FIRE PUMP CONTROLLERS

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A large building or factory requires some kind of fire protection, usually in the form of sprinklers. In most cases, the public water supply cannot provide enough volume and/or pressure to directly driver the fire sprinklers so a fire pump installation is required. A typical fire pump installation includes several components:

- A pump that is specified to the correct water pressure and flow
- A pump driver, either an electric motor or a diesel engine
- A fire pump controller for automatic operation of the pump driver
- A gear drive for transmitting power from the pump driver to the pump itself
- A water relief valve to relieve or limit excess pressure in the event of diesel overspeed
- A water supply, either from a natural or man-made pond or from a water tank.

There are many different fire pump installation rules and regulations through out the world. The nearest thing we have to a world standard is the NFPA 20 (National Fire Protection Association pamphlet 20). NFPA 20 originates from the USA.

All buildings, factories and industrial sites are insured, a large number of which are under written by an American based company called Factory Mutual (FM) Global. FM play a major part in the world of fire pump controllers since they approve them for use within their insured buildings. FM uses its own standard 'class 1321/1323' in conjunction with the NFPA20 specification as their guidelines when approving controllers.

Diesel Engine Driven Fire Pumps

The standard NFPA20 specifies in detail the correct operation of the fire pump system and in particular the controller functions. On a diesel set, there are two engine starter batteries fitted, either a 12v or 24v set. It is the controller's responsibility to ensure that these batteries are fully charged and ready to crank the engine in an emergency. NFPA20 specifies that the battery charger must be able to completely re-charge these batteries from a fully discharged state within 24 hours. The controller must have facilities to manually crank the engine and to have an automatic start function via a crank timer. The standard defines the crank timer operation as:

15 seconds crank from battery A
15 seconds dwell
15 seconds crank from Battery B
15 seconds dwell

This sequence is repeated three times after which a failed to start condition is realised. At all times, the battery voltage is monitored. Should the voltage fall below ½ the normal float level, then that battery becomes locked out from further cranking.

Once the engine is running, it is monitored for:

Low oil pressure
High water temperature
Engine Overspeed.

Only the engine overspeed alarm is allowed to shut the engine down. The rules specify that low oil pressure and high water temperature must not shut the engine down in a fire condition although the engine may shutdown if the engine was started due to the weekly test requirement. Under fire conditions the engine is required to run to destruction.

The controller is usually monitored by a remote station, achieved by remote contacts within the controller. Such signals that are monitored include: engine running, engine failed to start and fault on engine or controller. There is also an audible alarm located on the controller that may be silenced in certain conditions.

NFPA 20 additionally specifies that the engine shall be started once a week automatically via a weekly start timer in a test mode. The diesel fuel tank level must also be monitored and when the fuel level is low, a low fuel level alarm on the controller is activated.

The FM approval standard 1321/1323 also goes on specify additional alarms for the fire pump controllers. One in particular for the diesel controller being 'DC Contactor fault' which monitors the engine starter contactors for open circuit.

The Metron Eledyne FD4e diesel engine fire pump controller is FM approved and now UL Listed. It performs all of the functions mentioned above and in addition it has 11 extra indicators and alarms which can all be programmed in the field. All functions such as a delay start timer for multiple pump installations and auto stop timer can all be enabled and adjusted at any stage. One of the most powerful features of the FD4e controller though is its ability to record and log each event as it happens. It can record over 4000 events in memory and each event is stored with a date and time stamp. The water pressure is also stored in non volatile memory which is also a requirement of NFPA 20 and FM.

Electric Motor Driven Fire Pumps.

The main components in a NFPA20 electric motor controller are:

* Isolator switch — Sized >115% FLC (Full load current) of motor
* Contactors — Either Direct on Line or Star Delta (horse power rated)
* Circuit breaker — sized to >115% FLC of motor.
* Logic circuit with various monitoring channels
* Emergency start mechanism for starting when the control circuit has failed

The circuit breaker is defined in great detail within the standard NFPA20 and FM 1321/1323. The principal points covered are:

Non- thermal over current sensing type
Instantaneous trip facility, which must be set <20 times FLC
To have a tripping time between 8 and 12 seconds at 6 times FLC
Be able to hold 300% FLC indefinitely.

The standard defined lamps are named 'power available' and 'phase reversal'; however, controller manufacturers offer other functions as options. Any alarm must not prevent the motor from starting.

Metron Eledyne now offer a fully microprocessor controlled range of controllers for starting and stopping an electric motor. These controllers have an identical operator interface to the FD4e diesel engine controller which enables the operator to make easy adjustments to the functionality of the controller. Event data logging and water pressure storage is also included as standard.

Electric Motor Controllers, Starting Methods

To correctly specify an electric motor fire pump controller you must of course know the motor kW or HP rating along with the supply voltage. The starting method must then be chosen. The following methods have been traditionally used in Europe:

* Direct on line or across the line, up to 100kW (MP300 type)
* Star delta or wye delta reduced starting method for over 100kW. (MP430 type)

Electronic soft starters (MP700) are now becoming an alternative accepted method of starting the motor where the incoming supply has limited capacity. The MP700 soft start controller will precisely limit the electric motor starting current. NFPA20 now specifically allows this method of starting although the controller must also have an emergency direct on line by pass contactor included.

Jockey Pumps

The above mentioned diesel engine or electric motor controller will automatically start the pump once it detects a drop in water pressure. Usually a jockey pump is included on an installation in order to maintain a steady water in the system. There are limited specifications for the jockey pump controller and these are often very simple direct on line low kW rated units with a minimum run timer. Occasionally there is a need in Europe for these controllers to be UL listed, but this is a standard requirement in the United States.

Other Fire Pump Standards.

When FM is not the insurer, then the building can be protected by a fire sprinkler that is manufactured to local rules. Most countries throughout Europe have their own set of standards:

COUNTRY	STANDARD	CONTROLLER APPROVAL NEEDED
U.K	LPC	None
The Netherlands	VAS	None
Germany	VDS	Yes, diesel and electric
France	APSAD	Diesel Engine controller must be approved. No approval needed for electric controllers.
Italy	UNI9490	None, just compliance.
Belgium	NVBB	Diesel Engine controller must be approved. No approval needed for electric controllers.
Spain	CEPREVEN	None

Local Rules Electric Controllers

Most of the standards have common elements between them and there are also similarities to NFPA20. The biggest difference is in the electric motor controllers and the protective device. NFPA20 calls for a circuit breaker but all of the above local rules specify a fused isolator. The fuse in this instance, generally speaking, must be able to carry the stalled motor current for a period of not less than 75% of the time needed for the motor windings to fail and thereafter be able to carry the normal current plus 100% for a minimum of 5 hours.

Local Rules Diesel Controllers

There are many differences in the rules for diesel engine controllers. The main differences are surrounding the automatic cranking sequence. For example, with LPC and VAS, all automatic cranking is done from one set of batteries and after each automatic start a manual start is required from the other non- automatic battery. With NVBB and APSAD, the crank sequence is more like NFP20. Most of the local rules for diesel controllers do not have any kind of weekly automatic test start functions.

Standardization in Europe?

In September 2007 a European Norm standard EN12845 came into force. This is a fire sprinkler specification which includes a definition for the fire pump controller. In the UK, LPC have already adopted the standard. The diesel engine controller to the EN12845 standard is very similar to the LPC rules, but with:

- An alternative crank sequence
- Low fuel level monitor
- Jacket heater output
- Low jacket water temperature alarm

Most countries are embracing the new standard by modifying their ownspecification in order to comply. Only time will tell how successful this standard is in terms of harmonizing the fire sprinkler code through out Europe.

Generally

To complicate matters further, some people prefer to use NFPA 20 as the basis of the fire pump, but do not have it approved by FM. In this mode, the fire pump set is referred to as UNLISTED and is a lower cost option to the FM approach.

No matter which fire sprinkler standard is used in Europe, the fire pump controller must be CE marked, which covers the machinery and safety directive, the low voltage directive and the electromagnetic compatibility (EMC) directive. Very generally this means the controller must be tested for fast transient voltage burst, radiated emissions, radiated immunity, conducted emissions, conducted immunity and electrostatic discharge.

Future Trends.

Due to diesel engine developments, and also as a result of rapid developments in information technology, the whole field of fire pump control is likely to change dramatically over the next few years. Already we are seeing the change to electronically controlled diesel engines. This has come about due to the various world standards limiting emissions from diesel engines, but brings with it benefits in terms of higher levels of information from the engine systems. This when integrated with the advances in the controller systems will enable far more capability for remote monitoring and management of the fire pump system. International Companies with operating bases spread throughout the world, will be able to monitor both the operating characteristics and service requirements of their fire protection equipment from anywhere in the world via the internet, and receive fault notification by means of e-mail or text message to their service personnel. Engine and Controller manufacturers will be able to undertake remote fault analysis from their factories, and guide on site maintenance staff to a correct repair solution should a fault occur, without the need to send specialised service engineers to far flung corners of the world.