

PJM Data Concentrator DNP 3.0 Implementation Level 2

With

32-Bit Frozen Counter Event Support

Certification

Introduction:

In an effort to meet our customers needs, the PJM Interconnection is installing the infrastructure to enable direct acquisition of revenue information (MWH/MVARH) from customer facilities. PJM has established several standards for data communications and data modeling to facilitate this customer data connection. The Remote Terminal Unit (RTU) protocol that PJM requires the customer to use in this communication is DNP 3.0 implementation level 2. This level of DNP implementation lacks a critical object necessary to assure the un-interrupted flow of revenue information from PJM customers to PJMs Supervisory Control and Data Acquisition/Industrial Metering System (SCADA/IMS). This specification will document the necessary functionality that an RTU manufacturer will have to demonstrate in addition to being DNP 3.0 level 2 compliant to become a PJM certified Data Concentrator.

Historical Perspective:

Typically the acquisition of revenue information (MWH/MVARH) and the acquisition instantaneous information (MW, MVAR, Volts, Amps, Status, etc.) is done with separate systems. This is necessary because of the nature of the data (historical versus real-time) as well as the root source of the information (revenue meters versus transducers). Legacy SCADA systems attempted to collect revenue information using pulse accumulators, but this only produces an estimate of the energy that is not of revenue quality or reliable enough for accounting reconciliation.

General Implementation Details:

The PJM Interconnection is installing equipment and establishing standards that will enable PJM to acquire both of these types of information with the same system, while maintaining the accuracy and reliability of using two separate systems. The data model required by PJM for the customer equipment eliminates the need for two systems by carefully defining the source and reliability of different data types. A key component of the customer equipment necessary for direct connection to PJM is the Data Concentrator or RTU. The RTU collects the analog and digital information (MW, MVAR, Volts, Amps, Status, etc) in the historic manner using analog and digital inputs. The new approach is in the collection of revenue information (MWH/MVARH). The RTU acts as a data concentrator by polling the modern revenue meters using either DNP or MODBUS for the revenue information, and collecting that information in engineering units. This eliminates any inaccuracy due to Analog to Digital (A/D) or Digital to Analog (D/A) conversions, and shifts the responsibility for the top or hour freeze to software in the revenue meter. This implementation merges the collection of revenue information and instantaneous information into one system.

Failure condition Problem Statement:

The SCADA/IMS system at PJM will collect the revenue information and instantaneous information using DNP 3.0 as the communications protocol. Since the revenue information collected by the RTU from the revenue meters is a representation of the energy used in the previous hour, this data is only available in the RTU for one hour. This situation mandates that the SCADA/IMS system successfully communicates with the RTU at least once every hour. The limitation is when a SCADA/IMS or communications failure interrupts normal RTU communications for longer than one hour. If this situation occurs, data is lost for that hour, creating a data hole in the PJM Grid Accounting Database.

Failure condition Problem Solution:

To minimize the possibility of data holes, the PJM data model design includes the usage of object 23 variation 5 (23.5). This object, 32-Bit Frozen Counter Event with Time will be used to queue object id, value, quality code, and timestamp of the freezing of 32-Bit Running Counters (object 20.1) into 32-Bit Frozen Counters (object 21.1). The PJM SCADA/IMS will collect the object 23.5 events on an hourly basis. Under normal circumstances (no SCADA/IMS or communications failure) this will produce a single value, quality code, and time stamp for each occurrence of a freezing of an object 20.1 element each hour. Under abnormal circumstances (SCADA/IMS or communications failure for greater than 1 hour) this will produce a value, quality code, and time stamp for each occurrence of a freezing of an object 20.1 element for each hour while the failure condition existed. The PJM SCADA/IMS system will have the

ability to acquire and store up to the maximum number of queued events of a freezing of an object 20.1 element into an object 21.1 elements for each object 20.1 element defined in the RTU.

Technical Requirements:

- RTU must support DNP 3.0 implementation level 2 communications protocol from RTU to Master Station.
- RTU must support DNP 3.0 implementation level 2 or ModBus communications protocols from RTU to Revenue Meter(s).
- RTU must support the definition, usage, and collection of DNP 3.0 object 23 variation 5.
- RTU must support internal software driven freeze of all object 20.1 elements into object 21.1 elements at a user definable number of seconds after top of hour. The RTU must also support the interval for this software driven freeze as a user definable number of seconds between freezes.
- RTU must issue the internal software driven freeze of all object 20.1 elements into object 21.1 elements immediately after communications to revenue meters is established after RTU power up, hard reset, or soft reset.
- RTU must be able to be configured to store a minimum of 576 queued events for each occurrence of an object 20.1 element before loss of data or buffer wrap.
- RTU must be able to be configured to allow each occurrence of an object 20.1 element to frozen with a separate external contact or internal status indication.
- RTU must be able to be configured to accumulate pulses and convert those pulses into object 20.1 element. The object 20.1 element must be able to be frozen by the end of interval indication from the meter or software supplied internal freeze, creating an object 21.1 element. The creation of the 21.1 element should also cause an object 23.5 event message for this element.
- RTU must be able to be configured to allow the master to request the object 23.5 data stored in the event buffer as a Class-3 event poll.
- RTU must be able to be configured to allow the event buffer to wrap when the total number of events exceeds the event buffer size. This ensures that the most recent frozen counter events are stored in the event buffer, and the oldest events are overwritten when the buffer is full, and new events need to be stored.

Verification:

Initial validation of DNP 3.0 implementation level 2 compliance with Object 23.5 support will be conducted using an Applied Systems Engineering ASE2000 Communications Test Set. Final validation of required functions will be conducted with the PJM SCADA/IMS system which is based on the ALSTOM ESCA EMP Platform version 2.1 on Windows NT.

Conclusion:

The SCADA/IMS system will enable PJM to collect instantaneous information and revenue information with the same system without sacrificing accuracy. Once the functionality of DNP 3.0 object 23.5 is fully operational in the SCADA/IMS data model, the PJM Interconnection will also be able to collect the revenue information with high availability, and a low probability of data holes.

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