Low Voltage AMI Modular Meter Crossover Validation System

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I. Background

Due to the complex location of the meters in Taiwan, Taipower has decided to adopt a modular design framework for communication and metering, which has the advantage of maximizing the support for different communication technologies, allowing the selection of the most suitable communication technology for the meter installation site, and reducing future communication tuning and maintenance costs. It also reduces the cost of future communication and maintenance.

In addition, as communication technologies change rapidly when new communication technologies such as 5G mature in the future, the modular architecture can be updated by replacing communication modules without replacing the entire meter, effectively saving operating hours, materials, and labor costs.

Although the modular AMI system can provide the above advantages, its open-ended drawback is the problem of interoperability and integration between different units of the meter. To solve this problem, Taipower has defined and developed a standard communication interface for each component of the AMI, which is used as the communication standard for each manufacturer to produce related equipment. However, due to the differences in design concepts and technologies among manufacturers' meters and communication systems, it is not yet possible to cover all situations in the field at the specification level, and there are many different combinations of meter and control center communication modules (hereinafter referred to as FAN). In order to avoid compatibility problems after the official launch, it is necessary to establish a low-voltage AMI cross-validation system.

II. Study content

The schematics of this low voltage AMI cross-validation system are shown in Figure 1 and Figure 2. The system consists of "One FAN vs. Multi-Meter Test Bench," "One Meter vs. Multi-FAN Test Bench," and "test platform verification system".

The " One FAN vs. Multi-Meter Test Bench " and " One Meter vs. Multi-FAN Test Bench " of this system can perform the following test items through the test platform verification system:

(1) CVT-1 (Crossover Validation Test) Periodic meter reading: The meter must periodically transmit power consumption data (including kwh and kvarh) to the test platform for data validation through the communication system.

(2) CVT-2 random meter reading (On-demand): Load output (0.5A~2.5A) according to pre-set conditions, randomly given by the test platform with random meter reading items (including load value). The meter must transmit the meter-load-related data to the test platform for data verification through the communication system.

(3) CVT-3 Midnight Data Reading: The meter should send back the load data to the test bench for data verification through the communication system according to the set daily midnight schedule.

(4) CVT-4 Last Gasp verification: The verification system can send the power off signal to the designated remote switch and disconnect the meter connected to the switch according to the pre-set or manual method. After the meter is disconnected, the disconnection message must be immediately returned to the verification system.

(5) CVT-5 Restart Performance Verification: The verification system will send the power-on signal to the designated remote switch and restore the power to the meter connected to the switch according to the pre-set or manual method. After the meter is restarted, the restart message should be sent back to the verification system immediately.

The test platform verification system serves for the above tests, which can estimate the connection

success rate of overall and separated meter and FAN module. With that, we can inform vendors if a failure occurs and even help them to solve the issues.

III. Research results

The test platform was completed at the end of 2022, and the UI interface was optimized in early 2023 according to the test requirements. Several malfunctions occurred at the meter installation site, and the cause was suspected to be abnormal communication between the meter and the communication module. In May 2023, we went to the meter factory to investigate the unstable voltage of the FAN module with colleagues from the Department of Power Distribution and the Electric Power Research Lab of the Taiwan Power Research Institute.

IV. Conclusion

In the future, a large number of smart meters will be installed, and stability and quality must be taken into
account while improving the production capacity.
The compatibility of the meter and communication module is an important issue, and the crossover validation system jointly developed by our group and Electric Power Research Lab can effectively improve the quality of the meter and communication module. This low-voltage AMI crossover validation system has achieved the expected benefits in the early stage of installation. This year, several communication module manufacturers will be evaluated, and this AMI validation system will be incorporated into the standard in the future to reduce the chance of compatibility issues between old/new FAN modules and meters.

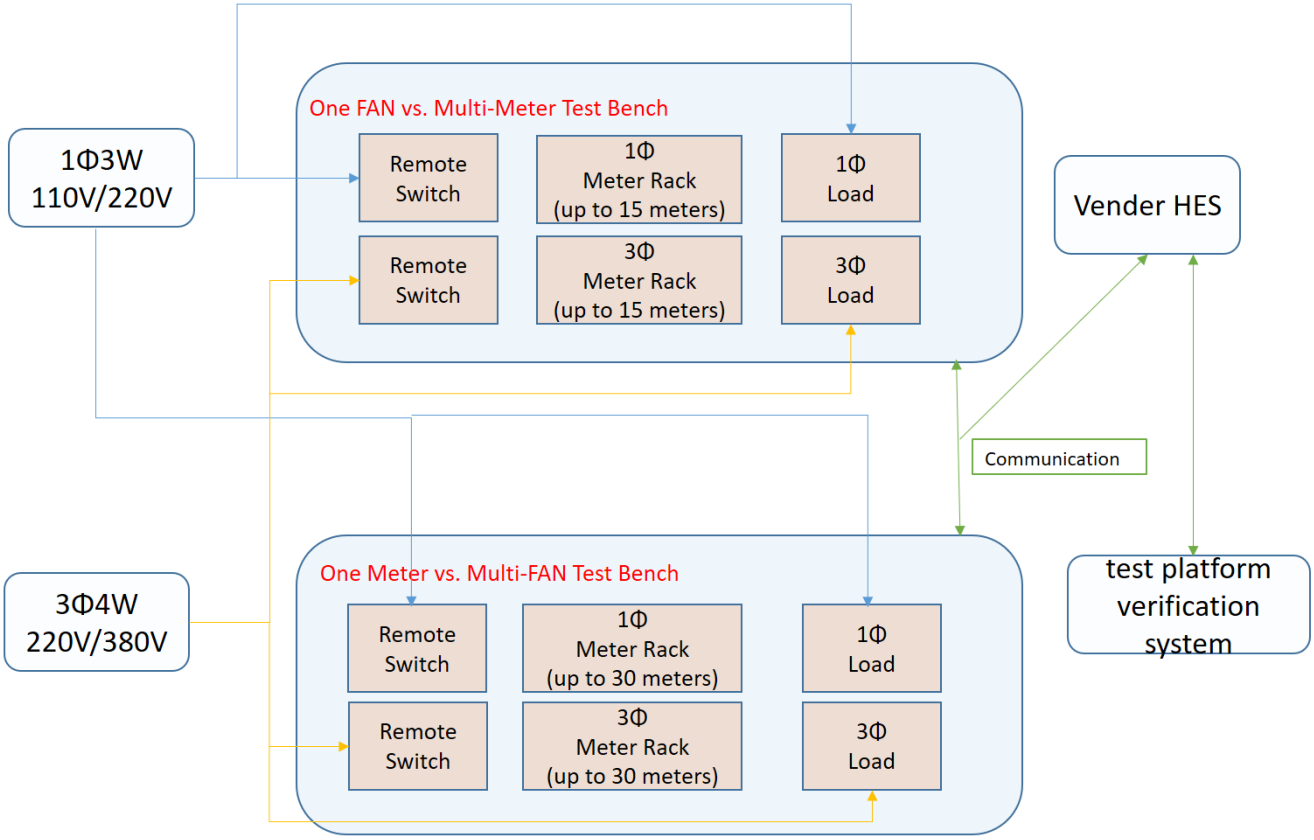

Figure 1 Schematic diagram of AMI cross-validation system architecture

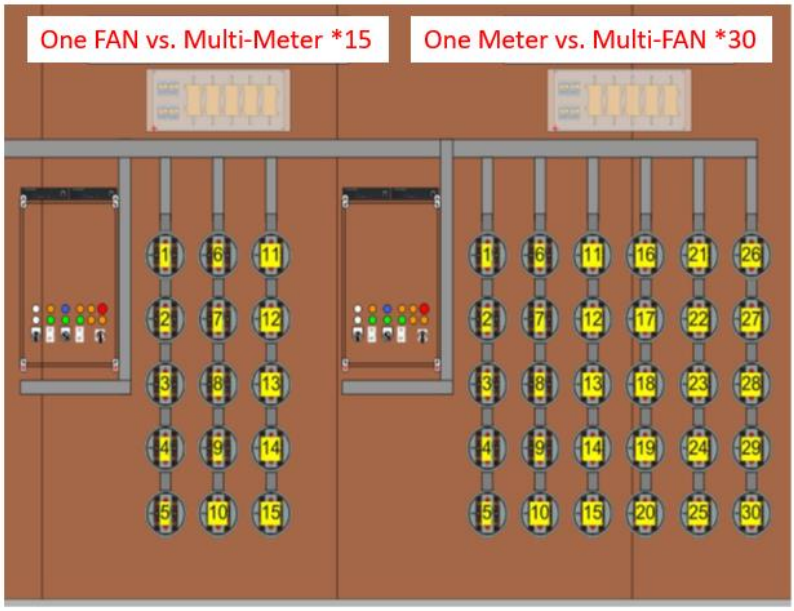

Figure 2 Schematic diagram of AMI cross-validation system meter rack