RIG Acceptance Testing Procedure

Version 1.2
Effective Date 10/7/2025

Approved by:

Priyanka Namburi 10/07/25

REVISION HISTORY

VERSION NO.	DATE REVIEW STARTED	EFFECTIVE DATE	REVISED BY	DESCRIPTION
1.0			-	Initial Release
1.1	02/20/2007	02/20/2007	-	Update
1.2	07/16/2025	10/07/2025	Jakob Helsher	Update

TABLE OF CONTENTS

1.0 PURPOSE

The procedure is intended to verify that the Remote Intelligent Gateway (RIG) supplied to each Generator Owner meets the requirements of the ISO Monitoring and Communications Requirements Technical Standards.

2.0 INTRODUCTION

The RIG Point to Point (P2P) test will be performed with the active participation of California Independent System Operator (CAISO) Energy Data Acquisition Specialists (EDAS) Team. However, the ISO's participation is limited to that of a facilitator and, as such, the ISO shall only be responsible for costs it may incur as a result of its participation in the process described herein.

The ISO expressly reserves the right to modify, or withdraw from, the process initiated and described herein. Additional requirements may be added or deleted by the ISO in its sole discretion at any time before, during or after the process. No rights shall be vested in any party, individual or entity by virtue of its preparation to participation in, or participation in, such process. The ISO shall be granted access rights as necessary to permit observation of the process. Successful completion of the process shall not in any way be deemed to affect any requirement of the ISO Tariff, including without limitation metering, certification and scheduling requirements. Validation of a RIG Unit by the ISO shall not exempt any affected person from participation in the process described herein. Participants are advised that this is an ISO document and hence ISO ADR Procedures apply to any dispute arising hereunder in accordance with Article 13 of the ISO Tariff.

3.0 DEFINITIONS

Unless the context otherwise indicates, any word or expression defined in the Master Definitions Supplement, Appendix A to the ISO Tariff, and capitalized herein has the same meaning where used in these principles. In addition, the following words and expressions used in these principles with initial capitalization have the meanings set forth below:

Automatic Generation Control (AGC): Generation equipment that automatically responds to signals from the ISO's EMS control in real time to control the power output of electric generators within a prescribed area in response to a change in system frequency, tieline loading, or the relation of these to each other, so as to maintain the target system frequency and/or the established interchange with other areas within the predetermined limits.

Battery Energy Storage System (BESS): Battery Energy Storage Systems, or BESS, are rechargeable batteries that can store energy from different sources and discharge it when

needed. BESS consist of one or more batteries and can be used to balance the electric grid, provide backup power and improve grid stability. (Also, ESS, or Energy Storage System).

Certificate: In cryptographic terms, an electronic document verifying a person or object's identity.

Certificate Revocation List (CRL): A list of certificates that have been revoked before their expiration date, which explicitly denounces trust for that person or object's communications.

Certifying Authority (CA): An entity that issues certificates to validate a person or object's identity.

Current Transformer (CT): A current transformer (CT) is a type of transformer that reduces or multiplies alternating current (AC), producing a current in its secondary which is proportional to the current in its primary. Current transformers, along with voltage or potential transformers, are instrument transformers, which scale the large values of voltage or current to small, standardized values that are easy to handle for measuring instruments and protective relays.

Distributed Control System (DCS): A microprocessor-based system used for data acquisition and control of plant processes. These control systems are "distributed" in that the controllers may be physically located near the process they are controlling. DCS's usually include some kind of Man Machine Interface (MMI) device used to allow a plant operator to view the status of the process and take corrective action when necessary.

Distributed Network Protocol, (DNP 3.0) Version 3.0: A data processing application that runs on master and remote devices and is used for data exchange. (See www.dnp.org for more information on this protocol)

Energy Communications Network (ECN): The Energy Communications Network (ECN) is a semi-private AT&T MPLS communications network option for telemetry from the Real-Time Device to the ISOCAISO's EMS. AT&T provisions access to the ECN. The ECN natively has no encryption.. AT&T can provision ECN connectivity either as a T1 circuit with a customer-provisioned router or as an ANIRA IPsec VPN tunnel to the ECN. The ANIRA gateway has Ethernet and cellular IP capability.

Energy Management System (EMS): The ISO's telemetry-based system for managing reliable operations of the ISO-controlled grid. The EMS system receives information every four seconds regarding the system load and generator operating levels. EMS also provides Automatic Generation Control (AGC) sending operating set points for units on regulation.

Field Remote Intelligent Gateway (RIG): A device functionally defined by the ISO to directly telemeter secure operational data from a Generator's Generating Units to the ISO EMS. Field

RIGs are used as the means for providing direct control of Generating Units by the ISO and are a prerequisite for participation in the ISO Regulation market.

Generator Resource Data Template (GRDT): The Generator Resource Data Template is one of several Excel spreadsheets, designed to capture data specific to a particular unit type, such as Wind, Biomass, Hydro, Solar, etc. The spreadsheet includes fields for dozens of data elements that describe the resource, including SCIDs, resource type, ramp rate, heat rate, startup requirements, forbidden operating regions, etc. - much of the data that is required for the ISO's MasterFile database.

Internet Service Provider (ISP): A commercial enterprise that supplies customers with access to the Internet.

Meteorological (MET) Data: Weather data. Also, met data or MET data.

Operational Data: Data (such as, but not limited to kV, MW, MVAr, MWh, MVARh, status) collected at defined periods by ISO EMS Telemetry that is immediately available for ISO system operator's use in determining system conditions.

Public-Key Cryptography Standards (PKCS): A series of cryptographic standards, published by RSA Laboratories that define the syntax for implementing public key handling.

Public Key Infrastructure – (PKI): PKIs are designed to establish secure domains and trusted relationships necessary for conducting secure electronic business. PKI involves the various processes that deal with the creation, distribution, authentication, and storage of keys and certificates. Scan Rate: Predefined rate for receiving or sending data.

Resource Interconnection Management System (RIMS): Web application accessed by external entities to post changes to transmission equipment and/or generators that may affect the ISO. RIMS is a secure, web-based database application used to track and manage data from Interconnection Requests in the ISO queue through energizing the generating facility and requesting modifications post-commercial operation date of the generating facility. Electronic submission of interconnection requests and New Resource Implementation (NRI) data is accomplished via the user interface in RIMS.

Secure Socket Layer (SSL): A security protocol that uses symmetrical and public key cryptography to secure communication over the Internet.

Single Line Diagram (SLD): In power engineering, a one-line diagram or single-line diagram (SLD) is a simplified notation for representing a three-phase power system.

Supervisory Control and Data Acquisition (SCADA): SCADA is a computer-based system used for gathering and analyzing real-time data to monitor and control equipment that deals

with critical and time-sensitive materials or events. Data is gathered, processed and presented, often to issue warnings when conditions become hazardous by sounding alarms. Based on the information received from the remote stations, automated or operator-driven supervisory commands can be pushed to remote station control devices, which are often referred to as field devices.

Transmission Control Protocol / Internet Protocol (TCP / IP): IP is used at the network layer of the Objective Systems Integrators (OSI) stack for routing packets. TCP is used at the transport layer of the OSI stack and works with IP for packet routing.

X.509v3: Digital certificate public key format defined by the International Telecommunications Unit (ITU) X.509 Standard

4.0 PROCEDURE

To run a successful test, it is necessary to establish the methods and general procedures that will be followed throughout the test. It is important that these rules and procedures be agreed to, and followed, by all parties during the test. In those cases where either methods or procedures are bypassed or changed, all parties shall acknowledge the change, reach a mutually agreeable resolution, and document said changes. This resolution may involve mutually agreed to changes being made to the test procedure or resumption of the previously agreed to methods and procedures. Any additional detailed testing required to further authenticate functionality and specifications of deliverables will be conducted with the owner and ISO personnel in a Site Acceptance Test conducted at Folsom.

The owner will appoint a Test Representative that is solely responsible for representing their respective companies during testing.

The ISO Test Supervisor may add or delete items from the test, redirect the test, skip sections, or review sections at any time during the test provided such changes are consistent with the scope of the project.

The tests are designed to run in the sequence given in this document except where noted. Proper sequencing of tests is necessary because of set up procedures that may have occurred in previous tests. However, it is recognized that circumstances often require that the sequence be interrupted. Such an interruption or rescheduling requires both Test Supervisors to agree, the impact of the sequence interruption be recognized, and said interruption or rescheduling be documented.

Successful testing involves active participation and understanding of test procedures by both parties. The tests will typically be executed in the order specified. This will provide the ISO with the opportunity to observe and question test results.

4.1 PREREQUISITES FOR ACCEPTANCE TESTING

Generator Owners will accomplish all the NRI prerequisites prior to the start of Generation Acceptance Testing:

4.1.1 Communication Block Diagram

Generator owners will provide the ISO with Communication Block Diagram showing functional and specific details. This diagram shows the RIG connecting to the input device(s) and initiating device(s) (such as meters, PLC, DCS, etc.). It is important to note that all devices between the meter(s) or transducers and the RIG must be documented on the block diagram. The diagram should also identify protocols used, master/slave arrangements, baud rates, circuit numbers, etc., to allow for proper troubleshooting and to facilitate discussions. If any changes are made during pre-testing that affect orientation of devices or point sources on the diagram, a new diagram must be submitted to the ISO prior to the P2P test.

4.1.2 RIG Spreadsheet

RIG spreadsheet sent by CAISO EDAS team will have the Analog Inputs/Outputs and Digital data points that ISO requires the site. CAISO EDAS will test all the points listed on the spreadsheet.

4.1.3 RIG Pre-Testing

Generator Owners will have performed all necessary pre-testing of the RIG to assure functional field systems prior to the start of the testing with the ISO. This pre-checkout will include but will not be limited to the following:

1. Power-up and diagnostic checks of the RIG device.

2. Device PKI certificates installed. Refer to Requesting access and certificates | California ISO for the procedures for establishing secure communication with the ISO.

3. Verification of the correct configuration, mapping and scaling of each point in the RIG database.

4. Verification of the correct protocol communication with other devices (i.e. meters, transducers, DCS's, PLC's, etc.). This must include a point-to-point check with each device connected with the RIG prior to the beginning of testing with the ISO. A DNP3 master emulator, master test set, or other DNP3 software capable of polling the RIG is required to simulate data flow to the ISO.

When pre-testing is completed, send an email to edas@caiso.com including the Project Code requesting a Communications Check. The Communications Check must be requested at least 5 days prior to the P2P test.

4.2 TEST OVERVIEW

After the RIG has been connected and powered up, secure connectivity with the ISO interface shall be verified. Once communication has been verified, the test of inputs and outputs (I/O) will commence. A point-to-point check validating the correct scaling of the signal from the meter side through each device to the EMS display at the ISO will be conducted. All analog inputs will be verified using a three-point check (0, mid-scale, and full scale). The data will be validated, as scaled correctly through each input device, as appropriate.

4.2.1 Generator Owner Responsibility for Existing Facilities

Generator Owners of existing facilities and/or units in commercial operation must schedule an outage with the ISO Outage Coordination no later than 72 hours prior to performing the data points check. Testing will be conducted on the online system and all related entities must be aware of the scheduled testing.

The Generator Owner is solely responsible for supplying the means to drive the appropriate signals through to the RIG that reflect 0%, 50% and 100% analog values to the ISO EMS System and an appropriate means to validate digital points. At the ISO's discretion, a field engineer may audit this test.

4.3 LOGISTICS

While CAISO EDAS will administer the test, it is the responsibility of the Resource Owner to send an Outlook invite to edas@caiso.com for the P2P test date.

The test period will begin with an orientation of all personnel involved in the testing. The purpose of this orientation is to review testing procedures and to set forth what is to be accomplished by the end of the test period. The test period will conclude with a review meeting. In the case where unsatisfactory test results are obtained, this meeting will be used to determine the proper course of action to obtain satisfactory results.

4.4 INITIAL TEST

The following initial test will be conducted prior to testing accuracy of I/O values and calculations:

4.4.1 Confirm RIG Visibility to EMS

ISO Representative will verify if ISO EMS is receiving the DNP3 data and the RIG heartbeat is incrementing as expected.

4.5 PERFORM DATA CHECK ON ALL I/O VALUES

4.5.1 Metering Checkout (CAISO Metered Entities)

All participating CAISO Metered Entities are required to complete a metering checkout in coordination with a CAISO certified inspector as part of the P2P test. The CAISO inspector must demonstrate with test kit injections that interval meter data is being accurately recorded in load and generation channels. At least 3 five-minute intervals are required for each direction, inclusive of kW and kVAR channels.

The following additional requirements apply:

- For BESS resources, BESS IDLE must be validated for correctness in the MV90 load profile. The BESS IDLE source device must be unplugged to confirm that data fails over to recording in Channel 1
- For loss compensation schemes, failover to static losses must be validated by unplugging the loss calculation meter(s) and the CAISO inspector verifying that static losses are enabled.
- For peer-to-peer netting, validate readings for the connected state, failed state, and reconnect state. EDAS will provide guidance on required MV90 test cases for each scheme on a case-by-case basis.

4.5.2 Analog Values

Manually input an analog value for each point. Verify that the correct value is displayed at the EMS display. All analog inputs will be verified using a three-point check (0, mid-scale, and full scale). All newly installed meters or relays supplying analog data to the RIG must be validated through test kit injections. All other analog points must be tested from their respective source devices.

The following additional requirements apply:

- For BESS units, BESS IDLE Active must set the UPMW point to 0. Other MW points (e.g. UGMW, UAMW, UNMW) should not be impacted by BESS IDLE logic.
- For units providing AGC, the AGC setpoint test must be validated across all relevant systems to ensure it accurately reflects performance under actual operating conditions.
- Sites reporting weather data must be tested using live data; substituted or forced values will not be accepted.

4.5.3 Digital Values

Toggle each digital value. Verify that the correct value is displayed in the EMS display. Verify each correct state of the digital point. All newly installed devices serving discrete status to CAISO (e.g. circuit breakers, reclosers, switches) must be tested through direct methods such as manual operation, simulating the signal via direct contact closure, or triggering the signal internally via the relay. Testing solely via upstream controller commands does not meet validation requirements. All other discrete points must be tested from their respective source devices.

4.5.4 Calculations

Any data points in the generator's database that rely on calculated values (e.g. UCON, HSLMW, UAGC) must be demonstrated with verification of both input accuracy and resulting outputs. It is expected that both the value and DNP3 quality inputs will propagate up through calculated points. All logic-derived results transmitted to the EMS must be validated for correctness.

4.6 PERFORM ALARM AND DATA FLAGGING CHECK

Test data quality alarms by physically disconnecting communication media for each of the Originating Devices listed on the Communication Block Diagram. Section 5.6 of the Direct Telemetry BPM outlines the differences between Originating and Non-Originating Devices. Each device communication disconnect should set the points sourced from that device to bad quality – EDAS may require updates to the Communication Block Diagram if there are mismatches between the Comm Block and test observations. Reconnect each line and note system restoration times.

4.7 PERFORM UPS FAILOVER

All resources operating under requirements of Appendix Q of the CAISO tariff are required to operate and maintain a UPS backup for CAISO metering and telemetry systems. UPS systems are subject to failover testing by disconnecting the main power supply to ensure all critical systems maintain good telemetry.

4.8 OUTSTANDING ISSUES

There may be cases where test results are not satisfactory. All unsatisfactory results are to be communicated to the RIG Owner and summarized in RIMS. All items or features that are not available at the time of the tests will be documented in RIMS. If appropriate, the test may be postponed pending resolution of an unsatisfactory result.

4.9 TEST SUMMARY

The following list provides a summary of the tests conducted during the P2P test:

- Validate source mapping to the points list.
- Confirm scaling: ensure raw values from the RIG translate correctly to engineering units in CAISO EMS based on the CAISO RIG spreadsheet.
- Verify that data reflects the requested measurement units.
- Confirm polarity for current measurements.
- Confirm all analog point values and discrete statuses from relevant source devices
- Check inputs used in calculations.
- Ensure failed quality flags propagate correctly when sources are disconnected, and that dependent calculations are appropriately impacted.
- Perform UPS failover if applicable.

5.0 CONTACTS

For any questions regarding this procedure, you may contact EDAS (edas@caiso.com).