

Z750 Control System Improvement Descriptions

1. Variable Pitch Controller Watch Dog Timer

Extensive testing, on Z750 turbines located in the midwest, confirmed the source of a “hang-up” problem that plagued the operation of these turbines during periods of lightning activity. That problem resulted in loss of communication between the down-tower controller and the up-tower variable pitch controller. Returning the turbine to proper operation required a visit by a technician to cycle power on the variable pitch controller.

The solution to the hang-up problem is an outboard “Watch Dog Timer” (WDT) module driven by the variable pitch control’s main processor. The WDT board will reset the variable pitch controller’s main processor. This process will then reestablish communication between the variable pitch controller and the down-tower controller and thereby restoring proper turbine operation.

The Watch Dog Timer (WDT) is divided into two parts, a board mounted interface circuit and a DIN rail-mounted Watch Dog Timer board. Additionally, new software is provided to enable this operation on the variable pitch controller itself. The combination of these changes has proven very effective in keeping turbines from long hours of non-operation during high lightning activity events.

The WDT board also provides a second output that can be used to signal the turbine that a fault has occurred by tripping the brake wear sensor output. In the last case, this will require that the wind park SCADA system be used to bring the turbine back on line, but assures that an event occurring during high winds will not result in an over-speed condition. It also prevents any visit by site technicians as in the past.

A picture of the external Watch Dog Timer board mounted in its DIN rail enclosure is shown in Figure 1.0. Connections between this board and the modified Variable Pitch Controller are simple and straightforward. This product increases the availability of the Z750 turbines by providing a solution to the hang-up problems and its resultant loss of communications during periods of high lightning activity.

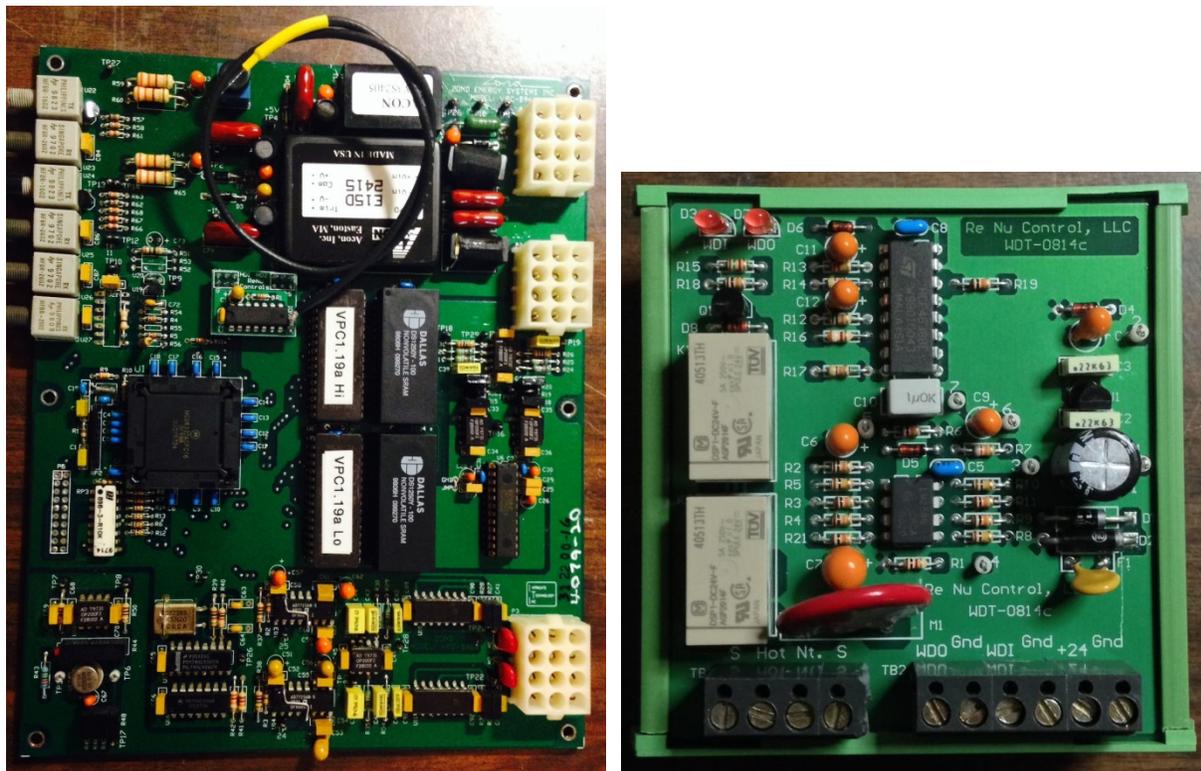


Figure 1.0, PID Modified Z750 Variable Pitch Controller and its Associated Watch Dog Timer

2. New Technology NOS Board

Located within the variable pitch controller enclosure up-tower, is a Non-volatile Over Speed (NOS) circuit board. This board is designed to feather the turbine during a power outage if the turbine achieves an over-speed condition at the hub. It is also designed to signal the down-tower Wintelgence controller that the hub tachometer system used on the NOS board is

functioning through a direct hardwire connection to the down-tower Wintelience Relay Input Control Board #2 (ICB 2). A series of problems with these boards has developed over the past 15 years since their manufacturing, including failure of the down-tower signaling transistors, obsolesces of the NOS board processor, and the degradation of the main energy storage capacitor.

Re Nu Controls developed a revised NOS board, designed to tackle all of the problems noted above. This board is the same size, uses the same mounting bolts, and same interface connector as the original. It is a true pin-for-pin compatible unit designed to replace the original. The down-tower communication transistor Q3 was replaced by a much larger device with over-current and over-voltage protection. The processor used on the new NOS board is a modern, fully available unit from Microchip.

Additionally, the energy storage for this board is provided by modern “super capacitors” with a long life span that meets or exceeds the original storage capacitor. These super-capacitors offer 15% more energy storage in an area occupying only one fifth the original. This is technology that was simply not available in 1997 when the NOS board was designed. More than 30 of these units are operating in the mid-west on both Z48’s and Z50 turbines. Figure 2.0 shows the reduction in components and component size with this new design.



Figure 2.0, New Technology NOS Board versus Original

3.0 ABT Replacement Board

The ABT board connects to the generator shaft encoder and converts its electronic signals to fiber optics. Due to the extensive failures of the main connector on these boards, and its associated single-sided printed circuit board connection pads, a new board was developed by ReNu Controls. This board is pin-for-pin compatible with a more modern interface connector, and several important improvements including:

- ⤵ A double sided circuit board providing better levels of shielding and mechanical integrity.
- ⤵ A lower profile terminal block to lower the leverage and forces applied to the connectors solder joints when compared to the original
- ⤵ Improved transient protection for the critical generator shaft encoder.
- ⤵ Reduced fiber optic transmitter LED current to help provide for longer life.