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Pumper's Guide to VFDs On Oilwell Rod Pump Applications

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WARNING!

A shock hazard exists even when power to drive is disconnected!

Variable speed drives contain capacitors that hold significant electrical charges even after power is removed from the drive. This charge can be held for up to 5 minutes.

Introduction

Just a few years ago variable speed drives were so rare in the oilfield that many pumpers had not seen or even heard of them. But their use has rapidly expanded to the point that they are now very common. This guide is specifically written to help pumpers become familiar with their ABB drives installed by Yost Electric, however much of the information in this guide can be applied to other brands of drives as well.

There are many advantages to using a variable speed drive (also called variable frequency drive, drive, VSD, or VFD) to run electrical equipment.

By using a variable speed drive the pumper can have infinite control over the pumping unit's speed by simply touching a button. No more sheave changes! VFDs allow a motor to run with high levels of efficiency. By using a properly sized VFD, phase convertors can be eliminated. VFDs provide extremely high levels of motor protection. We have never had to replace a burnt motor on a pumping unit equipped with a VFD! Mechanical wear on equipment is greatly reduced by providing smoother starts and more consistent operation. You are able to run the unit 24 hours a day at the optimum speed instead of starting and stopping with a time clock.

In February, 2008 Yost Electric began to install some SPOC brand drives. From a pumper's perspective, there is very little difference between these two brands of drives. The few differences will be noted throughout this manual where necessary.

The pumper can generally disregard the factory ABB or SPOC manual that came with the drive. The factory manuals are written for the installer, and are of little use to the end user. This guide will include all the information relevant to the pumper.

Opening the Panel Door

As is the case with almost all electrical enclosures, the VFD panel has a disconnect that will not allow the panel door to be opened with the power switched on.

To open the door on an ABB panel, turn the disconnect switch 1/4 turn counter-clockwise to the "off" position. Then turn the two door retainers 1/4 turn counter-clockwise with a screwdriver. The door can then be opened.

On the early panel versions (anything installed before September 2007) it is necessary to open the main panel door to make speed adjustments and reset faults. We can easily retrofit these panels with an external keypad window if necessary. Call Yost Electric for assistance with these panels.

It will seldom be necessary to open the enclosure door on panels equipped with a keypad access door.

Opening the door on a SPOC panel is much the same as on the new style ABB panels. The difference is that the disconnect handle must be held over to the "open" (spring-loaded) position while opening the door. The door retainers have hand knobs and do not require a screwdriver to open.

Adjusting Unit Speed

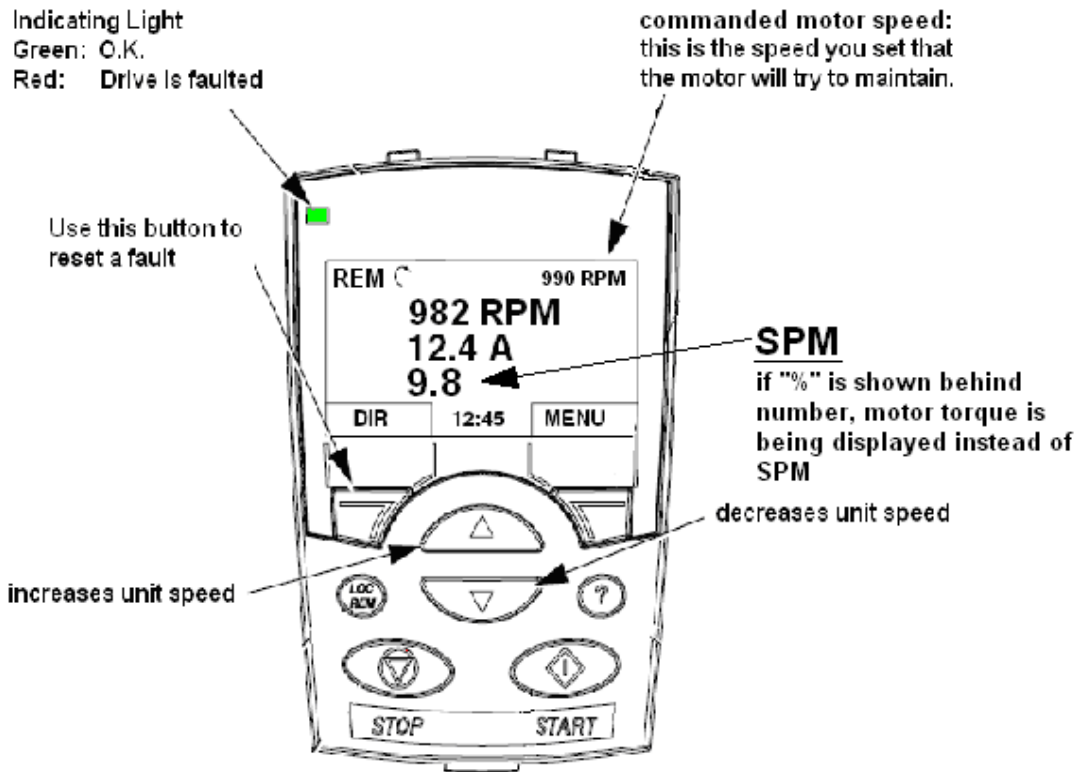
The VFD must have power to adjust the unit speed. To adjust the unit speed you simply press the up or down arrow. The commanded strokes per minute are displayed on the bottom line of the LCD display. See drawing of display on the next page. (On earlier drive installations, the strokes per minute may not be displayed. If not, the commanded motor speed will be displayed in the upper right hand corner of the display. We can change the

programming in the older drives to display strokes per minute if desired).

Do NOT wear greasy gloves while using the drive's keypad! Excessive grease and dirt will damage the keypad.

The SPOC panels have a dial adjustment for speed adjustment instead of pushbuttons. The strokes per minute will be displayed, however this is not a highly accurate reading. You will probably still want to time the unit to make sure it is running at the desired speed.

Display



Pump Off Control

Pump Off Control software is available for some brands of VFDs. This software monitors the motor load in relation to the stroke position. The pumping unit is then slowed as the fluid level in the well drops. When the fluid level increases, the drive will then increase the speed of the motor.

At this time, the pump off control software is fairly expensive and the manufacturers are still working on getting this perfected. For most wells, a standard VFD without pump off control will allow for optimum adjustment of the pumping unit speed. The pump off control option may be useful for wells with constantly changing conditions.

Faults

Faults can be reset in two ways. If the drive is faulted the LED in the upper left hand corner of the keypad will be red and a fault code will be displayed on the display. Make a note of this fault code. It will be helpful if an electrician is needed to troubleshoot the drive. Press the upper left hand button to clear the fault. (See display). All faults can be reset this way.

Some faults can also be reset by turning the disconnect on the panel door to the “off” position, waiting 5 minutes, and then restoring power. The disadvantage to using this method is that the reason the drive faulted remains unknown. This method of resetting faults should only be used on the older panels without a keypad window.

Maintenance

Modern technology has made these variable speed drives very durable and long lasting. However, there are a few things you should periodically check in order to extend the life of your drive.

Variable speed drives produce a large amount of heat when they operate. These panels are equipped with filtered fans and vents to dissipate the heat from the panel. You need to make sure that these fans are in working order. The fans are thermostatically controlled, so they might not be running on a cold day. Panels are equipped with anywhere from one to four fans, depending on the size of the VFD.

You also need to make sure that the fan and vent filters are clean. These should be inspected every year. Make sure nothing is blocking the airflow at the air filters. This is especially important on the new panel configuration with the bottom mount inlet filter. Any dirt that does accumulate inside the enclosure should be cleaned from the panel when the filters are changed.

The SPOC panels do not have fans or filters. No maintenance is

necessary.

The ABB panels also contain a heater to remove moisture and condensation from the panel. This should be checked by the electrician when filters are changed and panels are cleaned.

Make sure lightning arrestors are intact.

Make sure pulling unit crews have not removed wellhead grounds. Proper grounding is very critical to protecting the drive.

MAINTENANCE CHECKLIST

- Fans in working order
- Heater in working order
- Filters clean and air flow not blocked
- Panel interior clean
- Lightning arrestors intact
- Surge protection functioning (if equipped)
- Grounding intact

Other Oilfield Applications

PC Pumps (screw pumps)

Variable speed drives also work well on PC pumps. There is very little difference in the operation of a VFD on a PC pump compared to a standard pumping unit.

A PC pump can be programmed with an UNDERLOAD feature which will shut the motor down in the event of broken belts or parted rods.

Saltwater Pumps

There are many benefits to running a centrifugal pump with a VFD. Check out the “variable speed drives” section on our website www.yostelectric.com for more information.

A properly installed VFD will greatly increase the efficiency of a centrifugal pump, reducing power bills. When using a VFD on a saltwater pump, a level sensor is used instead of a standard float switch. The level will be displayed on the drive's keypad.

The level sensor will allow the drive to automatically adjust the pump speed to the level of fluid in the tank. The pump will run 24 hours a day at reduced flow rates, rather than cycle on and off. A small decrease in pump speed and flow rates will result in an exponential reduction of the horsepower requirement and energy used.

Because the pump runs constantly and doesn't cycle, the amount of wear on the pump, couplings, and pipelines will be greatly reduced.

We have seen some drive installations on saltwater pumps that use a float switch instead of a level sensor. This increases the chance of spills because the drive cannot react to changing conditions. It also wastes the power savings potential of the drive.

Troubleshooting

Most VFD faults are caused by mechanical problems in the pumping unit or the well, not by the VFD itself.

If there is a disadvantage to variable speed drives on pumping units, it is that the unit must be well balanced. The importance of proper unit balance cannot be stressed enough. Even if an unbalanced unit is not causing faults, it may be shortening the life of the drive.

OVERSPEED

The most common cause for an OVERSPEED fault is a pumping unit that is out of balance. Balance the unit. If the unit is properly balanced and the drive still faults on OVERSPEED, the tolerances on the speed limits may need to be adjusted. Call Yost Electric.

Although it is uncommon, poor quality power from the utility may also cause OVERSPEED faults.

DC OVERVOLT

The pumping unit may be out of balance. Excessive DC voltage will damage the variable speed drive. Do not continue to run the unit out of balance.

EXT FAULT 14

Early VFD Installations: The most common cause of this fault is a power outage. The drive will usually reset automatically after a power failure, but if there are too many power outages in a short amount of time, the drive will stay down until manually reset. If this is a consistent fault after power outages, we can upgrade the parameter settings in the drive.

If the motor is equipped with thermal protection, an overheating motor will cause an EXT FAULT 14.

Recent VFD Installations: Check for tripped beam switches or pressure switches

EXT FAULT 15

Check for tripped beam switches or pressure switches

DEV OVERTEMP

The ventilation fans may not be working or the ventilation filters are dirty. This needs immediate attention even if the drive is reset and running. High temperatures will damage the variable speed drive.

Make sure airflow is not blocked.

USER LOAD CURVE

This is usually due to an underload condition (broken belts, rod parts, etc.) but depending on the application, it could also indicate an overload.

No display on drive

Check fuses and incoming power supply.

Well runs, but not up to desired speed

Check fuses and incoming power supply.

Drive does not display a fault, but external switch will not start motor.

Check to make sure LOC/REM button is not in LOC (local mode). If LOC is displayed in upper left hand corner, push the LOC/REM button once until REM is displayed.

Make sure motor is not overheated.

Check fuses on fan and heater transformer.

Cooling Fan Maintenance Trigger

After 6 months of runtime, the keypad will display a reminder to

check the cooling fans. When this is displayed, make sure the fan and exhaust filters are clean. You will be able to see these filters from the outside of the panel by looking up into the rain hoods (on the side of the panel). On the new panels there is only one large filter to check. It is located on the bottom of the enclosure. Also check the fans, thermostats and the heater for proper operation.

Make sure airflow to panel is not blocked.

Do not leave panel without filters installed.

Drive will not run in extreme cold

This is not a problem with ABB VFDs equipped with enclosure heaters.

Make sure heater is operational.

We can install a heater and thermostat in enclosures other than ABB.

FAQ (frequently asked questions)

Why is there no keypad viewing window on the new style drive panels?

ABB was concerned about UV damage to the keypad.

What happens during an extended winter power outage when the heater is off?

The heater within the enclosure is to prevent condensation from forming. In extreme cases the drive may not start if the temperature is too low. If there is not excessive moisture within the enclosure, the drive will start once the heater warms the drive.

If there is excessive moisture in the panel it would be best to let the heater dry out the panel before applying power to the drive. Contact Yost Electric for instructions on how to do this.

Other brands of drive packages that are not equipped with heaters may not run in extremely cold weather.

How slow can we run the motor?

This depends on the motor. The motor must run fast enough to allow the

adequate cooling. Different motor manufacturers have different inverter ratings. Yost Electric generally uses North American brand, 1200 rpm motors which can be slowed to 240 rpm. Some brands of motors won't cool at less than half-speed. The drive will be programmed by Yost Electric to match the motor.

Can I switch direction of the unit?

Generally not, at least not with a simple push of a button. When the drive is initially installed we set the parameters to work properly with the pumping unit in one direction. Call Yost Electric for help with direction changes.

Fusing

1 PHASE HP	3 PHASE HP	DRIVE RATING (amps)	FRS fuses (older panels)	JJS fuse size	Acceptable maximum JJS fuse size
	10	23	20	30	30
10	15	31	25	40	50
	20	38	35	50	50
15	25	45	40	60	100
20	30	59	45	80	100
25	40	72	60	90	100
	50	78	80	100	100

Call Yost Electric, Inc.

If you have any questions at all about these drives or their capabilities, feel free to contact Yost Electric at (785) 637-5454.

Please check out our website for more information or to download additional copies of this manual.

www.yostelectric.com