

SiloSAFE



Leading process technology from

HYCONTROL

Leading level control specialists Hycontrol have developed an integrated silo protection system designed to prevent the problems caused by the overfilling or over-pressurisation of bulk storage silos. The SiloSafe concept provides a comprehensive system where the operational integrity of the primary sensing elements can be fully checked at ground level prior to each filling.

Each year millions of tonnes of powdered and granular materials as diverse as cement, animal feed, silicates, fertilizer, fly ash and flour, are routinely off-loaded from tankers into storage silos across the UK. Normally the loads are discharged by fluidising the materials with compressed air and blowing them into the silo. For commercial reasons, vehicle operators want to discharge their loads as quickly as possible using the maximum pneumatic conveying pressure, a situation which can bring conditions within the silos close to critical levels. Protection systems designed to prevent the overfilling of silos have been used for some years and now new recommendations have been introduced to meet the growing number of safety and environmental related regulations. However despite this, incidents, in some cases life threatening, still occur during the filling process.



Silo protection system implementation is designed to address two main unrelated issues focused on the safety of site personnel and environmental problems associated with the emissions of particulate material to the atmosphere. There is currently no single set of guidelines stipulating exactly how such systems should operate across all industries. The British Cement Association, in conjunction with Defra and the HSE, have drawn up one of the most comprehensive set of guidelines, but even these leave some aspects open to interpretation. However all current guidelines make it clear that silos filled via pneumatic conveying should be fitted with automatic protection systems to prevent over-filling or over-pressurisation. Such systems should have three independent sensing elements, namely a pressure relief valve, pressure sensor and high level alarm.

Effective and safe filling relies on the controlled release of air through the air filter, ensuring a steady pressure is maintained inside the silo. Problems typically arise through air filters becoming blocked or from excess discharge pressures generated by the tanker filling system. Most storage silos are not designed as pressure vessels and even an overpressure of 1 psi may be sufficient to cause serious damage. Theoretically any excess pressure should be detected by the pressure sensor allowing the filling to be halted. If all else fails the pressure relief valve should act as the final backstop, allowing rapid silo venting.

A prime example of the dangers involved if things go wrong is demonstrated by the following example. Due to a misunderstanding between a cement tanker driver and a plant operator, cement was discharged into a silo that had been filled the previous day. On that occasion the high level alarm on the silo had been activated at the end of the fill and had been muted. Under normal circumstances, the alarm would have reset once the cement level dropped. However because the cement still covered the probe this had not happened.



During the delivery, a loud explosion occurred and the whole filter unit was ejected from the silo roof onto the ground. Fortunately no-one was injured. The subsequent investigation showed that the air filter was not operating correctly allowing cement powder to leak out and build up in and around the pressure relief valve. This had hardened causing the valve to seize up. In this case no pressure detector was fitted and the other three lines of defence failed through poor maintenance and poor operating

procedures. Had an adequate pre check system been in place the problems would have been highlighted immediately.

But how can operators be sure their systems will work when necessary. The latest guidelines stipulate that the system's critical sensors must be regularly checked to ensure they are in good working order. However as Hycontrol's Sales and Marketing Director Nigel Allen explains: *"Under ideal working conditions, the three fold safety regime should be more than adequate to prevent problems, but the only way to ensure equipment is fully operational is to carry out physical checks just prior to each filling. Carrying out adequate checks on a regular basis can be difficult, particularly if the main protection components are not part of an integrated system. In practice, especially in busy working environments, the checking procedure may not be carried out. Historically checks have had to rely on visual inspections placing the onus on the operator to make informed decisions on the condition of vital components. New restrictions on working at height now prevent operatives routinely climbing to the top of silos to carry out inspections."*

The Hycontrol SiloSafe solution provides an easy to use, fool proof and fail-safe system, which mandates the automatic testing of the key components directly from the integrated control panel at ground level. The panel also incorporates twin multi-segment bar graphs for continuous level and pressure monitoring as well as digital displays for both.



When the delivery driver reports on site he is issued with a dedicated panel key for the particular silo to be filled. Having activated the panel with the key, the driver must then press the Sensor Test button and release it. At this stage the discharge butterfly valve is locked. Each of the primary sensing elements is collectively tested by this single button press and any malfunction will be immediately highlighted. Should any faults be detected, the valve will remain locked and not allow filling to take place until the problems have been remedied. If the sensors pass the test, the white “ready to fill” lamp is illuminated indicating that the discharge valve has opened and delivery can proceed.



The pressure sensor module is the first line of defence, measuring the pressure in the silo as the filling takes place. If this exceeds a preset value it first provides an audible alarm, followed by a flashing red beacon and then an output signal which immediately closes the discharge valve in the fill pipe. Hycontrol have developed an innovative method for checking the integrity of the sensor and cleaning it at the same time. During the ground level test (GLT) a small air supply connected to the sensor applies a fixed pressure of approximately 90% of full range output directly to the sensor face. This change in pressure is measured by the system and verifies correct operation. As the air escapes through the porous membrane at the end of the sensor tube it removes any build up of material. If the membrane is blocked the system alerts the operator and does not allow filling to take place until the situation is remedied.

Current requirements call for a high level probe to be fitted to silos to prevent overfilling. As part of the SiloSafe system, Hycontrol recommend the use of their wave guided radar system to provide continuous level monitoring even during dusty filling conditions. This will give a clear indication of level in the silo prior to filling, ensuring the load to be discharged



will fit in the silo. Where only a high level probe is fitted, the SiloSafe GLT will automatically check its operational integrity. If a high level condition is reached during filling, warning is given via the siren and

flashing red beacon. A countdown timer now closes the discharge valve after 30 seconds, giving the driver time to cease filling and clear down his line.



The PRV is the last line of defence and should never have to be used. The Hycontrol system allows for optional full testing of this vital component. Using small air cylinders, the system can lift the valve to check operation, with proximity switches detecting correct lifting and closing.

As Nigel Allen concludes: *“We are confident that our system is the most comprehensive available today and more than meets the current requirements for safe silo filling. By offering an integrated solution with the ability to carry out tests on all the key elements in one action at ground level just prior to filling ensures the system will work in earnest if required. During filling, operators and drivers can clearly follow the conditions inside the silo via the bar graphs and displays, giving them ample time to react to any adverse trends. If any preset level or pressure limits are reached, the system will automatically close the inlet valve to the silo.”*

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