Design Guidelines for SCADA & DSA

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1 INTRODUCTION

These guidelines are designed to cover all requirements that need to be satisfied to ensure Essential Energy's minimum standards for SCADA & DSA Systems are met while maintaining the technical currency of these systems.

As a result, some items may appear in these Guidelines that are not relevant to a particular Project.

These guidelines and associated drawings shall cover Essential Energy's minimum requirements but shall not exclude any area because of the use of this specification. If a requirement is not covered by these guidelines but is crucial to the correct functioning of the SCADA & DSA Systems then approval for the design, implementation or inclusion of the requirements shall be sought from Essential Energy.

Where it is desired by the contractor to deviate from the requirements of these guidelines, written approval from the SCADA & DSA Manager must be obtained. Any request for deviations must be fully documented and contain substantiating proof of performance to the recommended standard. Essential Energy reserves the right to decline the offer and insist on the nominated method.

The SCADA systems deployed shall be configured in such a way as they become an overlay to the stations so affected. In no way shall the failure of an RTU on site or a collapse of the platform used to communicate with these remote sites effect the performance and control of the sites in question. It is accepted that there may need to be minor local issues to contend with such as alarms or Automatic Voltage Regulation which would need immediate intervention, but the basic premise is that the site will still function normally without communication or RTU functions available on site.

Essential Energy's SCADA & DSA Systems design policy and procedures will need to accommodate the above philosophy but still deliver common standards for all projects. The guideline will need to consider the needs of all other sections and include those requirements in the design of SCADA & DSA Systems.

This document should not exclude any new technology or device that is compatible with Essential Energy's SCADA & DSA Systems requirements.

Existing and additional requirements may be either modified or incorporated as necessary, based on the merits of individual circumstances or at the discretion of SCADA & DSA Manager. However, they should be consistent with the latest industry best practice.

2 CHALLENGES

All relevant staff associated with the design, installation and commissioning of the SCADA & DSA Systems will carry out works in accordance with this procedure, Australian Standards and other relevant Standards, Technical Guides and any other interrelated Essential Energy policies or procedures.

The development of SCADA & DSA Systems must deliver achievable outcomes that are balanced with:

- Employee Safety
- Public Safety
- Environmental Considerations
- Quality Performance
- Maximising Reliability
- Maximising efficiency of the Transmission and Distribution Network
- Monitoring and control of System Assets.

This procedure will be revised at least annually, or as directed by the SCADA & DSA Manager, to ensure the contents are consistent with industry best practice.

The Manager SCADA & DSA is responsible for the revision and updating of the document, and will consult widely with all interested parties, both internal and external to the organisation, when carrying out the review.

3 SCADA SYSTEM DETAILS

3.1 Master Station/DSA

Essential Energy's SCADA and DSA Master Station is PowerOn Fusion. A GE product, that serves as a complete Network Management System of which SCADA & DSA, forms an important part.

3.2 Communications

Essential Energy's SCADA & DSA communications is IP based apart from a few legacy sites which are earmarked for upgrade. By using IP technology Essential Energy is able to take advantage of the benefits this technology brings across our vast region.

3.2.1 Medium

A number of communications mediums are used or deployed throughout Essential Energy, ranging from direct radio links, fibre-optics to microwave links, NextG modems are also used in some cases where other options are unavailable or as a back-up to the primary communications systems. Copper landlines are not to be used due to safety issues surrounding EPR.

The actual link used is largely dependent upon bandwidth required, the area in which it is being deployed, the distance the signal needs to traverse, the terrain and the distance from the nearest nodal point.

Two communications paths are also required in our Zone Substations where the primary voltage is 132kV or the site is monitored by AEMO to gain redundancy.

3.2.2 Protocols

Essential Energy uses the DNP3 Protocol at Level 2 compliance. The DNP3 protocol has been developed specifically for SCADA in the Utilities industry and is recognised as being the most suitable for the remote environment Essential Energy covers. Essential Energy uses DNP3 over IP based technology to communicate to SCADA & DSA RTUs.

Essential Energy has some legacy protocols in use but these are being phased out over time.

3.3 Australian Energy Market Operator (AEMO)

Essential Energy has an ICCP link to AEMO. This link is used to pass network related data as requested by AEMO.

Essential Energy collects the network data via its SCADA system, once in the system the relevant data points are identified and passed through a protocol convertor into the ICCP format and transmitted to AEMO.

3.4 RTU – Remote Terminal Unit

There are two major suppliers for RTUs being utilised within Essential Energy, both of which exhibit high reliability with excellent performance and development support. These are:

- Schneider - Serck Magna series
- CGI (formerly Logica) – MD300 and MD311.

Selection of RTU type for a new or upgrade install is at the discretion of the SCADA & DSA Manager and generally regionally based.

Essential Energy has a number of legacy devices that are being phased out over time.

Although the above RTU's are currently Essential Energy's preferred RTUs, this should not preclude other vendor's products from future developments. Distinct advantages would need to be found for creating an extra, preferred vendor of SCADA RTU equipment.

The make-up of I/O, comms modules etc are dependent on site specific requirements. In Zone Substations where the primary voltage is 132kV or the site is monitored by AEMO, the RTUs will be installed as a Primary RTU with a redundant Secondary RTU to achieve redundancy.

3.5 Enclosures

The standard RTU cabinet footprint throughout Essential Energy is 800mm Wide by 600mm deep by 2000mm high.

It is preferred that allowance be made for two (2) standard RTU cabinets for sites with a large I/O count.

Adequate clearance for reasonable access for staff to work in and around these cabinets is to be provided.

3.6 HMI – Human Machine Interface

It is required to have a HMI installed at each Zone Substation. The type of HMI used is dependent on the type of RTU that is used at each site and will be nominated by Essential Energy. The HMI uses Touch Screen technology and is to be DC powered and use a solid state hard drive so that there are no moving parts.

The HMI is installed for operator safety, centralised control within the substation and ease of local switching.

HMI's are not to be used as a substitute for localised control (i.e. replace local/remote switches or trip/close buttons), and are to be regarded as REMOTE CONTROL.

HMIs are to be located away from switchgear or other equipment that may endanger an operator in the event of a failure.

3.7 Convention of Direction

A convention of direction for the indication of Current, Real and Reactive Power flow is to be followed to ensure that a standard convention is used throughout Essential Energy for both Master Stations and HMI's.

The direction of current flow from a source (generator) **into** and through a substation is taken as positive (+).

If the flow of current is outwards from a substation along a sub-transmission feeder (i.e. supply to a downstream radial substation) the direction of current flow for that feeder is taken as negative (-).

3.8 Hardware Control

For safety and reliability reasons, the following hardware shall be controlled via SCADA:

- CB Auto-Reclose Control
- Single AR schemes where it is not available in the protection relay. If AR routine is located in SCADA, then protection-initiated points are to be hardwired to RTU
- Local/Remote switch
- SEF Control
- Trip/Close control
- Feeder & Transformer Auto Change Over
- Voltage regulation of the transformers
- Indication and control to be hardwired to the RTU for Control routines run via SCADA.

At all times, interposing control output relays are to be used to meet load requirements.

Note: The features listed above are controlled by SCADA RTUs but their functionality is controlled by the Principles of Substation Design.

3.9 Transducers

The outputs of Transducers used with RTUs should be Current based. There is a move by industry towards 4-20mA outputs. Essential Energy has in the past used a variety of output types but where possible 4-20mA output should be used.

An accuracy Class of 0.2% should be a minimum requirement. The Auxiliary Supply can be either passive or active.

Current Transducers are to be passive and mean sensing.

A.C. Voltage Transducers used for indication can be either passive or active (using the same voltage as being measured) and should be True RMS.

A.C. voltage transducers used for voltage regulation in the SCADA RTU shall be of a narrow band to increase accuracy and will be True RMS. Eg. where measuring 110 VAC the band would be 80 – 130 VAC (95 – 125 VAC is preferred if voltage levels permit).

Watts & VARS Transducers should be 3 Phase 3 wire unbalanced. They can be Uni or Bi-directional, as the situation requires.

All Transducers should be able to be both DIN rail and surface mounted and comply with all relevant Australian and International Standards.

3.10 Cable Wiring

Stranded multi-cored cable is to be used between RTU's and field equipment and is to be of suitable size and rating for its purpose.

For sites upgrading to a CGI RTU that use a Weidmuller termination block it is essential that Pirelli 12 pair cable Type P2012CS cable or equivalent be used.

3.11 Q/A Documentation

Standard Quality Assurance Documentation has been developed which includes a checklist following the commissioning process leading to the substation SCADA being handed to the System Control for operational use.

3.12 Input/ Output Points

The RTU shall be programmed to perform the following functions:

- CB Trip and Close
- Local / Remote Supervisory Status
- CB Auto Reclose
- SEF Protection Operation Indication
- Auto Close features (for standby equipment)
- Capacitor / Reactive Plant Control
- Automatic & Manual Voltage Regulation & Control
- Site Alarms
- Intruder / Fire Alarms
- Load Control where applicable

- Indication of Protection relays operated and / Or Failed
- Indication of CB or other device status
- Indication of distance-to-fault
- Analogue indication of feeder currents, voltage levels, Real and reactive power, temperatures, tap positions.

Indication of transformer taps performed, CB operations performed and maximum demand of transformer and feeder currents.

Some of these features may be site-specific. In other words, they may not be available for every site, since not all sites are in need of displaying these features nor are they capable of (e.g. distance-to-fault).

Where the SCADA RTU performs a control routine such as voltage regulation indication will be hardwired directly to the RTU and not via a programmable protection relay using serial communications.

3.13 IED Devices

IED I/O points are to be programmed to a standard that is constant for each type of device. Any deviation from a set standard I/O listing for an IED must be must in consultation with the SCADA DSA Manager.

Interrogation and settings changes to the protection relays shall be done outside of the normal SCADA Communication channels. This is in an effort to stabilise and optimise the SCADA Communications Platform at all times.

Programming and implementation of IED Protection devices are the responsibility of the Protection Coordination Group. Refer to CEOP8002 Protection Guidelines.

3.14 Auxiliary Equipment

Auxiliary equipment must not be installed in such a manner as to make vulnerable the critical operation of the SCADA system.

3.15 DC Supplies

Separate battery chargers and banks for SCADA equipment can be used to supply auxiliary power to the RTU. The decision to use a DC-DC converter will be assessed on a site-by-site appraisal using the following guide.

If two sets of 110VDC battery banks are available then either:

- one 48VDC supply from DC converters where only one 48VDC supply is required; or
- one 48VDC supply from DC converters and the other from separate 48VDC battery bank where two 48VDC supplies are required.

If one 110VDC battery bank is available then one 48VDC supply from separate 48VDC battery bank is to be installed. If the site is of less than 8MVA capacity and not of a strategically significant nature to the network, a cost justification can be done in consultation with the Protection, Design Services and the SCADA groups, as to whether a DC converter may be connected to the 110VDC.

A second 48VDC supply will be installed on all AEMO monitored sites and sites that are supplied at 132kV. At other sites where the ZSS is of a strategically significant nature the

decision to have a second DC supply is to be made in consultation with Design Services and the SCADA & DSA groups at the project planning stage.

If a DC-DC converter is used it will be of a brand nominated by Essential Energy.

The SCADA DC battery supply will be sized sufficiently to supply the communications and SCADA equipment for an AC outage of up to eight hours.

3.16 Communication Equipment

Communication equipment located at a SCADA site is to be regarded as critical equipment. In view of this communication equipment are to be directly supplied from the SCADA or Station battery system.

3.17 UPS/Inverters

UPS/Inverters associated are not to be used to supply the SCADA RTU or communications equipment.

4 DISTRIBUTION SYSTEM AUTOMATION (DSA)

Distribution System Automation (DSA) comprises automated devices located outside the substation on the distribution network.

DSA devices may include but is not limited to:

- Automated reclosers
- Line Fault Indicators
- Gas switches.

4.1 Communications

Communications to DSA devices is generally via NextG modems connected to the Telstra network via Essential Energy's private VPN.

Due to geographic limitations other means of communications will be considered.

4.2 Q/A Documentation

Standard Quality Assurance Documentation has been developed which includes a checklist following the commissioning process leading to the substation SCADA being handed to the System Control for operational use.

4.3 Input/ Output Points

A standard set of I/O points is used on a device specific basis.

4.4 Protocol

DNP3 Level two is the protocol used to communicate to DSA devices.

5 HISTORICAL DATA

Essential Energy uses the following proprietary software to access historical data stored by PowerOn Fusion:

- Webview

- PowerOn Fusion Report Manager.

6 KEY TERMS AND DEFINITIONS

Auto/Non-Auto: Auto/Non-Auto is terms to be used to describe the state of functions controlled via SCADA. Auto is to mean the function is enabled and Non-Auto is to mean the function is disabled.

Contractor: The contractor shall mean the person, firm, company or corporation who has been engaged by Essential Energy.

Essential Energy: Shall mean Essential Energy or a person nominated by Essential Energy

Drawings: Drawings and detailed drawings shall mean, all drawings indicated by a drawing number and any drawings referenced to by that drawing or any drawing referenced to by a referenced drawing.

DSA: Distribution System Automation.

Engineer: The person or persons appointed by Essential Energy to supervise the works.

EPR: Earth Potential Rise.

FI: Frequency Injection.

HMI: Human Machine Interface (also called MMI – Man Machine Interface or GUI – Graphical User Interface).

IED: Intelligent Electronic Devices such as smart protection relays.

I/O: Input/ Output to and from the RTU. Can be physically connected, and or from a Data connection i.e. IED's

Master: Essential Energy SCADA or Load Control Master Station.

POF: PowerOn Fusion, Essential Energy's distribution management System

RTU: Remote Terminal Unit, either dedicated equipment or PLC performing SCADA functions.

SCADA: Supervisory Control and Data Acquisition.

Site: Any location where RTU, DSA or Load Control equipment as defined exists or is proposed.

7 REFERENCES

CEOP8002 – Protection Guidelines

CEOP8032 – Design Guidelines for Transmission and Zone Substations

All appropriate Australian Standards.

All appropriate ESAA Publications

All appropriate Electricity Council of NSW Publications

All appropriate Codes of Practice

All appropriate RTU manuals – Includes RTU specific documents and manufacturers' manuals

8 REVISIONS

Issue Number	Section	Details of Changes in this Revision
2	All	Updated template in-line with Essential Energy re-branding
3	All	Complete rewrite and update
4	All	Annual Review