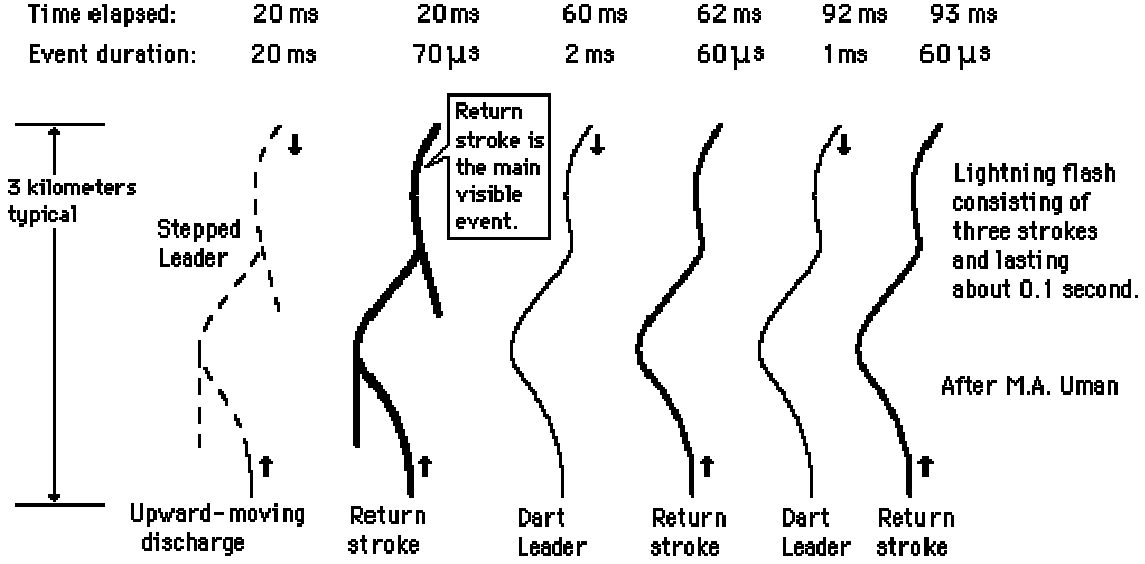
Lightning

Lightning is a difficult phenomenon to measure, for many reasons. Many have taken up the task and achieved results, although the accuracy of those results can be disputed. The bottom line is that the results provide a good idea of the order of magnitude and details of the event.

One analysis has determined the following lightning time sequence by the use of high speed film.



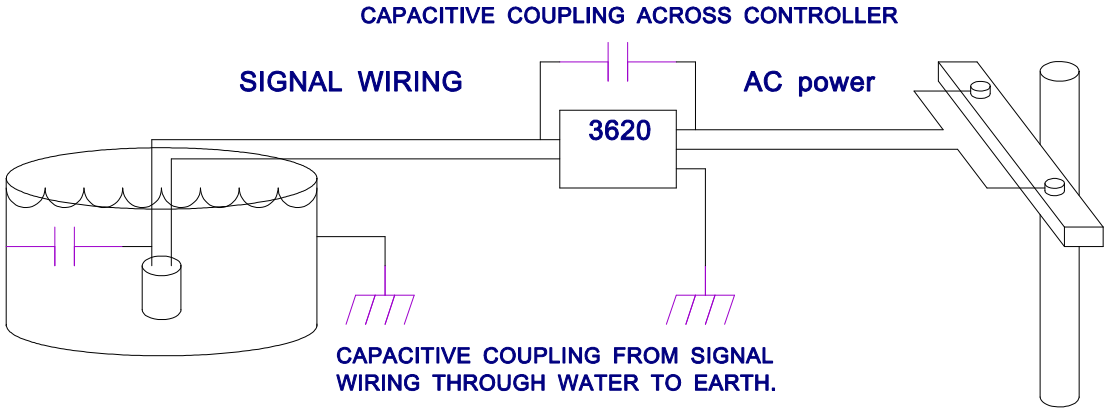
Most of the current measurements were determined by examining the magnetization of articles near the strike zone. In this study the measurements have been in the range 5,000 to 20,000 amps.

Lightning is a big problem with some pump stations. Local conditions seem to be very important, as some stations suffer no damage while others have to repair damage on a regular basis. These sites have not been surveyed to determine if there are any identifiable factors that would contribute to this phenomenon.

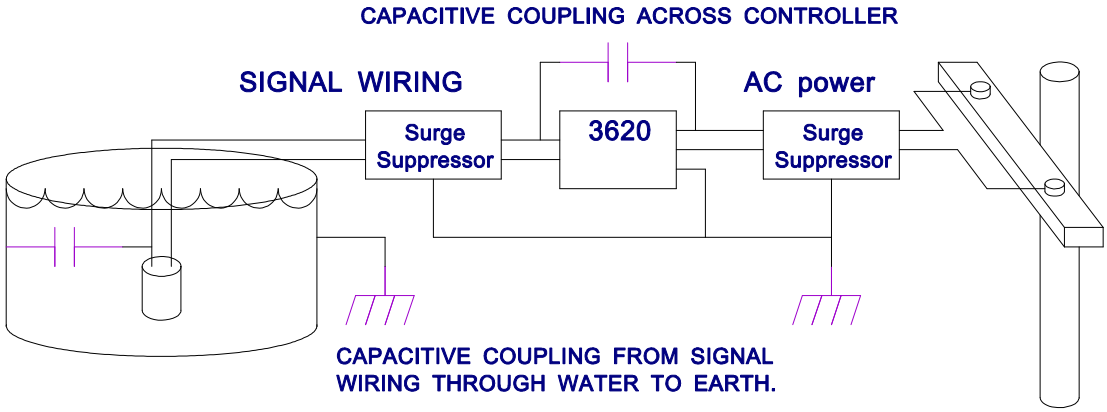
The damage caused to the controller and the transducer is caused by the excessive current flowing through the power and signal wires as the spikes seek earth ground. Most attempts to limit lightning damage consist of installing devices that couple the spikes to earth ground. After analysis of damaged units, and some knowledge of the installation, we believe that there are some other devices and methods that may reduce or eliminate the possibility of damage caused by these electrical spikes.

The following diagram illustrates what is believed to be the pathway that the spike travels. Even though lightning is a DC current, its short duration makes it act like an AC current. The capacitive link between the AC input side and the analog side is inherent in the power supply. The capacitive link between the signal wiring, through the water, into the tank and ground is a property of the physical layout. Notice that the earth on the 3620 and the earth on the water tank are drawn as two separate pieces. The resistance of the ground is not equal to zero nor do two separate ground points have the same characteristics. As lightning travels though the ground a voltage will be developed along the path that it travels. Therefore, when this lightning spike

travels through the site wiring it is possible that several hundred volts exist between the two earth ground points making it impossible to predict what is necessary to protect circuitry.



Lightning arcs across several miles of air and produces several thousand amps of current, so absolute protection against lightning damage does not exist. The methods available to minimize lightning damage are to shunt the spike away from the equipment and to minimize the effect of the spike that does get to the equipment. The lightning spike will follow any path to ground. Surge protection circuitry attempts to give the spike an easier path to ground than through the protected devices. Because the path to ground through the protected devices still exists, some of the spike will still go through it.



Looking through documentation available from the American Radio Relay League regarding lightning shows many recommendations that may be useful. One recommendation from the ARRL documents that intrigues this engineer is to connect all the earth groundings at one point, so the system has the property that most of the components will be at as near the same potential as possible at the thousands of amps course through it. From this, and the physical layout of a pump station, what might cause a reduction in lightning damage is to run a heavy ground wire from the tank to the same ground point where the 3620 and the surge suppressors are attached.