Aclara™

PROVIDING MORE ACCURATE PHASING FOR YOUR DMS, GIS OR OMS SYSTEMS

APPLICATION GUIDE

Auto-Phase ID

Save Operational Expenses, Improve Accuracy, Protect Crew Safety

Aclara Power Sensor

Your distribution network is constantly changing. Maintaining accurate records of your distribution system, especially during new construction, storm restoration or removals of aging equipment, can prove challenging. Asset management computer systems such as a Geographic Information System (GIS) are used by many utilities to maintain asset records. However, these systems come with a cost. Without near perfect record keeping, GIS systems can become out of date after long periods of construction. Maintaining records can be a painful, manual process for many utilities and often gets lost in the day-to-day operations that are a much higher priority.

One commonly inaccurate piece of information is the phasing of the overhead and underground lines. Some utilities employ construction techniques to help the continuity of phasing, where the middle phase is always "B" phase, for example. However, most utilities do not have standards for phase position. Different pole framing techniques and transposing phases can easily cause phasing to be inaccurate in the GIS. Phase markers are installed on the pole or crossarm at regular intervals so the lineman and engineers can identify the phasing, but phase markers can also be inaccurate. The phases can also be installed incorrectly after an outage occurs, such as when a tree falls on the line and breaks the wire.

Aclara's Grid Monitoring platform has the ability to continually determine what phase they are installed on without any additional hardware or software. Aclara's Medium Voltage (MV) Sensors detect the correct phase automatically and provides this information in the Sensor Management System (SMS) software so it can be shared with engineers and operators for various applications such as phase balancing, record purification in GIS systems and ensuring single phase switching will not cause a phase to phase fault.

This Application Guide describes how Auto-Phase ID works and the advantages of using Aclara Smart Grid Sensors to determine the phasing of the line. By using the platform in this manner, you can eliminate the need for manual phasing checks which can: 1.) Help your utility save operational expenses; 2.) Improve the accuracy of your GIS, Outage Management and Distribution Management Systems (DMS) and 3.) Protect the safety of your crews.

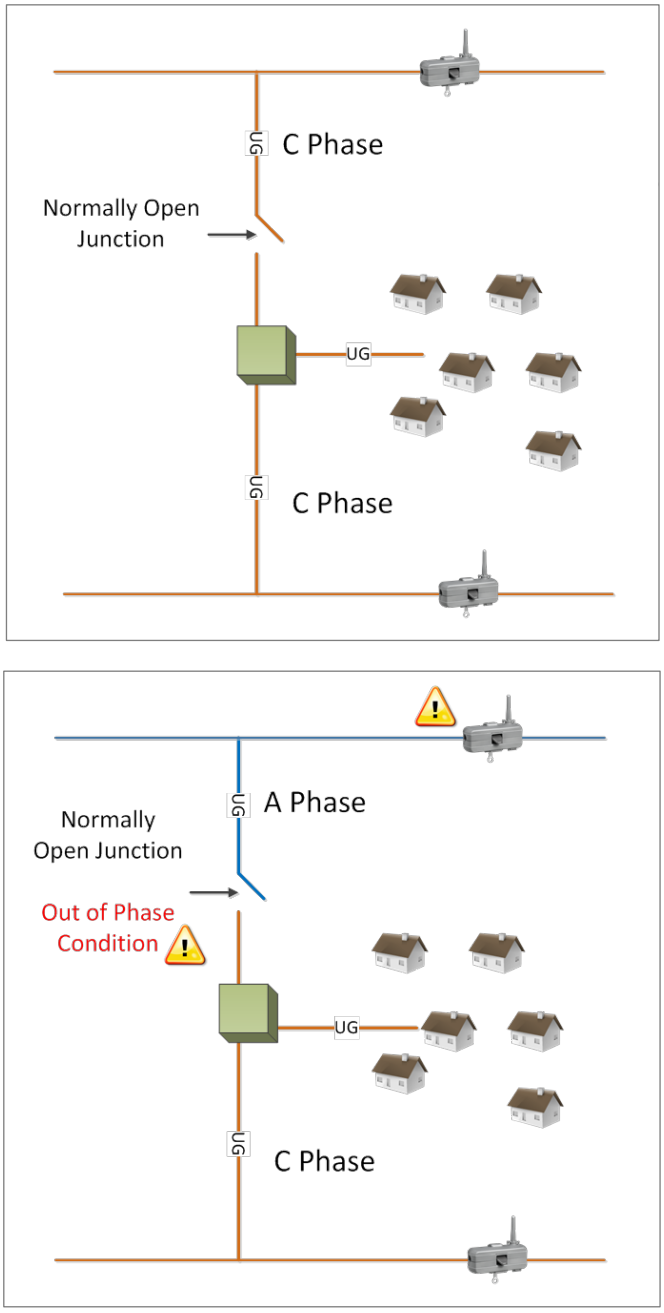

Figure 1: Identifying an "Out of Phase" Condition on a URD

Benefits of Auto-Phase ID

The accuracy of the phasing of the line is important to many computer systems and can even have an impact on the safety of the line crews. As more utilities are deploying advanced DMS and Outage Management Systems (OMS) to improve their outage response times and implement distribution automation at all levels of the circuit, phasing will be important to make sure the systems operate properly. DMS systems rely on a state estimator and underlying system model to predict the loading on all sections of the circuit. This is often compared with real-time SCADA data to solve the load flow model every 15 minutes in some cases. If the SCADA or metering data is not being applied to the correct phase, the load flow will be inaccurate or may not solve in extreme cases. This may impact the decision of how to restore a line after an outage or delay switching during maintenance work.

The correct phasing is also very important during switching operations such as on Underground Residential Development (URD) cables. There are situations in single phase URDs where a tie point exists so that for a failure of a cable, the rest of the development can be restored by re-energizing from a normally open tie point. In some cases, the two single phase URD cables can be supplied by two different overhead lines. During storms or other field work, the phasing may change, which could create an out of phase condition at the URD tie point. A switchman may become injured or worse if they create a phase to phase fault while closing this tie point.

Smart Sensor Installation with Hot-Stick

Deployment and Installation

Aclara's Smart Grid Sensors weigh approximately 5.5lbs and are designed for applications on standard distribution size conductors and neutrals. These purpose-built sensors offer utilities the easiest installation process available. Aclara holds the design patent for the way its line sensors clamp onto the line so that crews need only use the hot-stick once. Only one lineman is needed with a hot-stick or insulated gloves and sensors are deployed on the line in a matter of minutes.

Deployment is quick and easy because our sensors, are lightweight and do not require calibration or pole mounted cabinets. In addition, the line sensors are inductively powered; there are no solar panels to manage and no batteries to maintain. Once installed, Aclara's sensors are 100% maintenance-free. Smart Grid Sensors with integrated cellular communications don't require any ancillary equipment to be installed.

How Auto-Phase ID Works

The Auto-Phase ID feature was added in the platform 4.0 release. It is compatible with all existing and new sensors with the optional GPS receiver installed. Auto-Phase ID works in 3 simple steps:

1. Reference Set of Sensors

   The utility designates a 3 phase sensor location as the reference sensors. These can be existing sensors that are already installed. There are no physical changes required to the sensor to use it as a reference location. The reference location should be a 3 phase location where the utility knows the correct phasing on the line. This is typically near the substation at the head of the feeder. Ideal locations have more than 20 amps of load and good radio connectivity. Multiple sensor locations can be used for references.

2. Reference Sensor Searches for New Sensors Every Hour

   Once the reference sensors are established, the SMS software begins searching for other sensors within the "Auto Phase Reference Distance" which is programmed in the System Parameters menu (see figure below). Searching occurs at the beginning of each hour with a default distance of 20 miles from the reference location.

Using the real-time GPS coordinates, all sensors that are located within 20 miles from the reference location are automatically identified and assigned. The substation or circuit that each sensor is installed on is irrelevant. The radius can be changed by the administrator for each utility.

3. View Sensor Phase Information

Each sensor and the reference location assigned to it can be viewed under the "View Sensor Details" menu. For each sensor, the reference phase location is provided along with the distance from the reference as shown on the right. The Orange Ave sensor location is the reference and is labelled "Self". The Colonial Rd sensors are assigned to the Orange Ave reference and are 6.64 miles away.

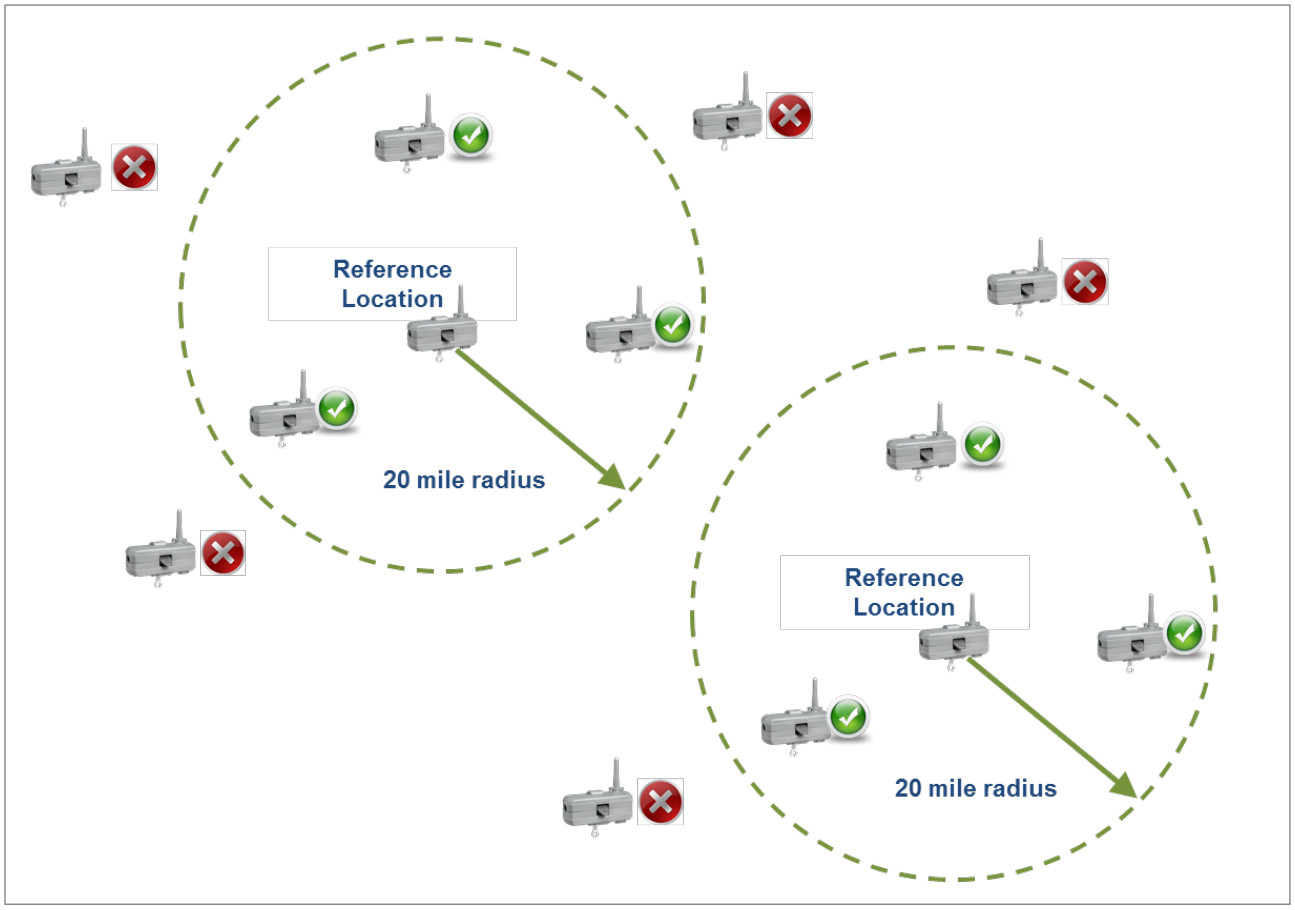

Figure 2: Sensors are automatically discovered within a 20 mile radius

The Innovative Technology Behind Auto-Phase ID

Circuit	Location Name	Phase	Phase Reference Location	Phase Reference Distance
35-6-13	Colonial Rd	1	Orange Ave	6.63
35-6-13	Colonial Rd	2	Orange Ave	6.64
35-6-13	Colonial Rd	3	Orange Ave	6.64
17-2-13	Orange Ave	1	Self	
17-2-13	Orange Ave	2	Self	
17-2-13	Orange Ave	3	Self	

Figure 3: Sensor Details Menu

The SMS system uses metrics collected by each sensor to accurately determine the phase relationship. This innovative technology also allows the system to accommodate delta/wye transformation where a 30° phase shift occurs.

When the users initially add the sensors to the SMS system, they must choose a phase that the sensor was installed on. The Auto-Phase ID feature compares the *measured* phase to the phase that users entered when the sensor was *commissioned*. If a discrepancy is found, the system records an "Out-of-Phase" event and can send an alert to users of the system.

The View Sensor Details menu will show which sensor has the discrepancy and which phase it measured it on. In the example below, the sensor labelled "24 55 Zone 3" was *commissioned* as Phase 1, but it was *measured* as Phase 3.

Date/Time	Substation	Circuit ID	Phase	Event Type
2014-01-23 14:23:18	Pittsburgh	Efield	Y	Out of Phase Clear
2014-01-23 14:23:08	Pittsburgh	Efield	X	Out of Phase Clear
2014-01-23 14:23:08	Pittsburgh	Efield	Y	Out of Phase Clear
2014-01-22 19:44:13	Pittsburgh	Efield	Y	Power Disturbance
2014-01-22 19:20:45	Pittsburgh	Efield	Z	Out of Phase
2014-01-22 19:20:45	Pittsburgh	Efield	X	Out of Phase
2014-01-22 19:20:45	Pittsburgh	Efield	Y	Out of Phase

Circuit	Location Name	Phase	Phase Reference Location	Phase Reference Distance
L7	22 67 Zone 4	1	Self	
L7	22 67 Zone 4	2	Self	
L7	22 67 Zone 4	3	Self	
L7	24 55 Zone 3	1 --> 3	22 67 Zone 4	4.05
L7	24 55 Zone 3	2	22 67 Zone 4	4.04
L7	24 55 Zone 3	3 --> 1	22 67 Zone 4	3.97
L7	87 74 Zone 2	1 --> 2	22 67 Zone 4	5.98
L7	87 74 Zone 2	2 --> 1	22 67 Zone 4	5.89
L7	87 74 Zone 2	3	22 67 Zone 4	5.98

View Sensor Detail menus

Figure 4: See "Out of Phase" Events

The administrator can then modify the sensor and code it to Phase 3. Another event will be generated showing that the "Out of Phase" condition cleared. The users can then go into their GIS, OMS and DMS and adjust the phasing thereby updating the official record.

"Getting data from the grid through sensors makes business sense. We are now of the mind set to monitor everything"

Vince Dow
Vice President, Distribution Operations, DTE Energy

Conclusion

Proper phase identification is a core requirement for the operation of multi-million dollar OMS and DMS systems. Without correct phasing information, a utilities significant investment could be at risk of being deemed unreliable for certain switching operations. It could also impact worker safety if the phasing is changed accidentally. The problem may not reveal itself for many months or years after the phasing was flipped. Aclara's sensors will send immediate notification of the error and let you correct it before it causes an accident or another outage. They can also eliminate the need for manual phasing checks by lineman using phasing sticks, thereby saving Operating and Maintenance (O&M) costs to the utility.

For more information about how this application could be applied to help your utility improve the accuracy of your data, improve safety and reduce O&M expenses schedule a consultation with one of our sales representatives at 800.297.2728. We can help you select the right Aclara's sensors and architecture designed to meet your specific application use case and needs.