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From: Jon Hagen  
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Subject: Vertex Emergency Off Circuit

The emergency off switch chain is shown on page PD24 (PD = "power distribution) of the schematic diagram in the Vertex Manual, Vol. III, Installation. Note first that the chain is really two parallel chains; each mushroom cap switch is a DPST unit. The top chain is the working chain, while the bottom chain supplies the status bit ("*emergency stop local*") to the PLC as digital input I0.5. The status contacts on the drive cabinet E-Stop button are supplied separately to the PLC as digital input I0.6 ("*emergency stop drive cabinet*").

The heart of the circuit is the Siemens "Back-up Combination Unit" model S-3KT2804 (data sheet is included in Vertex Manual IV.2, Vendor Publications II). In the parts list, Vertex refers to this unit as the "emergency tripping device". The device is a combination of three relays whose overall functionality is the same as a single, more reliable relay; if any one of the three relays fails, the equivalent single relay fails in a safe manner. This unit is designated 24D01 ("Device #01 on page 24"). Vertex indicates its functionality by representing it as a single relay "24CR01".

The equivalent circuit works as follows: Terminals X1 through X6 are the control inputs. X1 is connected internally to L+, which is connected externally to 24V. The e-stop switch chain connects the 24V from X1 to X2,3,and4. If the chain is broken (the device opens (i.e. unlatches or "trips"). This chain contains the platform mounted pushbutton switches, the "fiber optic cable drum drive ok" switches, the drive system front panel E-stop switch, and a relay contact pair (PLC-28CR07) activated by the PLC in the event of an e-stop coming from the PCU (portable control unit).

The only way to re-latch the tripping device is to short its reset inputs, X5 and X6. This is done by pressing the drive cabinet push-button switch "POWER ON", or by relay PLC-28CR10, which is in parallel with the "POWER ON" switch. This relay is pulsed ("pushed") by a power on command from the CP581, but only if the Flag F10.7 (e-stop) is low. This flag will be low if there has been a 'legitimate' emergency stop, i.e. a "Drive Cabinet e-stop", an "External e-stop", or a "PCU e-stop". The flag can only be reset by pressing the "POWER ON" pushbutton.

**Illegitimate E-stops:** We have added several e-stop switches to the chain, including additional mushroom cap pushbuttons around the platform, two microswitches on the fiber cable wrap at the central bearing, and an E-stop switch downstairs on the console in the control room. These added switches are all SPST switches; they lack a second contact pair to signal their operation as legitimate emergency stops. When any one of these switches is open, the system halts as for a legitimate e-stop, but the message displayed is only "Drive Power Off", rather than "E-Stop" and "Drive Power Off". When an illegitimate e-stop fault is corrected, the system can be reset from downstairs, because flag F10.7 has not been set.

There are three outputs from the safety relay (a.k.a. "power on relay" a.k.a emergency tripping device), "24CR01":

The first output is simply a status bit, 24 vdc sent to the PLC as digital input I1.1 “power on relay feedback”. This signal is produced by a normally-open pair of contacts (terminals 33 and 34 on the safety relay unit). This is the pair that produces the message “Drive Power Off.”

The second output uses another normally-open contact pair (terminals \_\_\_ and \_\_\_) to send 24 volts to relay 24CR02, whose three contacts connect 3-phase ac to the brake release power supply. If the safety relay unit trips, brake release power is interrupted and spring power applies the brakes.

The third output uses another normally-open contact pair (terminals \_\_\_ and \_\_\_) to energize the supply line for the control and limit switch circuitry that powers the main contactors for the three axes. Thus an emergency stop will shut down the main contactors, removing ac power from the servo amp power supplies.