Electricity Distribution

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Company Directive

ENGINEERING SPECIFICATION
EE SPEC: 143

Functional Specification for WPD's Connection Control Panels (CCPs)

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Implementation Date: July 2020

Approved by

Paul Jewell
DSO Development Manager

Date: 29th July 2020

Target Staff Group	**Staff involved with the specification and procurement of Connection Control Panels**
Impact of Change	**Amber – This is a new specification for equipment currently being procured. Future tenders will be required to reference this document.**
Planned Assurance checks	**The Author will ensure that this specification is reviewed by the end of March 2021, and that the updated specification forms the basis of any new Invitation to Tender for this equipment. The current contract is due to expire in December 2021.**

All references to Western Power Distribution or WPD must be read as National Grid Electricity Distribution or NGED

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IMPLEMENTATION PLAN

Introduction

This document specifies the requirements for Connection Control Panels. As the requirements for these panels is still evolving, with changes currently being assessed, this specification is deliberately functional.

Main Changes

New Document.

Impact of Changes

Target Staff Group	**Staff involved with the specification and procurement of Connection Control Panels**
Impact of Change	**Amber – This is a new specification for equipment currently being procured. Future tenders will be required to reference this document.**

Implementation Actions

To allow for further refinements to requirements, this specification shall be reviewed in March 2021 to ensure that the appropriate level of detail is included. This date provides ample lead time ahead of the tendering process.

Implementation Timetable

Specification to be reviewed by the end of March 2021. The current contract for Connection Control Panels expires in December 2021.

REVISION HISTORY

Document Revision & Review Table		
Date	**Comments**	**Author**
July 2020	• New document	Sven Hoffmann

CONTENTS

1. INTRODUCTION

1.1. This document specifies the requirements for WPD's Connection Control Panel (CCP). These requirements are necessarily high-level in order to provide maximum flexibility in the design. Any offerings to WPD will need to be assessed in detail in order to ensure that CCPs behave in a predictable manner and present the same levels of visibility and functionality to WPDs SCADA and Distribution Network Management System (DNMS).

1.2. The purposes of the CCP are two-fold. The first is to provide monitoring of voltage as well as directional real and reactive power flow at customer points of connection. The second is to provide control signals to the customer to allow for alternative connection agreements utilising Load Management Schemes (LMS) such as Voltage Constraint, Soft Intertrip, and Active Network Management (ANM).

1.3. Control signals provided by the CCP to customers may originate either from the DNMS or from the CCP itself. The CCP will therefore require some internal logic and control functions of its own. Section 6 contains details of these required functions.

1.4. Although referred to as a single unit, the CCP shall comprise two discreet, physical cubicles: a main cubicle (referred to in this specification as the **Main Panel**) housing all the communications, processing, and logic equipment along with backup battery power supplies; and a smaller cubicle (referred to as the **Customer Interface Panel**) dedicated to providing connections for the customer's control system wiring.

2. REFERENCES

ENATS 50-18 – Application of Ancillary Electrical Equipment

EE SPEC 136 – Ancillary Electrical Equipment for Use in Conjunction with Switchgear and Protection/Control Panels

BS EN61000-6-2 – Electromagnetic compatibility (EMC). Generic standards. Immunity standard for industrial environments

BS EN61000-6-4 – Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments

BS EN61000-6-5 – Electromagnetic compatibility (EMC). Generic standards. Immunity for equipment used in power station and substation environment

3. GENERAL REQUIREMENTS

3.1. All equipment and systems shall satisfy requirements of the EMC directive. EMC emissions and immunity requirements shall satisfy the requirements of the generic emission standard for industrial environments, BS EN 61000-6-2, the generic immunity standard for power station and substation environments, BS EN 61000-6-5, and the generic immunity standard for industrial environments, BS EN 61000-6-4, and all relevant EMC product standards.

3.2. The equipment shall be suitable for use within three phase systems in which the primary system neutral is earthed either solidly or through a resistance or reactance of low value or through a reactor or arc suppression coil. Tenderers are advised to consider carefully the implications of this, with particular emphasis on the phase to earth voltages during earth fault conditions.

3.3. All equipment shall be suitable for the service conditions defined in ENATS 50-18 for outdoor installations.

3.4. The equipment shall have a design life of 25 years. The supplier shall provide manuals and drawings as required by WPD, and shall ensure that the product can be supported and maintained for its entire life.

3.5. In order to allow for updates to internal software / firmware and to allow for the configuration (by WPD) of settings governing the internal logic functions, the CCP shall be provided with the means to interface with a laptop PC running Microsoft Windows. The supplier shall provide the necessary software and associated support.

3.6. Cubicles

3.6.1. Cubicles shall comply with ENATS 50-18 and shall be suitable for outdoor use.

3.6.2. Cubicle earthing requirements and earthing of small apparatus shall be in accordance with ENATS 50-18.

3.6.3. The **Main Panel** shall be suitable both for installation directly onto WPD's standard Ring Main Units and for wall mounting. The **Customer Interface Panel** shall be wall mounted. Both cubicles shall be front access. Relevant drawings and dimensional information for mounting arrangement design shall be provided by WPD at the time of tender.

3.6.4. The **Main Panel** shall be provided with two doors: an outer door to provide overall protection and security and an inner door providing the external operator interface. Doors shall be fitted with mechanisms that prevent inadvertent closing while open. The **Main Panel** shall also provide internal space to allow the direct installation of WPD's GE iBox RTU and associated wiring.

3.6.5. The **Customer Interface Panel** shall be provided with the means to provide electrical isolation between WPD and customer control systems.

3.6.6. Cubicles shall be suitable for both top and bottom entry multicores. The gland fixing arrangement shall be such that additional cables may be added at a future date without need to disturb the wiring of existing cables. The gland fixing arrangement shall provide an effective anti-vermin barrier.

3.6.7. As required by ENATS 50-18, outer doors shall be fitted with one central lockable (with padlock) fastening handle unless otherwise agreed at the time of tender.

3.7. **Power Supplies**

3.7.1. The CCP (**Main Panel**) shall be powered from the 230V AC site supply.

3.7.2. Internally, an AC to 48V DC converter and battery system is required to provide power to the CCP's internal systems including, where fitted, WPD's GE iBox RTU.

3.7.3. The battery system shall be capable of powering the CCP for at least 72 hours.

3.7.4. An additional 48V DC to 12V DC converter is required in order to provide power to any additional communications equipment, if required, as well as to provide power to the analogue output module in the **Customer Interface Panel** (see 5.2.4 and 5.2.5 below).

4. POWER FLOW MONITORING

4.1. The **Main Panel** shall provide the ability to measure the voltage and directional real and reactive power flows at the point of connection. This is to be achieved by the fitting, by the supplier, of WPD's standard multifunction transducer to EESPEC 136, reference TD4. The supplier shall provide the necessary wiring terminals to allow WPD to make the necessary CT / VT connections.

4.2. Some sites will require monitoring of the aggregated power flow across multiple connection points. To cater for these situations, the **Main Panel** shall be capable of accommodating up to two additional transducers and aggregating their outputs, which utilise RS485 MODBUS connections. Further details can be supplied at the time of tender.

5. INTERFACE REQUIREMENTS

5.1. A schematic overview of interfaces is provided at Appendix A.

5.2. **Customer Interface Panel:**

5.2.1. All customer wiring requiring connection to the CCP shall be terminated within the **Customer Interface Panel**. While this specification allows for some flexibility in the nature of the interface between the **Customer Interface Panel** and the **Main Panel**, the customer-facing requirements have been standardised by WPD and are detailed below:

5.2.2. Stage 1 and Stage 2 constraint activation: two separate digital signals via **WPD** normally-open contacts within the main panel, closing onto **customer**-energised circuits.

5.2.3. Stage 1 and Stage 2 constraint signal confirmation: two separate digital signals via **customer** normally-open contacts within the main panel, closing onto **WPD** energised 48V DC circuits.

5.2.4. ANM power setpoints: a total of four setpoints shall be provided to the customer in the form of 4-20mA analogue signals. WPD's preferred arrangement for the provision of analogue signals to the customer is for serial link signalling and necessary power to be provided from the main panel to a digital/analogue converter installed in the customer interface panel.

5.2.5. Where enhanced isolation requirements between WPD and customer wiring is required (at "hot sites"), signalling shall be provided from the **Main Panel** via fibre, with power for the equipment installed in the **Customer Interface Panel** provided by the customer.

5.3. **Main Panel:**

5.3.1. The **Main Panel** shall be provided with a Serial RS232 interface with WPD's RTU. The protocol shall be DNP3.0. An additional digital input from the RTU is required to provide a "comms fail" signal.

5.3.2. As indicated in Section 4, the **Main Panel** shall provide suitable connections to instrument transformer wiring (WPD metering / protection CTs and VT). In addition WPD's standard multifunction transducers will require RS485 serial MODBUS protocol connections.

5.3.3. In order to provide Stage 1 and Stage 2 constraint activation signals to the customer, the **Main Panel** shall provide two normally-open contacts to close onto customer-energised circuits. The Stage 2 contact shall be latching.

5.3.4. In order to receive Stage 1 and Stage 2 confirmation signals from the customer, the **Main Panel** shall provide two 48V DC open circuits (the customer's control system shall provide the normally-open contacts).

5.3.5. In order to provide ANM power set-points to the customer, WPD's preferred arrangement requires digital signalling from the **Main Panel** for conversion to analogue within the **Customer Interface Panel**. The digital/analogue converter is normally powered from the **Main Panel**, but powered by the customer where a "hot site" **Customer Interface Panel** is used.

5.3.6. The **Main Panel** inner door shall provide a local operator interface. This interface shall provide the manual means to switch between remote and local operation modes, engage or disengage automatic constraint, and provide the means to operate and reset both Stage 1 and Stage 2 signals. Switches and indicators to ENATS 50-18 are required as follows:

- Local / Remote Mode: two-position rotary selector switch
- Auto Constraint IN: push button with enclosed white indicator lamp
- Auto Constraint OUT: push button with enclosed white indicator lamp
- Stage 1 Operate: solid green push button
- Stage 1 Reset: solid red push button
- Stage 2 Operate: solid green push button
- Stage 2 Reset: solid red push button
- Stage 1 Operated: white lamp indicator
- Stage 1 Confirmed: white lamp indicator
- Stage 2 Operated: white lamp indicator
- Stage 2 Confirmed: white lamp indicator

6. INTERNAL LOGIC REQUIREMENTS

6.1. In order to provide the functionality necessary for the implementation of Load Management Schemes (LMS) and testing requirements, some logic functions are required to be performed by the CCP. Flowchart summaries of key logic requirements are provided at Appendix B.

6.2. It shall be noted that all automated processes shall only function when the CCP Auto Constraint mode is selected as "IN".

6.3. In the descriptions below, any "pre-set" variables or other settings shall be deemed to be configurable by WPD.

6.4. Communication System Failures

6.4.1. Where Load Management Schemes rely on network communications for the determination of constraint requirements, CCPs must be able to provide fail safe measures in the event that the communication link between the site RTU and the DNMS is lost. The DNMS sends regular “heartbeat” signals to the RTU, and in the event that the RTU fails to detect this heartbeat, a normally open contact is closed, providing a signal to the CCP that communications have failed. In this event, after a pre-set time, the CCP shall automatically trigger Stage 1, again requiring the customer to restrict import or export until communications have been re-established and remain intact for a pre-set period of time when the Stage 1 constraint is lifted. Upon initiation of Stage 1, the CCP follows the Stage 1 checking process. Figures 2 and 3 of Appendix B outline the automatic setting and resetting of Stage 1, with Figure 8 outlining the Stage 1 checking process.

6.4.2. For applications where there is no such reliance on external communications, this communications failure logic shall be provided with a “disable” setting.

6.5. (Automatic) Voltage Constraint Schemes

6.5.1. Implementation of a Voltage Constraint LMS involves the CCP continually monitoring the voltage at the point of connection. If this voltage exceeds a pre-set upper threshold for a pre-set minimum period of time, the CCP automatically initiates Stage 1, which requires the customer to restrict export to a pre-set power limit until the voltage reduces below a given lower threshold and remains there for a pre-set minimum period of time. Figures 4 and 5 of Appendix B outline the automatic setting and resetting of Stage 1, with Figure 8 outlining the Stage 1 checking process.

6.6. Active Network Management (ANM)

6.6.1. ANM is a sophisticated LMS, run from a central server linked to WPD’s DNMS. The connected customer is continually subject to an import and/or export limit determined by the ANM system with the setpoint(s) updated within the CCP via SCADA communications. Under this condition, the CCP shall monitor the power flow at the point of connection against this variable limit. If the limit is infringed for more than a pre-set minimum period of time, the CCP shall initiate Stage 1. For ANM schemes, the Stage 1 power limit is typically zero. If the Stage 1 limit is successfully adhered to for a pre-set minimum period of time, the CCP automatically resets the Stage 1 constraint. Figures 6 and 7 of Appendix B outline the automatic setting and resetting of Stage 1, with Figure 8 outlining the Stage 1 checking process.

6.6.2. WPD currently runs ANM systems supplied by two, separate providers. While the information in this specification provides the high-level process required to be followed by the CCP, further details will be required for a CCP to be fully compatible. With ANM systems still being refined, these further details shall be provided by WPD along with this specification at the time of tender.

6.7. Remote Stage Initiation over SCADA

6.7.1. The CCP shall also be required to accept direct Stage 1 and Stage 2 initiation signals via SCADA communications. These may be as a result of a direct command initiated by a Control Engineer or as a result of an automated control scheme such as the Soft Intertrip LMS, which involves WPD's DNMS monitoring the network for specific constraint conditions and issuing a command to the CCP to trigger Stage 1 when it detects that the network has become constrained. The customer is then required to restrict import and/or export to a pre-set limit until a further command to the CCP to lift the Stage 1 constraint is received. Upon initiation of Stage 1 or Stage 2, the CCP follows the process of Figures 8 and 9 of Appendix B, respectively.

6.8. Resetting Constraints

6.8.1. It shall be noted that the processes outlined in 6.4 to 6.7 above could be running in parallel, with each system capable of initiating and resetting Stage 1. Further, higher level, logic is therefore required to ensure that the Stage 1 contact within the CCP is only opened (thereby cancelling the Stage 1 signal to the customer) when all triggers for Stage 1 being initiated are removed. Figure 10 of Appendix B outlines this overall reset process.

6.8.2. A Stage 2 constraint may only be reset by Control Engineer action via SCADA or locally via the local operator panel.

6.9. Constraint Escalation

6.9.1. Upon initiation of Stage 1, regardless of the reason, the CCP shall monitor the power flow at the point of connection against the pre-set Stage 1 limit. If this limit is infringed for a pre-set maximum period of time, the CCP shall initiate Stage 2. Additionally, the customer is required to send a signal confirming the initiation of Stage 1. If this confirmation is not received by the CCP within a pre-set time limit, the CCP shall trigger Stage 2. It is WPD's requirement that Stage 2 results in the tripping of a customer-owned circuit breaker, disconnecting the customer's controlled load. Upon initiation of Stage 2, the CCP follows the process of Figure 9 of Appendix B.

6.10. Local Operator Interface

6.10.1. Local Operation: The Stage 1 Constraint and/or Stage 2 Constraint can be selected manually on site when the Local / Remote switch is in the Local position. If Automatic Constraint is left in its Enabled status when Stage 1 Constraint is operated locally the scheme will escalate to Stage 2 if the customer confirmation and Active Power checks are not successful. Also, in the case of a Voltage Constraint scheme, the scheme may automatically reset if the voltage is below the reset voltage setting. If Automatic Constraint is Disabled the scheme will not escalate to Stage 2 or reset automatically.

6.10.2. Remote Operation: The Stage 1 Constraint and/or Stage 2 Constraint can be selected remotely by Control when the Local / Remote switch is in the Remote position. If Automatic Constraint is left in its Enabled status when Stage 1 Constraint is operated locally the scheme is still capable of operating and resetting automatically (as described above). If Automatic Constraint is Disabled the scheme will not reset / operate automatically and it will not check that the customer has successfully implemented their constraint instructions.

APPENDIX A

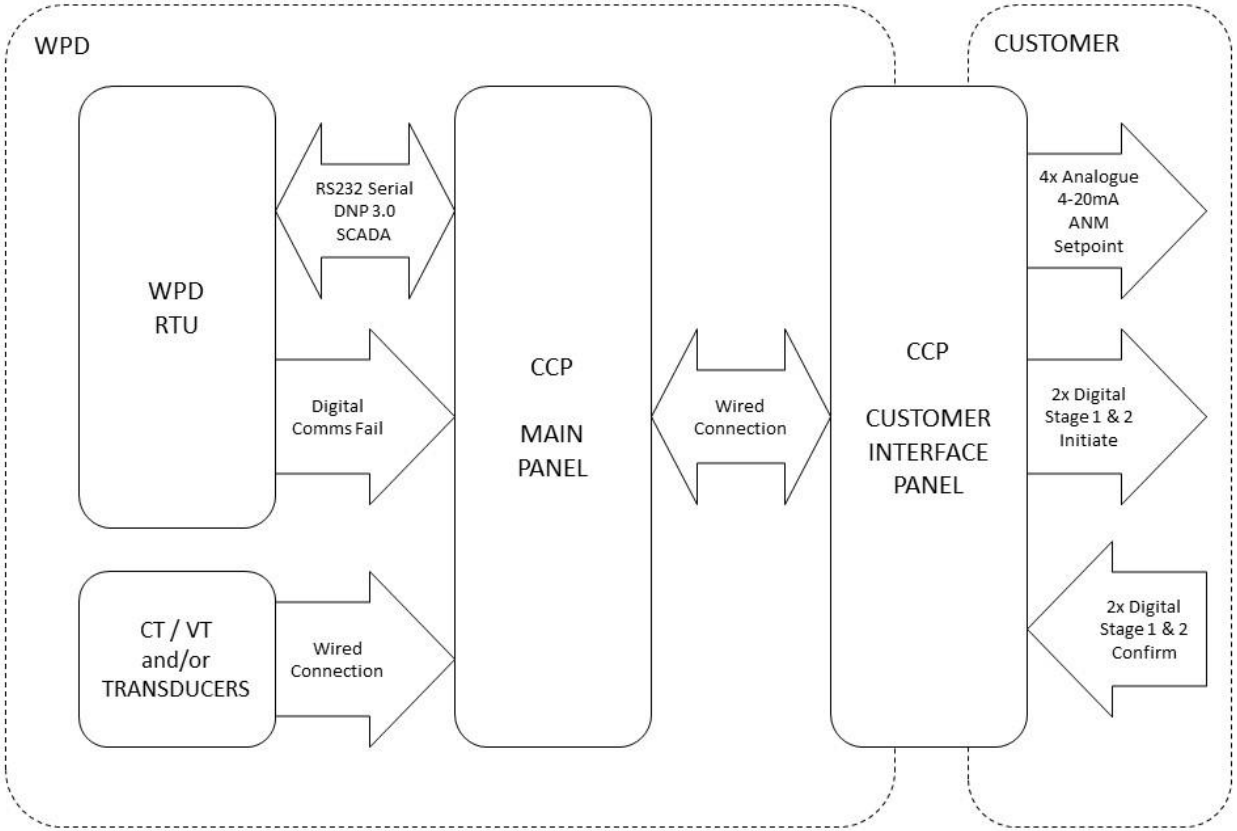


Figure 1.
OUTLINE SCHEMATIC OVERVIEW OF CCP INTERFACE REQUIREMENTS

APPENDIX B

INTERNAL LOGIC DIAGRAMS

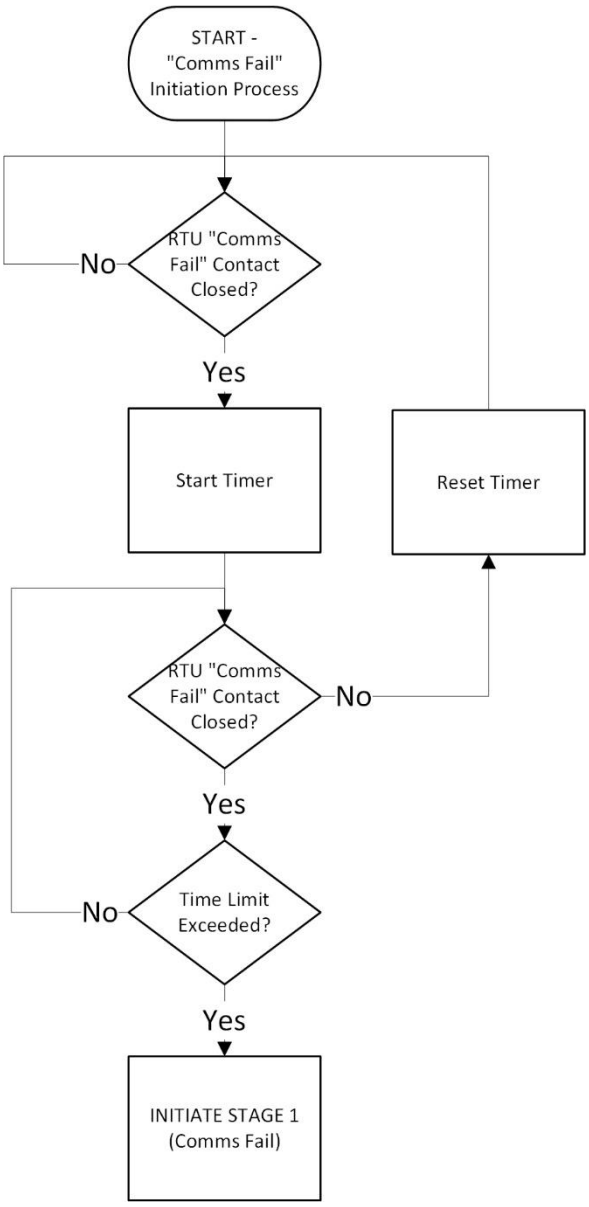


Figure 2. Stage 1 (Comms Fail) Initiation Process

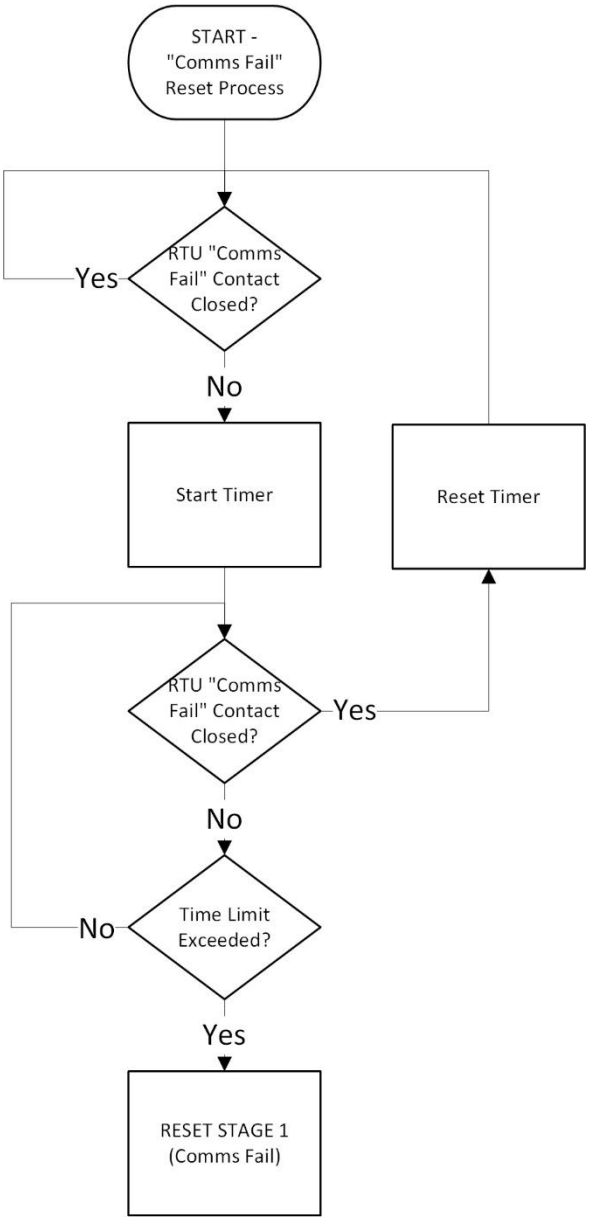


Figure 3. Stage 1 (Comms Fail) Reset Process

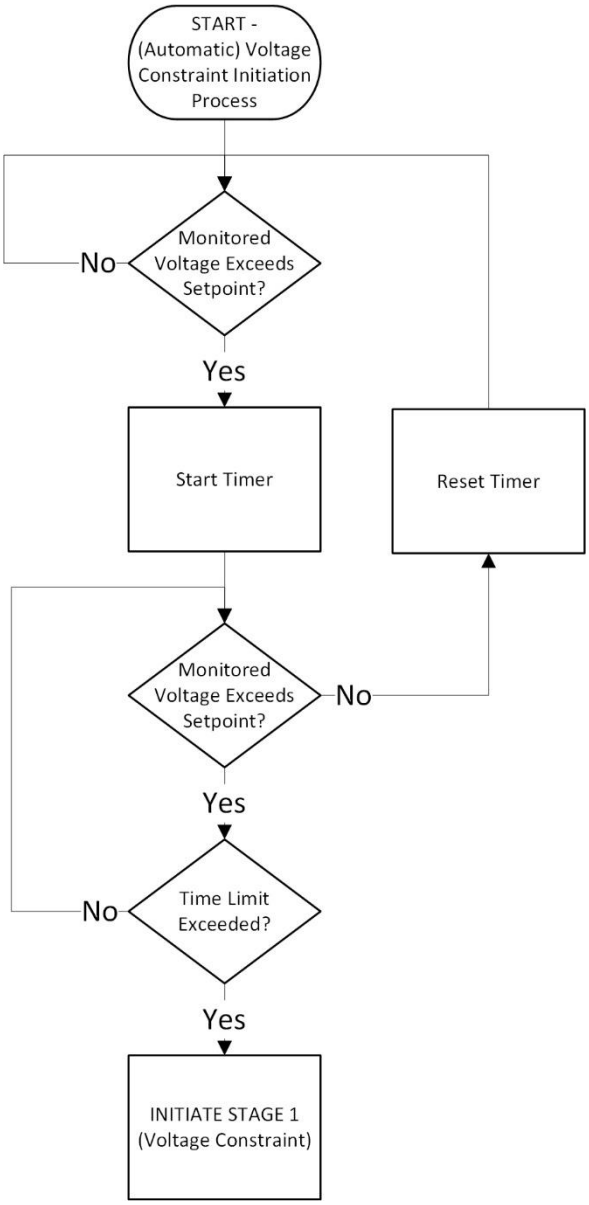


Figure 4. Stage 1 (Voltage Constraint) Initiation Process

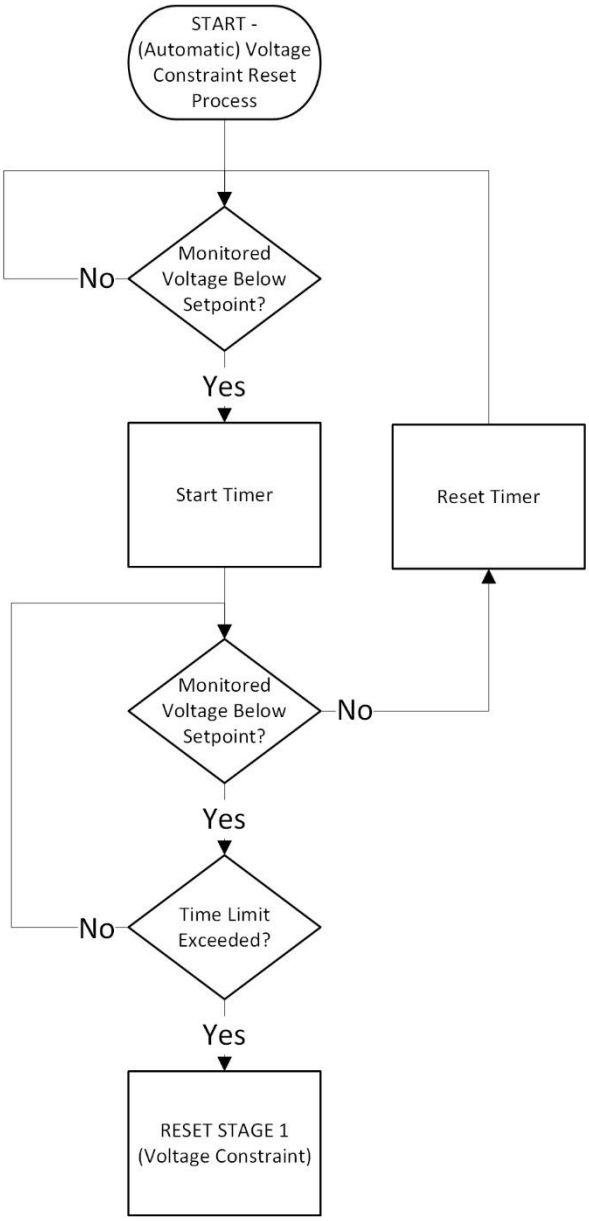


Figure 5. Stage 1 (Voltage Constraint) Reset Process

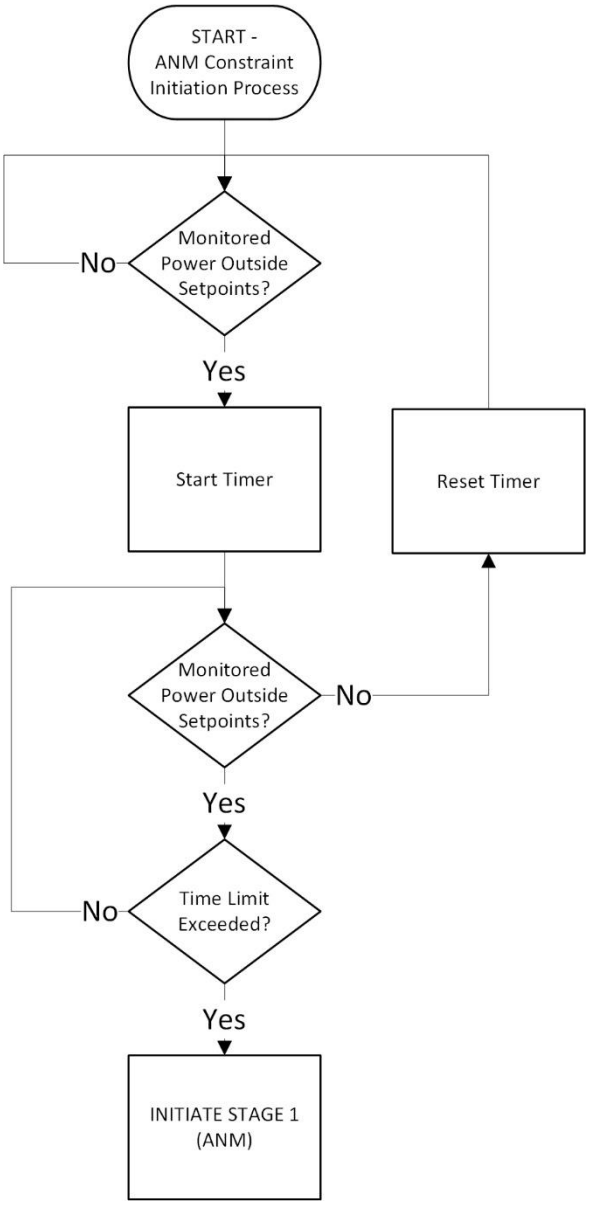


Figure 6. Stage 1 (ANM) Initiation Process

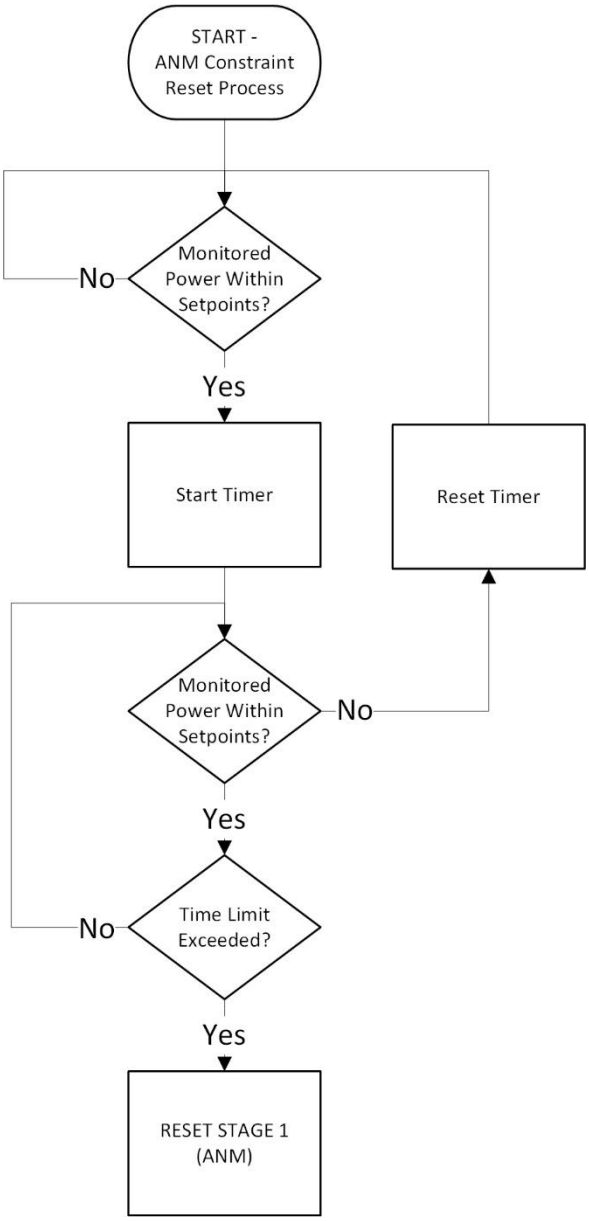


Figure 7. Stage 1 (ANM) Reset Process

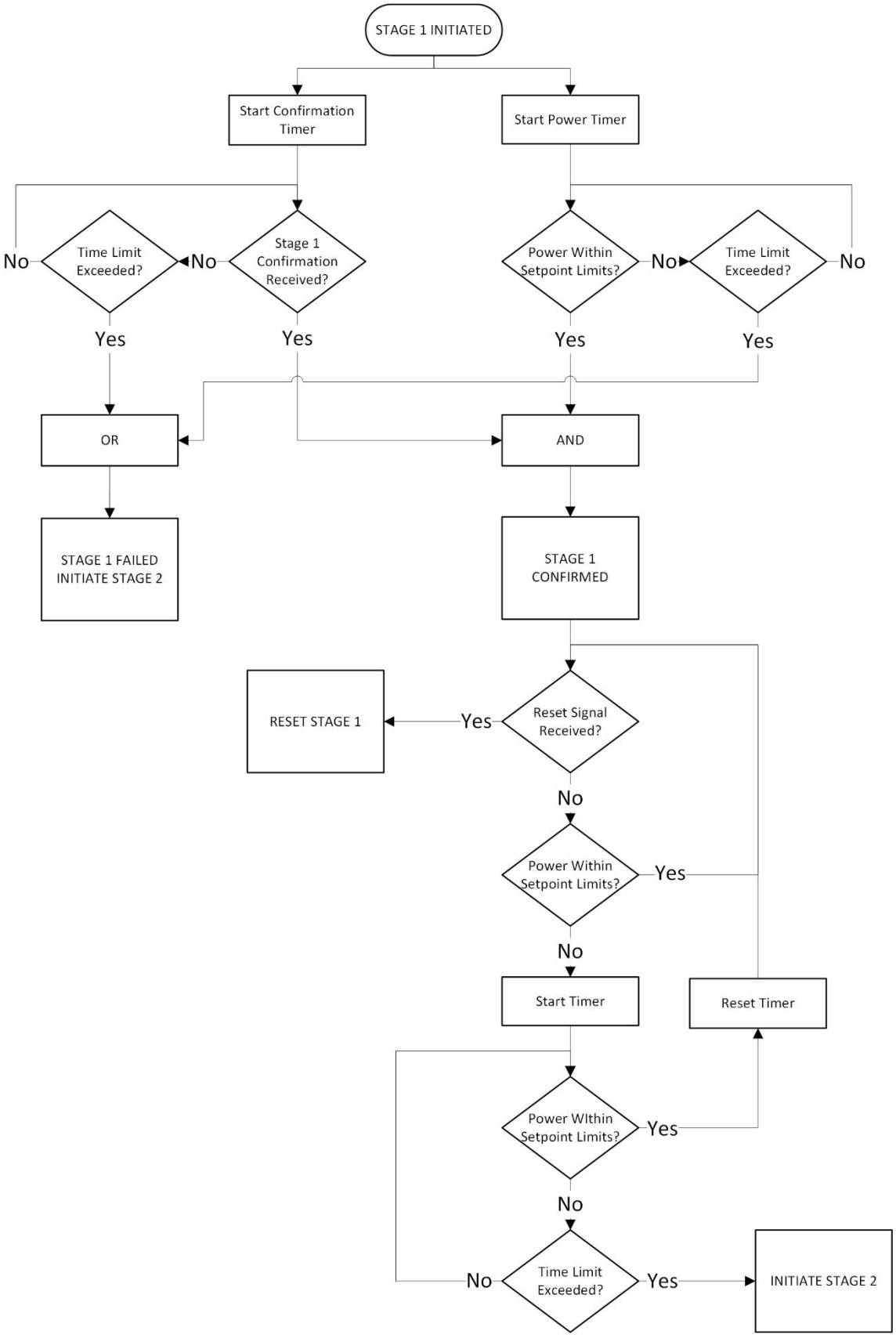


Figure 8. Stage 1 Checking and Escalation Process

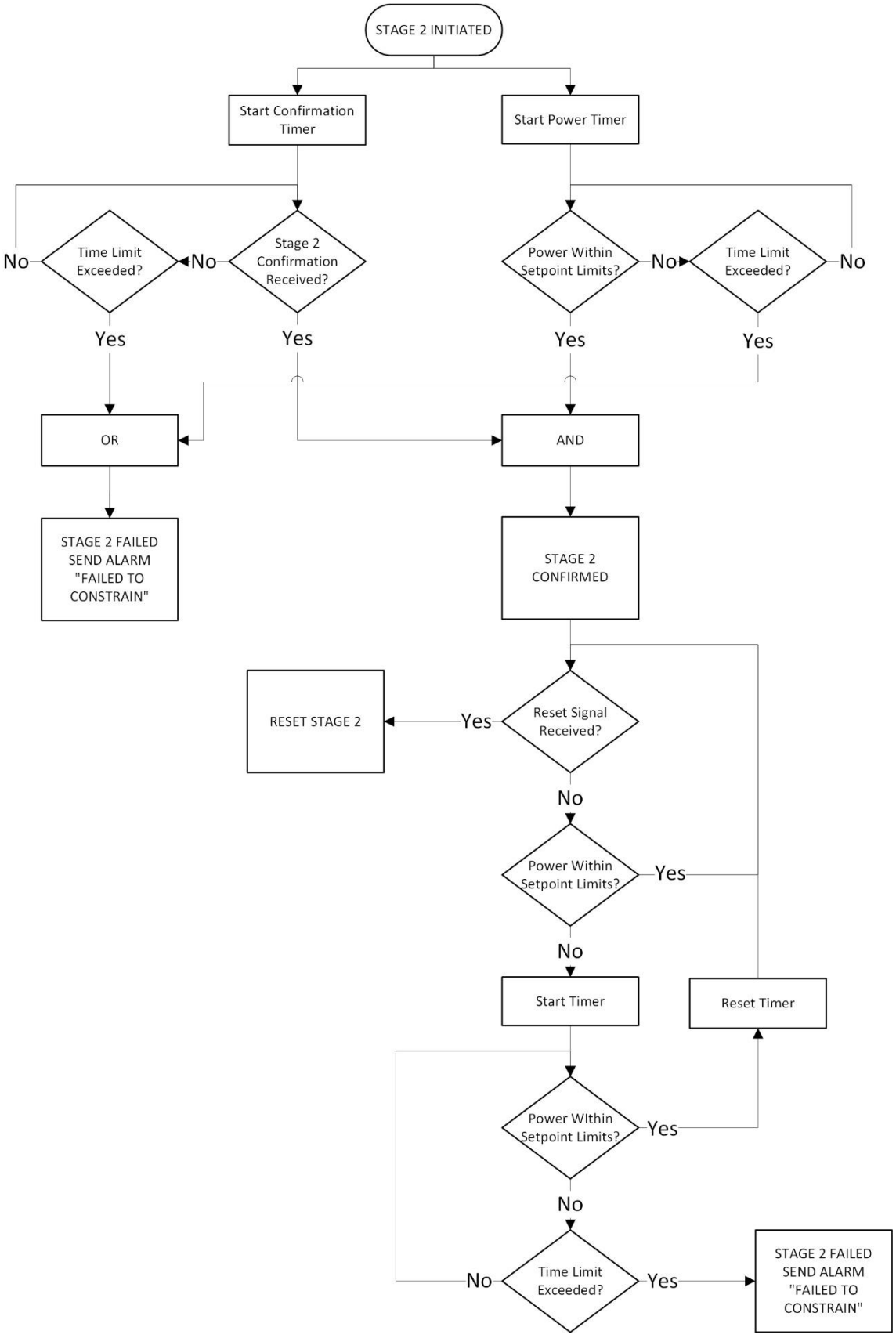
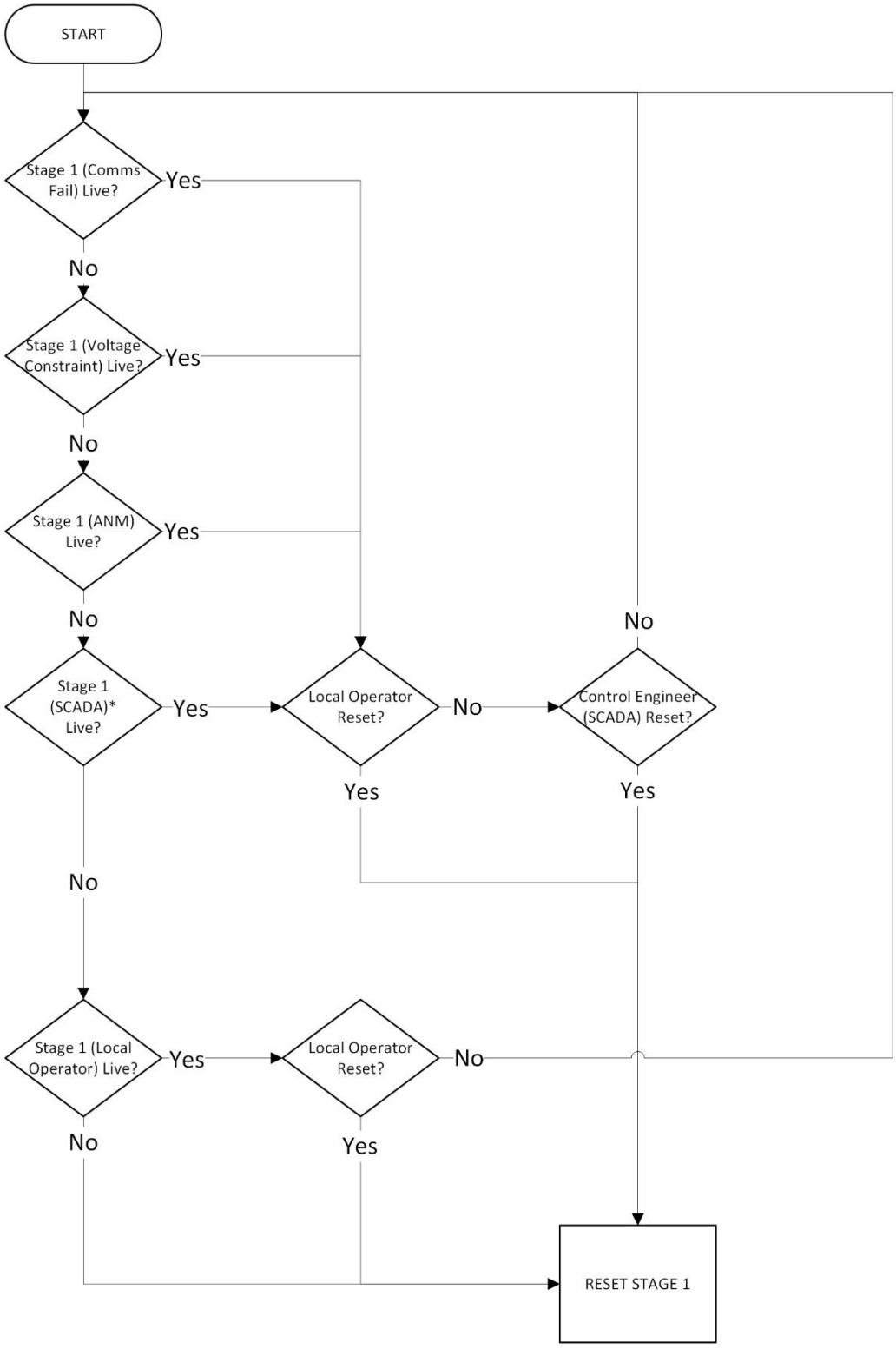


Figure 9. Stage 2 Checking and Escalation Process



*SCADA Stage 1 includes automated instruction e.g. Soft Intertrip schemes as well as control engineer action

Figure 10. CCP Stage 1 Reset Process

APPENDIX C

SUPERSEDED DOCUMENTATION

This is a new document and no document is superseded by its issue.

APPENDIX D

RECORD OF COMMENT DURING CONSULTATION

EE SPEC: 143 – Comments

APPENDIX E

ASSOCIATED DOCUMENTATION

ST:TP18A	"Application of Connection Control Panels for Soft Intertrip and/or Voltage Constraint Schemes"
POL:SD10	"Relating to Managing Processes for Alternative Connections"
EE SPEC 136	"Ancillary Electrical Equipment for Use in Conjunction with Switchgear and Protection/Control Panels"

APPENDIX F

KEY WORDS

Connection Control Panel, CCP, Constraint, Load Management Scheme