

To: file c:\hagen\wpfiles\vertexdoc\brake_interlock_release.wpd
From: Jon Hagen
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Subject: Vertex Brake Interlock Release

In the Vertex equipment shelter on the platform, there are several switches on the doors of the three equipment cabinets. The function of these switches is fairly obvious: On, Off, Emergency Off, and Reset. However there are three switches, one for each axis of motion, labeled "Brake Interlock Release".

Brake Interlock is a safety measure; if all the servo amplifiers are not powered up, the (parking) brakes cannot be released. (Before the installation of the hydraulic dampers, the downhill braking was done entirely by the servo motors: regenerative braking in which the potential energy of the dome or carriage house was dissipated as heat in a bank of "regeneration resistors". If the amplifiers are not powered up, the motors simply spin free, and a catastrophic downhill slide would be possible. Such a slide could not be stopped by the brakes, which are very small and adequate only as parking brakes.

As Phil remembers, originally Vertex implemented Brake Interlock in software. NAIC insisted that it be done outside the PLC in relay logic, in order to withstand failure of the PLC computer. The hardware implementation was done without regarding operation in "Aux Mode," where an axis runs with one of its motors out of service. The problem was that in, Aux Mode, there will be one servo amplifier that is not powered up. (It may even be out of the system for repair). Rather than making the hardware brake interlock circuitry more complicated, Vertex added the "Brake Interlock Release" switches to defeat the hardware interlock and leave only the original software interlock.

Unfortunately, our package of schematics does not show the cabinet switches, nor any other part of this hardware interlock system. It is mentioned in the Vertex Manual II (Operating Manual), which states that the interlock must be in the RELEASE position when using auxiliary mode.

Yet the PLC program refers to bit I7.0 as "Az: brake interlock override activated"
I11.0 as "GD: brake interlock override activated"
and I19.0 as "CH: brake interlock override activated"

Looking up the program references to these bits, it seems that they are used only to prohibit the system from aux mode operation, i.e. as far as the program is concerned, they could be labeled "lock out aux mode option". Therefore it does seem that the switches must control some hardware relay logic.

How would they have chosen to implement this? Originally the "drive up" status from each amplifier was connected only to its respective digital input at the PLC. A relay circuit to make the AND of all the amplifiers for any axis would require a relay for each amplifier.