IMPROVING FAULT CURRENT ACCURACY

APPLICATION GUIDE

Fault Current Detection

Figure 1: Aclara MV Sensor

In the U.S., 90 percent of outages occur on the distribution network. To improve reliability, many utilities are looking to deploy smart grid technologies like Aclara's Smart Grid Sensors to bring real-time situational awareness to their crews, engineers and planners. These new technologies must complement existing technology installed at substations and on the circuits. The information and results provided by every device on the line must be consistent and minimize the particular methods that are proprietary to each vendor to calculate this information.

In 2014, Aclara introduced a feature that gives utilities the ability to better coordinate fault current information provided with that of specific substation and recloser relays. This configurable option available in Aclara's sensors will better match the proprietary algorithms that are built into these substation and recloser relays.

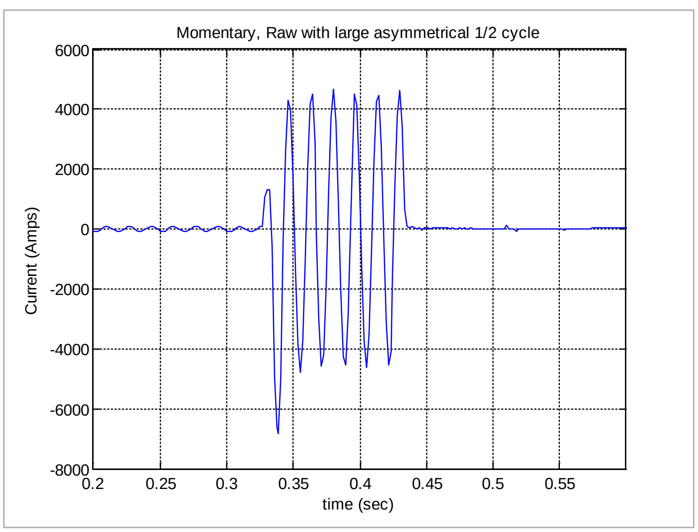

Figure 2: Asymmetric Fault Waveform

Existing Methodology

Aclara's Sensor Management System (SMS) software and MV Sensors currently have two methods to display fault current. The current can be displayed as a PEAK or RMS value. The PEAK value will report the highest measurement during the entire fault. Asymmetrical faults which have a very large DC offset in the first few cycles can provide peak fault current values that are significantly different from the entire waveform. This can be misleading if the data is used automatically by a computer system such as a Distribution Management

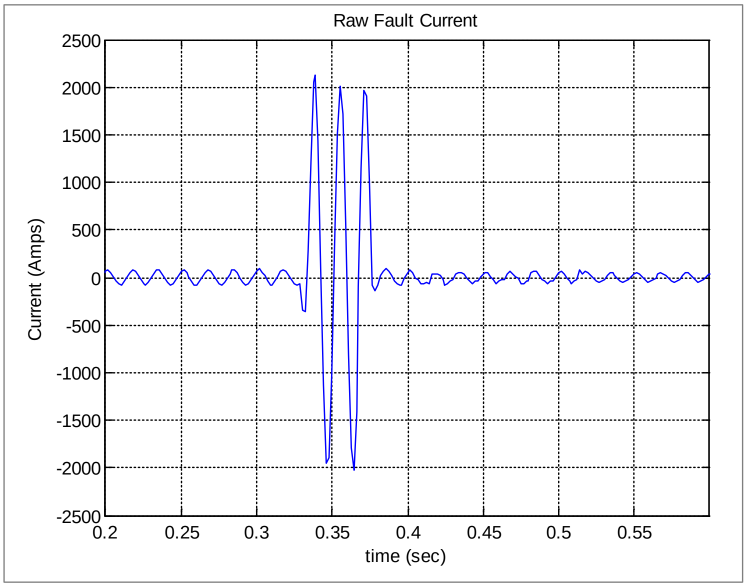

Figure 3: Typical Symmetrical Fault Waveform using RMS method

System (DMS) or other engineering tool. Usually, a manual review of the waveform is required to determine a more steady state fault current value. Aclara's line sensors also have the ability to calculate the RMS fault current. In this method, the average energy provided by the fault is calculated. This takes the asymmetrical waveform including any significant DC offsets and calculates the equivalent current that would represent the waveform's energy. This fault current value is lower than the peak value.

New Filtering Technique

Relays that use traditional CT circuits to measure current on circuit breakers and reclosers need to be able to produce predictable results even when CTs saturate during high fault current levels. Therefore, most manufacturers have implemented algorithms and digital filters to measure fault currents when the CT is in saturation. The implementation of these digital filters modifies the measured waveform and provides results that may not match the waveform of a device that uses other measuring methods which don't involve a traditional CT circuit (e.g. Rogowski coils, Hall Effect sensor, etc). The resulting fault current calculated by the processor may not match depending on the measuring method used. See the fault waveforms

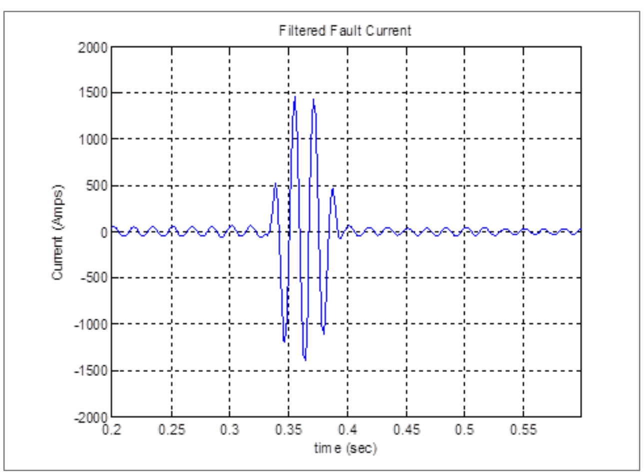

Figure 4: Filtered Fault Waveform

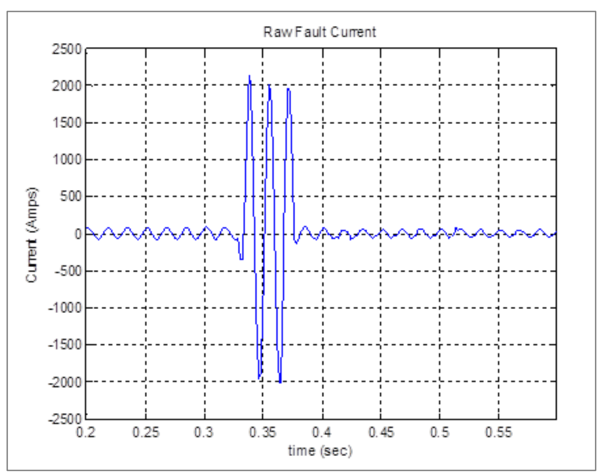

Figure 5: Raw Fault Waveform

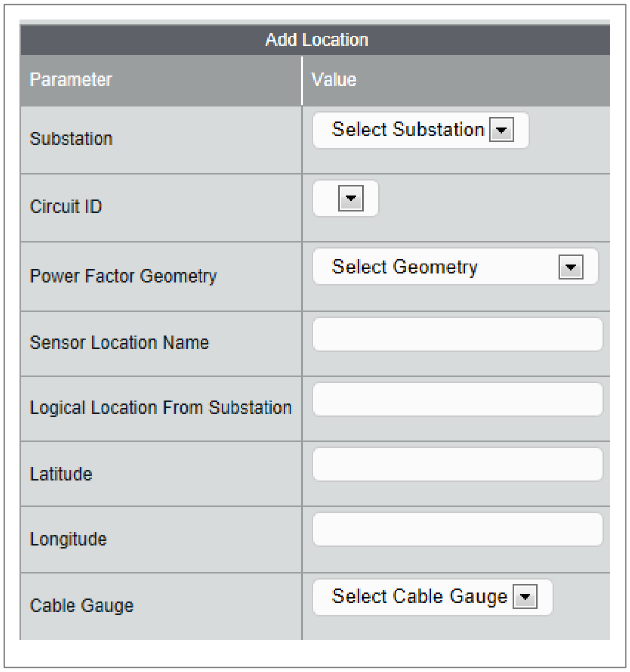

Figure 6: New Input Screen in Aclara SMS software

The sensors now include new digital filters to The sensors now include new digital filters to more accurately reproduce the results provided by relays which use CT circuits. Utilities now have the ability to implement this measurement technique on their system to ensure consistent fault current measurements when the sensors and substation relays are sent to the same back office system, such as a DMS. The utility will be able to choose PEAK, RMS or FILTERED as their preferred method to calculate fault current levels and display waveforms.

Utilities will also have the ability to input the wire size that the line sensor is installed on to further match the fault current levels from other devices on their line. This option will be available for each sensor location and all wire sizes between #6 AWG and 795 AAC are available. If no wire size is selected, the system will assume 336.4 kcmil which was demonstrated in lab testing to provide effective results.

Lab Testing Results

Lab testing comparing the new filtering technique to major relay vendors was very successful using real world fault waveforms captured by the sensors. The results shown below indicate that the fault current magnitude between the line sensor and a major relay vendor were typically within 5 percent. Additional field trials are scheduled in the third and fourth quarter of 2014 to continue gathering data to refine the filters if necessary.

Waveform Scenario	Aclara Sensor Peak (amps)	Aclara Sensor Filtered (amps)	Aclara Filtered and Adjusted for Wire Size (amps)	Major Relay Vendor (amps)	Comparison
1	3942	3707	2509	2616	Within 4%
2	2287	2287	1673	1620	Within 3%
3	2822	1986	1561	1498	Within 4%
4	2244	1950	1533	1542	Within 1%
5	1398	1489	1171	1070	Within 10%
6	1440	1489	1171	1144	Within 2%

Conclusion

Aclara's customers now have a new feature to better align the results of the sensors with their other equipment installed at substations or at recloser locations. By enabling this new filtering and optionally inputting the wire size, testing has demonstrated the results are typically within 5 percent of the most commonly used relays' measurements.