RIG Engineering/Deployment Guide

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1. Introduction

1.1. Background

Transferring Automatic Generation Control (AGC) from the Investor Owned Utilities (IOU) to the Independent System Operator (ISO) was one of the requirements of the restructuring framework for California. The technology selected by the ISO to access plant information and/or controls, on behalf of this requirement, is the Remote Intelligent Gateway (RIG). Unless exempted by the ISO, a Generator providing AGC must install equipment and software (a Field RIG unit or equivalent acceptable to the ISO) that can interface with the ISO's Energy Management System (EMS).

The Generator is responsible for satisfying this requirement and adhering to all ISO standards. The ISO standards for AGC can be found in the ISO Technical Standard, **"ISO Generation Monitoring and Control Requirements for AGC/Regulation Units"** located on the ISO GCP Web Page. (http://www.caiso.com/docs/1999/09/30/19990930153320164 78.pdf) The procurement, engineering, installation and maintenance of the Field RIG (or equivalent equipment acceptable to the ISO) is the responsibility of the Generator, under this standard. To assist Generators in meeting this standard, "**The RIG Engineering/Deployment Guide**" has been prepared. This guide can be located on the ISO web site, at: http://www.caiso.com/docs/2000/01/20/20000120073242241 59.pdf

The ISO is responsible for verifying the correct implementation of the ISO required point list and appropriate AGC control with each generator. Maintenance of standards and process documents will be through the ISO GCP web site at http://www.caiso.com/thegrid/operations/gcp. The ISO will provide engineering processes and related support as more fully described herein to satisfy such responsibility. In addition, the ISO will continue to sponsor regular Generator meetings and Engineering Seminars to keep the Generators apprised of developments. Refer to the ISO Contact list for questions and comment. Further, the ISO appreciates any Generator comment and considers such dialog invaluable to our commitment to continual communication and process improvement.

This guide focuses on the process necessary for a Generator to install a RIG for the purpose of meeting ISO standards for AGC/Regulation. This guide provides a framework for communication with the ISO and an overview of the steps necessary in the Engineering and Deployment of a RIG. This guide is written from an engineering perspective to assist the Generator's staff performing the engineering tasks associated with implementing a RIG.

This guide references ISO publications illustrating ISO standards and technical details of RIG implementation. These companion documents are located on the ISO GCP web site (http://www.caiso.com/thegrid/operations/gcp/index.html) and will be maintained and upgraded as necessary by the ISO.

The California ISO makes no warranty with regard to this guide, including but not limited to the accuracy or completeness of the guide, responsibility for any damage or loss to systems or software caused by the use of the guide or assurances that the user of the guide will not require additional third party engineering services.

1.2. Affected Parties

Communication between the various involved parties is critical to the procurement; engineering, installation, testing, operation and maintenance of a Field RIG for purposes of affecting ISO direct AGC control of a unit. The following parties with their perspective roles are listed. The Generator is responsible for scheduling the engineering process amongst these groups. The ISO is committed to an open door policy and should be actively engaged by the Generator and Vendor on any issue affecting the installation of a RIG. Each site will be assigned an ISO Project Engineer to assist in the implementation and coordination of each RIG. It is paramount that the Generator not hesitate to contact the ISO with questions regarding policies, procedures, scheduling and standards.

There are three parties involved in the implementation of a field RIG. A brief summary of these parties and their areas of responsibility are listed below.

Generator

- Provide engineering services to complete equipment and software procurement, engineering, installation and maintenance (Third Party Engineering Services may be desired).
- Adhere to Telecom circuit protection standards.
- Adhere to ISO standards and procedures.
- Procure and install all necessary Telecom circuits.
- O & M of Generator Telecom circuits.
- Provide database as specified in ISO standards.
- Procure RIG.
- Execute RIG O & M plans.

3rd Party Engineering Firm

- Supply Product Overviews (Standard RIG catalog) and quotations.
- Supply RIG Training packages and costs.
- Provide O & M packages and costs.
- Construct RIG.
- Provide Factory Acceptance Testing in agreement and coordination with plant.
- Participate in Site Acceptance Testing.
- Provide technical support and coordination.

Independent System Operator

- Maintain and publish standards.
- Assist with communication circuit procurement.
- Operate, maintain and monitor the ISO telecom network.
- Coordinate the interface and monitoring of metering data into RIG.
- Provide sample acceptance testing procedures for site installations.
- Review and approve plant Engineering proposals and documents.
- Review and approve plant interface drawings.
- Approve initial RIG database content.
- Participate in coordinated testing of installed and configured RIGs.
- Implement RIG/ISO database.
- Approve plant database changes and corresponding changes to the master database template for the plant.
- Participate in AGC tuning with the Generating Plant
- Perform A/S Certification tests.
- Provide, maintain and distribute security certificates and cards.
- Maintain RIG software revision inventories.
- Coordinate Database maintenance and point gathering processes in conjunction with ISO standards.

1.3. Reference Documents And ISO Information

The ISO web site (**http://www.caiso.com/thegrid/operations/gcp**) contains a great deal of useful information to the Generator. These documents are critical information to guide the Generator through ISO standards, procedures and engineering processes.

Web Page	Information Found	Source
What is GCP?	Introduction to GCP	http://www.caiso.com/docs/2001/02/15/2001021518161510632.pdf
Requirements	Technical Standards and Requirements	http://www.caiso.com/docs/1999/09/30/1999093015332016478.pdf
Contacts	RIG Engineers	http://www.caiso.com/1c87/1c876ec3409b0.pdf
Contacts	Third Party Engineering Firms	http://www.caiso.com/docs/2000/02/10/2000021015332512998.pdf
RIG Vendor Contacts	Valid RIGS	http://www.caiso.com/docs/2002/02/26/2002022614265427743.pdf

2. Engineering Process

2.1. Overview

Deploying and engineering a RIG at a plant requires coordination and extensive communication between the Generator, ISO, the Vendor and any Third Party Engineering organization employed by the Generator. The ISO maintains and depends on an open door policy for this process. Pictured in figure 1, is an overview of the steps involved.

The ISO maintains a full compliment of engineering expertise to assist a Generator in engineering/deploying a RIG. Each of these areas of expertise may be from duplicate individuals, as appropriate. ISO staff will often be involved in more than one plant at one time. Specific ISO resources should be identified when the engineering group is established (see 2.2).

1. Each site will be assigned an ISO Project Engineer.
   - Primary contact between the plant and ISO.
   - Advises the plant on ISO naming conventions.
   - Advises the plant on ISO point requirements.
   - Advises the plant on the ISO RIG engineering process.
   - Finalizes and collects completion package.
   - Maintains a schedule on the progress of the site.
   - Coordinates the ISO support roles of engineering a site.
   - Routes the approval package to all involved parties.
   - Accounts for the quality of the engineering packages from the plant.

2. MDAS Engineering (ISO metering)
   - Advises and coordinates the routing of ISO metering data from the plant, for delivery of metering information to the ISO.

3. ISO security representative
   - Advises and coordinates the issuing of security cards and certificates for implementation in the plant RIG.

4. ISO Telecom representative
   - Advises and coordinates the procurement, installation, configuration and engineering of all telecom requirements for the RIG.

5. Operations Engineering representative
   - Advises, coordinates and insures that the engineering design and effort meets ISO requirements.

6. Each site is assigned an Operations Representative
   - Advises, coordinates and consults with the plant engineers to insure implementation to the ISO EMS system.

Figure 1

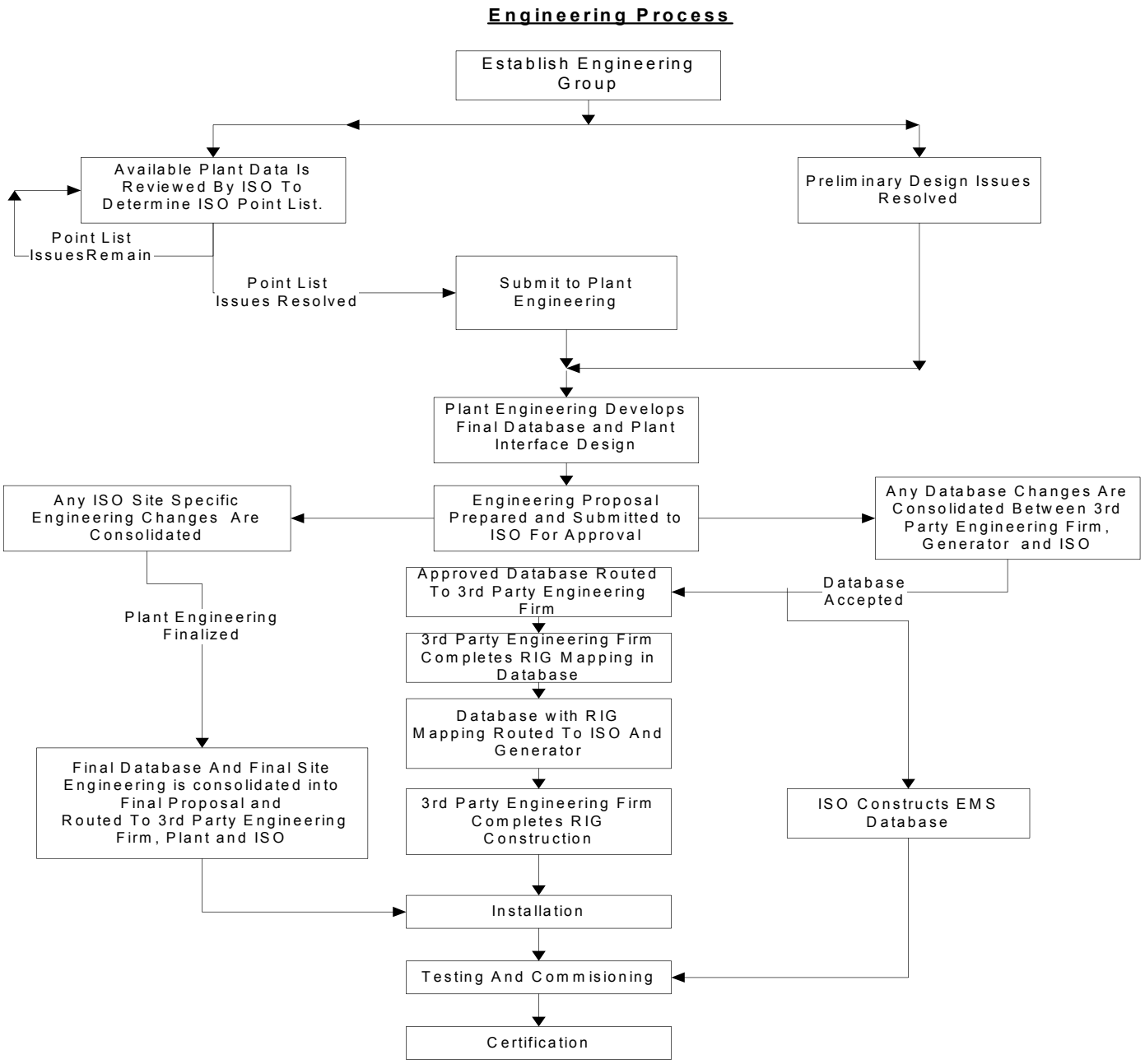

Figure 1

2.2. Establishing The Engineering Group

The first step in the engineering process is to clearly communicate between the ISO, Vendor, Generator and any Third Party Engineers what the team structure is going to be for those engaged in engineering the plant. This is often done at a "kick off" meeting where all the involved individual meet to set up the structure of the engineering effort. The following items should be included along with additional information as deemed necessary for clarity.

- The plant engineering team.
- The ISO engineering team.
- The Vendor engineering team.
- A contact list should be distributed to ISO, the plant and anyone else involved in the effort.
- Any additional information or procedures such as change management should be clearly documented, distributed and openly published.

2.3. Determine Available Plant Data

This step is critical. The data available at the plant needs to be fully researched. The result of this first research step lies in the hands of the Generator to produce a full description of the plant system, including block diagrams to illustrate the plant equipment and connectivity associated with the data. This information is then used by the ISO to discuss point lists with the Generator and determine the appropriateness of items on the points list. The Generator and the Generator's engineering staff submits this to the ISO in a package containing the following items:

- High Level diagram of plant equipment and control systems.
- Detailed descriptions of all the data available at the plant including type, scaling, initiating devices etc.
- Other information as deemed necessary for clarity of describing the plant systems (refer to section 3.2).

The Generator and the ISO will discuss the information gathered, relating it to the necessary requirements of the ISO to effect AGC control. Additional information requirements, if needed for clarity, will be resolved between the generator and the ISO at this time. The Vendor should be involved in this step as well.

2.4. ISO Point List

In close conference with the Generator and the Vendor, the ISO engineering team determines the required point list. Communication of the point list and resolution of any issues is coordinated with the ISO, the Vendor and the Generator through the ISO Project Engineer.

2.5. Finalizing The Point List

The point list is finalized and distributed to the all parties. As is necessary for clarity, the point list will be reviewed for implementation details according to ISO technical standards.

2.6. Initial Design Issues

Design issues should be discussed between the Generator, Vendor and ISO to the extent that they will effect any of the required functionality of the RIG. It is imperative that all groups are involved in design changes. Some of these issues are:

- RIG power sources
- Unit Authority
- DCS / non DCS configurations and AGC control strategies
- Router Configuration
- Telecom circuit types, ordering and installation
- Telecom Circuit numbers
- Other design issues such as High Voltage Protection or RIG location

The ISO is open for discussion and is a valuable resource for the Generator. Discussions on these issues can be coordinated by the plant through the ISO Project Engineer.

2.7. Submission To Plant Engineering

The ISO Project Engineer submits the final database.

2.8. Generator Development of Database And Plant Interface Design

In coordination and discussion with the ISO, Vendor and Generator, the engineering team develops the final database and plant interface design. This step requires very close coordination with all parties. The

EMS Project Engineer coordinates the communication between these parties. The following issues need to be addressed and finalized in an engineering proposal from the Generator, submitted to the ISO.

- The ISO spreadsheet format is to be used to submit point data for all parties.
- ISO engineering team provides advice and helps facilitate support.
- The Generator prepares an engineering proposal for submission to the ISO for approval containing:

  - Plant Overview.
  - Telecom circuit configuration description.
  - Plant block diagrams illustrating the RIG installation and plant interfaces.
  - Plant blueprints detailing interfaces to the RIG, status, analog, Comms, control, etc.
  - Tuning parameters for each unit.
  - Completed RIG database.
  - Summary of the individual unit characteristics and control methodologies.
  - RIG class chosen for plant.
  - Any further documentation deemed necessary for clarity.
  - Plant project work schedule, and charge numbers that may be required for record keeping.
  - Test plans.

2.9. Engineering Proposal Review

There are two components to the ISO's review of the Generator engineering proposal. First is the database. Secondly is the plant interface design for the RIG. The ISO Project Engineer will coordinate routing the engineering proposal through the ISO for review and any communication necessary between the ISO, Vendor and Generator to resolve issues with either the database or the engineering design in the proposal.

2.10. ISO Database Acceptance

Once all issues with the database have been satisfied, the ISO EMS Project Engineer will route the database to the Vendor for completion of RIG construction, and the Generator.

2.11. ISO Engineering Proposal Acceptance

Once all the issues with engineering the plant interface have been accepted by the ISO and the database is accepted by the ISO, the engineering proposal is accepted. The approved engineering proposal is routed, by the ISO EMS Project Engineer to the Generator, the ISO and the Vendor.

2.12. RIG Construction Completed

Having received the final database, the Vendor will finalize the RIG specific mapping in the database and route the database with this mapping to the ISO and the Generator. The Vendor completes construction of the RIG.

2.13. ISO Constructs EMS Database

Having approved the database, the ISO implements the database in the ISO EMS system(s).

2.14. Installation

Having completed construction, the Vendor coordinates delivery of the RIG to the Generator if not already delivered. This process of finalizing the database, delivery and installation is coordinated between the Vendor and the Generator.

2.15. Testing And Commissioning

Once the RIG is installed, testing and commissioning begins. The ISO expects that the Generator and the Vendor have verified the correct implementation of the database in the RIG. The purpose of testing the RIG includes:

- Verification of proper equipment construction. This is left to the Generator and the Vendor to resolve (such as Factory Acceptance Testing).
- Verification that the approved installation described in the Engineering proposal was implemented.
- Verification of correct database implementation.
- Verification of control strategy implementation.
- Verification of ISO EMS connectivity and alarm notification.

The testing and commissioning will go through the following steps:

1. Factory Acceptance Testing: This is between the Vendor and the Generator to insure that the equipment has been properly constructed.

2. Database Testing: The Generator verifies that the database commissioned for installation in the RIG and specified in the Engineering proposal is correctly installed.

3. ISO Site Inspection: An ISO Field Engineer will visit the site, if deemed necessary, and inspect the installation of the RIG to insure that the Approved Engineering proposal has been implemented and that ISO technical standards have been met. Step 2 must be completed before an inspection will be undertaken.

4. Development Site Integration Testing: Once the ISO has implemented the database in the ISO Development EMS full testing of all aspects of the RIG systems, starting at the ISO and progressing through the ECN to the plant Field RIG and the plant control system will be systematically tested. Generator personnel, ISO Engineers and Vendor personnel will be coordinated to conduct this test. All required ISO points will be verified. Steps 1 to 3 must be completed before any Site Integration Testing will begin.

5. Development Site System Tuning: In conjunction with Step 4, the ISO will verify and implement tuning parameters on the ISO EMS system to identify unit performance satisfactory to the ISO. The ISO is committed to achieving comparable unit performance as was observed by units previously under ISO direct AGC through IOU EMS systems. In the case of these units both the ISO and the Generator will pay particular attention to achieving comparable performance and any issues should this performance not be met. Plant issues may be uncovered that the Generator will be required to resolve. Any ISO tuning issues will also be identified and addressed by the ISO. Close communication and coordination will be engaged between the ISO and the Generator's plant.

6. Production Site Integration Testing: Once the RIG has been fully tested on the ISO development system it will be moved to the ISO Production EMS system for final commissioning. Testing will be performed on the RIG system to verify that the implementation is correct.

7. Commissioning: The final step is for the plant to be commissioned on the RIG. The ISO will begin controlling the units under ISO Direct AGC Control at this time.

Example testing procedures can be found on the ISO web site at http://www.caiso.com/thegrid/operations/gcp.

Commissioning the RIG installation verifies adherence to ISO technical standards and performance of RIG control of Generator units on AGC control. This process also involves tuning of the ISO EMS to obtain unit control satisfactory to the ISO. Test plans will be coordinated at the time the ISO reviews and accepts the Generator Engineering Proposal.

Commissioning of the RIG installation results in the Generator's units being implemented on the ISO production EMS system for AGC. For units previously under ISO Direct AGC Control through an IOU, the ISO is committed to obtaining as a level of performance comparable to performance levels under the IOU. The ISO cautions owners that there are many reasons why performance can change. Examination of these reasons, under these circumstances, will be carried out between the ISO and the Generator.

2.16. Certification

After the series of tests and tuning that occurs in the testing phase, certification of the RIG is required. Some Generators may be bringing new units into the AGC market. Other units may have been providing AGC through the IOU's.

Units that are new to the AGC market will require certification as soon as testing is complete. The Generator is responsible for scheduling this certification with the ISO Client Relations group. ISO contacts to the ISO Client Relations group can be coordinated through the ISO Project Engineer.

Units providing AGC through the IOU's will be required to re-certify in order to continue participation in the ISO ancillary market. Some clarification is needed regarding "grace periods" and the Unit's assigned values. The following guidelines have been developed:

- Upon completion of the RIG development and production testing, a test for Ancillary Services re-Certification (scheduled through ISO Client Relations and Outage

Coordination) must be conducted within 2 weeks. The unit will re-certify at the new values per the certification tests.

- If the Unit's A/S test raises issues (i.e., poor performance, or failure) further tuning and adjustments may be made. Any additional attempts at A/S re-Certification shall be completed within 4 weeks from the production test checkout. The ISO is committed to resolving these issues in the testing phase prior to migrating the unit to production status. It is sometimes necessary to perform verification, tuning and testing on the production system to effect resolution of issues.

- During this period of tuning and A/S re-Certification (until the A/S test results reach finality), the Unit will retain it's previous certified (i.e., non-RIG) A/S status and values, regardless of RIG performance. In this transitional period, the Unit may remain on the RIG, or switch back to the former communications/control technology as needed. However, A/S compliance still applies: Scheduling Coordinators (SC's) of Units with new RIG installations are encouraged to only bid those services and quantities they have confidence in delivering.

- On or before the end of the 4 week grace period, the latest A/S test results (including results of failed performance) shall be declared final and the Unit shall only operate via RIG from this point forward.

- Some small delay is expected between the time the A/S values are made final and their entrance into the Master File due to coordination of Master File changes.

Coordination with the ISO should be conducted through the ISO EMS Project Engineer for engineering issues and ISO Client Relations for certification schedules.

2.17. Completion

Once the Generator's unit is certified on AGC the RIG Deployment and Engineering is complete. The ISO Project Engineer will help complete a package of materials in conjunction with the ISO, Vendor and Generator to document the final implementation of the RIG. This package will minimally contain the following items:

- Acceptance Testing results and variance resolutions.

- Signed acceptance from the Generator that the engineering is complete, the security cards are accepted and installed, and a Generator signed CPS subscriber's agreement.
- Accepted Engineering Proposal
- Final approved Database
- All plant design documents communicated between ISO and the plant during the life of the engineering process.

Please refer to the sample signoff package on the ISO GCP web site. Coordination with the ISO EMS Project Engineer on the content of this documentation is critical in order to manage site-specific content.

3. Engineering Details

3.1. Overview

Engineering a plant site for receipt of a RIG involves many organizations and coordination of these various organizations. The ISO has the responsibility of insuring that technical standards are met, but the engineering responsibility lies with the Generator. The ISO maintains an open door policy and is available to consult and advise on meeting ISO standards and the engineering process.

The engineering process describes how to interface to the ISO. The detailed efforts required involves the following general categories:

- Requirements and Information Gathering
- Design and Engineering
- Procurement
- Installation And Testing
- Commissioning
- Engineering Check List

3.2. Requirements and Information Gathering

- Generator determines telecommunications requirements (T1, ISDN, High Voltage Protection).
- Generator orders telecommunications circuits (refer to the ISO's Communications Subscriber Service Guide).
- Generator coordinates High Voltage Protection compliance with local Telco.
- Generator determines Interfaces – (RTU, DCS, PLC, Plant Information Requirements, EMS System / UAS, Telephone Systems).
- Generator determines requirements for existing RTU (Protocol, Type, Status wetting supply, A/D subsystem, etc.).
- Generator determines if a RIO is to be added any additional points that are required and if the RIO is to be installed as part of an additional phase.
- Generator determines environmental requirements such as HVAC.
- Generator selects the installation site for the RIG.

- Generator determines all power requirements including whether a UPS is going to be implemented.
- Generator determines all grounding requirements.
- Generator determines the location of the revenue meter(s) and cabling requirements.
- Generator determines necessary GPS antenna down lead routing, length and whether or not an amplifier is required.
- Generator determines if a Factory Acceptance Test is required and coordinates with the ISO and Vendor.
- Generator determines the extent of a Site Acceptance Test and coordinates with the ISO.
- Generator researches existing documentation and drawings.
- Generator develops a schedule.

3.3. Design and Engineering

- Generator creates a block diagram for the installation, for each phase if more then one installation phase is required.
- Generator Identifies and documents all interfaces – (DCS, Configuration, PI, PLC, Termination Panel, etc.)
- The Generator collects wiring Diagrams (Drafting, Prints).
- Generator submits a description of the data available at the plant with a high level diagram of the plant control equipment.
- ISO determines a point list from the description of the plant data and equipment.
- ISO coordinates resolution of point list issues with the Plant and the Vendor.
- Generator creates the database for each phase (if more then one installation phase is required).
- Generator documents site specific (such as FAT and SAT Procedures). Refer to the sample acceptance tests posted on the ISO GCP Web page.
- Generator prepares a site installation proposal package that includes all design issues at the plant, diagrams and the final spreadsheet submitted in ISO spreadsheet format.
- ISO coordinates the resolution of any issues with the site installation proposal.
- Generator coordinates approval and testing with the ISO Field Engineering Group and the Vendor.

3.4. Procurement

- Review the site installation proposal with the Generator, the ISO Field Engineering Group and the Vendor.
- Determine and implement any changes forthcoming from the review.
- Submit the site installation proposal to the ISO field-engineering group for approval.
- ISO will approve the proposal if all recommended changes have been implemented.
- Prepare Order for RIG with the Vendor.
- Procurement and installation proposal is finalized.

3.5. Installation And Testing

- Execute the FAT (if required) and resolve any discovered variances.
- Perform any necessary I/O checks at the Generator site.
- Prepare the chosen installation site.
- Prepare all cables and conduits.
- Document and coordinate the installation of any new instruments.
- Perform all necessary calibrations.
- Perform any required continuity checks.
- Land (mount) the RIG/RIO.
- Install power to the RIG/RIO and test.
- Coordinate and test all telecommunications circuits.
- Execute installation and testing of necessary DCS & PI interfaces.
- Install ISO security cards.
- Execute signal connections and test.
- Execute any end to end point checkouts in coordination with ISO and the Vendor.
- Execute the SAT in coordination with ISO and the Vendor.
- In coordination with ISO and the Vendor, perform AGC system integration tests from ISO EMS to RIG and generator units.
- Resolve any variances.

3.6. Commissionsing

- Coordinate with the ISO to schedule an AGC Certification test.
- Document operation and maintenance agreements and procedures.

- ISO Sign final turnover Package and submit a copy to the Generator, the ISO and the Vendor (see attached example).

3.7. Engineering Check List

Appendix A contains a check list outlining the details of engineering the plant interface. This checklist is being provided to you for a means to monitor and track completed and outstanding activities as they relate to the Engineering and Deployment of a RIG.

3.8. Critical Milestones

We have determined that the following items are critical milestones to the success of a RIG installation. These items require high visibility and attention from all parties involved.

- Telecom circuit ordering: Telecom circuit requirements should be determined as early in the process as possible. Telecom circuits are ordered through the ISO and are coordinated with local telcos. Installation of the RIG depends on circuit availability for downloading of essential software and configuration items. Testing of the RIG is also highly dependent on completed telecom circuits. Refer to the ISO's Communications Subscriber Service Guide.

- High Voltage Protection : At the same time as telecom circuits are ordered all high voltage protection issues should be researched and scheduled. This item is as critical as telecom circuits can affect the availability of telecom circuits.

- Database collection: The internal configuration of the RIG is highly dependant on the resolution of the ISO required points list and successful implementation of the RIG database. The database is also required for configuration of the ISO EMS system. The database in conjunction with researching the plant equipment that the RIG will be interfacing is a major determining factor on the RIG configuration. Researching, engineering and collecting this database requires coordination with the Generator, the ISO and Vendor. Successful database collection and ISO approval is necessary before procurement and installation of the RIG can continue. This is the responsibility of the Generator.

- Finalization of ISO Required Point List: Once the data available at the plant and the interface requirements to report that data is determined; the ISO will examine the

data and specify a point list for implementation through the RIG. This point list is based on the ISO required point list for AGC control plus convenient data that the ISO requires from the available plant data. A description of the plant including data available and diagrams of the plant control equipment is required by the ISO for this purpose.

- Protocols: The plant equipment that the RIG will be interfacing to requires careful research to determine the protocols that are necessary for the plant. This requires careful research to determine a strategy for taking advantage of existing equipment or upgrades to plant equipment. These defined protocols for this interface to the plant are used to determine the class of RIG necessary. Future issues should also be considered. A careful examination of the plant will allow leverage of the extensive capabilities of the RIG.

- RIG Ordering: When placing an order for a RIG coordination with a Vendor is paramount as there is a manufacturing time requirement.

- ISO plant engineering approval: The ISO maintains standards for plant interface to the RIG. Coordination and communication with the ISO is critical to insure that the ISO standards are met. An overall proposal for a RIG installation is necessary for review by ISO and subsequent approval or modification.

- ISO database approval: The ISO maintains standards for the points required for AGC control. The database collected at a plant must be submitted to the ISO for approval along with specific plant interface design criteria and diagrams. This requires coordination with the ISO.

- Test scheduling: Both the Vendor and the ISO are critical participants in the testing of a RIG installation. Testing activities should be coordinated and scheduled accordingly.

- Certification scheduling with ISO: Before a RIG can be scheduled for Ancillary Services the ISO requires a test to certify the plant and RIG installation. This needs careful scheduling to determine outages, unit tuning parameters, and optimal use of all participants time. Certification testing of a RIG installation is coordinated through ISO Client Services.

4. Conclusion

The installation of a RIG in a generating plant for the purpose of Direct AGC Control with the ISO requires proactive communication with all stakeholders. We at the ISO are committed to actively engaging the Generators in the process believing that as clients the Generators are a significant part of the solution. Effective and open communication is crucial and paramount. We encourage open questions and dialog. For questions please contact us as we proceed with RIG implementation to improve System Reliability and Grid Operations.

RIG Installation and Commissioning Checklist

1. Checklist

1.1 Site Introduction

- ❑ ISO Site Visit (if needed)
- ❑ Establish Contact List
  - Determine ISO, Owner Representatives, Telecom and key plant personnel
  - Obtain addresses, phone number's, pager number's and cell phone number's.
  - Define ISO Project Engineer role
- ❑ Discuss RIG Architecture
- ❑ Discuss Security, VOIP, interface to revenue meters, etc.
- ❑ Discuss Telecom requirements
- ❑ Identify Site PBX interface for VoIP
- ❑ Discuss ISO Required Points List
- ❑ Genpoints List.xls
- ❑ Discuss existing RTU(s), DCS(s) or other control and monitoring equipment and method of interface.
- ❑ Document each interface as to type, protocol, function

1.2 Telecom Survey

- ❑ Schedule telco Pre-Order for site
- ❑ Coordinate local telco representative on site
- ❑ High Voltage Protection on telco circuits (ground rise potential >600 ft)
- ❑ Multi-Plex GPS Antenna

1.3 Plant Walkdown

(Note locations on drawing or sketch)

- ❑ Locate Revenue Meters (if installed)
- ❑ Locate Revenue Meter Router (if installed)
- ❑ Locate existing telecommunications circuit point of entry and equipment
- ❑ Locate and Identify existing RTU(s) (if applicable)
- ❑ Locate and Identify existing DCS(s), PLC(s) or other unit control equipment (if applicable)
- ❑ Locate Control Room(s)
- ❑ Determine best location(s) for RIG equipment – Describe space/environment restrictions (type of rack(s), cooling, cabinet access, etc.)
- ❑ Locate and identify nearest sources of power for the RIG (UPS, raw, etc.).
- ❑ Note GPS Antenna run lengths
- ❑ Note Hardware UAS run lengths for each unit

1.4 Post-Plant Walkdown

- ❑ Roles and Responsibilities
  - Reiterate ISO's role
  - Document all work participants and their responsibilities
- ❑ Preliminary Schedule
  - Establish milestones (if possible)
- ❑ Plant Documentation Request (availability)
  - Block diagrams
  - Data Flow sheets
  - Water Shed Flow sheets
  - Single Line Meter and Relay Diagram for Plant and Substation
  - Plant plot plans
  - Telecom room (or other) floor plan
  - RTU, DCS, PLC communications diagrams/documentation (if req'd)
- ❑ Establish Meeting Documentation and Review of Minutes

1.5 Establish RIG Hardware Requirements

- ❑ Finalize the required and desired points availability
- ❑ Determine all interface requirements (RTU(s), EMS, DCS, Historians, etc.)
- ❑ Finalize power requirements and availability
  - Determine need for cabinet UPS
  - Determine power requirements for analog points (if req'd)
  - Determine wetting voltage requirements for discrete points (if req'd)
- ❑ Generation owner to determine best cabinet design
- ❑ Determine modem requirements (if necessary)
- ❑ Determine need for 8550 Protocol Engine
- ❑ Owner determines the need for RTU replacement and phased cutover requirements
- ❑ Raw Power surge suppression
- ❑ Provide RIG Catalog
- ❑ Future control system upgrades.

1.6 Establish RIG Database Requirements

- ❑ Determine all interface requirements (RTU(s), EMS, DCS, Historians, etc.)
- ❑ Identify all protocols
  - Currently available
    - ➢ DNP 3.0 (ISO Standard)
    - ➢ Modbus (+)
    - ➢ CDC Type I
    - ➢ Conitel 2020
    - ➢ Conitel 2100H
    - ➢ PGAE
    - ➢ ICCP
- ❑ Obtain existing Revenue Metering Documentation (if applicable)
- ❑ Obtain existing RTU/SCADA/DCS database listings (if available)
- ❑ ISO PE & EMS develop initial database with owners
- ❑ Work with owner to fill in standard RIG Database Spreadsheet
  - Identify Analog Inputs (eng. units, min./max. scales, resistors, PT/CT ratios, etc)
  - Identify Analog Outputs (Analog Setpoints, etc.)
  - Identify Digital Inputs (Type, wetting voltage, etc.)

- Identify Digital Outputs (Type, wetting voltage, relays, etc.)
- Identify Pulse Width Outputs (Pulse type, base time, base multiplier, relays, etc)
- Identify Accumulators (Type, etc.)
- DCS configuration for optimum AGC tuning parameters and ramp rates.
- Reactive curves for units

❑ EMS reviews and approves
❑ Send database to RIG vendor
❑ Work with RIG vendor to determine appropriate mapping for each point
❑ Finalize each port requirement (Type, protocol, etc.)
❑ RIG Vendor returns project spreadsheet with mapping and other comments
❑ EMS and PE resolve spreadsheet
❑ Check final updates with owners and resolve with RIG Vendor
❑ RIG Engineers sends final spreadsheet to RIG vendor for production

1.7 RIG Procurement Assistance

❑ ISO works with generator owner to establish final RIG hardware requirements
❑ Obtain agreement on RIG database
❑ Owner sends database to RIG Vendor for review
❑ Owner approves final database and RIG layout design from RIG Vendor
❑ ISO and Owner review RIG Vendor hardware design drawings
❑ Owner issues purchase order for equipment
❑ Check with Market Operations for required information in SA Master File

1.8 Telecom Circuits

❑ Provide Owner with Communications Subscriber Guide from IT Telecommunications
❑ Owner orders communication access circuits from AT&T
❑ ISO/Owner/AT&T schedule installation (important to include Owners IT group)
❑ ISO/Owner/AT&T schedule testing/commissioning of communication circuits
❑ Owner extends communications circuits from MPOE to RIG Location

1.9 Site Preparation

- ❑ Owner and ISO PE establish site prep work plan
- ❑ Owner designs and installs conduit and cabling where required (power, communication, field I/O, etc)
- ❑ Owner designs and installs foundation for RIG cabinet where required

1.10 Factory Acceptance Testing

- ❑ RIG ready for testing (IOC and PE configured), Identify test location scenario, methods and participants with Vendor.
  - ❑ SNW Kent Factory
  - ❑ RIG Vendor Corporation (Maryland)
  - ❑ Plant Site

1.11 Site Installation

- ❑ Owner completes RIG cabinet/rack installation
- ❑ Vendor completes power and grounding connection
- ❑ Telecommunication Communication circuits connection
  - T1 circuit(s) connection
  - ISDN circuit connection
  - 1MB circuit connection
- ❑ Revenue Metering connection
- ❑ Phone system connection to control room(s)
- ❑ Plant interface circuits connection (DCS, PLC, etc)
- ❑ Owner to complete GPS installation
- ❑ Field I/O cable connections (if req'd – phased and/or parallel circuit approach may be necessary)
- ❑ Owner updates plant drawings
  - Wiring diagrams
  - Schematics
  - Block diagrams

1.12 Site Acceptance Testing

- ❑ Owner and Vendor do preliminary testing of functionality and data processing.
- ❑ Schedule necessary outages with ISO Operations, Owner EMS's, etc. for any point to point testing involving the ISO EMS system.
- ❑ Power up/down testing
- ❑ Telecom circuit testing
  - T1 circuit(s), ISDN circuit, POTS circuits
- ❑ Revenue Meter Verification at Folsom (if req'd)
- ❑ Router communication testing
- ❑ GPS unit testing
- ❑ VOIP testing
- ❑ Security testing
- ❑ Cabinet sensors testing
- ❑ Hardware Unit Authority Switch testing (if req'd)
- ❑ End-to-end checkout of all points (Unit(s) **offline**)
- ❑ End-to-end checkout of all points (Unit(s) **online**)
- ❑ Site Acceptance Testing Reports

1.13 Site Certification Testing

- ❑ AGC ramp rate testing from all EMS systems
- ❑ Data through put timing testing
- ❑ Site Certification Test Report

1.14 Final Turnover Package

- ❑ Final system database
- ❑ Protocol documents
- ❑ Cabinet layout drawings
- ❑ As-built plant drawings (if req'd)
  - Wiring diagrams
  - Schematics

- Block diagrams

- ❑ As-built Telecom drawings/documents
- ❑ As-built RIG room floor plan
- ❑ As-built plot plan
- ❑ Test reports

1.15 ISO Master File Update

- ❑ Update Master Files with all Documentation at Folsom and Alhambra
- ❑ Hardcopy Database Spreadsheet to files for doc on startup Configuration