored in the tank – i.e. the usable tank capacity - once the level switch is activated. Overfilling the tank is possible in some cases.
- E) Scenario E illustrates the correct proximity of the level switch to the vent, with both items installed in the centre of the tank. This will achieve a compromise between scenarios C & D in the event tank gradients in either direction is common whilst refilling.

This section shall be considered in conjunction with **Figure 9** to ensure correct specification of the Level Switch, and the correct placement of the Level Switch with a tank vent(s).



Figure 9 - Five (5) Potential Tank Gradient Scenarios

# 8 Maintenance

This section provides troubleshooting recommendations for the Banlaw BFSP2R Series Power Controller when installed, operated and maintained in accordance with Banlaw guidelines. Any fault should be rectified at the earliest possible opportunity. Faults deemed by the end-user to be unsafe must be rectified before the fluid dispensing system is again used.

Observe the front panel of the FillSafe power controller and note the state of illumination of the Stop and Fill Buttons

Stop LED	Fill LED	Comments
Off	Off	Power off or failed
On	Off	Power available and Tank level above TLS trip level
On	On	Power available and Tank level below TLS trip level
On	Flashing @ once / sec	Power available, Tank is filling
Flashing @ 10 Times / sec	Flashing @10 Times / sec	LEDs are flashing alternately; Actuated ball valve position error *
Flashing @ once / sec	Flashing @ once / sec	LEDs are flashing alternately; TLS error *
Flashing @ once / sec	Flashing @ once / sec	LEDs are flashing simultaneously; Over Temperature Error

#### **Table 3 HMI Indications**

\* Only on models fitted with smart TLS and /or actuated ball valve with feedback

# 9 Spare Parts

There are no spare parts available, if the unit is faulty return it to Banlaw for service or replacement.

# **10 Product Warranty**

Banlaw is committed to providing quality products and services. To provide further assurance, our products and services are backed by generous warranties.

A copy of the Banlaw product warranty terms and conditions is available from Banlaw, the Banlaw website, or your nearest authorised Banlaw agent.

# 10.1 Warranty Claim Process

To help us provide better customer support, please follow the process below when returning parts under warranty:

- 1. Contact the Banlaw Helpdesk and obtain a Return Authorisation Number prior to shipping the product.
- 2. Fill in a Warranty Claim Form (which can be downloaded from www.banlaw.com).
- 3. Ship the product and Form to the place of purchase, clearly labelled "Warranty".

Banlaw will assess the claim and determine whether warranty is applicable and take appropriate action. Banlaw may contact you for further information, so please ensure correct contact details are included on the claim form.

If assistance is required with respect to Banlaw's Warranty, or to check the warranty status for your product, contact your approved supplier.

#### **APPENDIX A - Previous Obsolete Versions – FillSafe Controllers**

The current Banlaw FillSafe<sup>™</sup> Power G4 system is the 4<sup>th</sup> generation of the FillSafe system.

Figure 10 illustrates an example of a 1<sup>st</sup> generation FillSafe<sup>™</sup> Controller.

• ZP2 series "Blue Box" unit.



Figure 10 – 1st Generation FillSafe™ ZP2 Controller

**Figure 11** illustrates an example of a 2<sup>nd</sup> generation BFSZP2R series FillSafe<sup>™</sup> controller, the first Controller to use the custom-manufactured cast metal enclosure. The user interface (HMI) used a membrane style front fascia incorporating 2 LEDs and 2 push-buttons.



Figure 11 – 2nd Generation FillSafe<sup>™</sup> BFSZP2R Series Controller

**Figure 12** illustrates an example of the current 3<sup>rd</sup> generation BFSP2R series FillSafe<sup>™</sup> Power controller, incorporating *piezo-electric push-buttons* with integral coloured LEDs, *"plug & play*" functionality, and a completely new PCB board.



Figure 12 – 3rd Generation FillSafe<sup>™</sup> Power BFSP2R Series Controller

Figure 13 illustrates an example of the current 4<sup>th</sup> generation BFSP2R series FillSafe<sup>™</sup> Power G4 controller, adding noticeably features from the 3<sup>rd</sup> generation.

- Wide input voltage range
- Comply with EN50155 for rail industry applications
- Comply with industrial industry temperature range (-40 to 85°C)
- Input power cable ignition (by over-current flow) protection
- Actuated valve feedback monitoring, exceptional status management, and alarm display
- Banlaw Smart Fluid Level Switch<sup>™</sup> with exceptional status detection and management and alarm display
- Over-temperature detection (FillSafe<sup>™</sup> inside) and management, and alarm display
- Backward compatibility with the former version of FillSafe<sup>™</sup> Power series



Figure 13 – 4th Generation FillSafe<sup>™</sup> Power BFSP2R Series Controller

# **APPENDIX B - FillSafe Power Level Switch Calculations**

The FillSafe Power system can be configured to a wide range of flow rates and applications. In order to correctly design a system for a given application, it is first required that some calculations must be undertaken.

It is critical that the final ullage of the tank is known, and that the calculations ensure that the level switch is designed so that the relationship between the flow rate, tank geometry and actuated valve lag are taken into account. This will avoiding tank over fill or underfill.

To calculate the required level sensor shutoff length, a few parameters MUST be known. The calculation of the length of the level sensor is vital to ensure that the final level fluid does not exceed the tank capacity, minimum tank Air Gap (Ullage), or reach the vent valve shutoff level. The calculation method below will ensure



that the "Buffer" value remains positive. Once the **Absolute Level Sensor Shutoff** is known, the Buffer value at final fluid level will be zero, and it is advised to add a nominal additional length to the level Sensor if required to increase the nominal "Buffer".

The physical dimensions of the tank, the fill flow-rate, the actuated valve closure time and the nominal shutoff level for the tank vent OR the air gap ullage must be taken into account.



If Buffer = 25mm, the final design length will be 140mm.

#### **APPENDIX C - Product Part Numbers**

10.1.1.1 M20x1.5(F) Conduit Entry Version



Figure 14 - FillSafe Power Controller M20x1.5(F) Conduit Version

[	BFSP2R T		]
	SMART LEVEL SWITCH 0: NO 1: YES	WATCHDOG TIMER: A: 15 MIN B: 30 MIN C: 45 MIN D: 60 MIN	BALL VALVE FEEDBACK Y: YES N: NO
	PLUG TYPE T: M20(F) D: DEUTCH M: MILSPEC	MOUN ORIENT L: LE R: RIC	TING ATION FT SHT
BFSP2R0TALY	FillSafe Power Controller NLF M20X1.5F 15 min Left BVF	BFSP2R0TALN	FillSafe Power Controller NLF M20X1.5F 15 min Left NBVF
BFSP2R0TARY	FillSafe Power Controller NLF M20X1.5F 15 min Right BVF	BFSP2R0TARN	FillSafe Power Controller NLF M20X1.5F 15 min Right NBVF
BFSP2R0TBLY	FillSafe Power Controller NLF M20X1.5F 30 min Left BVF	BFSP2R0TBLN	FillSafe Power Controller NLF M20X1.5F 30 min Left NBVF
BFSP2R0TBRY	FillSafe Power Controller NLF M20X1.5F 30 min Right BVF	BFSP2R0TBRN	FillSafe Power Controller NLF M20X1.5F 30 min Right NBVF
BFSP2R0TCLY	FillSafe Power Controller NLF M20X1.5F 45 min Left BVF	BFSP2R0TCLN	FillSafe Power Controller NLF M20X1.5F 45 min Left NBVF
BFSP2R0TCRY	FillSafe Power Controller NLF M20X1.5F 45 min Right BVF	BFSP2R0TCRN	FillSafe Power Controller NLF M20X1.5F 45 min Right NBVF
BFSP2R0TDLY	FillSafe Power Controller NLF M20X1.5F 60 min Left BVF	BFSP2R0TDLN	FillSafe Power Controller NLF M20X1.5F 60 min Left NBVF
BFSP2R0TDRY	FillSafe Power Controller NLF M20X1.5F 60 min Right BVF	BFSP2R0TDRN	FillSafe Power Controller NLF M20X1.5F 15 min Left NBVF
BFSP2R1TALY	FillSafe Power Controller LF M20X1.5F 15 min Left BVF	BFSP2R1TALN	FillSafe Power Controller LF M20X1.5F 15 min Left NBVF
BFSP2R1TARY	FillSafe Power Controller LF M20X1.5F 15 min Right BVF	BFSP2R1TARN	FillSafe Power Controller LF M20X1.5F 15 min Right NBVF
BFSP2R1TBLY	FillSafe Power Controller LF M20X1.5F 30 min Left BVF	BFSP2R1TBLN	FillSafe Power Controller LF M20X1.5F 30 min Left NBVF
BFSP2R1TBRY	FillSafe Power Controller LF M20X1.5F 30 min Right BVF	BFSP2R1TBRN	FillSafe Power Controller LF M20X1.5F 30 min Right NBVF
BFSP2R1TCLY	FillSafe Power Controller LF M20X1.5F 45 min Left BVF	BFSP2R1TCLN	FillSafe Power Controller LF M20X1.5F 45 min Left NBVF
BFSP2R1TCRY	FillSafe Power Controller LF M20X1.5F 45 min Right BVF	BFSP2R1TCRN	FillSafe Power Controller LF M20X1.5F 45 min Right NBVF
BFSP2R1TDLY	FillSafe Power Controller LF M20X1.5F 60 min Left BVF	BFSP2R1TDLN	FillSafe Power Controller LF M20X1.5F 60 min Left NBVF
BFSP2R1TDRY	FillSafe Power Controller LF M20X1.5F 60 min Right BVF	BFSP2R1TDRN	FillSafe Power Controller LF M20X1.5F 60 min Right NBVF

#### 10.1.1.2 Deutsch Plug Version







	FillSafe Power Controller NLF		FillSafe Power Controller NLF DEUTSCH
BESPZRUDALY	DEUTSCH Plug 15 min Left BVF	BFSPZRUDALN	Plug 15 min Left NBVF
BESP2RODARY	FillSafe Power Controller NLF		FillSafe Power Controller NLF DEUTSCH
DI SI ZI(ODAI(I	DEUTSCH Plug 15 min Right BVF	DI OI ZIODANN	Plug 15 min Right NBVF
BESP2RODBLY	FillSafe Power Controller NLF	RESP2RODRI N	FillSafe Power Controller NLF DEUTSCH
	DEUTSCH Plug 30 min Left BVF	DI GI ZI(ODDEN	Plug 30 min Left NBVF
BESP2R0DBRY	FillSafe Power Controller NLF	BESP2R0DBRN	FillSafe Power Controller NLF DEUTSCH
	DEUTSCH Plug 30 min Right BVF	51 01 2105 5101	Plug 30 min Right NBVF
BFSP2R0DCLY	FillSafe Power Controller NLF	BFSP2R0DCLN	FillSafe Power Controller NLF DEUTSCH
5. 0. 2.05 02.	DEUTSCH Plug 45 min Left BVF	51 01 2105 0211	Plug 45 min Left NBVF
BFSP2R0DCRY	FillSafe Power Controller NLF	BFSP2R0DCRN	FillSafe Power Controller NLF DEUTSCH
	DEUTSCH Plug 45 min Right BVF		Plug 45 min Right NBVF
BFSP2R0DDLY	FillSafe Power Controller NLF	BFSP2R0DDLN	FillSafe Power Controller NLF DEUTSCH
	DEUTSCH Plug 60 min Left BVF		Plug 60 min Left NBVF
BFSP2R0DDRY	FillSafe Power Controller NLF	BFSP2R0DDRN	FillSafe Power Controller NLF DEUTSCH
	DEUTSCH Plug 60 min Right BVF		Plug 60 min Right NBVF
BFSP2R1DALY	FIIISate Power Controller LF DEUTSCH	BFSP2R1DALN	FILISATE POWER CONTROLLE DEUTSCH
	Fillor for David Constration LE DEUTOOL		Flug 15 min Left NBVF
BFSP2R1DARY	FillSale Power Controller LF DEUTSCH	BFSP2R1DARN	FillSale Power Controller LF DEUTSCH
BFSP2R1DBLY	Philode Power Controller LF DEUTSCH	BFSP2R1DBLN	Philode Power Controller LF DEUTSCH
	FillSofo Dower Controller LE DEUTSCH		FillSofe Dower Controller   E DELITSCH
BFSP2R1DBRY	RY FillSale Power Controller LF DEUTSCH	BFSP2R1DBRN	Philodie Power Controller LF DEUTSCH
	Fills of Dower Controller LE DEUTSCH		FillSafa Dowar Controllar LE DELITSCH
BFSP2R1DCLY	Plug 45 min Left BVF	BFSP2R1DCLN	Plug 45 min L oft NBVE
	FillSafe Power Controller LE DEUTSCH		FillSafe Power Controller LE DELITSCH
BFSP2R1DCRY	Plug 45 min Right BVF	BFSP2R1DCRN	Plug 45 min Right NBVE
	FillSafe Power Controller LE DEUTSCH		FillSafe Power Controller LE DELITSCH
BFSP2R1DDLY	Plug 60 min Left BVF	BFSP2R1DDLN	Plug 60 min Left NBVF
	FillSafe Power Controller LE DELITSCH		FillSafe Power Controller LE DELITSCH
BFSP2R1DDRY	Plug 60 min Right BVF	BFSP2R1DDRN	Plug 60 min Right NBVF

#### 10.1.1.3 MIL Spec. Plug Version







RESDODOMALV	FillSafe Power Controller NLF MILSPEC	BFSP2R0MALN	FillSafe Power Controller NLF MILSPEC
DESEZRUIVIALT	Plug 15 min Left BVF		Plug 15 min Left NBVF
RESDODOMADY	FillSafe Power Controller NLF MILSPEC		FillSafe Power Controller NLF MILSPEC
DFSFZRUIVIART	Plug 15 min Right BVF	DFSFZRUIVIARIN	Plug 15 min Right NBVF
	FillSafe Power Controller NLF MILSPEC		FillSafe Power Controller NLF MILSPEC
DFSPZRUIVIDLY	Plug 30 min Left BVF	DFSPZRUIVIDLIN	Plug 30 min Left NBVF
RESDODOMRDV	FillSafe Power Controller NLF MILSPEC	RESDODOMRDN	FillSafe Power Controller NLF MILSPEC
DFSFZRUIVIDRT	Plug 30 min Right BVF	DESEZKUIVIDKIN	Plug 30 min Right NBVF
	FillSafe Power Controller NLF MILSPEC		FillSafe Power Controller NLF MILSPEC
DFSPZRUIVICLY	Plug 45 min Left BVF	DFSPZRUWUCLIN	Plug 45 min Left NBVF
RECORDANCOV	FillSafe Power Controller NLF MILSPEC		FillSafe Power Controller NLF MILSPEC
DESEZRUIVICRY	Plug 45 min Right BVF	DFSPZRUNICRN	Plug 45 min Right NBVF
	FillSafe Power Controller NLF MILSPEC		FillSafe Power Controller NLF MILSPEC
BESPZRUMULY	Plug 60 min Left BVF	BESPZRUMULIN	Plug 60 min Left NBVF
DECDODOMDDV	FillSafe Power Controller NLF MILSPEC	BFSP2R0MDRN	FillSafe Power Controller NLF MILSPEC
DFSPZRUIVIDRY	Plug 60 min Right BVF		Plug 60 min Right NBVF
	FillSafe Power Controller LF MILSPEC		FillSafe Power Controller LF MILSPEC
DESEZKTIVIALT	Plug 15 min Left BVF	DI SI ZIVINIALIN	Plug 15 min Left NBVF
RESDOD1MADV	FillSafe Power Controller LF MILSPEC	BFSP2R1MARN	FillSafe Power Controller LF MILSPEC
DFSPZRINARY	Plug 15 min Right BVF		Plug 15 min Right NBVF
	FillSafe Power Controller LF MILSPEC		FillSafe Power Controller LF MILSPEC
DFSFZRINDLT	Plug 30 min Left BVF	DESEZKTIVIDLIN	Plug 30 min Left NBVF
	FillSafe Power Controller LF MILSPEC		FillSafe Power Controller LF MILSPEC
DFSPZRINDRY	Plug 30 min Right BVF	BESPZRINIBRN	Plug 30 min Right NBVF
RESDOD1MOLV	FillSafe Power Controller LF MILSPEC	RESDOD1MOLNI	FillSafe Power Controller LF MILSPEC
DFSFZRINICLT	Plug 45 min Left BVF	BESPZRIMULIN	Plug 45 min Left NBVF
	FillSafe Power Controller LF MILSPEC		FillSafe Power Controller LF MILSPEC
DFSPZRTNICRY	Plug 45 min Right BVF	BESEZKIMUCRN	Plug 45 min Right NBVF
	FillSafe Power Controller LF MILSPEC		FillSafe Power Controller LF MILSPEC
DFSFZRIMDLY	Plug 60 min Left BVF	BESP2RIMULN	Plug 60 min Left NBVF
RESDOD1MDDV	FillSafe Power Controller LF MILSPEC	BFSP2R1MDRN	FillSafe Power Controller LF MILSPEC
DESEZKINDRY	Plug 60 min Right BVF		Plug 60 min Right NBVF



Figure 17 - BFSP2R\*T\*\* M20x1.5 Conduit Connection

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Figure 19 - BFSP2R\*M\*\* MIL Spec Connector

#### **APPENDIX D – Gen 3 Deutsch Controller to Gen 4 Deutsch Controller Installation.**

Gen 3 and previous model **Deutsch** Controllers lacked the capacity to receive feedback of errors from the level switch or control valve and display those errors on the controller. The Gen 4 Controller was modified to retain the Gen 3 mechanical upgrades, and include 2 new functions;

- Ball Valve positioning feedback.
- Controller to Level Switch harness connection communication.

In order to achieve this, 2 additional pin in/outs were added to the Gen 4 controller PCB. The Deutsch Plug variant of controllers necessitated a change from an 8 pin Deutsch DT style receptacle to a 12 pin Duetsch DT style Receptacle.

To replace a Gen 3 Controller with a Gen 4 controller, there are 2 options available;

- 1. Purchase a Harness Adaptor (Banlaw Part No# **BFSPHA01**) to adapt from the existing 8 position plug harness to the new Gen 4 Controller.
- **2.** Replace the Harness 8 Pin DT Series Deutsch Plug with a 12 Pin DT Series Deutsch Plug.

#### Harness Adaptor

The Harness adaptor is a 500mm long. (Figure 20 & Figure 21 are not to scale)



Figure 20: Adaptor Harness, Part No# BFSPHA01.



Figure 21: Harness Adaptor.

# Deutsch Plug Replacement

For clients who wish to replace the 8-pin plug from the original harness to a 12-pin plug, see **Table 2** for wire position assignment.

Replacing a Gen 3 controller with a Gen 4 controller will not achieve access to the 2 new feedback features alone. To achieve either of the feedback functions offered by the Gen 4 controller, the following changes are required:

The level switch must be changed to a Smart Level Switch product equivalent.

The harness will require an additional 2 conductor wire upgrade between the control valve and the controller. The harness will require replacement or a rebuild. These 2 additional conductors are required to be terminated to the position terminals on the actuated valve PCB (only for models which has position terminals).

#### **APPENDIX E – General Notes on Level Switch Termination**

Banlaw offer the Smart Level Switch as a Banlaw Product which checks for integrity of the connection between the level switch and the Gen 4 Controller manufactured with the feedback option. However for systems that wish to use a basic standard level switch without the feedback option, the termination block in the head will differ between manufacturers. Banlaw recommends checking the pin designation against the float switches as part of the installation or commissioning step before testing with fluid.

A standard level switch offered by Banlaw is wired with the switches Normally Closed (N/C) with the float in air. Most Level switches are manufactured with 2 float switches, however single and multiple floats are possible.

The common standard 2 float level switch offered by Banlaw are independently wired. That is, each float is wired independent of each other. During installation either the top or bottom float may be selected as per Figure 23. If the system is wired with both floats in



Figure 22: 2 Float N/C Position

series as per Figure 24, then fluid reaching either the top or bottom float will initiate the FillSafe Power controller to close the valve. This will give system redundancy, however if the bottom switch does not open, then the operator will not know that the system has lost redundancy and the top float is the only active float.





Figure 23: Single Float Termination



**Dual Float Connection Example** 

Figure 24: Dual float Termination with Switches in Series.



Figure 25: Example of Single Float Termination

Please ensure you have the latest version of this document

# **APPENDIX F – General Notes on Actuator Termination**

The FillSafe Power overfill protection system is highly configurable and may be used to control a wide array of valve actuator types. FillSafe Power systems require valves which are Normally Closed (N/C), and the actuator or solenoid source power must match or be compatible with the source power of the controller. For systems where the actuator power requirements exceed the Controller source power limitations, the controller may instead be used to control, relays.

Broadly actuators used in the FillSafe Power systems fall into 3 main groups;

- 2 Wire Control (On or Off)
- 4 Wire Control (power to open, power to close)
- 6 Wire Control (power to open, power to close, position open, position closed)

# 2-Wire Control

2-wire actuators require electrical power to open the valve, with the power to close provided from another source such as spring rewind, a pneumatic energy source or similar. This is ideal for small rewind valves or solenoid valves for spring rewind single acting pneumatic valves.



Figure 26: Spring Rewind Electric Ball Valve.



Figure 27: N/C Solenoid Valve.

BV24V (PU) 1 BV24V (PU) 2		
	BV24V (PU)	1
	BV N/O (BL)	

2 WIRE ACTUATOR

Figure 28: Schematic Diagram – See Table 2



Figure 29: 5 way 2 Position Solenoid Spring Valve

# 4-Wire Control

4-wire Actuators require power to open the valve and power to close the valve. These are the most typical valve type used with Banlaw FillSafe Power systems. Many Actuators are either factory fitted with, or have options to provide limit switches for positional feedback.



Figure 30: Electric Quarter Turn Electric Actuator.



Figure 31: Electric Quarter Turn Electric Actuator.



4 WIRE ACTUATOR



# 6-Wire Control

6-wire control Actuators are functionally the same as a 4-wire control system, with the 2 additional wires connected to the position limit switches built into the Actuator, or connected to a Limit Switch Box used on a pneumatic actuator.



Figure 33: Electric Quarter Turn Electric Actuator with Manual Rewind.



Figure 34: Limit Switch Box for Pneumatic Actuator.



Figure 35: Schematic Diagram – See Table 2

#### **APPENDIX G – Plug and Play Harness Components.**

In order to assist with the installation of a FillSafe Power system, Banlaw has provided the option to purchase prewired harness parts which can be selected in the appropriate lengths to produce a complete assembly. These Deutsch Plug DT Series and Harnessflex plug and play harness assemblies remove the risk of incorrect harness manufacture and time saved in building a bespoke harness.

#### **BFSPHA02- Harness Controller Breakout**

The Harness Controller Breakout connects directly to a Gen4 Deutsch Plug variant controller. This routes the 12pin Deutsch plug to the Actuator, Level Switch and source power areas.



Figure 36: BFSPHA02

#### **BFSPHA03-** Actuator Extension Harness

The Actuator Extension Harness connects between the Harness Controller Breakout and the 6 pin actuator harness. The harness is made from 16mm conduit. It is available in the configurations in Table 4.



Figure 37: BFSPHA03

# **BFSPHA04-** Level Switch Extension Harness

The Level Switch Extension Harness connects between the Harness Controller Breakout and the Level Switch harness. The harness is made from 12mm conduit. It is available in the configurations in Table 4.



Figure 39: BFSPHA04

# BFSPHA05- Source Power Extension Harness

The Source Power Extension Harness connects between the Harness Controller Breakout and a junction box with a 16mm conduit hole. The harness is made from 12mm conduit. It is available in the configurations in Table 4.



Figure 38: BFSPHA05

No.	Description
BFSPHA01	Adaptor, Harness, Deutsch DT Series 8 Receptacle-12 Pin Plug
BFSPHA02	Harness Controller Breakout
BFSPHA03-10M	Actuator Extension, Harness, 10m
BFSPHA03-2.5M	Actuator Extension, Harness, 2.5m
BFSPHA03-5M	Actuator Extension, Harness, 5m
BFSPHA03-7.5M	Actuator Extension, Harness, 7.5m
BFSPHA04-10M	Level Switch Extension, Harness, 10m
BFSPHA04-2.5M	Level Switch Extension, Harness, 2.5m
BFSPHA04-5M	Level Switch Extension, Harness, 5m
BFSPHA04-7.5M	Level Switch Extension, Harness, 7.5m
BFSPHA05-10M	Source Power Extension, Harness, 10m
BFSPHA05-2.5M	Source Power Extension, Harness, 2.5m
BFSPHA05-5M	Source Power Extension, Harness, 5m
BFSPHA05-7.5M	Source Power Extension, Harness, 7.5m

Table 4:Banlaw FillSafe Power Harness Adaptors.

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