Irrigation Districts **RESEARCH REPORT**

Power Quality Measurement and Conditioning

Goals:

1. Determine if there is an economical benefit to using filters for conditioning the electric power used by electric pump motors.
2. Quantify the harmonics that are generated by typical irrigation district Variable Frequency Drive controllers.

Technology Path: Both active (very expensive) and broad band passive (less expensive) filters are available to condition the power into motors. However, they are not used in agricultural motor installations. The economics of their future usage will depend upon (i) the amount of harmonics that are present in the power supply, (ii) the degree to which the poor incoming power quality impacts the motor efficiency, and (iii) the relative costs of the filters and benefits of improved motor efficiency. Documentation of these three aspects will indicate if it is worthwhile for CEC and electric utilities to encourage farmers (and others) to install power filters. Documentation will also assist others in determining the value of investigating source control of harmonics.

A possible source of power harmonics is existing Variable Frequency Drive (VFD) controllers, which are becoming more popular with irrigation districts. The popularity arises from advantages in both improved water pressure/water level control and power savings. The non-linear loads of VFDs generate voltage and current harmonics that can have adverse effects on equipment designed for operation as linear loads – the nature of the problem that was previously described. Transformers that bring power into an industrial environment are subject to higher heating losses due to harmonic generating sources to which they are connected. When capacitors are used for power factor improvements (where non-linear loads exist), resonance conditions can occur that may result in even higher levels of harmonic voltage and current distortion thereby causing equipment failure, and disruption of power service.

A question to be addressed by this second aspect of this task is: By how much does the power quality on the line degrade due to typical agricultural irrigation district VFD installations? The answer may show that there is a negligible impact, that improved design and installation standards should be developed and enforced, or that it is best to concentrate upon the usage of filters for incoming power.

Principal Investigator:

Dr. Charles Burt, CalPoly San Luis Obispo University, Irrigation Technology Research Center, is the project manager.