

# **Duke Power Nantahala Area Relicensing Franklin Hydro Plant Operations**

## **Introduction**

Duke Power Nantahala Area (DPNA) formed Technical Leadership Teams (TLT) early in 2000 to develop study plans to address concerns of stakeholders in the relicensing of the hydroelectric plants of DPNA. A TLT was formed to investigate reservoir level control of the DPNA plants that include Franklin, Bryson, Mission, and Dillsboro plants. These hydroelectric stations are operated by float control systems that regulate the reservoir outflow through the generators and tainter gates. All elevations are referenced in the U.S. Geological Survey (USGS) datum and are expressed in feet above mean sea level.

## **Background**

The Franklin Plant reservoir level is controlled by several independent float systems. These are float control systems that have been in operation for over fifty years. Each generating unit and spill gate has its own float control system. The control system consists of several mechanical devices including ball floats, connecting rods, micro switches, and cams. A small electric motor turns the cams and provides a tainter gate motor or a generator unit load control motor with a run time control loop. Even though the control systems are independent, the floats must be calibrated relative to one another in order to maintain the balance between reservoir level, generator output, and tainter gate operation. This float control system has many moving parts that require periodic maintenance. Most of the replacement parts for this system must be fabricated. Each time an operator visits one of these plants; he checks the float control system and does the necessary maintenance to help ensure proper operation of the system. These float control systems have been a dependable means of controlling reservoir level within a band of 0.2 to 0.4 feet. However, there have been some equipment or controls' failures that have resulted in large fluctuations in the reservoir level.

High and low reservoir level alarm points are set using the float system. The status of each point is wired into a station monitoring system. When the reservoir level reaches one of these alarm points, this system initiates a call to a monitoring center, Hydro Central, in Charlotte. Hydro Central then dispatches an operator to the plant to investigate the problem.

The large bandwidth in this float control system results in very poor reservoir control when inflows are low. During these low inflow periods, one of the tainter gate float controls may be disabled. This gate would be manually set to pass the minimum flow requirement. The present monitoring system only alerts Hydro Central after the reservoir level reaches an alarm point. The system does not report failures of the independent float systems.

## **Objectives**

The TLT determined that a more accurate reservoir control system was needed in order to achieve a stable reservoir level and hence an outflow equals inflow equilibrium. This is especially needed during periods of low inflow to help ensure that a minimum outflow from the

station is maintained. The new control system would need to be able to do the same functions as the float control system, but be more accurate and have a quicker response time to changing conditions. The control system should be able to monitor all generator and tainter gate controls and alert the station monitoring system of any failures. The control system should ensure minimum flow to be passed at all times.

### **DPNA Franklin Plant Operation Plan**

The float control systems at the Franklin Plant will be replaced with a programmable logic controller (PLC) and pressure transducers. A pressure transducer placed in the reservoir provides a continuous reservoir level signal to the PLC. The integrity of this signal is constantly checked and an alarm point is set if there is a loss of this signal. A second pressure transducer will be installed and used for backup. When completed, this control system will monitor reservoir level, operate tainter gates, load or unload generators, and perform other station monitoring functions. A reservoir level variance of 0.1 feet will be maintained. The PLC will provide a faster acknowledgement of trouble and subsequent reporting to Hydro Central. The float control system settings will be readjusted to provide backup control in case of a PLC failure.

The Franklin Plant PLC will maintain the reservoir level at Full Pond Elevation 2000.22 feet. There are three free flowing or overtopping spillways at Franklin with crest elevation 2000.22 feet. By maintaining the reservoir level at 2000.22 feet, almost no flow interruption would occur in case of any tainter gate motor failure or loss of gate control.