Assets Planning and Delivery Group
Engineering

DESIGN STANDARD DS 24

Electrical Drafting

VERSION 1
REVISION 2

DECEMBER 2022

FOREWORD

The intent of Design Standards is to specify requirements that assure effective design and delivery of fit for purpose Water Corporation infrastructure assets for best whole-of-life value with least risk to Corporation service standards and safety. Design standards are also intended to promote uniformity of approach by asset designers, drafters and constructors to the design, construction, commissioning and delivery of water infrastructure and to the compatibility of new infrastructure with existing like infrastructure.

Design Standards draw on the asset design, management and field operational experience gained and documented by the Corporation and by the water industry generally over time. They are intended for application by Corporation staff, designers, constructors and land developers to the planning, design, construction and commissioning of Corporation infrastructure including water services provided by land developers for takeover by the Corporation.

Nothing in this Design Standard diminishes the responsibility of designers and constructors for applying the requirements of the Western Australia's Work Health and Safety (General) Regulations 2022 to the delivery of Corporation assets. Information on these statutory requirements may be viewed at the following web site location:

Overview of Western Australia's Work Health and Safety (General) Regulations 2022 (dmirs.wa.gov.au)

Enquiries relating to the technical content of a Design Standard should be directed to the Senior Principal Engineer, Electrical Section, Engineering. Future Design Standard changes, if any, will be issued to registered Design Standard users as and when published.

Head of Engineering

This document is prepared without the assumption of a duty of care by the Water Corporation. The document is not intended to be nor should it be relied on as a substitute for professional engineering design expertise or any other professional advice.

Users should use and reference the current version of this document.

DISCLAIMER

Water Corporation accepts no liability for any loss or damage that arises from anything in the Standards/Specifications including any loss or damage that may arise due to the errors and omissions of any person. Any person or entity which relies upon the Standards/Specifications from the Water Corporation website does so that their own risk and without any right of recourse to the Water Corporation, including, but not limited to, using the Standards/Specification for works other than for or on behalf of the Water Corporation.

The Water Corporation shall not be responsible, nor liable, to any person or entity for any loss or damage suffered as a consequence of the unlawful use of, or reference to, the Standards/Specifications, including but not limited to the use of any part of the Standards/Specification without first obtaining prior express written permission from the CEO of the Water Corporation.

Any interpretation of anything in the Standards/Specifications that deviates from specific Water Corporation Project requirements must be referred to, and resolved by, reference to and for determination by the Water Corporation's project manager and/or designer for that particular Project.

REVISION STATUS

The revision status of this standard is shown section by section below:

REVISION STATUS						
SECT.	**VER./ REV.**	**DATE**	**PAGES REVISED**	**REVISION DESCRIPTION (Section, Clause, Sub-Clause)**	**RVWD.**	**APRV.**
0	0/0	01.10.00	All	New Version	NHJ	AAK
0	0/1	01.09.03	All	Reformatted	NHJ	AAK
0	0/2	27.05.04	All	Reformatted	CT	NHJ
0	1/0	01.04.19	All	All	SAM	NHJ
0	1/1	24.05.22	All	Document reviewed; no changes required	EG	EG
1	0/0	01.10.00	All	New Version	NHJ	AAK
1	0/1	01.09.03	All	Reformatted	NHJ	AAK
1	0/2	27.05.04	All	Reformatted	CT	NHJ
1	1/0	01.04.19	All	New Section	SAM	NHJ
1	**1/2**	**22.12.22**	**1, 3**	**1.1, 1.8, 1.9**	**SAM**	**EG**
2	0/0	01.10.00	All	New Version	NHJ	AAK
2	0/1	01.09.03	All	Reformatted	NHJ	AAK
2	0/2	27.05.04	All	Reformatted	CT	AAK
2	1/0	01.04.19	All	New Section	SAM	NHJ
2	**1/2**	**22.12.22**	**4, 6**	**2.2, 2.2.3, 2.2.4**	**SAM**	**EG**
3	0/0	01.10.00	All	New Version	NHJ	AAK
3	0/1	01.09.03	All	Reformatted	NHJ	AAK
3	0/2	27.05.04	All	Reformatted	CT	NHJ
3	1/0	01.04.19	All	New Section	SAM	NHJ
3	**1/2**	**22.12.22**	**7, 9, 11, 13**	**3.1, 3.2, 3.3, 3.4.3, 3.4.6, 3.4.7, 3.4.9**	**SAM**	**EG**
4	0/0	01.10.00	All	New Version	NHJ	AAK
4	0/1	01.09.03	All	Reformatted	NHJ	AAK
4	0/2	27.05.04	All	Reformatted	CT	NHJ
4	1/0	01.04.19	All	New Section	SAM	NHJ
4	**1/2**	**22.12.22**	**14, 15**	**4.4, 4.5.1**	**SAM**	**EG**
5	0/0	01.10.00	All	New Version	5	0/0
5	0/1	01.09.03	All	Reformatted	5	0/1
5	0/2	27.05.04	All	Reformatted	5	0/2
5	1/0	01.04.19	All	New Section	5	1/0
5	**1/2**	**22.12.22**	**17, 18, 22, 25 - 29**	**5.2, 5.5.2, 5.6.7, 5.9.6 (New), 5.10.2, 5.11.1, 5.11.3 (New), 5.11.4 (NEW), 5.11.5, 5.11.6, 5.11.7, 5.11.8**	**5**	**1/2**

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SECT.	**VER./ REV.**	**DATE**	**PAGES REVISED**	**REVISION DESCRIPTION (Section, Clause, Sub-Clause)**	**RVWD.**	**APRV.**
6	0/0	01.10.00	All	New Version	NHJ	AAK
6	0/1	01.09.03	All	Reformatted	NHJ	AAK
6	0/2	27.05.04	All	Reformatted	CT	NHJ
6	1/0	01.04.19	All	New Section	SAM	NHJ
6	**1/2**	**22.12.22**	**31, 32**	**6.1, 6.6, 6.6.1, 6.6.2, 6.7, 6.8**	**SAM**	**EG**
7	0/0	01.10.00	All	New Version	NHJ	AAK
7	0/1	01.09.03	All	Reformatted	NHJ	AAK
7	0/2	27.05.04	All	Reformatted	CT	NHJ
7	1/0	01.04.19	All	New Section	SAM	NHJ
7	**1/2**	**22.12.22**	**33, 34**	**7.2, 7.3, 7.4, 7.5.1, 7.6**	**SAM**	**EG**
8	0/0	01.10.00	All	New Version	NHJ	AAK
8	0/1	01.09.03	All	Reformatted	NHJ	AAK
8	0/2	27.05.04	All	Reformatted	CT	NHJ
8	1/0	01.04.19	All	New Section	SAM	NHJ
9	0/0	01.10.00	All	New Version	NHJ	AAK
9	0/1	01.09.03	All	Reformatted	NHJ	AAK
9	0/2	27.05.04	All	Reformatted	CT	AAK
9	1/0	01.04.19	All	New Section	SAM	NHJ
9	**1/2**	**22.12.22**	**38**	**9.3**	**SAM**	**EG**
10	0/0	01.10.00	All	New Version	NHJ	AAK
10	0/1	01.09.03	All	Reformatted	NHJ	AAK
10	0/2	27.05.04	All	Reformatted	CT	NHJ
10	1/0	01.04.19	All	New Section	SAM	NHJ
10	**1/2**	**22.12.22**	**39**	**10.4**	**SAM**	**EG**
11	0/0	01.10.00	All	New Version	NHJ	AAK
11	0/1	01.09.03	All	Reformatted	NHJ	AAK
11	0/2	27.05.04	All	Reformatted	CT	NHJ
11	1/0	01.04.19	All	New Section	SAM	NHJ
11	**1/2**	**22.12.22**	**41**	**11.1, 11.2, 11.3**	**SAM**	**EG**
12	0/0	01.10.00	All	New Version	NHJ	AAK
12	0/1	01.09.03	All	Reformatted	NHJ	AAK
12	0/2	27.05.04	All	Reformatted	CT	NHJ
12	1/0	31.12.18	All	New Section	SAM	NHJ
12	**1/2**	**22.12.22**	**43**	**12.2, 12.5**	**SAM**	**EG**
13	0/0	01.10.00	All	New Version	NHJ	AAK
13	0/1	01.09.03	All	Reformatted	NHJ	AAK
13	0/2	27.05.04	All	Reformatted	CT	NHJ
13	1/0	01.04.19	All	New Section	SAM	NHJ

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SECT.	**VER./ REV.**	**DATE**	**PAGES REVISED**	**REVISION DESCRIPTION (Section, Clause, Sub-Clause)**	**RVWD.**	**APRV.**
14	0/0	01.10.00	All	New Version	NHJ	AAK
14	0/1	01.09.03	All	Reformatted	NHJ	AAK
14	0/2	27.05.04	All	Reformatted	CT	NHJ
14	1/0	01.04.19	All	New Section	SAM	NHJ
14	**1/2**	**22.12.22**	**49, 50, 51**	**14.2, 14.5-14.11 (New)**	**SAM**	**EG**
15	0/0	01.10.00	All	New Version	NHJ	AAK
15	0/1	01.09.03	All	Reformatted	NHJ	AAK
15	0/2	27.05.04	All	Reformatted	CT	NHJ
15	1/0	01.04.19	All	New Section	SAM	NHJ
15	**1/2**	**22.12.22**	**52, 53, 54**	**15.1.1. (New), 15.3.1, 15.4, 15.5.1, 15.6, 15.7**	**SAM**	**EG**
16	0/0	01.10.00	All	New Version	NHJ	AAK
16	0/1	01.09.03	All	Reformatted	NHJ	AAK
16	0/2	27.05.04	All	Reformatted	CT	AAK
16	1/0	01.04.19	All	New Section	SAM	NHJ
16	**1/2**	**22.12.22**	**55, 60, 62**	**16.1, 16.7.3, 16.8**	**SAM**	**EG**
17	0/0	01.10.00	All	New Version	NHJ	AAK
17	0/1	01.09.03	All	Reformatted	NHJ	AAK
17	0/2	27.05.04	All	Reformatted	CT	NHJ
17	1/0	01.04.19	All	New Section	SAM	NHJ
17	**1/2**	**22.12.22**	**64, 66**	**17.1, 17.2, 17.8.1**	**SAM**	**EG**
18	0/0	01.10.00	All	New Version	NHJ	AAK
18	0/1	01.09.03	All	Reformatted	NHJ	AAK
18	0/2	27.05.04	All	Reformatted	CT	NHJ
18	1/0	01.04.19	All	New Section	SAM	NHJ
18	**1/2**	**22.12.22**	**69, 70, 72**	**18.2, 18.3.1, 18.3.2, 18.6, 18.10**	**SAM**	**EG**
19	0/0	01.10.00	All	New Version	NHJ	AAK
19	0/1	01.09.03	All	Reformatted	NHJ	AAK
19	0/2	27.05.04	All	Reformatted	CT	NHJ
19	1/0	01.04.19	All	New Section	SAM	NHJ
19	**1/2**	**22.12.22**	**74**	**19 Title, 19.1**	**SAM**	**EG**
20	0/0	01.10.00	All	New Version	NHJ	AAK
20	0/1	01.09.03	All	Reformatted	NHJ	AAK
20	0/2	27.05.04	All	Reformatted	CT	NHJ
20	1/0	01.04.19	All	New Section	SAM	NHJ
20	**1/2**	**22.12.22**	**75**	**20.2**	**SAM**	**EG**
21	0/0	01.10.00	All	New Version	NHJ	AAK
21	0/1	01.09.03	All	Reformatted	NHJ	AAK
21	0/2	27.05.04	All	Reformatted	CT	NHJ
21	1/0	01.04.19	All	New Section	SAM	NHJ

REVISION STATUS						
SECT.	**VER./ REV.**	**DATE**	**PAGES REVISED**	**REVISION DESCRIPTION (Section, Clause, Sub-Clause)**	**RVWD.**	**APRV.**
22	0/0	01.10.00	All	New Version	NHJ	AAK
22	0/1	01.09.03	All	Reformatted	NHJ	AAK
22	0/2	27.05.04	All	Reformatted	CT	NHJ
22	1/0	01.04.19	All	New Section	SAM	NHJ
23	1/0	01.04.19	All	New Section	SAM	NHJ
24	1/0	01.04.19	All	New Section	SAM	NHJ
25	1/0	01.04.19	All	New Section	SAM	NHJ
26	1/0	01.04.19	All	New Section	SAM	NHJ
27	1/0	01.04.19	All	New Section	SAM	NHJ
28	1/0	01.04.19	All	New Section	SAM	NHJ
29	1/0	01.04.19	All	New Section	SAM	NHJ
30	1/0	01.04.19	All	New Section	SAM	NHJ
31	1/0	01.04.19	All	New Section	SAM	NHJ
32	1/0	01.04.19	All	New Section	SAM	NHJ
33	1/0	01.04.19	All	New Section	SAM	NHJ
34	1/0	01.04.19	All	New Section	SAM	NHJ
App A	**1/2**	**22.12.22**	**All**	**Updated F**	**SAM**	**EG**

DESIGN STANDARD DS 24

Electrical Drafting

CONTENTS

1 Introduction

1.1 Purpose

The Water Corporation has adopted a policy of outsourcing most of the electrical engineering and electrical detail design associated with the procurement of its assets. The drawings which document the resulting assets need to be in accordance with the Corporation's operational needs and standard practices.

This design standard (i.e. Electrical Design Standard DS24) sets out the Water Corporation drafting standards and recommended practice which shall be followed in respect to the design and specification of Electrical Power, Control, Instrumentation, Communications and SCADA drawings for assets being acquired by the Corporation.

This design standard does not address all issues that will need to be considered by the Designer in respect to a particular installation.

It is the Corporation's objective that its assets will be documented so that these can be constructed and maintained at minimum long term cost. In respect to matters not covered specifically in this standard, the Designer shall aim his/her drafting practice at achieving this objective.

Users are invited to forward submissions for continuous improvement to the Senior Principal Engineer, Advisory Section, Engineering.

1.2 Scope

The scope of this standard (i.e. Electrical Design Standard DS24) covers all drafting which documents the Electrical Power, Control, Instrumentation, Communications and SCADA aspects of assets to be owned and/or operated by the Corporation

Electrical standard design drawings produced by the Corporation maintain the requirements of this standard wherever practical. However, due to the unique nature of standard drawings to convey specific additional information to the designer and drafter, electrical standard design drawings are exempt from absolute conformance with this standard.

1.3 Mandatory requirements

Within this design standard the use of the imperative 'shall' indicates a mandatory requirement. The use of verbs other than 'shall' such as 'will' 'should', or 'may' indicates recommended and preferred practice.

1.4 References

Reference should be made also to the following associated design standards:

DS20 Design Process for Electrical Works

DS 21 Major Pump Station - Electrical

DS 22 Ancillary Plant and Small Pump Stations - Electrical

DS 23 Pipeline AC Interference and Substation Earthing

DS 25 Solar Energy Systems

DS 26 Type Specifications

DS28 Water and Wastewater Treatment Plants – Electrical

DS29 Arc Flash Hazard Assessment of Switchgear Assemblies

DS40 Design Process for SCADA Works

DS80 WCX CAD Standard, Water Corporation eXternal (WCX) Manual

1.5 Definitions

Asset Manager	The Corporation officer responsible for the operation of the asset being acquired.
Corporation	The Water Corporation (of Western Australia)
Designer	The technical professional undertaking the electrical design under the authority of the Engineering Designer e.g. design drafter or engineering associate.
Engineering Designer	The appropriately qualified engineer carrying out the design, e.g. Electrical Engineer, Instrumentation engineer, Communications engineer.
Senior Principal Engineer	The Senior Principal Engineer Electrical, Engineering.
Small Pump Station	Pump station having individual drives rated not greater than 150 kW and an incoming electrical supply rated not greater than 315 kVA.
Major Pump Station	Pump station having individual drives rated greater than 150 kW and an incoming electrical supply rated in excess of 315 kVA.
Water Treatment Plants	A facility containing processes which improve the quality of water to attain safe drinking water standards.
Wastewater treatment Plant	A facility containing processes which remove physical and biological contaminants from wastewater.
Small Treatment Plant	Either a Water or Wastewater Treatment Plant site having an installed duty transformer capacity rated at ≤ 315 kVA
Medium Treatment Plant	Either a Water or Wastewater Treatment Plant site having an installed duty transformer capacity rated at > 315 kVA and ≤ 2 MVA
Major Treatment Plant	Either a Water or Wastewater Treatment Plant site having an installed duty transformer capacity rated at > 2 MVA
DMS	Drawing Management System - The software system which regulates and archives drawings within the Water Corporation.
SCADA	Supervisory Control and Data Acquisition

1.6 National Standards

Electrical drawings shall be drawn in accordance with the latest edition of all relevant Australian Standards, except where specified otherwise in this design standard.

1.7 Associated Sections

Sections of this design standard referring to specific types of drawing (e.g. power diagrams) shall be read in conjunction with all associated general requirements sections (e.g. symbols).

1.8 General Drafting Requirements

Except where specified otherwise in this design standard, the Designer shall ensure compliance with the requirements of the latest edition of Design Standard DS80 entitled "WCX CAD Standard, Water Corporation eXternal (WCX) Manual" published by the Water Corporation.

For Water Corporation drafting personnel this manual is available within AutoCAD.

For consulting engineers and contractors this manual is provided as part of the WCX download, for AutoCAD or Microstation.

1.9 Mandatory Requirements

In general, the requirements of this design standard are mandatory. If there are special circumstances which would justify deviation from the requirements of this standard, the matter shall be referred to the Senior Principal Engineer – Electrical, Advisory Section, Engineering for consideration. No deviation from the requirements of this standard shall be made without the written approval of the Senior Principal Engineer.

2 Standards

2.1 General Requirements

As a general practice except where specified otherwise in this design standard, drawings should incorporate only the drawing practices recommended and laid down by the Standards Association of Australia. Caution shall be exercised when considering the inclusion of drawing practices and symbols recommended in Australian Standards applicable to engineering disciplines other than electrical. When conflict arises, the drawing practices and symbols recommended for electrotechnology shall be implemented.

2.2 Preferred Standards

2.2.1 General Drafting

Preferred standards include applicable parts of the standards listed.

Many Australian Standards for the preparation of documents used in Electrotechnology have been withdrawn by Standard Australia without reference to replacement standards.

It has been identified that IEC 60617 Graphical Symbols for Diagrams is a database which can be used as a replacement for the withdrawn Australian Standard - Graphical Symbols for Electrotechnology as both standards are almost identical.

It is the Corporations preference to maintain the use of the withdrawn standards until such time as replacement standards are created or alternate standards are identified. Where AS/NZS standards are no longer viewable within Standards Australia, the symbols can be viewed on the IEC 60617 Graphical Symbols for Diagrams database.

Australian Standards:

AS ISO 1000 The international system of units

1000 – 1998 The international system of units (S1) and its application

AS 1046 Letter symbols for use in Electrotechnology

1046.1 - 1978 General (Withdrawn)

1046.2 – 1978 Telecommunication and electronics (Withdrawn)

1046.3 – 1991 Logarithmic quantities and units (Withdrawn)

1046.4 – 1991 Symbols for quantities to be used for rotating electrical machines (Withdrawn)

AS 1100 Technical drawing1100.101 – 1992 (R2014) General principles

1100.101 – 1992/Amdt 1 - 1994 General principles

1100.201 – 1992 Mechanical engineering drawing

1100.201 – 1992/Amdt 1 - 1994 Mechanical engineering drawing

1100.301 - 2008 Architectural drawing

1100.301 – 2008/Amdt 1 - 2011 Architectural drawing

1100.401 – 1984 Engineering survey and engineering survey design drawing

1100.401 – 1984.Amdt 1 - 1984 Engineering survey and engineering survey design drawing

1100.501 – 2002 Structural engineering drawing

AS 1101 Graphical Symbols for general engineering

1101.1 - 2007 Hydraulic and pneumatic systems

1101.3 – 2005 Welding and non-destructive examination

1101.4 – 1989 (OBSOLETE – DO NOT USE)

1101.5 – 1984 (OBSOLETE – DO NOT USE)

1101.6 – 1989 (OBSOLETE – DO NOT USE)

2.2.2 Electrical Power Drafting

International Standards:

IEC 60617 Graphical Symbols for Diagrams (database)

Australian Standards:

AS/NZS 1102Graphical Symbols for Electrotechnology

1102.12 - 1994 Electric traction (Withdrawn)

1102.101 - 1989 General information and general index (Withdrawn)

1102.102 - 1997 Symbol elements, qualifying symbols & other symbols having general application (Withdrawn)

1102.103 - 1997 Conductors and connecting devices (Withdrawn)

1102.104 - 1997 Basic passive components (Withdrawn)

1102.105 - 1997 Semiconductors and electron tubes (Withdrawn)

1102.106 - 1997 Production and conversion of electrical energy (Withdrawn)

1102.107 - 1997 Switchgear, control gear and protective devices (Withdrawn)

1102.108 - 1997 Measuring instruments, lamps and signaling devices (Withdrawn)

1102.109 - 1997 Telecommunications – switching and peripheral equipment (Withdrawn)

1102.110 - 1997 Telecommunications – transmission (Withdrawn)

1102.111 - 1997 Architectural and topographical installation plans and diagrams (Withdrawn)

1102.112 - 1995 (EXCLUDED-DO NOT USE) (Withdrawn)

1102.113 - 1995 (EXCLUDED-DO NOT USE) (Withdrawn)

AS 1852 International Electrotechnical Vocabulary

1852 Ch 301 – 1988 General terms on measurements in electricity (Withdrawn)

1852 Ch 302 – 1988 Electrical measuring instruments (Withdrawn)

1852 Ch 303 – 1988 Electronic measuring instruments (Withdrawn)

1852 Ch 321 – 1988 Instrument transformers (Withdrawn)

AS/NZS 4383 Preparation of documents used in Electrotechnology

4383.1 - 1996 General principles (Withdrawn)

4383.2 - 1996 Function-orientated diagrams (Withdrawn)

4383.3 - 1996 Connection diagrams, tables and lists (Withdrawn)

4383.4 - 1996 Location and installation documents (Withdrawn)

2.2.3 Instrumentation Drafting

Preferred standards include applicable parts of the standards listed.

American National Standards Institute (ANSI)

International Society of Automation (ISA)

ANSI/ISA

5.1 - 2022 Instrumentation Symbols and Identification

5.4 – 1991 Instrument Loop Diagrams

2.2.4 Process Operation Drafting

Preferred standards include applicable parts of the standards listed.

American National Standards Institute (ANSI)

International Society of Automation (ISA)

ANSI/ISA

5.1 – 2022 Instrumentation Symbols and Identification

5.2 – 1976 (R1992) Binary Logic Diagrams for Process Operations

2.3 Associated Standards

Associated standards include such Australian Standards applicable to the manufacture, performance, connection, installation, etc of electrical equipment.

Diagrams, drawing practices and symbols, included in associated standards, do not necessarily reflect drafting standards and shall not be implemented in preference, where conflict arises.

2.4 Miscellaneous Standards

As a general rule miscellaneous standards should not be applied. However, where any part of a miscellaneous standard is incorporated in a drawing, a general note shall be included on the drawing stating which part or parts are not in accordance with the Preferred Standards.

3 Drawing Management and Plan registration

3.1 Drawing Management System

The Water Corporation has created a central database for plan registration, drawing management and drawing number allocation. This database forms the basis of the Drawing Management System (DMS).

All drawings shall be registered, numbered, archived and retrieved for revision, or copying via the drawing management system.

For further details refer Design Standard DS80 - "WCX CAD Standard, Water Corporation eXternal (WCX) Manual".

3.2 Responsibility for the drawing content

Every drawing shall identify the the Drafter that produced the drawing.

Every drawing shall identify the the person that Quality Control checked the drawing for conformance with the presentation requirements of the drawing.

IF required, each drawing shall be signed, in accordance with Design Standard DS80 Appendix * - Digital Signing Instructions by the relevant associated professional/s that performed the following tasks.

- Design Calculations
- Design Calculation Checking

Every drawing shall be signed, in accordance with Design Standard DS80 Appendix * - Digital Signing Instructions by the Designer within the 'Recommended' signatory box in the drawing titleblock.

Every drawing shall be signed, in accordance with Design Standard DS80 Appendix * - Digital Signing Instructions by the Engineering Designer that takes **professional responsibility** for the drawing content. The signature shall be located within the 'Approved' signatory box in the drawing titleblock.

3.3 Issue of Drawings

Each electrical drawing shall be produced as an original A1 sheet size in accordance with the requirements of Design Standard DS80.

The electronic CAD version of the drawing shall have the titles, dates and signatures inserted into the relevant signatory boxes in the drawing titleblock, and submitted with all relevant files (e.g. dwg, pdf, TIT files etc) for archival in accordance with Design Standard DS80 Appendix * - Digital Signing Instructions and DMS Procedures.

Only the image of the drawing stored in the Water Corporation – Drawing Management System shall be regarded as the **master drawing**. All drawings issued for independent review or construction purposes shall be copies of this master drawing.

3.4 Drawing Numbering and Titling

3.4.1 Drawing Numbering

All new drawings shall be numbered in accordance with the requirements of Design Standard DS80.

The drawing number is formed by assembling a sequence of different drawing number components.

The typical drawing number format is e.g. AA01 – 41 – 1. 1 A. (Note: The use of leading zeroes is not required within the drawing sheet title block for the bundle, sheet and part number components.)

The drawing number consists of the following components:

Planset Number

- In one of three formats (e.g. AA01 or 01245 or 53726)

Bundle Number - Electrical drawings

- In the range 40-49 for small projects
- In the range 400-499 for medium and large projects

Bundle number - Control, Instrumentation, Communications and SCADA drawings

- In the range 50-57 for general use
- Bundle 58 for Instrument Schedules
- Bundle 59 for Loop diagrams
- Bundle 61 for Control Logic Diagrams
- Bundle 72 for Profibus Topology

Sheet Number

- In the range 1-999

Part Number

- In the range 1-99

Issue Letter

- In the range A-Z (Note: Issue Y is the last useable issue letter)
- All new drawings shall be issue ‘A’

3.4.2 Planset number allocation origin

The first component of the drawing number (i.e. the planset number) can take the form of one of three different number sequences, dependent upon the origin of the drawing.

The drawings created, maintained and stored by the Water Corporation have originated from three previous organizations, namely,

- The Public Works department of Western Australia (PWD)
- The Metropolitan Water Authority (MWA)
- The Water Authority of Western Australia (WAWA).

Each organization had a different planset number allocation system as follows:

MWA - 00001 to 19240 inclusive

PWD - 19450 to 58617 inclusive

WAWA - AA01-ZZ99 inclusive

The Water Corporation maintains all three planset numbering systems, however, only the WAWA system is used to allocate new planset numbers for new Water Corporation projects.

3.4.3 Planset Number Allocation for SCADA Drawings by Region

All SCADA drawings shall be allocated specific planset numbers and bundle numbers and be titled for specific regions in accordance with the requirements of Design Standard DS80 Sections 2.5and 3.12.

3.4.4 MWA Plan numbers having less than five digits

All existing MWA drawing plansets having less than five digit plan numbers shall be shown with a leading zero in accordance with the requirements of Design Standard DS80. E.g. planset 1128 becomes 01128.

3.4.5 Adding New Drawings into existing PWD or MWA Plan numbering

Where an additional drawing is to be added into an existing PWD or MWA planset, the original plan number shall be maintained and the drawing number allocated should be an extension of the existing drawing numbers, where possible.

3.4.6 Drawings Titles

All new drawings shall be titled in accordance with the requirements of Design Standard DS80.

The drawing title shall consist of a maximum of four title lines.

The drawing title block provides title lines for the following

- Title Line 1 (Planset title Line 1 - refer Design Standard DS80 Section 2)
- Title Line 2 (Planset title line 2 - refer Design Standard DS80 Section 2)
- Title Line 3 (Project sub-title)
- Title Line 4 (Drawing content title)

3.4.7 Drawings Title naming conventions

All new drawings shall be titled in accordance with the requirements of Design Standard DS80.

The drawing title shall consist of a maximum of four title lines.

The drawing title block provides title lines for the following

- Title Line 1 (Planset title Line 1 - refer Design Standard DS80 Section 2)
- Title Line 2 (Planset title line 2 - refer Design Standard DS80 Section 2)
- Title Line 3 (Project sub-title)
- Title Line 4 (Drawing content title)

3.4.8 Drawing title naming conventions

For the purpose of developing titles to be used on drawings, the following conventions based on the type or size of the project shall be applied. Generally, projects fall into three categories they are small, medium or large.

Small Projects

Small projects are typically for projects located at one site and have one main process. Small projects include Minor Power Electrical Work as defined by Design Standard DS20.

Medium Projects

Medium projects can include one or more sites and typically have more than one process. Medium projects can include combinations of features from both small project Minor Power Electrical Work as defined by Design Standard DS20 and large project Water and Wastewater Treatment Plants as defined by Standard DS28.

Large Projects

Large projects are typically for projects located at one major site and have many processes.

Large projects can include Major Pump Stations as defined by Standard DS21 and Water and Wastewater Treatment Plants as defined by Standard DS28.

The number of drawings required to define a project depend on the complexity of the project, therefore the title structure will change to accommodate the complexity of the project.

Small Project Titles

A small project having only one main process may only require a set of switchboard and electrical installation detail drawings. The first and second line titles as defined by Design Standard DS80 provide sufficient details to establish the type of installation, its location and identification number. Therefore, little or no additional information is required within the third and fourth line titles other than to define the purpose of each individual drawing. e.g.

1st line title: Metropolitan Wastewater

2nd line title: East Cannington Pumping Station No4 – Sevenoaks St & PM

3rd line title: Switchboard layout

Medium Project Titles

A medium sized project may have a number of different processes and require a number of sets of switchboard and electrical installation detail drawings. The first and second line titles as defined by Design Standard DS80 provide sufficient details to establish the type of installation, its location and identification number.

However, additional information is required within the third line title to define which part of the installation the drawing is associated. The fourth line title defines the purpose of each individual drawing. e.g.

1st line title: Donnybrook Water Supply

2nd line title: Water Treatment Plant

3rd line title: Transfer Pumping Station – Main Switchboard

4th line title: Switchboard layout

Large Project Titles

A large project may have many different locations and/or processes and require many sets of switchboard and electrical installation detail drawings. The first and second line titles as defined by Design Standard DS80 provide sufficient details to establish the type of installation, its name and location.

However, the third line title is significant as it is assigned as a sub-title to divide the plant, installations or individual processes into a series of sets of drawings within the planset. The fourth line title defines the purpose of each individual drawing. e.g.

1st line title: Metropolitan Water Supply

2nd line title: East Mirrabooka Ground Water Scheme - Borefield

3rd line title: Bore M35

4th line title: Switchboard Layout

Typical examples of first line titles

- Metropolitan Wastewater
- Metropolitan Water supply
- Metropolitan Drainage
- Bunbury Wastewater
- Donnybrook Water Supply
- Goldfields & Agricultural Water Supply – Main Conduit
- South West Region
- Christmas Island Water Supply

Typical examples of second line titles

- East Cannington Pumping Station No4 – Sevenoaks St & PM
- Beenyup Wastewater Treatment Plant
- William Road Main Drain
- Glen Iris Pumping Station No3 – Styx Lane & PM
- Water Treatment Plant – Bridge Street
- Boondi Pumping Station
- Harris Dam
- 410m3 Summit Tank – Murray Road

Typical examples of third line titles

Title line 3 shall clearly identify the specific aspect of the project or design for which the drawing is created. Where an entire drawing is dedicated to one function and the drawing Title Line 3 describes that function, the use of sub-titles within the body of the drawing located below the drawing content is not required.

NOTE: Title Line 3 is mandatory and must contain a title. Where a drawing does not require a project sub-title, the title normally located in Title Line 4 shall be relocated to Title Line 3

Typical examples of Title Line 3 include the following:

- Project sub-title e.g. Operations Building or Intake Tower
- Process area identification e.g. Aeration facilities
- Bore or asset identification e.g. Bore 1/18 or Transfer Pump Station
- Switchboard title e.g. Main Switchboard or 22kV Switchboard

Typical examples of forth line titles

Title line 4 shall clearly and uniquely identify the specific purpose or content of the drawing. . Where an entire drawing is dedicated to one function and the drawing Title Line 4 describes that function, the use of sub-titles within the body of the drawing located below the drawing content is not required.

NOTE: Title Line 4 is not mandatory, the title normally located in Title Line 4 can be relocated to Title Line 3 and Title Line 4 can remain blank.

Typical examples of Title Line 4 include the following:

- Locality Plan
- Electrical Site Layout
- Switchboard Layout
- Material Schedule
- Label Schedule
- Power Diagram
- Control Diagram
- Motor Control Diagram
- Logic Diagram
- Transducer Installation Detail
- Instrumentation - Loop Diagram
- Instrumentation – Connection diagram
- Communication - Connection Diagram

Title Line 4 of drawings having mixed content shall include the major component titles which appear as sub-titles within the drawing. e.g.

- Locality Plan and Electrical Site Layout
- Material and Label Schedules
- Power and motor control Diagrams
- No1 and No2 Motor Control Diagrams

3.4.9 Drawing file numbers

Each project drawing should have the Water Corporation project reference numbers inserted into the drawing title block. There are three reference numbers as follows:

File Number - This is the Water Corporation Capital Investment Program Project number and is entered into the title block location marked ‘PROJECT’ e.g. C-S00964.

Project Number - This is the Water Corporation file number and is entered into the title block location marked ‘FILE’ e.g. JT1 2017 08108 V01

Design Reference - This is the Designers project file number and is entered into the title block location marked ‘DES REF’.

4 Drawing General Requirements

4.1 Presentation

The presentation of drawings is a unique process dependent on individual imagination and skills and as such cannot be predetermined completely. As a general requirement the presentation of all drawings should incorporate the following features.

(a) General ease of appreciation.

(b) Clarity of detail.

(c) Balanced uncluttered appearance.

(d) Provision for possible future extensions or additions.

(e) Component view sizes drawn relative to importance, i.e. important views to be given preference when considering view sizes and available space.

4.2 Standard formats and examples

Corporation standard formats and drafting examples aimed at promoting drawing consistency are included in this Design Standard and are referred to throughout.

Standard formats shall be incorporated unchanged. Standard drafting examples should be used to provide guidelines when considering the preparation of particular presentations. Standard drafting examples shall not be used for reproduction as project working drawings.

4.3 Standard Drafting formats – Schedules

Schedules shown within drawings should be in accordance with the Corporation standard schedule formats as shown on drawing 4-1.

4.4 Drawing Sheet and Titleblock

All electrical and instrumentation drawings shall be prepared on A1 ‘Electrical’ drawing sheets only, as provided by the Water Corporation in accordance with the requirements of Design Standard DS80.

For Water Corporation drafting personnel, the ‘Electrical’ drawing sheet titled ‘WC_A1ELE’ is available within AutoCAD.

For consulting engineers and contractors, drawings sheets are provided as part of the WCX download for AutoCAD.

The ‘Electrical’ drawing sheet contains grid co-ordinates consisting of letters on the vertical axis and numerals on the horizontal axis. These grid co-ordinates are used in association with the Grid Referencing System as described in Section 8.

4.5 Electrical Drawings

With the exception of major installation project drawings, the sequence/arrangement of drawings and sheet numbering for most typical small to medium size projects should be arranged and numbered in the preferred sequence as listed hereunder.

4.5.1 Preferred Sequence of Engineering and Detail Design Drawings

NOTE: The bundle and sheet numbers used in the following examples are typical only.

Engineering Design

Bundle No.	Sheet No.	Title
40	1	ELECTRICAL SITE LAYOUT and/or LOCALITY LAYOUT
40	2	POWER DIAGRAM
40	3	EARTHING DIAGRAM
40	4	PROTECTION GRADING CURVES
40	5	PROTECTION SYSTEMS CONTROL BLOCK DIAGRAM

NOTE: Additional drawings required for specific projects may be added and the numbering system continued.

Detail Design
In the Bundle No range 041-049, 400-499 inclusive

Bundle No.	Sheet No.	Title
41	1	(RESERVED) for additional site and building layouts etc (if required)
41	2	SWITCHBOARD LAYOUT
41	3	MATERIAL SCHEDULE
41	4	LABEL SCHEDULE
41	5	POWER DIAGRAM
41	6	No 1 AND No 2 MOTOR CONTROL DIAGRAMS
41	7	POWER SYSTEM INTERFACE CONNECTION DIAGRAM
41	8	POWER SYSTEM ETHERNET CONNECTION DIAGRAM (if required)
41	9	PROTECTION LOGIC DIAGRAM (if required)

NOTE: Additional drawings required for specific projects may be added and the numbering system continued.

Drawings not required may be omitted. Reassign drawing sheet numbers to suit.

4.6 Control, Instrumentation, Communications and SCADA Drawings

With the exception of major installation project drawings, the sequence/arrangement of drawings and sheet numbering for most typical small to medium size projects should be arranged and numbered in the preferred sequence as listed hereunder.

4.6.1 Preferred Sequence of Concept, Engineering and Detail Design Drawings

NOTE: The bundle and sheet numbers used in the following examples are typical only.

Concept Design

Bundle No.	Sheet No.	Title
55	1	CONCEPT INTERCONNECTION BLOCK DIAGRAM OR CONCEPT SYSTEM ARCHITECTURE DIAGRAM

Engineering Design

Bundle No.	Sheet No.	Title
50	1	CONTROL & INSTRUMENTATION DIAGRAM OR CONTROL INTERCONNECTION BLOCK DIAGRAM
50	2	CONTROL SYSTEM ARCHITECTURE DIAGRAM (If required)

Detail Design

In the Bundle No range 051-053, 055-058 and 059 inclusive.

Bundle No.	Sheet No.	Title
51	1	CONTROL SITE LAYOUT OR INSTRUMENT GENERAL ARRANGEMENT (If required)
51	2	CONTROL CUBICLE LAYOUTS
51	3	MATERIAL SCHEDULE
51	4	LABEL SCHEDULE
51	5	POWER DIAGRAM (includes solar for telemetry)
51	6	COMMON CONTROL DIAGRAMS
59	1	LOOP DIAGRAM – WET WELL LEVEL (LIT***)
59	2	LOOP DIAGRAM – PUMP CURRENT (IT*** AND IT***)
59	3	LOOP DIAGRAM – FLOW (FIT***)
59	4	MODBUS CONNECTION DIAGRAM (FIT***)

NOTE: Additional drawings required for specific projects may be added and the numbering system continued.

Drawings not required may be omitted. Reassign drawing sheet numbers to suit.

5 Drawing Practices

5.1 Drawing Disciplines

Electrical drafting typically encompasses elements of both the mechanical and electrical disciplines. The mechanical aspect of electrical drafting is typically in the form of arrangement drawings, switchboard layout drawings, manufacturing detail drawings and installation drawings.

The electrical aspect of electrical drafting is typically in the form of power distribution diagrams, protection diagrams, control schematic diagrams, interconnection diagrams, termination drawings, material schedules and cable schedules.

Electrical drafting can, in limited circumstances include elements of instrumentation, communications and SCADA details where there is interconnection between power and control devices.

The information in this section applies to the creation of drawings from all these disciplines.

5.2 Computer Aided Drafting

All new drawings shall be produced using the AutoCAD version 2018 computer aided drafting system (or later revision of same).

Conventional 2D drafting remains an acceptable method for the production of electrical drawings.

With the introduction of Computer Aided Drafting, 3D modelling is now possible and may be employed where practical. 3D modelling is not a mandatory requirement for the production of electrical or mechanical drawings.

Typical drawings where 3D modelling may be employed could include applications such as complex building services, intricate busbar assemblies and complex switchboard component arrangements.

The use of 3D drawings may reduce the number of individual detail views and section views required to convey the same information by 2D drafting methods.

5.3 Manual Drafting

Manual drafting methods shall not be used for new drawings or revising existing drawings which were prepared originally by manual drafting methods.

5.4 Conversion of Manual Drawings to AutoCAD Drawings

All existing manual drawings shall be converted to AutoCAD as the need arises to modify the drawings. Two methods can be adopted, subject to an assessment of the existing manual drawing.

Method 1 – Complete redraw in AutoCAD to be adopted if:

- The existing manual drawing requires more than 50% modification or
- The image quality is poor and un-readable requiring extensive re-touching to restore drawing

Method 2 – Partial redraw in AutoCAD utilizing an inserted image to be adopted if:

- The existing manual drawing requires less than 50% modification and
- The image quality is good and easily readable requiring limited or no re-touching to restore drawing

The following sequence of steps further describes Method 2:

- Obtain an image of the original drawing (e.g. TIFF)
- Import Image into raster editor (e.g. Paint)
- Crop/erase drawing sheet and title block off drawing, leaving internal content of drawing
- Clean up remaining image of internal content of the drawing as required (i.e. de-speckle), erase any features which are to be deleted or replaced as part of the revision of the internal content of the drawing
- In a new AutoCAD drawing, insert a new CAD drawing sheet/title block and in-fill the titleblock with the original titles, names and dates from the previous version.
- Update drawing title block to next revision issue.
- Insert cropped image into the new AutoCAD drawing, adjust image scale to suit
- Revise drawing by overlaying image with new CAD linework, text and symbols as appropriate
- Complete checking and signature process
- Check into Drawing Management System as an ‘AutoCAD’ drawing

5.5 Lettering

5.5.1 Lettering on existing Manual Drawings

When revising manual drawings the lettering added as part of revision work to the drawings shall be adjusted to match the height, width and angle of the original lettering.

5.5.2 Lettering on new Drawings

Default text style (Font)
On new drawings the default text style shall be the Water Corporation version of the AutoCAD style "ROMANS". The Water Corporation version has been modified to distinguish between the letter "I" and the number "1".
For Water Corporation drafting personnel the modified AutoCAD text style "ROMANS" is available within AutoCAD.
For consulting engineers and contractors the modified AutoCAD text style "ROMANS" is provided as part of the WCX download for AutoCAD.

Upper/Lower case text
All drawing text shall be upper case lettering except where lower case letters are required to describe standard units of measurement as defined by the International System of Units (SI) or are required to be used on labels containing large amounts of text, to enhance label readability.

Text symbol style
In some circumstances it may be necessary to use text styles other than "ROMANS' to obtain specific features such as mathematical and scientific symbols, or specialized signage and label fonts. The use of text styles or fonts other than "ROMANS', should be carefully considered and applied only where necessary.

Bold text style
Bold text should only be used in limited cases, if bold text is required, AutoCAD text style "ROMAND" shall be used as it creates a double struck character which maintains the shape and characteristics of the "ROMANS" style.

Italic text
The use of Italic text should only be used in limited cases, if italic text is required, it can be achieved by assigning the text an 'obliquing' angle of 15 degrees. The use of Italic text should be limited to highlighting a comment which requires further attention or action by others, for example.

- '*HOLD – ADDITIONAL INFORMATION REQUIRED'*
- '*INSUFFICIENT INFORMATION – INSTALLER TO VERIFY DETAILS ON SITE PRIOR TO CONSTRUCTION'*

5.5.3 Lettering Heights

The minimum height of characters used for all lettering shall be 2.5mm at sheet size A1 in accordance with AS 1100.101-1992 Table 4.1.

Application of lettering heights within the body of drawings shall conform to the following:

(a) 2.5mm lettering – Notes, material schedule text, label schedule text, terminal designations, dimensions, item numbers, plug numbers, pin numbers, wire numbers and scale bars.

(b) 3.0mm lettering – Codes, column and function table headings

(c) 3.5mm lettering – Sub-designations such as subtitles, headings, view and section designations e.g. FRONT VIEW, SECTION A-A.

(d) 5.0mm lettering – Main designations or titles within the body of the drawing e.g. POWER, DIAGRAM, CONTROL DIAGRAM, CUBICLE LAYOUT

5.5.4 Lettering Layers and CAD text types

The drawing default layering system as described in Design standard DS80 section 4 provides layers for lines and text.

AutoCAD provides two different types of text handling applications for users, i.e. Single line text (DTEXT) and Multi Line text (MTEXT). The use of 'MTEXT' is dependent upon the individual AutoCAD user's preference.

Single line text (DTEXT) has been used extensively within the Water Corporation and has been associated with specific layers for electrical drawing purposes since the 1980's. Preference is given to maintaining where practical the use of DTEXT and the associated layers.

Multi Line text (MTEXT) introduced by AutoCAD more recently has similar functionality to a word processor. MTEXT can be used for general text applications, such as notes and tables etc. However, MTEXT does not handle embedded special characters and symbols required for electrical applications well, therefore, preference is given to DTEXT, especially within block attributes.

The following layer and application information shall be applied on electrical drawings:

LAYER	SIZE	TEXT TYPE	APPLICATION
0	0.25	DTEXT	Block attribute – Type, and XREF
2	0.25	DTEXT	Terminal number attribute, Wire numbers
3	0.30	DTEXT	Code attribute, Description attribute
4	0.25	DTEXT	Cross reference attribute
5	0.25	DTEXT	All other attributes
6	0.25	DTEXT	Stand-alone connect node and arrow node7
21	0.25	DTEXT	Notes, material, label and code schedule text.
22	0.30	DTEXT	Column and function table headings
22	0.35	DTEXT	Subtitles, headings, view and section designations
24	0.5	DTEXT	Main designations or titles
25	0.7	DTEXT	Major titles (rarely used)
102	0.25	DTEXT	Item numbers on layouts
105	0.25	DTEXT	Label numbers on layouts
228	0.25	DTEXT	Dimensions
T25	0.25	MTEXT	General applications. E.g. Notes, tables etc
T35	0.35	MTEXT	General applications. E.g. minor headings
T50	0.5	MTEXT	General applications. E.g. major headings

5.5.5 Lettering width factor

Text width should be maintained to a width factor of "1.0' wherever possible, if the available horizontal spacing for text is insufficient, the creation of additional lines of text is preferred.

Reducing text width factor is not preferred and should normally only be used in the following limited applications.

The following exceptions may be applied.

- Label engraving text - this text may be reduced within the range of "0.9" to a minimum of "0.7" to fit within the restricted space limited by the physical size of the label.
- Material schedule description and specification text - this text may be reduced to a width factor of "0.9" in limited circumstances where the creation of additional rows of text is not possible.

The general principle to be applied when reducing text width is that it may be reduced to "0.9" for no more than 10% of the text on any one line of text.

5.5.6 Line Spacing

The preferred minimum spacing between lines of text is as follows:

TEXT HEIGHT	LINE SPACING
2.5 mm	2.0 mm
3.5 mm	2.8 mm
5.0 mm	4.0 mm
7.0 mm	5.6 mm

It is acknowledged that the line spacing of 'MTEXT' in AutoCAD is a pre-defined function based on a word processor and therefore does not meet the values shown in the above table. If 'MTEXT' is used the line spacing of 'MTEXT' is an acceptable alternative to the above table.

5.5.7 Underlining

Underlines shall not be used for the purpose of highlighting main tittles or sub-titles or any other lettering group.

5.5.8 Subscript and Superscript Lettering

Subscript and superscript lettering within the drawing titleblock shall not be used. Examples of acceptable alternate representations:

"sq. mm" or "mm2' to represent square millimetres

"cub. m" or "m3 to represent cubic metres

Subscript and superscript lettering within the body of the drawing is acceptable, but should be avoided wherever practical.

The acceptable presentation is to lower or raise the full size character e.g. I_n, mm^2.

Where subscript or superscript characters are required, the use of reduced height characters shall not be used. E.g. I_n , mm^2

5.5.9 Fractions

The use of reduced height characters for fractions shall not be used. E.g. ½, ¼,

The use of full height characters shall be maintained. E.g. 1/2, 1/4, 3/4.

5.5.10 Abbreviations

As a general requirement Australian Standard abbreviations should be used in every instance. Abbreviations other than internationally recognized abbreviations defined for mathematical, scientific or engineering purposes should not be used.

The following preferred abbreviations shall be used:
"&" for the word 'and'
"No" for the word "number'
"3.3 Ω" to represent a 3.3 ohm resistor
"AL" to represent the symbol for aluminium (Al)
"L' to represent the symbol for litres (l)
(Due to the reduced readability of the lower case letter 'l' within the AutoCAD text font the upper case 'L' shall be substituted as shown above)

The following abbreviations shall NOT be used:
"c/w" or "c/-" meaning 'complete with'
"#" meaning the word number
"ditto" or - -"- - indicating that the word(s) or figure(s) above it are to be repeated.
"3R3" to represent a 3.3 ohm resistor

5.6 Scale

5.6.1 Type and Designation

Bar type metric scales shall be used as indication of scale throughout. Scales shall be designated millimetres or metres as applicable.

5.6.2 Scale Ratio Presentation

Scale ratios shall be shown immediately below the bar scale including the drawing sheet size at which the ratio applies, e.g. 1:10 AT SHEET SIZE A1.

5.6.3 Preferred Scales

Preferred scales for reduction include:

$1:2x10^n$, $1:2.5x10^n$, $1:5x10^n$, $1:10x10^n$, millimetres or metres as applicable.

Preferred scales for full size and larger drawings include:

1:1, 2:1, 5:1, 10:1 millimetres.

5.6.4 Multiple Scales

Where multiple scales are used on one drawing sheet each bar scale shall be shown. All bar scales should be grouped and located preferably at the bottom of the sheet.

Each scale and corresponding drawing part shall be identified by a circled number positioned below the scale and drawing part sub-title respectively.

5.6.5 Choice of Standard Scale Ratios

The choice of scale ratios shall be considered with regard to availability of space and clarity of detail required in line with the recommended scales for engineering drawing practice as described in AS 1100.101- 1992

As a general requirement the choice of scale ratios shall result in the provision of balanced easy to read drawings.

5.6.6 Choice of Non-standard Scale Ratios

The choice of non-standard scale ratios is not preferred, and should only be used in exceptional and limited circumstances provided that:

No suitable scale ratio as recommended in AS 1100.101- 1992 Section 5.4 can be used.

A bar type scale is included on each drawing

The non-standard scale ratio is clearly stated

The application of a non-standard scale should only be considered in situations where the use of a standard scale ratio either, makes the image too large and it will not fit into a standard drawing sheet or too small where the image is reduced to a size which does not allow sufficient ease of readability or the addition of detail.

5.6.7 Not to Scale

When a detail or view within a drawing is not drawn to a scale, the note 'NOT TO SCALE' shall be provided immediately below the title of the detail.

The use of the letters (N.T.S) shall not be used.

For label schedule specific requirements refer Section 15.4.

For dimensioning specific requirements refer Section 15.9.6.

5.6.8 Scale Ratio Check Dimension

At least one overall dimension shall be shown on every view in order to provide a means of checking against the bar scale shown.

5.7 Projections

5.7.1 Preferred Type of Projection

The preferred method of projection used for all drawings should be Orthogonal Projection.

Other methods of projection such as Isometric should only be used in a restricted capacity to clarify drawing views and assemblies.

5.7.2 Orthogonal Projection Method

The 3rd angle method of orthogonal projection shall be used.

Full sectional views when located on the same drawing with the main views should preferably be drawn using the 3rd angle method. Part sectional views may be located to suit available space.

5.7.3 Designation of Views

All views using the 3rd angle method of orthogonal projection shall be designated in accordance with AS 1100.101- 1992 Section 6.1, Figure 6.1

5.7.4 Designation of Views

Cutting planes shall be indicated by lines drawn through an object and terminated at each end using arrowheads. Letters shall be placed adjacent to the tail of the arrows to identify each cutting plane.

The resulting section view shall have the title “SECTION A-A” or similar located beneath the view to identify its association with the specific cutting plane. For an example refer AS1100.101-1992 Section 7.

For electrical switchboard layouts the title “SECTIONAL FRONT VIEW” may be used without the associated cutting plane being identified on any other view.

The use of the sectional front view is restricted to electrical switchboard applications only and is intended to show the internal components within the enclosure.

5.8 Scale

5.8.1 Lines and CAD Layers

The drawing default layering system as described in DS80 section 4 provides layers for specific linetypes. Electrical drawings utilize a combination of general layers and specific electrical layers for presenting specific line features.

5.8.2 Lines for General Applications

Lines for general drafting applications, such a mechanical manufacturing assemblies and details shall be selected in accordance with AS 1100.101-1992 (R2014) Table 3.1 and as shown on drawing 5-1.

5.8.3 Lines for Electrical Power, Control and Protection logic applications

Lines for electrical power, control and protection logic applications shall be selected from

Water Corporation linetypes as shown on drawing 5-1.

5.8.4 Lines for Electrical Site Layout Applications

Lines for electrical site layouts and building layout applications shall be selected from Water Corporation linetypes as shown on drawing CAD_LAYERS 4.2 in Design Standard DS80 section 4 and from Water Corporation modified linetypes as shown on drawing 5-2.

5.8.5 Lines for Control and Instrumentation Applications

Lines for control and instrumentation applications shall be selected from Water Corporation linetypes as shown on drawing 5-3.

5.8.6 Lines for P&I Diagram Applications

Lines for Process and Instrumentation Diagram applications shall be selected from Water Corporation linetypes as shown on drawing 5-3.

5.9 Dimensions

5.9.1 Metric Units

All drawings shall be dimensioned using metric units.

The choice of metric units should be restricted normally to metres and millimetres.

5.9.2 Decimal Places

The number of decimal places associated with drawings dimensioned in metres shall not be greater than one decimal place.

The number of decimal places associated with drawings dimensioned in millimetres shall be:

(a) Whole units – for large items of plant, cubicles, metalwork bends etc.

(b) One decimal place – for panel drillings, cut-outs etc.

(c) Two decimal places – for machining.

5.10 General Notes

5.10.1 Basic Requirements

General notes shall be limited to information which is considered necessary for a complete understanding of a drawing, or set of drawings, and which for practical reasons cannot be included within the body of the drawing.

Reference to other drawings, material specifications and manufacturing details etc should not normally be included in general notes.

General notes shall convey the intended information briefly and to the point.

The use of punctuation marks such as full stops at the end of each general note is not required. Punctuation marks should only be used to facilitate the better understanding of the information contained in the note. Excessive use of punctuation marks is not recommended.

Space constraint shall be an important consideration when compiling all general notes.

5.10.2 General Notes in Common Usage

The following general notes shall be used where appropriate and should be adopted for inclusion in project drawings. They should remain unchanged with the exception that the data represented by "*" should be replaced with the current values.

(a) REVISED AS CONSTRUCTED AT ISSUE *

(b) REVISED AS CONSTRUCTED AT ISSUE * WITH INFORMATION RECEIVED FROM **********, DATED **/**/2022

(c) REVISED AS COMMISSIONED AT ISSUE *

(d) REVISED AS COMMISSIONED AT ISSUE * WITH INFORMATION RECEIVED FROM **********, DATED **/**/2022

(e) CONSTRUCTED AS DRAWN AT ISSUE *

(f) CONSTRUCTED AS DRAWN AT ISSUE "*" WITH INFORMATION RECEIVED FROM **********, DATED **/**/2022

(g) COMMISSIONED AS DRAWN AT ISSUE *

(h) COMMISSIONED AS DRAWN AT ISSUE * WITH INFORMATION RECEIVED FROM **********, DATED **/**/2022

(i) DRAWN AS CONSTRUCTED

(j) DRAWN AS CONSTRUCTED WITH INFORMATION RECEIVED FROM **********, DATED **/**/2022

(k) DRAWN AS COMMISSIONED

(l) UNLESS OTHERWISE SHOWN ALL DIMENSIONS ARE IN MILLIMETRES

(m) UNLESS OTHERWISE SHOWN ALL DIMENSIONS ARE IN METRES

5.10.3 Order of Listing

The order of listing of general notes shall be descending with note 1 occupying the upper position.

5.10.4 Preferred Location

General notes should be located preferably below the main body of the drawing at the bottom left-hand side of the drawing sheet. If insufficient space exists below the main body of the drawing to allow one group of general notes, the general notes may be split into two or more groups located across the bottom of the drawing.

Where the main body of the drawing consumes most of the available space within the drawing, the general notes may be relocated to any practical location within the drawing.

5.10.5 General notes on drawings consisting of multiple parts

Where necessary for general notes to be added on drawings consisting of multiple parts, each drawing part shall have its own set of general notes. The order of listing of general notes on each part drawing shall be descending with note 1 occupying the upper position.

5.11 Revisions

5.11.1 Revision Note Wording

The wording of revision notes shall be compiled to record in brief form the amendments carried out.

Revision notes shall include specific information relevant to particular changes, e.g. item 6 rating was 10 ampere, rather than Item 6 rating revised.

Where As-constructed changes are too numerous to record, revision notes shall call up the areas revised in general terms, e.g. switchboard layout and material schedule revised or wire numbers and terminal numbers revised, etc.

For As-constructed revisions, the words “AS CONSTRUCTED” or “AS BUILT’ shall not be used in the drawing revision column of the drawing sheet title block. Instead, this information shall be conveyed within the general notes and a reference to the general notes be made within the revision column, e.g. General note text: ‘4. REVISED AS CONSTRUCTED AT ISSUE B’

Revision column text: ‘ITEM 6 RATING WAS 10A, NOTE 4 ADDED’

In circumstances necessitating redrawing an existing manual drawing, it shall be treated as a formal revision and the drawing revision block shall read “REDRAWN IN CAD”. If, additional changes are made to the redrawn drawing the changes shall be fully described in the drawing revision block.

The revision note sequential lettering system shall remain unbroken.

5.11.2 Revision Identification Symbols

A revision identification symbol in the form of an issue letter or number within a triangle 

shall **NOT** be used within electrical drawings. No symbol shall be located adjacent to any area of a drawing for the purpose of identifying features that have been revised. No other symbol shall be used or is required.

All revision information to a drawing shall be identified as described in 5.11.1 and located within the revision section provided as an integral part of the drawing title block.

5.11.3 The Use of Clouds

Clouds within electrical drawings have a specific use and their use is primarily reserved to highlight proposed changes only. Clouds should not normally be used for any other purpose.

5.11.4 The Use of Clouds as 'Hold Points'

The use of clouds within electrical drawings to identify 'Hold Points' are rarely required. The presentation of 'reverse clouds' containing the word '**Hold**' with descriptive text to highlight outstanding information shall not be used for this purpose.

5.11.5 Highlighting Proposed Changes Using Clouds

Where drawings are revised to show new proposed upgrades, or where drawings are revised in detail to provide clear guidance and instruction for the manufacture and installation of field modifications the proposed changes shall be highlighted on the body of the drawing.

The proposed changes shall be highlighted by a cloud around the proposed change areas, a note may be added in the general notes to explain the use of the clouds if necessary and the drawing revision block shall describe the areas of proposed change.

When the proposed changes have been completed in the field, the drawing shall be revised with the 'As Constructed' details and the clouds removed from the drawing.

If the proposed changes affect the entire drawing the entire drawing shall not be encircled by a cloud, instead, the drawing revision shall describe that the entire drawing has been revised.

To aid fast recognition of proposed changes, the shape of the clouds should take an irregular form made up of irregular arcs of differing size. Clouds in the form of a rectangular box made up of arcs of the same size should not be created.

Cloud features shall be presented as detailed in the example shown on drawing 5-5.

5.11.6 Removal of Existing Detail from Drawings with Proposed Changes

It is preferable that the existing information affected by proposed changes are not deleted from drawings when new proposed upgrade revisions are undertaken. The reasons are:

1. When a drawing is revised it becomes the current version in the Drawing management System and the previous version becomes superseded, if the proposed changes are delayed or abandoned completely, the current version does not reflect the true status of the site.
2. When the proposed modifications are undertaken in the field, the installer can more easily compare and identify the existing details on site with the proposed changes.

If it is not possible to maintain the existing details on the drawing and show the proposed changes, consideration should be given to supplying a copy of the previous issue of the drawing together with the revised drawing showing the proposed changes highlighted by clouded areas for comparison purposes.

5.11.7 Cancellation of Drawings

Cancellation of drawings shall be in accordance with the requirements of Design Standard DS80.

When it is necessary to cancel a drawing and a reference to a replacement drawing is not required, the drawing shall be revised similar to any normal revision and the statement 'DRAWING CANCELLED' shall be placed in the revision description section of the revision block. In addition the statement 'DRAWING CANCELLED" is to be placed diagonally across the body of the drawing.

When it is necessary to cancel a drawing and a reference to a replacement drawing is required, the drawing shall be revised similar to any normal revision and the statement 'DRAWING CANCELLED – REFER TO DRAWING ZZ99-99-99' shall be placed in the revision description section of the revision block. In addition the statement 'DRAWING CANCELLED – REFER TO DRAWING ZZ99-99-99"shall be placed diagonally across the body of the drawing.

If the drawings to be cancelled were originally created by manual drafting techniques, no CAD version will exist. The process for cancellation remains the same, except that the method of revising the drawing will change. Either of the following methods is acceptable.

Method 1

- Obtain an image of the original drawing (e.g. TIFF)
- Import Image into raster editor (e.g. Paint)
- Crop/erase drawing sheet and title block off drawing, leaving internal content of drawing
- Clean up image as required, e.g. de-speckle and erase non-essential marks
- In a new AutoCAD drawing, insert a new CAD drawing sheet/title block
- Insert cropped image into a new AutoCAD drawing, adjust image scale to suit
- Copy and manually transfer content of drawing titles, signatures, dates, general notes, etc from original drawing into new CAD drawing title block
- Insert 'DRAWING CANCELLED' details as described above
- Complete checking and signature process
- Check into Drawing Management System as an 'AutoCAD' drawing

Method 2

- Obtain an image of the original drawing (e.g. TIFF)
- Import Image into raster editor (e.g. Paint)
- Clean up image as required, e.g. de-speckle and erase or crop non-essential marks lying outside drawing sheet border
- Insert image into a new AutoCAD drawing, adjust scale to match original drawing size
- Overlay image with new stand-alone 'DRAWING CANCELLED' text to replicate requirements as described above
- Complete checking and signature process
- Check into Drawing Management System as a 'Manual' drawing

5.11.8 Authority to Cancel Drawings

Upon completion of a project the as-constructed version of the drawings become the responsibility of the branch or region that control and maintain the asset that the drawings represent. At the end of an assets life the drawings are required to be cancelled. Three paths for cancelling the drawings are possible.

1. Where an asset is decommissioned by the region, the cancellation of drawings can be authorized by the branch or region that control and maintain the asset.
2. Where a project identifies that an asset has been decommissioned or is obsolete and a drawing/s needs to be cancelled, arrangements shall be made with the Project Manager for the cancellation of the relevant drawings.
3. Where a project identifies that an asset/s are planned to be removed or made obsolete by the project and an existing drawing/s will need to be cancelled, a 'Recommendation to cancel drawings' shall be made to the Project Manager. Drawings shall not be cancelled until after the decommissioning works have been completed.

Drawings cannot be cancelled without permission from either the relevant branch or region or the Project Manager. If permission cannot be obtained the drawing/s shall not be cancelled.

5.11.9 Recommendation to Cancel Drawings

If during the design of a project it is identified that existing drawings will become obsolete after the new project upgrade has been completed, the drawings shall not be cancelled immediately as the cancelled version of a drawing becomes the current version in the Drawing Management System and the previous version becomes superseded, if the proposed upgrade or changes are delayed or abandoned completely, the current version in the Drawing Management System does not reflect the current status of the site.

As a substitute for cancelling the drawing/s too early in the process, a copy of the current version of the drawing/s should be produced with the words "CANCELLATION RECOMMENDED" placed diagonally across each drawing in bold lettering.

The 'cancellation recommended' copy should then accompany the rest of the project drawings through to the As-constructed stage of the project where it is endorsed as As-constructed and returned with the rest of the As-constructed marked-up drawings for completion. The drawing can then be cancelled.

5.12 As-Constructed Drawings

The Corporation relies on the quality of the information and data contained within the electrical drawings to accurately represent the current state of electrical assets for the reliability and safe operation of those assets.

Electrical drawings within the Corporation are used continuously over the entire life of an asset and are required to be maintained up to date at each stage of an electrical assets life.

Typically each stage of an electrical assets life represented by the drawings includes but is not limited to the following:

1. Conceptual Design
2. Detail Design
3. Manufacture
4. Installation
5. Commissioning
6. Maintenance
7. Upgrades
8. Decommissioning

To be able to maintain the current status of electrical drawings, As-constructed field data shall be collected and recorded from the point of manufacture until decommissioning.

It is essential that all electrical As-constructed data is accurately collected and accurately recorded on the drawings to ensure safety for operators, the general public and electrical trade personnel.

Typically, As-constructed field data is recorded by electrical trade personnel in the form of marked up copies of existing drawings and or free-hand sketches.

In addition to the marked-up drawings and sketches, it is highly recommended that an extensive range of digital camera images be created and provided to the drafter together with the marked-up drawings and sketches of all electrical assets that have been modified.

Digital images provide the drafter with much needed detail necessary to ensure an accurate record is captured on the drawings. The images allow the drafter to cross-check information on the marked-up drawings and sketches and can often fill-in information not fully recorded on the marked-up drawings and sketches.

Please note, digital images on their own without field marked-up drawings and sketches do not provide sufficient detail to accurately record As-constructed data.

It is essential that **all** electrical modifications to an electrical asset be As-constructed, including site layouts, building layouts, electrical switchboard & panel layouts, material schedules and label schedules drawings.

5.13 Checking and Review of As-Constructed Drawings

As-constructed revisions to drawings shall be subjected to the same levels of checking and review as the original drawings.

6 Symbols

6.1 General Requirements

Unless specified otherwise in this design standard, symbols shall be in accordance with the relevant standards as specified in Section 2.

The presentation requirement of symbols used within the AutoCAD drawing environment is that the symbols be in accordance with the standards specified in Section 2. i.e. style, shape, features, proportionality, scale etc.

With the exception of Instrument Symbols where a CAD library is provided by the Water Corporation, the Water Corporation does not provide electrical CAD block libraries to consulting engineers and contractors.

6.2 Creation of New Symbols

If a suitable symbol cannot be identified within the relevant standards and a new symbol is required to be created, the new symbol shall be based on existing similar symbols, symbol elements and qualifying symbols in accordance with the relevant standards as specified in Section 2.

6.3 Special Symbols and Preferred Presentation

The Corporation has developed special symbols for use on power and control diagrams where:

- No symbols exist within Australian and international standards as specified in Section 2. Or
- One preferred presentation of a symbol has been selected from available standards.

The symbols and preferred presentation shown on drawings 6-1, 6-2 and 6-3 shall be used in preference to any other symbols or methods of presentation for similar items of equipment.

The style of presentation of these symbols can be adopted to present any electrical or electronic device of a similar nature where no specific symbols are provided within the relevant standards as specified in Section 2.

6.4 Proportions and Sizes of Symbols

Proportions and sizes of all symbols shall be such as to preserve the features which render the symbols unique. Proportions and sizes of all symbols shall be consistent throughout a drawing or a set of drawings.

6.5 Superseded Symbols

The use of superseded symbols shall be limited to revision work, and then only where it is necessary to match existing superseded symbols.

6.6 Electrical Power and Control Symbols

6.6.1 Preferred presentation

The symbols and preferred presentation shown on drawings 6-4, 6-5 and 6-6 shall be used for all electrical power and control symbols in preference to any other symbols or methods of presentation for similar items of equipment.

For consulting engineers and contractors, the Water Corporation does not provide a CAD block library of electrical symbols.

6.6.2 Correct presentation of electrical contacts

The correct presentation of electrical symbols representing electrical device contacts, such as relays, timers and contactors etc. is dependent upon the condition of electrical activation representing the entire control schematic diagram. i.e. whether the schematic diagram is drawn in an energized or de-energized condition. A contact can be represented as normally open (NO) or normally closed (NC) and can change state upon activation of the circuit. The standard convention adopted by the Water Corporation is that all power and control diagrams are drawn in the de-energized condition.

Each control diagram shall have a general note stating the condition of electrical activation represented by the schematic diagram. E.g. ‘DRAWN NO POWER CONDITION’. Additional information such as ‘NO ALARMS, NO FLOW and DOORS CLOSED CONDITION’ may be added as required.

An example of a motor control diagram representing the correct symbology and note is shown on drawing 18-1.

6.7 Logic Symbols

The symbols and preferred presentation shown on drawings 6-7, 6-8 and 6-9 shall be used for all binary or analogue logic symbols in preference to any other symbols or methods of presentation for similar items of equipment.

For consulting engineers and contractors, the Water Corporation does not provide a CAD block library of logic symbols.

6.8 Instrument Symbols

Generally, all symbols for P &I Diagrams shall be in accordance with the requirements set out in Design Standard DS81 – Process Engineering.

To compliment Design Standard DS81 a CAD library of P&ID symbols is provided by the Water Corporation and shall be used as is, without modification.

For Water Corporation drafting personnel this library is available within AutoCAD.

For consulting engineers and contractors this library is provided as part of the WCX download for AutoCAD.

6.9 Use of Grid and Snap Settings for Symbol Placement

Generally, all CAD schematic symbols displayed on Water Corporation drawings shall be placed to maintain consistent and equal spacing both horizontally and vertically such that readability and a balanced uncluttered appearance is produced.

The drafter shall establish a suitable grid spacing for the application (Typically 10 x10 or 12 x12) and set the CAD ‘Grid’ setting to ‘on’ to assist in the symbol placement and alignment.

The drafter shall establish a suitable snap spacing for the application (Typically 1x1) and set the CAD ‘Snap’ setting to ‘on’ to ensure each symbol is inserted at a snap point matching the grid.

7 Codes, Acronyms and Abbreviations

7.1 Definitions

Throughout electrical drawings codes, acronyms and abbreviations are used extensively to convey information in the shortest method possible. Many acronyms and abbreviations are in common use in the electrical industry.

7.1.1 Codes

Codes used within Water Corporation electrical drawings have a specific definition.

Codes are an abbreviation formed from an assembly of letters and/or numbers assigned to succinctly describe the name and/or function of a device within an electrical design.

Codes are typically formed from the initial letters of the words forming the description assigned to a device by the designer.

7.1.2 Acronyms

In a similar manner to codes acronyms are an abbreviation formed from the initial letters of words except that the acronym is pronounced as a word.

7.1.3 Abbreviations

An abbreviation is defined as ‘a shortened form of a word or phrase’.

7.2 General requirements

Codes shall be assigned to identify all electrical power and control symbols used on power and control diagrams.

Tag and loop numbers as described in ANSI/ISA 5.1 – 2022 - Instrumentation Symbols and Identification are NOT codes as described in this design standard. Tag and loop numbers shall not be substituted for codes.

Within electrical drawings an electrical device or instrument shall be identified by a code.

In limited applications, if it is necessary to identify an instrument on an electrical drawing the instrumentation tag and loop number may be included on the electrical drawings as secondary information only and located adjacent to the code.

The instrumentation tag and loop number shall not form part of the code.

7.3 Code Structure

Codes shall consist of a single letter or a combination of letters and numbers NOT exceeding four characters in total.

Although permissible, the use of numbers in codes should be restricted to extremely limited applications, such as to identify two or more devices having exactly the same purpose, such as, where two relays have been wired in parallel to increase the number of available contacts. E.g. Auxiliary relay 1 and Auxiliary relay 2 would have the codes AxR1 and AxR2, not 1.AxR and 2.AxR.

7.4 Code Prefixes and Suffixes

The power and control diagrams utilize codes to uniquely identify each device within the design.

Most project designs call for one or more processes and each process may have two or more sets of equipment to provide back-up security. For example, equipment providing Duty/Standby or Duty/Standby/assist functions. To uniquely identify each set of equipment, a unit number is assigned to each set, e.g. No1 unit, No2 unit, No3 unit etc.

The number of sets of equipment associated with each process results in the power and control drawings containing multiples of exactly the same devices, where each device is represented by exactly the same symbol and code.

Every device represented by a symbol and code on the power and control diagrams shall be uniquely identifiable, therefore, the unit number for each set of equipment shall be used as a prefix to the code.

E.g. 1.LC = No1 unit Line Contactor, 2.LC = No2 unit Line Contactor etc.

Suffixes to codes shall not be used.

7.5 Interpretation of Codes

All codes shall be interpreted fully by means of a separate legend (i.e. Code Schedule) included as part of the relevant circuit diagrams or assembly drawings, and/or by inclusion in the ‘code’ and ‘description’ columns in material schedules on associated drawings.

7.5.1 Acronyms and Abbreviations

Although acronyms and abbreviations in common use are not codes as described by this standard. It is often beneficial for the complete understanding of the design drawings that the acronyms and abbreviations be interpreted fully by means of a description. Where necessary, preference is given to acronyms and abbreviations being fully interpreted in a separate legend to the Code Schedule. If this is not practical acronyms and abbreviations may be included in code schedules, in limited applications.

Exception: Terminal symbols display the letter ‘T’ above or adjacent the symbol. The letter T is typically combined with a sequence of numbers or letters to give it a unique identification e.g. T1, T2, T3 etc or TA, TB, TC, TE. Etc. The letter ‘T’ only signifies that the symbol is to be interpreted as a terminal.

The letter ‘T’ itself is not required to be interpreted within a code schedule.

The number or letter prefix or the number or letter suffix associated with the letter ‘T’, is not considered to be a code and therefore not required to be interpreted within a code schedule.

7.6 Codes on Labels

With the exception of the requirements of AS/NZS 3000:2018 Amd 2:2021 Clauses 2.10.5.1 to 2.10.5.6 inclusive the following practice may be applied.

Due to the limitations of space in areas of switchboards accessible **only** to qualified electrical trades personnel, codes may be substituted for fully worded descriptions on labels to allow the labels to be reduced in size.

Only codes assigned to symbols and interpreted fully by means of a separate legend (i.e. Code Schedule) included on the relevant circuit diagram or assembly drawing shall be used on labels.

Codes on labels shall not be used in areas of a switchboard accessible to operators and other non-electrical trade personnel.

7.7 Creation of Project Specific Codes

With the exception of reserved codes, the project designer may create a code/s to identify devices presented on power and control diagrams within a set of project drawings. These project specific codes shall be in accordance with clauses 7.2, 7.3 and 7.4.

Codes presented and described on Corporation Standard Drawings shall be maintained and not replaced for project specific codes.

7.8 Typical Codes In Common Use

A list of codes and descriptions in common use has been included in appendix A.

This list includes:

- Codes used in current standards and current project drawings
- Codes used in previous standards included within existing project drawings
- Codes with reserved meanings

It is preferred that the codes and their meanings listed in appendix A, be maintained on new and existing project drawings, wherever possible.

With the exception of reserved codes, codes in common use may be assigned other meanings on project drawings only and the codes with modified meanings shall be interpreted fully by means of a legend (i.e. Code Schedule).

7.9 Reserved Codes

Specific codes have been reserved and SHALL NOT be assigned to any other meanings. Reserved codes are displayed in bold italics within the list of codes located in appendix A.

8 Grid Reference System

8.1 General

The grid reference system shall be used for referencing associated pieces of information between power diagrams, control diagrams, Instrumentation - Loop Diagrams, Instrumentation – Connection diagrams and Communication - Connection Diagrams only. The grid reference system shall not be used to reference between logic diagrams and power diagrams or between logic diagrams and control diagrams.

The referencing of information other than for electrical power and control schematic applications is not preferred. Features such as General notes, or information within Material schedules, Label schedules or Cable schedules shall not be referenced using the grid reference system. Where the grid reference system is adopted a reference explanation shall appear on all drawing sheets where the grid referencing system is employed.

The grid reference system for the referencing of power and control diagrams pertaining to new installations shall be as follows:

For drawings of power and control diagrams pertaining to existing installations, the grid reference system used on the existing drawings shall be used for any new drawings. Horizontal spaces shall be lettered, and vertical spaces numbered. Grid lines shall not be visible on finished drawings. Location of wiring and equipment may either be on the grid lines, or within spaces bounded by horizontal and vertical coordinating lines.

8.2 Cross Reference Location

The cross-reference locations of all associated contacts should appear adjacent to operating coils.

The cross-reference location of the relevant operating coils should be referenced directly under the code located above each contact.

The cross-reference locations of all separated switch contacts should be referenced at each separated switch contact or contact group.

A basic grid reference system, with examples showing the intended method of operation, and a typical reference explanation is shown on drawing 8-1.

9 Wiring Numbering Assignment

9.1 Wire Numbers for New Switchboards

For the purpose of developing new wire numbering systems to be used on drawings for manufacturing new switchboards, the following guidelines based on the type of switchboard construction shall be applied.

Type of Switchboard Construction

Switchboards are either, located outdoors where they are exposed to the natural environment or internally in a building where the environment is not affected by external conditions, as such different types of switchboard construction are employed.

Outdoor Switchboards

Typically, outdoor switchboards are a composite of one or more cubicles where each cubicle consists of two internal zones located behind secured doors. These zones are created by internal panels. The zone that occupies the front of a cubicle and located behind the front door is reserved for access by operations personnel and the zone that occupies the rear of a cubicle and located behind the rear door is restricted to access by qualified electrical personnel only.

Outdoor switchboards may be located indoors

Indoor Switchboards

Typically, indoor switchboards consist of two zones similar to outdoor switchboards except indoor switchboards usually have only one internal panel mounted in the rear of the switchboard. The first zone is the front of the switchboard doors or removable module covers. The second zone is the internal panel. Equipment mounted on the front door allows direct access to operations personnel, the interior of the switchboard is restricted to access by qualified electrical personnel only.

Indoor switchboards shall not be located outdoors.

Wire Numbering system for an Outdoor Switchboard.

Where an outdoor switchboard consisting of individual cubicles having both front and rear doors with internal panels is employed, each panel shall be considered independent of all the other panels in the switchboard and identified on the switchboard drawings with a unique panel name and identification letter. e.g. “Main Switch Panel - Panel A”.

Every control wire (Excluding interconnection wires) situated on a panel shall be identified with a unique number on a permanent wire number marker.

The wire number sequence shall begin with one (1) and be consecutively numbered.

Wire Numbering system for an Indoor Switchboard.

Where an indoor switchboard consisting of front doors (or removable covers) only and having only one internal panel behind each door is used, the panel and its associated door shall be considered as one compartment. Each compartment shall be considered independent of all the other compartments and identified on the switchboard drawings with a unique cubicle (compartment) name and identification letter. e.g. “Main Switch Cubicle - Cubicle A”.

Every control wire (Excluding interconnection wires) situated in a compartment shall be identified with a unique number on a permanent wire number marker.

The wire number sequence shall begin with one (1) and be consecutively numbered.

Interconnection wires between panels or between compartments do not require wire numbers.

9.2 Wire Number System for New Switchboards

For new switchboards the following wire number system shall be employed to differentiate wire numbers with different purposes.

The following wire number system shall be used within a switchboard in conjunction with cable colour coding as defined in Design Standard DS26-09 section 8.1.

- AC power distribution and AC control applications

  AC power wire number sequence shall be consecutively numbered (1-99).

  AC neutral wire number sequence shall be consecutively numbered (N1-N99).

- AC filtered power distribution applications

  AC filtered power wire number sequence shall be consecutively numbered (F1-F 99).

  AC filtered neutral wire number sequence shall be consecutively numbered (FN1-FN99).

- DC control applications

  DC power wire number sequence shall be consecutively numbered (D1-D99).

  DC neutral wire number sequence shall be consecutively numbered (D1-D99).

- DC distribution from DC Fuse (DCF) applications.

  DC power wire number sequence from DCF shall be consecutively numbered (DC1-DC99).

  DC negative wire number sequence from DCF shall be consecutively numbered (DN1-DN99).

9.3 Wire Numbers for Existing Switchboards

For the purpose of adding new equipment to an existing switchboard, the wire numbering systems already in use should be maintained and extended where practical. The existing drawings should be investigated to establish the wire numbering system in use and identify the last wire numbers assigned.

If the last assigned wire numbers cannot be established from the existing drawings or from site investigations, then the existing wire numbering system should be maintained and extended by providing a sizeable gap in the wire numbering system before allocating new wire numbers.

Where significant modifications to an existing switchboard require the addition of new panels, or new cubicles, then the existing drawings un-effected by the additions shall maintain the existing wire numbering system. However, the new additions may employ a new wire numbering system. This new wire numbering system shall be fully defined on the design drawings.

10 Engineering Design Drawings

10.1 Definition

Engineering design drawings are defined as those drawings which show all the major design decisions taken in respect to a particular project.

There are two types of Engineering design drawings:

- Primary Design Drawings – for small projects
- Design Summary Drawings – for major projects

10.2 Maintaining Engineering Design Drawings

Both Primary Design Drawings and Design Summary drawings shall be maintained and updated for the entire life of an asset by formal revision of the drawings. All previous revisions of Primary Design Drawings and Design Summary Drawings shall be kept as a record of design decisions.

10.3 Checking and review

Revisions to Primary Design Drawings and Design Summary Drawings shall be subjected to the same levels of checking and review as the original drawings.

10.4 Equipment Specifications on Design Summary Drawings

Design Summary drawings display symbols representing project specific features and equipment selected. The equipment selected is to be uniquely identified and associated with the product specifications and design settings.

For small designs the equipment shall be identified by locating a circle containing an item number adjacent the symbol. An equivalent circle containing an item number with the written specification located adjacent the circle can be located on the same drawing where space permits.

For large designs distributed over a series of drawings, the equipment shall be identified as for small designs. The written specifications shall not be located on each drawing part, instead the first drawing part shall display all the manufacturer's specifications and design settings for the entire design.

10.5 Primary Design Drawing Examples

Examples of various types of Primary Design Drawings are as follows:

An example of an Electrical Site Layout is shown on drawings MN01-31-1 and MN01-32-1.

An example of a Power Diagram is shown on drawings MN01-31-2 and MN01-32-2.

An example of an Earthing Diagram is shown on drawings MN01-31-3 and MN01-32-3.

An example of Protection Grading Curves is shown on drawings MN01-31-4 and MN01-32-4.

10.6 Design Summary Drawing Examples

Examples of various types of Design Summary Drawings are as follows:

Note: not all the examples shown may be required for every project application

An example of a typical Power Diagram is shown on drawing 10-1.

An example of a typical Equipment schedule is shown on drawing 10-2.

An example of a typical Overcurrent protection grading curve drawing is shown on drawing 10-3.

An example of a typical Earth Fault protection grading curve drawing is shown on drawing 10-4.

An example of a typical Major earthing connections diagram is shown on drawing 10-5.

An example of a typical Electrical safety interlocking facilities diagram is shown on drawing 10-6.

An example of a typical Protection systems control block diagram is shown on drawing 10-7.

11 Locality Plans and Electrical Site Layouts

11.1 Use of Civil Site Plans and Featured Detail

Civil site plans shall provide a basis for the preparation of electrical site layouts. For convenience and consistent accurate site detail an AutoCAD copy of a civil site plan should be obtained.

In accordance with Design Standard DS80 section 8 the Locality Plans and Electrical Site layout drawings shall be drawn using the Co-ordinate System – Map Grid of Australia (MGA94).

The amount of civil detail included on electrical site layouts shall be limited to that necessary for the ready location and appreciation of the electrical installations.

Civil features and detail shall not appear prominent to the detriment of electrical detail clarity, i.e. those dimensions, level markings, contour lines etc which are not relevant to the electrical work should not be included or alternately be made not visible. Manipulation of AutoCAD layer settings to turn off unwanted layers containing unwanted features is recommended. If unwanted features cannot be turned off, then their line thicknesses shall be reduced such that they display with less prominence.

11.2 Conduits and Cables

Electrical conduits and cables whether installed above or below ground level shall be shown as relatively thick full lines except that, lines may be broken at intervals for the insertion of identifying codes and symbols indicating whether the conduit or cable is installed underground, on the surface, or overhead.

The location of conduits and cables will not normally require dimensioning from other objects.

An example of a typical electrical site layout is shown on drawing MN01-31-1.

11.3 Preferred Orientation

The preferred orientation of all Locality Plans and electrical site Layouts is with the north aspect to the top of the drawing sheet.

A North sign shall be included on all electrical site plans irrespective of the orientation.

Where locality plans and electrical site layouts are aligned parallel on the same drawing sheet, a single North sign located in the drawing sheet title block in the assigned position will be acceptable.

11.4 Preferred Location of Locality Plans and Electrical Site Layouts

The Electrical Site Layout is required to be created as part of the Primary Design process for each project and is assigned as the first drawing in the 40 bundle planset numbering. The electrical site Layout drawing is the preferred location for the Locality plan, where the Locality plan is shown with its own sub-title within the body of the combined drawing.

The title of this drawing shall be “LOCALITY PLAN AND ELECTRICAL SITE LAYOUT”

If a locality plan cannot be incorporated with the electrical Site layout on one drawing, then a separate drawing shall be created for the locality plan. The drawing containing only the locality plan is to be considered as an extension of the drawing containing the electrical site layout drawing.

The title structure of the drawings shall be “LOCALITY PLAN AND ELECTRICAL SITE LAYOUT – PART 1”and “LOCALITY PLAN AND ELECTRICAL SITE LAYOUT – PART 2”.

An example of a typical electrical site layout is shown on drawing MN01-32-1.1 and 1.2

11.5 Instrument General Arrangement

For very large projects only, it may be necessary to identify the location and identity of instruments, instrument stands and instrumentation cubicles on an Instrument general arrangement drawing.

Where an Instrument general arrangement drawing is considered necessary, a bubble symbol containing the instrument tag number and a leader line pointing at its mounting position shall be used. The bubble may be placed adjacent to the item to be identified so long as clarity is maintained.

12 Switchboard Layouts

12.1 Layout Presentation Forms

Switchboards are made in different sizes and have differing levels of functionality and complexity in construction. As such, two forms of switchboard layout presentation have been adopted.

Form 1: Large outdoor or indoor switchboards comprising multiple or single panels (or modules) within joined multiple cubicle enclosures (or tiers).

Form 2: Small outdoor or indoor switchboards having a single panel located within a single enclosure (with or without rear door access). Small switchboards include off the shelf commercial distribution boards.

12.2 Large Switchboard Layouts (Form 1)

Layout for an Outdoor Switchboard.

Layouts of large outdoor switchboards (typically comprising one or more cubicles) shall comprise front and rear views drawn to identify all features mounted on the exterior of the switchboard including features such as lifting eye bolts (if required), labels, signs, power outlets, power inlets and mounting bases etc.

AND

Front and rear view (Doors Removed) drawn to expose all internally mounted equipment in full. Such as individual panels, electrical equipment, labels, equipment mounting rails, cable ducts and door limit switches etc.

Layout for an Indoor Switchboard.

Large indoor switchboard layouts shall comprise a front view drawn to identify all features mounted on the exterior of the switchboard including features such as lifting eye bolts, labels, signs, door mounted switching and control devices, mounting bases etc.

AND

A front view (Doors Removed) drawn to expose all internally mounted equipment in full. Such as individual panels and modules, electrical equipment, labels, equipment mounting rails, cable ducts etc.

It is preferable that all the switchboard layouts be drawn on one drawing sheet. However, due to the large size of some switchboards, the switchboard layouts can be located on separate drawing sheet parts.

Preference is given to allocating the switchboard front and rear external layouts on the first drawing sheet or sheet part and the switchboard front and rear internal views directly following on the next sheet part or parts.

An example of a Switchboard layout - Form 1 is shown on drawings 12-1.1 and 12-1.2.

12.3 Small Switchboard Layouts (Form 2)

Layout for an Outdoor Switchboard.

Small outdoor switchboard layouts shall comprise front and rear views drawn to identify all features mounted on the exterior of the switchboard including features such as labels, signs, power outlets and power inlets, pole or wall mounting brackets etc.

AND

A front view only with hidden detail representing equipment mounted on the rear of the internal panel.

OR.

A front and rear view drawn to expose all internally mounted equipment in full. Such as individual panels, electrical equipment, labels, equipment mounting rails, cable ducts, door limit switches etc.

Layout for an Indoor Switchboard.

Small indoor switchboard (Typically wall mounted) layouts shall comprise a front view drawn to identify all features mounted on the exterior of the switchboard including features such as labels, signs, door mounted switching and control devices, wall mounting brackets etc.

AND

A front view (Door removed) with hidden detail representing equipment mounted on the internal panel. Such as electrical equipment, labels, equipment mounting rails, cable ducts, door limit switches etc.

An example of a Switchboard layout - Form 2 is shown on drawing 12-2.

12.4 Switchboard Layouts and Sectional views

Switchboard side views and sections taken through the switchboard are not required for project switchboards and shall not normally be included in project drawings.

Exception: Use of sections on project drawings is permitted in limited circumstances where switchboards may require detailed instructions for special fabrication and manufacturing purposes or where equipment is mounted on a side wall panel and is not identifiable from any other drawing view.

12.5 Combined Switchboard Layouts, Material, and label Schedules

For most projects, the switchboard layouts, material schedules and label schedules will normally be located on separate drawing sheets due to their large size.

For projects which have small switchboard layouts, the material schedule and label schedule may appear with the switchboard layout on the same drawing sheet, where space permits.

An example of a Switchboard layout combined with a material and label schedule is shown on drawings 12-2.

12.6 Identification of Equipment

Each item of equipment shall be identified by an item number (2.5mm high at sheet size A1), located where practicable, within the equipment's profile and preferably at the lower right-hand side.

In circumstances where equipment profiles are too small to include an identifying number, then the number shall be located outside the profile adjacent to the lower right side. Where insufficient space is available to position numbers in the preferred location external to profiles, the nearest alternative location within the cubicle boundary shall be used, in conjunction with a leader.

Identical items of equipment may be allocated the same number, except where it is necessary to distinguish between them.

Where individual panels are identified with a letter, the word PANEL with identifying letter should appear alongside the panels, preferably within the cubicle profile.

The cubicles of multi-cubicle switchboards shall be identified with the name and purpose of each cubicle, shown above the cubicles.

12.7 Item Numbers – Order of Listing

The order of listing of item numbers shall be from top of sheet to bottom, with lower numbers occupying upper positions.

Generally, switchboards consist of one or more enclosures (cubicles or tiers) with one or more assembled panels (compartments). The order of listing of item numbers associated with the enclosure/s shall be assigned to the beginning of the material schedule, with item numbers associated with each panel following.

The item numbers associated to the enclosures or additional equipment forming the assembled switchboard shall be identified by unique item numbers on the material schedule. The item numbering shall begin with the number 1 (one) without any prefix or suffix. (For most projects item numbers in the range 1-99 is usually sufficient).

Where switchboards are assembled using panels having different functions and which are considered independent of all the other panels in the switchboard and identified by a unique panel identification letter. e.g., “Panel A”. The item numbers on the material schedule shall uniquely identify the equipment associated with each panel. E.g., A1, A2 etc for items associated with equipment on panel A and B1, B2 etc for items associated with equipment on panel B etc.

In large switchboards where an entire cubicle has only one panel or function, such as, an incoming cubicle consisting of only a Service on Device (SPD) and supply authority metering devices. The item numbers on the material schedule shall uniquely identify the items associated with equipment within the entire cubicle, e.g. A1, A2 etc.

12.8 Metalwork Detail

If metalwork fabrication detail is required to undertake switchboard construction, it shall be shown on drawings separate from equipment layout drawings.

13 Control Cubicle Layouts

13.1 Layout Presentation Forms

Control cubicles are made in different sizes and have differing levels of functionality and complexity in construction. As such, two forms of control cubicle layout presentation have been adopted.

Form 1: Large outdoor or indoor control cubicles comprising multiple or single panels (or modules) within joined multiple cubicle enclosures (or tiers).

Form 2: Small outdoor or indoor control cubicles having a single panel located within a single enclosure (with or without rear door access). Small control cubicles include off the shelf commercial enclosures.

13.2 Large Control Cubicle Layouts (Form 1)

Layouts for Outdoor Control Cubicles.

Layouts of large outdoor control cubicles (typically comprising one or more cubicles) shall comprise front and rear views drawn to identify all features mounted on the exterior of the control cubicle including features such as lifting eye bolts, labels, signs and mounting bases etc.

AND

Front and- rear view (Doors Removed) drawn to expose all internally mounted equipment in full. Such as individual panels, control, instrumentation and communication equipment, labels, equipment mounting rails, cable ducts and door limit switches etc.

Layout for Indoor Control Cubicles.

Large indoor control cubicle layouts shall comprise a front view drawn to identify all features mounted on the exterior of the control cubicle including features such as lifting eye-bolts, labels, signs, door mounted control devices, mounting bases etc.

AND

A front view (Doors Removed) drawn to expose all internally mounted equipment in full. Such as individual panels and modules, control, instrumentation and communication equipment, labels, equipment mounting rails, cable ducts etc.

It is preferable that all the control cubicle layouts be drawn on one drawing sheet. However, due to the large size of some control cubicles, the control cubicle layouts can be located on separate drawing sheet parts.

Preference is given to allocating the control cubicle front and rear external layouts on the first drawing sheet or sheet part and the control cubicle front and rear internal views directly following on the next sheet part or parts.

An example of a control cubicle layout - Form 1 is shown on drawings 13-1.1 and 13-1.2.

13.3 Small Control Cubicle Layouts (Form 2)

Layout for an Outdoor Control Cubicle.

Small outdoor control cubicle layouts shall comprise front and rear views drawn to identify all features mounted on the exterior of the control cubicle including features such as labels, signs, pole, or wall mounting brackets etc.

AND

A front view only with hidden detail representing equipment mounted on the rear of the internal panel.

OR.

A front and rear view drawn to expose all internally mounted equipment in full. Such as individual panels, control, instrumentation and communication equipment, labels, equipment mounting rails, cable ducts, door limit switches etc.

Layout for an Indoor Control Cubicle.

Small indoor control cubicle (Typically wall mounted) layouts shall comprise a front view drawn to identify all features mounted on the exterior of the control cubicle including features such as labels, signs, door mounted control, instrumentation and communication equipment, wall mounting brackets etc.

AND

A front view (Door removed) with hidden detail representing equipment mounted on the internal panel. Such as control, instrumentation and communication equipment, labels, equipment mounting rails, cable ducts, door limit switches etc.

13.4 Control cubicle Layouts and Sectional views

Control cubicle side views and sections taken through the cubicle are not required for control cubicles and shall not normally be included in project drawings.

Exception: Use of sections on project drawings is permitted in limited circumstances where control cubicles may require detailed instructions for special fabrication and manufacturing purposes or where equipment is mounted on a side wall panel and is not identifiable from any other drawing view.

13.5 Combined Control Cubicle Layouts, Material, and label Schedules

For the majority of projects, the control cubicle layouts, material schedules and label schedules will normally be located on separate drawing sheets due to their large size.

For projects which have small control cubicle layouts, the material schedule and label schedule may appear with the control cubicle layout on the same drawing sheet, where space permits.

13.6 Identification of Equipment

Each item of equipment shall be identified by an item number (2.5mm high at sheet size A1), located where practicable, within the equipment's profile and preferably at the lower right-hand side.

In circumstances where equipment profiles are too small to include an identifying number, then the number shall be located outside the profile adjacent to the lower right side. Where insufficient space is available to position numbers in the preferred location external to profiles, the nearest alternative location within the cubicle boundary shall be used, in conjunction with a leader.

Identical items of equipment may be allocated the same number, except where it is necessary to distinguish between them.

Where individual panels are identified with a letter, the word PANEL with identifying letter should appear alongside the panels, preferably within the cubicle profile.

The cubicles of multi-cubicle control cubicles shall be identified with the name and purpose of each cubicle, shown above the cubicles.

13.7 Item Numbers – Order of Listing

The order of listing of item numbers shall be from top of sheet to bottom, with lower numbers occupying upper positions.

Generally, control cubicles consist of one or more enclosures (cubicles or tiers) with one or more assembled panels (compartments). The order of listing of item numbers associated with the enclosure/s shall be assigned to the beginning of the material schedule, with item numbers associated with each panel following.

The item numbers associated to the enclosures or additional equipment forming the assembled control cubicle shall be identified by unique item numbers on the material schedule. The item numbering shall begin with the number 1 (one) without any prefix or suffix. (For most projects item numbers in the range 1-99 is usually sufficient).

Where control cubicles are assembled using panels having different functions and which are considered independent of all the other panels in the control cubicle and identified by a unique panel identification letter. e.g., “Panel A”. The item numbers on the material schedule may uniquely identify the equipment associated with each panel. E.g., A1, A2 etc for items associated with equipment on panel A and B1, B2 etc for items associated with equipment on panel B etc.

In large control cubicles where an entire cubicle has only one panel or function. The item numbers on the material schedule shall uniquely identify the items associated with equipment within the entire cubicle.

13.8 Metalwork Detail

If metalwork fabrication detail is required to undertake control cubicle construction, it shall be shown on drawings separate from equipment layout drawings.

14 Material Schedules

14.1 Dimensions and Format

The dimensions and format of material schedules shall be as shown on drawing 4-1.

Overall dimensions of material schedules shall remain unaltered.

The format may be amended to exclude code and/or label columns as necessary with a corresponding increase in description column width.

14.2 Arrangement

Material schedules shall be arranged in a maximum of three vertical columns per A1 drawing sheet. The standard preferred arrangement and location for material schedules is that the first column occupies the right-hand side of the drawing sheet and be arranged so that the top and right-side border lines are common to the material schedule and drawing sheet and that the third column occupies the left-hand side of the drawing sheet and be arranged so that the top and left side border lines are common to the material schedule and drawing sheet.

Exception: For large projects only, where the entire A1 drawing/s is dedicated to the purpose of displaying the material schedule only, and where the material schedule is distributed over two or more drawing sheet parts, the material schedule arrangements as described above may be reversed.

This exception to the standard arrangement should only be applied in limited situations and only where large quantities of materials are required, otherwise, the standard arrangement method shall be applied.

14.3 Item Numbers – Order of Listing

The order of listing of item number shall be from top of sheet to bottom, with lower numbers occupying upper positions, irrespective of the number of columns.

Where switchboards are assembled using panels having different functions and which are considered independent of all the other panels in the switchboard and identified by a unique panel identification letter. e.g. “Panel A”. The item numbers on the material schedule shall uniquely identify the equipment associated with each panel, e.g. A1, A2 etc for equipment on panel A and B1, B2 etc for equipment on panel B etc.

In large switchboards where an entire cubicle has only one panel or function, such as, an incoming cubicle consisting of only a Service Protective Device (SPD) and supply authority metering devices. Then the item numbers on the material schedule shall uniquely identify the equipment associated with the entire cubicle, e.g. A1, A2 etc.

14.4 Guidelines for Compiling

The compiling of material schedules shall be along the following guidelines.

Descriptions shall be limited to the name and function of equipment.

Specifications shall include the manufacturer’s name, catalogue number and all pertinent information sufficient for the correct identification and supply of the equipment, by non-technical store persons.

Manufacturer’s voltage ratings shall be stated irrespective of the intended supply voltage.

All associated parts and/or accessories having separate identifying catalogue numbers shall be listed below the parent item, within one common item number.

A typical material schedule is shown on drawing 14-1.

14.5 Renumbering New Project Drawing Material Schedule Items

Where new project material schedules are compiled from information provided in standard switchboard design drawings, the equipment and item numbers shall not be re-numbered and shall remain the same as shown on the standard switchboard design drawing/s. Within the standard switchboard designs, optional equipment is provided, which may be selected or omitted as necessary, to suit project needs. Where standard equipment is omitted from the project, the remaining item numbers shown on the project drawings shall maintain the item numbers of the standard switchboard design and not be re-numbered to remove holes in the item numbering system.

Where optional equipment item numbers have been omitted from a project material schedule compiled from standard switchboard design components, new or additional equipment shall not be re-assigned to the omitted item numbers. Instead, new or additional equipment may be assigned new item numbers following on from the last standard item number used.

14.6 Renumbering Existing project Drawings Material Schedule Items

Where existing project material schedules are revised for As constructed or upgrade purposes, equipment and associated item numbers may become obsolete and removed from the material schedule. Where any equipment is deleted from the project material schedule, the remaining item numbers shown on the existing project drawings shall maintain their current item numbers and not be re-numbered to remove holes in the item numbering system. Deleted item numbers shall be fully described in the drawing revision block.

Where equipment and item numbers are deleted from the project material schedule, new or additional equipment may be re-assigned to the deleted item number/s and the item number/s be re-used. This method is acceptable where limited space in the drawing does not allow for the creation of additional item numbers and the extension of the material schedule.

Alternately, where space in the drawing does allow for the creation of additional item numbers and the extension of the material schedule, new or additional equipment may be assigned new item numbers following on from the last item number used on the project.

14.7 Identification of Omitted or Deleted Item Numbers

Where item numbers have been omitted from new project material schedules or deleted from existing material schedules, there is no requirement to leave a space between remaining items in the material schedule. However, if considered necessary, unused item numbers may be displayed in the 'ITEM' number column with a corresponding entry in the 'DESCRIPTION' column of the material schedule. E.g.

ITEM	CODE	LABEL	DESCRIPTION	SPECIFICATION	QTY
22	AB	8, 9, 10	ACTIIVE BAR	NETEC, AN165-13-R	1
23-27			NOT USED		
28	MS	11	MAIN SWITCH	K+N, C32	1

14.8 Substitution of Standard Descriptions

Where new project material schedules are compiled from information provided in standard switchboard design drawings, the equipment descriptions shall be used as-is and not re-worded or substituted for other description/s. Substitution of Standard Specifications

Where new project material schedules are compiled from information provided in standard switchboard design drawings, the equipment specifications shall be used as-is and not re-worded or substituted for other products.

Exception: If material specifications are required to be altered to suit project specific requirements, equipment shall not be varied, without reference to the switchboard manufacturer and/or written dispensation sort from the Senior Principal Engineer, Electrical Standards, Engineering.

14.9 Substitution of Standard Quantities

Where new project material schedules are compiled from information provided in standard switchboard design drawings, and equipment has been uniquely identified, the equipment item quantities shall not be altered or re-placed with other values or wording. e.g., Where similar items, having unique item numbers are displayed on the standard switchboard design drawings, the items shall remain un-changed and not rationalized into one item and their combined quantity value altered or substituted for the wording “AS REQ’D”.

14.10 Separation lines between Grouped Items

Where project material schedules are compiled from equipment grouped together on individual panels or in separate cubicles in accordance with Section 12.7, there is no requirement to leave space in the material schedule between the grouped items and/or insert special text inside the material schedule as a heading between grouped items. e.g. PANEL B followed by the panel B items etc.

However, a thickened horizontal dividing line may be used in the material schedule, between groups of items, such as between Panel A and Panel B etc to assist in the ease of reading the project material schedule.

15 Material Schedules

15.1 Dimensions and Format

The dimensions and format of label schedules shall be as shown on drawings 4-1.

Overall dimensions of label schedules shall remain unaltered.

15.1.1 Standard Label and Signs

Where new project label schedules are compiled from information provided in standard switchboard design drawings, the labels and signs shall be used as-is and not re-worded or substituted for other products.

Exception: If standard labels and signs make provision for adjustable text indicated by asterisks (*) and are required to be altered to suit project specific requirements, the text may be varied to suit, without the need for dispensation.

15.2 Arrangement

Label schedules shall be arranged in a maximum of three vertical columns per A1 drawing sheet.

The first column shall occupy the left-hand side of the drawing sheet and be arranged so that the top and left side border lines are common to the label schedule and drawing sheet.

The third column shall occupy the right-hand side of the drawing sheet and be arranged so that the top and right-side border lines are common to the label schedule and drawing sheet.

15.3 Project Labels

15.3.1 New Projects

New project labels shall be detailed fully on a label schedule with regard to profile dimensions and lettering heights.

The presentation of text within engineering drawings to comply with AS 1100 - Technical Drawing, which specifies standard text heights of 2.5, 3.5, 5.0, 7.0 and 10mm. Label text should be displayed within label schedules utilizing these text heights, regardless of the height of text being specified for engraving or etching by the label manufacturer.

The following label text sizes commonly in use and engraved/etched on labels, shall be displayed on the label drawing/s using the following text heights:

2.5mm high label text shall be presented on the drawing as 2.5mm high text.

3mm high label text shall be presented on the drawing as 3.5mm high text.

6mm high label text shall be presented on the drawing as 5mm high text.

12mm high label text shall be presented on the drawing as 7mm high text.

20mm high label text shall be presented on the drawing as 10mm high text.

Exception: Large tabular or graphic labels created by a printing process/es may utilize special linework, shading, fonts and text sizes. Where these labels are displayed within label schedules, text sizes and fonts should be adopted, to present a representation of the label as close as possible to the original.

The text font required by the Water Corporation for engraving/etching text on most labels is ‘ARIAL’, the standard font for engineering drawings used by the Water Corporation is ‘ROMANS’. The width of these fonts differ and need to be taken into account when determining label lengths.

The overall dimensions of new labels if not provided by the designer shall be determined as follows:

A close approximate label length suitable for manufacturing purposes can be determined by the designer by adding up the number of text characters required and multiplying by a known factor (shown below) then adding 5 to 10mm if space permits.

Letter Size	Multiplication Factor
2.5 mm	1
3 mm	2.65
6 mm	5.3
12 mm	10.65
20 mm	17.6 mm

e.g. label required "MAIN SWITCH".

Number of characters (including space between words) = 11.

Letter size required = 6mm high text

Multiplication factor = 5.3

$\therefore$ 11 x 5.3 = 58.3mm

As text length is 58.3mm, a label length of 70mm would be suitable if space permits. If space does not permit, the characters can be reduced in width slightly during manufacture.

The arrangement of text shown on the drawing shall be in the format required on the finished label.

Where vertical lines are required to separate text within a label, the location of such lines shall be dimensioned back to a common origin, with a running dimension. Dimensioning is not required to position text.

15.3.2 As Constructed Drawings

As constructed project labels should be detailed on a label schedule.

The overall dimensions of As Constructed labels are not always known and therefore cannot be drawn to correct profile. Label text information should be included in a label schedule even though dimensions are unknown.

15.4 Label Drawing Scales

Labels appearing in label schedules shall be drawn full size at sheet size A1 wherever possible.

Label schedule drawings shall include a bar scale indicating that the drawing is at a scale of 1:1 at sheet size A1.

Where large labels cannot be drawn full size on the label schedule, they shall be drawn as large as possible within the label schedule columns and the correct dimension sizes shall appear in the 'wide' and 'high' columns. The dimension text shall be underlined to represent that the label shown is not to scale.

Labels appearing on layouts shall be drawn to the same scale as the layout drawing.

15.5 Identification of Labels

15.5.1 Project Drawings

Each label shall be identified by a unique number.

Label numbers shall appear in the label schedule and in the material schedule.

Label numbers shall be displayed in the column titled ‘LABEL’ provided in the material schedule.

Where several separate items of equipment are identified with a common label then, in such instances, the label number shall appear in the material schedule against each individual item of equipment.

In circumstances where labels are not readily identified on layouts, a leader may be taken from the label to a location outside the view main profile and the word “LABEL” with applicable number shown.

Exception: In limited applications where available space does not readily allow a label to be identified with the word ‘LABEL’ the label number may be prefixed with the letter “L”

The label number shall be included in the material schedule.

15.6 Label Schedules

All labels shall be listed and specified in label schedules except that, for a single label, the schedule may be omitted. The arrangement of label schedule columns shall be as shown on drawing 15 -1.

Label schedules may be incorporated as part of other drawing's or arranged as separate drawings.

The choice of arrangement, either on a separate label schedule drawing or incorporated as part of another drawing will be determined by the magnitude of the quantity of labels required to be displayed.

A typical label schedule arranged on separate drawing part sheets is shown on drawings15-1.1, 15-1.2.

15.7 Label Numbers – Order of Listing

The order of listing of label numbers shall be from top of sheet to bottom, with lower numbers occupying upper positions, irrespective of the number of columns. Where switchboards are assembled using panels having different functions and which are considered independent of all the other panels in the switchboard and identified by a unique panel identification letter. e.g., “Panel A”. The label numbers on the label schedule shall uniquely identify the equipment associated with each panel. E.g., A1, A2 etc for labels associated with equipment on panel A and B1, B2 etc for labels associated with equipment on panel B etc.

In large switchboards where an entire cubicle has only one panel or function, such as, an incoming cubicle consisting of only a Service Protection Device (SPD) and supply authority metering devices. Then the label numbers on the label schedule shall uniquely identify the labels associated with equipment associated with the entire cubicle, e.g. A1, A2 etc.

15.8 General Requirements

General requirements applicable to all power diagrams include the following.

(a) Diagrams shall be drawn for the power off, i.e. main switch open condition.

(b) Diagrams shall be drawn with normal power flow left to right and top to bottom.

(c) Items of equipment shall be grouped and enclosed within panel and/or switchboard perimeter lines as shown on drawings 16-1 and 16-2.

(d) Ratings of fuses shall be shown alongside the fuse symbols and shall include the rating of the fitting shown above a horizontal line, with the cartridge link rating below.

(e) The actual current ratios in use shall be shown adjacent to current transformer symbols irrespective of alternative tapping's available, or the number of primary turns applicable.

(f) Items of equipment associated with control circuits, e.g., fuses, isolators, etc, if included on power diagrams shall not be repeated on control diagrams.

(g) All codes shall be interpreted fully by means of a separate Code Schedule included on each power diagram or power diagram sheet part.

(h) All moulded-case circuit breaker protection settings shall NOT be displayed or on each power diagram or power diagram sheet part. Circuit breaker protection settings shall be displayed only in one location within the project primary design Protection Grading Curves drawing or the design summary Protection Grading Curves drawing.

The maximum nominal current rating only of the circuit breaker shall be displayed adjacent each circuit breaker symbol on the power diagram or power diagram sheet part.

The note '(SEE PROTECTION SETTINGS, REFER ****-40-**)' referencing the protection settings shall be located adjacent the circuit breaker symbol.

(i) All miniature Circuit breakers having non-adjustable settings, shall be displayed adjacent each circuit breaker symbol on the power diagram or power diagram sheet part.

(ii) The wording 'Single Line Power Diagram' or similar, shall NOT be used in drawing titles. Drawings shall be titled 'Power Diagram' only.

15.9 Codes

Codes shall be assigned to identify all electrical power symbols used on power diagrams.

All codes shall be interpreted fully by means of a separate Code Schedule included on each power diagram or power diagram sheet part.

15.10 Cable, wire, and Conductor Identification

Power diagrams shall have all cables, wires and conductors identified by symbols, descriptions, notes and cable numbers as appropriate for each project application.

For small projects, cables and conductors identified by symbols combined with cable specifications is sufficient identification. For general small wiring not specifically identified on the drawing, the minimum wiring sizes can be described in the general notes.

For medium size and large projects, cables identified by symbols combined with a cable numbering system fully detailed in a cable schedule shall be used. For general small wiring not specifically identified on the drawing, the minimum wiring sizes can be described in the general notes.

16 Power Diagrams

16.1 General Requirements

General requirements applicable to all power diagrams include the following.

(a) Diagrams shall be drawn for the power off, i.e. main switch open condition.

(b) Diagrams shall be drawn with normal power flow left to right and top to bottom.

(c) Items of equipment shall be grouped and enclosed within panel and/or switchboard perimeter lines as shown on drawings 16-1 and 16-2.

(d) Ratings of fuses shall be shown alongside the fuse symbols and shall include the rating of the fitting shown above a horizontal line, with the cartridge link rating below.

(e) The actual current ratios in use shall be shown adjacent to current transformer symbols irrespective of alternative tapping's available, or the number of primary turns applicable.

(f) Items of equipment associated with control circuits, e.g., fuses, isolators, etc, if included on power diagrams shall not be repeated on control diagrams.

(g) All codes shall be interpreted fully by means of a separate Code Schedule included on each power diagram or power diagram sheet part.

(h) All moulded-case circuit breaker protection settings shall NOT be displayed or on each power diagram or power diagram sheet part. Circuit breaker protection settings shall be displayed only in one location within the project primary design Protection Grading Curves drawing or the design summary Protection Grading Curves drawing.

The maximum nominal current rating only of the circuit breaker shall be displayed adjacent each circuit breaker symbol on the power diagram or power diagram sheet part.

The note '(SEE PROTECTION SETTINGS, REFER ****-40-**)' referencing the protection settings shall be located adjacent the circuit breaker symbol.

(iii) All miniature Circuit breakers having non-adjustable settings, shall be displayed adjacent each circuit breaker symbol on the power diagram or power diagram sheet part.

(iv) The wording 'Single Line Power Diagram' or similar, shall NOT be used in drawing titles. Drawings shall be titled 'Power Diagram' only.

16.2 Codes

Codes shall be assigned to identify all electrical power symbols used on power diagrams.

All codes shall be interpreted fully by means of a separate Code Schedule included on each power diagram or power diagram sheet part.

16.3 Cable, wire, and Conductor Identification

Power diagrams shall have all cables, wires and conductors identified by symbols, descriptions, notes and cable numbers as appropriate for each project application.

For small projects, cables and conductors identified by symbols combined with cable specifications is sufficient identification. For general small wiring not specifically identified on the drawing, the minimum wiring sizes can be described in the general notes.

For medium size and large projects, cables identified by symbols combined with a cable numbering system fully detailed in a cable schedule shall be used. For general small wiring not specifically identified on the drawing, the minimum wiring sizes can be described in the general notes.

16.4 Conductor and Cable Symbols

16.4.1 Conductor Symbol

The symbols used to identify conductors and cables shall be as per Australian and IEC 60617 Standards.

The symbol for a conductor shall be as per AS/NZS 1102-103:1997 (Withdrawn) item 03-01-01.

The qualifying symbol to identify the number of conductors shall be FORM 2 as per AS/NZS 1102-103:1997 (Withdrawn) item 03-01-03.

16.4.2 Cable Symbol

The symbol for conductors in a cable shall be as per AS/NZS 1102-103:1997 (Withdrawn) item 03-01-09. **This symbol shall only be used to represent a multi-core cable**. It shall not be used to identify single core cables, single cable cores, busbars, wires, or other types of conductors.

The symbol for conductors in a cable as per AS/NZS 1102-103:1997 (Withdrawn) item 03-01-10 is non-preferred and should not be used.

16.5 Methods of Presenting Conductors and Cables on Power Diagrams

There are two basic methods preferred for presenting conductor or cable information on power diagrams.

Method 1

A single conductor or single cable core shall be shown as a single continuous line. A leader line with an arrowhead pointing to (touching) the conductor may be added. The leader line will be followed by the conductor specification or a single core cable number. The qualifying symbol to identify the number of conductors may be added if required.

Method 2

A multi-core cable shall be shown as a continuous line or parallel continuous lines representing each conductor. The continuous line/s shall have a cable symbol (elongated circle as per AS/NZS 1102-103:1997 (Withdrawn) item 03-01-09) applied to the conductor/s. This cable symbol may be combined with a leader line with an arrowhead pointing to (touching) the cable symbol. The leader line will be followed by a cable specification or a multi-core cable number. The qualifying symbol to identify the number of conductors may be added if required.

16.6 Conductor and Cable Requirements for Different Types of Power Diagrams

The following provides specific guidance for presenting conductor and cable information on single-line representation and multiline representation power diagrams.

16.6.1 Single-line Representation for Single Conductors

- A single conductor or single cable core shall be shown as a single continuous line representing only ACTIVE OR LIVE conductors.
- Earth conductors shall not be shown on single line representation power diagrams.
- A leader line with an arrowhead pointing to (touching) the conductor may be added.
- The leader line will be followed by the conductor specification or a single core cable number.

- The qualifying symbol to identify the number of conductors may be added if required. It shall comprise an oblique stroke followed by the figure for the number of ACTIVE OR LIVE conductors ONLY. e.g. 1 or 1(R) or 1(W) or 1 (B).

16.6.2 Single-line Representation for Multiple Conductors

- Multiple conductors or multiple single cable cores shall be shown as a single continuous line representing only ACTIVE OR LIVE conductors.
- Earth conductors shall not be shown on single line representation power diagrams.
- A leader line with an arrowhead pointing to (touching) the conductor may be added.
- The leader line will be followed by the conductor specifications or multiple single core cable numbers.
- The qualifying symbol to identify the number of conductors may be added if required. It shall comprise an oblique stroke followed by the figure for the number of ACTIVE OR LIVE conductors ONLY, e.g. 2 or 3 or 1+N or 3+N or R or W or B or R+N or W+N or B+N.

16.6.3 Single-line Representation for Multi-core Cables

- A Multi-core cable shall be shown as a single continuous line representing only ACTIVE OR LIVE conductors.
- Earth conductors shall not be shown on single line representation power diagrams.
- The continuous line shall have a cable symbol applied to the conductor.
- The cable symbol may be combined with a leader line with an arrowhead pointing to (touching) the cable symbol.
- The leader line will be followed by the multi-core cable specification or multi-core cable number.
- The qualifying symbol to identify the number of conductors within the cable may be added if required. It shall comprise an oblique stroke followed by the figure for the number of ACTIVE OR LIVE conductors ONLY. e.g. 2 or 3 or 6 or 1+N or 3+N

16.6.4 Single-line Representation for Multi-core Cables

- A single conductor or single cable core shall be shown as one or more continuous lines representing an ACTIVE OR LIVE OR EARTH conductor.
- A leader line with an arrowhead pointing to (touching) each conductor may be added.
- The leader line will be followed by the conductor specifications or multiple single core cable numbers.
- The qualifying symbol to identify the number of conductors may be added if required. It shall comprise an oblique stroke followed by the figure for the number of ACTIVE OR LIVE OR EARTH conductors. e.g. 1 or N or E or R or W or B.

16.6.5 Multi-line Representation for Multiple Conductors

- Multiple conductors or multiple single cable cores shall be shown as one or more continuous lines representing the ACTIVE OR LIVE OR EARTH conductors.
- A leader line with an arrowhead pointing to (touching) each conductor may be added.
- The leader line will be followed by the conductor specifications or multiple single core cable numbers.
- The qualifying symbol to identify the number of conductors may be added if required. It shall comprise an oblique stroke followed by the figure for the number of ACTIVE OR LIVE OR EARTH conductors. e.g. 1 or N or E or R or W or B.

16.6.6 Multi-line Representation for Multi-core Cables

- Multi-core cables shall be shown as one or more continuous lines representing the ACTIVE OR LIVE OR EARTH conductors.
- The continuous lines shall have a cable symbol applied to the conductors.
- The cable symbol may be elongated to cover all the conductors within the multi-core cable, if required.
- The cable symbol may be combined with a leader line with an arrowhead pointing to (touching) the cable symbol.
- The leader line will be followed by the multi-core cable specification or multi-core cable number.
- The qualifying symbol to identify the number of conductors within the multi-core cable may be added if required. It shall comprise an oblique stroke followed by the figure for the number of ACTIVE OR LIVE OR EARTH conductors. e.g. 2 or 3 or 1+N or 3+N+E or R+N+E or W+N+E or B+N+E.

16.6.7 Combined Multi-line / Single-line Representation for Multi-core Cables

Where multi-line and single line representations are combined on the same drawing the single and multiple conductors shall be presented as described above, with the exception that the multi-core cable conductors shown in the single-line representation shall include EARTH conductors.

The qualifying symbol to identify the number of conductors within the multi-core cable may be added if required. It shall comprise an oblique stroke followed by the figure for the number of ACTIVE OR LIVE OR EARTH conductors. e.g. R+N or W+N or B+N or R+N+E or W+N+E or B+N+E or 3 or 3+E or 3+N+E.

16.6.8 Multi-line Representation for Multiple Bushbars

Single or multiple busbars shall be shown as continuous thick parallel lines representing each conductor.
Busbars shall only be identified by a leader line with an arrowhead pointing to (touching) each busbar followed by text describing the busbar specification.
An example of a Power diagram showing multiple busbars is shown on drawing 16-4.

16.7 Cable Specification Format for Power Diagrams

Where cables are identified with a leader line and arrowhead pointing to (touching) the cable symbol or conductor followed by text describing the cable specification. The preferred format for presenting the conductor or cable specification shall consist of the following elements presented in the following order.

1st element: Number of cables

2nd element: Number of cable cores

3rd element: Conductor cross-sectional area

4th element: Identification of ancillary conductors with a reduced cross-sectional area

5th element: Conductor material

6th element: Conductor insulation material

7th element: Bedding insulation material

8th element: Armour material

9th element: Sheath (jacket) insulation material

10th element: Voltage rating of the cable

The assembled cable specification shall be presented in a left to right sequence, from the 1st element through to the 10th element, i.e. 1st element 2nd element 3rd element ---------- 10th element.

(NOTE: Not all cables require all 10 elements. Elements may be omitted if not required)

The elements of the following cable specification example are fully described below:

1 x 3 core 25mm2 + E Cu PVC XLPE PVC 0.6/1kV

Each element need only be separated by a space, the use of other characters such as a full stop (.), comma (,), forward slash (/) etc is not required.

16.7.1 Number of Cables

The number of individual cables required for each circuit.

For example, if there is only one cable whether single or multi-core, then the number would be ‘1’.

If each phase (RWB) is an individual single core cable, then the number would be ‘3’.

EXCEPTION: For Multi-line power diagrams the number of cables may be omitted if each conductor is identified separately by a leader line with an arrowhead pointing to (touching) each conductor.

16.7.2 Number of Cable Cores

The number of cable cores within a multicore cable.

For a single-core cable, the number would be ‘1’

For a multi-core cable, the number is either:

- The total number of cores (where all cores have the same cross-sectional area). e.g. If a multi-core cable has only three cores, then the number would be 3
- The number of the main current carrying cores (where large conductors and ancillary conductors having smaller cross-sectional areas are combined within the same cable). e.g. If a multi-core cable has four cores with the same large cross-sectional area (RWBN) and a single core with one small cross sectional area (E), then the number would be ‘4’.

EXCEPTION: For Multi-line power diagrams the number of cable cores may be omitted if each conductor is identified separately by a leader line with an arrowhead pointing to (touching) each conductor.

16.7.3 Conductor Cross Sectional Area

The cross-sectional area of main current carrying core/s within the cable, typically measured in the metric unit of square millimetres. (mm2).

Example: 25mm2

NOTE: It is possible to specify both metric and imperial cables by utilizing the alternate method where the number of strands of wire are displayed followed by the nominal diameter of the wire. e.g.: 7/.064. This method should normally be restricted to Imperial cables.

Where Imperial cables exist, the Imperial cable dimensions are in the form “Number of strands of wire followed by the nominal diameter of the wire) may be used as long as the imperial unit of measurement is displayed e.g. INCH or the abbreviation. (”).

Example: 7/.064 INCH or 7/.064”

16.7.4 Identification of Ancillary Conductors with a Reduced Cross Sectional Area

Where multi-core cables have ancillary conductors with cross sectional areas smaller than the main current carrying conductors, the purpose of the ancillary conductor shall be identified. Typically the earth conductor within a three phase multicore cable has a reduced cross-sectional area. The letter E (for earth) is to be combined with the cross sectional area of the main current carrying core/s.

e.g. (Main current carrying core/s) + (Ancillary conductor identification)

Example: 25mm2+E

EXCEPTION: For Multi-line power diagrams ancillary conductors may be omitted as each conductor is identified separately by a leader line with an arrowhead pointing to (touching) each conductor.

16.7.5 Conductor material

Chemical element symbols shall be used to describe conductor material.

For example,

Cu for copper or Al for aluminium etc

16.7.6 Conductor Insulation Material

Abbreviations in general use within the cable industry shall be used to describe insulation material.

For example,

CSPE – Chlorosulfonated Polyethylene Synthetic Rubber

EPR – Ethylene Propylene Rubber

PVC – Polyvinylchloride

XLPE – Cross Linked Polyethylene

TPR - Thermoplastic rubber

Cable manufacturer’s proprietary product codes may be used where a specific insulation product is required.

For example,

LSFLEX R-70 (X-HF-110) – Cross-linked, Thermoset, Elastomeric

16.7.7 Bedding Insulation Material

Abbreviations in general use within the cable industry shall be used to describe bedding material.

Most bedding compounds are similar to conductor insulation material.

For example,

PVC – Polyvinylchloride

LSF - Low Smoke and Fume

LSHF - Low Smoke Halogen free

16.7.8 Armour Material

The material required to provide physical protection to the cable.

For example,

AWA – Aluminium Wire Armour

SWA – Steel Wire Armour

GSFA – Galvanized Steel Flat Armour

GSTA – Galvanized Steel Tape Armour

GSWB – Galvanized Steel Wire Braid

MIMS – Mineral Insulated Metal Sheath (insulation typically magnesium oxide powder)

PILSWA – Paper Insulated Lead Covered Steel Wire Armoured

16.7.9 Sheath (Jacket) Insulation Material

Abbreviations in general use within the cable industry shall be used to sheath insulation material.

For example,

CPE – Chlorinated Polyethylene

CSPE – Chlorosulfonated Polyethylene Synthetic Rubber

EPDM – Ethylene Propylene Diene Monomer

LSHF – Low Smoke Halogen free

LSZH – Low Smoke Zero Halogen

PUR – Polyurethane

PVC - Polyvinylchloride

TPE – Thermoplastic Elastomer

TPR - Thermoplastic rubber

TPS – Thermoplastic Sheath

16.7.10 Voltage Rating of the Cable

Presented in the form *.*/*kV where:

The first number indicates the RMS voltage rating of the insulation between conductor and earth.

The second number indicates the RMS voltage rating of the insulation between adjacent conductors.

e.g. 0.6/1kV, 1.8/3kV, 3.6/6kV, 6/10kV, 8.7/15kV, 12/20kV, 18/30kV

16.7.11 Additional Information and Abbreviations

Other information and abbreviations may be included in cable specifications to fully describe the cable. For example,

ABS – Aerial Bundle Conductor

An example of single-line power diagram showing cable symbols and cable specification examples is shown on drawing 16-1.

An example of a multi-line power diagrams showing cable symbols and cable specification examples is shown on drawing 16-2.

An example of a combined single-line and multi-line power diagram showing cable symbols and cable specification examples is shown on drawing 16-3

An example of a multi-line power diagram showing busbar identification is shown on drawing 16-4.

16.8 Power Diagrams – Single Line Presentation

Single line presentation of power diagrams shall be used for the following purposes:

- Engineering design – Both primary design drawings and design summary drawings.
- Large projects to represent the major power reticulation and switching functions within a large plant.
- Electrical safety interlocking facilities diagram
- HV switching diagram

Single line presentation of power diagrams shall not be used for detail design purposes.

With the Exception of High voltage Switchgear, the general requirement is for power diagrams to be drawn with normal power flow left to right and top to bottom is to be maintained for single line presentation of power diagrams.

Single line presentation of power diagrams representing High Voltage switchboards shall be drawn to match the assembled arrangement of the switchgear within the High Voltage switchboard, such that personnel standing in front of the switchboard can immediately identify the same device in the same relative location represented on the single line power diagram drawing. Where cables enter and exit the High Voltage switchgear from the bottom the power diagram shall be drawn likewise.

An example of single line presentation of power diagrams for a major pump station installation is shown on drawing 16-5.

Termination details for items such as a metering selector switch, shall be referred to multi-line standard reference drawings, or to metering and protection circuit drawings, where such are included as part of a major project.

16.9 Electrical Safety Interlocking Facilities Diagram

Where switchgear interlocking is required for small projects it shall be represented on project power diagrams. For large projects, switchgear interlocking may require an Electrical safety interlocking facilities diagram. This drawing should be based on the project single line representation power diagram.

Switchgear interlock symbols and interlock key identification shall be interpreted fully by means of a separate legend included on each Electrical safety interlocking facilities diagram.

The Corporation preferred interlock symbols are shown on drawing 17-1.

An example of interlocking within a power diagram is shown on drawing 16-6.

An example of an Electrical Safety Interlocking Facilities diagram is shown on drawing 10-6.

16.10 Power Diagrams – Multi-line presentation

Multi line presentation of power diagrams is to be used for both large and small projects to represent detail design components for the manufacture, operation and maintenance of individual switchboards, starters and distribution boards.

An example of multi-line presentation is shown on drawing 16-2

16.11 Grid Referencing

All power diagrams shall be arranged to provide grid referencing in accordance with requirements of Section 8 of this Electrical Design Standard.

16.12 Wire Presentation

All power wires and cables represented on power diagrams shall be shown as continuous lines. Wires on power diagrams which are a continuation of the control circuitry should be represented as defined by Section 18 – Control Diagrams.

17 High Voltage Switching Diagrams

17.1 General

High Voltage switching diagrams are special purpose drawings with unique features created for detailing safe high voltage switching operations.

High Voltage switching diagrams for each site containing high voltage switchgear and high voltage power distribution shall be created by the Corporation.

The drawings shall only be located within the corporations drawing plan-set, titled “HV Switching Diagrams for various sites”, plan-set number 55979.

High Voltage switching diagrams existing within bundles 1 to 75 of planset 55979 shall remain current and active until cancelled. No further drawings shall be added to bundles 76-99.

The existing drawings within bundles 1 to 75 will be cancelled and replaced over time with new High Voltage switching diagrams as described below.

17.2 Drawing Management and Control

High Voltage Switching Diagrams within planset 55979 shall be secured within the Corporations Drawing Management System to ensure accountability of change control by authorized personnel.

Project engineering concept and detail design drawings containing high voltage switchgear and high voltage power distribution shall be secured within the Corporations Drawing Management System to ensure accountability of change control by authorized personnel.

Co-ordination of drawings within planset 55979 and HV drawings at existing or new sites is essential and permission to access drawings shall be obtained from the Team Leader – Mechanical & Electrical Field Support or Senior Principal Engineer – Mechanical & Electrical within the Engineering Business Unit, Assets Planning and Delivery Group.

To request access to existing drawings or reserve new drawing numbers at existing or new sites contact the Team Leader – Drawing Management.

17.3 Drawing Types

A set of new HV switching diagrams will consist of one or more drawings titled as shown:

- Locality layout and/or Site layout and/or Pole route layout and/or building layout
- System overview
- HV switching and interlocking Diagram

17.4 Drawing Numbering System for Planset 55979

New High Voltage switching diagram drawings shall be numbered in accordance with the following system:

Planset Number - 55979

Bundle Number - In the range 100-999

Sheet Number - In the range 1-999

Part Number - In the range 1-99

Issue Letter

- In the range A-Z (Note: Issue Y is the last useable issue letter)

- All new drawings shall be issue 'A'

17.5 Drawing Bundle Number Grouping by Region

Drawing bundles shall be assigned by region in accordance with the following system:

Bundle No	Region
100	Reserved for drawings common to all regions e.g.
101-200	Metropolitan Region - North
201-300	Metropolitan Region - South
301-400	Goldfields & Agricultural Region
401-500	Great Southern Region
501-600	Mid-West Region
601-700	North-West Region
701-800	South-West Region

17.6 Drawing Bundle Numbering by Site

Each site containing HV switchgear and HV power distribution shall be assigned a separate bundle number within its respective regional bundle number group.

17.7 Drawing Sheet and Part Numbering

Each High Voltage switching diagram shall be arranged only in the following order and assigned the following sheet and part numbers.

17.8 Drawing Content and Presentation

17.8.1 Locality Layout and/or Site Layout, Pole Route and Building Layouts

The Locality layout, Site layout, pole route layout and building layout drawings should be based on civil site plans. For convenience and consistent and accurate site detail an AutoCAD copy of a civil site plan should be obtained.

In accordance with Design Standard DS80 the locality plan and Electrical Site layout drawings shall be drawn using the Co-ordinate System – Map Grid of Australia (MGA94).

The amount of civil detail included on electrical site layouts shall be limited to that necessary for the ready location and appreciation of the electrical installations.

Civil features and details shall not appear prominent to the detriment of electrical detail clarity, i.e. those dimensions, level markings, contour lines etc which are not relevant to the electrical work should not be included or alternately be made not visible. Manipulation of AutoCAD layer settings to turn off unwanted layers containing unwanted features is recommended. If unwanted features cannot be turned off then their line thicknesses shall be reduced such that they display with less prominence.

17.8.2 System Overview

The purpose of the system overview drawing is to facilitate quick familiarization of a site and to identify the location of all the HV components. The drawing aids in the planning and development of HV switching programmes which increases safety for personnel.

The drawing provides the Issuing Officer an overview of the HV system and allows for the easier development of the HV switching programme. In addition, the drawing provides the Switching

Programme Checker, who may not have an intimate understanding of the site, a comprehensive overview of the system.

The system overview drawing should be based on the data contained within the project single line representation power diagram and/or Electrical safety interlocking facilities diagrams.

The system overview drawing shall be presented in a simplified form, the physical location and relational association of equipment is not necessary.

The system overview drawing will include features such as HV switches, HV circuit breakers, HV isolators, HV transformers, HV bus-tie switches, voltage transformers, current transformers, metering, surge diverters etc. LV switchboards which are required for the complete understanding of the system for safe operation of the plant need be included.

The system overview drawing shall not include mechanical, key and electrical interlocking of the High Voltage system, HV control circuitry or HV switching operation instructional notes.

For large sites where the system overview drawing cannot be easily contained within one drawing sheet the drawing shall be divided in to separate drawing sheet parts and assigned part numbers.

Each individual drawing part shall be titled as for the primary drawing except that the part number of the individual drawing sheet shall be appended to the end of title line 4.

System overview drawings shall not be compressed to force the presentation to be congested or cramped and should incorporate the following features: general ease of appreciation, clarity of detail, balanced uncluttered appearance and provision for possible future extensions or additions.

To facilitate the understanding of the system overview drawings when divided into individual drawing parts, grid referencing in accordance with requirements of Section 8 of this Electrical Design Standard shall be used.

Only where necessary, the wording 'ADJOINS DRAWING 55979-***-**-*' may be located within the border of each system overview part drawing to indicate the adjoining drawing sheet and its part number.

(Replace asterisks with the planset, bundle and sheet numbers of each drawing). To identify the relevant project drawing set from which the system overview is derived, each system overview drawing shall have the following note included within the general notes:

"THIS DRAWING DERIVED FROM ****-**-** *"

(*Replace asterisks with the planset, bundle and sheet numbers and the issue letter of each drawing*).

Where room permits, individual reference drawing numbers may be located adjacent individual switchboard components within the body of the system overview drawings. Each reference shall have the following wording:

"(SEE DRAWING ****-**-** *)"

(*Replace asterisks with the planset, bundle and sheet numbers and the issue letter of each drawing*).

Where room does not permit individual reference drawing numbers to be located adjacent individual switchboard components within the body of the system overview drawing, drawing references shall appear in the general notes and have the following wording:

"FOR MECHANICAL AND ELECTRICAL INTERLOCKS REFER DRAWING ****-**-** *"

(*Replace asterisks with the planset, bundle and sheet numbers and the issue letter of each drawing*).

17.8.3 HV Switching and Interlocking Diagram

The purpose of the HV Switching and Interlocking Diagram is to create a HV Switching Programme for the day-to-day operation and maintenance of HV assets, by condensing essential HV data contained in multiple engineering design drawings into one drawing.

The benefits of this approach are to simplify the layout of information, standardize symbology, locate all HV switching diagrams in one drawing set for ease of maintaining the drawings and increase the safety for electrical workers while protecting HV switching assets and equipment.

The HV switching and interlocking diagram should be based on the project single line representation power diagram and/or Electrical safety interlocking facilities diagram.

HV switching and interlocking diagrams shall be drawn to match the assembled arrangement of HV switchgear within an installation. For example, a High Voltage switchboard shall be presented such that personnel standing in front of the switchboard can immediately identify the same device in the same relative location represented on the HV switching and interlocking diagram drawing.

Where cables enter and exit the High Voltage switchgear from the bottom the HV switching and interlocking diagram shall be drawn likewise.

The HV switching and interlocking diagram shall include all mechanical, key and electrical interlocking of the High Voltage system including ancillary equipment and should include any operational instructions and information necessary for the safe operation and switching of the plant.

17.8.4 Code Schedule

The codes associated with the symbols located within the body of the System Overview drawing and the HV switching and interlocking diagram shall be fully interpreted by a code schedule. Code schedules can be positioned anywhere on the drawing, preference is given to bottom of the drawing sheet.

17.8.5 Symbol Legend

Each HV switching and interlocking diagram shall have a symbol legend located within the body of the drawing describing the interlocking symbols and their associated meanings used on the drawing. A sample symbol legend is provided on drawing 16-1. Symbol legends can be positioned anywhere on the drawing, preference is given to bottom of the drawing sheet.

17.8.6 Interlock Key Legend

Each HV switching and interlocking diagram shall have an interlock key legend located within the body of the drawing describing the interlock key identification numbers and their associated meanings used on the drawing. A sample interlock key legend is provided on drawing 17-1. Interlock key legends can be positioned anywhere on the drawing, preference is given to bottom of the drawing sheet.

17.9 Grid Referencing

All HV switching diagrams shall be arranged to provide grid referencing in accordance with requirements of Section 8 of this Electrical Design Standard.

17.10 Wire Presentation

All power wires and cables represented on HV Switching diagrams shall be shown as continuous lines.

The Corporation preferred interlock symbols are shown on drawing 17-1

An example of a System Overview drawing is shown on drawing 17-2

An example of a HV switching and interlocking diagram is shown on drawing 17-3

18 Control Diagrams

18.1 Definitions

The word ‘control’ as used in industry has many meanings and covers a very broad range of functions. Within the Water Corporation the word ‘control’ when used for electrical applications is defined as follows:

POWER SYSTEMS CONTROL

Functions related to the operation and protection of electrical power systems.

OPERATIONAL PROCESS CONTROL

Functions related to the supervision and operation of process control systems, (Includes SCADA, Instrumentation and Communications).

18.2 General Requirements

(a) As a general requirement all control diagrams shall be drawn for the power off, no flow, no pressure, tanks and pipes empty condition.

(b) Diagrams shall be arranged for normal logic flow left to right and top to bottom.

(c) Control diagrams developed from standards such as MN01 or compiled from information provided in standard switchboard design drawings shall incorporate unchanged, the presentation, the terminal numbers, wire number, plug & socket numbers, pin numbers and contact designations, etc as shown on the standard drawings.(d) Timer settings and similar information shall be shown adjacent to the relevant symbols where practicable.

18.3 Control Diagrams for Power Systems Control Applications

18.3.1 Control Diagrams – Where Required

Control diagrams should be produced for the following power system applications:

1. Motor starter control diagrams for:
    - Direct on-line starter
    - Auto Transformer starter
    - Electronic Soft Starter
    - Variable Speed Controller
2. Automatic transfer switch control diagram
3. Protection control diagram
4. Brush lifting facilities control diagram
5. Rheostatic rotor starter control diagram
6. Valve motor control diagram

An example of a motor control diagram for a small pump station is shown on drawing 18-1.

An example of a motor control diagram for a major pump station is shown on drawing 18-2.

18.3.2 Control Diagram Presentation and drawing Numbering

Where two or more control diagrams are presented on separate drawings, the drawing titles shall be unique to represent the purpose of each individual control diagram and each control diagram shall be provided with its own drawing number. The use of one common title within Title Lines 3 an/or 4 having the extension of "-PART 1' or 'PART 2" etc shall not be used.

18.4 Control Diagrams for Operational Process Control Applications

Control diagrams should be produced for the following operational process control system applications:

1. RTU control diagram
2. PLC control diagram
3. UV disinfection control diagram
4. Networking
5. Operator Interface Panel

18.5 Control Diagrams for Other Control Applications

Control diagrams should be produced for the following application:

1. Cathodic protection control diagram

18.6 Codes

Codes shall be assigned to identify all electrical control symbols used on control diagrams.

All codes shall be interpreted fully by means of a separate Code Schedule included on each power diagram or power diagram sheet part.

Tag and loop numbers as described in ANSI/ISA 5.1 – 2022 - Instrumentation Symbols and Identification are NOT codes as described in this design standard. Tag and loop numbers shall not be substituted for codes.

Within electrical control drawings an electrical device or instrument shall be identified by a code.

In limited applications, if it is necessary to identify an instrument on an electrical control drawing the instrumentation tag and loop number may be included on the electrical drawings as secondary information only and located adjacent to the code.

The instrumentation tag and loop number shall not form part of the code.

18.7 Location of Codes

18.7.1 Contacts

Contact identification codes shall be located above contact symbols.

18.7.2 Coils

(a) Relay coil identification codes shall be located outside the symbol, preferably above.

(b) Where the relay is shown detailed as a sub-assembly or as a black box, the code may be located within the boundary lines.

18.8 Wire Presentation

18.8.1 Internal

Wires connected to equipment or terminals on a panel, but which do not leave the panel, shall be shown as a ‘continuous thin’ line as shown in the table titled ‘Electrical power and control’ on drawing 5-1.

18.8.2 External

Wires connected to equipment or terminals on a panel, and which exit the panel to interconnect with another panel or piece of equipment within the same cubicle or external to the cubicle shall be shown as a ‘dashed thin’ line as shown in the table titled ‘Electrical power and control’ on drawing 5-1.

18.9 Wire Junctions and Terminations

18.9.1 Definitions

Wire connections displayed using the junction symbol (i.e. the filled in circle) on schematic diagrams, do not indicate any specific wire junction method or any devices required to make the junction. The junction symbol only indicates that the lines representing wires are ‘electrically’ connected.

An example of different wire junction presentations is shown on drawing 18-3.

Wire connections displayed using the terminal symbol (i.e. the open circle) on schematic diagrams, not only indicate a specific wire junction method, but show exactly where each wire terminates and identifies each terminating device.

18.9.2 Terminal types

There are primarily three types of terminals shown on control diagrams.

Type 1.

Typically, a screw type or push-in type connection device which is rail mounted and assembled singularly or in multiples. Used to facilitate connection between a conductor in a circuit on a panel (or within an enclosure) and either another circuit or another panel or a piece of equipment at an external location.

Terminals of this type can typically be arranged in any combination or orientation and be assigned any purpose. This type of terminal symbol is identified by a letter (T) above or adjacent the symbol.

Type 2.

Typically, a screw type connection device incorporated or moulded into proprietary switchgear or electrical devices by a manufacturer to facilitate connection between the internal circuitry of the device and other equipment in the circuit. Terminals of this type cannot be re-arranged and have a fixed purpose. This type of terminal symbol shall not be identified by a letter (T), but by the manufacturer’s designation/s.

Type 3.

Typically, a plug and socket connection device assembled singularly or in multiples and incorporated or moulded into proprietary switchgear or electrical devices by a manufacturer to facilitate connection between the internal circuitry of the device and other equipment in the circuit. Terminals of this type cannot be re-arranged and have a fixed purpose. This type of terminal symbol shall not be identified by a letter (T), but by the manufacturer’s designation/s.

18.9.3 Terminal Representation

To differentiate between the three types of terminals, different combinations of symbols, codes and numbers are used.

(a) Separately mounted terminals i.e. terminals not part of proprietary switchgear or electrical devices shall be shown as separate terminal symbols with the relevant identification letter and numbers located immediately above or adjacent to the symbol.

(b) Terminals included as part of proprietary switchgear or electrical devices shall not be shown as separately mounted terminal symbols. There are three methods of presentation preferred for proprietary devices.

Method 1.

For simple devices e.g. relay coils and contacts the manufacturers connection identification number should appear immediately adjacent the symbol below the wire at the point of connection.

Method 2.

For complex devices where an internal component such as an individual relay contact or limit switch is required to be shown to convey extra information e.g. a normally open contact. The specific component along with its associated terminals shall be uniquely identified using the terminal symbol in association with the manufacturers connection identification number appearing above or adjacent the terminal symbol. The sub-assembly shall be represented enclosed in a common border and the name of the device displayed.

Method 3.

For complex devices where multiple modules are combined together to form the entire device and where each module has its own group of terminals, then the terminals associated with each module shall be uniquely identified using the terminal symbol in association with the manufacturers connection identification number appearing above or adjacent the terminal symbol. The whole assembly shall be represented enclosed in a common border.

(c) Plug and socket terminals included as part of proprietary switchgear or electrical devices shall not be shown as separately mounted terminal symbols. They shall be shown as a combined assembly using the terminal symbol and the plug and socket symbols. The manufacturers connection identification number shall appear below and adjacent the terminal symbol. The whole plug and socket assembly shall be represented enclosed in a common border.

Examples of terminal representation are shown on drawing 18-3.

18.10 Similar Diagrams

For small project applications each motor control diagram shall be drawn separately regardless of whether they are considered similar. Each motor control diagram shall include a title or similar, to identify the specific pump or motor that the diagram represents.

For large projects, where control circuits are the same for a number of installations, as may be the case for several motor installations at one site, then a control diagram drawing for each installation or for one installation only may be provided. If the latter is the case, minor differences such as wire number and terminal number prefixes, which may be applicable to the installations not drawn shall be explained on the control diagram drawing by notes or tables.

18.11 Grid Referencing

All control diagrams shall be arranged to provide grid referencing in accordance with the requirements of Section 8-1 of this Electrical Design Standard.

18.12 Control Interconnections

Interconnection of the power systems control and operational process control is typically achieved by connecting power system relay coils and contacts to the process control RTU or PLC via interconnecting terminals.

Most of the power system control interconnections are typically presented on the motor control diagrams (other power system control interconnections may be located on other power system control drawings).

To achieve a complete and concise representation of the overall scheme control functionality on a project, two methods of presentation are to be employed.

Method 1

Where a single detail designer/manufacturer of a project is responsible for both the power systems control and operational process control design drawings the preferred method is to relocate the power system control interconnections from the motor control diagrams and other power system control interconnections that may be presented on other power system control drawings to the appropriate RTU or PLC control diagrams and cross reference the drawings in accordance with requirements of Section 8 of this Electrical Design Standard.

Method 2

Where two or more detail designer/manufacturers with responsibilities for separate project components and therefore separate power systems control drawings and separate operational process control drawings, the preferred method is to locate the power system control interconnections on the motor control diagrams. Other power system control interconnections are to be presented on other power system control drawings (as required).

The RTU or PLC control diagrams shall not have the power system control interconnections represented, but shall display a written reference to the power system motor control diagrams.

Likewise, the power system control interconnections represented on the motor control diagrams shall display a written reference to the operational process control RTU or PLC control diagrams.

This method reduces duplication, discrepancies and errors occurring across multiple drawings.

19 Communications Connection Diagrams for power applications

Traditional protection and control devices for power applications (e.g. circuit breaker trip units) did not have communication functionality. New protection and control devices allow for serial communication utilizing different communications protocols. Where new protection and control devices are used, the traditional motor control diagram may be supplemented by a Communication Connection Diagram, if required.

19.1 General Requirements

The Communication Connection Diagram will generally describe each protection and control device in a simplified block diagram format, detailing the power and signal connections and cabling requirements as well as other features such as specialized communication adaptation devices.

Where control devices such as Automatic Changeover Switches, Variable Speed Controllers or Electronic Soft Starters etc have their own control diagrams the Communication connections may be shown on these diagrams in a simplified form with cross references to the overall Communications Connection Diagram.

20 Connection and Termination Diagrams

20.1 Connection Diagrams for Power System Interface Applications

Connection diagrams shall be produced to identify panel interconnections between the Power System Interface and other switchboard panels within the switchboard.

Connection diagrams should generally follow the presentation style of control diagrams.

An example of a connection diagram is shown on drawings 20-1.1 and 20-1.2

20.2 Termination Diagrams for Marshalling Applications

Termination diagrams shall be produced for applications where separate circuits within a switchboard are marshalled together to facilitate interconnection to a remote switchboard or cubicle.

A termination diagram shall be produced to marshal the circuit connections within each switchboard where it is to be connected to a remote switchboard housing the Power System Interface.

For large projects, termination diagrams may be produced for each field junction box.

For large projects, termination diagrams shall be coordinated with cable termination diagrams and cable schedules as appropriate.

20.3 Connection Diagrams for Other Applications

Connection diagrams may be produced for other applications, including communications connection Purposes, if required.

21 Protection Logic Diagrams

Protection Logic Diagrams shall be drawn for the purpose of describing the process logic for protection of power system applications.

Logic drawings created for this purpose shall be titled ‘Protection Logic Diagrams’ The use of the generic title ‘Logic Diagram’ shall not be used for this purpose.

21.1 Drawing Formats

21.1.1 Excluded Formats

Protection logic functions shall be designed and documented in the block logic format.

Sequential Function Charts shall not be used to document sequential control functions

Ladder logic format shall not be used to document logic functions.

21.1.2 Block Logic Diagram Format

Protection Logic Diagrams shall be drawn in the modular block logic format detailed in Section A2.3 of the Corporation’s Electrical Design Standard No. DS22.

Protection logic programs shall be designed and drawn in modules with each module having a total input and output count of not more than 32.

Protection logic diagrams shall be arranged for ease of understanding rather than economy of logic elements.

Inputs and outputs to logic modules shall be either controller external connections or internal linkages designated as “Internal Buses”. Module boundaries should be arranged so that Internal Buses only occur at “Milestones” in the logic flow.

Internal Buses connecting to logic inputs shall be shown to the left of relevant groups of logic elements.

Internal buses being generated by logic elements or from external inputs shall be shown to the right of relevant groups of logic elements.

All internal buses shall be annotated on the logic diagram describing the milestone represented.

21.2 Block Logic Symbols

Block Logic Symbols as adopted by the Corporation are shown on drawings 6-7, 6-8 and 6-9. These symbols shall be used to represent digital and analogue logic.

21.3 Presentation of Protection Logic Diagrams

21.3.1 Protection Logic Diagram Alignment

The vertical column presentation and column headings for presenting Protection logic diagrams is shown on drawing 20-1. All logic diagrams shall use this format.

To facilitate clear and easy readability of Protection logic diagrams all diagrams shall be drawn by assembling block logic symbols at regularly spaced intervals. The use of a grid spacing system shall be employed by the drafter when assembling logic symbols. A 6 x 6 or 12 x 12 grid interval is recommended, and all symbol origins and interconnecting lines shall be located on or along a grid intersection.

21.3.2 Module Headings

Each Protection logic module shall have a module heading located below each module describing the function of each module.

21.3.3 Legend

Each Protection logic diagram shall have a legend located within the body of the drawing describing the line types and their associated meanings used on the drawing. A sample legend is provided on drawing 21-1 and drawings 6-7, 6-8 and 6-9. Legends can be positioned anywhere on the drawing, preference is given to bottom of the drawing sheet.

21.3.4 Code Schedule

The codes associated with the symbols connected to the external inputs or outputs shall be fully interpreted by a code schedule. Code schedules can be positioned anywhere on the drawing, preference is given to bottom of the drawing sheet.

Acronyms and abbreviations considered self-explanatory need not be included in a code schedule associated with the block logic symbols. Acronyms and abbreviations considered important for the clear understanding of the drawing may be described in the code schedule at the drafter's discretion.

22 Control Logic Diagrams

22.1 Drawing Formats

22.1.1 Use of Sequential Function Charts

Sequential Function Charts in accordance with AS 4168.3-1994 may be used to document sequential control functions associated with process control. However, all Function Blocks within Sequential Function Charts shall be documented as Graphical Function Blocks.

Sequential Function Charts shall not be used to document protection functions. Similarly, Sequential Function Charts shall not be used to document non-sequential control functions.

Graphical Function Blocks shall be drawn as block logic diagrams as detailed hereunder.

22.1.2 Block Logic Diagrams

Block Logic Diagrams shall be drawn in the modular format detailed in Section A2.3 of the Corporation's Electrical Design Standard No. DS22.

Logic programs shall be designed and drawn in modules with each module having a total input and output count of not more than 32. Inputs and outputs to logic modules shall be either PLC external connections or internal linkages designated as "Internal Buses". Module boundaries should be arranged so that Internal Buses only occur at "Milestones" in the logic flow.

Internal Buses connecting to logic inputs shall be shown to the left of relevant groups of logic elements.

Internal buses being generated by logic elements or from external inputs shall be shown to the right of relevant groups of logic elements.

All internal buses shall be annotated on the logic diagram describing the Milestone represented.

A sample logic diagram is shown on drawing 22-1.

22.2 Block Logic Symbols

Block Logic Symbols as adopted by the Corporation are shown on drawings 6-7, 6-8 and 6-9.

23 Cable Termination Diagrams

23.1 Where Required

Cable termination diagrams will generally be required only for complex and major installations. The provision of cable termination diagrams should be considered where positive identification of interconnecting cable or wiring terminations cannot be readily obtained from power and control or other related diagrams.

23.2 General Requirements

Two basic types of presentation of cable termination diagrams are acceptable and both presentation types shall incorporate the following information:

- Cable origin or destination description
- Cable number or designation
- Cable core number, core code or core colour
- Terminal Number
- Wire number (where appropriate)
- Reference drawing number and/or cross reference (where appropriate)

23.3 Presentation Type 1

Typically used for medium size and less complex project applications, the presentation is in a diagrammatic form arranged similar to the actual appearance of cables and terminals.

This presentation type can be arranged vertically or horizontally to match the orientation of the actual installation.

An example of a cable termination diagram drawing presented for a power application is shown as example 1 on drawing 23-1

An example of a cable termination diagram drawing presented for a control application is shown as example 2 on drawing 23-2

23.4 Presentation Type 2

Typically used for larger and more complex project applications, the presentation is in tabular form.

The orientation of this presentation type shall only be arranged vertically.

An example of a cable termination diagram drawing presented for field cabling terminating at a switchboard application is shown as example 1 on drawing 23-3.

An example of a cable termination diagram drawing presented for field cabling entering and exiting a switchboard or junction box application is shown as example 2 on drawing 23-3.

24 Cable Schedules

24.1 Where Required

Cable schedules will be required only for complex and `major installations.

24.2 Standard Formats

Cable schedules should be in accordance with the standard formats for cable schedules included as shown on drawing 4-1.

24.3 Power, Control and Data Cable Identification Number – Components

Cable identification numbers shall be allocated for all power, control and data cables.

Cable identification numbers are formed by assembling a sequence of different identification components. There are four components in total. Please note, not all components are required for all cable identification numbers.

The components are:

Component 1: Cable Destination Equipment Title or Number

Component 2: Cable Application Code

Component 3: Unique Number

Component 4: Multiple cables per phase identification number + Cable phase colour

Cable Destination Equipment Title or Number

The first component requires all electrical plant and major electrical equipment such as switchboards, transformers, control cubicles, junction boxes, motors and ancillary devices etc to be identified individually.

- For simple and small installations the title of cable destination equipment described in full or an abbreviation of the cable destination equipment title may be used.

  For example, Motor 1 or Starter 2 or PS SWBD, VSC No1 etc.
- For complex, non-standard, medium size or major installations an assigned number system is recommended.

There is no preferred or defined method for assigning a numbering system for electrical equipment within the Corporation. Therefore, the assigned numbering system shall be developed by the project electrical designer to meet project specific requirements.

Some examples of electrical equipment numbering system used in past projects include.

E.g. HV03001A or MC03201B or MCC3 or S4902 or E101 etc,

Cable Application Code

The second component consists of a cable code to identify the purpose of the cable. The codes shall be as follows:

AC – Identifying **AC** power cables for HV, MV and LV applications.

DC – Identifying **DC** power cables for large DC voltages, including Renewable energy sources.

C – Identifying **C**ontrol cables for signal and control, typically LV or ELV applications.

D – Identifying **D**ata cables (non-optical fibre) for communications and data transfer applications.

OF – Identifying **O**ptical **F**ibre cables for communications and data transfer applications.

Unique Number

A unique number shall be assigned to each individual cable. The numbers shall be assigned starting from the number one (1) onwards.

Multiple cables per phase identification number + Cable phase colour

This is optional and, only required where power cables have multiple cables per phase. When required, an additional number plus the phase colour of that cable may be included.

For example if a three phase circuit required two cables per phase the individual cable identification numbers might be:

MCC3-AC-21-**1R** and MCC3-AC-21-**2R**,

MCC3-AC-21-**1W** and MCC3-AC-21-**2W**

MCC3-AC-21-**1B** and MCC3-AC-21-**2B**

24.4 Cable Numbering for Small Installations

For small installations, typically consisting of one or two switchboards a control cubicle and one or two motors, the basic cable identification number components shall form the basis of a numbering system.

An example of an AC power cable numbered '1' originating at the only Switchboard and terminating at No1 pump motor could be:

Pump 1-AC-1

An example of a DC power cable numbered '11' originating at a Solar Panel array and terminating at the only Switchboard could be:

SWBD-DC-11

An example of a control cable numbered '21' originating at the only Switchboard and terminating at the control cubicle could be:

CC-C-21

An example of a data cable numbered '31' originating at the only Switchboard and terminating at the control cubicle could be:

CC-D-31

A typical power cable schedule and control cable schedule are shown on drawing 24-1.

24.5 Cable Numbering for Medium Size or Major Installations

For complex, non-standard, medium size or major installations, the basic cable identification number components shall form the basis of a numbering system.

This method requires all electrical plant and major electrical equipment to be assigned individual identification numbers.

Two examples of electrical equipment and cable identification numbering

Example 1 (Simple numbering system)

Main switchboard designated (E1), Pump Station Switchboard designated (E2),

No1 auxiliary Transformer designated (E3), 415V Switchboard designated (E20),

Common Control Cubicle designated (E31) etc.

Using this example a power cable numbered '2' originating at the 415V Switchboard is numbered: **E20-AC2,** a control cable numbered '12' originating at the Control Cubicle is numbered: **E31-C12**.

Example 2 (Complex numbering system)

22kV Switchboard designated (HV03001A), 6.6kV Switchboard designated (HV03101A),

Air Compressor Switchboard designated (MC03305), Standby generator designated (GE14003), No1 VSC designated (VD14101), Control Cubicle designated (CC14050) etc.

Using this example a power cable numbered '2' originating at the Air Compressor Switchboard is numbered: MC03305-AC2, a control cable numbered '12' originating at the Control Cubicle is numbered: CC14050-C12.

A typical power cable schedule for complex and major Installations is shown on drawing 24-2.

24.6 Instrument Cable Numbering

Cable identification numbers shall be allocated for all Instrument cables. On small installations the cables should be prefixed M plus a numerical suffix, for example M1, M2 etc.

On larger installations the cables should be identified by their respective loop number, if several cables are associated with a loop then a numerical suffix should be added. When several loops are associated with a cable the lowest loop number is used followed by the letter X which denotes that it is a multi-loop cable (see examples below).

M101-1

Where	M	Letter code
	101	Loop number
	1	Suffix (only used when more than 1 cable associated with loop)

M101X

Where	M	Letter code
	101	Lowest loop number of cable
	X	Suffix to indicate multi-loop cable

A typical cable schedule is shown on drawing 24-1.

24.7 Instrument Cable Schedules

Instrument Cable Schedules shall be in accordance with the Corporation standard Instrument Schedule format as shown on drawing 24-4.

25 Cable Layouts

25.1 General Requirements

For ease of understanding, it may be more appropriate to provide a Diagrammatic Cable Layout in association with a cable schedule for large projects.

A diagrammatic cable layout comprises a simplified block diagram of an installation. For example, drawing 25-1 shows the power and control cable block diagram for a major pump station.

As a general requirement, the diagrammatic cable layout shall have cables shown in a thicker profile than the building layout. Each cable shall have its cable number shown inside the line.

The cable route should approximate the real path taken, but is not an exact scaled reproduction of cable location.

If a separate detailed cable schedule is not required a simplified schedule shall be shown on the diagrammatic cable layout to describe cable sizes and type.

26 Building Light and Power Layouts

26.1 Building Detail

Civil building layouts should provide a basis for the preparation of electrical building light and power layouts. For convenience and consistent accurate site detail an AutoCAD copy of a civil building layout should be obtained.

The amount of civil detail included on electrical building light and power layouts should be limited to that necessary for the ready location and appreciation of the electrical installations.

Civil features and details should not appear prominent to the detriment of electrical detail clarity, i.e. those dimensions and features which are not relevant to the electrical work should not be included or alternately be made not visible. Manipulation of AutoCAD layer settings to turn off unwanted layers containing unwanted features is recommended. If unwanted features cannot be turned off then their line thicknesses shall be reduced such that they display with less prominence. As a general requirement, building plan details shall include all walls, doors and windows. Profiles of plant may be included provided that the clarity of electrical details is not impaired.

26.2 Building Scale

The final choice of building scale will be determined to suit space availability and the amount of electrical detail to be shown on the drawing. Generally the choice of building scale should be selected from 1:50 or 1:100 with the preference being 1:50.

26.3 Building Orientation

Building orientation with respect to north cardinal point shall be indicated by a north sign.

26.4 Identification of Equipment

Identification of equipment shall be affected by using appropriate symbols and a number series. Each symbol or group of identical symbols identifying the same equipment shall be allocated a unique number.

The same numbers shall be used to identify particular symbols on the layout plan and in the material schedule item column.

Symbols shall be numbered on the plan in a system of order which will facilitate identification.

No other numbers shall be appended to equipment symbols. An example is shown on drawing 26-1.

26.5 Circuit Information

Circuit information where required to be shown should be tabulated in a fuse and/or circuit breaker circuit schedule in accordance with the standard format included on drawing 4-1.

26.6 Equipment Mounting Heights

Equipment mounting heights shall be given in millimeters above finished floor levels to the centre of equipment. Equipment mounting heights should be set down in a equipment mounting height schedule, details of which are shown on drawing 4-1.

27 Piping and Instrumentation

For Piping and Instrumentation diagram (P&ID) requirements refer Design Standard DS81 – Process Engineering.

28 Loop Diagrams

28.1 General Requirements

General requirements applicable to all loop diagrams shall include the following.

(a) Diagrams shall be drawn for the no flow, tank empty, power off condition.

(b) Diagrams shall be arranged to show each loop clearly and in its entirety.

(c) Diagrams shall be arranged with vertical partitions to indicate physical areas traversed by the loop. Each area shall be clearly labelled at the top of its partition.

(d) Items of equipment shall be shown within the partitions to reflect their physical location.

(e) Diagrams shall read left to right and in correct sequence with the field equipment on the left.

(f) Where more than one loop is shown on a single drawing sheet, sufficient space shall be allowed to separate them clearly. If this is impractical then a horizontal line may be used.

(g) The loop diagram may cover the entire horizontal area of the drawing sheet, however if extra information is required to be shown, then the right hand side of the drawing sheet may be used for this purpose.

(h) A device / function / calibration table, showing instrument details shall be located below the loop diagram.

(i) Setpoint values and function designations associated with controllers, converters, relays and computing devices shall be shown adjacent to the corresponding symbol.

28.2 Terminal Numbers

Terminals shall be numbered in ascending order from 1 onwards and be prefixed with either their rail number (1-1 i.e. terminal 1 on TB1) or by their type (A1, D1, P1 being analog, digital or 240V power). The practice of identifying terminals by their instrument function (i.e. FT301+) shall not be used as this presents practical problems both as to physically marking the terminals and adding additional loops with a similar function.

An example of a typical Loop Diagram is shown on drawing 28-1.

28.3 Instrument Tag Numbers

Each instrument or function shall be identified by a tag number in accordance with ANSI/ISA-5.1 SECTION 4.

28.4 Instrument Schedules

Instrument Schedules shown within loop drawings shall be in accordance with the Corporation standard Instrument Schedule format as shown on drawing 24-4.

29 Control Interconnection Block Diagrams

29.1 General Requirements

Examples of control interconnection block diagrams for small and large installations are shown on drawings 29-1.1 and 1.2 and 29-2.1 and 2.2 respectively.

30 SCADA Block and Communications Diagrams

30.1 SCADA Block Diagram

An example of a SCADA block Diagram is shown on drawings 30-1.

An example of a SCADA block Diagram – Large Scale Plant is shown on drawings 30-4.

30.2 Communications Details

An example of a Communications Detail Drawing is shown on drawings 30-2.

30.3 Communications Location Plan

An example of a Communications Location Plan is shown on drawings 30-3.

31 Common PLC Control Diagrams

An example of a Common PLC Control Diagram is shown on drawings 31-1.1 to 31-1.4 inclusive.

32 Control and instrumentation Diagrams

An example of a Control and Instrumentation Diagram for wastewater is shown on drawings 32-1.1 and 32-1.2.

33 Fibre Optic Termination Diagrams

Refer to DS40 series Design Standards.

34 Probibus Topology Diagrams

Refer to DS40 series Design Standards.

Appendix A

Reserved codes are displayed in bold italics

CODE	DESCRIPTION
*CuT	CURRENT TRANSFORMER
*Esp	EMERGENCY STOP PUSHBUTTON
*MoA	MOTOR PROTECTION AUXILIARY RELAY
*MoC	MOTOR CIRCUIT BREAKER
*MoF	MOTOR SURGE DIVERTER FAULT CURRENT LIMITER
*MoL	MOTOR OVERLOAD INDICATING LIGHT
*MoR	MOTOR THERMISTOR RELAY
*MOS	MOTOR OVERTEMPERATURE SURGE DIVERTER
*MoS	MOTOR SURGE DIVERTER
*Mre	MOTOR PROTECTION RELAY RESET
*MRR	MOTOR PROTECTION REMOTE RESET RELAY
*MTh	MOTOR THERMISTOR
*PRS	PUMP RTD SURGE DIVERTER
*PRT	PUMP RESISTANCE TEMPERATURE DETECTOR
*PTM	PUMP TEMPERATURE MONITORING RELAY
*SrR	STARTER THERMISTOR RELAY
*STh	STARTER THERMISTOR
1DAR	1 DUTY AUXILARY RELAY
1FAR	1 FAULT AUXILARY RELAY
2DAR	2 DUTY AUXILARY RELAY
2FAR	2 FAULT AUXILARY RELAY
A	***AMMETER***
AAP	ALARM ACKNOWLEDGE PUSHBUTTON
AAPb	ALARM ACKNOWLEDGE PUSHBUTTON
AB	***ACTIVE BAR***
ABC	AUXILIARY BYPASS CONTACTOR
ABSF	ARC FLASH MONITOR BATTERY CHARGER SUPPLY FUSE
Abt	ARC FLASH MONITOR BATTERY
ABtC	ARC FLASH MONITOR BATTERY CHARGER
AcC	ACCELERATING CONTACTOR
ACMS	AUXILIARY CIRCUITS MAIN SWITCH
AcR	ACCELERATING RELAY
AcT	ACCELERATING TIMER
AD	ALARM DIALLER
ADPS	ALARM DIALLER POWER SUPPLY
ADM	AUTO DIALLER MODEM
AFAB	ARC FLASH ALARM BUZZER
AFAL	ARC FLASH ALARM LIGHT
AFAR	ARC FLASH ALARM RELAY
AFCF	ARC FLASH MONITOR CONTROL FUSE
AFCL	ANCILLARY FAULT CURRENT LIMITER

AFCT	ARC FLASH MONITOR CURRENT TRANSFOMER
AFD	ACTIVE FIELD DISTRIBUTOR
AFM	ARC FLASH MONITOR
AFMI	ARC FLASH MONITOR INDICATOR PANEL
AFR	ALARM FAULT RELAY
AFS	ARC FLASH SENSOR
AH	ALARM HORN
AHLS	ALARM HIGH LEVEL SWITCH
AIM	ANALOGUE INPUT MODULE
AIR	ALARM INTERPOSING RELAY
AIU	ALARM INTERFACE UNIT
AL	ALARM INDICATING LIGHT
ALC	AUXILIARY LINE CONTACTOR
Alt	ALARM LIGHT
AM	ADSL MODEM
AMCT	STATION AUXILIARIES METERING CURRENT TRANSFORMER
AOM	ANALOGUE OUTPUT MODULE
APHL	ARC FLASH MONITOR POWER HEALTHY INDICATING LIGHT
APLF	ARC FLASH MONITOR POWER LINE FILTER
APR	ANTI-PUMP RELAY
AR	***ALARM RELAY***
ARCR	AUXILIARY RUN CONTACTOR RELAY
ASCL	AUTOMATIC START CALLING INDICATING LIGHT
ASCS	ANCILLARY SIGNALS CABLE SURGE DIVERETR
ASS	***AMMETER SELECTOR SWITCH***
ASSD	ANCILARY EQUIPMENT SECURITY SURGE DIVERTER
ASSO	AUTOMATIC SWITCHED SOCKET OUTLET
AT	***ALARM TRANSMITTER***
ATI	AMBIENT TEMPERATURE INDICATOR
Ati	ALARM TIMER
Atr	***AUTOTRANSFORMER***
ATrS	AUTOTRANSFORMER STARTER
ATS	AUTOMATIC TRANSFER SWITCH
ATSC	AUTOMATIC TRANSFER SWITCH CONTROLLER
ATSI	AUTOMATIC TRANSFER SWITCH INTERFACE PANEL
ATT	AMBIENT TEMPERATURE THERMOMETER
AUPS	ARC FLASH MONITOR UNINTERRUPTABLE POWER SUPPLY
AuSF	AUXILIARY SUPPLY FUSE
AvR	AVAILABLE RELAY
AVR	AUTOMATIC VOLTAGE REGULATOR
AxR	AUXILIARY RELAY
B	BELL
BC	***BYPASS CONTACTOR***
BCAR	BYPASS CONTACTOR AUXILIARY RELAY

BCDF	BACK-UP CONTROL DC FUSE
BCDT	BYPASS CONTACTOR DELAY TIMER
BcF	BATTERY CHARGER FUSE
BCF	BACK-UP CONTROL FUSE
BcFL	BATTERY CHARGER FAULT CURRENT LIMITER
BCI	BUS COUPLER ISOLATOR
BCSF	BATTERY CHARGER SUPPLY FUSE
BCSO	BATTERY CHARGER SOCKET OUTLET
BCUR	BATTERY CHARGER UNDER VOLTAGE RELAY
BDCF	BATTERY CHARGER DC FUSE
BF12	BATTERY FUSE 12V DC
BF24	BATTERY FUSE 24V DC
BFFL	BLOCKED FILTER FAULT INDICATING LIGHT
BFR	BLOCKED FILTER FAULT RELAY
BFRR	BLOCKED FILTER FAULT RELAY RELEASE
BHLR	BACK-UP HIGH LEVEL RELAY
BHPS	BACK-UP HIGH LEVEL PROBE SURGE DIVERTER
BI	BATTERY ISOLATOR
BILS	BYPASS CUT-IN LEVEL SWITCH
BIR	BATTERY ISOLATING RELAY
BIRR	BATTERY ISOLATING RELAY RELEASE
BLSD	BORE LEVEL SURGE DIVERTER
BOIL	BACK-UP OPERATING INDICATING LIGHT
BOLS	BYPASS CUT-OUT LEVEL SWITCH
BPHR	BACK-UP PLC HEARTBEAT RELAY
BPLC	BACK-UP PROGRAMMABLE LOGIC CONTROLLER
BPLF	BACK-UP CONTROL POWER LINE FILTER
BpR	BYPASS RELAY
BR	BRIDGE RECTIFIER
BR1R	BACK-UP RUN No1 UNIT RELAY
BR2R	BACK-UP RUN No2 UNIT RELAY
BRIR	BACK-UP RUN INTERLOCK RELAY
BRPb	BACK-UP RESET PUSHBUTTON
BRPS	BACK-UP CONTROL REGULATED POWER SUPPLY
BSF	BATTERY SUPPLY FUSE
Bt	***BATTERY***
BtC	***BATTERY CHARGER***
BtCF	BATTERY CHARGER FUSE
BtF	BATTERY FUSE
BtF1	BATTERY No1
BtF2	BATTERY No2
BTh	BEARING THERMOSTAT
BTPb	BACK-UP TEST PUSHBUTTON
BTPR	BEARING TEMPERATURE PROTECTION RELAY
BTR	BEARING TEMPERATURE RELAY
BtT	BATTERIES TERMINAL

BtTR	BATTERY TEST RELAY
BtWR	BATTERY WARNING RELAY
BUVC	BATTERY UNDER VOLTAGE CONTACT
BUVR	BATTERY UNDER VOLTAGE RELAY
BVCL	BACKWASH VALVE CLOSED INDICATING LIGHT
BVCR	BACKWASH VALVE CLOSE RELAY
BVCS	BACKWASH VALVE CONTROL SELECTOR SWITCH
BVFL	BACKWASH VALVE FAULT INDICATING LIGHT
BVFT	BACKWASH VALVE FAULT TIMER
BVOC	BACKWASH VALVE OPENINGS COUNTER
BVOh	BACKWASH VALVE OPEN HOUR METER
BVOL	BACKWASH VALVE OPEN INDICATING LIGHT
BVOR	BACKWASH VALVE OPEN RELAY
BVR	BACKWASH VALVE FAULT RELAY
BVRR	BACKWASH VALVE FAULT RELAY RELEASE
BwR	BACKWASH RELAY
Bz	BUZZER
C	***CAPACITOR***
CADS	CONTAINMENT ALARM DOOR SWITCH
CAPF	CONTROL AND ALARM PANELS MAIN FUSE
CAR	OVERCURRENT AUXILIARY RELAY
CARR	OVERCURRENT AUXILIARY RELAY RELEASE
CB	***CIRCUIT BREAKER***
CBR	CIRCUIT BREAKER RELAY
CBTS	CIRCUIT BREAKER TROLLEY SWITCH
CC	CONTROL CONTACTOR
CCB	CONTROL CIRCUIT BREAKER
CCCF	CONNECTION CUBICLE CONTROL FUSE
CCD	COMMON CONTROL DC FUSE
CCES	CONNECTION CUBICLE EARTHING SWITCH
CCF	COMMON CONTROL FUSE
CCI	COMMON CONTROL ISOLATOR
CCIF	COMMON CONTROL ISOLATING FUSE
CCNB	COMMON CONTROL NEUTRAL BAR
CCSD	COAXIAL CABLE SURGE DIVERTER
CCSS	CLOSING CONTROL SELECTOR SWITCH
CCTS	CONTROL CIRCUIT TEST SWITCH
CDCF	CONTROL DC FUSE
CdIL	CLOSED INDICATING LIGHT
CDr	CONTROL DECONTACTOR
CDSL	CYCLIC DUTY SELECTED INDICATING LIGHT
CF	CONTROL FUSE
CFCL	CONTROL FAULT CURRENT LIMITER
CFL	CONVEYOR FAULT INDICATING LIGHT
CFS	***COMBINATION FUSE SWITCH***
CgC	CLOSING COIL

CgSL	CHARGING SPRING LIMIT SWITCH
CIF	CONTROL ISOLATING FUSE
CIL	CLOSING INDICATING LIGHT
CIR	CONTROL INTERPOSING RELAY
CLC	CLOSING CONTACTOR
ClR	CLOSE RELAY
CLR	CONTROL LEVEL RELAY
CLSD	COAXIAL LINE SURGE DIVERTER
CLSS	COAXIAL LINE SURGE SUPPRESSOR
CLSU	ONTROL LINE SURGE SUPPRESSION UNIT
CLSw	CUBICLE LIGHT SWITCH
CLtS	CLOSED LIMIT SWITCH
CMC	CLOSING MOTOR CONTACTOR
CMCR	COMPRESSOR MOTOR CONTROL RELAY
CMIF	COMMON METERING POTENTIAL ISOLATING FUSE
CMR	CHARGER MONITOR RELAY
CMRL	COMPRESSOR MOTOR RUNNING INDICATING LIGHT
CMT	CHARGER MONITOR TIMER
CNB	CONTROL NEUTRAL BAR
CNBB	COMMON NEUTRAL BUSBAR
CoCI	CONTROL CIRCUIT ISOLATOR
CoCS	COMMUNICATION CABLE CONNECTOR SOCKET
CoDF	COMMUNICATION DC FUSE
COR	CHANGEOVER RELAY
ComD	COMMUNICATION DIALLER
CoSD	COMMUNICATION CABLE SURGE DIVERTER
CoSU	COMMUNICATION LINE SURGE SUPPRESSION UNIT
CPC	CONTROL PLUG CONNECTOR
CPF	CAPACITOR PROTECTION FUSE
CPFL	COMMON PHASE FAILURE INDICATING LIGHT
CPI	CONTROL PANEL ISOLATOR
CPL	CALLING No* PUMP INDICATING LIGHT
CPR	CHANGEOVER PULSE RELAY
CPSR	CONTROL POWER SUPPLY RELAY
CPU	***CENTRAL PROCESSOR UNIT***
CR	***CONTROL RELAY***
CrF	CHLORINATOR FUSE
CrR	CHLORINATOR RELAY
CRR	CONTROL RELAY RELEASE
CRWR	CLOSE RECIRCULATING WATER VALVE RELAY
CS	CLOSING SOLENOID
CSC	CLOSING SOLENOID CONTACTOR
CSCB	CONTROL CUBICLE SUPPLY CIRCUIT BREAKER
CSCM	CLOSING SPRING CHARGING MOTOR

CSD	CONDUCTIVITY SURGE DIVERTER
CSLS	CLOSING SPRING LIMIT SWITCH
CSRS	CLOSING SPRING RELEASE SOLENOID
CSS	***CONTROL SELECTOR SWITCH***
CSSD	CURRENT SIGNAL SURGE DIVERTER
CST	CONTROLLER START TIMER
CStC	CONTROL SOCKET CONNECTOR
CSU	CURRENT SENSING UNIT
CT	***CURRENT TRANSFORMER***
CTAC	CURRENT TO ANALOGUE CONVERTER
CTFL	CLOSING TORQUE FAULT INDICATING LIGHT
CTIR	CHEMICAL TREATMENT INTERLOCK RELAY
CTIS	CHEMICAL TREATMENT INTERLOCK SURGE DIVERTER
CTPF	CONTROL AND TELEMETRY PANEL MAIN FUSE
CTR	CLOSING TORQUE FAULT RELAY
CTr	CONTROLLER TRANSFORMER
CTRR	CLOSING TORQUE FAULT RELAY RELEASE
CUR	CONTROL UNDERVOLTAGE RELAY
CuT	CURRENT TRANSFORMER
CuTr	CURRENT TRANSFORMER AND TRANSDUCER
CUVR	COMMON CONTROL UNDERVOLTAGE RELAY
CvC	CONVEYOR CONTACTOR
CVHL	COMMON VOLTS HEALTHY INDICATING LIGHT
CvR	CONVEYOR THERMAL OVERCURRENT RELAY
CvRR	CONVEYOR THERMAL OVERCURRENT RELAY RESET
D	***DIODE***
D1L	DUTY 1 CALLED INDICATING LIGHT
D2L	DUTY 2 CALLED INDICATING LIGHT
DAR	DUTY AUXILARY RELAY
DBC	DOWN BRUSHES CONTACTOR
DBR	DYNAMIC BRAKING RELAY
DBRR	DYNAMIC BRAKING RELAY RELEASE
DBT	DYNAMIC BRAKING TIMER
DCAF	DC ALARM FUSE
DCC	DC/DC CONVERTER
DCCF	DC CONTROL FUSE
DCF	DC FUSE
DcFL	DUST COLLECTOR FAULT INDICATING LIGHT
DCFr	DC FILTER
DCR	DUTY CHANGEOVER RELAY
DCSF	DC SUPPLY FUSE
DCSS	DRIVE CONTROL SELECTOR SWITCH
DCT	DESLUDGE CYCLE TIMER
DF	DELIVERY FAULT
DFAR	DELIVERY FAULT AUXILIARY RELAY
DFL	DELIVERY FAULT INDICATING LIGHT

DFLS	DRY WELL FLOODED LEVEL SWITCH
DFR	DELIVERY FAULT RELAY
DFS	DISTRIBUTION FUSE SWITCH
DfT	DIFFERENTIAL TIMER
DHPS	DELIVERY HIGH PRESSURE SWITCH
DHSD	DELIVERY HIGH PRESSURE SURGE DIVERTER
DIM	DIGITAL INPUT MODULE
DLPT	DELIVERY LINE PRESSURE TRANSMITTER
DLS	DOOR LIMIT SWITCH
DLSS	DOOR LIMIT SWITCH SURGE DIVERTER
DLSU	DUAL LEVEL SWITCH UNIT
DLtS	DOOR LIMIT SWITCH
Dm	DEMODULATOR
DMT	DRIVE MOTOR TACHOMETER
DOF	DROP OUT FUSE
DOLS	DIRECT ON LINE STARTER
DOM	DIGITAL OUTPUT MODULE
DPC	DIFFERENTIAL PRESSURE CELL
DPFR	DELIVERY PRESSURE AND FLOW RATE RECORDER
DPG	DELIVERY PRESSURE GAUGE
DPOL	DELIVERY PROTECTION ON INDICATING LIGHT
DPR	DUTY PRIMARY RELAY
DPS	DELIVERY PRESSURE SWITCH
DPSD	DELIVERY PRESSURE SURGE DIVERTER
DPTx	DELIVERY PRESSURE TRANSMITTER
Dr	DECONTACTOR
DR	DUTY RELAY
DRR	DUTY RELAY RELEASE
DSCT	DUTY START CHECK TIMER
DSR	DELAY START RELAY
DSS	***DUTY SELECTOR SWITCH***
DST	DELAY START TIMER
DT	DUTY TIMER
DTB	DISTRIBUTION TERMINAL BLOCK
DuLS	DUAL LEVEL SWITCH
DuSR	DUTY SELECTED RELAY
DUVR	DC UNDER VOLTAGE RELAY
dVdT	dV/dT FILTER
EAR	EXCESS AIR RELAY
EB	***EARTH BAR***
EB1	EARTH BAR No1
EB2	EARTH BAR No2
EB3	EARTH BAR No3
EB4	EARTH BAR No4

EB5	EARTH BAR No5
EB6	EARTH BAR No6
EBB	***EQUIPOTENTIAL BONDING BAR***
ECM	ETHERNET COMMUNICATIONS MODULE
ECSD	ETHERNET CABLE SURGE DIVERTER
EESD	EXTERNAL EQUIPMENT SECURITY SURGE DIVERTER
EFCL	EMERGENCY SUPPLY FAULT CURRENT LIMITER
EFR	EARTH FAULT RELAY
EFRP	ELECTRONIC SOFT STARTER FAULT RESET PUSHBUTTON
EFtR	ELECTRICAL FAULT RELAY
EGBC	EMERGENCY GENERATOR BATTERY CHARGER CIRCUIT BREAKER
EGCB	EMERGENCY GENERATOR CIRCUIT BREAKER
EGRT	EMERGENCY GENERATOR RUN TIMER
EGSR	ENABLE GENERATOR START RELAY
EGTB	EMERGENCY GENERATOR TEST BYPASS RELAY
EGTP	EMERGENCY GENERATOR TEST PUSHBUTTON
EGTS	EMERGENCY GENERATOR TEST SELECTOR SWITCH
EHSD	EXTRA HIGH LEVEL ALARM SWITCH SURGE DIVERTER
EIM	ETHERNET COMMUNICATION INTERFACE MODULE
EL	EARTH LEAKAGE
ELAR	EARTH LEAKAGE ALARM RELAY
ELCB	EARTH LEAKAGE CIRCUIT BREAKER
ELPO	EARTH LEAKAGE POWER OUTLET
ELR	***EARTH LEAKAGE RELAY***
ELT	EARTH LEAKAGE TOROID
EM	ENERGY METER
EnFR	ENGINE FAULT RELAY
EOCB	EXTERNAL OUTLET CIRCUIT BREAKER
EOIO	END OF INTERVAL PULSE OPTO-ISOLATOR
EOIP	END OF INTERVAL PULSE CONTACT
EOIS	END OF INTERVAL PULSE SURGE DIVERTER
EPLC	EXPANSION PROGRAMMABLE LOGIC CONTROLLER
EPP	ETHERNET PROGRAMMING PORT
ER	ECONOMY RESISTOR
ERO	EVENT RECORDER OUTLET
ES	***EARTH SWITCH***
ESAS	EMERGENCY STORAGE IN USE ALARM SURGE DIVERTER
ESD	AVAILABLE FOR RE-USE
ESDF	ESSENTIAL SERVICES DISTRIBUTION BOARD FUSE
ESEB	ESSENTIAL SERVICES EARTH BAR
ESF	EMERGENCY SUPPLY FUSE
ESFL	ELECTRONIC SOFT STARTER FAULT INDICATING LIGHT
ESFR	ELECTRONIC SOFT STARTER FAULT RELAY
ESI	ESSENTIAL SERVICES ISOLATOR
ESLS	EMERGENCY STORAGE IN USE ALARM LEVEL SWITCH
ESMS	EMERGENCY SUPPLY MAIN SWITCH

ESNB	ESSENTIAL SERVICES NEUTRAL BAR
ESpP	EMERGENCY STOP PUSHBUTTON
ESRR	ELECTRONIC SOFT STARTER REMOTE RESET RELAY
ESS	***ELECTRONIC SOFT STARTER***
ESSD	EMERGENCY STORAGE IN USE LEVEL ALARM SWITCH SURGE
EthS	ETHERNET SWITCH
EVSR	EMERGENCY VOLTAGE SENSING PHASE FAILURE RELAY
F	***FUSE***
FAR	FAULT AUXILARY RELAY
FBA	FEEDER CIRCUIT BREAKER CLOSING MOTOR ARMATURE
FBC	FEEDER CIRCUIT BREAKER CRADLE
FBCB	FEEDER CIRCUIT BREAKER
FBCC	FEEDER CIRCUIT BREAKER CLOSING CONTACTOR
FBCF	FEEDER CIRCUIT BREAKER CLOSING MOTOR FIELD
FBCI	FEEDER CIRCUIT BREAKER MOTOR CONTROL SAFETY ISOLATING SWITCH
FBCL	FEEDER CIRCUIT BREAKER CONTROL FAULT CURRENT LIMITER
FBCM	FEEDER CIRCUIT BREAKER CLOSING SPRING CHARGING MOTOR
FBCR	FEEDER CIRCUIT BREAKER SOLID STATE OVERCURRENT RELAY
FBCS	FEEDER CIRCUIT BREAKER CLOSING SPRING RELEASE SOLENOID
FBER	FEEDER CIRCUIT BREAKER ECONOMY RESISTOR
FBLC	FEEDER CIRCUIT BREAKER LOCAL CLOSE PUSHBUTTON
FBLS	FEEDER CIRCUIT BREAKER LIMIT SWITCH
FBLT	FEEDER CIRCUIT BREAKER LOCAL TRIP PUSHBUTTON
FBRC	FEEDER CIRCUIT BREAKER REMOTE CLOSE
FBRT	FEEDER CIRCUIT BREAKER REMOTE TRIP
FBST	FEEDER CIRCUIT BREAKER SHUNT TRIP
FBTS	FEEDER CIRCUIT BREAKER TROLLEY SWITCH
FC	FEEDER CONTACTOR
FCB	FEEDER CIRCUIT BREAKER
FCBS	FEEDER CIRCUIT BREAKER CONTROL SELECTOR SWITCH
FCF	FEEDER CONTROL FUSE
FCIF	FEEDER CONTROL ISOLATING FUSE
FCL	***FAULT CURRENT LIMITER***
FDLS	FRONT DOOR LIMIT SWITCH
FDTP	FAULT/DUTY INDICATOR TEST PUSHBUTTON
FELS	FLOW TO EMERGENCY STORAGE LEVEL SWITCH
FFL	FEEDER FAULT INDICATING LIGHT
FFR	FEEDER FAULT RELAY
FFRR	FEEDER FAULT RELAY RESET
FFT	FEEDER FAULT TIMER
Fil	FILTER
FIL	FAULT INDICATING LIGHT
FIR	FAULT INDICATING RELAY
FITP	FAULT INDICATOR TEST PUSHBUTTON
FItR	FAULT INTERPOSING RELAY
FLS	FUEL LEVEL SWITCH

FLSw	FLOAT LEAKAGE SWITCH
FMC	FLOW METER CONVERTER
FMCT	FEEDER METERING CURRENT TRANSFORMER
FMT	FLOWMETER TRANSMITTER
FMTB	FLOW METER TERMINAL BLOCK
FNBB	FEEDER NEUTRAL BUSBAR
FNL	FEEDER NEUTRAL LINK
FNT	FILTERED NEUTRAL TERMINAL
FOBT	FIBRE OPTIC BREAKOUT TRAY
FPI	FEEDER PULSE INITIATOR
FPIF	FEEDER POTENTIAL ISOLATING FUSE
FR	***FAULT RELAY***
FRC	FINAL ROTOR CONTACTOR
FRCT	FINAL ROTOR CONTACTOR TIMER
FRI	FLOW RATE INDICATOR
FRIT	FLOW RATE INDICATOR AND TOTALISER
FRM	FUEL RACK MOTOR
FRP	FAULT RESET PUSHBUTTON
FrR	FLASHER RELAY
FRRR	FAULT REMOTE RESET RELAY
FRS	FUEL RACK SOLENOID
FRuC	FINAL RUN CONTACTOR
FSLS	FLOW TO STORAGE ALARM LEVEL SWITCH
FSP	FORCE START PUSHBUTTON
FSSD	FLOW TO STORAGE LEVEL ALARM SWITCH SURGE DIVERTER
FT	FUSED TERMINAL
FTB	FUSED TERMINAL BLOCK
FTR	FEEDER THERMAL OVERCURRENT RELAY
FTRR	FEEDER THERMAL OVERCURRENT RELAY RESET
FTSF	FLOW TRANSMITTER SUPPLY FUSE
FwD	FLOW DETECTOR
FwR	FLOW FAULT RELAY
FwRR	FLOW FAULT RELAY RESET
FwS	***FLOW SWITCH***
FwSD	FLOW SWITCH SURGE DIVERTER
FwSR	FLOW SWITCH RELAY
FwST	FLOW SWITCH TIMER
FwT	FLOW TIMER
FwTI	FLOW TOTAL SIGNAL ISOLATOR
FwTT	FLOW TOTALISATION TRANSMITTER
G	***GENERATOR***
GBCB	GENERATOR BATTERY CHARGER CIRCUIT BREAKER
GCB	GENERATOR CIRCUIT BREAKER
GFCL	GENERATOR BATTERY CHARGER FAULT CURRENT LIMITER
GFFS	GENERATOR FUEL LEVEL SURGE DIVERTER
GFR	GENERATOR FAULT RELAY

GFSD	GENERATOR FAULT SURGE DIVERTER
GLCB	GPO AND LIGHT CIRCUIT BREAKER
GLEB	GPO AND LIGHT EARTH LEAKAGE CIRCUIT BREAKER
GLRB	GPO AND LIGHT RESIDUAL CURRENT CIRCUIT BREAKER
GPLF	GENERAL PURPOSE OUTLET AND LIGHT FUSE
GPLS	GENERAL PURPOSE OUTLET AND LIGHT SWITCH
GPO	GENERAL PURPOSE OUTLET
GPOF	GENERAL PURPOSE OUTLET FUSE
GR	GENERATOR RELAY
GRCB	GPO AND LIGHT RESIDUAL CURRENT CIRCUIT BREAKER
GRSD	GENERATOR RUNNING SURGE DIVERTER
GRTR	GENERATOR REMOTE TEST RELAY
GSR	GENERATOR START RELAY
GTP	GENERATOR TEST PUSHBUTTON
GTR	GENERATOR TEST RELAY
h	***HOUR METER***
HaF	HARMONIC FILTER
HCDC	HARMONIC FILTER CAPACITOR DISCONNECT CONTACTOR
HDPS	HIGH DELIVERY PRESSURE SWITCH
HEST	HIGH ENERGY SHUNT TRIP
HF	HEATER FUSE
HFL	HYDRAULIC FAULT INDICATING LIGHT
HFR	HYDRAULIC FAULT RELAY
HgR	HIGH RELAY
HHB	HOPPER HEATER CIRCUIT BREAKER
HIR	HORN INTERPOSING RELAY
HLAS	HIGH LEVEL ALARM SWITCH
HLER	HIGH LEVEL TANK EMPTY RELAY
HLL	HIGH LEVEL INDICATING LIGHT
HLR	HIGH LEVEL RELAY
HLS	***HIGH LEVEL SWITCH***
HLSD	HIGH LEVEL ALARM SWITCH SURGE DIVERTER
HLtS	HATCH LIMIT SWITCH
Hn	HORN
HOT	HAND OPERATED TIMER
HR	HYDRAULIC RELAY
HSAS	HALF STORAGE ALARM SURGE DIVERTER
HSIR	HORN SILENCE INTERPOSING RELAY
HSLS	HALF STORAGE ALARM LEVEL SWITCH
HSSD	HALF STORAGE LEVEL ALARM SWITCH SURGE DIVERTER
HT	HYDRAULIC TIMER
I	ISOLATOR
IAR	INSUFFICIENT AIR RELAY
IAxR	INSTANTANEOUS AUXILIARY RELAY
IC	***INTEGRATED CIRCUIT***
ICL	INTERLOCK CALLED INDICATING LIGHT

ICR	INSTANTANEOUS OVERCURRENT RELAY
IDCF	INSTRUMENT DC FUSE
IDSL	INCORRECT DUTY SELECTED INDICATING LIGHT
IECF	INVERTER ENERGY SYSTEM CONTROL FUSE
IECT	INVERTER ENERGY SYSTEM CURRENT TRANSFORMER
IEMR	INVERTER ENERGY SYSTEM MONITORING RELAY
IESR	INVERTER ENERGY SYSTEM SHUTDOWN RELAY
IF	INDICATION FUSE
IFCL	INVERTER ENERGY SYSTEM FAULT CURRENT LIMITER
IFRI	INSTANTANEOUS FLOW RATE INDICATOR
IIR	INTERLOCK INTERPOSING RELAY
IkR	INTERLOCKING RELAY
IkT	INTERLOCK TIMER
ILCB	INTERNAL OUTLET AND LIGHT SWITCH CIRCUIT BREAKER
InF	INDICATION FUSE
IO	INTERNAL OUTLET
IOC	INSTANTANEOUS OVERCURRENT
IOCB	INTERNAL OUTLET CIRCUIT BREAKER
IOCR	INSTANTANEOUS OVERCURRENT RELAY
IOL	INTERLOCK OPERATING INDICATING LIGHT
IOLS	INTERNAL OUTLET AND LIGHT SWITCH
IPL	INSUFFICIENT PLANT FAULT INDICATING LIGHT
IPLF	INSTRUMENT POWER LINE FILTER
IR	***INTERPOSING RELAY***
IS	INTERLOCK SWITCH
IsC	ISOLATING CONTACTOR
IsF	ISOLATING FUSE
ISL	INCOMPLETE START INDICATING LIGHT
ISMS	INVERTER SUPPLY MAIN SWITCH
ISR	INCOMPLETE START RELAY
IST	INCOMPLETE START TIMER
IStL	INCOMPLETE START INDICATING LIGHT
ITAR	INCOMPLETE START TIMER AUXILIARY RELAY
IVE	ELECTRICAL INTERLOCKING UNIT
J	JUMPER
JB	JUNCTION BOX
kFCL	KILOWATT HOUR PULSE METER FAULT CURRENT LIMITER
kVES	kVARh AND END OF INTERVAL PULSE SURGE DIVERTER
kVhO	kVARh PULSE OPTO-ISOLATOR
kVhP	kVARh PULSE CONTACT
kVhS	kVARh PULSE SURGE DIVERTER
kWh	***KILOWATT HOUR METER***
kWhO	KILOWATT HOUR PULSE OPTO-ISOLATOR
kWhP	KILOWATT HOUR PULSE CONTACT
kWhS	KILOWATT HOUR PULSE SURGE DIVERTER
L	INDUCTOR

LaR	LATCH RELAY
LAR	LIGHTNING ALARM RELAY
LaRR	LATCH RELAY RELEASE
LBC	LIFT BRUSHES CONTACTOR
LC	***LINE CONTACTOR***
LCAR	LINE CONTACTOR AUXILIARY RELAY
LCF	LINE CONTACTOR FUSE
LCIF	LOGIC CONTROLLER SUPPLY ISOLATING FUSE
LCLR	LOW CHEMICAL LEVEL RELAY
LCP	LOCAL CONTROL PANEL
LCPb	LOCAL CLOSE PUSHBUTTON
LCSF	LOGIC CONTROLLER SUPPLY FUSE
LCSD	LOWER CROWN OF WINDING TEMPERATURE SURGE DIVERTER
LSCR	LOCAL CONTROL SELECTED RELAY
LCSS	LEVEL CONTROL SELECTOR SWITCH
LCTM	LOWER CROWN OF WINDING TEMPERATURE MONITOR
LD	LEVEL DETECTOR
LDCF	LIGHTING DC FUSE
LDL	LOW DISCHARGE FAULT INDICATING LIGHT
LdLR	LIQUID LEVEL RELAY
LDP	LOW DELIVERY PRESSURE
LDPR	LOW DELIVERY PRESSURE RELAY
LDPS	LOW DELIVERY PRESSURE SWITCH
LEB	***LOCAL EARTH BAR***
LED	LIGHT EMITTING DIODE
LF	LIGHTING FUSE
LFCL	LIGHTING AND POWER OUTLETS FAULT CURRENT LIMITER
LFLR	LOW FUEL LEVEL RELAY
LFLS	LOW FUEL LEVEL SWITCH
LgCB	LIGHTING CIRCUIT BREAKER
LgS	LIGHT SWITCH
LIC	LINE ISOLATING CONTACTOR
LIOS	LOCAL INHIBIT OVERRIDE SWITCH
LIR	LINE INTERPOSING RELAY
LiR	LINE REACTOR
LIT	LINE INTERPOSING RELAY
LIU	LINE INTERFACE UNIT
LKI	LINE KEYING INTERFACE
LLAR	LOW LEVEL ALARM RELAY
LLAS	LOW LEVEL ALARM SWITCH
LLL	LOW LEVEL INDICATING LIGHT
LLR	LOW LEVEL RELAY
LLS	***LOW LEVEL SWITCH***
LLSR	LOW LEVEL SHUT-OFF RELAY
LM	LEVEL MONITOR
LMSS	LOCAL MODE SELECTOR SWITCH

LNB	***LOCAL NEUTRAL BAR***
LOP	LOCK OFF PUSHBUTTON
LOPR	LOW OIL PRESSURE RELAY
LOPS	LOW OIL PRESSURE SWITCH
LOR	LOCK OUT RELAY
LpC	LOOP CONTROLLER
LPCB	LIGHTING AND POWER OUTLETS CIRCUIT BREAKER
LPDF	LIGHT AND POWER DISTRIBUTION BOARD FUSE
LPMS	LIGHTING AND POWER OUTLETS MAIN SWITCH
LPO	LAPTOP POWER OUTLET
LpTP	LAMP TEST PUSHBUTTON
LR	LOW RELAY
LRCP	LAPTOP OUTLET RESIDUAL CURRENT CIRCUIT BREAKER
LRP	LOCAL RESET PUSHBUTTON
LRPS	LIGHTING REGULATED POWER SUPPLY
LRTD	LOWER CROWN OF WINDING RESISTANCE TEMPERATURE DETECTOR
LS	LEVEL SWITCH
LSFC	LEVEL SENSOR FAIL CONTACT
LSFL	LEVEL SENSOR FAIL INDICATING LIGHT
LSFR	LEVEL SENSOR FAIL RELAY
LSIL	LOW SUCTION INDICATING LIGHT
LSP	LOCAL START PUSHBUTTON
LSPD	LIGHT AND SMALL POWER DISTRIBUTION BOARD
LSPL	LOW SUCTION PRESSURE INDICATING LIGHT
LSpP	LOCAL STOP PUSHBUTTON
LSPR	LOW SUCTION PRESSURE RELAY
LSPS	LOW SUCTION PRESSURE SWITCH
LSS	LEVEL SELECTOR SWITCH
LSSD	LOW SUCTION PRESSURE SURGE DIVERTER
LSU	LIQUID SENSING UNIT
LSw	LIGHT SWITCH
LTCL	LOCAL TRIP CALLED INDICATING LIGHT
LTP	LOCAL TRIP PUSHBUTTON
LtS	***LIMIT SWITCH***
LTx	LEVEL TRANSMITTER
M	***MOTOR***
M1OS	MOTOR No1 OVERTEMPERATURE SURGE DIVERTER
M2OS	MOTOR No2 OVERTEMPERATURE SURGE DIVERTER
MaFL	MASTER FAULT INDICATING LIGHT
MAH	MOTOR ANTI-CONDENSATION HEATER
MAHF	MOTOR ANTI-CONDENSATION HEATER FUSE
MAHT	MOTOR ANTI-CONDENSATION HEATER TRANSFORMER
MBC	MAIN CIRCUIT BREAKER CRADLE
MBCC	MAIN CIRCUIT BREAKER CLOSING CONTACTOR
MBCM	MAIN CIRCUIT BREAKER CLOSING SPRING CHARGING MOTOR
MBCS	MAIN CIRCUIT BREAKER CLOSING SPRING RELEASE SOLENOID

MBDL	MOTOR BEARING DRIVE END OVER TEMPERATURE INDICATING LIGHT
MBDM	MOTOR BEARING DRIVE END TEMPERATURE MONITOR
MBDS	MOTOR BEARING DRIVE END TEMPERATURE RTD SENSOR
MBDT	MOTOR BEARING DRIVE END OVER TEMPERATURE
MBER	MAIN CIRCUIT BREAKER ECONOMY RESISTOR
MBLC	MAIN CIRCUIT BREAKER LOCAL CLOSE PUSHBUTTON
MBLS	MAIN CIRCUIT BREAKER LIMIT SWITCH
MBLT	MAIN CIRCUIT BREAKER LOCAL TRIP PUSHBUTTON
MBNL	MOTOR BEARING NON DRIVE END OVER TEMPERATURE INDICATING LIGHT
MBNM	MOTOR BEARING NON DRIVE END TEMPERATURE MONITOR
MBNS	MOTOR BEARING NON DRIVE END TEMPERATURE RTD SENSOR
MBNT	MOTOR BEARING NON-DRIVE END OVER TEMPERATURE
MBR	MOTOR BEARING RELAY
MBST	MAIN CIRCUIT BREAKER SHUNT TRIP
MCB	***MAIN CIRCUIT BREAKER***
MCBS	MAIN CIRCUIT BREAKER CONTROL SELECTOR SWITCH
MCC	MOTOR CONTROL CENTRE
MCCF	MAIN SWITCH COMMUNICATIONS CONTROL FUSE
MCF	MOTOR CONTROL FUSE
MCI	MAIN CONTROL ISOLATOR
MCIL	MOTOR CIRCUIT BREAKER ISOLATED LIMIT SWITCH
MCIM	MAIN SWITCH COMMUNICATION INTERFACE MODULE
MCIS	MANUAL CONTROL SAFETY ISOLATING SWITCH
MCL	MOTOR OVERCURRENT FAULT INDICATING LIGHT
MCP	MANUAL CLOSE PUSHBUTTON
MCPS	MAIN SWITCH COMMUNICATION REGULATED POWER SUPPLY
MCR	MULTI CHANNEL RECORDER
MCRP	MAIN SWITCH COMMUNICATIONS REGULATED POWER SUPPLY
MCS	MAINS CHANGEOVER SWITCH
MCT	***METERING CURRENT TRANSFORMER***
MCTL	MOTOR CIRCUIT BREAKER TEST LIMIT SWITCH
MCTS	METERING CURRENT TRANSFORMER SCREEN TERMINAL
MDA	MAXIMUM DEMAND AMMETER
MDCF	MAIN DC FUSE
MdI	MODULE ISOLATOR
MDr	MOTOR DECONTACTOR
MDSP	MANUAL DUTY STEP PUSHBUTTON
MEB	***MAIN EARTH BAR***
MELB	MOTOR ANTI-CONDENSATION HEATER EARTH LEAKAGE CIRCUIT BREAKER
MENL	MULTIPLE EARTHED NEUTRAL LINK
MeLS	MAINTENANCE LEVEL SWITCH
MES	MOTOR EARTHING SWITCH
MF	MOTOR FUSE
MFC	MACERATOR FORWARD CONTACTOR
MFCL	METERING FAULT CURRENT LIMITER

MFES	MOTOR FUSE EARTHING SWITCH
MFI	MOTOR FUSE ISOLATOR
MFL	MOTOR FAULT INDICATING LIGHT
MFR	MOTOR FAULT RELAY
MFRP	MOTOR STARTER FAULT RESET PUSHBUTTON
MFRR	MOTOR FAULT RELAY RELEASE
MFS	MAIN FUSE SWITCH
MHCB	MOTOR HEATER CIRCUIT BREAKER
MHLS	MAN HOLE LIMIT SWITCH
MHSD	MAN HOLE LIMIT SWITCH SURGE DIVERTER
MHTF	MOTOR ANTI-CONDENSATION HEATER TRANSFORMER FUSE
MI	MOTOR ISOLATOR
MIL	MAIN ISOLATING LINK
MLL	MID LEVEL INDICATING LIGHT
MLR	MID LEVEL RELAY
MLS	***MID LEVEL SWITCH***
MLSS	MAINTENANCE LEVEL SELECTOR SWITCH
MNB	***MAIN NEUTRAL BAR***
MnCF	MAIN CONTROL FUSE
MnF	MAIN FUSE
MnI	MAIN ISOLATOR
MOC	MOTOR OVERCURRENT
MoCB	***MOTOR CIRCUIT BREAKER***
MOCL	MOTOR OVERCURRENT INDICATING LIGHT
MOCR	MAGNETIC OVERCURRENT RELAY
Mod	MODEM
MoFC	MOTOR SURGE DIVERTER FAULT CURRENT LIMITER
MOFR	MOTOR OVERCURRENT FAULT RELAY
MOIL	MOTOR OVERLOAD FAULT INDICATING LIGHT
MOL	MOTOR OVERLOAD
MOLL	MOTOR OVERLOAD INDICATING LIGHT
MOP	MANAUL OPEN PUSHBUTTON
MOR	MOTOR OVERLOAD RELAY
MORP	MOTOR OVERLOAD FAULT RESET PUSHBUTTON
MORR	MOTOR OVERLOAD RELAY RESET
MOSD	MOTOR OVERTEMPERATURE SURGE DIVERTER
MoSD	MOTOR SURGE DIVERTER
MPAR	MOTOR PROTECTION AUXILIARY RELAY
MPF	METERING PROTECTION FUSE
MPFL	METERING POTENTIAL FAULT CURRENT LIMITER
MPIF	METERING POTENTIAL ISOLATING FUSE
MPM	MOTOR POWER MONITOR
MPPF	MOTOR PROTECTION POTENTIAL FUSE
MPR	***MOTOR PROTECTION RELAY***
MPRF	MOTOR PROTECTION RELAY FUSE
MPRR	MOTOR PROTECTION RELAY RESET

MPST	MAIN POWER SUPPLY TRANSFORMER
MPT	METERING POTENTIAL TRANSFORMER
MPTF	METERING POTENTIAL TRANSFORMER FUSE
Mr	MODULATOR
MRC	MACERATOR REVERSE CONTACTOR
MRPS	MULTI CHANNEL RECORDER POWER SUPPLY
MRRR	MOTOR PROTECTION REMOTE RESET RELAY
MS	***MAIN SWITCH***
MS1	MAIN SWITCH No1
MS2	MAIN SWITCH No2
MSD	MAINS SURGE DIVERTER
MSDS	MAINS SURGE DIVERTER FAULT SURGE DIVERTER
MSP	MANUAL START PUSHBUTTON
MSS	MASTER SELECTOR SWITCH
MSSD	MAIN SWITCHBOARD SECURITY SURGE DIVERTER
MStP	MANUAL STOP PUSHBUTTON
MT	MARK TIMER
MTFL	MOTOR TEMPERATURE FAULT INDICATING LIGHT
MTFR	MOTOR THERMISTOR FAULT RELAY
MThD	MOTOR THERMISTOR DECONTACTOR
MThL	MOTOR THERMISTOR FAULT INDICATING LIGHT
MThr	MOTOR THERMISTOR
MThR	MOTOR THERMISTOR RELAY
MTL	***METERING TEST LINKS***
MTR	MOTOR THERMISTOR FAULT RELAY
MTS	MANUAL TRANSFER SWITCH
MTRR	MOTOR THERMISTOR FAULT RELAY RELEASE
MVC	MOTORISED VALVE CONTACTOR
MWOL	MOTOR WINDING OVER TEMPERATURE INDICATING LIGHT
MWOT	MOTOR WINDING OVER TEMPERATURE
MWR	MOTOR WINDING RELAY
MWTR	MOTOR WINDING THERMISTOR RELAY
MWTT	MOTOR WINDING TEMPERATURE THERMISTOR
N1FS	No1 UNIT NO FLOW SWITCH SURGE DIVERTER
N2FS	No2 UNIT NO FLOW SWITCH SURGE DIVERTER
NAvR	NOT AVAILABLE RELAY
NB	***NEUTRAL BAR***
NB1	NEUTRAL BAR No1
NB2	NEUTRAL BAR No2
NB3	NEUTRAL BAR No3
NB4	NEUTRAL BAR No4
NB5	NEUTRAL BAR No5
NB6	NEUTRAL BAR No6
NCSD	NEXT G COAXIAL CABLE SURGE DIVERTER
NCSR	NORMAL CONTROL SELECTED RELAY
NFCL	NORMAL SUPPLY FAULT CURRENT LIMITER

NFR	NO FLOW RELAY
NFRR	NO FLOW RELAY RELEASE
NFSD	NO FLOW SWITCH SURGE DIVERTER
NFwD	NO FLOW DETECTOR
NFwL	NO FLOW INDICATING LIGHT
NFwS	***NO FLOW SWITCH***
NFwT	NO FLOW TIMER
NL	NEUTRAL LINK
NGM	NEXT G MODEM
NSF	NORMAL SUPPLY FUSE
NSMI	NORMAL SUPPLY MAIN ISOLATOR
NSMS	NORMAL SUPPLY MAIN SWITCH
NT	NEUTRAL TERMINAL
NVSR	NORMAL SUPPLY VOLTAGE SENSING PHASE FAILURE RELAY
Oamp	OPERATIONAL AMPLIFIER
OCR	OVERCURRENT RELAY
OEAS	OVERFLOW TO ENVIRONMENT ALARM SURGE DIVERTER
OELS	OVERFLOW TO ENVIRONMENT ALARM LEVEL SWITCH
OESD	OVERFLOW TO ENVIRONMENT LEVEL ALARM SWITCH SURGE DIVERTER
OgC	OPENING CONTACTOR
OgCl	OPENING COIL
OgL	OPENING INDICATING LIGHT
OIAS	OVERFLOW IMMINENT LEVEL ALARM SWITCH
OIL	OFF INDICATING LIGHT
OIP	OPERATOR INTERFACE PANEL
OLAS	OVERFLOW LEVEL ALARM SWITCH
OLtS	OPEN LIMIT SWITCH
OMIL	ON MASTER INDICATING LIGHT
OnL	OPEN INDICATING LIGHT
ONPO	OPTICAL NETWORK POWER OUTLET
ONPS	OPTICAL NETWORK POWER SUPPLY
ONTD	OPTICAL NETWORK TERMINATION DEVICE
OpR	OPEN RELAY
OPTC	ON PEAK TARIFF CONTACT
OPTS	ON PEAK TARIFF SURGE DIVERTER
OR	OVERSPEED RELAY
OS	OPENING SOLENOID
OsS	OVERSPEED SWITCH
OTFL	OPENING TORQUE FAULT INDICATING LIGHT
OTR	OPENING TORQUE FAULT RELAY
OTRR	OPENING TORQUE FAULT RELAY RELEASE
P4LR	PCA-4 LINE RELAY
P5LR	PCA-5 LINE RELAY
PBDL	PUMP BEARING DRIVE END OVER TEMPERATURE INDICATING LIGHT
PBDM	PUMP BEARING DRIVE END TEMPERATURE MONITOR
PBDS	PUMP BEARING DRIVE END TEMPERATURE RTD SENSOR

PBDT	PUMP BEARING DRIVE END OVER TEMPERATURE
PBNL	PUMP BEARING NON DRIVE END OVER TEMPERATURE INDICATING LIGHT
PBNM	PUMP BEARING NON DRIVE END TEMPERATURE MONITOR
PBNS	PUMP BEARING NON DRIVE END TEMPERATURE RTD SENSOR
PBR	PUMP BEARING RELAY
PBSF	PRIMARY CONTROL BATTERY CHARGER SUPPLY FUSE
PBtC	PRIMARY CONTROL BATTERY CHARGER
PC	PILOT CONTACTOR
PCA	PUMP CONTROL APARATUS
PCDF	PRIMARY CONTROL DC FUSE
PCF	PRIMARY CONTROL FUSE
PCL	PUMPING CALLED INDICATING LIGHT
PCLS	POWER AND CONTROL LINE SURGE SUPPRESSOR
PCMS	POWER CONDITION MONITORING (MODBUS) SURGE DIVERTER
PCR	PUMP CONTROLLER/RTU
PCT	PROTECTION CURRENT TRANSFORMER
PD1L	PUMP SELECTED DUTY 1 INDICATING LIGHT
PDCF	PROGRAMMABLE LOGIC CONTROLLER DC FUSE
PDL	PUMP SELECTED DUTY INDICATING LIGHT
PDT	POWER DISTRIBUTION TERMINAL
PEIP	POWER END OF INTERVAL PULSE CONTACT
PEMS	PUMP STATION EMERGENCY SUPPLY MAIN SWITCH
PES	PHOTO ELECTRIC SWITCH
PF	POTENTIAL FUSE
PFAR	PHASE FAILURE AUXILIARY RELAY
PFAT	PHASE FAILURE ALARM TIMER
PFCL	POWER TRANSDUCER FAULT CURRENT LIMITER
PFIL	PHASE FAILURE INDICATING LIGHT
PFL	PUMP FAULT INDICATING LIGHT
PFR	***PHASE FAILURE RELAY***
PFSS	PHASE FAILURE SURGE DIVERTER
PFT	POWER TRANSDUCER FUSE
PFtR	PLANT FAULT RELAY
PI	PANEL ISOLATOR
PIF	POTENTIAL ISOLATING FUSE
PLAR	PUMP LEAK ALARM RELAY
PLC	***PROGRAMMABLE LOGIC CONTROLLER***
PLF	POWER LINE FILTER
PM	PSTN MODEM
PMBU	PUMP MONITORING BASE UNIT
PMCM	PROGRAMMABLE MULTI CHANNEL MONITOR
PMCU	PUMP MONITORING CENTRAL UNIT
PMD	PUMP MONITORING DECONTACTOR
PMFC	POWER MONITORING FAULT CURRENT LIMITER
PMFP	PUMP MONITORING RELAY FAULT RESET PUSHBUTTON
PMOI	PUMP MONITORING OPERATOR INTERFACE PANEL

PMPF	PROTECTION AND METERING POTENTIAL FUSE
PMR	PUMP MONITORING RELAY
PMRR	PUMP MONITORING REMOTE RESET RELAY
PMRU	PUMP MONITORING RELAY UNIT
PMSD	PUMP MONITORING SURGE DIVERTER
PnCT	PROTECTION CURRENT TRANSFORMER
PNMS	PUMP STATION NORMAL SUPPLY MAIN SWITCH
PnTL	PROTECTION TEST LINK
POL	POWER ON INDICATING LIGHT
POR	PRIMARY OVERCURRENT RELAY
PPLF	PRIMARY CONTROL POWER LINE FILTER
Pr	POTENTIOMETER
PR	PUMP RELAY
PR1R	PRIMARY RUN No1 UNIT RELAY
PR2R	PRIMARY RUN No2 UNIT RELAY
PrF	POWER FILTER
PRSD	PUMP RESISTANCE TEMPERATURE DETECTOR SURGE DIVERTER
PRTD	PUMP RESISTANCE TEMPERATURE DETECTOR
PS	POWER SUPPLY
PSC	PRESSURE SENSOR CONVERTER
PSCB	PUMP STATION SWITCHBOARD SUPPLY CIRCUIT BREAKER
PSDT	PUMP START DELAY TIMER
PSF	POWER SUPPLY FUSE
PSFC	POWER SYSTEM INTERFACE FAULT CURRENT LIMITER
PSHS	POWER SUPPLY HEALTHY SURGE DIVERTER
PSIF	POWER SYSTEM INTERFACE CONTROL FUSE
PSI	***POWER SYSTEM INTERFACE***
PSM	POWER SUPPLY MONITOR
PSMC	POWER SUPPLY MONITOR CURRENT TRANSFORMER
PSMS	PUMP SWITCHBOARD SUPPLY MAIN SWITCH
PSO	POWER SUPPLY OUTLET
PSPR	PUMP SEAL PROTECTION RELAY
PSSD	POWER SIGNAL SURGE DIVERTER
PSSO	POWER SUPPLY SWITCHED SOCKET OUTLET
PST	POWER SUPPLY TRANSFORMER
PSU	POWER SUPPLY UNIT
PT	POWER TRANSDUCER
PTAR	PUMP MOTOR HIGH TEMPERATURE ALARM RELAY
PTL	***PROTECTION TEST LINKS***
PTMR	PUMP TEMPERATURE MONITORING RELAY
PTPF	POWER TRANSDUCER POTENTIAL FUSE
PTr	POWER TRANSDUCER
PuR	PULSE RELAY
Q	TRANSISTOR
Q1	NORMAL SOURCE CONTROL CIRCUIT BREAKER
Q2	EMERGENCY SOURCE CONTROL CIRCUIT BREAKER

R	***RESISTOR***
Rad	RADIO TRANSCEIVER
RAR	REMOTE ALARM RELAY
RC	***RUN CONTACTOR***
RCAR	REMOTE CONTROL ALARM RELAY
RCF	RUN CONTACTOR FUSE
RcPS	RECEIVER POWER SUPPLY
RCR	REMOTE CONTROL RELAY
RCSD	RADIO COAXIAL CABLE SURGE DIVERTER
RDFI	REMOTE DELIVERY FLOW INDICATOR
RDLS	REAR DOOR LIMIT SWITCH
RDR	RAMP DOWN RELAY
RFI	RESETTABLE FLOW INDICATOR
RHLS	RING SHORTING MOTOR HAND WHEEL LIMIT SWITCH
RIL	RUNNING INDICATING LIGHT
RIR	RECORDER ISOLATING RELAY
RL	RELAY
RM	RADIO MODEM
RMIF	RING SHORTING MOTOR ISOLATING FUSE
RMLS	RING SHORTING MOTOR LIMIT SWITCH
RMOC	RING SHORTING MOTOR OPEN CIRCUITING CONTACTOR
RMOT	RING SHORTING MOTOR OPEN CIRCUITING TIMER
RMSC	RING SHORTING MOTOR SHORT CIRCUITING CONTACTOR
RMTR	RING SHORTING MOTOR THERMAL OVERCURRENT RELAY
RNB	RESIDUAL CURRENT NEUTRAL BAR
ROR	RING GEAR OVERCURRENT RELAY
RP	RESET PUSHBUTTON
RPb+A44	RESET PUSHBUTTON
RPS	***REGULATED POWER SUPPLY***
RPSF	REGULATED POWER SUPPLY FUSE
RR	RECEIVE RELAY
RrC	RECORDER CONTROLLER
RRM	REMOTE RESET MAGNET
RSC	RESISTANCE STARTER CONTACTOR
RSF	RADIO SUPPLY FUSE
RSMF	RING SHORTING MOTOR FUSE
RSP	RTU STATUS PUSHBUTTON
RSTA	RJ45 TO SCREW TERMINAL ADAPTOR
RT	REMOTE TRIP
RtC	REMOTE CLOSE
RTCR	REMOTE TRIP CALLED INDICATING RELAY
RTD	RESISTANCE TEMPERATURE DETECTOR
RTh	RESISTANCE THERMOSTAT
RTM	RADIO TELEMETRY MODULE
Rtr	ROUTER

RTU	***REMOTE TERMINAL UNIT***
RuIR	RUN INTERPOSING RELAY
RuR	RUN RELAY
RWV	RECIRCULATING WATER SOLENOID VALVE
Rx	***RECEIVER***
Ry	RELAY
S	***SWITCH***
SA	SOLAR ARRAY
SACB	STATION AUXILIARIES CIRCUIT BREAKER
SACT	SUPPLY AUTHORITY METERING CURRENT TRANSFORMER
SADS	SECURITY ALARM DOOR SWITCH
SAIR	STANDBY ALARM INTERPOSING RELAY
SAPF	SUPPLY AUTHORITY POTENTIAL FUSE
SBOL	STANDBY OPERATED INDICATING LIGHT
SBPR	STANDBY PRIMARY RELAY
SBR	STANDBY RELAY
SBRR	STANDBY RELAY RELEASE
SC	***START CONTACTOR***
SCA	SWITCHGEAR & CONTROL GEAR ASSEMBLY
SCAR	STANDBY CALLED ALARM RELAY
SCB	***STARTER CIRCUIT BREAKER***
SCC	SECONDARY RESISTANCE STARTER CONTROL CONTACTOR
SCeL	START COMPLETE INDICATING LIGHT
SCeR	START COMPLETE RELAY
SCES	SUPERVISORY CONTROL ETHERNET SWITCH
SCF	STARTER CONTACTORS FUSE
SCM	SPRING CHARGING MOTOR
SCR	SILICON CONTROLLED RECTIFIER
SCS	STANDBY SUPPLY CHANGEOVER SWITCH
SCSD	SATELLITE COAXIAL CABLE SURGE DIVERTER
SD	***SURGE DIVERTER***
SDEB	SURGE DIVERTER EARTH BAR
SDF	SURGE DIVERTER FUSE
SDFC	SURGE DIVERTER FAULT CURRENT LIMITER
SDLS	SECOND DUTY LEVEL SWITCH
SDR	STALL DETECT RELAY
SF	SUPPLY FILTER
SFCL	SURGE DIVERTER FAULT CURRENT LIMITER
SFL	SUCTION FAULT INDICATING LIGHT
SFR	SUCTION FAULT RELAY
SFRR	SUCTION FAULT RELAY RELEASE
SFS	STATION AUXILIARIES FEEDER SELECTOR SWITCH
SFSC	STARTER FINAL STEP CONTACTOR
SFTh	STARTER FAULT THERMOSTAT
ShT	***SHUNT TRIP***
SiC	SIGNAL ISOLATOR

SIC	SAFETY INTERLOCK CONTACT
SiCB	SIGNAL COMMON BAR
SiCT	SIGNAL COMMON TERMINAL
SIIL	STATION INHIBITED INDICATING LIGHT
SIR	START INITIATE RELAY
SLCB	SINGLE PHASE OUTLET AND LIGHT SWITCH RESIDUAL CURRENT CIRCUIT BREAKER
SLdR	STANDBY LATCHED RELAY
SLFS	STATOR LEAKAGE FLOAT SWITCH (FLYGT FLS)
SLIR	STANDBY LATCHED INTERPOSING RELAY
SLL	STANDBY LATCHED INDICATING LIGHT
SLLS	SUCTION TANK LOW LEVEL SWITCH
SLPT	SUCTION LINE PRESSURE TRANSMITTER
SLR	STANDBY LATCH RELAY
SLS	SUCTION LEVEL SWITCH
SLSD	SUCTION TANK LOW LEVEL SURGE DIVERTER
SM	STARTER MOTOR
SMCB	SUB MAIN SUPPLY CIRCUIT BREAKER
SMCS	SUPPLY AUTHORITY METERING CONNECTION SOCKET
SMF	SECONDARY RESISTANCE STARTER MOTOR FUSE
SMFI	STARTER AND MOTOR FUSE ISOLATOR
SMI	STARTER MOTOR ISOLATOR
SMTR	SECONDARY RESISTANCE STARTER MOTOR THERMAL OVERCURRENT RELAY
SNB	STATION AUXILIARIES NEUTRAL BAR
SnF	SINE FILTER
SnPS	SUCTION PRESSURE SWITCH
SOCB	SINGLE PHASE OUTLET CIRCUIT BREAKER
SOFL	STARTER OVERTEMPERATURE FAULT INDICATING LIGHT
SOLS	SINGLE PHASE OUTLET AND LIGHT SWITCH
SOR	STARTER OVERTEMPERATURE FAULT RELAY
SORR	STARTER OVERTEMPERATURE FAULT RELAY RELEASE
SOSR	STATION OVERRIDE STOP RELAY
SOWT	STARTER OVERTEMPERATURE WARNING THERMOSTAT
SP	SURGE PROTECTOR
SP3R	SET POINT 3 RELAY
SP4R	SET POINT 4 RELAY
SPb	START PUSHBUTTON
SPC	***STAR POINT CONTACTOR***
SPCM	SEWAGE PUMP CONTROL MODULE
SPD	SERVICE PROTECTION DEVICE
SPF	SEMICONDUCTOR PROTECTION FUSE
SPG	SUCTION PRESSURE GAUGE
SPLR	SET POINT LATCHING RELAY
SpLR	SPARE LEVEL RELAY
SpP	***STOP PUSHBUTTON***
SPR	SUCTION PRESSURE RECORDER

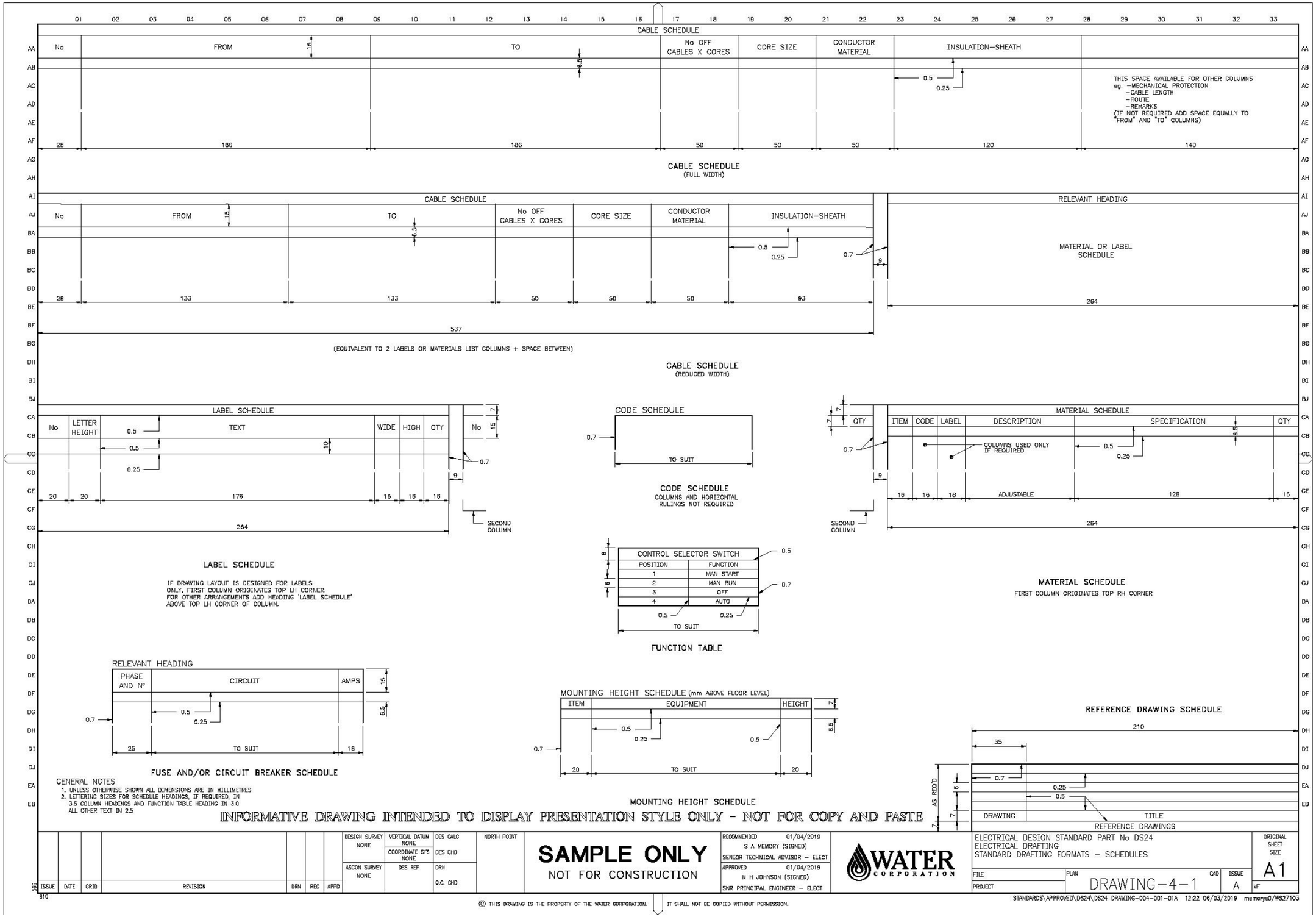
SpS	STOP SOLENOID
SPSD	SUCTION PRESSURE SURGE DIVERTER
SpT	SPACE TIMER
SPTx	SUCTION PRESSURE TRANSMITTER
SR	SOLAR REGULATOR
SRDC	SECONDARY RESISTANCE STARTER RUN DOWN CONTACTOR
SrF	STIRRER FUSE
SrFL	STIRRER FAULT INDICATING LIGHT
SRR	STARTER READY RELAY
SRsR	STANDBY RESET RELAY
SRUC	SECONDARY RESISTANCE STARTER RUN UP CONTACTOR
SS	SURGE SUPPRESSOR
SSAI	STANDBY SUPPLY APPLIANCE INLET
SSCR	SOLID STATE OVERCURRENT RELAY
SSD	SECURITY SURGE DIVERTER
SSI	STANDBY SUPPLY APPLIANCE INLET
SSMS	STANDBY SUPPLY MAIN SWITCH
SSNT	STANDBY SUPPLY NEUTRAL TERMINAL
SSO	SWITCHED SOCKET OUTLET
SSS	SOLID STATE STARTER
SSU	SURGE SUPPRESSION UNIT
ST	START TIMER
STES	STATION AUXILIARIES TRANSFORMER EARTHING SWITCH
STF	STATION AUXILIARIES TRANSFORMER FUSE
StFL	STARTER FAULT INDICATING LIGHT
STFT	SECONDARY RESISTANCE STARTER OVERTEMPERATURE FAULT THERMOSTAT
SThR	STARTER THERMISTOR RELAY
SThr	STARTER THERMISTOR
STI	STATION AUXILIARIES TRANSFORMER ISOLATOR
STLS	SUCTION TANK LEVEL SURGE DIVERTER
StP	***START PUSHBUTTON***
STR	STIRRER THERMAL OVERCURRENT RELAY
StR	START RELAY
STRR	STIRRER THERMAL OVERCURRENT RELAY RESET
StS	START SOLENOID
STWT	SECONDARY RESISTANCE STARTER OVERTEMPERATURE WARNING THERMOSTAT
SVCS	SLUDGE VALVE CONTROL SELECTOR SWITCH
SVOC	SLUDGE VALVE OPENINGS COUNTER
SVOh	SLUDGE VALVE OPEN HOUR METER
SVOL	SLUDGE VALVE OPEN INDICATING LIGHT
SVOR	SLUDGE VALVE OPEN RELAY
SWTh	STARTER WINDING THERMOSTAT
T	TERMINAL
TBP	TIME DELAY RELAY BRIDGING PLUG
TBSD	THRUST BEARING TEMPERATURE SURGE DIVERTER

TBTM	THRUST BEARING TEMPERATURE MONITOR
TC	TELEPHONE CONNECTION
TCPS	TELEPHONE CONNECTION PLUG AND SOCKET
TCR	***THERMAL OVERCURRENT RELAY***
TCRC	THERMAL OVERCURRENT RELAY CONVERTER
TCRR	THERMAL OVERCURRENT RELAY RESET
TDLS	THIRD DUTY LEVEL SWITCH
TDPP	TEST DUTY PUMP PUSHBUTTON
TDR	TIME DELAY RELAY
TeS	TEMPERATURE SWITCH
TFI	TOTAL FLOW INDICATOR
TFR	TEMPERATURE FAULT RELAY
TFRR	TEMPERATURE FAULT RELAY RELEASE
Th	***THERMOSTAT***
Thr	***THERMISTOR***
ThrR	THERMISTOR RELAY
ThrT	THERMISTOR TIMER
ThSS	THERMOMETER SELECTOR SWITCH
TI	TEMPERATURE INDICATOR
Ti	TIMER
TIFL	TEST INSTRUMENT FAULT CURRENT LIMITER
TIIF	TEST INSTRUMENT ISOLATING FUSE
TINB	TEST INSTRUMENT NEUTRAL BAR
TL	***TEST LINKS***
TLI	TANK LEVEL INDICATOR
TLSD	TELEPHONE LINE SURGE DIVERTER
TM	TEMPERATURE MONITOR
TMF	TEMPERATURE MONITOR FUSE
TMPT	TEMPERATURE MONITOR POWER SUPPLY TRANSFORMER
TMR	TEMPORARY MEMORY RELAY
TOTL	TRANSFORMER OVERTEMPERATURE INDICATING LIGHT
TPAC	THREE PHASE AUXILIARY CIRCUIT FUSE
TPCB	THREE PHASE OUTLET CIRCUIT BREAKER
TPF	THERMISTOR PROTECTION FUSE
TPOF	THREE PHASE OUTLET FUSE
Tr	***TRANSFORMER***
TRTD	THRUST BEARING RESISTANCE TEMPERATURE DETECTOR
TRU	***TRANSFORMER RECTIFIER UNIT***
TS	***TIME SWITCH***
TSAR	TIME SWITCH AUXILIARY RELAY
TSS	TEST SELECTOR SWITCH
TSU	TRANSIENT SUPPRESSION UNIT
TTFL	TRANSFORMER TEMPERATURE FAULT INDICATING LIGHT
TThr	TRANSFORMER THERMISTOR
TThR	TRANSFORMER THERMISTOR RELAY
TVSP	TRANSIENT VOLTAGE SUPPRESSION PANEL

Tx	***TRANSMITTER***
U1ML	UNIT 1 MASTER INDICATING LIGHT
U2ML	UNIT 2 MASTER INDICATING LIGHT
UA	UNIVERSAL CONTROLLER
UAND	UNIT ALPHANUMERIC DISPLAY UNIT
UCSD	UPPER CROWN OF WINDING TEMPERATURE SURGE DIVERTER
UCTM	UPPER CROWN OF WINDING TEMPERATURE MONITOR
UDCF	UNIT CONTROL DC FUSE
UEI	ULTRASONIC EVALUATION INSTRUMENT
UFIL	UNIT FAULT INDICATING LIGHT
UFIR	UNIT FAULT INTERPOSING RELAY
UHLR	ULTRA HIGH LEVEL RELAY
ULD	ULTRASONIC LEVEL DETECTOR
ULM	ULTRASONIC LEVEL MONITOR
ULR	UNDER LOAD RELAY
UPS	UNINTERRUPTIBLE POWER SUPPLY
URIL	UNIT REMOTE INHIBITED INDICATING LIGHT
URM	UHF RADIO MODULE
URTD	UPPER CROWN OF WINDING RESISTANCE TEMPERATURE DETECTOR
UVR	***UNDER VOLTAGE RELAY***
V	***VOLTMETER***
VAM	VALVE ACTUATOR MOTOR
VCES	VSC CONTROL ETHERNET SWITCH
VCSS	VARIABLE SPEED CONTROLLER CONTROL SELECTOR SWITCH
VDR	VOLTAGE DEPENDENT RESISTOR
VF	VOLTMETER FUSE
VFIL	VSC FAULT INDICATING LIGHT
VHDL	VERY HIGH DRY WELL LEVEL INDICATING LIGHT
VHDS	VERY HIGH DRY WELL LEVEL SWITCH
VHL	VOLTS HEALTHY INDICATING LIGHT
VHLL	VERY HIGH LEVEL INDICATING LIGHT
VHLR	VERY HIGH LEVEL RELAY
VHLS	VERY HIGH LEVEL SWITCH
VHR	VOLTS HEALTHY RELAY
VLLR	VERY LOW LEVEL RELAY
VMF	VOLTAGE MONITORING FUSE
VPI	VOLTAGE PRESENCE INDICATOR
VR	***VOLTAGE REGULATOR***
VRIL	VSC RUNNING INDICATING LIGHT
VRR	VSC RUNNING RELAY
VSC	***VARIABLE SPEED CONTROLLER***
VSCB	VARIABLE SPEED CONTROLLER CIRCUIT BREAKER
VSCF	VARIABLE SPEED CONTROLLER FUSE
VSCI	VARIABLE SPEED CONTROLLER ISOLATOR
VSCL	VARIABLE SPEED CONTROLLER LINE CONTACTOR
VSFL	VARIABLE SPEED CONTROLLER FAULT INDICATING LIGHT

VSFP	VARIABLE SPEED CONTROLLER FAULT RESET PUSHBUTTON
VSFR	VARIABLE SPEED CONTROLLER FAULT RELAY
VSRR	VARIABLE SPEED CONTROLLER FAULT REMOTE RESET RELAY
VSMR	VARIABLE SPEED MOTOR REGULATOR
VSS	***VOLTMETER SELECTOR SWITCH***
VSWF	VARIABLE SPEED CONTROLLER SINEWAVE FILTER
VVCF	VSC VENTILATION FAN CONTROL FUSE
VVFC	VSC VENTILATION FAN CIRCUIT BREAKER
VVFL	VSC VENTILATION FAN LINE CONTACTOR
VVFO	VSC VENTILATION FAN POWER OUTLET
VVML	VSC VENTILATION FAN MOTOR OVERCURRENT FAULT LIGHT
VVTh	VSC VENTILATION FAN THERMOSTAT
VVVF	VARIABLE VOLTAGE VARIABLE FREQUENCY MOTOR STARTER
W	***WATTMETER***
WHLS	WATER SURGE HIGH LEVEL SWITCH
WHR	WATER SURGE HIGH RELAY
WLI	WATER LEVEL INDICATOR
WLLS	WATER SURGE LOW LEVEL SWITCH
WLR	WATER SURGE LOW RELAY
WMSD	WINDING MOTOR FRAME TEMPERTURE SURGE DIVERTER
WMTM	WINDING MOTOR FRAME TEMPERATURE MONITOR
WPSF	WELL WASHER POWER SUPPLY FUSE
WRPS	WELL WASHER REGULATED POWER SUPPLY
WRTD	WINDING MOTOR FRAME RESISTANCE TEMPERATURE DETECTOR
WTR	WINDING TEMPERATURE RELAY
WWRR	WELL WASHER RUN RELAY
WWSV	WELL WASHER SOLENOID VALVE
XAR	X AUXILIARY RELAY
YAR	Y AUXILIARY RELAY
YC	STAR CONTACTOR
ZD	***ZENER DIODE***

No reference or example drawings for Sections 1, 2, 3, 7, 9, 11, 19, 27, 33 and 34 of this Design Standard are required, therefore, the following drawings do not include drawings 1-1, 2-1, 3-1, 7-1, 9-1, 11-1, 19-1 or 27



GENERAL

APPLICATION	TYPE OF LINE	EXAMPLE OF LINE	THICKNESS	AUTOCAD PROPERTIES				
				INDEX COLOUR				
				COLOUR NAME	COLOUR NUMBER	LINE WIDTH	LINETYPE	LAYER
SECTION THROUGH SHEET METAL SCHEDULE BOUNDARY LINES UNDERGROUND CABLE ROUTES	CONTINUOUS – THICK		0.7 mm	–	14	0.7	CONTINUOUS	29
SCHEDULES – VERTICAL DIVIDING LINES	CONTINUOUS – MEDIUM		0.5 mm	MAGENTA	6	0.5	CONTINUOUS	24
GENERAL DETAILS	CONTINUOUS – THIN		0.35 mm	YELLOW	2	0.35	CONTINUOUS	22
SCHEDULES – HORIZONTAL DIVIDING LINES	CONTINUOUS – THIN		0.25 mm	GREEN	3	0.25	CONTINUOUS	21
BREAK LINES TOPOGRAPHICAL FEATURES	CONTINUOUS – THIN – FREEHAND		0.35 mm	YELLOW	2	0.35	CONTINUOUS	22
BREAK LINES	CONTINUOUS – THIN, RULED WITH ZIG ZAG		0.35 mm	YELLOW	2	0.35	CONTINUOUS	22
HIDDEN OUTLINES	DASHED – THIN		0.25 mm	BLUE	5	0.25	DASH	110
CENTRELINES – LONG	CHAIN – THIN		0.25 mm	RED	1	0.25	WC–CENT	111
CENTRELINES – SHORT, PATH LINES INDICATING MOVEMENT	CHAIN – THIN		0.25 mm	RED	1	0.25	WC–CENTS	112
CUTTING PLANES	CHAIN – THICK AT ENDS AND CHANGE OF DIRECTION – THIN ELSEWHERE		0.25 mm 0.5 mm	RED MAGENTA	1 6	0.25 0.5	WC–CENT CONTINUOUS	111 24
OUTLINES OF ADJACENT PARTS, ALTERNATIVE AND EXTREME POSITION OF MOVABLE PARTS, PHANTOM LINES	CHAIN – THIN, DOUBLE DASHED		0.?? mm	GREY	9	0.??25	WC–PHAN	WC–PHAN
DIMENSIONS	CONTINUOUS – THIN		0.25 mm	RED	1	0.25	CONTINUOUS	228

ELECTRICAL POWER AND CONTROL

APPLICATION	TYPE OF LINE	EXAMPLE OF LINE	THICKNESS	AUTOCAD PROPERTIES				
				INDEX COLOUR				
				COLOUR NAME	COLOUR NUMBER	LINE WIDTH	LINETYPE	LAYER
BUSBARS OR TRANSMISSION PATHS	CONTINUOUS – THICK		1.0 mm	DARK MAGENTA	202	1.5 (SEGMENT WIDTH 1.5)	CONTINUOUS (POLYLINE)	13
POWER WIRES	CONTINUOUS – THICK		0.7 mm	DARK MAGENTA	202	0.7	CONTINUOUS (POLYLINE)	13
CONTROL WIRES – ACTIVE – NEUTRAL – EARTH – DC POSITIVE – DC NEGATIVE	CONTINUOUS – THIN		0.35 mm	DARK CYAN	122	0.35	CONTINUOUS (POLYLINE)	1
INTERCONNECTION WIRES OR SIGNAL WIRES	DASHED – THIN		0.35 mm	–	40	0.35	WC–DASH (POLYLINE)	72
ASSEMBLIES SUB–ASSEMBLIES BLACK BOXES SYMBOLS	CONTINUOUS – MEDIUM		0.35 mm	YELLOW	2	0.35	CONTINUOUS	22
MAGNETIC SCREEN ELECTRIC SCREEN	DASHED – MEDIUM		0.35 mm	YELLOW	2	0.35	WC–DASH	22
MECHANICAL CONNECTION MECHANICAL OR FUNCTIONAL LINK	SHORT DASH		0.25 mm	BLUE	5	0.25	WC–DASH	110
MAJOR BOUNDARIES – CIRCUITS – PANELS – SWITCHBOARDS – BUILDINGS	CHAIN – THIN		0.25 mm	RED	1	0.25	WC–CENT	111
MINOR BOUNDARY WITHIN MAJOR BOUNDARIES	CHAIN – THIN		0.25 mm	RED	1	0.25	WC–CENTS	112

PROTECTION LOGIC DIAGRAMS

APPLICATION	TYPE OF LINE	EXAMPLE OF LINE	THICKNESS	AUTOCAD PROPERTIES				
				INDEX COLOUR				
				COLOUR NAME	COLOUR NUMBER	LINE WIDTH	LINETYPE	LAYER
ANALOGUE I/O SIGNAL (4–20mA, 1–5V) OR ANALOGUE LOGIC SIGNAL (BYTE, WORD, DOUBLE WORD)	DASHED – THIN		0.35 mm	–	40	0.35	WC–DASH (POLYLINE)	72
DIGITAL I/O SIGNAL (OFF OR ON) OR BINARY LOGIC SIGNAL (SINGLE BIT)	CONTINUOUS – THIN		0.35 mm	DARK CYAN	122	0.35	CONTINUOUS (POLYLINE)	1
COMMUNICATION LINK	SPECIAL		0.35 mm	DARK CYAN	122	0.35	WCI–LINKIS10 (POLYLINE)	1

NOTE

STANDARD LINES DERIVED FROM AS 1100.101–1992 (LINE GROUP 0.7mm)
FOR OTHER LINE TYPES AND THICKNESSES REFER TO AS1100

INFORMATIVE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	CRID	REVISION	DRN	REC	APPD
810						

DESIGN SURVEY NONE | VERTICAL DATUM NONE | COORDINATE SYS NONE | DES CALC | DES CHD | ASCON SURVEY NONE | DES REF | DRN | D.C. CHD | NORTH POINT

SAMPLE ONLY
NOT FOR CONSTRUCTION

RECOMMENDED 01/04/2019
S A MEMORY (SIGNED)
SENIOR TECHNICAL ADVISOR – ELECT

APPROVED 01/04/2019
N H JOHNSON (SIGNED)
SNR PRINCIPAL ENGINEER – ELECT

WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
STANDARD LINETYPES
GENERAL AND ELECTRICAL POWER, CONTROL & PROTECTION LOGIC

FILE | PLAN DRAWING–5–1 | CAD | ISSUE A | PROJECT

ORIGINAL SHEET SIZE A1

STANDARDS\APPROVED\DS24\DS24 DRAWING–005–001–01A 12:22 06/03/2019 memorys0/WS27103

ELECTRICAL SITE LAYOUTS

APPLICATION	TYPE OF LINE	EXAMPLE OF LINE	THICKNESS	AUTOCAD PROPERTIES				
				INDEX COLOUR				
				COLOUR NAME	COLOUR NUMBER	LINE WIDTH	LINETYPE	LAYER
CONTOURS AND BUILDINGS	CONTINUOUS		0.1 mm	–	9	0.1	BY–LAYER	9
KERBS, DRIVEWAYS	DOT, 0.5 GAP		0.18 mm	–	13	0.18	BY–LAYER	WC–DOT5
WC OPEN MAIN/ BRANCH DRAIN	10 DASH, 4.6 GAP WITH 1.5 HIGH 'DO'	DO	0.18 mm	–	13	0.18	BY–LAYER	WC–DO10
WC PIPED MAIN/ BRANCH DRAIN	2 DASH, 1 GAP, 2 DASH, 5.4 GAP WITH 1.5 HIGH 'DP', 2 DASH, 1 GAP	DP	0.18 mm	–	13	0.18	BY–LAYER	WC–DP10
LOCAL AUTHORITY/ PRIVATE OPEN DRAIN	10 DASH, 7.1 GAP WITH 1.5 HIGH 'DLAO'	DLAO	0.18 mm	–	13	0.18	BY–LAYER	WC–DLA10
LOCAL AUTHORITY/ PRIVATE PIPED DRAIN	2 DASH, 1 GAP, 2 DASH, 7.9 GAP WITH 1.5 HIGH 'DLAP', 2 DASH, 1 GAP	DLAP	0.18 mm	–	13	0.18	BY–LAYER	WC–DLAP10
ABOVE GROUND GAS	10 DASH, 3.1 GAP WITH 1.5 HIGH 'G'	G	0.18 mm	–	13	0.18	BY–LAYER	WC–G10
BELOW GROUND GAS	2 DASH, 1 GAP, 2 DASH, 3.9 GAP WITH 1.5 HIGH 'G', 2 DASH, 1 GAP	G	0.18 mm	–	13	0.18	BY–LAYER	WC–G10BG
ABOVE GROUND ELECTRICAL CABLE (HIGH VOLTAGE)	10 DASH, 5.9 GAP WITH 1.5 HIGH 'HVE'	HVE	0.18 mm *(0.5 mm)*	– *MAGENTA*	13 *(6)*	0.18 *(0.5)*	BY–LAYER	WC–HVE10
BELOW GROUND ELECTRICAL CABLE (HIGH VOLTAGE)	2 DASH, 1 GAP, 2 DASH, 6.7 GAP WITH 1.5 HIGH 'HVE', 2 DASH, 1 GAP	HVE	0.18 mm *(0.5 mm)*	– *(MAGENTA)*	13 *(6)*	0.18 *(0.5)*	BY–LAYER	WC–HVE10BG
ABOVE GROUND ELECTRICAL CABLE (LOW VOLTAGE)	10 DASH, 3.1 GAP WITH 1.5 HIGH 'E'	E	0.18 mm *(0.5 mm)*	– *(MAGENTA)*	13 *(6)*	0.18 *(0.5)*	BY–LAYER	WC–E10
BELOW GROUND ELECTRICAL CABLE (LOW VOLTAGE)	2 DASH, 1 GAP, 2 DASH, 3.9 GAP WITH 1.5 HIGH 'E', 2 DASH, 1 GAP	E	0.18 mm *(0.5 mm)*	– *(MAGENTA)*	13 *(6)*	0.18 *(0.5)*	BY–LAYER	WC–E10BG
COMMUNICATIONS CABLE (OVERHEAD)	10 DASH, 3.1 GAP WITH 1.5 HIGH 'C'	C	0.18 mm *(0.35 mm)*	– *(YELLOW)*	13 *(2)*	0.18 *(0.35)*	BY–LAYER	WC–C10
COMMUNICATIONS CABLE (BELOW GROUND)	2 DASH, 1 GAP, 2 DASH, 3.9 GAP WITH 1.5 HIGH 'C', 2 DASH, 1 GAP	C	0.18 mm *(0.35 mm)*	– *(YELLOW)*	13 *(2)*	0.18 *(0.35)*	BY–LAYER	WC–C10BG
PRESSURE MAIN (ABOVE GROUND)	10 DASH, 4.8 GAP WITH 1.5 HIGH 'PM'	PM	0.18 mm	–	13	0.18	BY–LAYER	WC–PM10
PRESSURE MAIN (BELOW GROUND)	2 DASH, 1 GAP, 2 DASH, 6.6 GAP WITH 1.5 HIGH 'PM', 2 DASH, 1 GAP	PM	0.18 mm	–	13	0.18	BY–LAYER	WC–PM10BG
SEWER – GRAVITY (PROPOSED)	CONTINUOUS		0.7 mm *(0.18 mm)*	– –	14 *(13)*	0.7 *(0.18)*	BY–LAYER	BYLAYER
SEWER – GRAVITY (EXISTING ABOVE GROUND)	10 DASH, 3.1 GAP WITH 1.5 HIGH 'S'	S	0.25 mm *(0.18 mm)*	GREEN –	3 *(13)*	0.25 *(0.18)*	BY–LAYER	WC–S10
SEWER – GRAVITY (EXISTING BELOW GROUND)	2 DASH, 1 GAP, 2 DASH, 3.9 GAP WITH 1.5 HIGH 'S', 2 DASH, 1 GAP	S	0.25 mm *(0.18 mm)*	GREEN –	3 *(13)*	0.25 *(0.18)*	BY–LAYER	WC–S10BG

ELECTRICAL SITE LAYOUTS

APPLICATION	TYPE OF LINE	EXAMPLE OF LINE	THICKNESS	AUTOCAD PROPERTIES				
				INDEX COLOUR				
				COLOUR NAME	COLOUR NUMBER	LINE WIDTH	LINETYPE	LAYER
TELEPHONE CABLE (ABOVE GROUND)	10 DASH, 4.8 GAP WITH 1.5 HIGH 'T'	T	0.18 mm *(0.35 mm)*	– *(YELLOW)*	13 *(2)*	0.18 *(0.35)*	BY–LAYER	WC–T10
TELEPHONE CABLE (BELOW GROUND)	2 DASH, 1 GAP, 2 DASH, 3.9 GAP WITH 1.5 HIGH 'T', 2 DASH, 1 GAP	T	0.18 mm *(0.35 mm)*	– *(YELLOW)*	13 *(2)*	0.18 *(0.35)*	BY–LAYER	WC–T10BG
OPTIC FIBRE CABLE (ABOVE GROUND)	10 DASH, 4.6 GAP WITH 1.5 HIGH 'OF'	OF	0.18 mm *(0.35 mm)*	– *(YELLOW)*	13 *(2)*	0.18 *(0.35)*	BY–LAYER	WC–OF10
OPTIC FIBRE CABLE (BELOW GROUND)	2 DASH, 1 GAP, 2 DASH, 5.4 GAP WITH 1.5 HIGH 'OF', 2 DASH, 1 GAP	OF	0.18 mm *(0.35 mm)*	– *(YELLOW)*	13 *(2)*	0.18 *(0.35)*	BY–LAYER	WC–OF10BG
WATER (ABOVE GROUND)	10 DASH, 3.1 GAP WITH 1.5 HIGH 'W'	W	0.18 mm	–	13	0.18	BY–LAYER	WC–W10
WATER (BELOW GROUND)	2 DASH, 1 GAP, 2 DASH, 3.9 GAP WITH 1.5 HIGH 'W', 2 DASH, 1 GAP	W	0.18 mm	–	13	0.18	BY–LAYER	WC–W10BG
COMPRESSED AIR (ABOVE GROUND)	10 DASH, 3.1 GAP WITH 1.5 HIGH 'A'	A	0.18 mm	–	13	0.18	BY–LAYER	WC–A10
COMPRESSED AIR (BELOW GROUND)	2 DASH, 1 GAP, 2 DASH, 3.9 GAP WITH 1.5 HIGH 'A', 2 DASH, 1 GAP	A	0.18 mm	–	13	0.18	BY–LAYER	WC–A10BG
FUEL (ABOVE GROUND)	10 DASH, 3.1 GAP WITH 1.5 HIGH 'F'	A	0.18 mm	–	13	0.18	BY–LAYER	WC–F10
FUEL (BELOW GROUND)	2 DASH, 1 GAP, 2 DASH, 3.9 GAP WITH 1.5 HIGH 'F', 2 DASH, 1 GAP	A	0.18 mm	–	13	0.18	BY–LAYER	WC–F10BG
FENCE	10 DASH, 2.6 GAP WITH 1.5 HIGH '/'	/	0.18 mm	–	13	0.18	BY–LAYER	WC–FENCEA10
ROAD RESERVES & LOT BOUNDARIES	CONTINUOUS		0.18 mm	–	13	0.18	BY–LAYER	18
PROPOSED PROPERTY CONNECTIONS	CONTINUOUS		0.5 mm *(0.18 mm)*	MAGENTA –	6 *(13)*	0.5 *(0.18)*	BY–LAYER	24
RETICULATION AREA BOUNDARY	3 DASH, 1.5 GAP		2.0 mm POLYLINE *(0.1 mm POLYLINE)*	–	9	0.1	BY–LAYER	WC–DASH
SWITCHBOARDS, CABLE PITS, TRANSFORMERS, JUNCTION BOXES	CONTINUOUS		0.5 mm	MAGENTA	6	0.5	BY–LAYER	24

GENERAL NOTES
1. LINETYPES FOR ELECTRICAL DRAFTING APPLICATIONS SHOWN ARE DERIVED FROM 'STANDARD DRAWING LAYER CONVENTION WASTEWATER RETICULATION' AS SHOWN ON 'CAD_LAYERS 4.2' DRAWING IN DESIGN STANDARD DSB0 SECTION 4
2. FOR ELECTRICAL SITE LAYOUT DRAWING APPLICATIONS USE THESE LINETYPES AND MODIFY SPECIFIC LINETYPES BY CHANGING COLOUR NUMBER AS SHOWN IN BOLD ITALICS ENCLOSED WITHIN BRACKETS

INFORMATIVE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD

DESIGN SURVEY: NONE | VERTICAL DATUM: NONE | DES CALC | NORTH POINT
COORDINATE SYS: NONE | DES CHD
ASCON SURVEY: NONE | DES REF | DRN | Q.C. CHD

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RECOMMENDED 01/04/2019 S A MEMORY (SIGNED) SENIOR TECHNICAL ADVISOR – ELECT
APPROVED 01/04/2019 N H JOHNSON (SIGNED) SNR PRINCIPAL ENGINEER – ELECT

WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
STANDARD LINETYPES
ELECTRICAL SITE LAYOUTS

FILE | PLAN | CAD | ISSUE
PROJECT | DRAWING–5–2 | A

ORIGINAL SHEET SIZE: A1

B10

STANDARDS\APPROVED\DS24\DS24 DRAWING–005–002–01A 12:22 06/03/2019 memorys0/WS27103

CONTROL DIAGRAMS

APPLICATION	TYPE OF LINE	EXAMPLE OF LINE	THICKNESS	AUTOCAD PROPERTIES				
				INDEX COLOUR				
				COLOUR NAME	COLOUR NUMBER	LINE WIDTH	LINETYPE	LAYER
CONTROL WIRES – ACTIVE – NEUTRAL – EARTH – DC POSITIVE – DC NEGATIVE	CONTINUOUS		0.35 mm	DARK CYAN	122	0.35	CONTINUOUS	1
ELECTRIC SIGNAL CONTINUOUSLY VARIABLE OR BINARY	SHORT DASH		0.357 mm	–	40	0.35	WC–DASH	72
BOUNDARY – EQUIPMENT – PANEL – CUBICLE – BUILDING	CENTRELINE		0.357 mm	RED	1	0.25	WC–CENT	111
SCREEN	SHORT DASH		0.357 mm	BLUE	5	0.25	WC–DASH	110

LOOP DIAGRAMS

APPLICATION	TYPE OF LINE	EXAMPLE OF LINE	THICKNESS	AUTOCAD PROPERTIES				
				INDEX COLOUR				
				COLOUR NAME	COLOUR NUMBER	LINE WIDTH	LINETYPE	LAYER
INSTRUMENT ELECTRIC POWER SUPPLY	CONTINUOUS		0.35 mm	DARK CYAN	122	0.35	CONTINUOUS	1
ELECTRONIC OR ELECTRICAL CONTINUOUSLY VARIABLE SIGNAL	SHORT DASH		0.35 mm	–	40	0.35	WC–DASH	72
BOUNDARY – EQUIPMENT – CUBICLE – FIELD DIVIDING LINE –VERTICAL	CENTRELINE		0.357 mm	RED	1	0.25	WC–CENT	111
SCREEN CONNECTIONS	SHORT DASH		0.35 mm	BLUE	5	0.25	WC–DASH	110
DRAWING DIVIDING LINE–HORIZONTAL	CONTINUOUS – MEDIUM		0.5 mm	MAGENTA	6	0.5	CONTINUOUS	24

P&I DIAGRAMS

APPLICATION	TYPE OF LINE	EXAMPLE OF LINE	THICKNESS	AUTOCAD PROPERTIES				
				INDEX COLOUR				
				COLOUR NAME	COLOUR NUMBER	LINE WIDTH	LINETYPE	LAYER
TRUNK MAIN	CONTINUOUS		1.0 mm		11	1.0	CONTINUOUS	77
MAJOR PIPE/FLOW LINE	CONTINUOUS		0.7 mm	DARK MAGENTA	202	0.7	CONTINUOUS	76
MINOR PIPE/ FLOW LINE	CONTINUOUS		0.5 mm	MAGENTA	6	0.5	CONTINUOUS	75
PROCESS PIPE	CONTINUOUS		0.35 mm	DARK CYAN	122	0.35	CONTINUOUS	74
FLEXIBLE HOSE	SPECIAL		0.25 mm	GREEN	3	0.25	WCI–HOSE12	WCI–HOSE12
PIPELINE (FUTURE)	DASH – SHORT		0.25 mm	GREEN	3	0.25	DASH5	DASH5
BOUNDARY LINE	CENTRELINE – SHORT		0.25 mm	RED	1	0.25	WC–CENT5	112
ELECTRIC SIGNAL	DASH		0.35 mm	–	40	0.35	WC–DASH	72
UNDEFINED SIGNAL (SHORT)	SPECIAL		0.25 mm	GREEN	3	0.25	WCI–SIGUND10	WCI–SIGUND10
UNDEFINED SIGNAL (LONG)	SPECIAL		0.25 mm	GREEN	3	0.25	WCI–SIGUND30	WCI–SIGUND30
PNEUMATIC SIGNAL (SHORT)	SPECIAL		0.25 mm	GREEN	3	0.25	WCI–SIGPNU10	WCI–SIGPNU10
PNEUMATIC SIGNAL (LONG)	SPECIAL		0.25 mm	GREEN	3	0.25	WCI–SIGPNU30	WCI–SIGPNU30
HYDRAULIC SIGNAL (SHORT)	SPECIAL		0.25 mm	GREEN	3	0.25	WCI–SIGHYD10	WCI–SIGHYD10
HYDRAULIC SIGNAL (LONG)	SPECIAL		0.25 mm	GREEN	3	0.25	WCI–SIGHYD30	WCI–SIGHYD30
CAPILLARY TUBE (SHORT)	SPECIAL		0.25 mm	GREEN	3	0.25	WCI–CAPTUBE10	WCI–CAPTUBE10
CAPILLARY TUBE (LONG)	SPECIAL		0.25 mm	GREEN	3	0.25	WCI–CAPTUBE30	WCI–CAPTUBE30
ELECTROMAGNETIC OR SONIC SIGNAL (NOT GUIDED)	SPECIAL		0.25 mm	GREEN	3	0.25	WCI–SIGESNG20	WCI–SIGESNG20
ELECTROMAGNETIC OR SONIC SIGNAL (GUIDED)	SPECIAL		0.25 mm	GREEN	3	0.25	WCI–SIGESG20	WCI–SIGESG20
INTERNAL SYSTEM LINK (SHORT) (SOFTWARE OR DATA LINK)	SPECIAL		0.25 mm	GREEN	3	0.25	WCI–LINKIS10	WCI–LINKIS10
INTERNAL SYSTEM LINK (LONG) (SOFTWARE OR DATA LINK)	SPECIAL		0.25 mm	GREEN	3	0.25	WCI–LINKIS30	WCI–LINKIS30
MECHANICAL LINK (SHORT)	SPECIAL		0.25 mm	GREEN	3	0.25	WCI–LINKME10	WCI–LINKME10
MECHANICAL LINK (LONG)	SPECIAL		0.25 mm	GREEN	3	0.25	WCI–LINKME30	WCI–LINKME30

GENERAL NOTES
1. LINETYPES FOR PROCESS & INSTRUMENTATION DRAFTING APPLICATIONS SHOWN, ARE IN ACCORDANCE WITH DRAWING GB72–60–2 IN DESIGN STANDARD DS80 SECTION B

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ISSUE	DATE	ORID	REVISION	DRN	REC	APPD

DESIGN SURVEY | VERTICAL DATUM NONE | DES CALC
COORDINATE SYS NONE | DES CHD
ASCON SURVEY | DES REF | DRN | Q.C. CHD

NORTH POINT

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RECOMMENDED 01/04/2019
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SENIOR TECHNICAL ADVISOR – ELECT
APPROVED 01/04/2019
N H JOHNSON (SIGNED)
SNR PRINCIPAL ENGINEER – ELECT

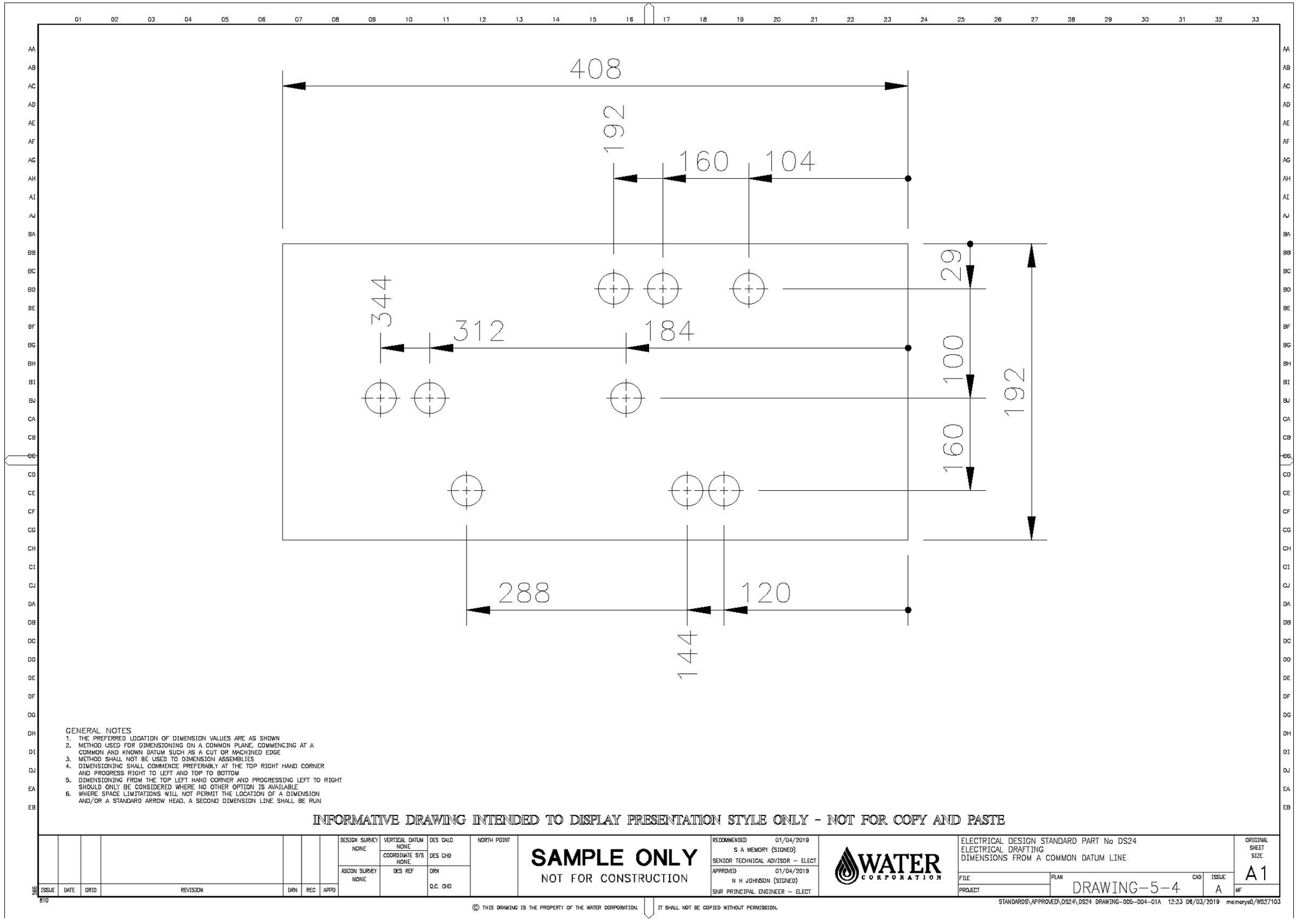
WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
STANDARD LINETYPES
CONTROL, LOOP AND P&I DIAGRAMS

ORIGINAL SHEET SIZE A1

FILE | PLAN DRAWING–5–3 | CAD | ISSUE A
PROJECT | MF

STANDARDS\APPROVED\DS24\DS24 DRAWING–005–003–01A 12:22 06/03/2019 memorys0/WS27103



GENERAL NOTES
1. THE PREFERRED LOCATION OF DIMENSION VALUES ARE AS SHOWN
2. METHOD USED FOR DIMENSIONING ON A COMMON PLANE, COMMENCING AT A COMMON AND KNOWN DATUM SUCH AS A CUT OR MACHINED EDGE
3. METHOD SHALL NOT BE USED TO DIMENSION ASSEMBLIES
4. DIMENSIONING SHALL COMMENCE PREFERABLY AT THE TOP RIGHT HAND CORNER AND PROGRESS RIGHT TO LEFT AND TOP TO BOTTOM
5. DIMENSIONING FROM THE TOP LEFT HAND CORNER AND PROGRESSING LEFT TO RIGHT SHOULD ONLY BE CONSIDERED WHERE NO OTHER OPTION IS AVAILABLE
6. WHERE SPACE LIMITATIONS WILL NOT PERMIT THE LOCATION OF A DIMENSION AND/OR A STANDARD ARROW HEAD, A SECOND DIMENSION LINE SHALL BE RUN

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ISSUE	DATE	GRID	REVISION	DRN	REC	APPD

DESIGN SURVEY NONE | VERTICAL DATUM NONE | COORDINATE SYS NONE | ASCON SURVEY NONE | DES REF | DES CALC | DES CHD | DRN | Q.C. CHD | NORTH POINT

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SNR PRINCIPAL ENGINEER – ELECT

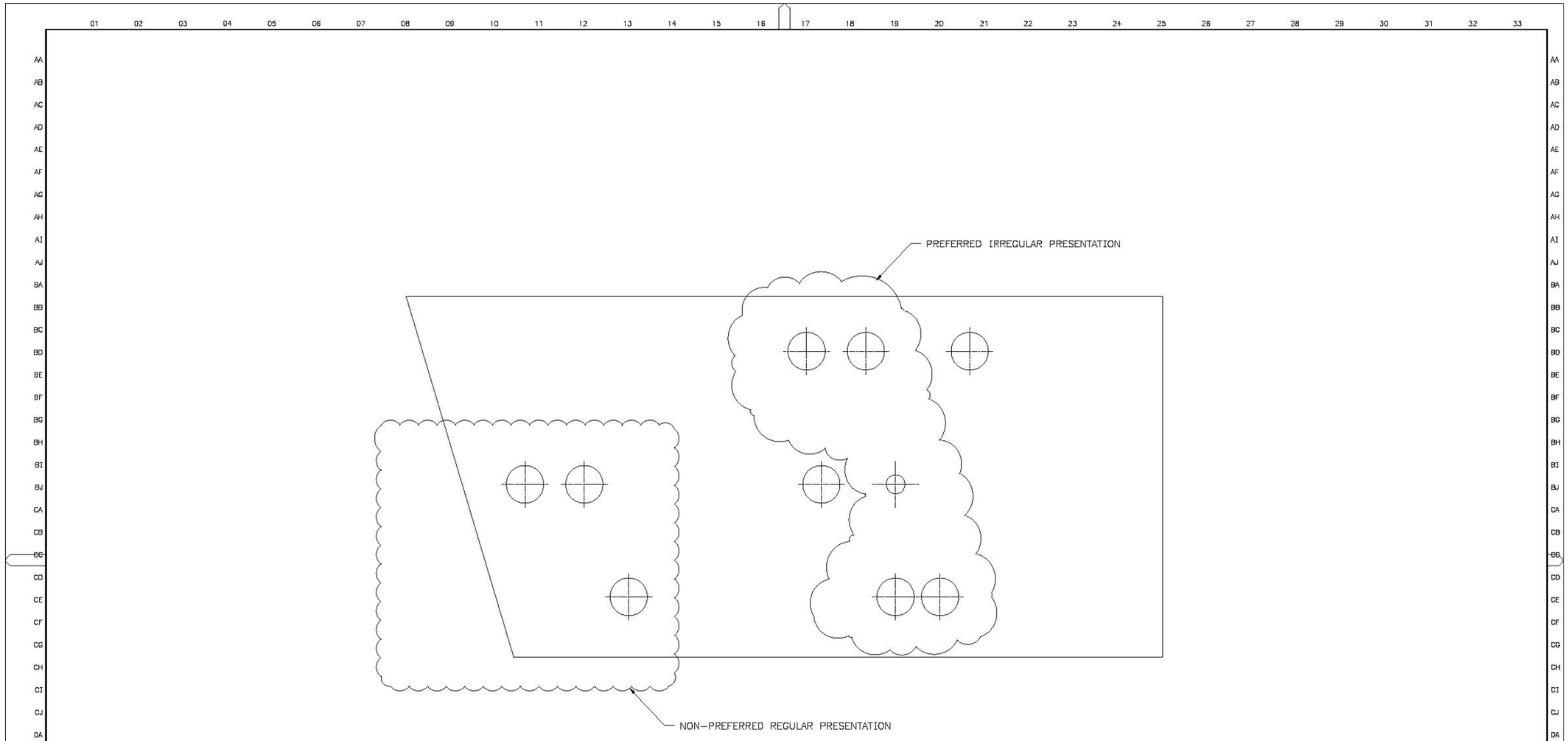
WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
DIMENSIONS FROM A COMMON DATUM LINE

FILE | PLAN DRAWING–5–4 | CAD | ISSUE A
PROJECT | MF

ORIGINAL SHEET SIZE A1

STANDARDS\APPROVED\DS24\DS24 DRAWING–005–004–01A 12:23 06/03/2019 memorys0/WS27103



GENERAL NOTES
1. A NOTE MAY BE ADDED IN THE GENERAL NOTES TO EXPLAIN THE USE OF THE CLOUDS IF NECESSARY
2. A REVISION IDENTIFICATION SYMBOL IN THE FORM OF AN ISSUE LETTER OR NUMBER WITHIN A TRIANGLE SHALL NOT BE USED. NO OTHER SYMBOL SHALL BE USED

INFORMATIVE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	CRID	REVISION	DRN	REC	APPD

DESIGN SURVEY: NONE | VERTICAL DATUM: NONE | COORDINATE SYS: NONE | ASCON SURVEY: NONE | DES REF | DES CALC | DES CHD | DRN | Q.C. CHD | NORTH POINT

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WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
HIGHLIGHTING PROPOSED CHANGES USING CLOUDS

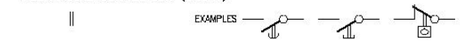
FILE | PLAN: DRAWING–5–5 | CAD | ISSUE: A | ORIGINAL SHEET SIZE: A1
PROJECT | MF

STANDARDS\APPROVED\DS24\DS24 DRAWING–005–005–01A 12:23 06/03/2019 memorys0/WS27103

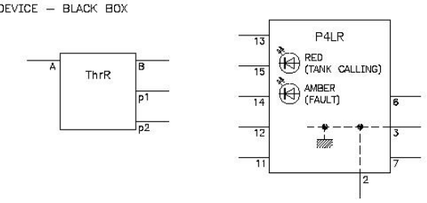
GENERAL

WIRE NUMBER
(SHOWING PREFERRED LOCATION OF IDENTIFYING TEXT)

MECHANICAL CONNECTION (SHORT)



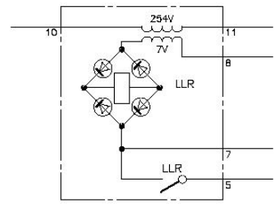
DEVICE – BLACK BOX



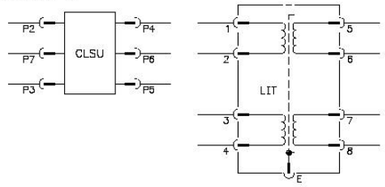
BASIC REPRESENTATION

WITH SIMPLIFIED ADDITIONAL DETAIL

DEVICE – CONTAINED WITHIN CHAIN DOT LINE



DEVICE – PLUG IN



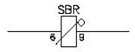
ARC FLASH

ARC FLASH DETECTOR

GENERAL NOTES
1. THE SYMBOLS AND METHODS OF PRESENTATION SHOWN SHALL BE USED IN PREFERENCE TO ANY OTHER SYMBOLS OR METHODS OF PRESENTATION FOR SIMILAR ITEMS OF EQUIPMENT.
2. THE STYLE OF PRESENTATION OF THE THESE SYMBOLS TO BE ADOPTED TO PRESENT ANY ELECTRICAL OR ELECTRONIC DEVICE OF A SIMILAR NATURE WHERE NO SPECIFIC SYMBOLS ARE PROVIDED WITHIN THE RELEVANT STANDARDS
3. AUTOMATIC TRIPPING FUNCTION INITIATED BY BUILT IN MEASURING RELAY OR RELEASE. USE WHERE NECESSARY TO DISTINGUISH BETWEEN MANUAL AND AUTOMATIC OPERATION

COILS AND CONTACTS

RELAY WITH FLAG INDICATOR



RELAY OR CONTACTOR COILS AND CONTACT (NON–PLUG IN)

LATCHED CONTACTS

PLUG–IN RELAY OR CONTACTOR COILS AND CONTACT

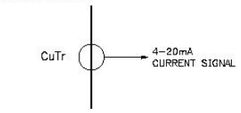
CURRENT TRANSFORMERS

CURRENT TRANSFORMER

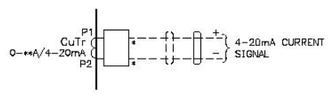
USE FOR MULTI–LINE DIAGRAM ONLY

TRANSDUCERS

CURRENT TRANSDUCER

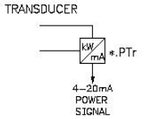


USE FOR SINGLE–LINE DIAGRAM ONLY

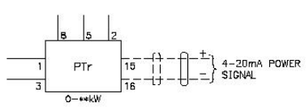


USE FOR MULTI–LINE DIAGRAM ONLY

POWER TRANSDUCER



USE FOR SINGLE–LINE DIAGRAM ONLY



USE FOR MULTI–LINE DIAGRAM ONLY

CIRCUIT BREAKERS

MINIATURE CIRCUIT BREAKER

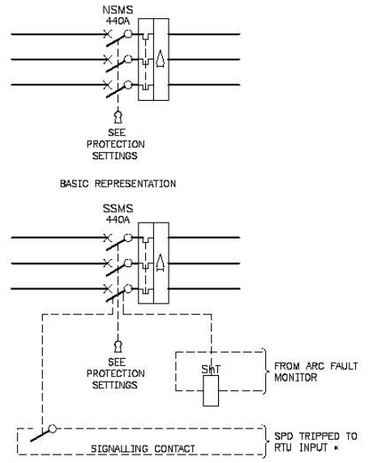
BASIC

(SEE NOTE 3)

RCD (SINGLE LINE)

RCD (MULT–LINE)

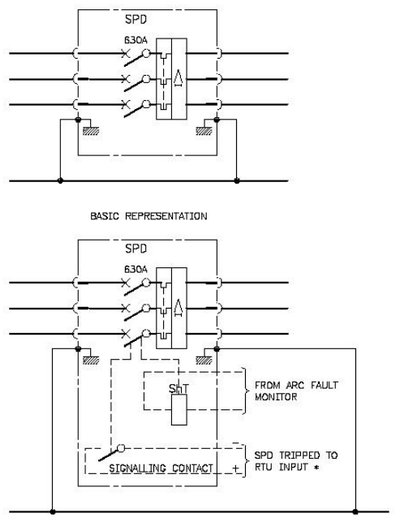
MAIN SWITCHES (MOULDED CASE CIRCUIT BREAKER)



BASIC REPRESENTATION

REPRESENTATION WITH ADDITIONAL SIGNALLING FUNCTIONS

SERVICE PROTECTION DEVICE (MOULDED CASE CIRCUIT BREAKER – PLUG–IN)

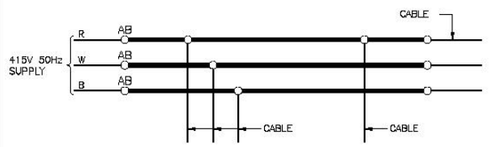


BASIC REPRESENTATION

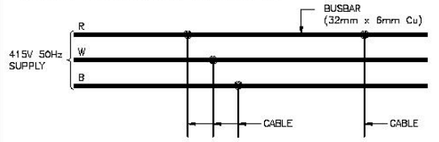
REPRESENTATION WITH ADDITIONAL SIGNALLING FUNCTIONS

ACTIVE AND EARTH BARS

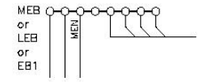
PHASE ACTIVE BAR
(PROPRIETARY DEVICE – TYPICALLY BRASS BAR WITH TUNNEL TERMINALS)



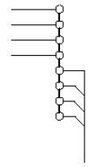
PHASE ACTIVE BUSBAR
(TYPICALLY MANUFACTURED FROM COOPER BUSBAR)



EARTH BAR
(PROPRIETARY DEVICE – TYPICALLY BRASS BAR WITH TUNNEL TERMINALS)



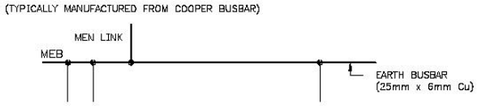
HORIZONTAL PRESENATION



VERTICAL PRESENATION

NOTES
1. NOT TO BE USED WHERE THE BAR IS A BUSBAR SIMILAR TO A PHASE BUSBAR
2. USE FOR MULTI–LINE DIAGRAM ONLY

MAIN EARTH BAR
(TYPICALLY MANUFACTURED FROM COOPER BUSBAR)



CODE SCHEDULE

AB	ACTIVE BAR
AFS	ARC FLASH SENSOR
CC	CONTROL CONTACTOR
CLSU	CONTROL LINE SURGE SUPPRESSION UNIT
CT	CURRENT TRANSFORMER
CuTr	CURRENT TRANSFORMER AND TRANSDUCER
EB1	EARTH BAR No1
LC	LINE CONTACTOR
LEB	LOCAL EARTH BAR
LIT	LINE INTERPOSING RELAY
LLR	LOW LEVEL RELAY
LPCB	LIGHTING AND POWER OUTLETS CIRCUIT BREAKER
MCB	MAIN CIRCUIT BREAKER
MEB	MAIN EARTH BAR
NSMS	NORMAL SUPPLY MAIN SWITCH
P4LR	PCA–4 LINE RELAY
PTr	POWER TRANSDUCER
SBR	STANDBY RELAY
SHT	SHUNT TRIP
SPD	SERVICE PROTECTION DEVICE
SSMS	STANDBY SUPPLY MAIN SWITCH
ThrR	THERMISTOR RELAY

INFORMATIVE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	ORID	REVISION	DRN	REC	APPD
810						

DESIGN SURVEY: NONE
VERTICAL DATUM: NONE
COORDINATE SYS: NONE
ASCON SURVEY: NONE
DES REF:
DES CALC:
DES CHD:
DRN:
Q.C. CHD:
NORTH POINT

SAMPLE ONLY
NOT FOR CONSTRUCTION

RECOMMENDED 01/04/2019
S A MEMORY (SIGNED)
SENIOR TECHNICAL ADVISOR – ELECT
APPROVED 01/04/2019
N H JOHNSON (SIGNED)
SNR PRINCIPAL ENGINEER – ELECT

WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
SPECIAL SYMBOLS AND PREFERRED SYMBOL PRESENTATION
PART 1

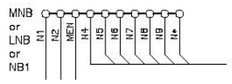
FILE | PLAN: DRAWING–6–1 | CAD | ISSUE: A | PROJECT

ORIGINAL SHEET SIZE: A1

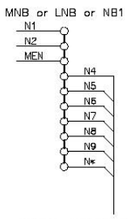
STANDARDS\APPROVED\DS24\DS24 DRAWING–006–001–01A 12:23 06/03/2019 memorys0/WS27103

NEUTRAL BARS

NEUTRAL BAR
(PROPRIETARY DEVICE – TYPICALLY BRASS BAR WITH TUNNEL TERMINALS)



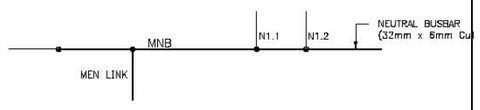
HORIZONTAL PRESENATION



VERTICAL PRESENATION

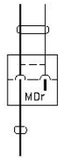
NOTES
1. NOT TO BE USED WHERE THE BAR IS A BUSBAR SIMILAR TO A PHASE BUSBAR
2. USE FOR MULTI–LINE DIAGRAM ONLY

MAIN NEUTRAL BAR
(TYPICALLY MANUFACTURED FROM COOPER BUSBAR)

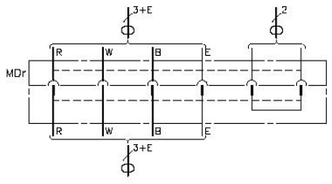


DECONTACTORS

DECONTACTOR



USE FOR SINGLE–LINE DIAGRAM ONLY

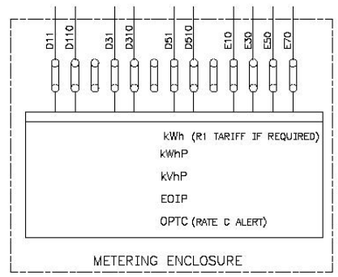


USE FOR MULTI–LINE DIAGRAM ONLY

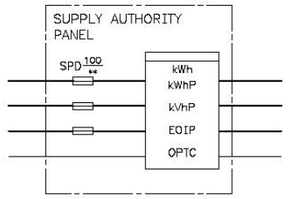
GENERAL NOTES
1. THE SYMBOLS AND METHODS OF PRESENTATION SHOWN SHALL BE USED IN PREFERENCE TO ANY OTHER SYMBOLS OR METHODS OF PRESENTATION FOR SIMILAR ITEMS OF EQUIPMENT.
2. THE STYLE OF PRESENTATION OF THE THESE SYMBOLS TO BE ADOPTED TO PRESENT ANY ELECTRICAL OR ELECTRONIC DEVICE OF A SIMILAR NATURE WHERE NO SPECIFIC SYMBOLS ARE PROVIDED WITHIN THE RELEVANT STANDARDS

SUPPLY AUTHORITY METERING

SUPPLY AUTHORITY kWh METER (C.T. METERING)

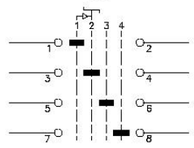


SUPPLY AUTHORITY kWh METER (DIRECT METERING)



SELECTOR SWITCHES

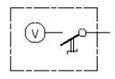
SELECTOR SWITCH



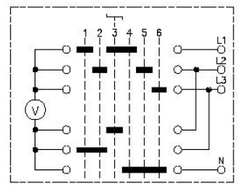
BASIC REPRESENTATION

USE FOR MULTI–LINE DIAGRAM ONLY

DEVICE INCORPORATING SELECTOR SWITCH



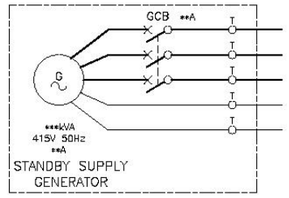
USE FOR SINGLE–LINE DIAGRAM ONLY



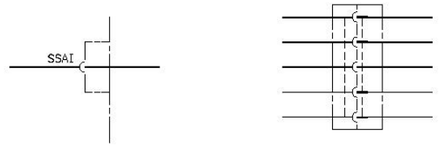
USE FOR MULTI–LINE DIAGRAM ONLY

STANDBY SUPPLIES

STANDBY SUPPLY GENERATOR



STANDY SUPPLY APPLIANCE INLET



USE FOR SINGLE–LINE DIAGRAM ONLY

USE FOR MULTI–LINE DIAGRAM ONLY

STARTERS

DIRECT ON–LINE STARTER

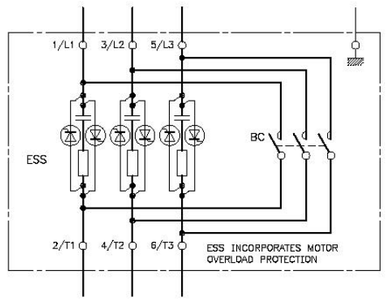
USE FOR SINGLE–LINE DIAGRAM ONLY

AUTO–TRANSFORMER STARTER

USE FOR SINGLE–LINE DIAGRAM ONLY

ELECTRONIC SOFT STARTER
(INTERNAL BYPASS CONTACTOR)

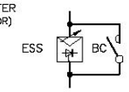
USE FOR SINGLE–LINE DIAGRAM ONLY



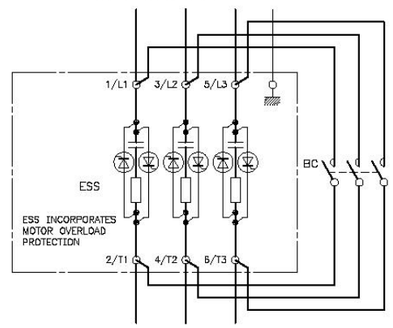
USE FOR MULTI–LINE DIAGRAM ONLY

STARTERS (CONT'D)

ELECTRONIC SOFT STARTER
(EXTERNAL BYPASS CONTACTOR)



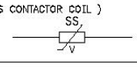
USE FOR SINGLE–LINE DIAGRAM ONLY



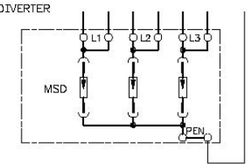
USE FOR MULTI–LINE DIAGRAM ONLY

SURGE DIVERTERS

SURGE SUPPRESSOR
(TYPICALLY CONNECTED ACROSS CONTACTOR COIL)



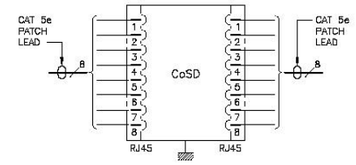
MAINS SURGE DIVERTER



CONTROL SURGE DIVERTER

TWO WIRE REPRESNTATION
(EARTHING VIA CABLE)

TWO WIRE REPRESENTATION
(EARTHING VIA CHASSIS
THROUGH MOUNTING RAIL



CODE SCHEDULE

ATrS	AUTOTRANSFORMER STARTER	LNB	LOCAL NEUTRAL BAR
BC	BYPASS CONTACTOR	MDr	MOTOR DECONTACTOR
CoSD	COMMUNICATION CABLE SURGE DIVERTER	MNB	MAIN NEUTRAL BAR
CSS	CONTROL SELECTOR SWITCH	MSD	MAINS SURGE DIVERTER
DOLS	DIRECT ON LINE STARTER	NB1	NEUTRAL BAR No1
EOIP	END OF INTERVAL PULSE CONTACT	OPTC	ON PEAK TARIFF CONTACT
ESS	ELECTRONIC SOFT STARTER	SPD	SERVICE PROTECTION DEVICE
GCB	GENERATOR CIRCUIT BREAKER	SD	SURGE DIVERTER
kVhP	kVARh PULSE CONTACT	SS	SURGE SUPPRESSOR
kWh	KILOWATT HOUR METER	SSAI	STANDBY SUPPLY APPLIANCE INLET
kWhP	KILOWATT HOUR PULSE CONTACT	V	VOLTMETER

INFORMATIVE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
B10						

DESIGN SURVEY NONE
VERTICAL DATUM NONE
COORDINATE SYS NONE
ASCON SURVEY NONE
DES REF
DES CALC
DES CHD
DRN
Q.C. CHD
NORTH POINT

SAMPLE ONLY
NOT FOR CONSTRUCTION

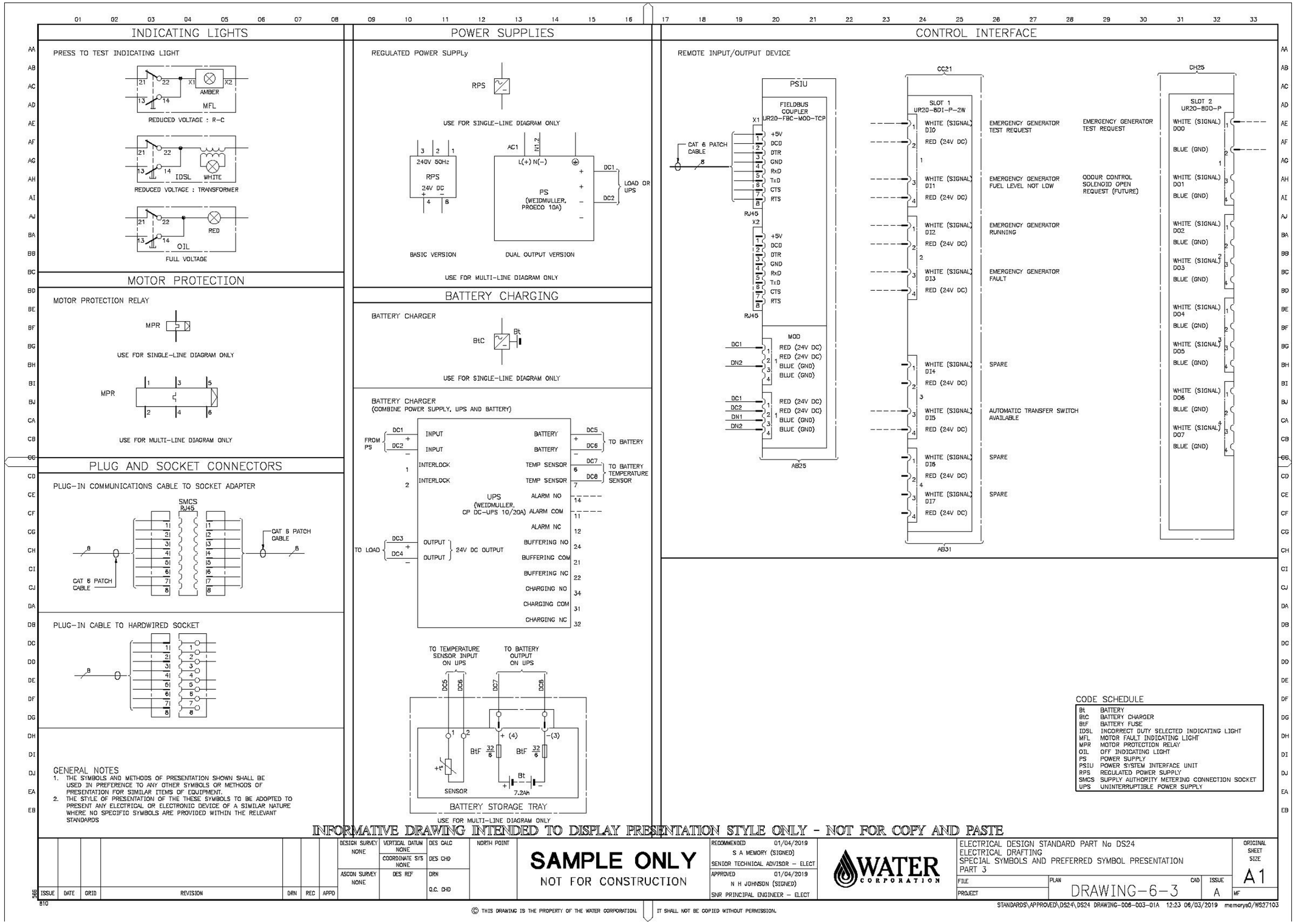
RECOMMENDED 01/04/2019
S A MEMORY (SIGNED)
SENIOR TECHNICAL ADVISOR – ELECT
APPROVED 01/04/2019
N H JOHNSON (SIGNED)
SNR PRINCIPAL ENGINEER – ELECT

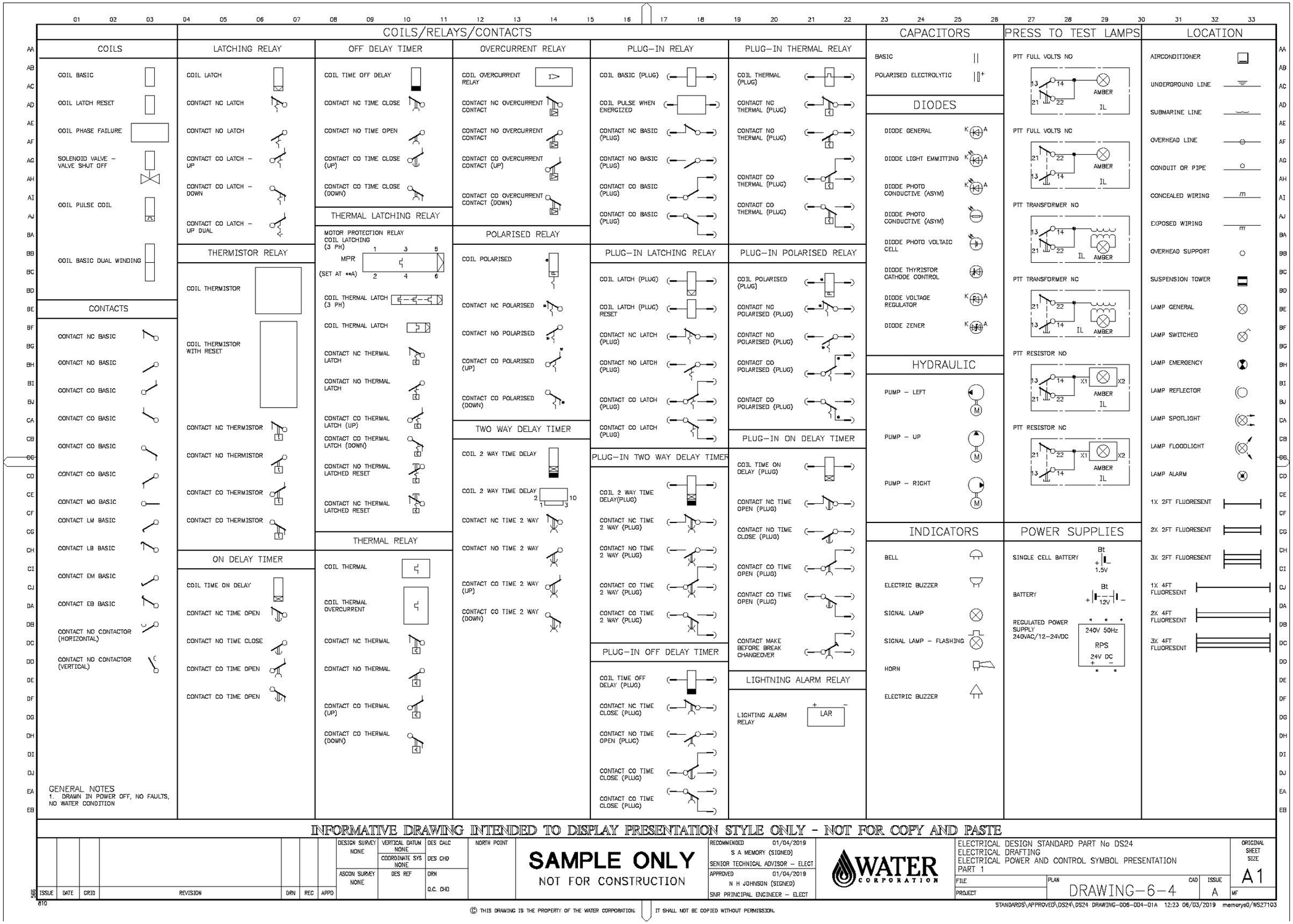
WATER CORPORATION

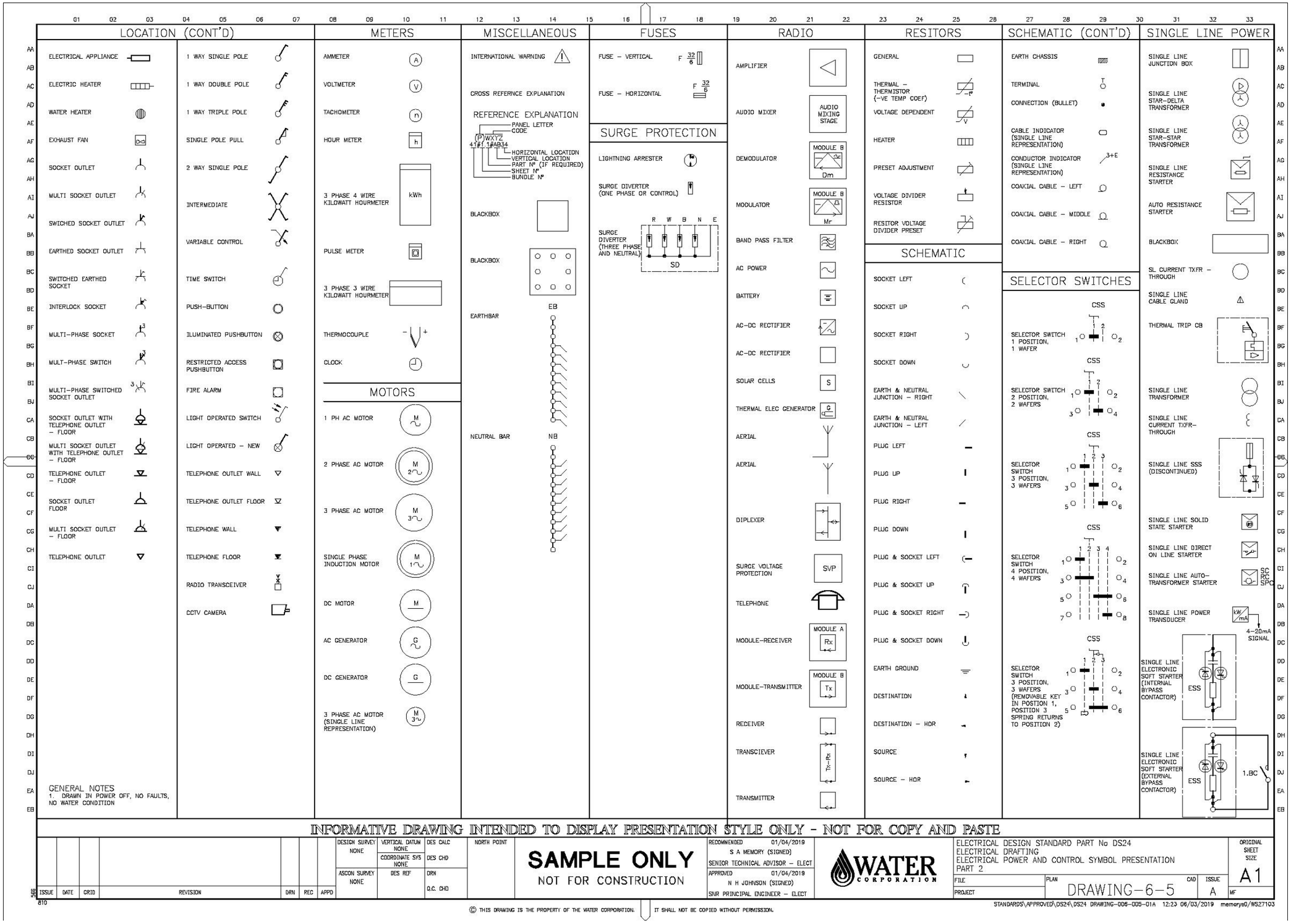
ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
SPECIAL SYMBOLS AND PREFERRED SYMBOL PRESENTATION
PART 2

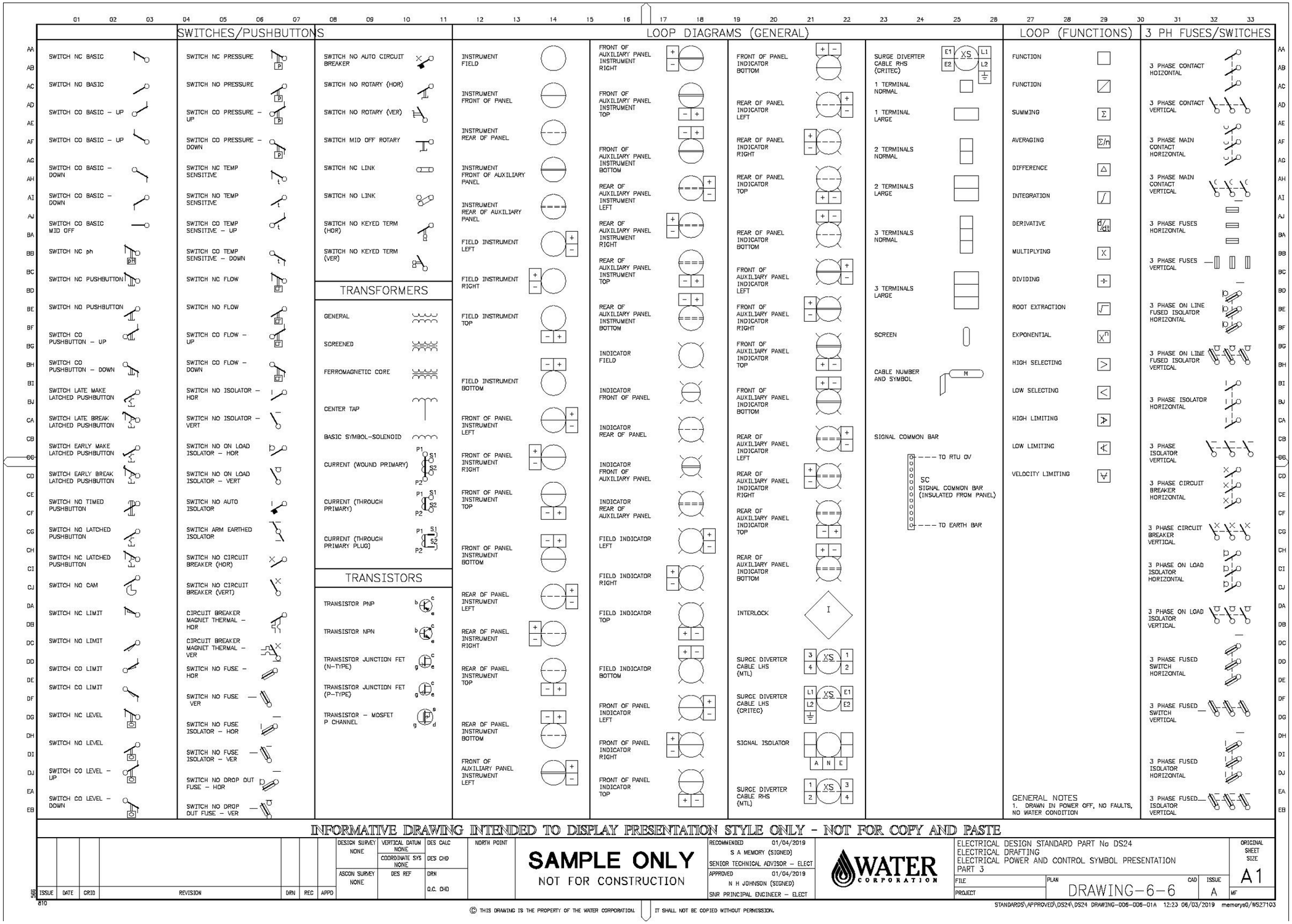
FILE
PROJECT
PLAN DRAWING–6–2
CAD
ISSUE A
ORIGINAL SHEET SIZE A1
MF

STANDARDS\APPROVED\DS24\DS24 DRAWING–006–002–01A 12:23 06/03/2019 memorys0/WS27103









GENERAL

LOGIC STATES
"ON" IS THE LOGICAL "1" STATE
"OFF" IS THE LOGICAL "0" STATE

INPUTS
INPUTS TO LOGIC ELEMENTS ARE SHOWN THUS

OUTPUTS
OUTPUT FROM LOGIC ELEMENTS ARE SHOWN THUS

PARALLEL CONNECTIONS
THE OUTPUT FROM ANY LOGIC ELEMENT MAY BE CONNECTED TO ANY NUMBER OF LOGIC ELEMENT INPUTS. HOWEVER LOGIC ELEMENT OUTPUTS MAY NOT BE CONNECTED TOGETHER

ON BUS — ON
THIS IS THE SOURCE OF THE DIGITAL SIGNAL ENTERING THE CONTROLLER. (ON BUSES ARE SHOWN ON THE LEFT OF THE DIAGRAM)

INTERNAL 'INPUT' BUS — BUS NAME
THIS IS A LINK WITHIN THE CONTROLLER BETWEEN A PARTICULAR LOGIC ELEMENT OUTPUT AND A NUMBER OF LOGIC ELEMENT INPUTS. (LOGIC ELEMENT INPUTS FROM INTERNAL BUSES ARE SHOWN ON THE LEFT OF THE DIAGRAM)

INTERNAL 'OUTPUT' BUS — BUS NAME
THIS IS A LINK WITHIN THE CONTROLLER BETWEEN A NUMBER OF LOGIC ELEMENT INPUTS AND A PARTICULAR LOGIC ELEMENT OUTPUT. (LOGIC ELEMENT OUTPUTS TO INTERNAL BUSES ARE SHOWN ON THE RIGHT OF THE DIAGRAM)

INTERNAL BUSES SHOULD ONLY BE CREATED AT "MILESTONE" POINTS IN THE LOGIC FLOW AND SHOULD BE ANNOTATED TO INDICATE THE POSITIVE CONDITION. ie STANDBY LATCHED INTERNAL BUS IS POSITIVE WHEN STANDBY IS LATCHED

HARDWARE INPUT OR OUTPUT — INPUT OR OUTPUT TERMINAL NUMBER / ADDRESS NUMBER
THIS IS THE POINT OF ENTRY TO, OR EXIT FROM THE CONTROLLER FOR BOTH DIGITAL AND ANALOGUE SIGNALS. (INPUTS ARE SHOWN ON THE LEFT OF THE DIAGRAM, AND OUTPUTS ARE SHOWN ON THE RIGHT OF THE DIAGRAM)

THIS SYMBOL IS SUFFICIENT REPRESENTATION OF THE CONVERSION OF EXTERNAL ANALOGUE SIGNALS TO INTERNAL DIGITAL SIGNALS. (ADDITIONAL SYMBOLOGY TO REPRESENT ANALOGUE TO DIGITAL CONVERSION NOT REQUIRED)

SOFTWARE INPUT OR OUTPUT — ADDRESS NUMBER
THIS IS THE POINT OF ENTRY TO, OR EXIT FROM THE CONTROLLER FOR DATA COMMUNICATION SIGNALS. (INPUTS ARE SHOWN ON THE LEFT OF THE DIAGRAM, AND OUTPUTS ARE SHOWN ON THE RIGHT OF THE DIAGRAM)

INTERNAL PROGRAMME CONVERSION
THESE EXAMPLES REPRESENT ACCEPTABLE METHODS OF CONVERSION OF DATA FORMATS WITHIN THE CONTROLLER PROGRAMME

%R07942 REAL → %R08765 INTEGER
DOUBLE WORD %R07038 → DOUBLE INTEGER
REAL = WHOLE NUMBERS, RATIONAL NUMBERS OR IRRATIONAL NUMBERS
INTEGER = WHOLE NUMBERS WITHOUT A FRACTIONAL OR DECIMAL COMPONENT
DOUBLE INTEGER = LARGE WHOLE NUMBERS WITHOUT A FRACTIONAL OR DECIMAL COMPONENT

X0–X17 → V2800 (BCD) →
BCD = BINARY CODED DECIMAL (A NUMBER 0 TO 9 CONVERTED TO FOUR DIGIT BINARY)
BIN = BINARY (A BASE 2, 8 BIT NUMBER REPRESENTED BY THE NUMERIC VALUE 0 OR 1)

X0–X17 → V2600 (BCD) → F → V2000 (BCD) → V5673 (BIN)

MISCELLANEOUS

INVERTER — 1/X
OUTPUT "ON" IF INPUT "OFF"
OUTPUT "OFF" IF INPUT "ON"

LATCH (RETENTIVE) — S, R, L
OUTPUT LATCHES "ON" IF "ON" PULSE APPLIED TO INPUT S.
OUTPUT LATCHES "OFF" IF "ON" PULSE APPLIED TO INPUT R.
INPUT S OVERRIDES INPUT R
(LATCHES MAINTAINED DURING POWER FAILURE)

ONE SCAN PULSE
OUTPUT "ON" FOR PERIOD OF ONE SCAN AFTER INPUT GOES "ON";
OTHERWISE OUTPUT "OFF"

VARIABLE TIME PULSE (OF T SECONDS DURATION) — Ts
OUTPUT "ON" FOR T SECONDS AFTER INPUT GOES "ON";
OTHERWISE OUTPUT "OFF"

FILTER — F
SAMPLE TIME = ** s
DIVISOR, K = **
(SEE NOTE 2)
FILTER ACTION DEPENDENT UPON SPECIFIC CONTROLLER MODEL.
EXAMPLE SHOWN APPLIES FOR KOYO PLC'S

ON TIME DELAY — Ts
PRESET ON TIME VALUE OF T SECONDS
OUTPUT "OFF" T SECONDS AFTER INPUT GOES "ON" AND THEN REMAINS "ON" WHILE INPUT "ON"
OUTPUT "OFF" IMMEDIATELY INPUT "OFF"

VARIABLE ON TIME DELAY — tn
ON TIME VALUE OF t SECONDS SET FROM EXTERNAL SOURCE
OUTPUT "OFF" T SECONDS AFTER INPUT GOES "ON" AND THEN REMAINS "ON" WHILE INPUT "ON"
OUTPUT "OFF" IMMEDIATELY INPUT "OFF"

ACCUMULATING TIME DELAY — RESET, ΣTs
ACCUMULATES TIME INTERVALS AND RETAINS VALUE. RESET FROM EXTERNAL SOURCE
INPUT GOES "ON" TIME ACCUMULATES, OUTPUT "OFF"
INPUT GOES "OFF" TIME ACCUMULATION STOPS, OUTPUT "OFF"
OUTPUT "ON" AFTER ACCUMULATED PRESET TIME VALUE ELAPSED AND INPUT "ON"
ACCUMULATED TIME VALUE RESET WHEN PULSE APPLIED TO INPUT "RESET"

FLIP–FLOP — F1, F2, FF, Q1, Q2
OUTPUTS SWITCH STATES EACH TIME AN "ON" PULSE APPLIED TO INPUT. Q1 IS THE INVERSE OF Q2 ie Q1 IS "OFF" WHEN Q2 IS "ON" AND VICA VERSA

CODE SCHEDULE

DV	CONTROL VARIABLE
F	FILTER
FF	FLIP–FLOP
K	CONSTANT
Kp	PROPORTIONAL GAIN
Ki	INTEGRAL GAIN
Kd	DERIVATIVE GAIN
L	LATCH
PID	PROPORTIONAL–INTEGRAL–DERIVATIVE
PV	PROCESS VARIABLE
Q	****
R	RESET
S	SET
s	SECONDS
SP	SET POINT
T	CONSTANT TIME VALUE
t	VARIABLE TIME VALUE
n	VARIABLE COUNTER VALUE
OIP	OPERATOR INTERFACE PANEL
PLC	PROGRAMMABLE LOGIC CONTROLLER
RTU	REMOTE TERMINAL UNIT
SCADA	SUPERVISORY CONTROL AND DATA AQUISITION

AND / OR

'AND' GATE TWO INPUT VERSION — AND
OUTPUT "ON" IF BOTH INPUTS "ON"
OTHERWISE OUTPUT "OFF"

'AND' GATE FOUR INPUT VERSION (REPRESENTATION MAY BE MODIFIED FOR ANY NUMBER OF INPUTS) — AND
OUTPUT "ON" IF ALL INPUTS "ON"
OTHERWISE OUTPUT "OFF"

'OR' GATE TWO INPUT VERSION — OR
OUTPUT "ON" IF ANY INPUT "ON"
OUTPUT "OFF" IF ALL INPUTS "OFF"

'OR' GATE FOUR INPUT VERSION (REPRESENTATION MAY BE MODIFIED FOR ANY NUMBER OF INPUTS) — OR
OUTPUT "ON" IF ANY INPUT "ON"
OUTPUT "OFF" IF ALL INPUTS "OFF"

COUNT

EXTERNAL RESET COUNTER — COUNTER ***, RESET
OUTPUT GOES "ON" AFTER PRESET COUNTER VALUE PULSES APPLIED TO INPUT
COUNT REGISTER RESET TO "OFF" IF "ON" PULSE APPLIED TO RESET INPUT

DEFINED RESET COUNTER — COUNTER ***, n, RESET
OUTPUT GOES "ON" AFTER PRESET COUNTER VALUE PULSES APPLIED TO INPUT
COUNT REGISTER RESET TO "OFF" WHEN PRESET COUNTER VALUE REACHED

DEFINED RESET COUNTER WITH CURRENT VALUE OUTPUT — COUNTER ********, COUNT VALUE, RESET
CURRENT COUNT VALUE IS OUTPUT AFTER EACH PULSE APPLIED TO INPUT
COUNT REGISTER RESET TO "OFF" WHEN PRESET COUNTER VALUE REACHED

VARIABLE RESET COUNTER — COUNTER, n, RESET
COUNTER RESET VALUE SET FROM EXTERNAL SOURCE
OUTPUT GOES "ON" AFTER VARIABLE COUNTER VALUE PULSES APPLIED TO INPUT
COUNT REGISTER RESET TO "OFF" WHEN VARIABLE COUNTER VALUE REACHED

VARIABLE RESET COUNTER WITH CURRENT VALUE OUTPUT — COUNTER, n, COUNT VALUE, RESET
COUNTER RESET VALUE SET FROM EXTERNAL SOURCE
CURRENT COUNT VALUE IS OUTPUT AFTER EACH PULSE APPLIED TO INPUT
COUNT REGISTER RESET TO "OFF" WHEN VARIABLE COUNTER VALUE REACHED

LEGEND

○	PHYSICAL I/O TERMINAL
□	SOFTWARE I/O
- - - - - - -	ANALOGUE I/O SIGNAL (4–20mA, 1–5V) OR ANALOGUE LOGIC SIGNAL (BYTE, WORD, DOUBLE WORD)
———	DIGITAL I/O SIGNAL (OFF OR ON) OR BINARY LOGIC SIGNAL (SINGLE BIT)
—○—○—	COMMUNICATION LINK

SAMPLE GENERAL NOTES

1. ANALOGUE INPUTS SET FOR 0–20mA OPERATION, WITH TRANSMITTER OUTPUTS 4–20mA. UNDER–RANGE SIGNAL CORRESPONDS TO 3.6mA (CONSTANT = 717). METHOD OF DETERMINING TRANSMITTER FAULTS WILL VARY DEPENDING ON PLC MANUFACTURER AND TYPE
2. FIRST ORDER FILTERS ARE OF FORM $y_n = x_{(n-1)} + \frac{x_n - x_{(n-1)}}{K}$, WHERE x_n IS INPUT AT nth SAMPLE AND y_n IS OUTPUT AT nth SAMPLE. TYPICAL SAMPLE TIME IS 1 SECOND AND TYPICAL DIVISOR (K) IS 20
3. ASTERISKS INDICATE A VARIABLE, DEPENDENT UPON PARTICULAR SITE REQUIREMENTS. THESE VARIABLES NOMINATED BY THE DESIGN ENGINEER
4. THE HARDWARE INPUT OR OUTPUT SYMBOL NOT ONLY REPRESENTS THE POINT OF ENTRY TO OR EXIT FROM THE CONTROLLING DEVICE, IT ALSO REPRESENTS THE CONVERSION OF EXTERNAL ANALOGUE SIGNALS TO INTERNAL DIGITAL SIGNALS. ADDITIONAL SYMBOLOGY TO REPRESENT ANALOGUE TO DIGITAL CONVERSION NOT REQUIRED

INFORMATIVE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	ORID	REVISION	DRN	REC	APPD

DESIGN SURVEY NONE | VERTICAL DATUM NONE | COORDINATE SYS NONE | DES CALC | DES CHD | ASCON SURVEY NONE | DES REF | DRN | Q.C. CHD | NORTH POINT

SAMPLE ONLY
NOT FOR CONSTRUCTION

RECOMMENDED 01/04/2019 S A MEMORY (SIGNED) SENIOR TECHNICAL ADVISOR – ELECT
APPROVED 01/04/2019 N H JOHNSON (SIGNED) SNR PRINCIPAL ENGINEER – ELECT

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
LOGIC SYMBOLS
PART 1

FILE | PLAN | CAD | ISSUE A | ORIGINAL SHEET SIZE A1
PROJECT | DRAWING–6–7 | MF

STANDARDS\APPROVED\DS24\DS24 DRAWING–006–007–01A 12:23 06/03/2019 memorys0/WS27103

COMPARE

TWO INPUT COMPARATOR

IF a=b — OUTPUT "ON" IF INPUT VALUE "a" EQUALS INPUT VALUE "b", OTHERWISE OUTPUT "OFF"

IF a>b — OUTPUT "ON" IF INPUT VALUE "a" IS GREATER THAN INPUT VALUE "b", OTHERWISE OUTPUT "OFF"

IF a<b — OUTPUT "ON" IF INPUT VALUE "a" IS LESS THAN INPUT VALUE "b", OTHERWISE OUTPUT "OFF"

IF a≥b — OUTPUT "ON" IF INPUT VALUE "a" IS GREATER THAN OR EQUAL TO INPUT VALUE "b", OTHERWISE OUTPUT "OFF"

IF a≤b — OUTPUT "ON" IF INPUT VALUE "a" IS LESS THAN OR EQUAL TO INPUT VALUE "b", OTHERWISE OUTPUT "OFF"

THREE INPUT COMPARATOR
(REPRESENTATION MAY BE MODIFIED FOR ANY NUMBER OF INPUTS AND ANY MATHEMATICAL FUNCTION)

IF a ≤ b ≤ c — OUTPUT "ON" IF INPUT VALUE "a" IS LESS THAN OR EQUAL TO INPUT VALUE "b" AND INPUT VALUE "b" IS LESS THAN OR EQUAL TO INPUT VALUE "c", OTHERWISE OUTPUT "OFF"

MOVE

ONE INPUT MOVE
DATA MOVED EACH SCAN

MOVE — MOVEMENT OF INPUT VALUE TO OUTPUT PERFORMED EVERY SCAN

MULTIPLE INPUT MOVE
DATA MOVED EACH SCAN
(REPRESENTATION MAY BE MODIFIED FOR ANY NUMBER OF INPUTS)

MOVE — MOVEMENT OF ALL INPUT VALUES TO OUTPUTS PERFORMED EVERY SCAN

ENABLED MOVE

ONE INPUT MOVE
DATA MOVED WHEN ENABLED

ENABLE, MOVE — INPUT VALUE MOVED TO OUTPUT WHEN ENABLE PULSE APPLIED

MULTIPLE INPUT MOVE
DATA MOVED WHEN ENABLED
(REPRESENTATION MAY BE MODIFIED FOR ANY NUMBER OF INPUTS)

MOVE — ALL INPUT VALUES MOVED TO OUTPUTS WHEN ENABLE PULSE APPLIED

CALCULATE

ONE INPUT CALCULATION
DATA CALCULATED EACH SCAN
(REPRESENTATION MAY BE MODIFIED FOR ANY MATHEMATICAL EXPRESSION)

CALC 1−a — OUTPUT VALUE EQUALS ONE MINUS INPUT VALUE "a". CALCULATION PERFORMED EVERY SCAN

CALC $\sqrt{a}$ — OUTPUT VALUE EQUALS SQUARE ROOT OF INPUT VALUE "a". CALCULATION PERFORMED EVERY SCAN

CALC a x −1 — OUTPUT VALUE EQUALS INPUT VALUE "a" MULTIPLIED BY MINUS ONE. CALCULATION PERFORMED EVERY SCAN

CALC a x 100 — OUTPUT VALUE EQUALS INPUT VALUE "a" MULTIPLIED BY ONE HUNDRED. CALCULATION PERFORMED EVERY SCAN

CALC $\frac{a}{1000}$ — OUTPUT VALUE EQUALS INPUT VALUE "a" DIVIDED BY ONE THOUSAND. CALCULATION PERFORMED EVERY SCAN

CALC |a| — OUTPUT VALUE EQUALS THE ABSOLUTE VALUE OF INPUT VALUE "a". CALCULATION PERFORMED EVERY SCAN

TWO INPUT CALCULATION
DATA CALCULATED EACH SCAN
(REPRESENTATION MAY BE MODIFIED FOR ANY MATHEMATICAL EXPRESSION)

CALC a − b — OUTPUT VALUE EQUALS INPUT VALUE "a" MINUS INPUT VALUE "b". CALCULATION PERFORMED EVERY SCAN

CALC a + b — OUTPUT VALUE EQUALS INPUT VALUE "a" PLUS INPUT VALUE "b". CALCULATION PERFORMED EVERY SCAN

CALC a^b — OUTPUT VALUE EQUALS INPUT VALUE "a" MULTIPLIED BY ITSELF, INPUT VALUE "b" TIMES. CALCULATION PERFORMED EVERY SCAN

CALC a x b — OUTPUT VALUE EQUALS INPUT VALUE "a" MULTIPLIED BY INPUT VALUE "b" CALCULATION PERFORMED EVERY SCAN

CALC $a^2 \times b$ — OUTPUT VALUE EQUALS INPUT VALUE "a" SQUARED, MULTIPLIED BY INPUT VALUE "b" CALCULATION PERFORMED EVERY SCAN

CALC $\frac{a}{b}$ — OUTPUT VALUE EQUALS INPUT VALUE "a" DIVIDED BY INPUT VALUE "b" CALCULATION PERFORMED EVERY SCAN

CALC MAX (a,b) — OUTPUT VALUE EQUALS THE MAXIMUM VALUE OF INPUT VALUE "a" AND INPUT VALUE "b" CALCULATION PERFORMED EVERY SCAN

CALC MIN (a,b) — OUTPUT VALUE EQUALS THE MINIMUM VALUE OF INPUT VALUE "a" AND INPUT VALUE "b" CALCULATION PERFORMED EVERY SCAN

CALC $\left|\frac{a}{b}\right|$ — OUTPUT VALUE EQUALS THE ABSOLUTE VALUE OF INPUT VALUE "a" DIVIDED BY INPUT VALUE "b". CALCULATION PERFORMED EVERY SCAN

CALC $\frac{a+b}{2}$ — OUTPUT VALUE EQUALS INPUT VALUE "a" PLUS INPUT VALUE "b" DIVIDED BY INPUT VALUE TWO". CALCULATION PERFORMED EVERY SCAN

THREE INPUT CALCULATION
DATA CALCULATED EACH SCAN
(REPRESENTATION MAY BE MODIFIED FOR ANY MATHEMATICAL EXPRESSION)

CALC a−b−c — OUTPUT VALUE EQUALS INPUT VALUE "a" MINUS INPUT VALUE "b" MINUS INPUT VALUE "c". CALCULATION PERFORMED EVERY SCAN

CALC $\frac{a}{b \times c}$ — OUTPUT VALUE EQUALS INPUT VALUE "a" DIVIDED BY INPUT VALUE "b" MULTIPLIED BY INPUT VALUE "c". CALCULATION PERFORMED EVERY SCAN

CALCULATE (COMPLEX FORMULA)

ONE INPUT CALCULATION
DATA CALCULATED EACH SCAN
(REPRESENTATION MAY BE MODIFIED FOR ANY MATHEMATICAL EXPRESSION)

CALC $1089\sqrt{\frac{a}{32000}}$ — OUTPUT VALUE EQUALS 1089 MULTIPLIED BY THE SQUARE ROOT OF INPUT VALUE "a" DIVIDED BY 32000. CALCULATION PERFORMED EVERY SCAN

TWO INPUT CALCULATION
DATA CALCULATED EACH SCAN
(REPRESENTATION MAY BE MODIFIED FOR ANY MATHEMATICAL EXPRESSION)

CALC $\frac{32000 \times 1000}{a \times b \times 10}$ — OUTPUT VALUE EQUALS 32000 MULTIPLIED BY 1000, DIVIDED BY INPUT VALUE "a" MULTIPLIED BY INPUT VALUE "b" MULTIPLIED BY 100 CALCULATION PERFORMED EVERY SCAN

CALC $\left|\frac{a-b}{210m} \times 100\right|$ — OUTPUT VALUE EQUALS THE ABSOLUTE VALUE OF INPUT VALUE "a" MINUS INPUT VALUE "b" DIVIDED BY 210, MULTIPLIED BY 100 CALCULATION PERFORMED EVERY SCAN

THREE INPUT CALCULATION
DATA CALCULATED EACH SCAN
(REPRESENTATION MAY BE MODIFIED FOR ANY MATHEMATICAL EXPRESSION)

CALC $\left(\frac{a \times b}{32000} + a\right) \times 10$ — OUTPUT VALUE EQUALS INPUT VALUE "a" MULTIPLIED BY INPUT VALUE "b" DIVIDED BY 32000 PLUS INPUT VALUE "c", MULTIPLIED BY 100 CALCULATION PERFORMED EVERY SCAN

FOUR INPUT CALCULATION
DATA CALCULATED EACH SCAN
(REPRESENTATION MAY BE MODIFIED FOR ANY MATHEMATICAL EXPRESSION)

CALC $\left|\frac{c(a-b)}{300\ ML/d} \times d \times 10\right|$ — OUTPUT VALUE EQUALS THE ABSOLUTE VALUE OF INPUT VALUE "c" MULTIPLIED BY INPUT VALUE "a" MINUS INPUT VALUE "b", DIVIDED BY 300, MULTIPLIED BY INPUT VALUE "d" MULTIPLIED BY 10 CALCULATION PERFORMED EVERY SCAN

FIVE INPUT CALCULATION
DATA CALCULATED EACH SCAN
(REPRESENTATION MAY BE MODIFIED FOR ANY MATHEMATICAL EXPRESSION)

CALC $\left(V_h + \frac{\pi d^2}{4} \times (h_c - h_t - a)\right) \times j$ — OUTPUT VALUE EQUALS INPUT VALUE "Vh" PLUS 3.1415 MULTIPLIED BY INPUT VALUE "d" SQUARED, DIVIDED BY 4 MULTIPLIED BY INPUT VALUE "hc" MINUS INPUT VALUE "ht" MINUS INPUT VALUE "a" MULTIPLIED BY INPUT VALUE "j" CALCULATION PERFORMED EVERY SCAN

ENABLED CALCULATE

TWO INPUT ENABLED CALCULATION
DATA CALCULATED WHEN ENABLED
(REPRESENTATION MAY BE MODIFIED FOR ANY MATHEMATICAL EXPRESSION)

ENABLE, CALC a+b — OUTPUT VALUE EQUALS INPUT VALUE "a" PLUS INPUT VALUE "b". CALCULATION PERFORMED WHEN ENABLE PULSE APPLIED

TWO INPUT ENABLED INCREMENTATION CALCULATION
DATA CALCULATED WHEN ENABLED
(REPRESENTATION MAY BE MODIFIED FOR ANY MATHEMATICAL EXPRESSION)

ENABLE, CALC a+b — OUTPUT VALUE EQUALS LAST OUTPUT VALUE (INPUT VALUE "a") ADDED TO INPUT VALUE "b". CALCULATION PERFORMED WHEN ENABLE PULSE APPLIED

LEGEND

- ○ PHYSICAL I/O TERMINAL
- □ SOFTWARE I/O
- ------ ANALOGUE I/O SIGNAL (4−20mA, 1−5V) OR ANALOGUE LOGIC SIGNAL (BYTE, WORD, DOUBLE WORD)
- ——— DIGITAL I/O SIGNAL (OFF OR ON) OR BINARY LOGIC SIGNAL (SINGLE BIT)
- —○—○— COMMUNICATION LINK

SCALE

SCALE
DATA CALCULATED EACH SCAN
(REPRESENTATION MAY BE MODIFIED FOR ANY MATHEMATICAL EXPRESSION)

SCALE 0−32000 — OUTPUT VALUE EQUALS INPUT VALUE SCALED TO RANGE 0−32000 CALCULATION PERFORMED EVERY SCAN

SCALE 0−210 mH_2O — OUTPUT VALUE EQUALS INPUT VALUE SCALED TO RANGE 0−210 IN THE UNITS OF mH_2O CALCULATION PERFORMED EVERY SCAN

SCALE 0−2350 (x 0.1 mH_2O) — OUTPUT VALUE EQUALS INPUT VALUE SCALED TO RANGE 0−2350 IN THE UNITS OF 0.1 mH_2O CALCULATION PERFORMED EVERY SCAN

SCALE 0−2100 x 0.1 m — OUTPUT VALUE EQUALS INPUT VALUE SCALED TO RANGE 0−210 IN THE UNITS OF METRES CALCULATION PERFORMED EVERY SCAN

SCALE 0−3000 (x 0.1 ML/d) — OUTPUT VALUE EQUALS INPUT VALUE RANGE SCALED TO RANGE 0−3000 IN THE UNITS OF 0.1 MEGALITRES/DAY CALCULATION PERFORMED EVERY SCAN

ENABLED SCALE

ENABLED SCALE
DATA CALCULATED EACH SCAN
(REPRESENTATION MAY BE MODIFIED FOR ANY MATHEMATICAL EXPRESSION)

ENABLE, SCALE 0−3000 (x 0.1 ML/d) — OUTPUT VALUE EQUALS INPUT VALUE RANGE SCALED TO RANGE 0−300 IN THE UNITS OF 0.1 MEGALITRES/DAY SCALING PERFORMED WHEN ENABLE PULSE APPLIED

PID CONTROLLER

PID CONTROLLER

ENABLE, PID CONTROLLER (SP, PV, CV, PROPORTIONAL GAIN Kp, INTEGRAL GAIN Ki, DERIVATIVE GAIN Kd, MANUAL REQUEST, AUTO REQUEST, MANUAL CV VALUE, UPPER CV LIMITS, LOWER CV LIMITS) — EXAMPLE REPRESENTED IS DRAWN FOR A SPECIFIC APPLICATION USING A GE FANUC PLC. (REPRESENTATION MAY BE MODIFIED TO INCLUDE ADDITIONAL PID LOOP FEATURES AND OTHER EQUIPMENT MANUFACTURERS SPECIFIC FEATURES)

SAMPLE GENERAL NOTES

1. ANALOGUE INPUTS SET FOR 0−20mA OPERATION, WITH TRANSMITTER OUTPUTS 4−20mA. UNDER−RANGE SIGNAL CORRESPONDS TO 3.5mA (CONSTANT = 717). METHOD OF DETERMINING TRANSMITTER FAULTS WILL VARY DEPENDING ON PLC MANUFACTURER AND TYPE
2. FIRST ORDER FILTERS ARE OF FORM $y_n = x_{(n-1)} + \frac{x_n - x_{(n-1)}}{K}$, WHERE x_n IS INPUT AT nth SAMPLE AND y_n IS OUTPUT AT nth SAMPLE. TYPICAL SAMPLE TIME IS 1 SECOND AND TYPICAL DIVISOR (K) IS 20
3. ASTERISKS INDICATE A VARIABLE, DEPENDENT UPON PARTICULAR SITE REQUIREMENTS. THESE VARIABLES NOMINATED BY THE DESIGN ENGINEER
4. THE HARDWARE INPUT OR OUTPUT SYMBOL NOT ONLY REPRESENTS THE POINT OF ENTRY TO OR EXIT FROM THE CONTROLLING DEVICE. IT ALSO REPRESENTS THE CONVERSION OF EXTERNAL ANALOGUE SIGNALS TO INTERNAL DIGITAL SIGNALS. ADDITIONAL SYMBOLOGY TO REPRESENT ANALOGUE TO DIGITAL CONVERSION NOT REQUIRED

INFORMATIVE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	ORID	REVISION	DRN	REC	APPD

DESIGN SURVEY NONE | VERTICAL DATUM NONE | COORDINATE SYS NONE | ASCON SURVEY NONE | DES REF | DES CALC | DES CHD | DRN | Q.C. CHD | NORTH POINT

SAMPLE ONLY
NOT FOR CONSTRUCTION

RECOMMENDED 01/04/2019 S A MEMORY (SIGNED) SENIOR TECHNICAL ADVISOR − ELECT
APPROVED 01/04/2019 N H JOHNSON (SIGNED) SNR PRINCIPAL ENGINEER − ELECT

WATER CORPORATION

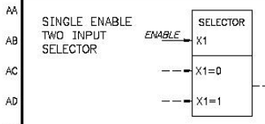
ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
LOGIC SYMBOLS
PART 2

FILE | PLAN DRAWING−6−8 | CAD | ISSUE A | PROJECT | ORIGINAL SHEET SIZE A1 | MF

STANDARDS\APPROVED\DS24\DS24 DRAWING−006−008−01A 12:23 06/03/2019 memorysa0/WS27103

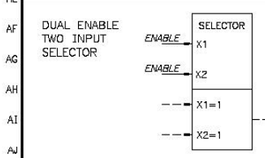
SELECTOR

SINGLE ENABLE TWO INPUT SELECTOR



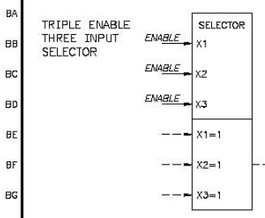
OUTPUT VALUE EQUALS INPUT VALUE "X1=0" WHEN X1 NOT ENABLED
OUTPUT VALUE EQUALS INPUT VALUE "X1=1" WHEN X1 ENABLED

DUAL ENABLE TWO INPUT SELECTOR



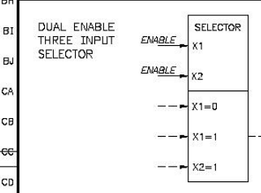
OUTPUT VALUE EQUALS INPUT VALUE "X1=1" WHEN X1 ENABLED
OUTPUT VALUE EQUALS INPUT VALUE "X2=1" WHEN X2 ENABLED
X1 AND X2 ARE MUTUALLY EXCLUSIVE
OUTPUT RETAINS LAST VALUE

TRIPLE ENABLE THREE INPUT SELECTOR



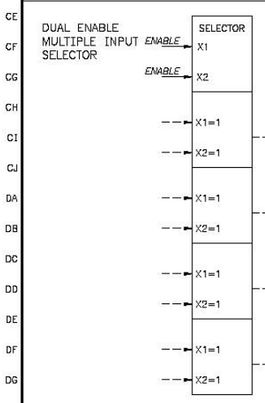
OUTPUT VALUE EQUALS INPUT VALUE "X1=1" WHEN X1 ENABLED
OUTPUT VALUE EQUALS INPUT VALUE "X2=1" WHEN X2 ENABLED
OUTPUT VALUE EQUALS INPUT VALUE "X3=1" WHEN X3 ENABLED
X1, X2 AND X3 ARE MUTUALLY EXCLUSIVE
OUTPUT RETAINS LAST VALUE

DUAL ENABLE THREE INPUT SELECTOR



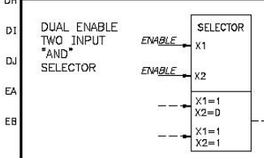
OUTPUT VALUE EQUALS INPUT VALUE "X1=0" WHEN X1 NOT ENABLED
OUTPUT VALUE EQUALS INPUT VALUE "X1=1" WHEN X1 ENABLED
OUTPUT VALUE EQUALS INPUT VALUE "X2=1" WHEN X2 ENABLED
X1, X2 AND X3 ARE MUTUALLY EXCLUSIVE
OUTPUT RETAINS LAST VALUE

DUAL ENABLE MULTIPLE INPUT SELECTOR



ALL FOUR OUTPUT VALUES EQUAL INDIVIDUAL INPUT VALUES "X1=1" WHEN X1 ENABLED
ALL FOUR OUTPUT VALUES EQUAL INDIVIDUAL INPUT VALUES "X2=1" WHEN X2 ENABLED
X1 AND X2 ARE MUTUALLY EXCLUSIVE
ALL OUTPUTS RETAIN LAST VALUE

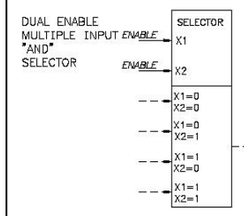
DUAL ENABLE TWO INPUT "AND" SELECTOR



OUTPUT VALUE EQUALS INPUT VALUE "X1=1, X2=0" WHEN X1 ENABLED AND X2 NOT ENABLED
OUTPUT VALUE EQUALS INPUT VALUE "X1=1, X2=1" WHEN X1 ENABLED AND X2 ENABLED
OUTPUT RETAINS LAST VALUE

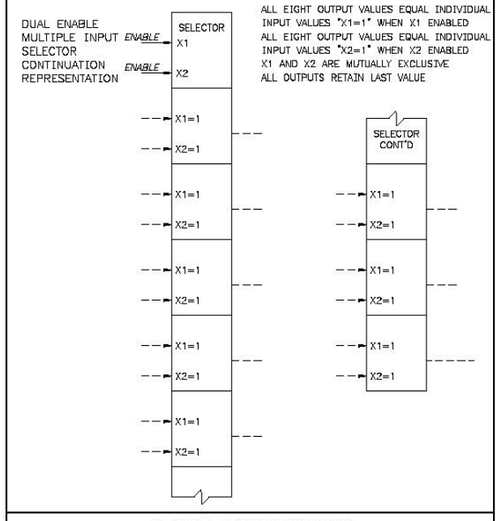
SELECTOR

DUAL ENABLE MULTIPLE INPUT "AND" SELECTOR



OUTPUT VALUE EQUALS INPUT VALUE "X1=0, X2=0" WHEN X1 NOT ENABLED AND X2 NOT ENABLED
OUTPUT VALUE EQUALS INPUT VALUE "X1=0, X2=1" WHEN X1 NOT ENABLED AND X2 ENABLED
OUTPUT VALUE EQUALS INPUT VALUE "X1=1, X2=0" WHEN X1 ENABLED AND X2 NOT ENABLED
OUTPUT VALUE EQUALS INPUT VALUE "X1=1, X2=1" WHEN X1 ENABLED AND X2 ENABLED
OUTPUT RETAINS LAST VALUE

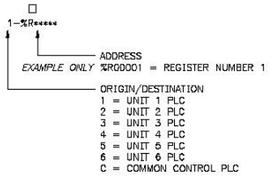
DUAL ENABLE MULTIPLE INPUT SELECTOR CONTINUATION REPRESENTATION



ALL EIGHT OUTPUT VALUES EQUAL INDIVIDUAL INPUT VALUES "X1=1" WHEN X1 ENABLED
ALL EIGHT OUTPUT VALUES EQUAL INDIVIDUAL INPUT VALUES "X2=1" WHEN X2 ENABLED
X1 AND X2 ARE MUTUALLY EXCLUSIVE
ALL OUTPUTS RETAIN LAST VALUE

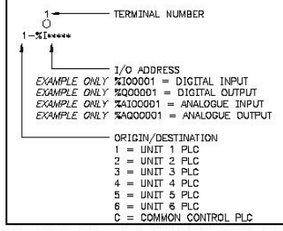
DEVICE IDENTIFICATION

SOFTWARE I/O IDENTIFICATION



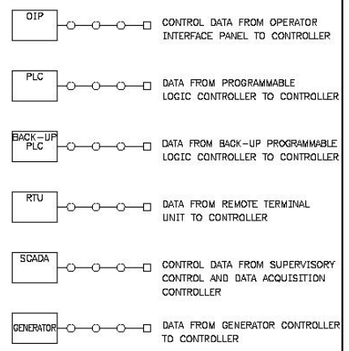
EXAMPLE REPRESENTED IS DRAWN FOR A MAJOR PUMP STATION WITH SIX PUMPING UNITS USING GE FANUC PLC. (REPRESENTATION MAY BE MODIFIED TO SUIT OTHER TYPES OF INSTALLATION AND OTHER EQUIPMENT MANUFACTURER PROGRAMMING CODE)

HARDWARE I/O IDENTIFICATION



EXTERNAL DEVICE INPUT COMMUNICATIONS LINK

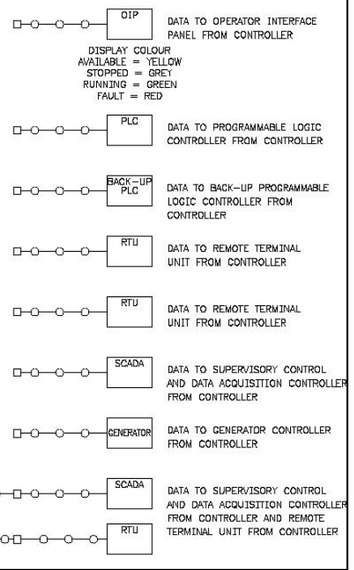
EXTERNAL DEVICE DATA INPUT VIA COMMUNICATIONS



CONTROL DATA FROM OPERATOR INTERFACE PANEL TO CONTROLLER
DATA FROM PROGRAMMABLE LOGIC CONTROLLER TO CONTROLLER
DATA FROM BACK–UP PROGRAMMABLE LOGIC CONTROLLER TO CONTROLLER
DATA FROM REMOTE TERMINAL UNIT TO CONTROLLER
CONTROL DATA FROM SUPERVISORY CONTROL AND DATA ACQUISITION CONTROLLER
DATA FROM GENERATOR CONTROLLER TO CONTROLLER

EXTERNAL DEVICE OUTPUT COMMUNICATIONS LINK

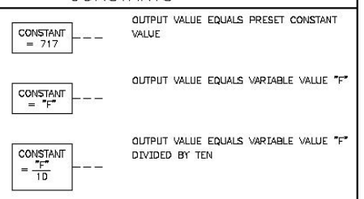
EXTERNAL DEVICE DATA OUTPUT VIA COMMUNICATIONS



DATA TO OPERATOR INTERFACE PANEL FROM CONTROLLER
DATA TO PROGRAMMABLE LOGIC CONTROLLER FROM CONTROLLER
DATA TO BACK–UP PROGRAMMABLE LOGIC CONTROLLER FROM CONTROLLER
DATA TO REMOTE TERMINAL UNIT FROM CONTROLLER
DATA TO REMOTE TERMINAL UNIT FROM CONTROLLER
DATA TO SUPERVISORY CONTROL AND DATA ACQUISITION CONTROLLER FROM CONTROLLER
DATA TO GENERATOR CONTROLLER FROM CONTROLLER
DATA TO SUPERVISORY CONTROL AND DATA ACQUISITION CONTROLLER FROM CONTROLLER AND REMOTE TERMINAL UNIT FROM CONTROLLER

CONSTANTS

CONSTANT VALUES

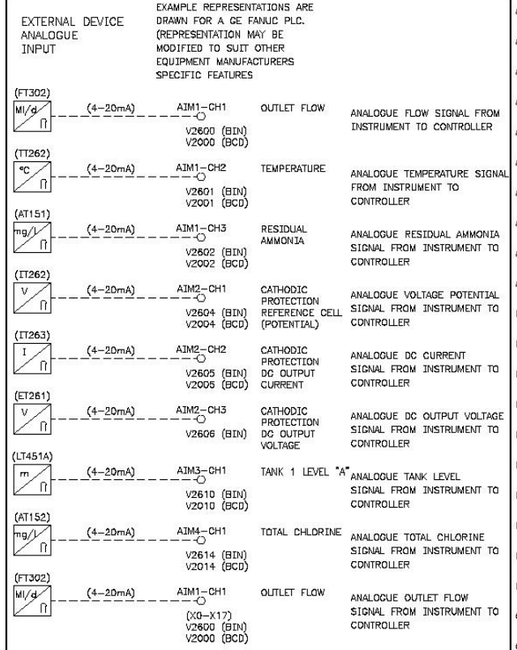


OUTPUT VALUE EQUALS PRESET CONSTANT VALUE
OUTPUT VALUE EQUALS VARIABLE VALUE "F"
OUTPUT VALUE EQUALS VARIABLE VALUE "F" DIVIDED BY TEN

EXTERNAL INSTRUMENTATION

EXTERNAL DEVICE ANALOGUE INPUT

EXAMPLE REPRESENTATIONS ARE DRAWN FOR A GE FANUC PLC. (REPRESENTATION MAY BE MODIFIED TO SUIT OTHER EQUIPMENT MANUFACTURERS SPECIFIC FEATURES



LEGEND

- ○ PHYSICAL I/O TERMINAL
- □ SOFTWARE I/O
- ------- ANALOGUE I/O SIGNAL (4–20mA, 1–5V) OR ANALOGUE LOGIC SIGNAL (BYTE, WORD, DOUBLE WORD)
- ——— DIGITAL I/O SIGNAL (OFF OR ON) OR BINARY LOGIC SIGNAL (SINGLE BIT)
- —○—○— COMMUNICATION LINK

SAMPLE GENERAL NOTES

1. ANALOGUE INPUTS SET FOR 0–20mA OPERATION, WITH TRANSMITTER OUTPUTS 4–20mA. UNDER–RANGE SIGNAL CORRESPONDS TO 3.6mA (CONSTANT = 717). METHOD OF DETERMINING TRANSMITTER FAULTS WILL VARY DEPENDING ON PLC MANUFACTURER AND TYPE
2. FIRST ORDER FILTERS ARE OF FORM $y_n = x_{(n-1)} + \frac{^{K}n - x(n-1)}{K}$, WHERE x_n IS INPUT AT nth SAMPLE AND y_n IS OUTPUT AT nth SAMPLE. TYPICAL SAMPLE TIME IS 1 SECOND AND TYPICAL DIVISOR (K) IS 20
3. ASTERISKS INDICATE A VARIABLE, DEPENDENT UPON PARTICULAR SITE REQUIREMENTS. THESE VARIABLES NOMINATED BY THE DESIGN ENGINEER
4. THE HARDWARE INPUT OR OUTPUT SYMBOL NOT ONLY REPRESENTS THE POINT OF ENTRY TO OR EXIT FROM THE CONTROLLING DEVICE, IT ALSO REPRESENTS THE CONVERSION OF EXTERNAL ANALOGUE SIGNALS TO INTERNAL DIGITAL SIGNALS. ADDITIONAL SYMBOLOGY TO REPRESENT ANALOGUE TO DIGITAL CONVERSION NOT REQUIRED

INFORMATIVE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY – NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
810						

DESIGN SURVEY NONE	VERTICAL DATUM NONE	DES CALC	NORTH POINT
	COORDINATE SYS NONE	DES CHD	
ASCON SURVEY NONE	DES REF	DRN	
		Q.C. CHD	

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SENIOR TECHNICAL ADVISOR – ELECT
APPROVED 01/04/2019
N H JOHNSON (SIGNED)
SNR PRINCIPAL ENGINEER – ELECT

WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
LOGIC SYMBOLS
PART 3

FILE	PLAN	CAD	ISSUE	ORIGINAL SHEET SIZE
PROJECT	DRAWING–6–9		A	A1
			MF	

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REFERENCE SPACES

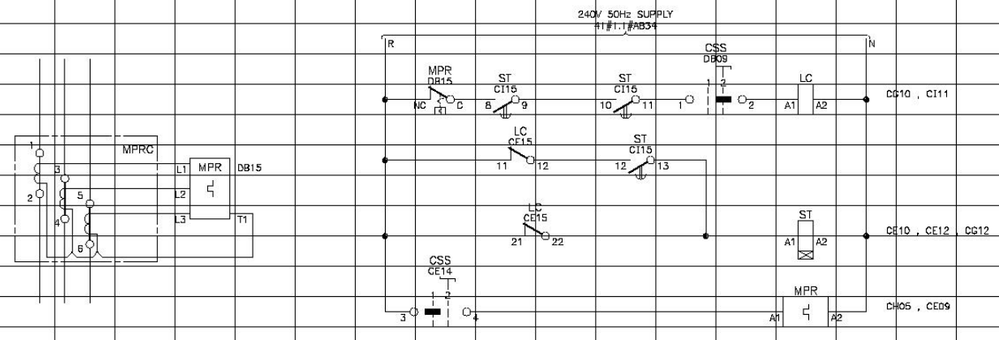
BD LIMITS OF VERTICAL SPACE

10 LIMITS OF HORIZONTAL SPACE

REFERENCE EXPLANATION

PANEL LETTER CODE
(P)WXYZ
41#1.1#AB34
HORIZONTAL LOCATION
VERTICAL LOCATION
PART N° (IF REQUIRED)
SHEET N°
BUNDLE N°

1. CROSS REFERENCE LOCATIONS SHOWN ADJACENT TO RELAY COILS REFER TO THE LOCATION OF ASSOCIATED CONTACTS
2. CROSS REFERENCE LOCATIONS SHOWN ABOVE RELAY CONTACTS REFER TO THE LOCATION OF THE ASSOCIATED COILS
3. CROSS REFERENCE LOCATIONS SHOWN ABOVE SWITCHES REFER TO THE LOCATION OF SEPARATED SWITCH CONTACTS
4. CROSS REFERENCE LOCATIONS SHOWN ADJACENT TO MPR ACTUATING DEVICES REFER TO THE LOCATION OF DETACHED PART AND ASSOCIATED CONTACTS
5. BUNDLE AND SHEET NUMBERS CAN BE OMITTED FROM THE CROSS REFERENCE WHEN CROSS REFERENCING WITHIN THE SAME DRAWING



POWER DIAGRAM

CONTROL DIAGRAM

REFERENCE EXAMPLE

INFORMATIVE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
810						

DESIGN SURVEY NONE | VERTICAL DATUM NONE | DES CALC | NORTH POINT
ASCON SURVEY NONE | COORDINATE SYS NONE | DES CHD
DES REF | DRN | Q.C. CHD

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ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
GRID REFERENCE SYSTEM

ORIGINAL SHEET SIZE A1

FILE | PLAN DRAWING-8-1 | CAD | ISSUE A
PROJECT | MF

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PUMP STATION BUILDING

6.6kV SWITCHBOARD SB03002 (3.0)

GENERATOR INCOMER No.1 (3.5) | GENERATOR INCOMER No.2 (3.5) | MAINS INCOMER No.1 (3.1) | MAINS INCOMER No.2 (3.1) | METERING (3.2) | SURGE DIVERTER (3.3) | MOTOR STARTER No.1 (3.4) | MOTOR STARTER No.2 (3.4)

630A, 16kA FOR 1 SECOND

HV GENERATOR 1&2 GE03001 & GE03002 (17)

40#1.1#CG10 | 40#1.1#AJ15 | 40#1.1#CF11 | 40#1.1#CG13 | 40#1.1#AJ12 | 40#1.1#CF14

RCP (NOTE 1)

MOTOR No.1 2000kW MF03001 — PUMP No.1 MOTOR STARTER RS03001

MOTOR No.2 2000kW MF03002 — PUMP No.2 MOTOR STARTER RS03002

BRUSH LIFTING MOTOR MF03003

BRUSH LIFTING MOTOR MF03004

CODE SCHEDULE

BPS	BRUSH POSITION LIMIT SWITCH
BRTD	BEARING RESISTANCE TEMPERATURE DEVICE
CB	CIRCUIT BREAKER
CM	CIRCUIT MONITOR
CT	CURRENT TRANSFORMER
DOL	DIRECT ON LINE STARTER
ES	EARTH SWITCH
F	FUSE
GC	GENERATOR CONTROLLER
LC	LINE CONTACTOR
MAH	MOTOR ANTI-CONDENSATION HEATER
MCT	METERING CURRENT TRANSFORMER
MRCB	MOTOR RESIDUAL CURRENT CIRCUIT BREAKER
PCT	PROTECTION CURRENT TRANSFORMER
PFR	PHASE FAILURE RELAY
PLC	PROGRAMMABLE LOGIC CONTROLLER
RCP	REMOTE CONTROL PANEL
RS	ROTOR STARTERS
S	SWITCH
SD	SURGE DIVERTER
VMS	VIBRATION MONITORING SYSTEM
VT	VOLTAGE TRANSFORMER
WRTD	WINDING RESISTANCE TEMPERATURE DEVICE

REFERENCE EXPLANATION

(P)WXYZ
41#1.1#AB34
PANEL LETTER
CODE
HORIZONTAL LOCATION
VERTICAL LOCATION
PART Nº (IF REQUIRED)
SHEET Nº
BUNDLE Nº

PROTECTION LEGEND

Idiff>	DIFFERENTIAL PROTECTION
t° >	OVERTEMPERATURE TRIP
I >	INVERSE TIME PHASE OVERCURRENT
I ⏚	INVERSE DEFINITE MINIMUM TIME EARTH FAULT
I ⏚ REF	RESTRICTED EARTH FAULT

GENERAL NOTES

1. REMOTE CONTROL PANEL, RCP, TO BE LOCATED IN CONTROL ROOM.
2. HYBRID SURGE DIVERTERS REQUIRED IF VACUUM CONTACTORS ARE USED.
3. REFER TO DRAWING ****-40-1-4 AND ****-40-1-5 FOR EQUIPMENT SCHEDULE.

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	CRID	REVISION	DRN	REC	APPD
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WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
DESIGN SUMMARY EXAMPLE DRAWING
POWER DIAGRAM

FILE | PLAN | CAD | ISSUE
PROJECT | DRAWING-10-1 | | A

ORIGINAL SHEET SIZE A1

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EQUIPMENT SCHEDULE

(1.0) WESTERN POWER RMU (WPRMU)

TO WESTERN POWER SPECIFICATION. IN ACCORDANCE WITH DSM 3-228

(1.1) WESTERN POWER POLE MOUNTED SURGE DIVERTER

TO WESTERN POWER SPECIFICATION.

(2.0) WATER CORPORATION 22kV SWITCHBOARD (SB03001)

COMPLIES WITH DS26.8 TYPE SPECIFICATION
NOMINAL VOLTAGE – 22kV
RATED VOLTAGE – 24kV
FREQUENCY – 50Hz
TYPE OF EARTHING SYSTEM – DIRECT
SYSTEM EARTH FAULT FACTOR – <1.4
ASSESSIBILITY AS IEC62271 200 – AFL
TYPE OF ARC GAS VENTING – REAR

SERVICE CONDITIONS

MAX DESIGN TEMPERATURE – 45°C
AVERAGE DAILY AMBIENT TEMPERATURE – 21°C
LEVEL OF LOSS OF SERVICE CONTINUITY – LSC2A
RATED SUPPLY OF AUXILIARY CIRCUIT – 24VDC
BUSBAR RATED CURRENT – 630A
P.F.W.V – 50kV
L.I.W.V – 125kV
ARC WITHSTAND – 12.5kA/1s
SHORT TIME WITHSTAND – 16kA/1s

(2.1) CUSTOMER MAIN SWITCH – CIRCUIT BREAKER

RATED CURRENT – 630A
BREAKING CAPACITY, ISC – 20kA
MAKING CAPACITY, IPEAK – 50kA
OVERCURRENT/EARTH FAULT PROTECTION RELAY – TO IEC60255
PROTECTION CURRENT TRANSFORMER (PHASE FAULT) – COMPLIES WITH DS26.21 TYPE SPEC. 100/5A 25kA/1s, CLASS 5P20; 10VA
METERING CT (POWER FACTOR) – 100/5A; CLASS 1M
METERING CT (PQM) – 100/5A; CLASS 0.5M

(2.2) TRANSFORMER FEEDER CIRCUIT BREAKER

RATED CURRENT – 630A
BREAKING CAPACITY, ISC – 20kA
MAKING CAPACITY, IPEAK – 50kA
OVERCURRENT/EARTH FAULT PROTECTION RELAY – TO IEC60255
PROTECTION CURRENT TRANSFORMER (PHASE FAULT) – COMPLIES WITH DS26.21 TYPE SPEC 100/5A 25kA/1s, CLASS 5P20; 10VA
RELAY FOR COMMUNICATION/TRIPPING FOR TRANSFORMER OVER TEMPERATURE AND RESTRICTED EARTH FAULT
SPRING CHARGE MOTOR POWER SUPPLY – 24VDC
SHUNT TRIP POWER SUPPLY – 24VDC
ANTI-CONDENSATION HEATER SUPPLY – 240VAC
AUXILIARY CONTACTS REQUIRED ON THREE POSITION ISOLATOR – 4NO AND 4NC
AUXILIARY CONTACTS REQUIRED ON CIRCUIT BREAKER – 4NO AND 4NC
AUXILIARY CONTACTS REQUIRED ON EARTH SWITCH – 4NO AND 4NC
AUXILIARY CONTACTS REQUIRED ON SPRING MECHANISM 2NO AND 2NC

(2.3) AUXILIARY TRANSFORMER FEEDER CIRCUIT BREAKER

RATED CURRENT – 630A
BREAKING CAPACITY, ISC – 20kA
MAKING CAPACITY, IPEAK – 50kA
OVERCURRENT/EARTH FAULT PROTECTION RELAY – TO IEC60255
PROTECTION CURRENT TRANSFORMER (PHASE FAULT) – COMPLIES WITH DS26.21 TYPE SPEC. 50/5A 25kA/1s, CLASS 5P20; 10VA
RELAY FOR COMMUNICATION/TRIPPING FOR TRANSFORMER OVER TEMPERATURE AND STAR POINT EARTH FAULT
SPRING CHARGE MOTOR POWER SUPPLY – 24VDC
SHUNT TRIP POWER SUPPLY – 24VDC
ANTI-CONDENSATION HEATER SUPPLY – 240VAC
AUXILIARY CONTACTS REQUIRED ON THREE POSITION ISOLATOR – 4NO AND 4NC
AUXILIARY CONTACTS REQUIRED ON CIRCUIT BREAKER – 4NO AND 4NC
AUXILIARY CONTACTS REQUIRED ON EARTH SWITCH – 4NO AND 4NC
AUXILIARY CONTACTS REQUIRED ON SPRING MECHANISM 2NO AND 2NC

(2.4) SURGE DIVERTER AND METERING

MERLIN GERIN ION 7650 OR EQUIVALENT
– MEASUREMENT OF PARAMETERS, VOLTAGE, CURRENT, REAL POWER, POWER FACTOR, TRANSIENT EVENT DISTURBANCE RECORD
– WALL MOUNTED ENCLOSURE
– MODBUS
– FUNCTIONALITY TO INCLUDE EVENT CAPTURE & VOLTAGE DISTURBANCE/MONITORING
– CURRENT TRANSFORMER – REFER ITEM 2.1
– VOLTAGE TRANSFORMER – 22kV/110V, 3 PHASE 3 WIRE, 50VA, CLASS 1M
HV SURGE DIVERTER – AREVA HE24 OR EQUIVALENT
RATED VOLTAGE – 24kV
RATED DISCHARGE CURRENT – 10kA
TESTED AND CERTIFIED TO IEC60099.4.
M.C.O.V. – 20kV

(3.0) 6.6kV SWITCHBOARD (SB03002)

COMPLIES WITH DS26.8 TYPE SPECIFICATION
NOMINAL VOLTAGE – 6.6kV
RATED VOLTAGE – 7.2kV
FREQUENCY – 50Hz
TYPE OF EARTHING SYSTEM – DIRECT
SYSTEM EARTH FAULT FACTOR – <1.4
ASSESSIBILITY AS IEC62271 200 – AFL
TYPE OF ARC GAS VENTING – REAR

SERVICE CONDITIONS

MAX DESIGN TEMPERATURE – 45°C
AVERAGE DAILY AMBIENT TEMPERATURE – 21°C
LEVEL OF LOSS OF SERVICE CONTINUITY – LSC2A
RATED SUPPLY OF AUXILIARY CIRCUIT – 24VDC
BUSBAR RATED CURRENT – 400A
P.F.W.V – 20kV
L.I.W.V – 60kV
ARC WITHSTAND – 20kA/1s
SHORT TIME WITHSTAND – 16kA/1s

(3.1) MAIN INCOMER

RATED CURRENT – 400A
BREAKING CAPACITY, ISC – 25kA
MAKING CAPACITY, IPEAK – 62.5kA
OVERCURRENT/EARTH FAULT PROTECTION RELAY – TO IEC60255
PROTECTION CURRENT TRANSFORMER (PHASE FAULT) – COMPLIES WITH DS26.21 TYPE SPEC. 300/5A 25kA/1s, CLASS 5P20; 10VA
PROTECTION CURRENT TRANSFORMER (RESTRICTED EARTH FAULT) – 250/1A, 25kA/1 SEC, CLASS PX
RESTRICTED EARTH FAULT PROTECTION RELAY – HIGH IMPEDANCE TYPE RMS2V73 OR EQUIVALENT
SPRING CHARGE MOTOR POWER SUPPLY – 24VDC
SHUNT TRIP POWER SUPPLY – 24VDC
ANTI-CONDENSATION HEATER SUPPLY – 240VAC
AUXILIARY CONTACTS REQUIRED ON THREE POSITION ISOLATOR – 4NO AND 4NC
AUXILIARY CONTACTS REQUIRED ON CIRCUIT BREAKER – 4NO AND 4NC
AUXILIARY CONTACTS REQUIRED ON EARTH SWITCH – 4NO AND 4NC
AUXILIARY CONTACTS REQUIRED ON SPRING MECHANISM 2NO AND 2NC

(3.2) METERING

RATED CURRENT – 400A
RESTRICTED EARTH FAULT CURRENT TRANSFORMER – COMPLIES WITH DS26.21 TYPE SPEC. 250/5A 25kA/1s, CLASS PX 10VA
METERING VOLTAGE TRANSFORMER – 6.6kV/110V, 3 PHASE 3 WIRE, 200VA, CLASS 1M
METERING CT (CM) – 400/5A, CLASS 0.5M
PHASE FAILURE RELAY – RMS2P740
SQUARE D POWER LOGIC PM800 CIRCUIT MONITOR OR EQUIVALENT
– MEASUREMENT OF PARAMETERS: VOLTAGE, CURRENT, REAL POWER, ENERGY (kWh), REACTIVE POWER, FREQUENCY HARMONIC, POWER FACTOR, TRANSIENT EVENTS
– FUNCTIONALITY TO INCLUDE EVENT CAPTURE & VOLTAGE DISTURBANCE/MONITORING

(3.3) SURGE DIVERTER

HV SURGE DIVERTERS – AREVA HE09 OR EQUIVALENT
RATED VOLTAGE – 9kV
RATED DISCHARGE CURRENT – 10kA
TESTED AND CERTIFIED TO IEC60099-4
M.C.O.V – 7.65kV

(3.4) MOTOR STARTER

MOTOR CONTACTOR WITH FUSE AND LOAD SIDE EARTHING SWITCH
RATED CURRENT – 203A
BREAKING CAPACITY – 63kA WITH FUSES
PROTECTION COORDINATION TO IEC632-1 APPENDIX B.
FUSE – SIBA 355RC225 OR EQUIVALENT
RELAY – MULTILIN 469
PROTECTION CURRENT TRANSFORMER (PHASE FAULT) – COMPLIES WITH DS26.21 TYPE SPEC 250/5A 25kA/1s. CLASS 5P20. 10VA
PROTECTION CURRENT TRANSFORMER (EARTH FAULT) – COMPLIES WITH DS26.21 TYPE SPEC 250/5A CORE BALANCED CT.

(3.5) GENERATOR INCOMER

RATED CURRENT – 630A

(4.0) 2.5MVA TRANSFORMER (TF03001 & TF03002)

2.5MVA, 22/6.6kV AN COMPLIES WITH DS26.16 TYPE SPECIFICATION
OPERATING MODE – SINGLE
TYPE OF LOAD – LINEAR
NUNBER OF WINDINGS – 2
VECTOR GROUP – Dyn1
NOISE LEVEL – 71.5dB
IP RATING OF ENCLOSURE – IP21
SURGE DIVERTER – RAYCHEM RSTI-SA-10 MCOV-18kV
STAR POINT CONNECTION CURRENT TRANSFORMER (RESTRICTED EARTH FAULT) – 250/1A, 25kA/1 SEC, CLASS PX
SYSTEM FAULT LEVEL – 19 MVA
OVERALL IMPEDANCE – 6.5%±10%

PRIMARY

NOMINAL VOLTAGE – 22kV
CONNECTION – DELTA
TERMINALS TO BE BROUGHT OUT – TO EN50181 TYPE A
CONTINUOUS RATING – 2.5MVA
L.I.W.V – 125kV
RATED VOLTAGE FOR EQUIPMENT UM – 24kV
SYSTEM FAULT LEVEL – 19MVA
METHOD OF EARTHING – SOLID

SECONDARY

NOMINAL VOLTAGE – 6.6kV
CONNECTION – WYE
TERMINALS TO BE BROUGHT OUT – TO EN50181 TYPE A
CONTINUOUS RATING – 2.5MVA
L.I.W.V – 60kV
RATED VOLTAGE FOR EQUIPMENT UM – 7.2kV
METHOD OF EARTHING – SOLID

(5.0) POWER FACTOR CORRECTION CUBICLE (PF03001)

COMPLIES WITH DS26.39 TYPE SPECIFICATION
CABLE ENTRY – BOTTOM
DEGREE OF POLLUTION – 1
MEASUREMENT C.T – REFER ITEM 2.1
REQUIRED CORRECTION 550kVAr
RATED VOLTAGE 415V
THREE STEPS (50/200/300kVAr)
IP31

(6.0) AUXILIARY TRANSFORMER (TF03003)

650/550/100kVA, 22kV/433V/433V CAST OR WOUND RESIN TYPE IN KIOSK ENCLOSURE COMPLIES WITH DS26.15 TYPE SPECIFICATION
OPERATING MODE – SINGLE
TYPE OF LOAD – LINEAR
NUNBER OF WINDINGS – 3
VECTOR GROUP – Dyn1yn1
NOISE LEVEL – 65dB
IP RATING OF ENCLOSURE – IP21
SURGE DIVERTER – RAYCHEM RSTI-WA-10; MCOV-18kV
RATED VOLTAGE – 22kV
OVERALL IMPEDANCE – 5.5%/3.8%

PRIMARY

NOMINAL VOLTAGE – 22kV
CONNECTION – DELTA
TERMINALS TO BE BROUGHT OUT – TO EN50181 TYPE A
CONTINUOUS RATING – 850kVA
L.I.W.V – 125kV
RATED VOLTAGE FOR EQUIPMENT UM – 24kV
SYSTEM FAULT LEVEL – 19MVA
METHOD OF SYSTEM EARTHING – SOLID

SECONDARY

NOMINAL VOLTAGE – 415V
CONNECTION – WYE
TERMINALS TO BE BROUGHT OUT – BOLTED LINK CONNECTION
CONTINUOUS RATING – 550kVA
RATED VOLTAGE FOR EQUIPMENT UM – 433V
METHOD OF SYSTEM EARTHING – SOLID
STAR POINT CONNECTION CURRENT TRANSFORMER (STAR POINT EARTH FAULT) – 800/1A, 25kA/1 SEC, CLASS PX

TERTIARY

NOMINAL VOLTAGE – 415V
CONNECTION – WYE
TERMINALS TO BE BROUGHT OUT – BOLTED LINK CONNECTION
CONTINUOUS RATING – 100kVA
RATED VOLTAGE FOR EQUIPMENT UM – 433V
METHOD OF SYSTEM EARTHING – SOLID

GENERAL NOTES

1. P.F.W.V. = POWER FREQUENCY WITHSTAND VOLTAGE FOR 1 MINUTE
2. L.E.W.V. = LIGHTNING IMPULSE WITHSTAND VOLTAGE PEAK
3. P.C.C. = POINT OF COMMON COUPLING
4. VOLTAGE AND CURRENT VALUES ARE RMS UNLESS OTHERWISE SPECIFIED.

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

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WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
DESIGN SUMMARY EXAMPLE DRAWING
EQUIPMENT SCHEDULE

FILE | PLAN | CAD | ISSUE
PROJECT | DRAWING-10-2 | A

ORIGINAL SHEET SIZE A1

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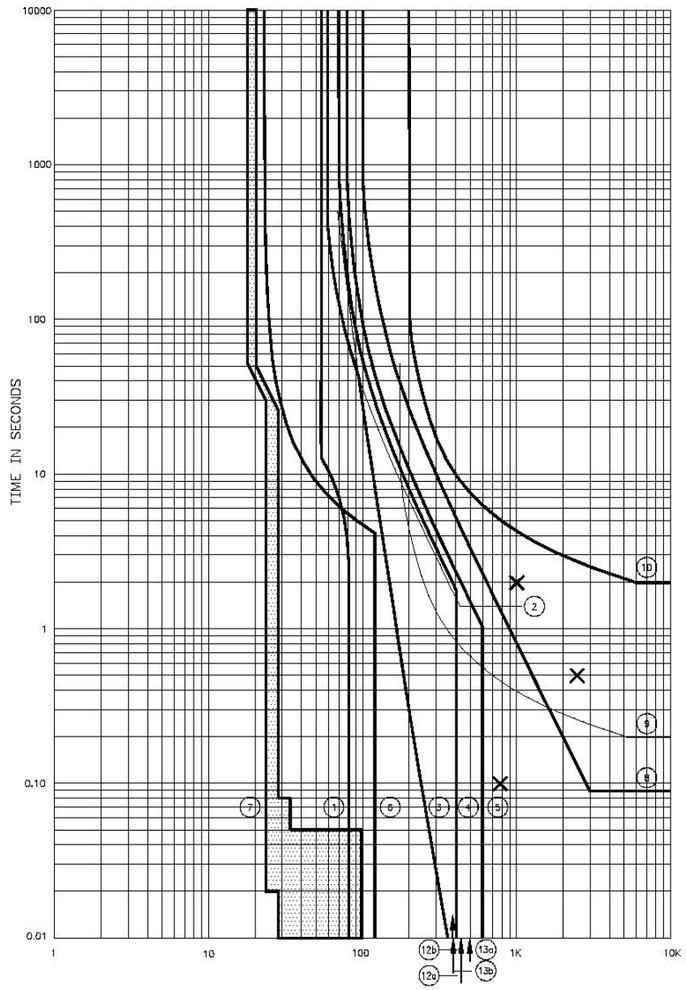

CURRENT IN AMPERES (REFERERED TO 22kV)

PROTECTION GRADING CURVES DIAGRAM
OVERCURRENT PROTECTION

OVERCURRENT SETTINGS

(1) MOTOR
BASED ON 2000kW, 6.6kV WITH RESISTANCE STARTERS
- CURRENT: 180A @ 6.6kV (54A @ 22kV)
- STARTING CURRENT: 1.3 x FLC (203A) = 263.9A @ 6.6kV (79.17A @22kV)

(2) MOTOR OVERLOAD PROTECTION RELAY
TYPE: GE MULTILIN 469
CT RATIO: 250/5A
- OVERLOAD PICK UP: 1.1 x 180A = 198A @ 6.6kV (59.4A @ 22kV)
- OVERLOAD CURVE TYPE: NUMBER 1

(3) 6.6kV MOTOR STARTER FUSE
SIBA 355RC225 FUSE OR EQUIVALENT

(4) 6.6kV SWITCHBOARD MAIN CIRCUIT BREAKER
TYPE: SEL TO IEC 60255
CT RATIO: 300/5A
- PICK UP: 233A @ 6.6kV (69.9A @ 22kV)
- CURVE: EXTREME INVERSE
- TIME MULTIPLIER (TMS): 0.72
- INSTANTANEOUS: 1355A @ 6.6kV (406.5A @ 22kV)

(5) TRANSFORMER FEEDER CIRCUIT BREAKER
TYPE: SEL TO IEC 60255
CT RATIO: 100/5A
- PICK UP: 79A
- CURVE: EXTREME INVERSE
- TIME MULTIPLIER (TMS): 0.74
- INSTANTANEOUS: 600A

(6) AUXILIARY TRANSFORMER FEEDER CIRCUIT BREAKER
TYPE: SEL TO IEC 60255
CT RATIO: 50/5A
- PICK UP: 23A
- CURVE: STANDARD INVERSE
- TIME MULTIPLIER (TMS): 1
- INSTANTANEOUS: 120A
- DEFINITE TIME: 0.01s

(7) POWER FACTOR CORRECTION INCOMING CIRCUIT BREAKER
BASED ON SIEMENS SENTRON 3WL
In: 1000A
Ir: 0.8 x In (1000A) = 900A
tr: 2s
Isd: 1.25 x In (1000A) = 1250A
tsd: 0.02s, I²t OUT
Ii: 1.5 x In (1000A) = 1500A

(8) CUSTOMER MAIN SWITCH
TYPE: SEL TO IEC 60255
CT RATIO: 100/5A
- PICK UP: 95A
- CURVE: EXTREME INVERSE
- TIME MULTIPLIER (TMS): 1

(9) WESTERN POWER RECLOSER W229A
PICK UP: 175A
TIME MULTIPLIER (TMS): 0.1
CURVE: STANDARD INVERSE

(10) WESTERN POWER RECLOSER W229A (PROPOSED)
PICK UP: 200A
TIME MULTIPLIER (TMS): 0.8
CURVE: STANDARD INVERSE

(11) TRANSFORMER DAMAGE AND INRUSH CURRENT

(12) FAULT LEVELS AT 6.6kV SWITCHBOARD
12a. MAXIMUM: 1461A @ 6.6kV (438.3A @ 22kV)
12b. MINIMUM: 1290A @ 6.6kV (387A @ 22kV)

(13) FAULT LEVELS AT 22kV SWITCHBOARD
13a. MAXIMUM: 498A
13b. MINIMUM: 388A

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COORDINATE SYS: NONE
ASCON SURVEY: NONE
DES REF:
DES CALC:
DES CHD:
DRN:
Q.C. CHD:
NORTH POINT

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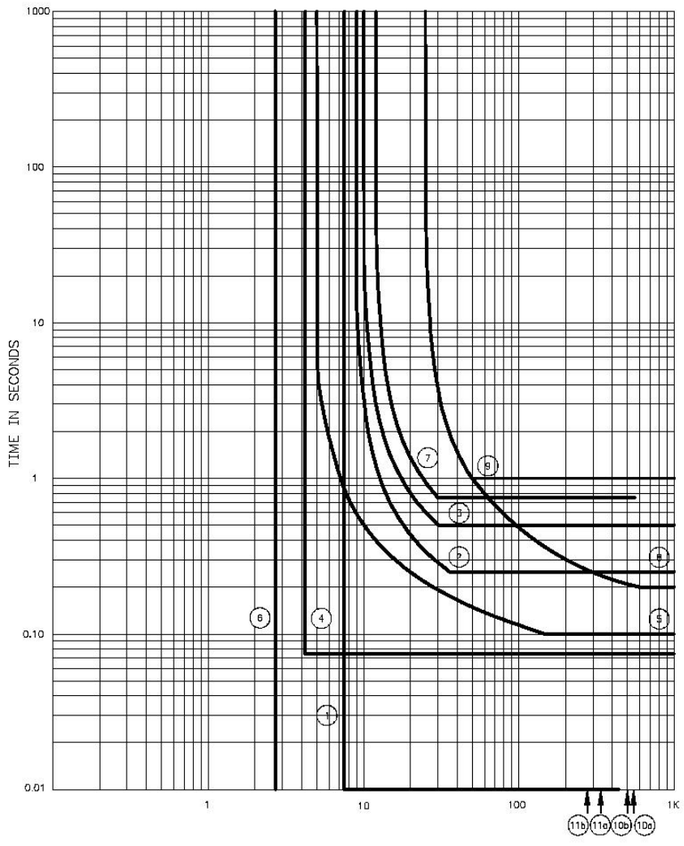
ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
DESIGN SUMMARY EXAMPLE DRAWING
OVERCURRENT PROTECTION GRADING CURVE

FILE:
PLAN: DRAWING–10–3
CAD:
ISSUE: A
PROJECT:
ORIGINAL SHEET SIZE: A1
MF

STANDARDS\APPROVED\DS24\DS24 DRAWING–010–003–01A 12:23 06/03/2019 memorys0/WS27103



PROTECTION GRADING CURVES DIAGRAM
EARTH FAULT PROTECTION

EARTH FAULT SETTINGS

(1) MOTOR OVERLOAD PROTECTION RELAY
TYPE : GE MULTILIN 469
CT RATIO : 250/5A
- PICK UP: 25A @ 6.6kV (7.5A @ 22kV)
- DEFINITE TIME: 0.01s

(2) 6.6kV SWITCHBOARD MAIN CIRCUIT BREAKER
TYPE: SEL TO IEC 60255
CT RATIO: 300/5A
- PICK UP: 30A @ 6.6kV (9A @ 22kV)
- CURVE: STANDARD INVERSE
- TIME MULTIPLIER (TMS): 0.05
- DEFINITE TIME: 0.25s

(3) TRANSFORMER FEEDER CIRCUIT BREAKER
TYPE: SEL TO IEC 60255
CT RATIO: 100/5A
- PICK UP: 10A
- CURVE: STANDARD INVERSE
- TIME MULTIPLIER (TMS): 0.08INSTANTANEOUS: 185A
- DEFINITE TIME: 0.50s

(4) TRANSFORMER FEEDER CIRCUIT BREAKER (RESTRICTED EARTH FAULT)
PROTECTION RELAY – RESTRICTED EARTH FAULT WITH 1 PHASE/EARTH FAULT ELEMENT.
CURVE INCLUDES CIRCUIT BREAKER OPENING TIME OF 0.065 SECONDS (TYPICAL)
CT RATIO: 250/1A
- PICK UP: 14A @ 6.6kV (4.2A @ 22kV)

(5) AUXILIARY TRANSFORMER FEEDER CIRCUIT BREAKER
TYPE: SEL TO IEC 60255
CT RATIO: 50/5A
- PICK UP: 5A
- CURVE: STANDARD INVERSE
- TIME MULTIPLIER (TMS): 0.05
- DEFINITE TIME: 0.01s

(6) AUXILIARY TRANSFORMER FEEDER CIRCUIT BREAKER (STAR POINT EARTH FAULT)
CT RATIO: 800/1A
- PICK UP: 150A @ 415V (2.83A @ 22kV)

(7) CUSTOMER MAIN SWITCH
TYPE: SEL TO IEC 60255
CT RATIO: 100/5A
- PICK UP: 12A
- CURVE: STANDARD INVERSE
- TIME MULTIPLIER (TMS): 0.10
- DEFINITE TIME: 0.75s

(8) WESTERN POWER RECLOSER W229A
PICK UP: 25A
TIME MULTIPLIER (TMS): 0.1A
CURVE: STANDARD INVERSE

(9) WESTERN POWER RECLOSER W229A (PROPOSED)
PICK UP: 25A
TIME MULTIPLIER (TMS): 0.1A
CURVE: STANDARD INVERSE
DEFINITE TIME: 1s

(10) FAULT LEVELS AT 6.6kV SWITCHBOARD
10a. MAXIMUM: 1837A @ 6.6kV (551A @ 22kV)
10b. MINIMUM: 1665A @ 6.6kV (500A @ 22kV)

(11) FAULT LEVELS AT 22kV SWITCHBOARD
11a. MAXIMUM: 340A
11b. MINIMUM: 278A

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	CRID	REVISION	DRN	REC	APPD
810						

DESIGN SURVEY NONE | VERTICAL DATUM NONE | DES CALC | NORTH POINT
ASCON SURVEY NONE | COORDINATE SYS NONE | DES REF | DES CHD | DRN | Q.C. CHD

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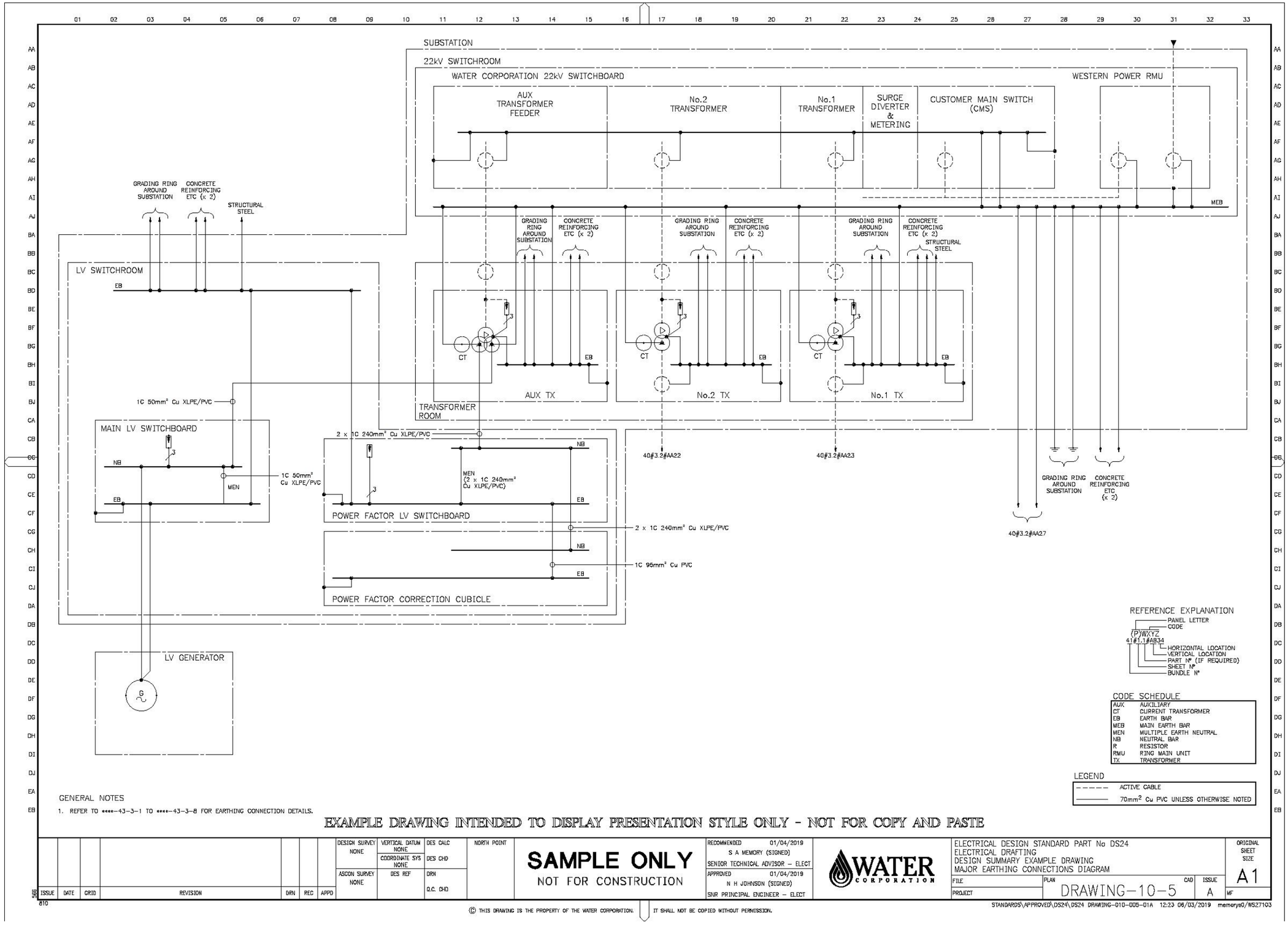
APPROVED 01/04/2019
N H JOHNSON (SIGNED)
SNR PRINCIPAL ENGINEER – ELECT

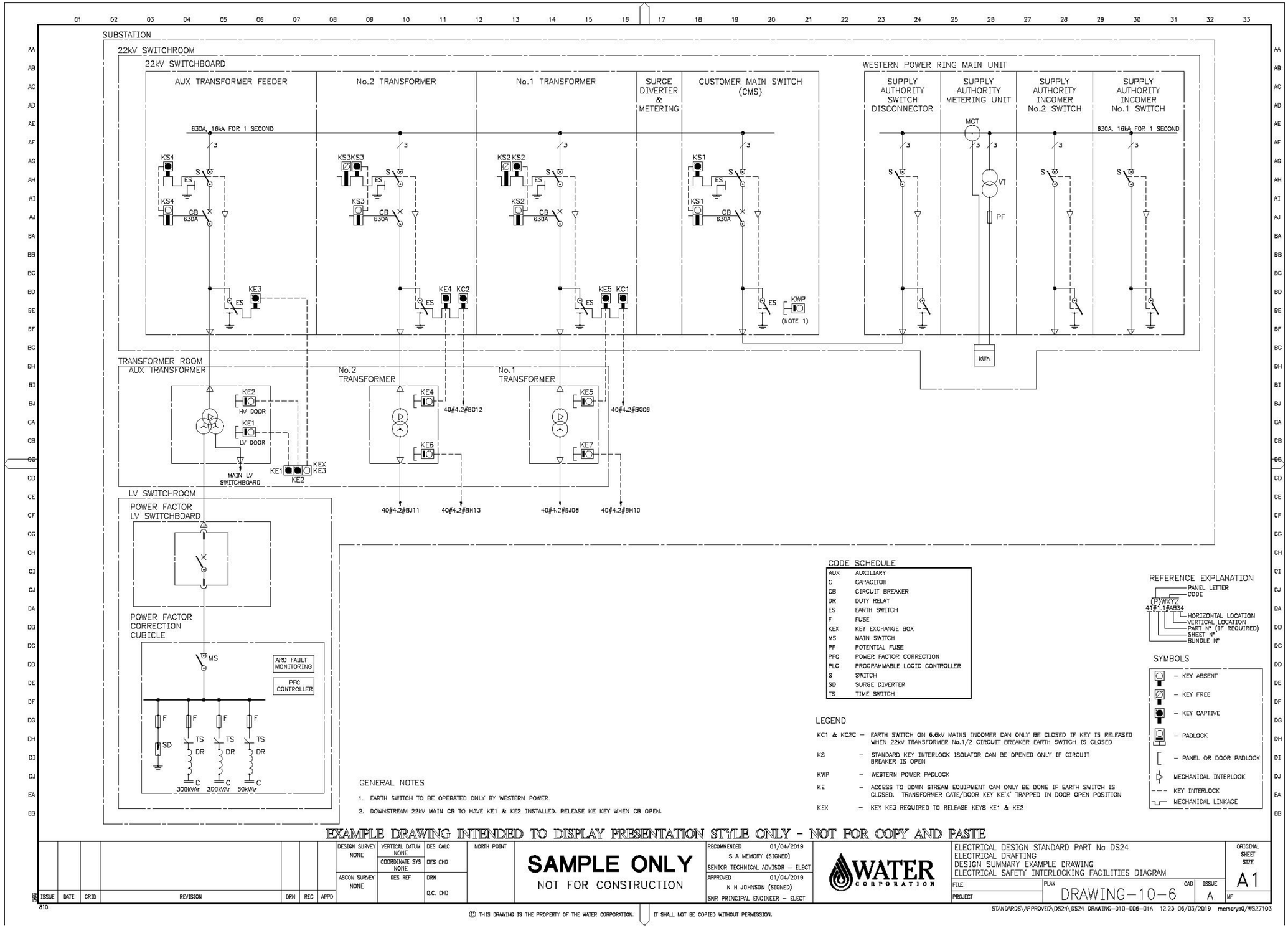
WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
DESIGN SUMMARY EXAMPLE DRAWING
EARTH FAULT PROTECTION GRADING CURVE

FILE | PLAN DRAWING-10-4 | CAD | ISSUE A | ORIGINAL SHEET SIZE A1
PROJECT | MF

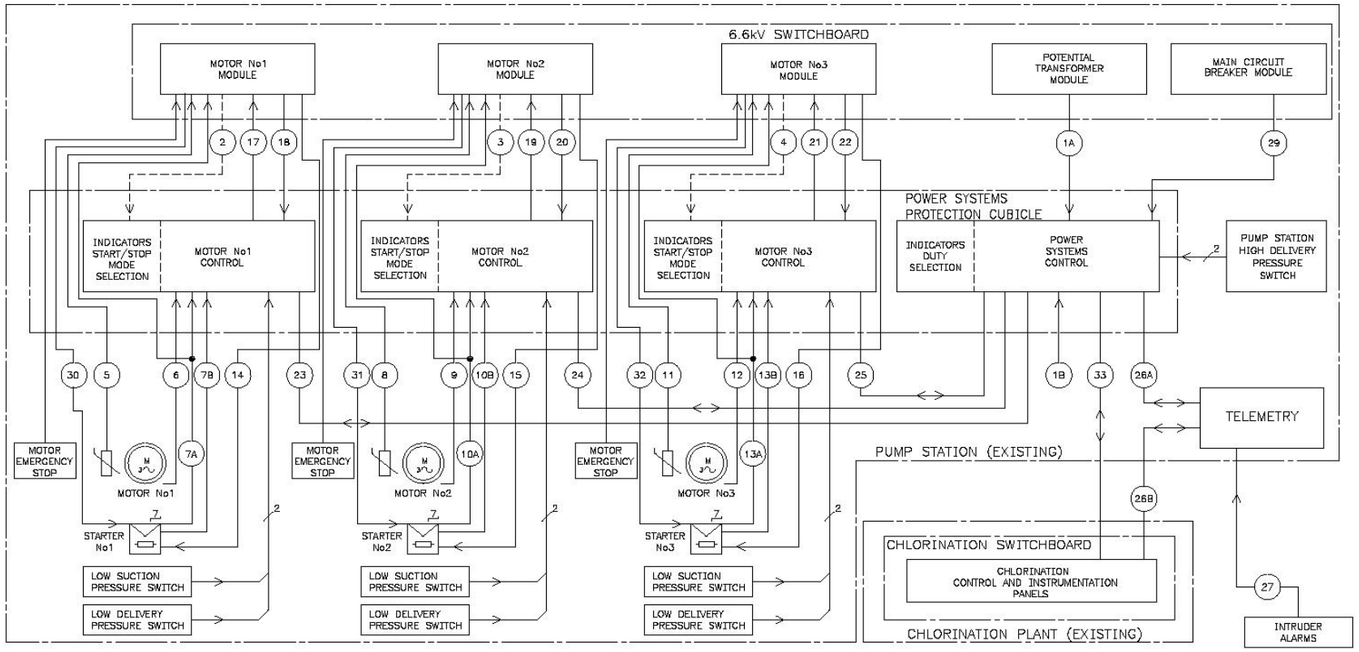
STANDARDS\APPROVED\DS24\DS24 DRAWING-010-004-01A 12:23 06/03/2019 memorysG/WS27103





FAULT SUMMARY (SEE NOTE 3.)

FAULT CONDITION	DETECTING ELEMENT	COMMENTS	CONTROL ELEMENT
MOTOR OVERCURRENT	P + B GOLDSTART, MPC 2000	PLANT FAULT	PUMP CONTROLLER
MOTOR SHORT CIRCUIT AND EARTH FAULT	P + B GOLDSTART, MPC 2000	PLANT FAULT	PUMP CONTROLLER
MOTOR DE BEARING OVERTEMPERATURE	PLATINUM RESISTANCE THERMOMETER, 100Ω	PLANT FAULT, TEMPERATURE MONITOR SET TO TRIP AT 80°C	PUMP CONTROLLER
MOTOR NDE BEARING OVERTEMPERATURE	PLATINUM RESISTANCE THERMOMETER, 100Ω	PLANT FAULT, TEMPERATURE MONITOR SET TO TRIP AT 80°C	PUMP CONTROLLER
PUMP DE BEARING OVERTEMPERATURE	PLATINUM RESISTANCE THERMOMETER, 100Ω	PLANT FAULT, TEMPERATURE MONITOR SET TO TRIP AT 80°C	PUMP CONTROLLER
PUMP NDE BEARING OVERTEMPERATURE	PLATINUM RESISTANCE THERMOMETER, 100Ω	PLANT FAULT, TEMPERATURE MONITOR SET TO TRIP AT 80°C	PUMP CONTROLLER
INCOMPLETE START	AUXILIARY CONTACT ON FINAL STAGE CONTACTOR	PLANT FAULT, CONTACT MUST CLOSE IN 60 SECONDS START PERIOD	PUMP CONTROLLER
MOTOR WINDING OVERTEMPERATURE	PLATINUM RESISTANCE THERMOMETER, 100Ω	PLANT FAULT	PUMP CONTROLLER
POWER PHASE FAILURE/UNDERVOLTAGE	RELAY PFR	LOCATED 6.6kV SWITCHBOARD	PUMP CONTROLLER
CONTROL CIRCUIT UNDERVOLTAGE	EMAIL, 2V330 24V DC UNDERVOLTAGE RELAY, SET TO TRIP AT 80%, RESET 85%	FAULT AND RESET BOTH DELAYED 10 SECONDS	PUMP CONTROLLER
PUMP UNIT No1 AND No2 NO FLOW	POWER TRANSDUCER	HYDRAULIC FAULT, DELAYED BY 10 SECONDS AFTER 60 SECOND START PERIOD	TRIP AMPLIFIER SET TO TRIP AT 252kW, RESET AT 285kW
PUMP UNIT No3 NO FLOW	POWER TRANSDUCER	HYDRAULIC FAULT, DELAYED BY 10 SECONDS AFTER 60 SECOND START PERIOD	TRIP AMPLIFIER SET TO TRIP AT 379 kW RESET AT 430 kW
UNIT No1 & No 2 LOW DELIVERY PRESSURE	PRESSURE SWITCH, SET AT 58m, RESET AT 63m	HYDRAULIC FAULT, DELAYED BY 30 SECONDS AFTER 60 SECOND START PERIOD	PUMP CONTROLLER
UNIT No3 LOW DELIVERY PRESSURE	PRESSURE SWITCH, SET AT 138m, RESET AT 149m	HYDRAULIC FAULT, DELAYED BY 30 SECONDS AFTER 60 SECOND START PERIOD	PUMP CONTROLLER
UNIT No1 & No2 LOW SUCTION PRESSURE	PRESSURE SWITCH, SET AT −2m, RESET AT 0m	HYDRAULIC FAULT, DELAYED BY 20 SECONDS	PUMP CONTROLLER
UNIT No3 LOW SUCTION PRESSURE	PRESSURE SWITCH, SET AT 60m, RESET AT 65m	HYDRAULIC FAULT, DELAYED BY 20 SECONDS	PUMP CONTROLLER
PUMP STATION HIGH DELIVERY PRESSURE	PRESSURE SWITCH, SET AT 200m, RESET AT 190m	HYDRAULIC FAULT, DELAYED BY 10 SECONDS	PUMP CONTROLLER
SECONDARY RESISTANCE STARTER OVERTEMPERATURE	THERMOSTAT, SET AT 100°C	PLANT FAULT, DELAYED BY 2 SECONDS	PUMP CONTROLLER



1A POWER PHASE FAILURE
1B CONTROL CIRCUIT UNDER VOLTAGE
2 ANALOGUE 4–20mA REPRESENTING 0–400kW
3 ANALOGUE 4–20mA REPRESENTING 0–400kW
4 ANALOGUE 4–20mA REPRESENTING 0–600kW
5 MOTOR WINDING RTD'S
6 BEARING TEMPERATURE RTD'S
7A ROTOR RESISTANCE UNIT OVERTEMPERATURE,
7B FINAL CONTACTOR CLOSED
8 MOTOR WINDING RTD'S
9 BEARING TEMPERATURE RTD'S
10A ROTOR RESISTANCE UNIT OVERTEMPERATURE,
10B FINAL CONTACTOR CLOSED
11 MOTOR WINDING RTD'S
12 BEARING TEMPERATURE RTD'S
13A ROTOR RESISTANCE UNIT OVER TEMPERATURE
13B FINAL CONTACTOR CLOSED
14 ROTOR RESISTANCE UNIT CONTROL INTERLOCKS
15 ROTOR RESISTANCE UNIT CONTROL INTERLOCKS
16 ROTOR RESISTANCE UNIT CONTROL INTERLOCKS
17 CONTACTOR CLOSE (MOTOR START)
18 MOTOR OVERCURRENT, OVERTEMPERATURE AND/OR MOTOR EARTH FAULT, CONTACTOR CLOSED
19 CONTACTOR CLOSE (MOTOR START)
20 MOTOR OVERCURRENT, OVERTEMPERATURE AND/OR MOTOR EARTH FAULT, CONTACTOR CLOSED
21 CONTACTOR CLOSE (MOTOR START)
22 MOTOR OVERCURRENT, OVER TEMPERATURE AND/OR MOTOR EARTH FAULT, CONTACTOR CLOSED
23 AUTO START, AUTO STOP, VOLTS HEALTHY, START INHIBIT } TO MOTOR CONTROL
HYDRAULIC FAULT, PLANT FAULT, INTERLOCK CALLED, ALARM } FROM MOTOR CONTROL
(REFER STANDARD DRAWINGS BB83–02–02, 03, 04 AND 10)
24 AUTO START, AUTO STOP, VOLTS HEALTHY, START INHIBIT } TO MOTOR CONTROL
HYDRAULIC FAULT, PLANT FAULT, INTERLOCK CALLED, ALARM } FROM MOTOR CONTROL
(REFER STANDARD DRAWINGS BB83–02–02, 03, 04 AND 10)
25 AUTO START, AUTO STOP, VOLTS HEALTHY, START INHIBIT } TO MOTOR CONTROL
HYDRAULIC FAULT, PLANT FAULT, INTERLOCK CALLED, ALARM } FROM MOTOR CONTROL
(REFER STANDARD DRAWINGS BB83–02–02, 03, 04 AND 10)
26A PUMP STATION CONTROL AND MONITORING TELEMETRY (SEE NOTE 4)
26B CHLORINATION CONTROL AND MONITORING TELEMETRY (SEE NOTE 4)
27 ENTRY DOOR LIMIT SWITCH
28 SPARE
29 MAIN CIRCUIT BREAKER CLOSED
30 STARTER CONTROL CONTACTOR
31 STARTER CONTROL CONTACTOR
32 STARTER CONTROL CONTACTOR
33 CHLORINATION CONTROL AND MONITORING SIGNALS (SEE NOTE 3)

CONTROL SUMMARY

1. SWITCHBOARD (6.6kV)
   1.1 SWITCHBOARD MOTOR CONTROL CIRCUITS PROVIDE FOR :
   EMERGENCY CONTROL – ONLY MOTOR OVERCURRENT/EARTH FAULT/OVERTEMPERATURE PROTECTION AVAILABLE
   NORMAL CONTROL – FULL PROTECTION AVAILABLE VIA PUMP CONTROLLER.
   1.2 SWITCHBOARD CONTROL SELECTION CIRCUITS PROVIDE FOR :
   LOCAL CONTROL – BY PUSHBUTTONS ON SWITCHBOARD
   REMOTE CONTROL – BY RELAY OUTPUTS FROM PUMP CONTROLLER
2. PUMP CONTROLLER
   2.1 PROVIDES START/STOP COMMAND SIGNALS TO INDIVIDUAL MOTOR PUMP UNIT STARTERS.
   2.2 ACCEPTS CONTROL SIGNALS FROM TELEMETRY.
   2.3 MARSHALLS FAULTS ACCORDING TO TYPE AND PROVIDES APPROPRIATE OUTPUT TO TELEMETRY SYSTEM.
   2.4 PROVIDES ALARM AND FAULT INDICATION.
   2.5 PROVIDES COMMON CONTROL FOR 3 MOTOR PUMP SETS OPERATING ON A DUTY/STANDBY/DUTY BASIS.
   2.6 MODULES ARE BASED ON SEPARATE PROGRAMMABLE LOGIC CONTROLLERS (PLC).
   2.7 START INTERLOCK PROVIDED BY CONTROLLER TO PREVENT MORE THAN ONE UNIT STARTING SIMULTANEOUSLY WHILE UNDER REMOTE CONTROL.
   2.8 PROVIDES ALARM INDICATION FOR PRESET PERIOD.
   2.9 PLANT FAULT TRIPS AND INDICATORS LATCHED UNTIL MANUALLY RESET AT CONTROLLER.
   2.10 HYDRAULIC FAULT AND PHASE FAILURE FAULT INDICATORS LATCHED UNTIL MANUALLY RESET AT CONTROLLER.
   2.11 HYDRAULIC FAULT AND PHASE FAILURE FAULT TRIPS LATCHED UNTIL RESET BY STOP COMMAND TO TRIPPED UNIT.
3. CHLORINATION SWITCHBOARD
   FOR CHLORINATION SYSTEM CONTROL SUMMARY, FAULT SUMMARY, CONTROL AND MONITORING SIGNALS REFER P&ID DRAWINGS EF79–60–2,–3.
4. TELEMETRY SYSTEM
   FOR TELEMETRY CONTROL AND MONITORING SIGNALS REFER P&ID DRAWINGS EF79–60–1,–2,–3.

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD

DESIGN SURVEY: NONE | VERTICAL DATUM: NONE | COORDINATE SYS: NONE | ASCON SURVEY: NONE | DES REF | DES CALC | DES CHD | DRN | Q.C. CHD | NORTH POINT

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APPROVED 01/04/2019 N H JOHNSON (SIGNED) SNR PRINCIPAL ENGINEER – ELECT

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
DESIGN SUMMARY
PROTECTION SYSTEMS CONTROL BLOCK DIAGRAM

FILE | PLAN DRAWING 10–7 CAD | ISSUE A | PROJECT | ORIGINAL SHEET SIZE A1 | MF

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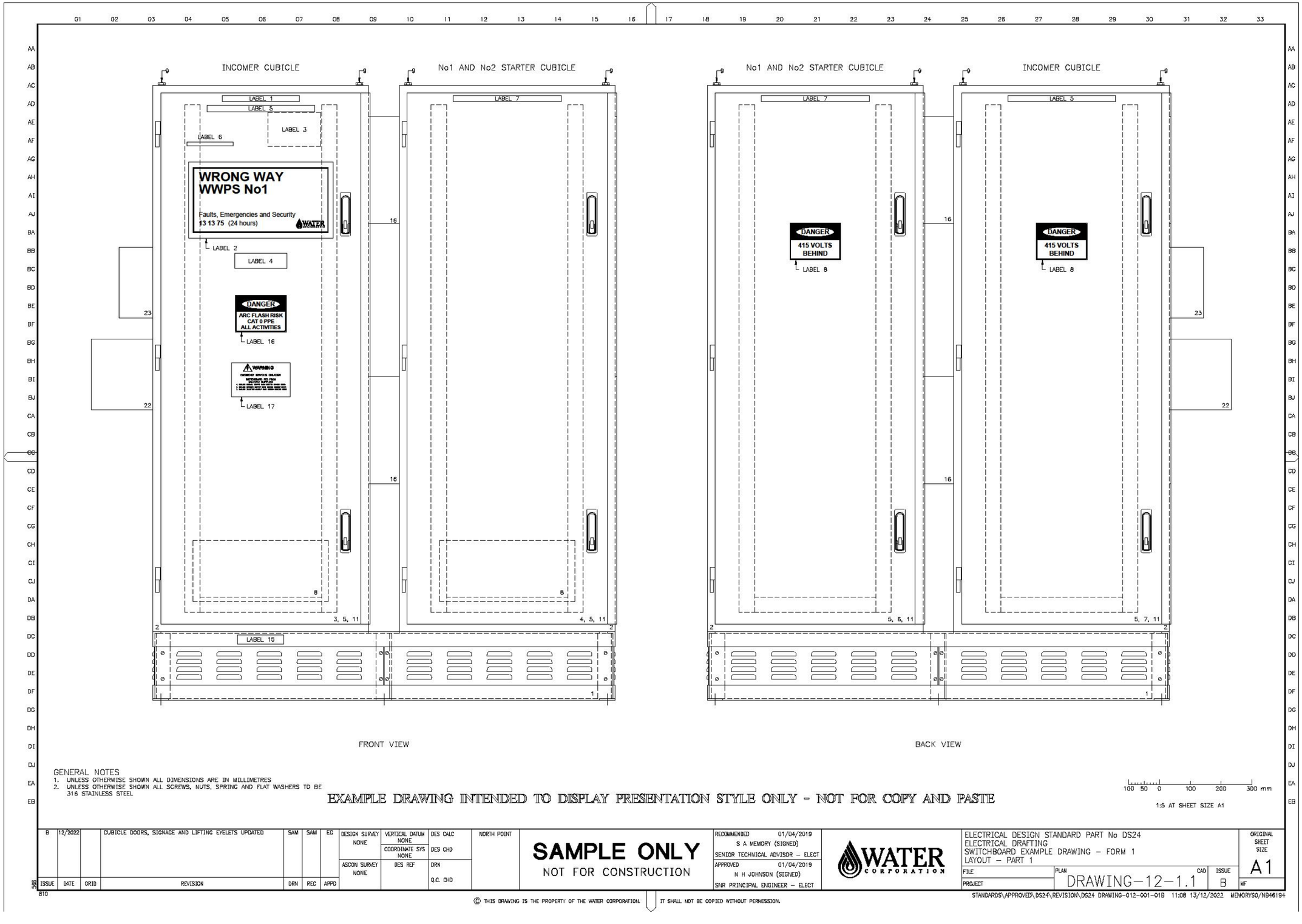

GENERAL NOTES
1. UNLESS OTHERWISE SHOWN ALL DIMENSIONS ARE IN MILLIMETRES
2. UNLESS OTHERWISE SHOWN ALL SCREWS, NUTS, SPRING AND FLAT WASHERS TO BE 316 STAINLESS STEEL

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

100 50 0 100 200 300 mm
1:5 AT SHEET SIZE A1

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
B	12/2022		CUBICLE DOORS, SIGNAGE AND LIFTING EYELETS UPDATED	SAM	SAM	EG

DESIGN SURVEY NONE | VERTICAL DATUM NONE | DES CALC
COORDINATE SYS NONE | DES CHD
ASCON SURVEY NONE | DES REF | DRN | Q.C. CHD
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ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
SWITCHBOARD EXAMPLE DRAWING – FORM 1
LAYOUT – PART 1

ORIGINAL SHEET SIZE A1
FILE | PLAN DRAWING–12–1.1 CAD | ISSUE B
PROJECT | MF

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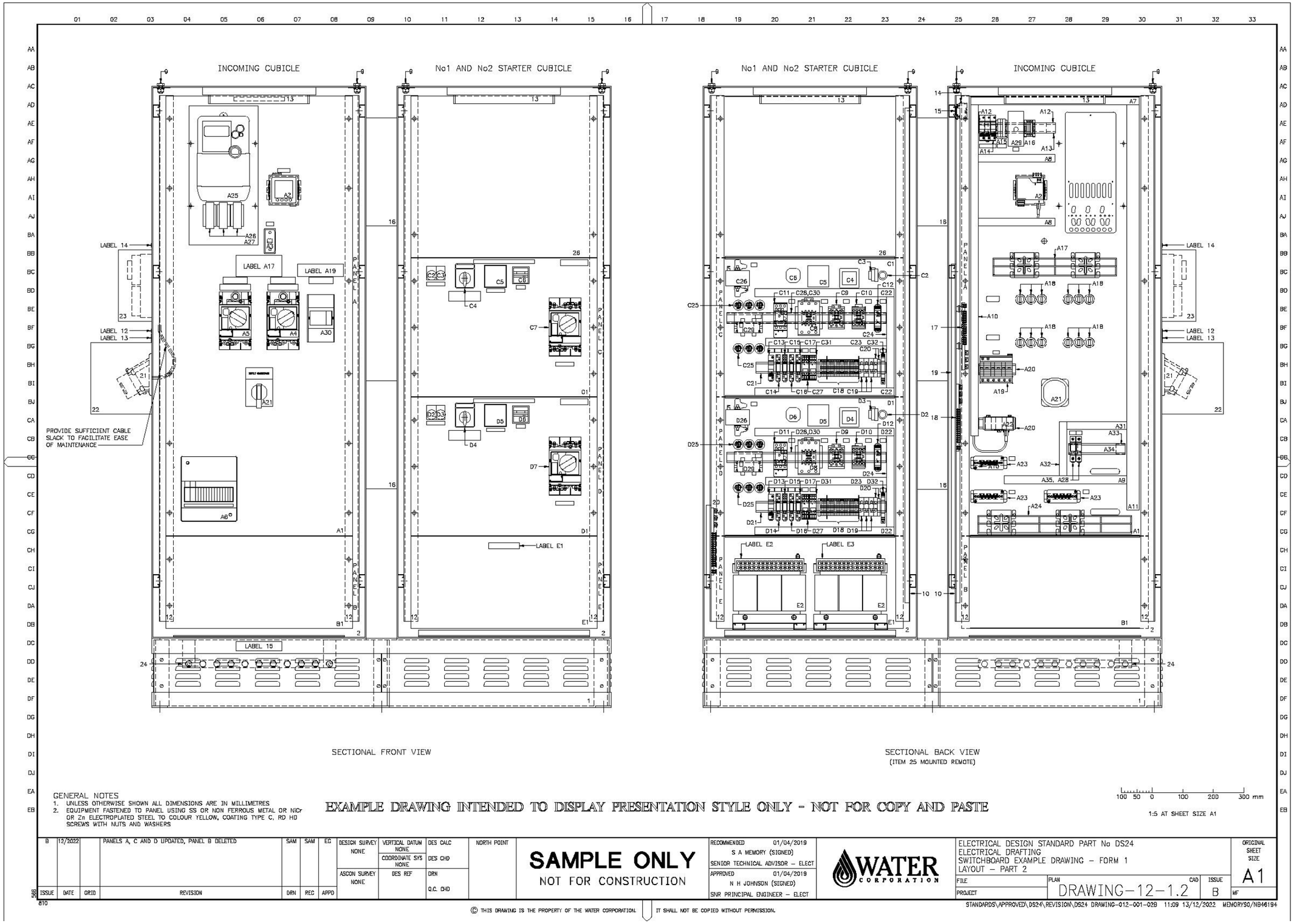

GENERAL NOTES
1. UNLESS OTHERWISE SHOWN ALL DIMENSIONS ARE IN MILLIMETRES
2. EQUIPMENT FASTENED TO PANEL USING SS OR NON FERROUS METAL OR NiCr OR Zn ELECTROPLATED STEEL TO COLOUR YELLOW, COATING TYPE C, RD HD SCREWS WITH NUTS AND WASHERS

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

100 50 0 100 200 300 mm
1:5 AT SHEET SIZE A1

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
B	12/2022		PANELS A, C AND D UPDATED, PANEL B DELETED	SAM	SAM	EG

DESIGN SURVEY NONE	VERTICAL DATUM NONE	DES CALC	NORTH POINT
	COORDINATE SYS NONE	DES CHD	
ASCON SURVEY NONE	DES REF	DRN	
		Q.C. CHD	

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SNR PRINCIPAL ENGINEER – ELECT

WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
SWITCHBOARD EXAMPLE DRAWING – FORM 1
LAYOUT – PART 2

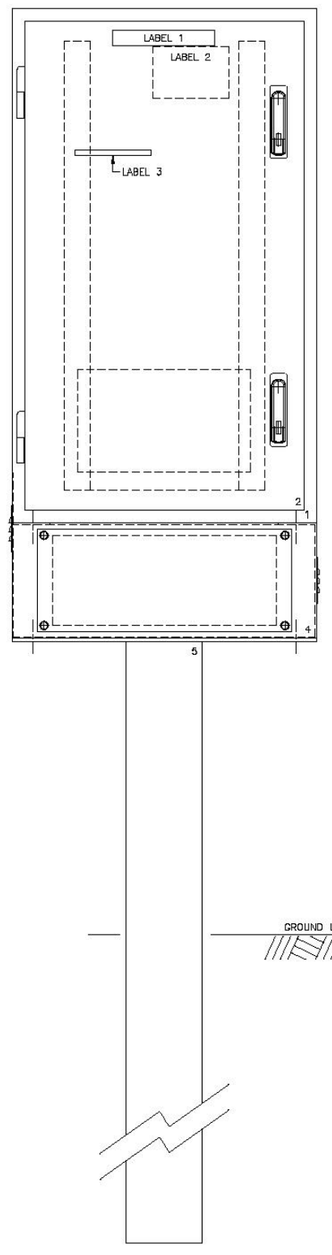
ORIGINAL SHEET SIZE A1

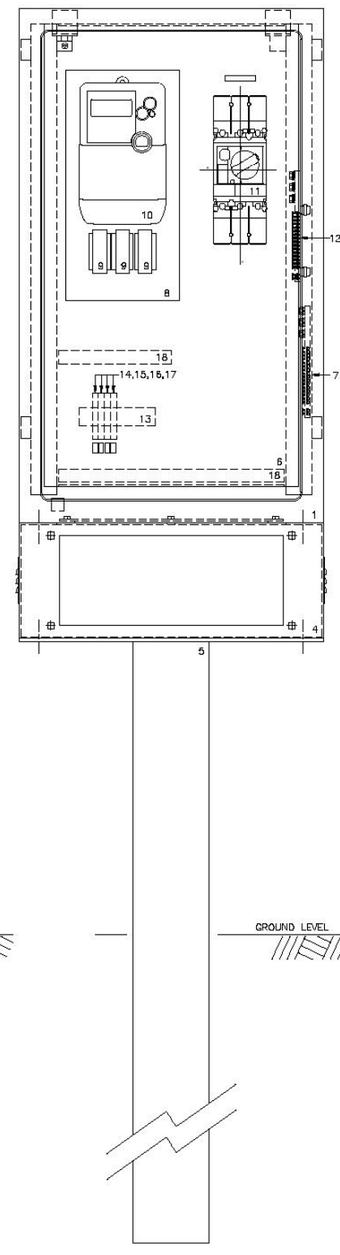
FILE
PROJECT
PLAN DRAWING-12-1.2 CAD ISSUE B MF

STANDARDS\APPROVED\DS24\REVISION\DS24 DRAWING-012-001-02B 11:09 13/12/2022 MEMORYSO/NB46194

LABEL SCHEDULE

No	LETTER HEIGHT	TEXT	WIDE	HIGH	QTY
1	12 6	OUTBACK WWTP MAIN SWITCHBOARD	200	30	1
2	2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5	1. MANUFACTURER – *** 2. DATE OF MANUFACTURE – **** 3. STANDARD – AS/NZS 3439.1 : 2002 4. TYPE TESTED – FOR DEGREE OF PROTECTION 5. MAXIMUM OPERATIONAL VOLTAGE – 456V 6. RATED CURRENT – 100A 7. MAX. SHORT CIRCUIT I^2t – 6 x 10^4 A^2s AT 10kA PROSPECTIVE 8. AMBIENT AIR TEMPERATURE – UPPER LIMIT – 55°C 9. AMBIENT AIR TEMPERATURE – DAILY AVERAGE MAXIMUM – 50°C 10. DEGREE OF PROTECTION – IP56 11. EARTHING SYSTEM – TN–C–S (MEN) 12. DRAWING NUMBER – ****–**	150	100	1
3	6	SUPPLY AUTHORITY METER BEHIND	200	12	1
4	15 15 15	WHITE LETTERING RED BACKGROUND WHITE ELLIPSE BLACK BACKGROUND DANGER 415 VOLTS BEHIND WHITE BACKGROUND BLACK LETTERING (SEE NOTE 5)	165	120	1
5	3.5	MEB	20	12	1
6	2.5 2.5	SERVICE PROTECTIVE DEVICE (80A)	70	12	1
7	2.5 2.5	MAIN SWITCH (100A) SET AT 80A	60	12	1
8	3.5	MNB	20	12	1
9	3.5	kWhS	20	10	1
10	3.5	kVES	20	10	1
11	3.5	OPTS	20	10	1
12	3.5	SSD	20	10	1





MATERIAL SCHEDULE

ITEM	CODE	LABEL	DESCRIPTION	SPECIFICATION	QTY
1			MAIN FRAME	ALUMINIUM OUTDOOR MINI CUBICLE : 1000 HIGH, PAINTED TO DS26–09 REQUIREMENTS WITH DULUX DURAPLAST AG WHITE ANTI–GRAFFITI PAINT. TYPE TESTED FOR DEGREE OF PROTECTION IP56 TO THE REQUIREMENTS OF CLAUSE 8.2.7 OF AS3439.1–2002	1
2		1–3	FRONT DOOR	RH DOOR, WITH PADLOCK KEY CYLINDER, GENERAL ACCESS BI–LOCK 2A	1
	FDLS		FRONT DOOR LIMIT SWITCH	SCHMERSAL, ZS–236–11z–M20 : 1 NO AND 1 NC CONTACT	1
3		4	REAR DOOR	LH DOOR, WITH PADLOCK KEY CYLINDER, ELECTRICAL ACCESS BI–LOCK 7A	1
	RDLS		REAR DOOR LIMIT SWITCH	SCHMERSAL, ZS–236–11z–M20 : 1 NO AND 1 NC CONTACT	1
4			BASE	MINI CUBICLE TALL BASE : 225 HIGH	1
5			STAND	MINI CUBICLE STAND : MODIFIED 1770 HIGH	1
6			PANEL	BLANK PANEL : 500 WIDE x 898 HIGH	1
7	MEB	5	MAIN EARTH BAR	SELECTRIX, B13018IX : 165A	1
8			SUPPLY AUTHORITY METER PANEL	GOOD SAMARITAN INDUSTRIES, THREE PHASE METER PANEL	1
9	SPD	6	SERVICE PROTECTION DEVICE (METER PROTECTION FUSE)	ALSTOM, SERIES 7, S71002ABWS : 500V, 100A (SUPPLIED WITH METER PANEL)	3
			FUSE LINK	80A (INSTALLED BY SUPPLY AUTHORITY)	3
10	kWh		KILOWATT HOUR METER	WESTERN POWER, JW0012 : CATALOGUE No ES131PN4B2NPWP TYPE EM5100, 3P, 4W, 3 x 240V (415V), 10–125A, 50Hz, CLASS 1, MAX OUTPUT SIGNAL VOLTAGE 48V DC, 100mA, 1VARh/IMPULSE, 1Wh/IMPULSE (SUPPLIED BY SUPPLY AUTHORITY)	1
11	MS	7	MAIN SWITCH	SCHNEIDER, COMPACT NSX100F, LV429770 : 100A 3 POLE, FIXED (COMPLETE WITH MICROLOGIC 2.2 (LSoI) 40–100A TRIP UNIT)	1
			DIRECT ROTARY HANDLE	SCHNEIDER, LV429337	1
			LONG TERMINAL SHIELD	SCHNEIDER, LV429517	2
12	MNB	8	MAIN NEUTRAL BAR	SELECTRIX, B13018IX : 165A	1
13			MOUNTING RAIL	NHP, NDRA–35–1 : 150 LONG	1
14	kWhS	9	KILOWATT HOUR PULSE SURGE DIVERTER	CRITEC, UTB30SP	1
15	kVES	10	kVARh AND END OF INTERVAL PULSE SURGE DIVERTER	CRITEC, UTB30SP	1
16	OPTS	11	ON PEAK TARIFF SURGE DIVERTER	CRITEC, UTB30SP	1
17	SSD	12	SECURITY SURGE DIVERTER	CRITEC, UTB30SP	1
18			CABLE DUCT	IBOCO, T1 25–80 : 25 WIDE x 80 HIGH	AS REQ

FRONT VIEW

FRONT VIEW
(DOORS REMOVED)

GENERAL NOTES
1. UNLESS OTHERWISE SHOWN ALL DIMENSIONS ARE IN MILLIMETRES
2. UNLESS OTHERWISE SHOWN ALL LABELS 1.5 THICK BLACK ANODISED ALUMINIUM WITH WHITE ENGRAVED LETTERING
3. ALL LABELS FASTENED WITH SCOTCH MOUNT 4032 DOUBLE COATED FOAM TAPE. WIDTH AND HEIGHT OF SCOTCH MOUNT IDENTICAL TO THAT OF THE LABEL
4. FOR LABEL SPECIFICATIONS REFER WATER CORPORATION IDENTITY MANUAL SECTION S.4
5. LABEL MANUFACTURED FROM 2 THICK ALUMINIUM WITH ANODISED INK

100 50 0 100 200 300 mm

1:5 AT SHEET SIZE A1

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SNR PRINCIPAL ENGINEER – ELECT

WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
SWITCHBOARD EXAMPLE DRAWING – FORM 2
LAYOUT, MATERIAL AND LABEL SCHEDULES

ORIGINAL SHEET SIZE A1

FILE | PROJECT | PLAN DRAWING–12–2 | CAD | ISSUE A | MF

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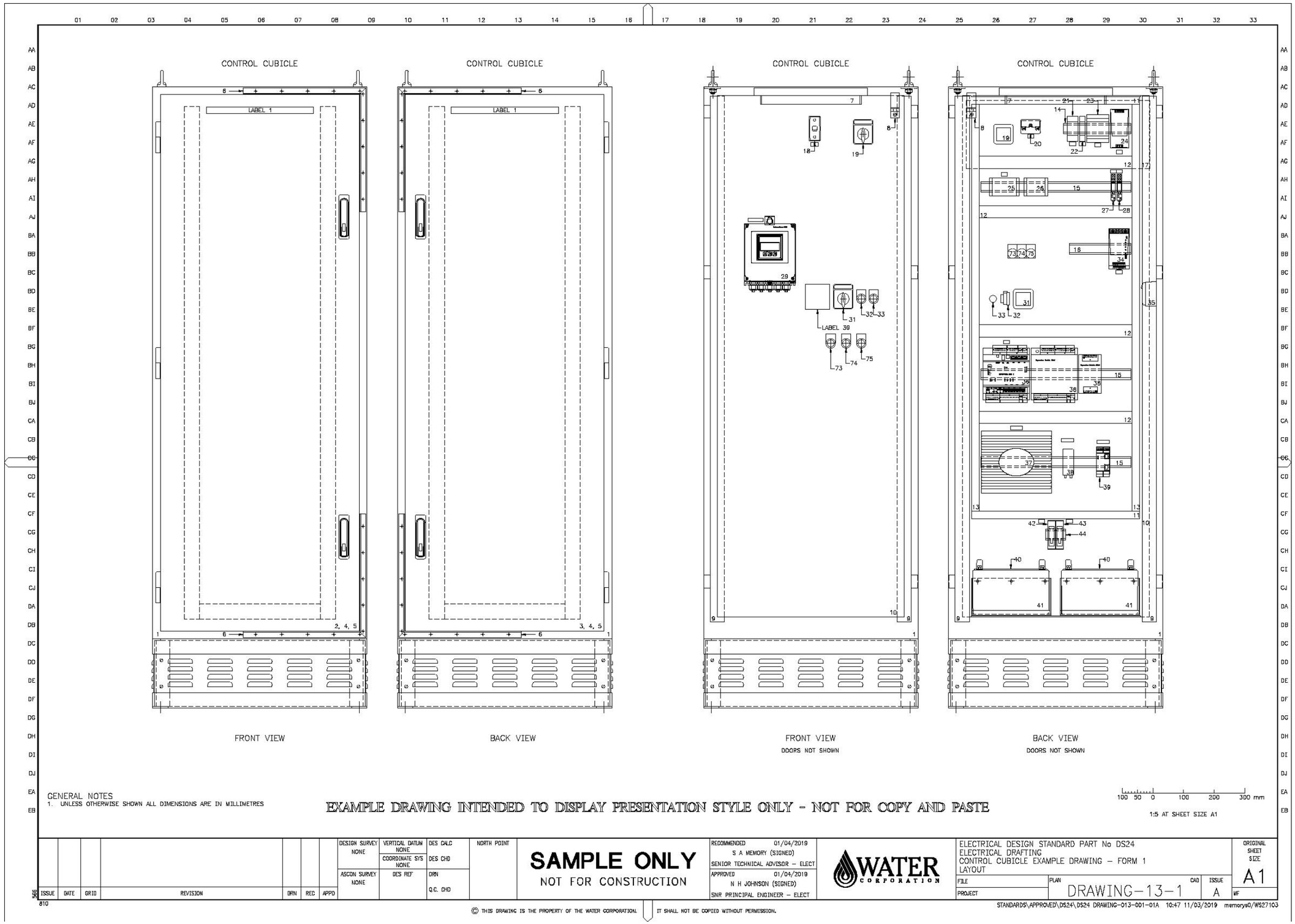

GENERAL NOTES
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100 50 0 100 200 300 mm
1:5 AT SHEET SIZE A1

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ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
CONTROL CUBICLE EXAMPLE DRAWING – FORM 1
LAYOUT

FILE | PROJECT | PLAN DRAWING-13-1 | CAD | ISSUE A | ORIGINAL SHEET SIZE A1 | MF

STANDARDS\APPROVED\DS24\DS24 DRAWING-013-001-01A 10:47 11/03/2019 memory0/W527103

MATERIAL SCHEDULE

ITEM	CODE	LABEL	DESCRIPTION	SPECIFICATION	QTY
C4	CSS	C2	CONTROL SELECTOR SWITCH	KRAUS & NAIMER, CH16B AU39C2 : ESCUTCHEON PLATE ENGRAVED "CONTROL SELECTOR", "LOCAL START, LOCAL RUN, OFF, NORMAL"	1
C5	A	C3	AMMETER	CROMPTON INSTRUMENTS, 243-026G : MOVING IRON, SCALED, 0-30/180A, TO SUIT 5A SECONDARY CT, TERMINAL SHROUDS	1
C6	h	C4	HOUR METER	SIEMENS, 7KT 5502 : 240V 50Hz	1
			TERMINAL SHROUD	SIEMENS, 7KT 9020	1
C7	MoCB	C5	MOTOR CIRCUIT BREAKER	SCHNEIDER ELECTRIC, COMPACT NSX100B, LV429775 : 100A 3 POLE, FIXED, COMPLETE WITH MICROLOGIC 2.2 (LSoI) 100A TRIP UNIT	1
			DIRECT ROTARY HANDLE	SCHNEIDER ELECTRIC, LV429337	1
			TERMINAL SHIELD	SCHNEIDER ELECTRIC, LV429515	2
			REAR CONNECTION STUD	SCHNEIDER ELECTRIC, LV429235 : 2 PIECES SHORT	2
			REAR CONNECTION STUD	SCHNEIDER ELECTRIC, LV429236 : 2 PIECES LONG	1
C8	RC	C6	RUN CONTACTOR	SPRECHER + SCHUH, CA7-60-00 : 240V 50Hz COIL	1
			AUXILIARY CONTACT BLOCK	SPRECHER + SCHUH, CA7-PA-L11 : 1NO EARLY MAKE AND 1NC LATE BREAK CONTACTS	1
			AUXILIARY CONTACT BLOCK	SPRECHER + SCHUH, CS7-PV-31 : 3NO AND 1NC CONTACTS	1
			AUXILIARY CONTACT BLOCK	SPRECHER + SCHUH, CA7-PA-11 : 1NO AND 1NC CONTACTS	1
			SURGE SUPPRESSOR	SPRECHER + SCHUH, CRC 7-280 : 240V 50Hz	1
C9	SC	C7	START CONTACTOR	SPRECHER + SCHUH, CA7-43-00 : 240V 50Hz COIL	1
			AUXILIARY CONTACT BLOCK	SPRECHER + SCHUH, CS7-PV-40 : 4NO CONTACTS	1
			SURGE SUPPRESSOR	SPRECHER + SCHUH, CRC 7-280 : 240V 50Hz	1
C10	SPC	C8	STAR POINT CONTACTOR	SPRECHER + SCHUH, CA7-30-00 : 240V 50Hz COIL	1
			AUXILIARY CONTACT BLOCK	SPRECHER + SCHUH, CS7-PV-31 : 3NO AND 1NC CONTACTS	1
			SURGE SUPPRESSOR	SPRECHER + SCHUH, CRC 7-280 : 240V 50Hz	1
C11	MPR	C9	MOTOR PROTECTION RELAY	SPRECHER + SCHUH, CEP7-EEFD : RANGE 9-45A	1
	MPRR		MOTOR PROTECTION RELAY RESET	SPRECHER + SCHUH, CEP7-EMRA : 240V 50Hz COIL	1
			SEPARATE MOUNTING BRACKET	SPRECHER + SCHUH, CEP7-EPD	1
C12	ST	C10	START TIMER	OMRON, H3DK-S1 : 240V 50Hz, 1-12 SECONDS RANGE	1
C13	CF	C11	CONTROL FUSE	SCHNEIDER, A9N15636 : 25A, 1 POLE, ISOLATABLE FUSE CARRIER	1
			FUSE LINK	FUSECO, 420006 : 8A 500V AC OR EQUIVALENT (1 SPARE)	2
C14	CR	C12	CONTROL RELAY	OMRON, G2R-1-SNDI-24VDC : 24V DC COIL, 1CO CONTACT	1
			BASE	OMRON, P2RF-05-E	1
C15	MRRR	C13	MOTOR PROTECTION REMOTE RESET RELAY	OMRON, G2R-2-SNDI-24VDC : 24V DC COIL, 2CO CONTACTS	1
			BASE	OMRON, P2RF-08-E	1
C16	AvR	C14	AVAILABLE RELAY	OMRON, G2R-1-SNI-240VAC : 240V 50Hz COIL, 1CO CONTACT	1
			BASE	OMRON, P2RF-05-E	1
C17	MPAR	C15	MOTOR PROTECTION AUXILIARY RELAY	OMRON, G2R-1-SNI-240VAC : 240V 50Hz COIL, 1CO CONTACT	1
			BASE	OMRON, P2RF-05-E	1

MATERIAL SCHEDULE

ITEM	CODE	LABEL	DESCRIPTION	SPECIFICATION	QTY
A6	LPCB	A6	LIGHT AND POWER OUTLETS CIRCUIT BREAKER	SCHNEIDER, IC60 RCBO, A9D61B10 : 240V, 10A, 6kA, C CURVE WITH 30mA RCD	1
	CSCB	A7	CONTROL CUBICLE SUPPLY CIRCUIT BREAKER	SCHNEIDER IC60N, A9F44120 : 240V, 20A, 6kA, C-CURVE	1
			POLE FILLER	SCHNEIDER, 4F6	4
			COVER	SCHNEIDER, 4CC9 : ENCLOSURE ONLY	1
A7			CABLE DUCT	IBOCO, T1 25-60 OR EQUIVALENT : 25 WIDE x 60 HIGH x 550 LONG	1
A8			CABLE DUCT	IBOCO, T1 25-60 OR EQUIVALENT : 25 WIDE x 60 HIGH x 250 LONG	2
A9			CABLE DUCT	IBOCO, T1 25-60 OR EQUIVALENT : 25 WIDE x 60 HIGH x 400 LONG	1
A10			CABLE DUCT	IBOCO, T1 25-60 OR EQUIVALENT : 25 WIDE x 60 HIGH x 1070 LONG	1
A11			CABLE DUCT	IBOCO, T1 40-60 OR EQUIVALENT : 40 WIDE x 60 HIGH x 1310 LONG	1
A12			MOUNTING BLOCK	ALUMINIUM, 32 x 32 x 1.6 RHS : 30 LONG	2
A13			MOUNTING RAIL	NHP, NDRA-35-1 : 250 LONG	1
A14	PF	AB	POTENTIAL FUSE	SCHNEIDER ELECTRIC, A9N15656 : 25A, 3 POLE, ISOLATABLE	3
			FUSE LINK	FUSECO, 420002 : 2A, 500V AC OR EQUIVALENT (3 SPARE)	6
A15	VMF	A9	VOLTAGE MONITORING FUSE	WEIDMULLER, 0474560000 : ASK 1/EN	3
			END PLATE	WEIDMULLER, 0380360000 : AP ASK1	1
			MARKING TAG	WEIDMULLER, 0190400000 : PESB8/10	3
			FUSE LINK	WEIDMULLER, 0430600000 : G 20/0.50A/F : 0.5A (1 LOOSE)	2
			END BRACKET	WEIDMULLER, 9540000000 : ZEW 35	2
A16	T1-4		TERMINAL (CONTROL)	WEIDMULLER, 1521850000 : A2C 2.5, PUSH-IN, DARK BEIGE	4
			END PLATE	WEIDMULLER, 1514400000 : AEP 2C 2.5	1
			END BRACKET	WEIDMULLER, 9540000000 : ZEW 35	2
			MARKING TAG	PACIFIC AUTOMATION, PM-CUSTOM-PRINT-DEK 5/5 : NUMBERS 1-4/HORIZONTAL	1
A17			CABLE TRAY	LEGRAND, CABLOFIL CF54/100, CM000074 : 316 STAINLESS STEEL, 404 LONG	1
			CABLE TRAY SUPPORT BRACKET	LEGRAND, CABLOFIL CM50XL, CM586133 : H.D. GALVANISED	2
A18			INSULATING SHROUD	ALCO, S02 : ORANGE : OR EQUIVALENT	12
A19	MSD	A10	MAINS SURGE DIVERTER	PHOENIX CONTACT, FLT-SEC-T1+T2-3C-350/25-FM : 2905469 415V, 25kA (8/20 µs)	1
A20			MOUNTING RAIL	NHP, NDRA-35-1 : 150 LONG	2
A21	SCS		SUPPLY CHANGEOVER SWITCH	KRAUS & NAIMER, CBD A213+AUN1203E : 4 POLE, 115A, ESCUTCHEON PLATE ENGRAVED "SUPPLY CHANGEOVER", "MAINS, OFF, STBY" WITH ALLEN KEY SCREWS, VB45 HANDLE WITH PADLOCK FACILITY IN "OFF" POSITION AND M160 PROTECTIVE COVERS	1
A22	PSMC	A11	POWER SUPPLY MONITOR CURRENT TRANSFORMER	SCHNEIDER ELECTRIC, METSECTV35010 : 100A PRIMARY, 3 IN 1 LVCT WITH RJ45 CONNECTION	1
A23	AB	A12, A13, A14	ACTIVE BAR	NETEC, AN165-13-R : 165A, RED	3
A24			CABLE TRAY	LEGRAND, CABLOFIL CF54/100, CM000074 : 316 STAINLESS STEEL, 504 LONG	1
			CABLE TRAY SUPPORT BRACKET	LEGRAND, CABLOFIL CM50XL, CM586133 : H.D. GALVANISED	2
A25	kWh		KILOWATT HOUR METER	3P, 4 WIRE, 3 x 240V (415V), 10-125A, 50Hz : COMPLETE WITH CUSTOMER PULSE OUTPUTS	1
A26	SPD		SERVICE PROTECTION DEVICE	ALSTOM, SERIES 7, S71002ABWS : 500V, 100A (SUPPLIED WITH METER PANEL)	3
			FUSE LINK	100A (INSTALLED BY SUPPLY AUTHORITY)	3
A27			SUPPLY AUTHORITY METER PANEL	GOOD SAMARITAN INDUSTRIES, THREE PHASE METER PANEL	1
A28	CFCL	A22	CONTROL FAULT CURRENT LIMITER	WOHNER, 31110 : 32A, 1 POLE, ISOLATABLE FUSE CARRIER	1
			FUSE LINK	FUSECO, 420025 : 25A, 500V AC OR EQUIVALENT (1 SPARE)	2
A29	PFR	A20	PHASE FAILURE RELAY	RMS, 2P740-EBA : 3 PHASE, 415V 50Hz, UNDERVOLTAGE TRIP SETTING FIXED AT 80%, UNBALANCE TRIP SETTING ADJUSTABLE FROM 5% TO 15% SET AT 5%	1
			DIN RAIL MOUNT KIT	RMS, 290407157	1
A30	ISMS	A21	INVERTER SUPPLY MAIN SWITCH	SCHNEIDER IC60N, A9F44363 : 415V, 63A, 6kA, C-CURVE	1
			POLE FILLER	SCHNEIDER, 4F6	1
			COVER	SCHNEIDER, 4CC4	1
A31			CABLE DUCT	IBOCO, T1 25-60 OR EQUIVALENT : 25 WIDE x 60 HIGH x 195 LONG	1
A32			CABLE DUCT	IBOCO, T1 25-60 OR EQUIVALENT : 25 WIDE x 60 HIGH x 175 LONG	1
A33			MOUNTING BLOCK	ALUMINIUM, 32 x 32 x 1.6 RHS : 30 LONG	2
A34			MOUNTING RAIL	NHP, NDRA-35-1 : 185 LONG	1
A35	AFCL	A23	ANCILLARY FAULT CURRENT LIMITER	WOHNER, 31110 : 32A, 1 POLE, ISOLATABLE FUSE CARRIER	1
			FUSE LINK	FUSECO, 420025 : 25A, 500V AC OR EQUIVALENT (1 SPARE)	2
B1			PANEL	LX00-91-13A : 298 HIGH	1
C1		C1, C27	PANEL	LX02-222-5C : 448 HIGH	1
			REFERENCE DRAWINGS	LX02-222-1C, 2C, 3C, 4C, LX02-291-1C, 2A	
C2	MOIL	C26	MOTOR OVERLOAD FAULT INDICATING LIGHT	PACIFIC AUTOMATION, SEL-LD-22D-240-AMBER : 240V 50Hz	1
			NAME PLATE	IDEC, HWAM : ENGRAVED "FAULT" IN 2.5 HIGH LETTERING	1
C3	MORP		MOTOR OVERLOAD FAULT RESET PUSHBUTTON	IDEC, HW1B-M1F10-S : BLUE ACTUATOR, 1NO CONTACT	1
			NAME PLATE	IDEC, HWAM : ENGRAVED "RESET" IN 2.5 HIGH LETTERING	1

MATERIAL SCHEDULE

ITEM	CODE	LABEL	DESCRIPTION	SPECIFICATION	QTY
1			BASE	LX00-1-3A : OPTION 2	1
2			CUBICLE	LX00-1-2C : OPTION 2	3
3		1, 2, 3, 4, 5, 6, 16, 17	FRONT DOOR	LX00-91-2C : RH DOOR	1
			PADLOCK	BULLANT, WC6244QSS : GENERAL ACCESS KEY CYLINDER 3P	2
	FDLS		FRONT DOOR LIMIT SWITCH	SCHMERSAL, ZS-236-11Z-M20 : 1NO AND 1NC CONTACT	1
4		7	FRONT DOOR	LX00-91-2C : LH DOOR	1
			PADLOCK	BULLANT, WC6244QSS : GENERAL ACCESS KEY CYLINDER 3P	2
	FDLS		FRONT DOOR LIMIT SWITCH	SCHMERSAL, ZS-236-11Z-M20 : 1NO AND 1NC CONTACT	1
5			DOOR STAY	LX00-91-5A	4
6		7, 8	REAR DOOR	LX00-91-2C : RH DOOR	1
			PADLOCK	BULLANT, WC83ALI840/TITAN : ELECTRICAL ACCESS KEY CYLINDER 7P	2
	RDLS		REAR DOOR LIMIT SWITCH	SCHMERSAL, ZS-236-11Z-M20 : 1NO AND 1NC CONTACT	1
7		5, 8	REAR DOOR	LX00-91-2C : LH DOOR	1
			PADLOCK	BULLANT, WC83ALI840/TITAN : ELECTRICAL ACCESS KEY CYLINDER 7P	2
	RDLS		REAR DOOR LIMIT SWITCH	SCHMERSAL, ZS-236-11Z-M20 : 1NO AND 1NC CONTACT	1
8			DOCUMENT HOLDER	LX00-91-3A	2
9			EYEBOLT HOLE SEALING ASSEMBLY	LX00-1-2*	2
10			CABLE TRAY	LX00-91-12A : ITEM 2	2
11			DOOR EARTHING CABLE	LX00-91-6A : OPTION 2	4
12			PANEL MOUNTING BRACKET	LX00-91-11A	2
13			CUBICLE LIGHT	IDEC, 1A-LF2B-C3P-ATHWW2-1M : 240V 50Hz, 7.5W, CLEAR COVER, 1m CABLE	4
14	T		TERMINAL (LIGHTING)	WEIDMULLER, 1521850000 : A2C 2.5, PUSH-IN, DARK BEIGE	6
			END PLATE	WEIDMULLER, 1514400000 : AEP 2C 2.5	2
			PLUGGABLE CROSS CONNECTION	WEIDMULLER, 1527890000 : ZQV 2.5N/10	1
			END BRACKET	WEIDMULLER, 9540000000 : ZEW 35	4
			MARKING TAG	WEIDMULLER, 0522761021 : DEK 5 GW A	3
			MARKING TAG	WEIDMULLER, 0522761034 : DEK 5 GW N	3
15			MOUNTING RAIL	NHP, NDRA-35-1 : 50 LONG	1
16			INTERCONNECTING DUCT	LX00-91-8B : OPTION 3	2
17	MNB	9	MAIN NEUTRAL BAR	SELECTLOK, B1301BIX : 165A	1
			INSULATOR	NHP, ERICO, ISO20M4, 551400 : 20 LONG	2
18	MEB	10	MAIN EARTH BAR	SELECTLOK, B1301BIX : 165A	1
19			NEUTRAL AND EARTH BAR BRACKET	LX00-91-24.2B : ITEM 2	1
20	EB1	11	EARTH BAR No1	SELECTLOK, B1301BIX	1
			EARTH BAR BRACKET	LX00-91-21B : ITEM 3	1
21	SSAI	12, 13	STANDBY SUPPLY APPLIANCE INLET	MARECHAL, DS6 : 9DA/400V (AC-23A), IP66/67, 3 PHASE, NEUTRAL AND EARTH	1
			30° WALL BOX	MARECHAL, 514B3M40	1
			INLET	MARECHAL, 3188017600 : 380-440V	1
			INLET CAP	MARECHAL, 318A426	1
22			APPLIANCE INLET COVER	LX00-91-18B	1
			PADLOCK	BULLANT, WC6244QSS : GENERAL ACCESS KEY CYLINDER 3P	1
23	EO	14	EXTERNAL POWER OUTLET	CLIPSAL, 56C310D : 250V, 10A, 3 FLAT PINS, DOUBLE POLE	1
			POWER OUTLET COVER	LX00-91-10B	1
			PADLOCK	BULLANT, WC6244QSS : GENERAL ACCESS KEY CYLINDER 3P	1
24	EBB	15	EQUIPOTENTIAL BONDING BAR	LX00-91-20A	1
25	MDr		MOTOR DECONTACTOR (INLINE) (MOUNTED REMOTE)	MARECHAL, DSN6 : 63A/400V (AC-23), 3 PHASE AND EARTH WITH 4 AUXILIARY CONTACTS	1
			HANDLE	MARECHAL, 513P0D30473	2
			SOCKET OUTLET	MARECHAL, 6184013264 : 380-440V	1
			INLET	MARECHAL, 6188013264 : 380-440V	1
			INLET CAP	MARECHAL, 313A426	1
26			PANEL	LX00-91-13A : 523 HIGH	1
A1		A1	PANEL	LX01-104-6A : 1423 HIGH	1
A2	PSM	A2	POWER SUPPLY MONITOR	SCHNEIDER ELECTRIC, METSEPM5320R : ETHERNET, RJ45 CONNECTION	1
			PATCH CABLE	SCHNEIDER ELECTRIC, DCEPCURJ02GYM : CAT 5e, 2m LONG	1
A3	LgS	A3	LIGHT SWITCH	CLIPSAL, 30 WE : 250V, 10A	1
			MOUNTING BLOCK	CLIPSAL, 70/1 WE	1
A4	NSMS	A4, A18	NORMAL SUPPLY MAIN SWITCH	SCHNEIDER ELECTRIC, COMPACT NSX100F, LV429770 : 100A 3 POLE, FIXED (COMPLETE WITH MICROLOGIC 2.2 (LSoI) 100A TRIP UNIT)	1
			DIRECT ROTARY HANDLE	SCHNEIDER ELECTRIC, LV429337	1
			TERMINAL SHIELD	SCHNEIDER ELECTRIC, LV429515	2
			REAR CONNECTION STUD	SCHNEIDER ELECTRIC, LV429236 : 2 PIECES SHORT	2
			REAR CONNECTION STUD	SCHNEIDER ELECTRIC, LV429236 : 2 PIECES LONG	1
	VPI		VOLTAGE PRESENCE INDICATOR	SCHNEIDER ELECTRIC, LV429325	1
A5	SSMS	A5, A18	STANDBY SUPPLY MAIN SWITCH	SCHNEIDER ELECTRIC, COMPACT NSX100F, LV429770 : 100A 3 POLE, FIXED (COMPLETE WITH MICROLOGIC 2.2 (LSoI) 100A TRIP UNIT)	1
			DIRECT ROTARY HANDLE	SCHNEIDER ELECTRIC, LV429339 : RED/YELLOW	1
			TERMINAL SHIELD	SCHNEIDER ELECTRIC, LV429515	2
			REAR CONNECTION STUD	SCHNEIDER ELECTRIC, LV429236 : 2 PIECES SHORT	2
			REAR CONNECTION STUD	SCHNEIDER ELECTRIC, LV429236 : 2 PIECES LONG	1
	VPI		VOLTAGE PRESENCE INDICATOR	SCHNEIDER ELECTRIC, LV429325	1

GENERAL NOTES
1. UNLESS OTHERWISE SHOWN ALL DIMENSIONS ARE IN MILLIMETRES
2. EQUIPMENT FASTENED TO PANEL USING SS OR NON FERROUS METAL OR NiCr OR Zn ELECTROPLATED STEEL TO COLOUR YELLOW, COATING TYPE C, RD HD SCREWS WITH NUTS AND WASHERS

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
B	12/2022		ITEMS 9, A2, A4, A5, A9-A11, A16, A17, A20, A22, A25, A28, UPDATED. ITEMS A31-35 ADDED. ITEMS B2 TO B15 DELETED	SAM	SAM	EG

DESIGN SURVEY NONE | VERTICAL DATUM NONE | DES CALC
COORDINATE SYS NONE | DES CHD
ASCON SURVEY NONE | DES REF | DRN | Q.C. CHD

NORTH POINT

SAMPLE ONLY
NOT FOR CONSTRUCTION

RECOMMENDED 01/04/2019
S A MEMORY (SIGNED)
SUPERVISING ELECTRICAL ENGINEER
APPROVED 01/04/2019
N H JOHNSON (SIGNED)
PRINCIPAL ELECTRICAL ENGINEER

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
SWITCHBOARD EXAMPLE DRAWING - FORM 1
MATERIAL SCHEDULE

FILE | PLAN DRAWING-14-1 | CAD | ISSUE B
PROJECT

ORIGINAL SHEET SIZE A1

STANDARDS\APPROVED\DS24\REVISION\DS24 DRAWING-014-001-01B 11:09 13/12/2022 MEMORYSO/NB46194

LABEL SCHEDULE

LABEL	LETTER HEIGHT	TEXT	WIDE	HIGH	QTY
1	12	MAIN SWITCHBOARD	250	20	1
2	30 30 15 15	**WRONG WAY** **WWPS No1** Faults, Emergencies and Security **13 13 75** (24 hours) WATER CORPORATION (SEE NOTE 5)	470	250	1
3	2.5	MANUFACTURER: BOB THE BUILDER PTY LTD DATE OF MANUFACTURE: 01/12/2022 DESIGN VERIFICATION BY TESTING: RESISTANCE TO CORROSION, RESISTANCE TO ULTRA VIOLET, DEGREE OF PROTECTION STANDARDS: AS/NZS 61439.1/2 : 2016 RATED OPERATIONAL VOLTAGE: 415V RATED INSULATION VOLTAGE: 440V RATED IMPULSE WITHSTAND VOLTAGE: 8kV (PEAK) RATED CURRENT/TEMPERATURE OF THE ASSEMBLY: 100A AT 50°C/55°C (MEAN/MAXIMUM TEMPERATURE) RATED SHORT-TIME WITHSTAND CURRENT: 10kA FOR 1s ARC FAULT CURRENT: 7kA (RMS) ARCING CLASS B, UNRESTRICTED ACCESS (ORDINARY PERSONS) POLLUTION DEGREE: POLLUTION DEGREE 3, MATERIAL GROUP IIIa DEGREE OF PROTECTION: INGRESS PROTECTION CODE – IP56 EARTHING SYSTEM: TN-C-S (MEN) DRAWING NUMBER: ZZ99-41	170	110	1
4	6 6 6 6	ATTENTION DESIGN VERIFIED SWITCHBOARD NOT TO BE MODIFIED WITHOUT MAKER'S APPROVAL	170	50	1
5	12	INCOMING CUBICLE	350	20	2
6	6	SUPPLY AUTHORITY METER BEHIND DOOR	150	12	1
7	12	No1 AND No2 STARTER CUBICLE	350	20	2

LABEL SCHEDULE

LABEL	LETTER HEIGHT	TEXT	WIDE	HIGH	QTY
8	15 15 15	**DANGER** **415 VOLTS BEHIND** (SEE NOTE 6)	165	120	3
9	3.5	MNB	20	12	1
10	3.5	MEB	20	12	1
11	3.5	EB1	20	12	1
12	2.5 2.5	STANDBY SUPPLY APPLIANCE INLET (90A)	70	12	1
13	2.5 2.5 2.5	MEN LINK IN SWITCHBOARD. DO NOT MAKE MEN CONNECTION AT GENERATOR SET	70	20	1
14	2.5 2.5	RCD PROTECTED	30		1
15	6 6	EQUIPOTENTIAL BONDING BAR LOCATED BEHIND PANEL	150	30	1
16	15 12 12 12	**DANGER** **ARC FLASH RISK** **CAT 0 PPE** **ALL ACTIVITIES** (SEE NOTE 6)	165	120	1
17	10 5 5 3.5 3.5 3.5	**WARNING** EMERGENCY SERVICES ISOLATION SWITCHBOARD FED FROM MULTIPLE SUPPLIES 1. ISOLATE NORMAL SUPPLY MAIN SWITCH BEHIND DOOR 2. ISOLATE STANDBY SUPPLY MAIN SWITCH BEHIND DOOR 3. ISOLATE INVERTER SUPPLY MAIN SWITCH BEHIND DOOR (SEE NOTE 7)	190	110	1

LABEL SCHEDULE

LABEL	LETTER HEIGHT	TEXT	WIDE	HIGH	QTY
A1	8	MAIN SWITCH PANEL	200	12	1
A2	2.5 2.5	POWER SUPPLY MONITOR	40	12	1
A3	2.5 2.5	LIGHT SWITCH	25	12	1
A4	6 6	MAIN SWITCH NORMAL SUPPLY	80	20	1
A5	6 6	MAIN SWITCH STANDBY SUPPLY	80	20	1
A6	2.5 2.5 2.5 2.5	LIGHTING AND POWER OUTLETS (10A) N*	35	20	1
A7	2.5 2.5 2.5 2.5	CONTROL CUBICLE SUPPLY (20A) N6	17.5	20	1
A8	2.5 3.5	45 | 27.5 | 9 R W B PF (2A)	55	12	1
A9	2.5 3.5	23 | 15 | 7 R W B VMF (0.5A)	30	12	1
A10	3.5	MSD	20	12	1
A11	3.5	PSMC	20	12	1
A12	3.5 2.5	AB (RED)	20	12	1
A13	3.5 2.5	AB (WHITE)	20	12	1
A14	3.5 2.5	AB (BLUE)	20	12	1
A15	2.5 2.5	MEN LINK (SEE NOTES 8 AND 9)	30	12	1
A16	2.5 2.5	GENERATOR NEUTRAL–EARTH LINK (SEE NOTE 10)	50	12	1
A17	10 5 5 5 5	**WARNING** **MULTIPLE SUPPLIES** **ISOLATE ALL SUPPLIES BEFORE WORKING ON THIS SWITCHBOARD** (SEE NOTE 8)	150	70	1
A18	2.5 2.5	NO CHANGES TO THE PROTECTION GRADING SETTINGS WITHOUT REFERENCE TO THE DESIGNER	110	20	2
A19	10 5 5	**SOLAR ARRAY** **SHORT CIRCUIT CURRENT **** A** **OPEN CIRCUIT VOLTAGE **** V** (SEE NOTE 11)	150	40	1

GENERAL NOTES
1. UNLESS OTHERWISE SHOWN ALL DIMENSIONS ARE IN MILLIMETRES
2. UNLESS OTHERWISE SHOWN ALL LABELS 1.6 THICK UV STABILIZED BLACK ACRYLIC LAMINATE (ROWMARK, LASERMAX LM922-402) WITH LASER ETCHED WHITE ARIAL FONT LETTERING
3. ALL INTERNAL ACRYLIC LABELS FASTENED WITH SCOTCH MOUNT 4032 DOUBLE COATED FOAM TAPE. WIDTH AND HEIGHT OF SCOTCH MOUNT IDENTICAL TO THAT OF THE LABEL.
4. ALL EXTERNAL ACRYLIC LABELS FASTENED WITH SIKAFAST-521S NT ADHESIVE WIDTH AND HEIGHT OF ADHESIVE IDENTICAL TO THAT OF THE LABEL, ALL EXCESS TO BE REMOVED
5. LABEL 2 MANUFACTURED FROM WHITE SELF ADHESIVE VINYL FILM (BRADY B-595) PRINTED WITH DARK BLUE (BRADY, BBP 85 RIBBON, 13515) UV RESISTANT INK AND COMPLETE WITH UV RESISTANT LAMINATE OVERLAY. IN ACCORDANCE WITH WATER CORPORATION BRAND GUIDLELINES, TITLE LINES 1–3 AND CONTACT PHONE NUMBER SHALL BE ARIAL BOLD FONT, REMAINING TEXT SHALL BE ARIAL FONT.
6. LABELS 8 AND 16 MANUFACTURED FROM WHITE SELF ADHESIVE VINYL FILM (BRADY B-595) PRINTED WITH BLACK AND RED (BRADY, BBP 85 RIBBON, 13520) UV RESISTANT INKS AND COMPLETE WITH UV RESISTANT LAMINATE OVERLAY
7. LABEL 17, 1.6 THICK UV STABILIZED YELLOW ACRYLIC LAMINATE (ROWMARK, LASERMAX LM922-704) WITH LASER ETCHED BLACK ARIAL FONT LETTERING
8. LABELS A15 AND A17, 1.6 THICK UV STABILIZED YELLOW ACRYLIC LAMINATE (ROWMARK, LASERMAX LM922-704) WITH LASER ETCHED BLACK ARIAL FONT LETTERING
9. LABEL A15 FASTENED TO MEN CABLE WITH CABLE TIES ADJACENT NEUTRAL BAR CONNECTION
10. LABEL A16 FASTENED TO GENERATOR NEUTRAL–EARTH CABLE WITH CABLE TIES ADJACENT NEUTRAL BAR CONNECTION
11. LABEL A19 1.6 THICK UV STABILIZED RED ACRYLIC LAMINATE (ROWMARK, LASERMAX TL923-264) WITH LASER ETCHED WHITE ARIAL FONT LETTERING

10 5 0 10 20 30 40 50 60 70 mm
1:1 AT SHEET SIZE A1

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
B	12/2022		LABELS 2, 3, 4, 8, 16 UPDATED. LABELS A18 AND A19 DELETED. NOTES 2 TO 11 UPDATED. NEW LABELS A18 AND A19 ADDED	SAM	SAM	EG

DESIGN SURVEY NONE | VERTICAL DATUM NONE | DES CALC
COORDINATE SYS NONE | DES CHD
ASCON SURVEY NONE | DES REF | DRN | Q.C. CHD
NORTH POINT

SAMPLE ONLY
NOT FOR CONSTRUCTION

RECOMMENDED 01/04/2019 S A MEMORY (SIGNED) SENIOR TECHNICAL ADVISOR – ELECT
APPROVED 01/04/2019 N H JOHNSON (SIGNED) SNR PRINCIPAL ENGINEER – ELECT

WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
SWITCHBOARD EXAMPLE DRAWING – FORM 1
LABEL SCHEDULE – PART 1

ORIGINAL SHEET SIZE A1
FILE | PLAN DRAWING-15-1.1 CAD | ISSUE B
PROJECT | MF

STANDARDS\APPROVED\DS24\REVISION\DS24 DRAWING-015-001-01B 11:09 13/12/2022 MEMORYSO/NB46194

LABEL SCHEDULE

LABEL	LETTER HEIGHT	TEXT	WIDE	HIGH	QTY
E2	3.5	No1	20	12	1
E3	3.5	No2	20	12	1

LABEL SCHEDULE

LABEL	LETTER HEIGHT	TEXT	WIDE	HIGH	QTY
A20	3.5	PFR	20	12	1
A21	6 6	MAIN SWITCH INVERTER SUPPLY	80	20	1
A22	3.5 2.5	CFCL (25A)	20	12	1
A23	3.5 2.5	AFCL (25A)	20	12	1
B1		RESERVED FOR PSI (FUTURE)			
C1	6	No1 AUTOTRANSFORMER STARTER PANEL	200	12	1
C2	6 2.5 2.5 2.5	WARNING : 1. HYDRAULIC PROTECTION BYPASSED IN LOCAL RUN MODE 2. MAXIMUM OF 1 PUMP TO RUN (SEE NOTE 5)	105	32	1
C3	2.5 2.5	INSTALLED MOTOR 15kW FLC = 28A	80	12	1
C4	2.5 2.5	HOURS RUN	30	12	1
C5	2.5	MOTOR CIRCUIT BREAKER	60	12	1
C6	3.5	RC	20	12	1
C7	3.5	SC	20	12	1
C8	3.5	SPC	20	12	1
C9	3.5	MPR	20	12	1
C10	3.5	ST	20	12	1
C11	3.5 2.5	CF (6A) N10	20	12	1
C12	3.5	CR	20	12	1
C13	3.5	MRRR	20	12	1
C14	3.5	AvR	20	12	1
C15	3.5	MPAR	20	12	1
C16	3.5	MCT	20	12	1
C17	3.5	SThR	20	12	1
C18	3.5	CuTr	20	12	1
C22	3.5	MThR	20	12	1
C23	3.5	MOSD	20	12	1
C25	2.5	MOTOR OVERLOAD	60	12	1
C27	3.5 2.5 2.5	STARTER DESIGN CAPACITY 42A MAX EQUIPMENT LIMITED TO 30A	90	20	1
E1	2.5 2.5	AUTOTRANSFORMER 01558S-04WC rated: 30kVA, 42A 5 x 3 second starts per hour	100	20	1

GENERAL NOTES
1. UNLESS OTHERWISE SHOWN ALL DIMENSIONS ARE IN MILLIMETRES
2. UNLESS OTHERWISE SHOWN ALL LABELS 1.6 THICK UV STABILIZED BLACK ACRYLIC LAMINATE (ROWMARK, LASERMAX LM922-402) WITH LASER ETCHED WHITE ARIAL FONT LETTERING
3. ALL INTERNAL ACRYLIC LABELS FASTENED WITH SCOTCH MOUNT 4032 DOUBLE COATED FOAM TAPE. WIDTH AND HEIGHT OF SCOTCH MOUNT IDENTICAL TO THAT OF THE LABEL.
4. ALL EXTERNAL ACRYLIC LABELS FASTENED WITH SIKAFAST-5215 NT ADHESIVE WIDTH AND HEIGHT OF ADHESIVE IDENTICAL TO THAT OF THE LABEL. ALL EXCESS TO BE REMOVED
5. LABEL C2, 1.6 THICK UV STABILIZED YELLOW ACRYLIC LAMINATE (ROWMARK, LASERMAX LM922-704) WITH LASER ETCHED BLACK ARIAL FONT LETTERING

10 5 0 10 20 30 40 50 60 70 mm

1:1 AT SHEET SIZE A1

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
B	12/2022		PSI LEGEND AND LABELS B1 TO B8 DELETED. LABELS A22 AND A23 ADDED. NOTES 4-6 DELEETD. NOTES 1-5 UPDATED	SAM	SAM	EC

DESIGN SURVEY NONE | VERTICAL DATUM NONE | DES CALC
COORDINATE SYS NONE | DES CHD
ASCON SURVEY NONE | DES REF | DRN
Q.C. CHD
NORTH POINT

SAMPLE ONLY
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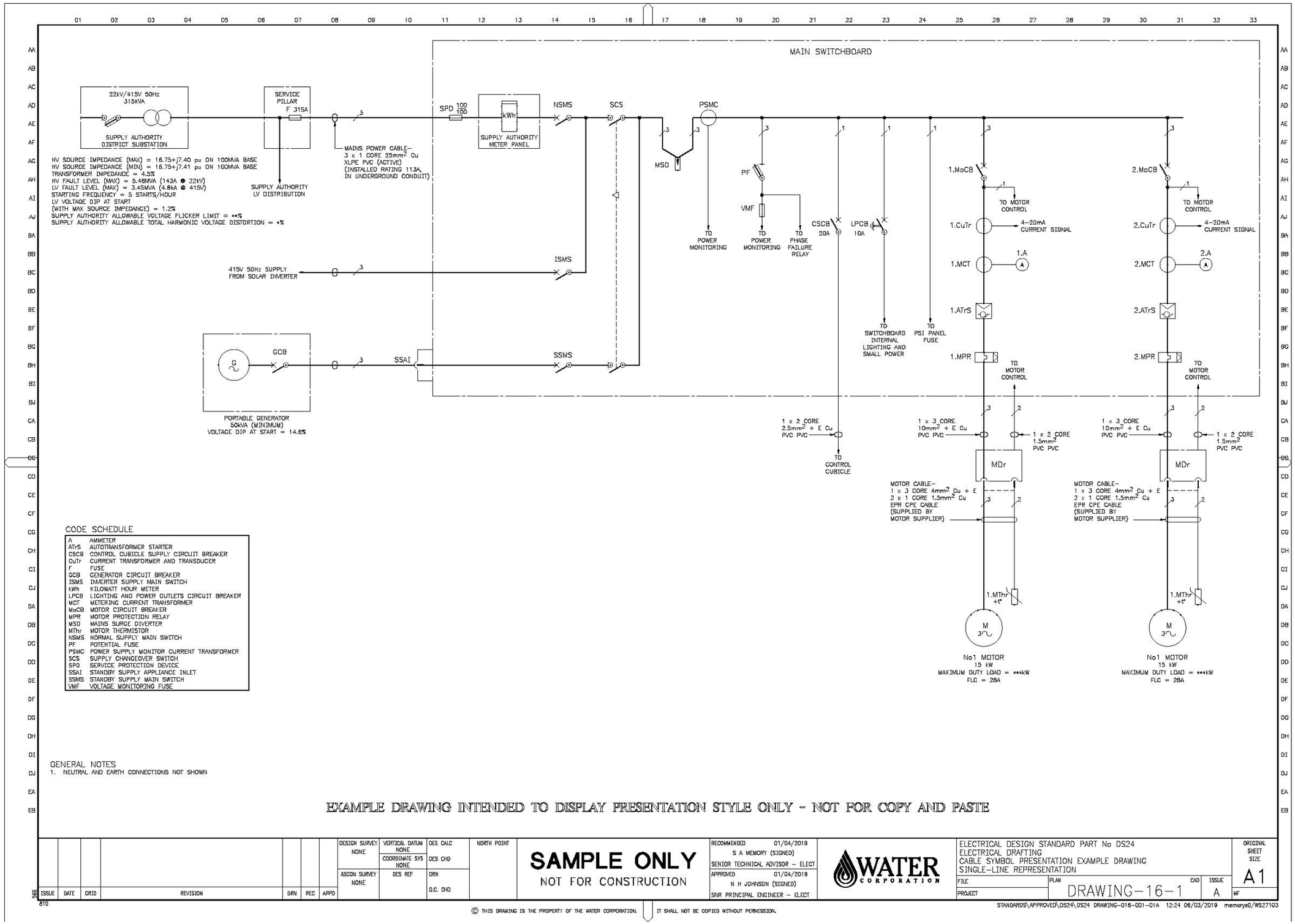
RECOMMENDED 01/04/2019
S A MEMORY (SIGNED)
SENIOR TECHNICAL ADVISOR – ELECT
APPROVED 01/04/2019
N H JOHNSON (SIGNED)
SNR PRINCIPAL ENGINEER – ELECT

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
SWITCHBOARD EXAMPLE DRAWING – FORM 1
LABEL SCHEDULE – PART 2

ORIGINAL SHEET SIZE A1

FILE | PLAN DRAWING-15-1.2 CAD | ISSUE B
PROJECT | MF

STANDARDS\APPROVED\DS24\REVISION\DS24 DRAWING-015-001-02B 11:09 13/12/2022 MEMORYSO/NB46194



CODE SCHEDULE

A	AMMETER
ATrS	AUTOTRANSFORMER STARTER
CSCB	CONTROL CUBICLE SUPPLY CIRCUIT BREAKER
CuTr	CURRENT TRANSFORMER AND TRANSDUCER
F	FUSE
GCB	GENERATOR CIRCUIT BREAKER
ISMS	INVERTER SUPPLY MAIN SWITCH
kWh	KILOWATT HOUR METER
LPCB	LIGHTING AND POWER OUTLETS CIRCUIT BREAKER
MCT	METERING CURRENT TRANSFORMER
MoCB	MOTOR CIRCUIT BREAKER
MPR	MOTOR PROTECTION RELAY
MSD	MAINS SURGE DIVERTER
MThr	MOTOR THERMISTOR
NSMS	NORMAL SUPPLY MAIN SWITCH
PF	POTENTIAL FUSE
PSMC	POWER SUPPLY MONITOR CURRENT TRANSFORMER
SCS	SUPPLY CHANGEOVER SWITCH
SPD	SERVICE PROTECTION DEVICE
SSAI	STANDBY SUPPLY APPLIANCE INLET
SSMS	STANDBY SUPPLY MAIN SWITCH
VMF	VOLTAGE MONITORING FUSE

GENERAL NOTES
1. NEUTRAL AND EARTH CONNECTIONS NOT SHOWN

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	CRID	REVISION	DRN	REC	APPD
810						

DESIGN SURVEY: NONE | VERTICAL DATUM: NONE | DES CALC | NORTH POINT
COORDINATE SYS: NONE | DES CHD
ASCON SURVEY: NONE | DES REF | DRN | Q.C. CHD

SAMPLE ONLY
NOT FOR CONSTRUCTION

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SNR PRINCIPAL ENGINEER – ELECT

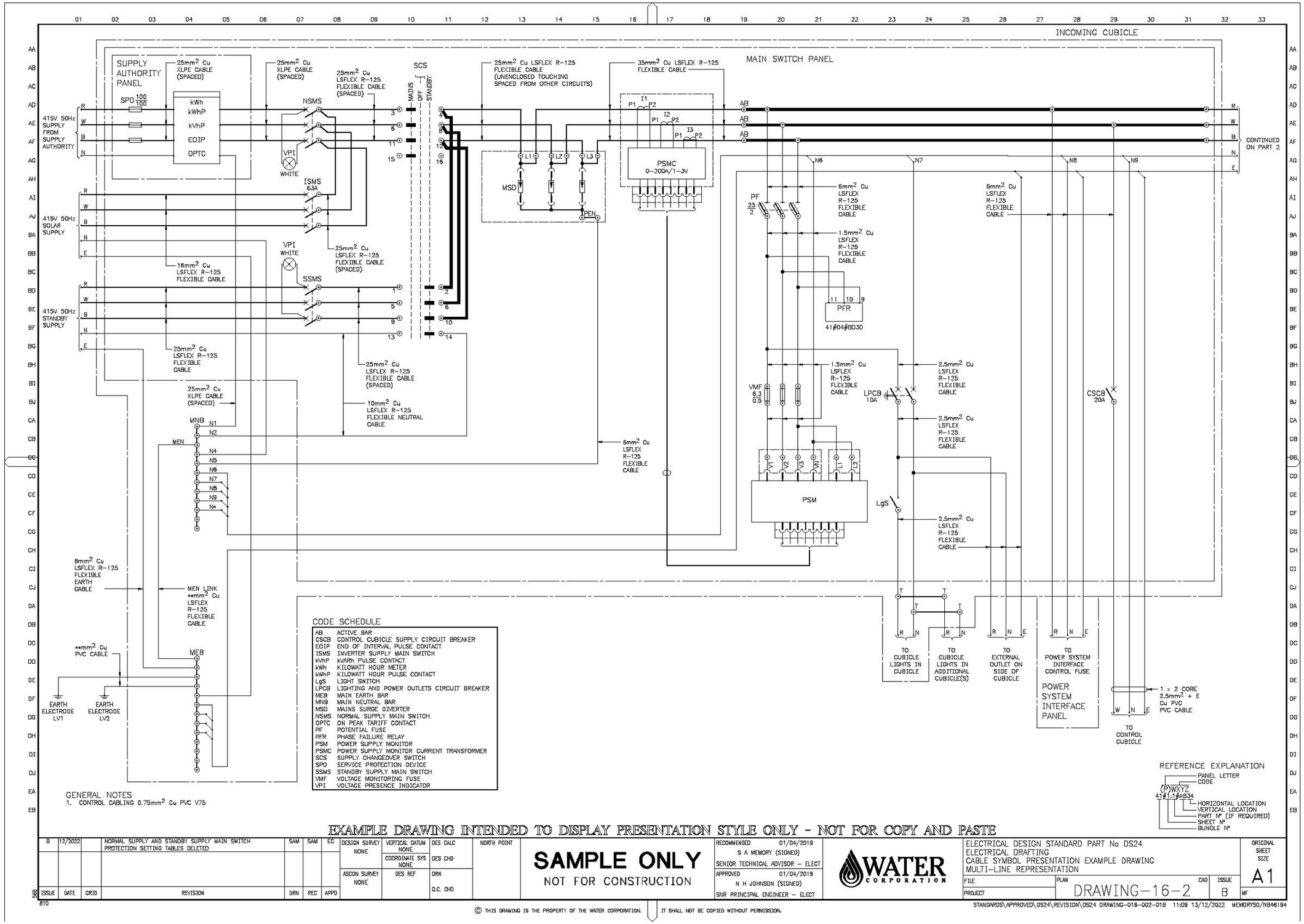
WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
CABLE SYMBOL PRESENTATION EXAMPLE DRAWING
SINGLE–LINE REPRESENTATION

ORIGINAL SHEET SIZE: A1

FILE | PLAN | CAD | ISSUE: A
PROJECT | DRAWING–16–1 | MF

STANDARDS\APPROVED\DS24\DS24 DRAWING–016–001–01A 12:24 06/03/2019 memory0/WS27103



CODE SCHEDULE

AB	ACTIVE BAR
CSCB	CONTROL CUBICLE SUPPLY CIRCUIT BREAKER
EOIP	END OF INTERVAL PULSE CONTACT
ISMS	INVERTER SUPPLY MAIN SWITCH
kVhP	kVARh PULSE CONTACT
kWh	KILOWATT HOUR METER
kWhP	KILOWATT HOUR PULSE CONTACT
LgS	LIGHT SWITCH
LPCB	LIGHTING AND POWER OUTLETS CIRCUIT BREAKER
MEB	MAIN EARTH BAR
MNB	MAIN NEUTRAL BAR
MSD	MAINS SURGE DIVERTER
NSMS	NORMAL SUPPLY MAIN SWITCH
OPTC	ON PEAK TARIFF CONTACT
PF	POTENTIAL FUSE
PFR	PHASE FAILURE RELAY
PSM	POWER SUPPLY MONITOR
PSMC	POWER SUPPLY MONITOR CURRENT TRANSFORMER
SCS	SUPPLY CHANGEOVER SWITCH
SPD	SERVICE PROTECTION DEVICE
SSMS	STANDBY SUPPLY MAIN SWITCH
VMF	VOLTAGE MONITORING FUSE
VPI	VOLTAGE PRESENCE INDICATOR

GENERAL NOTES
1. CONTROL CABLING 0.75mm² Cu PVC V75

REFERENCE EXPLANATION
PANEL LETTER CODE
(P)WXYZ
41#1.1#AB34
HORIZONTAL LOCATION
VERTICAL LOCATION
PART Nº (IF REQUIRED)
SHEET Nº
BUNDLE Nº

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	ORID	REVISION	DRN	REC	APPD
B	12/2022		NORMAL SUPPLY AND STANDBY SUPPLY MAIN SWITCH PROTECTION SETTING TABLES DELETED	SAM	SAM	EC

DESIGN SURVEY: NONE | VERTICAL DATUM: NONE | DES CALC | COORDINATE SYS: NONE | DES CHD | ASCON SURVEY: NONE | DES REF | DRN | Q.C. CHD | NORTH POINT

SAMPLE ONLY
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APPROVED 01/04/2019 N H JOHNSON (SIGNED) SNR PRINCIPAL ENGINEER – ELECT

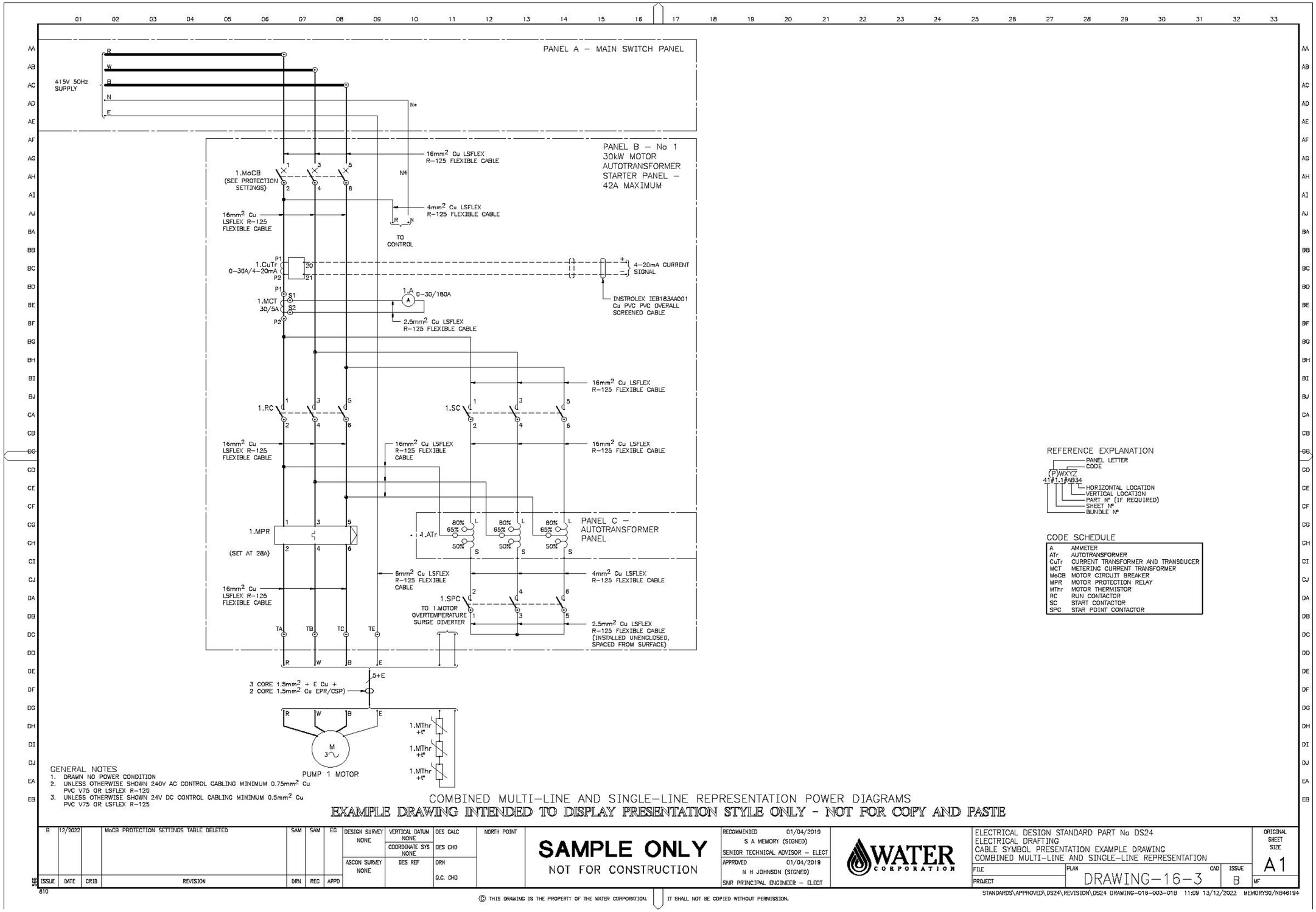
WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
CABLE SYMBOL PRESENTATION EXAMPLE DRAWING
MULTI-LINE REPRESENTATION

ORIGINAL SHEET SIZE A1

FILE | PLAN | CAD | ISSUE
PROJECT | DRAWING-16-2 | B | MF

STANDARDS\APPROVED\DS24\REVISION\DS24 DRAWING-018-002-018 11:09 13/12/2022 MEMORYSO/NB46194



COMBINED MULTI–LINE AND SINGLE–LINE REPRESENTATION POWER DIAGRAMS

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
B	12/2022		MoCB PROTECTION SETTINGS TABLE DELETED	SAM	SAM	EG

DESIGN SURVEY: NONE | VERTICAL DATUM: NONE | COORDINATE SYS: NONE | ASCON SURVEY: NONE | DES REF | DES CALC | DES CHD | DRN | Q.C. CHD | NORTH POINT

SAMPLE ONLY
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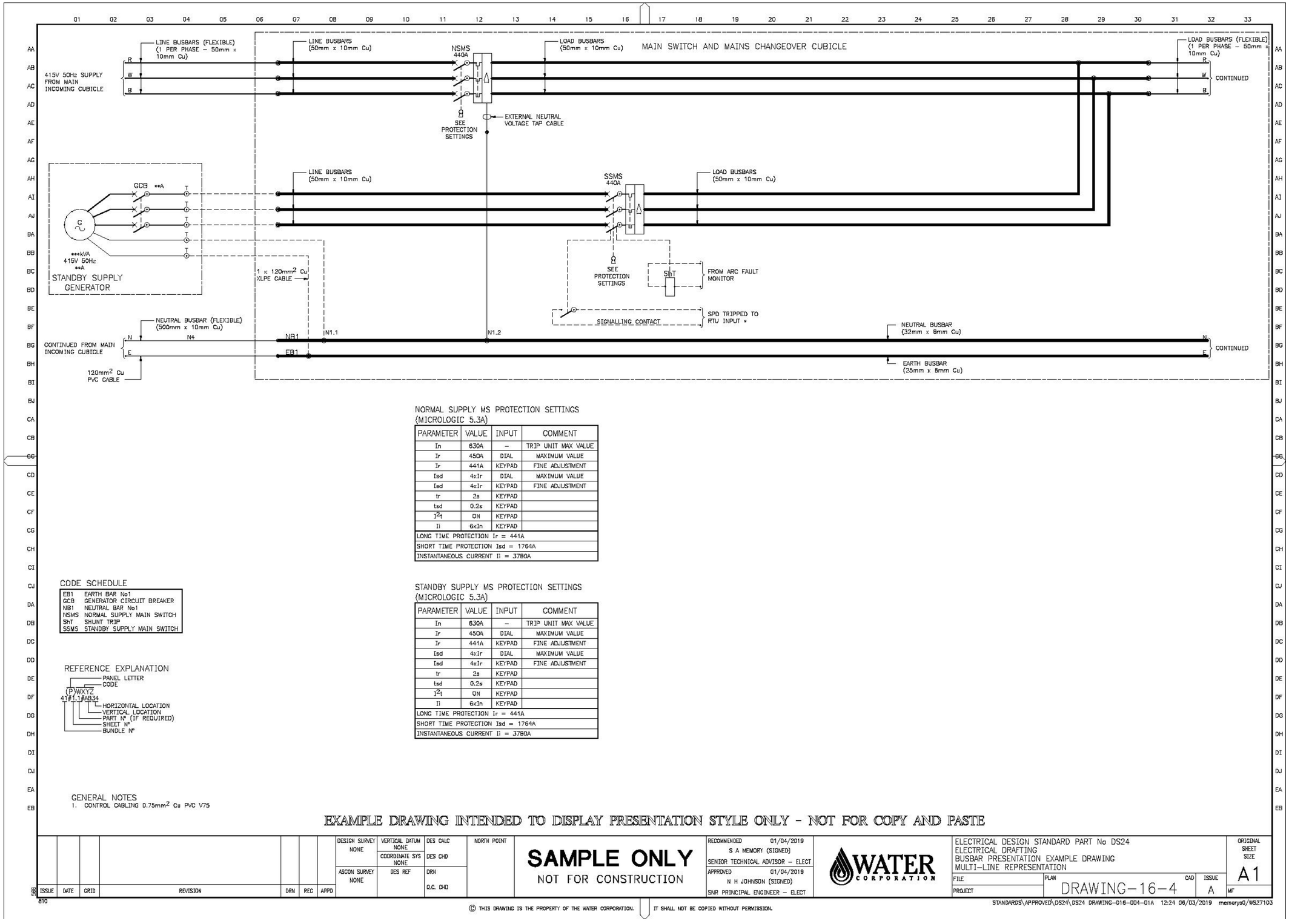
APPROVED 01/04/2019 N H JOHNSON (SIGNED) SNR PRINCIPAL ENGINEER – ELECT

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
CABLE SYMBOL PRESENTATION EXAMPLE DRAWING
COMBINED MULTI–LINE AND SINGLE–LINE REPRESENTATION

ORIGINAL SHEET SIZE: A1
FILE | PLAN | CAD | ISSUE: B | PROJECT: DRAWING–16–3 | MF

STANDARDS\APPROVED\DS24\REVISION\DS24 DRAWING–018–003–01B 11:09 13/12/2022 MEMORYSO/NB46194



NORMAL SUPPLY MS PROTECTION SETTINGS
(MICROLOGIC 5.3A)

PARAMETER	VALUE	INPUT	COMMENT
In	630A	–	TRIP UNIT MAX VALUE
Ir	450A	DIAL	MAXIMUM VALUE
Ir	441A	KEYPAD	FINE ADJUSTMENT
Isd	4xIr	DIAL	MAXIMUM VALUE
Isd	4xIr	KEYPAD	FINE ADJUSTMENT
tr	2s	KEYPAD	
tsd	0.2s	KEYPAD	
I^2t	ON	KEYPAD	
Ii	6xIn	KEYPAD	
LONG TIME PROTECTION Ir = 441A			
SHORT TIME PROTECTION Isd = 1764A			
INSTANTANEOUS CURRENT Ii = 3780A			

STANDBY SUPPLY MS PROTECTION SETTINGS
(MICROLOGIC 5.3A)

PARAMETER	VALUE	INPUT	COMMENT
In	630A	–	TRIP UNIT MAX VALUE
Ir	450A	DIAL	MAXIMUM VALUE
Ir	441A	KEYPAD	FINE ADJUSTMENT
Isd	4xIr	DIAL	MAXIMUM VALUE
Isd	4xIr	KEYPAD	FINE ADJUSTMENT
tr	2s	KEYPAD	
tsd	0.2s	KEYPAD	
I^2t	ON	KEYPAD	
Ii	6xIn	KEYPAD	
LONG TIME PROTECTION Ir = 441A			
SHORT TIME PROTECTION Isd = 1764A			
INSTANTANEOUS CURRENT Ii = 3780A			

CODE SCHEDULE

EB1	EARTH BAR No1
GCB	GENERATOR CIRCUIT BREAKER
NB1	NEUTRAL BAR No1
NSMS	NORMAL SUPPLY MAIN SWITCH
SHT	SHUNT TRIP
SSMS	STANDBY SUPPLY MAIN SWITCH

REFERENCE EXPLANATION

GENERAL NOTES
1. CONTROL CABLING 0.75mm² Cu PVC V75

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	ORID	REVISION	DRN	REC	APPD
810						

DESIGN SURVEY NONE | VERTICAL DATUM NONE | COORDINATE SYS NONE | DES CALC | DES CHD
ASCON SURVEY NONE | DES REF | DRN | Q.C. CHD
NORTH POINT

SAMPLE ONLY
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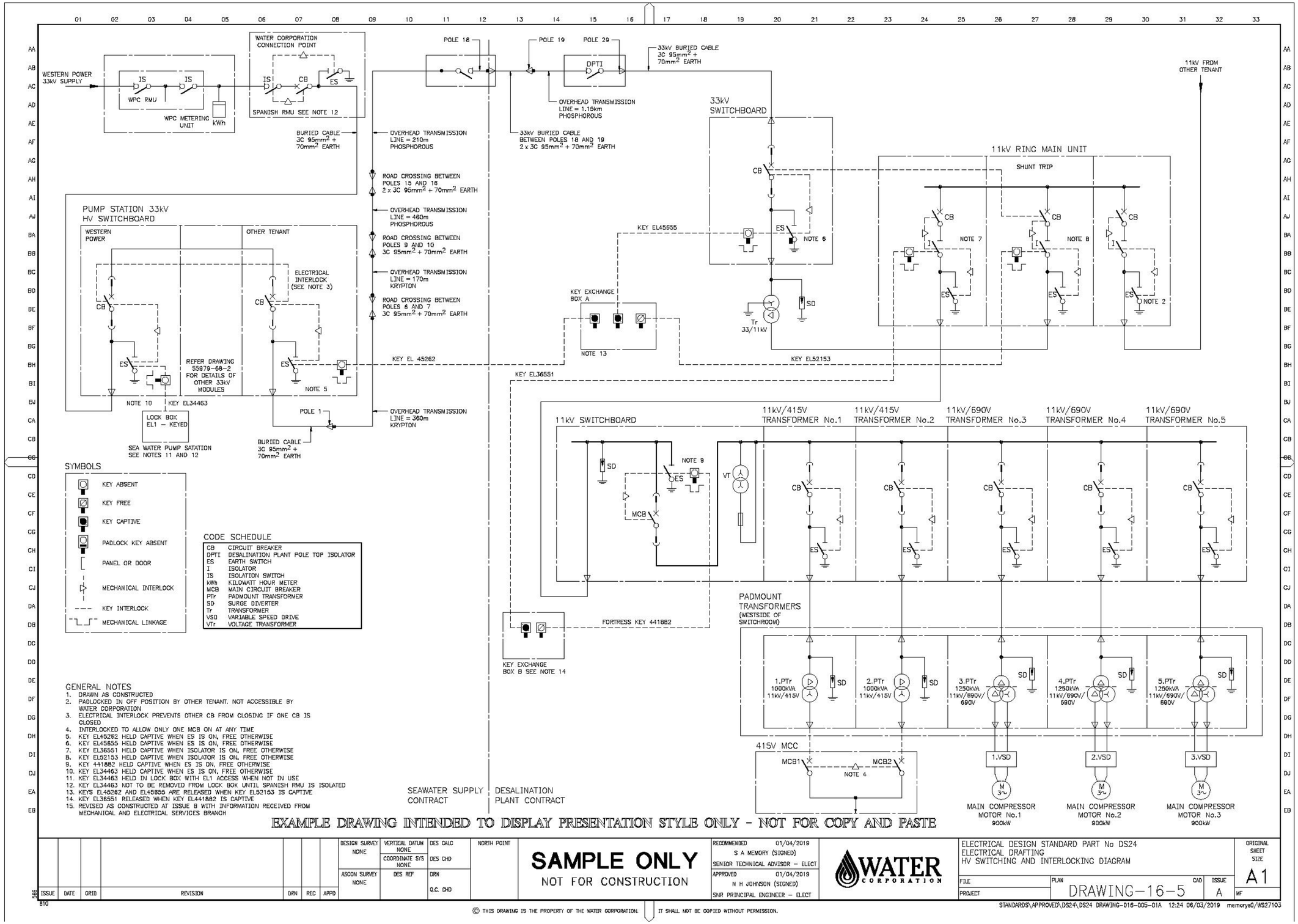
SENIOR TECHNICAL ADVISOR – ELECT
APPROVED 01/04/2019
N H JOHNSON (SIGNED)
SNR PRINCIPAL ENGINEER – ELECT

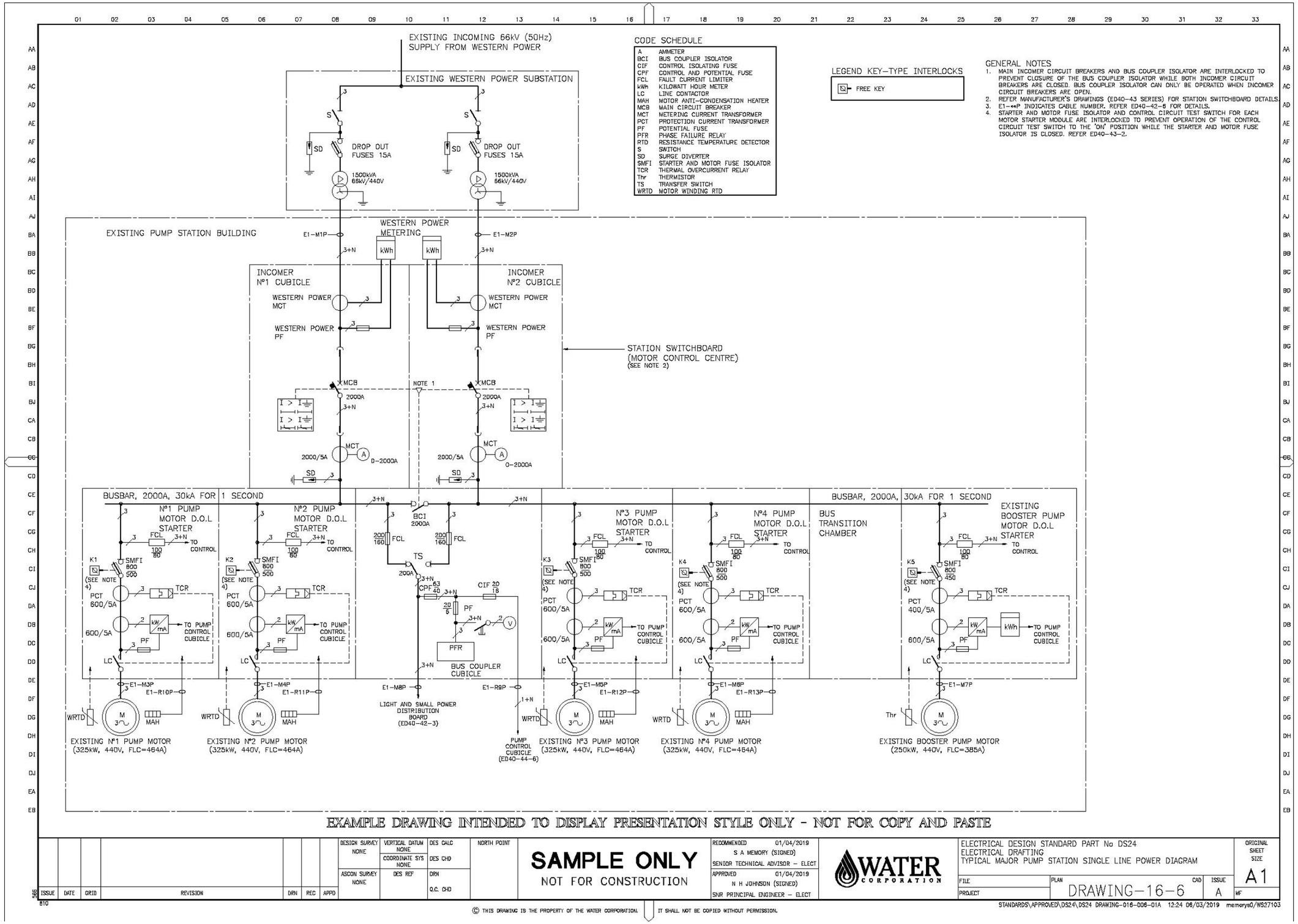
WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
BUSBAR PRESENTATION EXAMPLE DRAWING
MULTI-LINE REPRESENTATION

FILE
PROJECT
PLAN DRAWING-16-4 CAD
ISSUE A
ORIGINAL SHEET SIZE A1
MF

STANDARDS\APPROVED\DS24\DS24 DRAWING-016-004-01A 12:24 06/03/2019 memorya0/WS27103





EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
810						

DESIGN SURVEY NONE | VERTICAL DATUM NONE | DES CALC | NORTH POINT
COORDINATE SYS NONE | DES CHD
ASCON SURVEY NONE | DES REF | DRN | Q.C. CHD

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ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
TYPICAL MAJOR PUMP STATION SINGLE LINE POWER DIAGRAM

FILE | PLAN DRAWING-16-6 | CAD | ISSUE A | ORIGINAL SHEET SIZE A1
PROJECT | MF

STANDARDS\APPROVED\DS24\DS24 DRAWING-016-006-01A 12:24 06/03/2019 memorys0/WS27103

SYMBOL LEGEND

- KEY ABSENT
- KEY FREE
- KEY CAPTIVE
- PADLOCK KEY ABSENT
- PANEL OR DOOR
- MECHANICAL INTERLOCK
- KEY INTERLOCK
- MECHANICAL LINKAGE

EXAMPLE ONLY –
INTERLOCK KEY LEGEND WORDING
TO SUIT PROJECT REQUIREMENTS

INTERLOCK KEY LEGEND

KD – 22kV EARTH TO 6.6kV MCC TRANSFORMER PRIMARY TERMINATION DOOR INTERLOCK
– KEY IS RELEASED IN EARTHED POSITION
KE – 6.6kV EARTH TO 6.6kV MCC TRANSFORMER SECONDARY TERMINATION DOOR.
– KEY IS TO BE RELEASED IN EARTH POSITION.
KG – 22kV EARTH TO ISOLATING TRANSFORMER PRIMARY TERMINATION DOORS INTERLOCK.
– KEY IS RELEASED IN EARTHED POSITION
KH – 22kV EARTH TO ISOLATING TRANSFORMER SECONDARY TERMINATION DOOR INTERLOCK.
– KEY IS RELEASED IN EARTHED POSITION.
KI – SUPPLY AUTHORITY INCOMER SWITCH AND SUPPLY AUTHORITY BUS TIE INTERLOCK
KO – STANDARD INTERLOCK
– ISOLATOR CAN BE OPENED ONLY IF THE CIRCUIT BREAKER IS OPEN.

INFORMATIVE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	CRID	REVISION	DRN	REC	APPD
810						

DESIGN SURVEY NONE | VERTICAL DATUM NONE | DES CALC
COORDINATE SYS NONE | DES CHD
ASCON SURVEY NONE | DES REF | DRN | D.C. CHD
NORTH POINT

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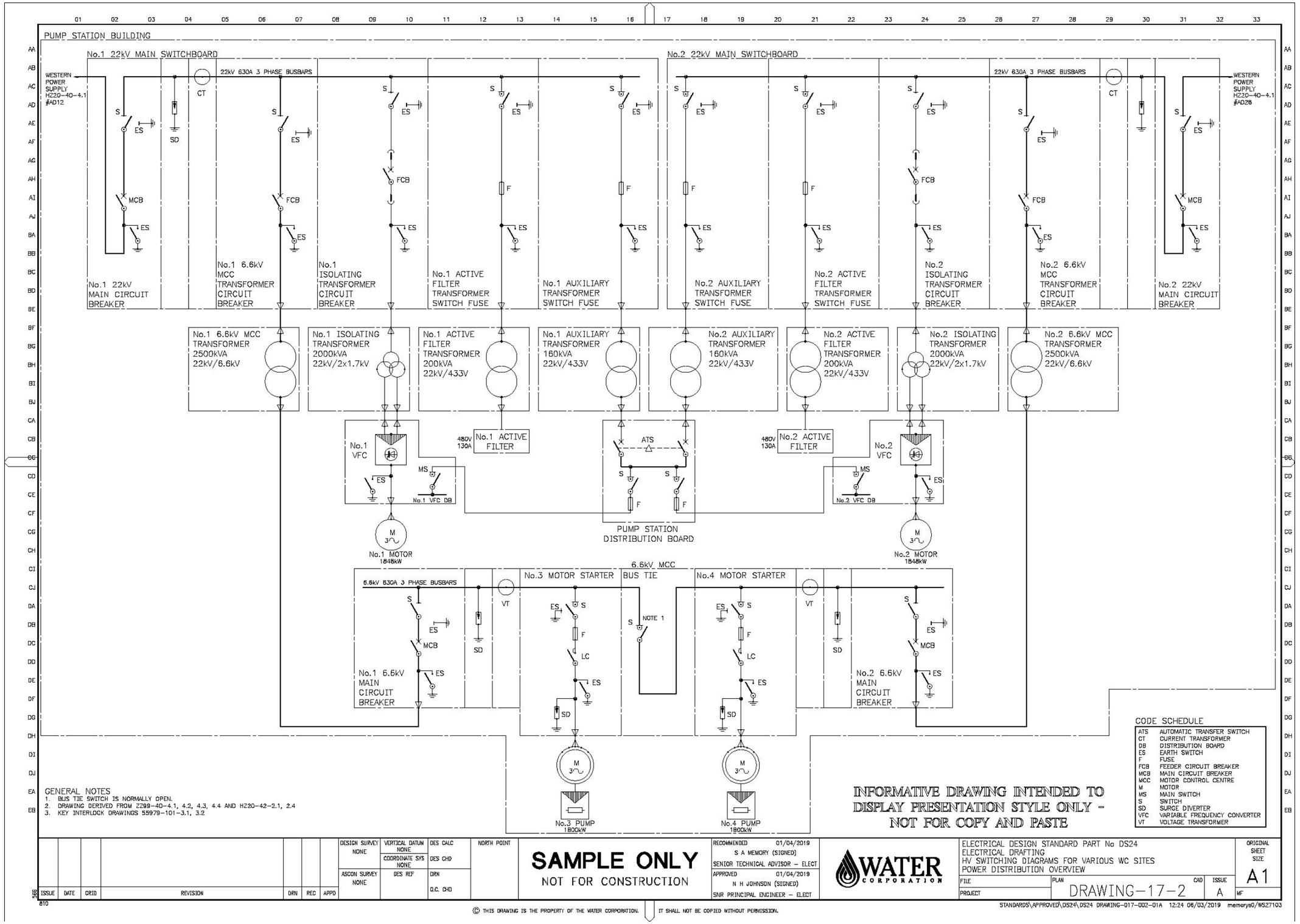
ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
PREFERRED INTERLOCK SYMBOLS AND LEGENDS

FILE | PLAN DRAWING-17-1 | CAD | ISSUE A
PROJECT

ORIGINAL SHEET SIZE A1

STANDARDS\APPROVED\DS24\DS24 DRAWING-017-001-01A 12:24 06/03/2019 memorys0/WS27103



GENERAL NOTES
1. BUS TIE SWITCH IS NORMALLY OPEN.
2. DRAWING DERIVED FROM Z299-40-4.1, 4.2, 4.3, 4.4 AND HZ20-42-2.1, 2.4
3. KEY INTERLOCK DRAWINGS 55979-101-3.1, 3.2

CODE SCHEDULE

ATS	AUTOMATIC TRANSFER SWITCH
CT	CURRENT TRANSFORMER
DB	DISTRIBUTION BOARD
ES	EARTH SWITCH
F	FUSE
FCB	FEEDER CIRCUIT BREAKER
MCB	MAIN CIRCUIT BREAKER
MCC	MOTOR CONTROL CENTRE
M	MOTOR
MS	MAIN SWITCH
S	SWITCH
SD	SURGE DIVERTER
VFC	VARIABLE FREQUENCY CONVERTER
VT	VOLTAGE TRANSFORMER

INFORMATIVE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	CRID	REVISION	DRN	REC	APPD

DESIGN SURVEY NONE | VERTICAL DATUM NONE | DES CALC | NORTH POINT
COORDINATE SYS NONE | DES CHD
ASCON SURVEY NONE | DES REF | DRN | D.C. CHD

SAMPLE ONLY
NOT FOR CONSTRUCTION

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APPROVED 01/04/2019 N H JOHNSON (SIGNED) SNR PRINCIPAL ENGINEER – ELECT

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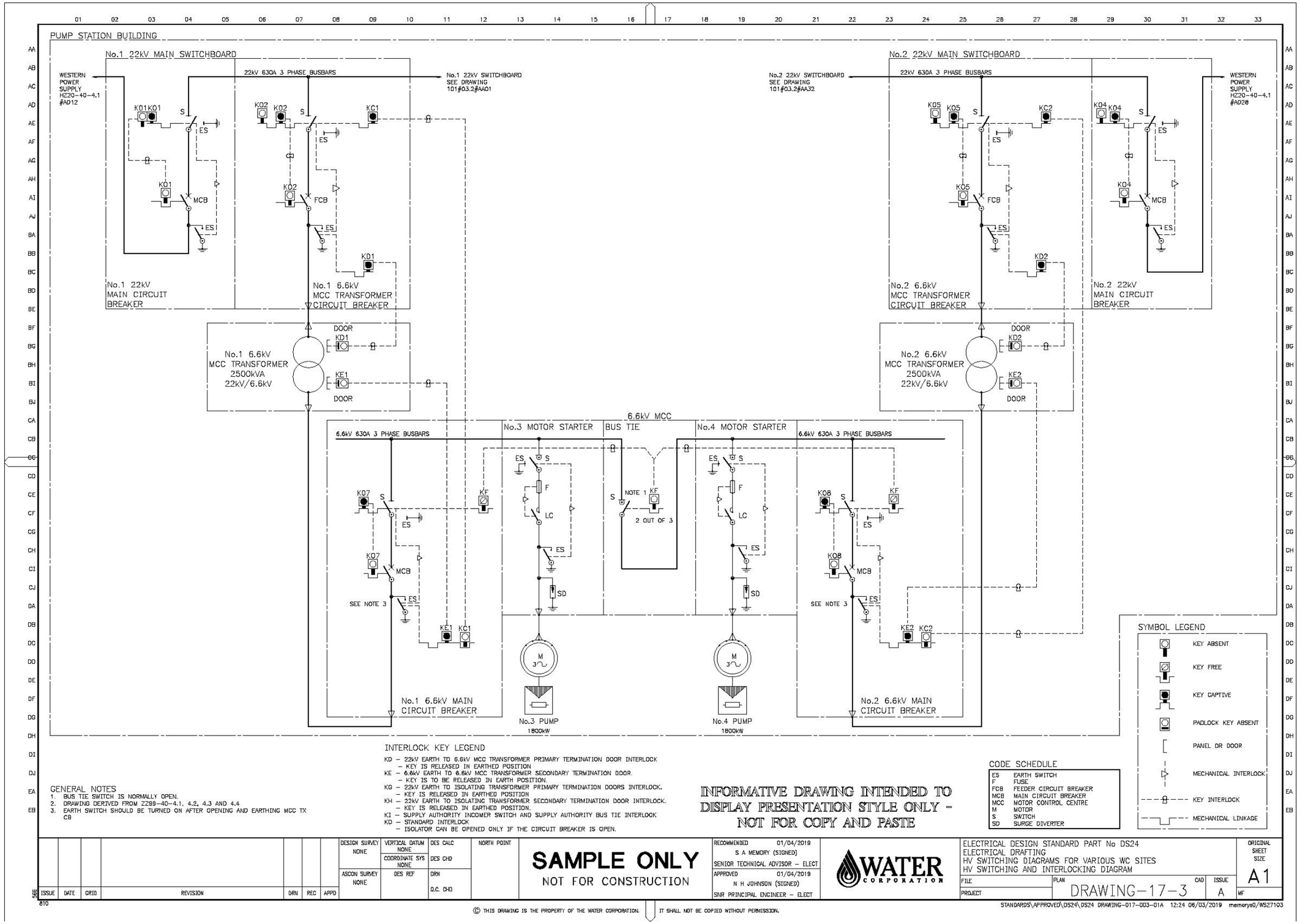
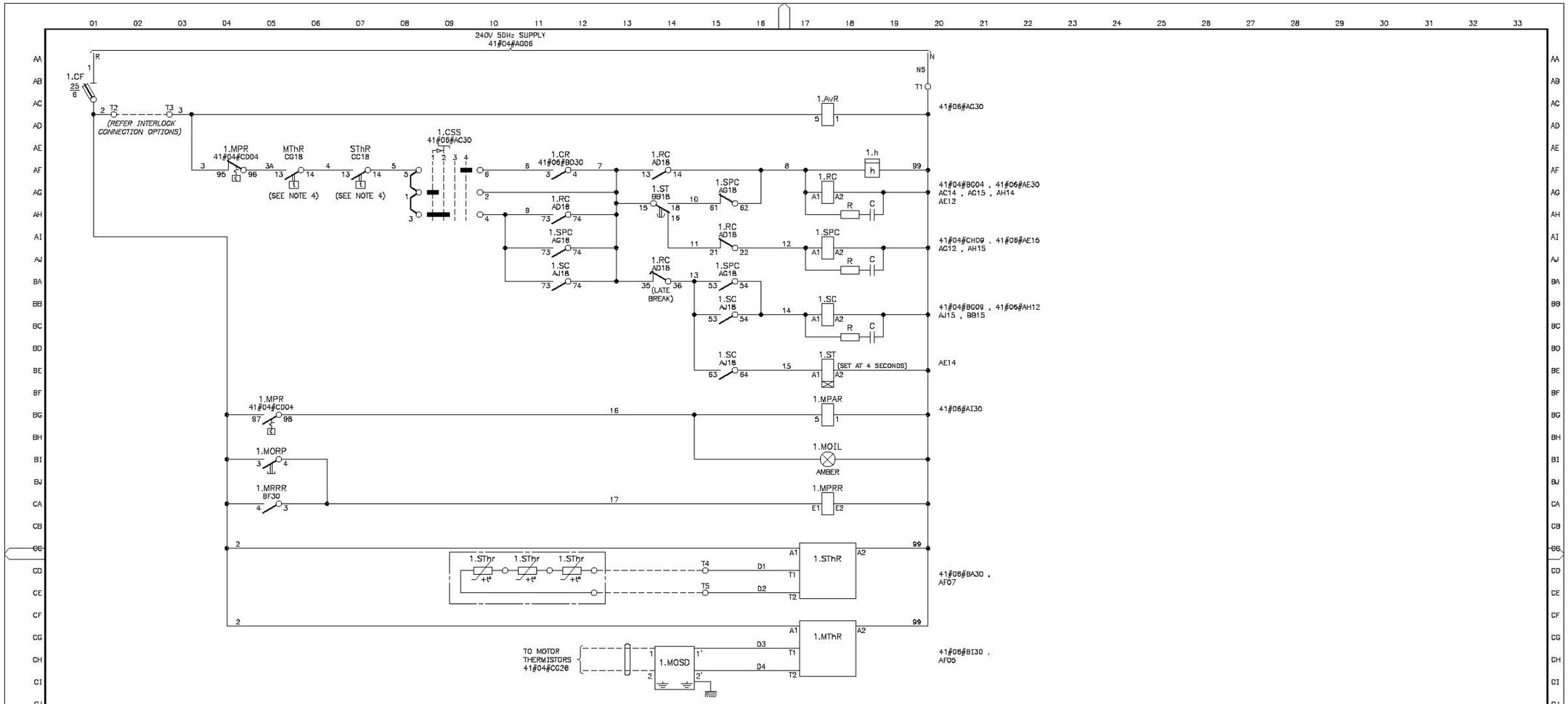
ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
HV SWITCHING DIAGRAMS FOR VARIOUS WC SITES
POWER DISTRIBUTION OVERVIEW

FILE | PLAN DRAWING-17-2 | CAD | ISSUE A | ORIGINAL SHEET SIZE A1
PROJECT | MF

STANDARDS\APPROVED\DS24\DS24 DRAWING-017-002-01A 12:24 06/03/2019 memorysG/WS27103





GENERAL NOTES

1. DRAWN NO POWER CONDITION.
2. UNLESS OTHERWISE SHOWN 240V AC CONTROL CABLING MINIMUM 0.75mm^2 Cu PVC V75 OR LSFLEX R-125
3. UNLESS OTHERWISE SHOWN 24V DC CONTROL CABLING MINIMUM 0.5mm^2 Cu PVC V75 OR LSFLEX R-125
4. MOTOR THERMISTOR RELAY AND STARTER THERMISTOR RELAY CONTACTS CHANGE STATE ON ENERGIZATION
3. LETTERS IN BRACKETS PREFIXING SYMBOL CODES SHOW PANELS ON WHICH EQUIPMENT IS LOCATED. EQUIPMENT NOT PREFIXED BY PANEL LETTER IS LOCATED ON PANEL J

CONTROL SELECTOR SWITCH	
POSITION	FUNCTION
1	LOCAL START
2	LOCAL RUN
3	OFF
4	NORMAL

REFERENCE EXPLANATION

(P)WXYZ
01#01#AB34
P = PANEL LETTER
WX = CODE
Y = HORIZONTAL LOCATION
Z = VERTICAL LOCATION
01 = SHEET N°
01#01#AB34 = DRAWING N°

CODE SCHEDULE

AvR	AVAILABLE RELAY
C	CAPACITOR
CF	CONTROL FUSE
CR	CONTROL RELAY
CSS	CONTROL SELECTOR SWITCH
h	HOUR METER
MOIL	MOTOR OVERLOAD FAULT INDICATING LIGHT
MORP	MOTOR OVERLOAD FAULT RESET PUSHBUTTON
MOSD	MOTOR OVERTEMPERATURE SURGE DIVERTER
MPAR	MOTOR PROTECTION AUXILIARY RELAY
MPR	MOTOR PROTECTION RELAY
MPRR	MOTOR PROTECTION RELAY RESET
MRRR	MOTOR PROTECTION REMOTE RESET RELAY
MThR	MOTOR THERMISTOR RELAY
R	RESISTOR
RC	RUN CONTACTOR
SC	START CONTACTOR
SPC	STAR POINT CONTACTOR
ST	START TIMER
SThr	STARTER THERMISTOR
SThR	STARTER THERMISTOR RELAY

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
B	12/2022		MThR AND SThR CONTACTS ADDED TO PRIMARY PROTECTION	SAM	SAM	EG

DESIGN SURVEY NONE | VERTICAL DATUM NONE | COORDINATE SYS NONE | ASCON SURVEY NONE | DES REF | DES CALC | DES CHD | DRN | Q.C. CHD | NORTH POINT

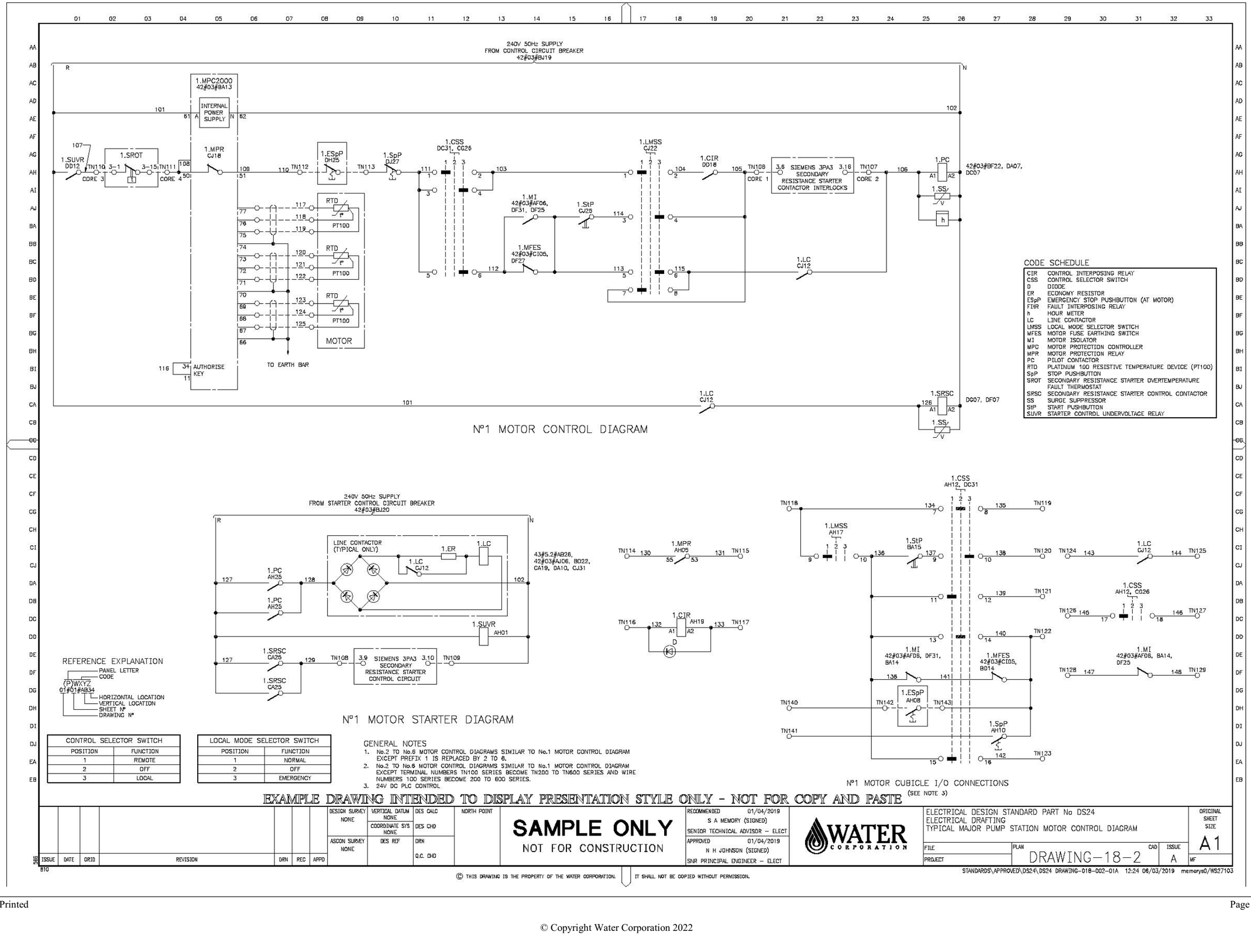
SAMPLE ONLY
NOT FOR CONSTRUCTION

RECOMMENDED 01/04/2019 S A MEMORY (SIGNED) SENIOR TECHNICAL ADVISOR – ELECT
APPROVED 01/04/2019 N H JOHNSON (SIGNED) SNR PRINCIPAL ENGINEER – ELECT

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
TYPICAL SMALL PUMP STATION MOTOR CONTROL DIAGRAM

FILE | PLAN CAD | ISSUE B | PROJECT DRAWING-18-1 | ORIGINAL SHEET SIZE A1 | MF

STANDARDS\APPROVED\DS24\REVISION\DS24 DRAWING-018-001-01B 11:09 13/12/2022 MEMORYSO/NB46194



CONTROL SELECTOR SWITCH	
POSITION	FUNCTION
1	REMOTE
2	OFF
3	LOCAL

LOCAL MODE SELECTOR SWITCH	
POSITION	FUNCTION
1	NORMAL
2	OFF
3	EMERGENCY

GENERAL NOTES
1. No.2 TO No.6 MOTOR CONTROL DIAGRAMS SIMILAR TO No.1 MOTOR CONTROL DIAGRAM EXCEPT PREFIX 1 IS REPLACED BY 2 TO 6.
2. No.2 TO No.6 MOTOR CONTROL DIAGRAMS SIMILAR TO No.1 MOTOR CONTROL DIAGRAM EXCEPT TERMINAL NUMBERS TN100 SERIES BECOME TN200 TO TN600 SERIES AND WIRE NUMBERS 100 SERIES BECOME 200 TO 600 SERIES.
3. 24V DC PLC CONTROL

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD

DESIGN SURVEY NONE | VERTICAL DATUM NONE | COORDINATE SYS NONE | DES CALC | DES CHD | ASCON SURVEY NONE | DES REF | DRN | Q.C. CHD | NORTH POINT

SAMPLE ONLY
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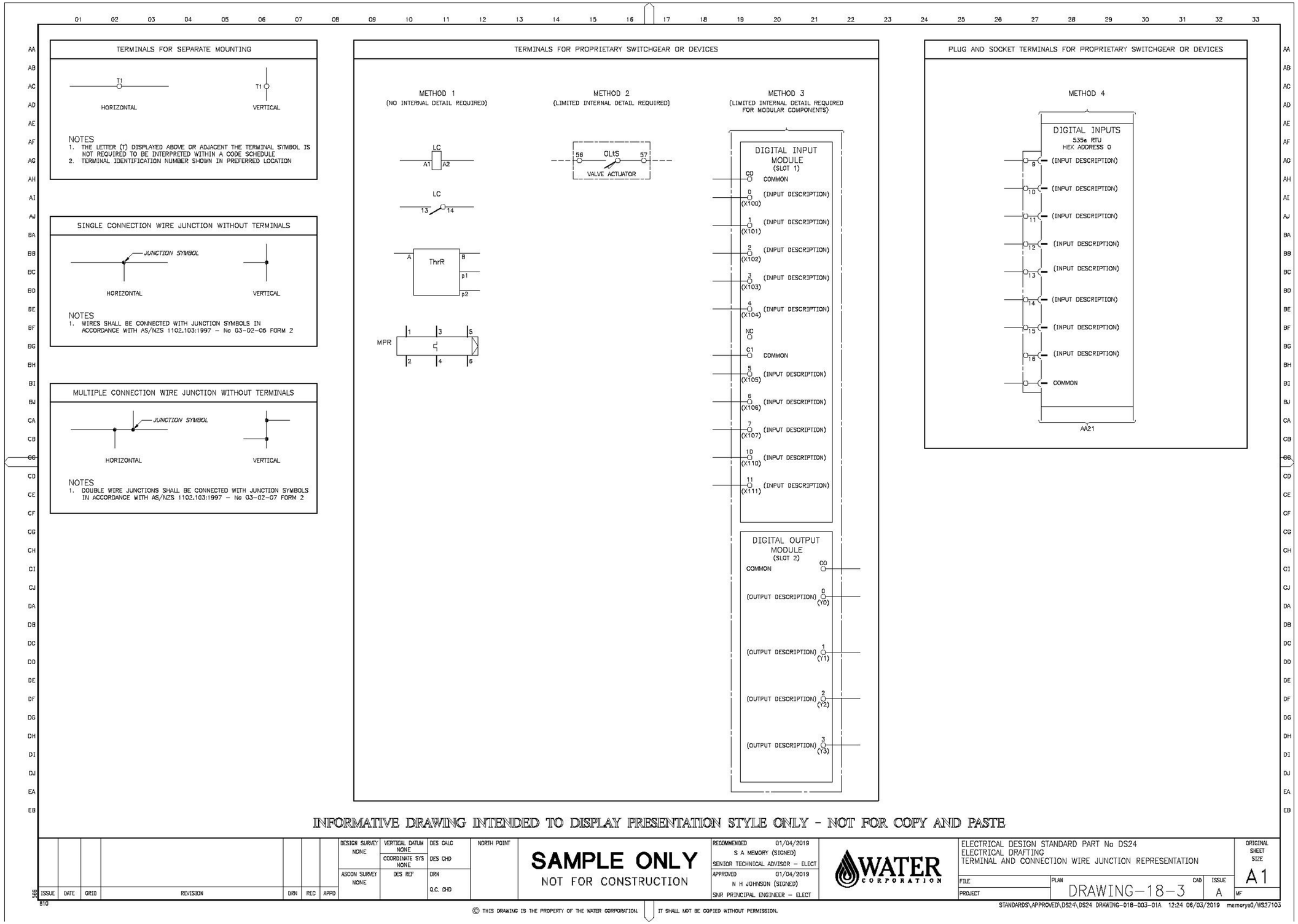
RECOMMENDED 01/04/2019
S A MEMORY (SIGNED)
SENIOR TECHNICAL ADVISOR – ELECT
APPROVED 01/04/2019
N H JOHNSON (SIGNED)
SNR PRINCIPAL ENGINEER – ELECT

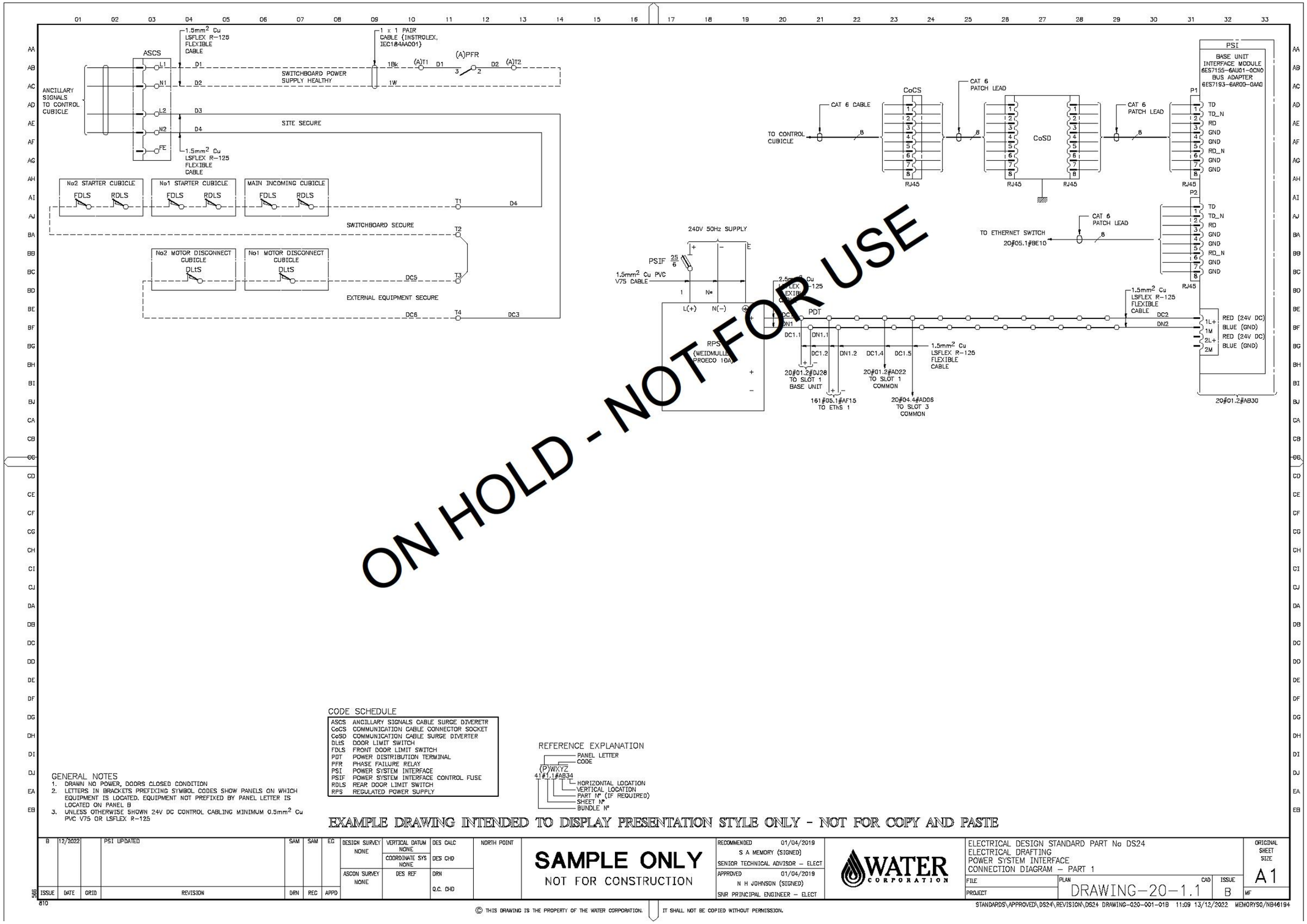
ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
TYPICAL MAJOR PUMP STATION MOTOR CONTROL DIAGRAM

FILE | PLAN DRAWING-18-2 | CAD | ISSUE A | PROJECT

ORIGINAL SHEET SIZE A1

STANDARDS\APPROVED\DS24\DS24 DRAWING-018-002-01A 12:24 06/03/2019 memorys0/WS27103





CODE SCHEDULE

ASCS	ANCILLARY SIGNALS CABLE SURGE DIVERETR
CoCS	COMMUNICATION CABLE CONNECTOR SOCKET
CoSD	COMMUNICATION CABLE SURGE DIVERTER
DLtS	DOOR LIMIT SWITCH
FDLS	FRONT DOOR LIMIT SWITCH
PDT	POWER DISTRIBUTION TERMINAL
PFR	PHASE FAILURE RELAY
PSI	POWER SYSTEM INTERFACE
PSIF	POWER SYSTEM INTERFACE CONTROL FUSE
RDLS	REAR DOOR LIMIT SWITCH
RPS	REGULATED POWER SUPPLY

REFERENCE EXPLANATION

(P)WXYZ
- PANEL LETTER
- CODE
- HORIZONTAL LOCATION
- VERTICAL LOCATION
- PART Nº (IF REQUIRED)
- SHEET Nº
- BUNDLE Nº

GENERAL NOTES
1. DRAWN NO POWER, DOORS CLOSED CONDITION
2. LETTERS IN BRACKETS PREFIXING SYMBOL CODES SHOW PANELS ON WHICH EQUIPMENT IS LOCATED. EQUIPMENT NOT PREFIXED BY PANEL LETTER IS LOCATED ON PANEL B
3. UNLESS OTHERWISE SHOWN 24V DC CONTROL CABLING MINIMUM 0.5mm² Cu PVC V75 OR LSFLEX R-125

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
B	12/2022		PSI UPDATED	SAM	SAM	EG

DESIGN SURVEY: NONE | VERTICAL DATUM: NONE | COORDINATE SYS: NONE | ASCON SURVEY: NONE | DES REF | DES CALC | DES CHD | DRN | Q.C. CHD | NORTH POINT

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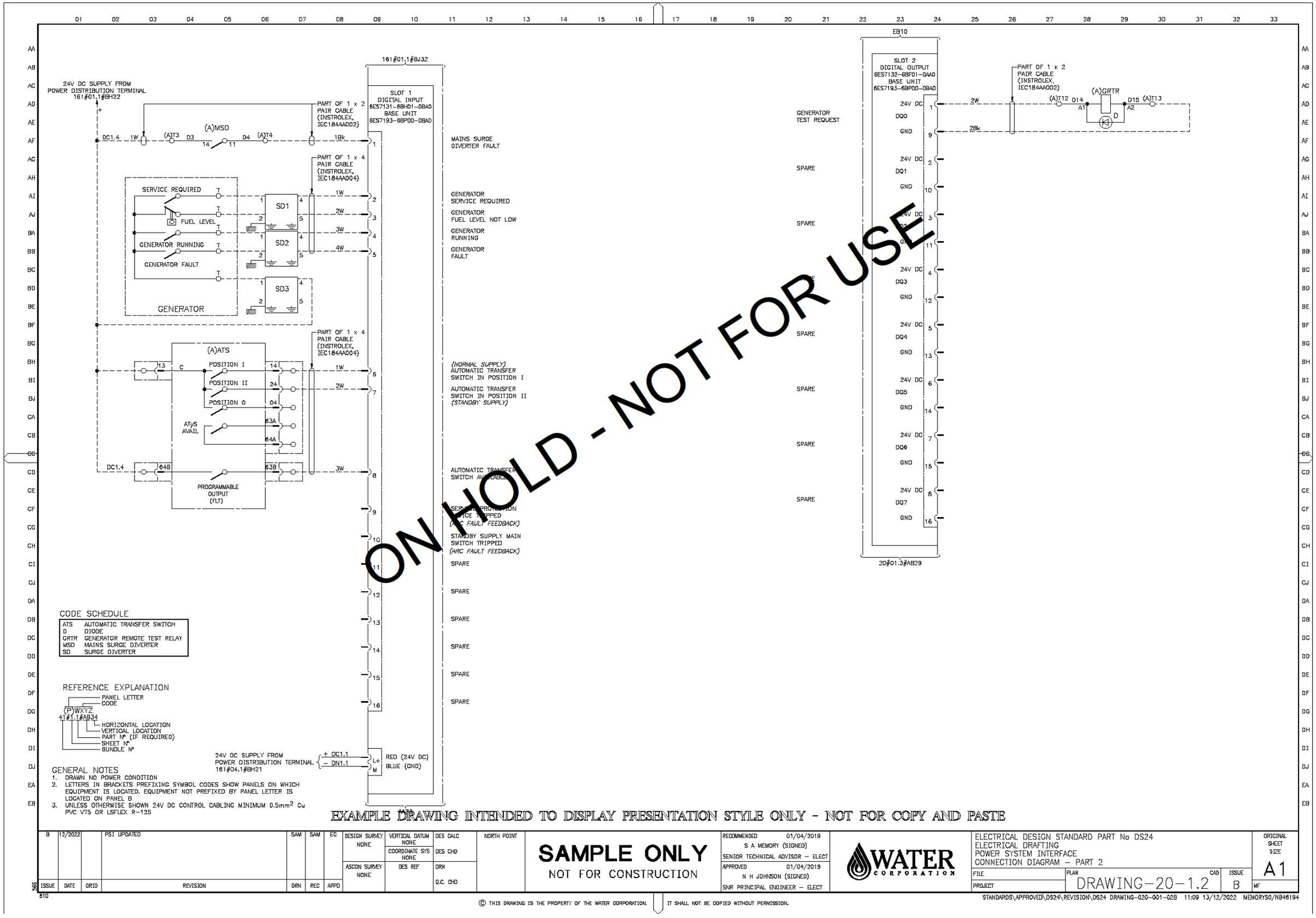
APPROVED 01/04/2019 N H JOHNSON (SIGNED) SNR PRINCIPAL ENGINEER – ELECT

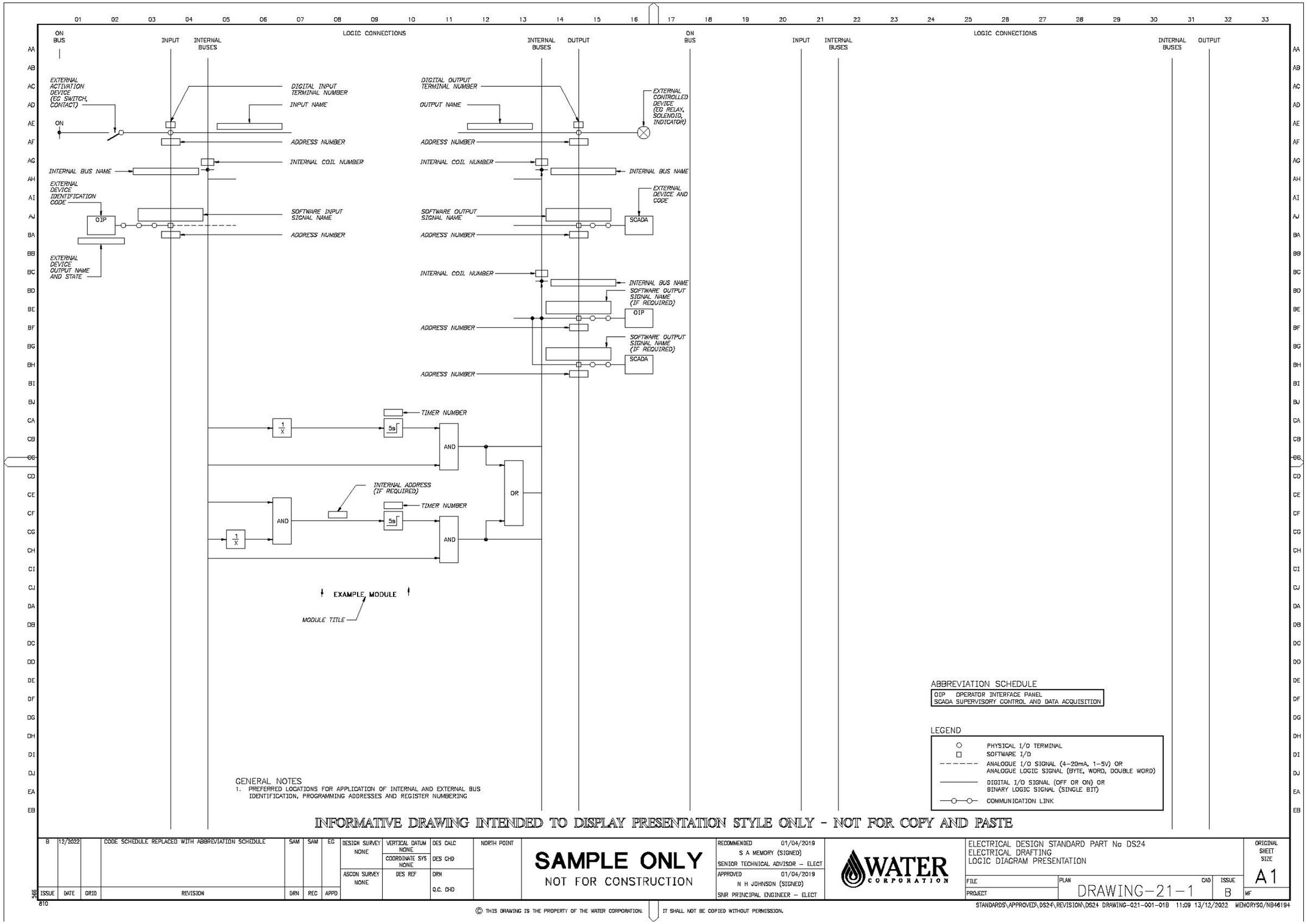
WATER CORPORATION

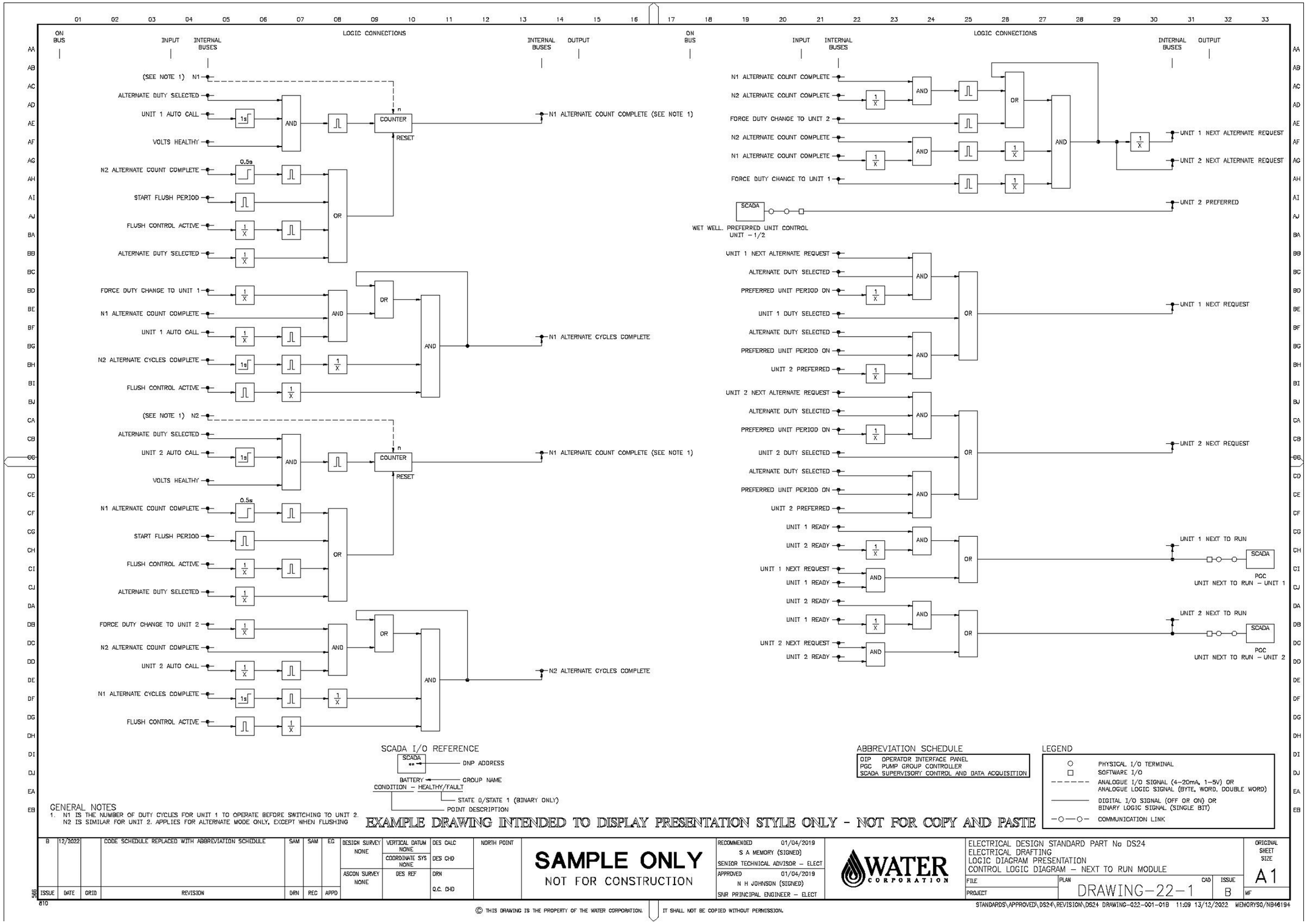
ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
POWER SYSTEM INTERFACE
CONNECTION DIAGRAM – PART 1

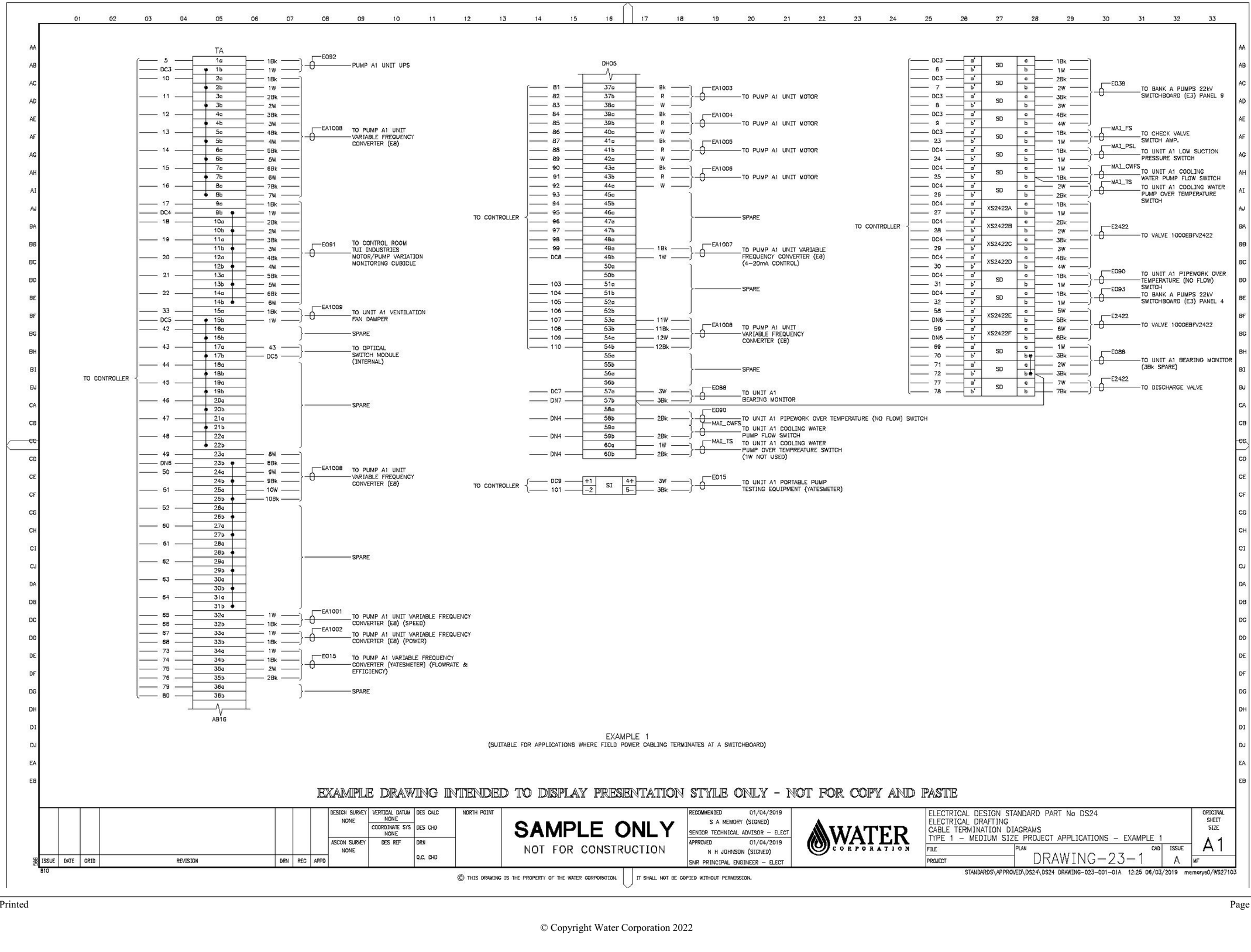
FILE | PROJECT | PLAN DRAWING-20-1.1 | CAD | ISSUE B | ORIGINAL SHEET SIZE A1 | MF

STANDARDS\APPROVED\DS24\REVISION\DS24 DRAWING-020-001-01B 11:09 13/12/2022 MEMORYSO/NB46194



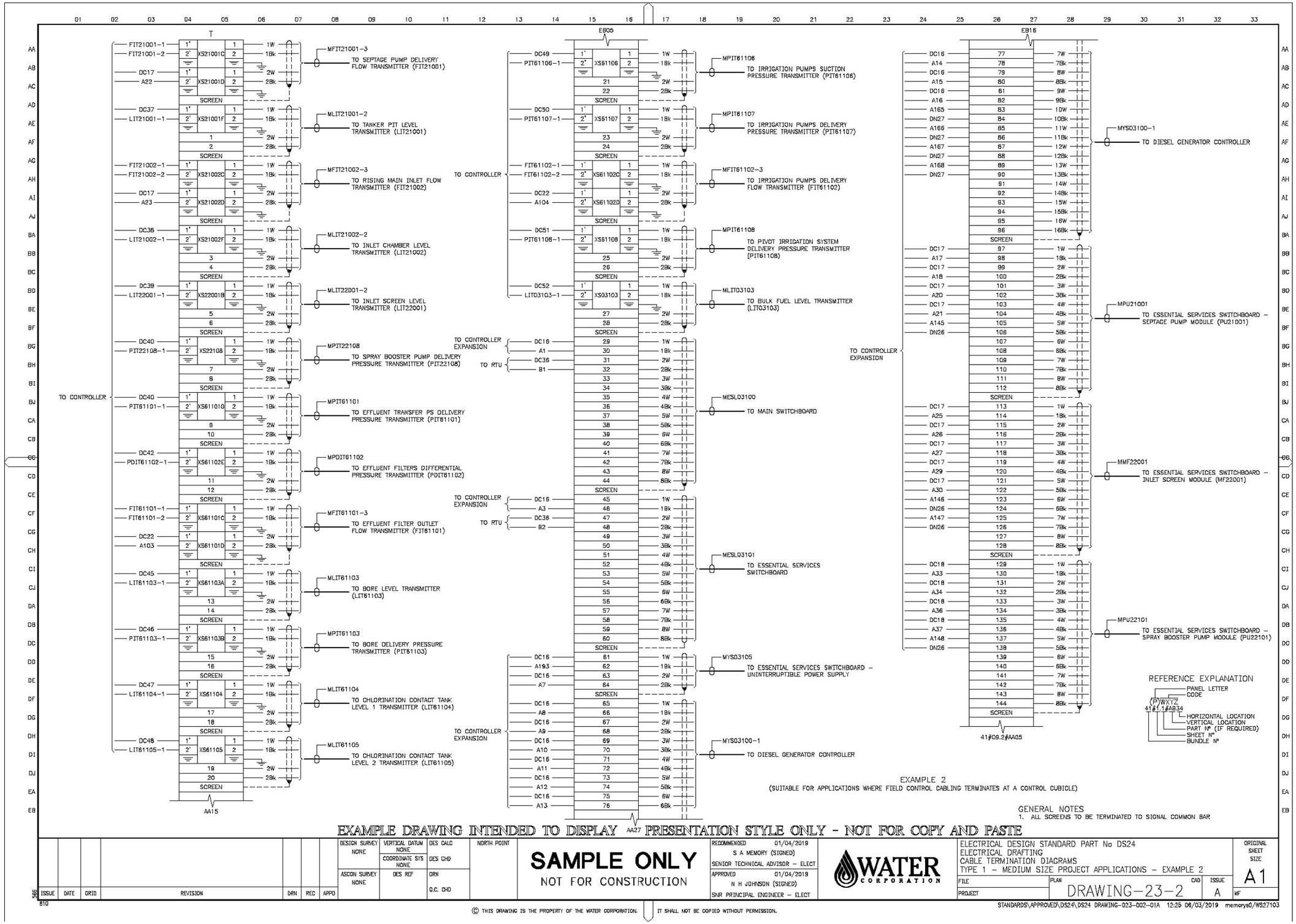






EXAMPLE 1
(SUITABLE FOR APPLICATIONS WHERE FIELD POWER CABLING TERMINATES AT A SWITCHBOARD)

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY – NOT FOR COPY AND PASTE



No1 UNIT CONTROL AND AUX. TERMINALS

CABLE DESTINATION	CABLE NUMBER OR DESIGNATION	CABLE CORE No, CODE OR COLOUR	TERMINAL No	REFERENCE DRG No & CROSS REF	WIRE No
MTR. HEATER	E2–R1C1	1	105	04–DJ16	34
		2	106	04–DJ17	94
SEC. RES. STR.	E2–R1C2	1	107	04–AC09	07
		2	108	04–AC17	08
		3	109	04–AC20	09
		4	110	04–AC22	10
		5	111	04–AJ15	20
		6	112	04–AJ17	21
		7	113	04–BI05	29
		8	114	04–BI08	98
RING. SHTG. MTR.	E2–M1P2	R	121	03–DG05	–
		Y	122	03–DG08	–
		B	123	03–DG05	–
RING. SHTG. GENR.	E2–R1C3	1	124	04–AC18	08
		2	125	04–AC20	09
		3	126	04–AJ04	18
		4	127	04–AJ07	19
		5	128	04–AJ18	21
		6	129	04–AJ20	22
		7	130	04–BA17	24
		8	131	04–BA20	25
LOGIC CONTROLLER	E2–D1C4	1W	138	04–BF21	143
		1B	139	04–BF24	144
		2W	140	04–BG21	145
		2B	141	04–BG24	146
		3W	142	04–BJ21	147
		3B	143	04–BJ24	148
		4W	144	04–CB21	149
		4B	145	04–CB24	150
		5W	146	04–CD21	151
		5B	147	04–CD24	152
		6W	148	04–BE25	153
		6B	149	04–BE29	155
		7W	150	04–BF25	156
		7B	151	04–BF29	157
		8W	152	04–BJ25	159
		8B	153	04–BJ29	160
		9W	154	04–CB25	161
		9B	155	04–CB29	162
		10W	156	04–CD25	163
		10B	157	04–CD29	164

EXAMPLE 1
(SUITABLE FOR APPLICATIONS WHERE FIELD CABLING TERMINATES AT A SWITCHBOARD)

JUNCTION BOX No1 (TERMINAL BLOCK DESIGNATION X7)

CABLE DESTINATION	CABLE NUMBER OR DESIGNATION	CABLE CORE No, CODE OR COLOUR	TERMINAL No	REFERENCE DRG No & CROSS REF	WIRE No	CABLE CORE No, CODE OR COLOUR	CABLE NUMBER OR DESIGNATION	CABLE DESTINATION
MCC №5 X 3 REF DRG	E4–MOC2	1W	1	001–AD07	201	1W	E5–DOC14	GRIT TANK 1 INLET
		1Bk	2	001–AD11	311	1Bk		PENSTOCK L/S
		2W	3	001–AI07	202	1W	E5–DOC15	GRIT TANK 2 INLET
		2Bk	4	001–AI11	312	1Bk		PENSTOCK L/S
		3W	5	001–BD07	203	1W	E5–DOC16	GRIT TANK 3 INLET
		3Bk	6	001–BD11	313	1Bk		PENSTOCK L/S
		4W	7	003–BE18	328	1W	E5–ROC17	SOLENOID 1
		4Bk	8	003–CF18	338	1W	E5–ROC18	SOLENOID 2
		5W	9	003–DC18	348	1W	E5–ROC19	SOLENOID 3
		5Bk	10	003–BE20	–VE	1Bk	E5–ROC17	SOLENOID 1
			11	003–CF20		1Bk	E5–ROC18	SOLENOID 2
			12	003–DC20		1Bk	E5–ROC19	SOLENOID 3
			13	004–BE20		1Bk	E5–ROC20	SOLENOID 4
			14	004–CF20		1Bk	E5–ROC21	SOLENOID 5
			15	004–DC20		1Bk	E5–ROC22	SOLENOID 6
		6W	16	004–BE18	378	1W	E5–ROC20	SOLENOID 4
		6Bk	17	004–CF18	388	1W	E5–ROC21	SOLENOID 5
		7W	18	004–DC18	398	1W	E5–ROC22	SOLENOID 6
		7Bk	19	001–AH05	+VE	1W	E5–ROC23	AIR PRESS SWITCH
			20	001–DF05		1W	E5–ROC24	TANK 1 LEVEL SW
			21	001–DH05		1W	E5–ROC25	TANK 2 LEVEL SW
			22	001–DJ05		1W	E5–ROC26	TANK 3 LEVEL SW
		8W	23	001–AH07		1Bk	E5–ROC27	AIR PRESS SWITCH
		8Bk	24	001–DF07		1Bk	E5–ROC28	TANK 1 LEVEL SW
		9W	25	001–DH07		1Bk	E5–ROC29	TANK 2 LEVEL SW
		9Bk	26	001–DJ07		1Bk	E5–ROC30	TANK 3 LEVEL SW
		10W	27					
		10Bk	28					

EXAMPLE 2
(SUITABLE FOR APPLICATIONS WHERE FIELD CABLING ENTERS AND EXITS A SWITCHBOARD, JUNCTION BOX OR SIMILAR)

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD

DESIGN SURVEY NONE | VERTICAL DATUM NONE | COORDINATE SYS NONE | DES CALC | DES CHD | DRN | Q.C. CHD | ASCON SURVEY NONE | DES REF | NORTH POINT

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APPROVED 01/04/2019
N H JOHNSON (SIGNED)
SNR PRINCIPAL ENGINEER – ELECT

WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
CABLE TERMINATION DIAGRAMS
TYPE 2 – COMPLEX AND MAJOR INSTALLATIONS

FILE | PLAN DRAWING–23–3 CAD | ISSUE A | PROJECT | MF

ORIGINAL SHEET SIZE A1

STANDARDS\APPROVED\DS24\DS24 DRAWING–023–003–01A 12:25 06/03/2019 memorys0/WS27103

CABLE SCHEDULE

No	FROM	TO	Nº OFF CABLES X CORES	CORE SIZE	CONDUCTOR MATERIAL	INSULATION–SHEATH	APPROXIMATE CABLE LENGTH	REMARKS
E1	METERBOX	SWITCHBOARD – MAIN SWITCH	1 x 2 + ECC	1.5mm^2	COPPER	PVC, PVC IN HD PVC CONDUIT	10m	
E2	SWITCHBOARD – T71 AND T72	CHLORINE LEAK ALARM HORN SILENCE PUSHBUTTON	2 x 1	1.5mm^2	COPPER	PVC IN HD PVC CONDUIT	5m	
E3	SWITCHBOARD – T15	MAGNETIC FLOWMETER	1 x 2 + ECC	2.5mm^2	COPPER	PVC IN HD PVC CONDUIT	7.5m	
E4	SWITCHBOARD – T1	DOSING PUMP DECONTACTOR	1 x 2 + ECC	2.5mm^2	COPPER	PVC,PVC V75 ON CABLE TRAY	52m	
E5	SWITCHBOARD – T2	SAMPLING PUMP DECONTACTOR	1 x 2 + ECC	2.5mm^2	COPPER	PVC,PVC V75 ON CABLE TRAY	52m	
E6	SWITCHBOARD – T3 AND T5	CHLORINATION ROOM FAN SWITCH–OUTSIDE CHLORINATION ROOM	2	1.5mm^2	COPPER	PVC, PVC V75	88m	
E7	SWITCHBOARD – T4 AND T6	CHLORINATION ROOM FAN SWITCH–OUTSIDE STORAGE ROOM	2	1.5mm^2	COPPER	PVC, PVC V75	4m	
E8	SWITCHBOARD – T5 AND T6	CHLORINATION ROOM FAN OUTLET	1 x 2 + ECC	1.5mm^2	COPPER	PVC, PVC V75	5m	
E9	SWITCHBOARD – T7 AND T9	ELECTRICAL ROOM FAN SWITCH	2	1.5mm^2	COPPER	PVC, PVC V75	12m	
E10	SWITCHBOARD – T8 AND T10	ELECTRICAL ROOM FAN THERMOSTAT	2	1.5mm^2	COPPER	PVC, PVC V75	17m	
E11	SWITCHBOARD – T9 AND T10	ELECTRICAL ROOM FAN OUTLET	1 x 2 + ECC	1.5mm^2	COPPER	PVC, PVC V75	28m	
E12	SWITCHBOARD – T12	CHLORINATOR HIGH RANGE POWER OUTLET	1 x 2 + ECC	2.5mm^2	COPPER	PVC, PVC V75	37m	
E13	SWITCHBOARD – T13	CHLORINATOR LOW RANGE POWER OUTLET	1 x 2 + ECC	2.5mm^2	COPPER	PVC, PVC V75	5m	
E14	SWITCHBOARD – T14	CHLORINE GAS LEAK DETECTOR POWER OUTLET	1 x 2 + ECC	2.5mm^2	COPPER	PVC, PVC V75	19m	
E15	SWITCHBOARD – T16	CHLORINE RESIDUAL ANALYSER POWER OUTLET	1 x 2 + ECC	2.5mm^2	COPPER	PVC, PVC V75	93m	
E16	SWITCHBOARD – T82 AND T83	CHLORINE GAS LEAK ALARM LIGHT	1 x 2	1.5mm^2	COPPER	PVC, PVC V75	102m	
E17	SWITCHBOARD – T84 AND T85	CHLORINE GAS LEAK ALARM LIGHT	1 x 2	1.5mm^2	COPPER	PVC, PVC V75	85m	
E18	SWITCHBOARD – T86 AND T87	CHLORINE GAS LEAK ALARM HORN	1 x 2	1.5mm^2	COPPER	PVC, PVC V75	33m	
E19	SWITCHBOARD – T88 AND T89	CHLORINE GAS LEAK ALARM HORN	1 x 2	1.5mm^2	COPPER	PVC, PVC V75	33m	
E20	SWITCHBOARD – T90 TO T105	ALARM TRANSMITTER	1 x 12	7/0.20	COPPER	PVC,PVC FLEXIBLE	11m	
E21	SWITCHBOARD – T22	ALARM TRANSMITTER POWER AND CONTROL LINE SURGE SUPPRESSOR	1 x 2 + ECC	1.5mm^2	COPPER	PVC V75	41m	
E22	SWITCHBOARD – T51 TO T54	CHLORINATOR HIGH RANGE HIGH AND LOW VACUUM PRESSURE SWITCHES	1 x 4	1.5mm^2	COPPER	PVC, PVC V75	40m	
E23	SWITCHBOARD – T55 TO T58	CHLORINATOR LOW RANGE HIGH AND LOW VACUUM PRESSURE SWITCHES	1 x 4	1.5mm^2	COPPER	PVC, PVC V75	50m	
E24	SWITCHBOARD – T59 TO T64	CHLORINATOR HIGH RANGE VALVE ACTUATOR	1 x 6	1.5mm^2	COPPER	PVC, PVC V75	12m	
E25	SWITCHBOARD – T65 TO T70	CHLORINATOR LOW RANGE VALVE ACTUATOR	1 x 6	1.5mm^2	COPPER	PVC, PVC V75	8m	
E26	SWITCHBOARD – T76 AND T77	INTRUDER ALARM LIMIT SWITCH Nº1	1 x 2	1.5mm^2	COPPER	PVC, PVC V75	8m	
E27	SWITCHBOARD – T77 AND T78	INTRUDER ALARM LIMIT SWITCH Nº2	1 x 2	1.5mm^2	COPPER	PVC, PVC V75	18m	
E28	SWITCHBOARD – T78 AND T79	INTRUDER ALARM LIMIT SWITCH Nº3	1 x 2	1.5mm^2	COPPER	PVC, PVC V75	11m	
E29	SWITCHBOARD – T80 AND T81	DOSING PUMP FLOW SWITCH	1 x 2	1.5mm^2	COPPER	PVC, PVC V75	3m	

CABLE SCHEDULE

No	FROM	TO	Nº OFF CABLES X CORES	CORE SIZE	CONDUCTOR MATERIAL	INSULATION–SHEATH	APPROXIMATE CABLE LENGTH	REMARKS
C1	METERBOX	SWITCHBOARD – MAIN SWITCH	1 x 2 + ECC	1.5mm^2	COPPER	PVC, PVC IN HD PVC CONDUIT	10m	
C2	SWITCHBOARD – T71 AND T72	CHLORINE LEAK ALARM HORN SILENCE PUSHBUTTON	2 x 1	1.5mm^2	COPPER	PVC IN HD PVC CONDUIT	5m	
C3	SWITCHBOARD – T15	MAGNETIC FLOWMETER	1 x 2 + ECC	2.5mm^2	COPPER	PVC IN HD PVC CONDUIT	7.5m	
C4	SWITCHBOARD – T1	DOSING PUMP DECONTACTOR	1 x 2 + ECC	2.5mm^2	COPPER	PVC,PVC V75 ON CABLE TRAY	52m	
C5	SWITCHBOARD – T2	SAMPLING PUMP DECONTACTOR	1 x 2 + ECC	2.5mm^2	COPPER	PVC,PVC V75 ON CABLE TRAY	52m	
C6	SWITCHBOARD – T3 AND T5	CHLORINATION ROOM FAN SWITCH–OUTSIDE CHLORINATION ROOM	2	1.5mm^2	COPPER	PVC, PVC V75	88m	
C7	SWITCHBOARD – T4 AND T6	CHLORINATION ROOM FAN SWITCH–OUTSIDE STORAGE ROOM	2	1.5mm^2	COPPER	PVC, PVC V75	4m	
C8	SWITCHBOARD – T5 AND T6	CHLORINATION ROOM FAN OUTLET	1 x 2 + ECC	1.5mm^2	COPPER	PVC, PVC V75	5m	
C9	SWITCHBOARD – T7 AND T9	ELECTRICAL ROOM FAN SWITCH	2	1.5mm^2	COPPER	PVC, PVC V75	12m	
C10	SWITCHBOARD – T8 AND T10	ELECTRICAL ROOM FAN THERMOSTAT	2	1.5mm^2	COPPER	PVC, PVC V75	17m	

GENERAL NOTES
1. CABLE LENGTH TOLERANCE ±20%

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ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
810						

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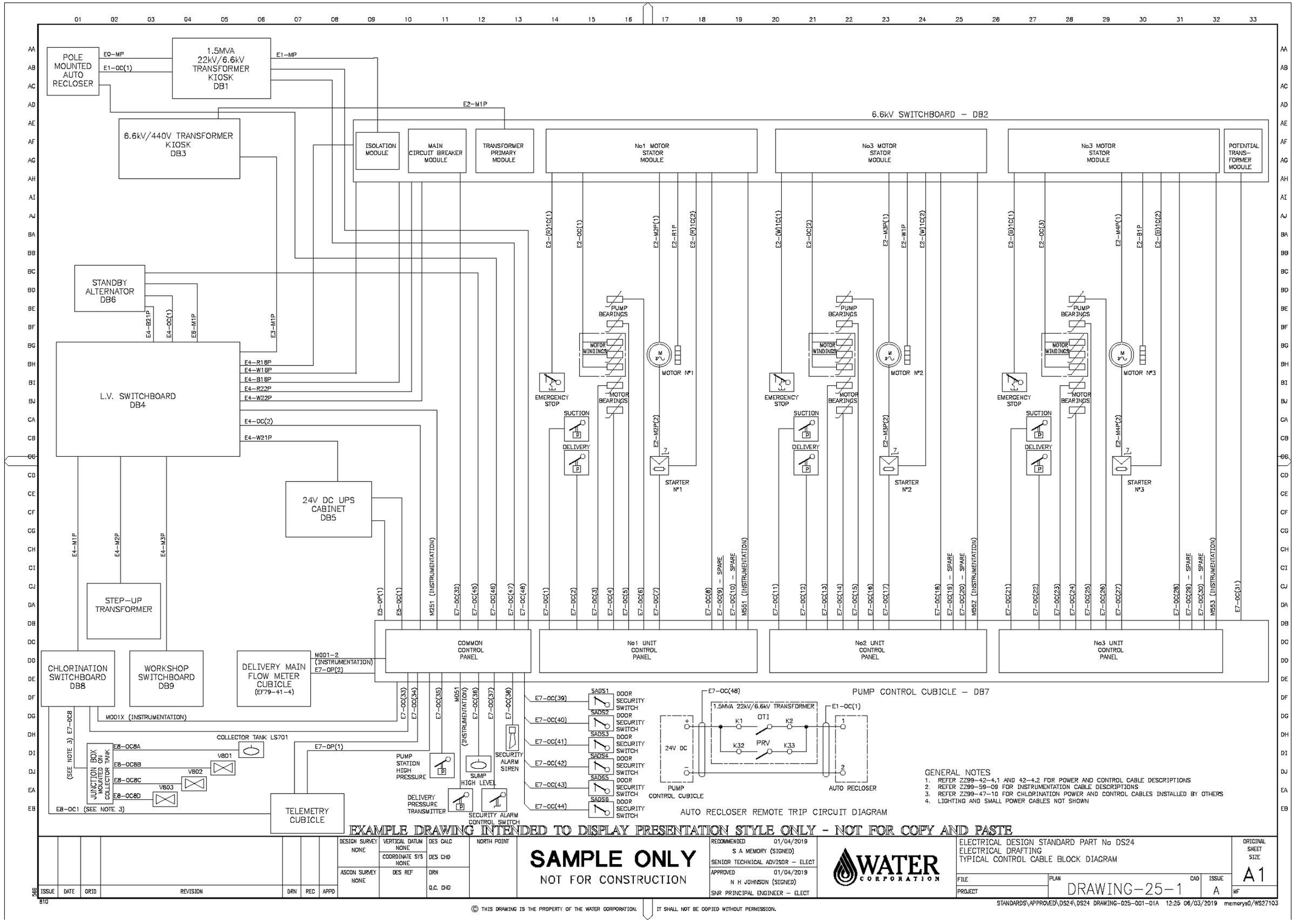
WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
TYPICAL POWER AND CONTROL CABLE SCHEDULE
SMALL TO MEDIUM INSTALLATIONS

FILE | PLAN DRAWING–24–1 | CAD | ISSUE A | ORIGINAL SHEET SIZE A1
PROJECT | MF

STANDARDS\APPROVED\DS24\DS24 DRAWING–024–001–01A 12:25 06/03/2019 memorys0/WS27103

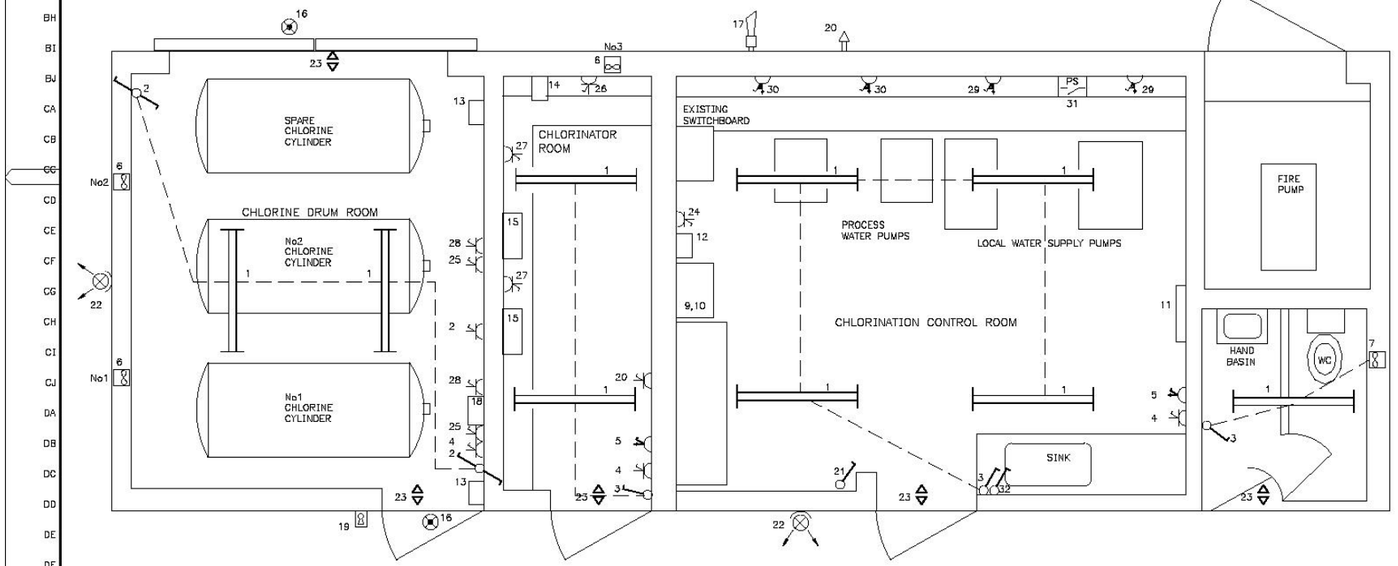


LABEL SCHEDULE

No	LETTER HEIGHT	TEXT	WIDE	HIGH	QTY
1	12 12	LIGHT AND SMALL POWER DISTRIBUTION BOARD E10	300	40	1
2	12	24V DC UPS E11	200	20	1
3	12	CONTAINMENT ALARM PANEL	200	20	1
4	3	RCD PROTECTED	50	20	1
5	3	CHLORINE LEAK DETECTOR	75	20	1
6	3	DRUM WEIGH SCALE A	75	20	1
7	3	DRUM WEIGH SCALE B	75	20	1
8	3	RESIDUAL CHLORINE ANALYSER	75	20	1
9	3	CHLORINATOR 1	50	20	1
10	3	CHLORINATOR 2	50	20	1

LABEL SCHEDULE

No	LETTER HEIGHT	TEXT	WIDE	HIGH	QTY
11	3	CHLORINE DRUM HEATER 1	75	20	1
12	3	CHLORINE DRUM HEATER 2	75	20	1
13	3	LOCAL WATER PUMP 1	75	20	1
14	3	LOCAL WATER PUMP 2	75	20	1
15	3	PROCESS WATER PUMP 1	75	20	1
16	3	PROCESS WATER PUMP 2	75	20	1



1:25 AT SHEET SIZE A1

MATERIAL SCHEDULE

ITEM	CODE	LABEL	DESCRIPTION	SPECIFICATION	QTY
1			LIGHT FITTING	PIERLITE SS8236 FITTINGS WITH SID/OE 236 REFLECTORS	9
2			SWITCH (NOTE 2)	WILCO, WIS 110 2W : 2 WAY, 250V, 10A	2
3			SWITCH (NOTE 2)	WILCO, WIS 110 : 1 WAY, 250V, 10A	3
4	GPO	4	GENERAL PURPOSE OUTLET (NOTE 2)	WILCO, WIC 110 : 1 POLE, 250V, 10A	3
5			SWITCH PLUG (NOTE 2)	WILCO, WIC 515 SWITCHPLUG, 500V, 15A	2
			PLUG TOP (NOTE 2)	WILCO, WIP 515	2
6			EXHAUST FAN (NOTE 2)	SMITHS, SPF 300-43WP ET : 3 PHASE, 440V, 50Hz	3
7			TOILET FAN (NOTE 2)	1 PHASE, 250V, 50Hz	1
8			CHLORINATION SWITCHBOARD	FK80-47-01	1
9		2	24V DC UPS	INNOVATIVE ENERGIES, Pt No SO497 : WALL MOUNTED IP54 CABINET, WITH BATTERY TEST, BATTERY OK CONTACT, TEST INTERVAL ONCE PER DAY, METERS FOR BATTERY VOLTAGE, BATTERY CURRENT & LOAD CURRENT, BATTERY CIRCUIT BREAKER, MAINS ISOLATOR, DC OUTPUT ISOLATOR, EARTH BAR, SEPARATE BATTERY COMPARTMENT TO AS2672 AND AS3011	1
			BATTERY CHARGER/DC POWER SUPPLY	INNOVATIVE ENERGIES C685, 500W, 240V 50Hz INPUT, 27.6VDC OUTPUT, WITH CHARGER OK CONTACT, TEMPERATURE COMPENSATION AND DISABLE CHARGER FOR BATTERY TEST	
			REGULATED 24VDC POWER SUPPLY (DC TO DC CONVERTER)	INNOVATIVE ENERGIES C524, 250W, 18-36VDC INPUT, 24VDC OUTPUT, WITH BATTERY DEEP DISCHARGE PROTECTION (SET AT 21V)	
10			BATTERY (NOTE 4)	HOPPECKE ENERGY 85505, 95Ahr @ 20hr discharge rate	2
11		1	LIGHT AND POWER DISTRIBUTION BOARD	MERLIN GERIN MD24A31 : MSC1B CHASSIS : 20kA FOR 0.1SEC, 415V, 250A, 160A MAIN SWITCH, 24 POLE, IP56	1
			CIRCUIT BREAKER	MERLIN GERIN C60N, 6KA, REF. No.25798 : 2A SINGLE POLE	8
			CIRCUIT BREAKER	MERLIN GERIN C60N, 6KA, REF. No.25802 : 10A SINGLE POLE	1
			CIRCUIT BREAKER	MERLIN GERIN C60N, 6KA, REF. No.25831 : 16A THREE POLE	2
			RCD/CIRCUIT BREAKER	MERLIN GERIN V40H, 10KA, REF. No.26894 : 10A SINGLE POLE, 30mA SENSITIVITY	1
			RCD/CIRCUIT BREAKER	MERLIN GERIN V40H, 10KA, REF. No.26895 : 16A SINGLE POLE, 30mA SENSITIVITY	1
12	AT101		CHLORINE LEAK DETECTOR	REFER LOOP DIAGRAM 59-03	1
13	AE101A AE101B		CHLORINE LEAK DETECTOR CELL (NOTE 3)	REFER LOOP DIAGRAM 59-03	2
14	AIT203		RESIDUAL CHLORINE ANALYSER	REFER LOOP DIAGRAM 59-06	1
15	FFC201A,B		CHLORINATOR	REFER LOOP DIAGRAM 59-06	2
16	AAHH101B,C		5PPM CHLORINE LEAK FLASHING LIGHT	CLIFORD & SNELL, V4 FLASHALARM YOD2020R, 24VDC, RED LENS	2
17	AAHH101E		5PPM CHLORINE LEAK AUDIBLE ALARM	YODALARM YODB0201 : 2400Hz CONTINUOUS, 10-35V, DC IP65	1
18		3	CONTAINMENT ALARM PANEL	NHP FIBOX, TYPE EK, SIZED TO SUIT, GREY HINGED LID	1
	YA101C		CONTAINMENT ALARM BUZZER	ASKARI FUL2130JW, COMPACT, 24VDC, 660Hz CONTINUOUS, IP65	1
	HS101B		BUZZER ACKNOWLEDGE PUSH BUTTON	SIEMENS 3SB1202-0AB01 BLACK "ACKNOWLEDGE"	1
19	HS101A		FANS SWITCH	CLIPSAL, 56K1SW115 : 250V, 15A SINGLE POLE, IP65 SURFACE SWTCH, LOCKABLE IN OFF POSTION ONLY	1
20	SAA		SECURITY SIREN	YODALARM YODB0201, SIREN : 10-35V, DC IP65	1
21	HS402		SECURITY ALARM CONTROL SWITCH	CLIPSAL, 56SW110 : 250V, 10A, IP56	1
22			SECURITY LIGHTING	WADCO, WALLSTAR, 70W HIGH PRESSURE SODIUM LAMP	2
23	YS101A,B YS402A,B,C		DOOR SWITCHES	RS COMPONENTS, PROXIMITY SWITCH, SURFACE MOUNT, TERMINAL TYPE	5
24		5	CHLORINE LEAK DETECTOR POWER OUTLET	CLIPSAL, 56C310 : 240V, 10A, 1 POLE	1
25		6,7	CHLORINE DRUM WIEGH SCALES POWER OUTLET	CLIPSAL, 56C310 : 240V, 10A, 1 POLE	2
26		8	RESIDUAL CHLORINE ANALYSER POWER OUTLET	CLIPSAL, 56C310 : 240V, 10A, 1 POLE	1
27		9,10	CHLORINATOR POWER OUTLET	CLIPSAL, 56C310 : 240V, 10A, 1 POLE	2
28		11,12	CHLORINE DRUM HEATER POWER OUTLET	CLIPSAL, 56C310 : 240V, 10A, 1 POLE	2
29	Dr	13,14	LOCAL WATER SUPPLY MOTOR SWITCHED OUTLET	CUTLER-HAMMER, MARECHAL : 440V 50Hz 16A DS1 DECONTACTOR WITH LATE MAKE INTERLOCK CONTACTS	2
			SWITCHED SOCKET	6 PIN (3P+E+2C), WALL MOUNTED IP557 31-14013-972-023	
			PLUG TOP	6 PIN (3P+E+2C), IP557 31-11013-972	
30	Dr	15,16	PROCESS WATER MOTOR SWITCHED OUTLET	CUTLER-HAMMER, MARECHAL : 440V 50Hz 16A DS1 DECONTACTOR WITH LATE MAKE INTERLOCK CONTACTS	2
			SWITCHED SOCKET	6 PIN (3P+E+2C), WALL MOUNTED IP557 31-14013-972-023	
			PLUG TOP	6 PIN (3P+E+2C), IP557 31-11013-972	
31	PS		LOCAL WATER PUMP PRESSURE SWITCH	NHP INDUSTRIAL PRESSURE SWITCH IPS-B046-FN4-VD: 1 C/O CONTACT, 40-1000kPa, IP65	1
32			SECURITY LIGHTING SWITCH	CLIPSAL, 56SW110 : 250V, 10A, IP56	1

GENERAL NOTES
1. THIS DRAWING IS BASED UPON, AND SUPERSEDES, S0803-37-1
2. ITEMS 2 TO 7 ARE EXISTING.
3. CHLORINE LEAK DETECTOR CELLS TO BE MOUNTED NEAR FLOOR LEVEL.
4. ITEM 10 TO BE MOUNTED INSIDE ITEM 9

ZZ99-91-1	CHLORINATION SYSTEM - PIPING LAYOUT PLAN
ZZ99-41-1.2	ELECTRICAL SITE LAYOUT - PART 2
ZZ99-41-5	CHLORINATION BUILDING SINGLE LINE POWER DIAGRAM
ZZ99-59-1 TO 8	LOOP DIAGRAMS
ZZ99-59-9	INSTRUMENT CABLE SCHEDULE
DRAWING	TITLE

REFERENCE DRAWINGS

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD

DESIGN SURVEY NONE | VERTICAL DATUM NONE | COORDINATE SYS NONE | ASCON SURVEY NONE | DES REF | DES CALC | DES CHD | DRN | Q.C. CHD | NORTH POINT

SAMPLE ONLY
NOT FOR CONSTRUCTION

RECOMMENDED 01/04/2019
S A MEMORY (SIGNED)
SENIOR TECHNICAL ADVISOR - ELECT
APPROVED 01/04/2019
N H JOHNSON (SIGNED)
SNR PRINCIPAL ENGINEER - ELECT

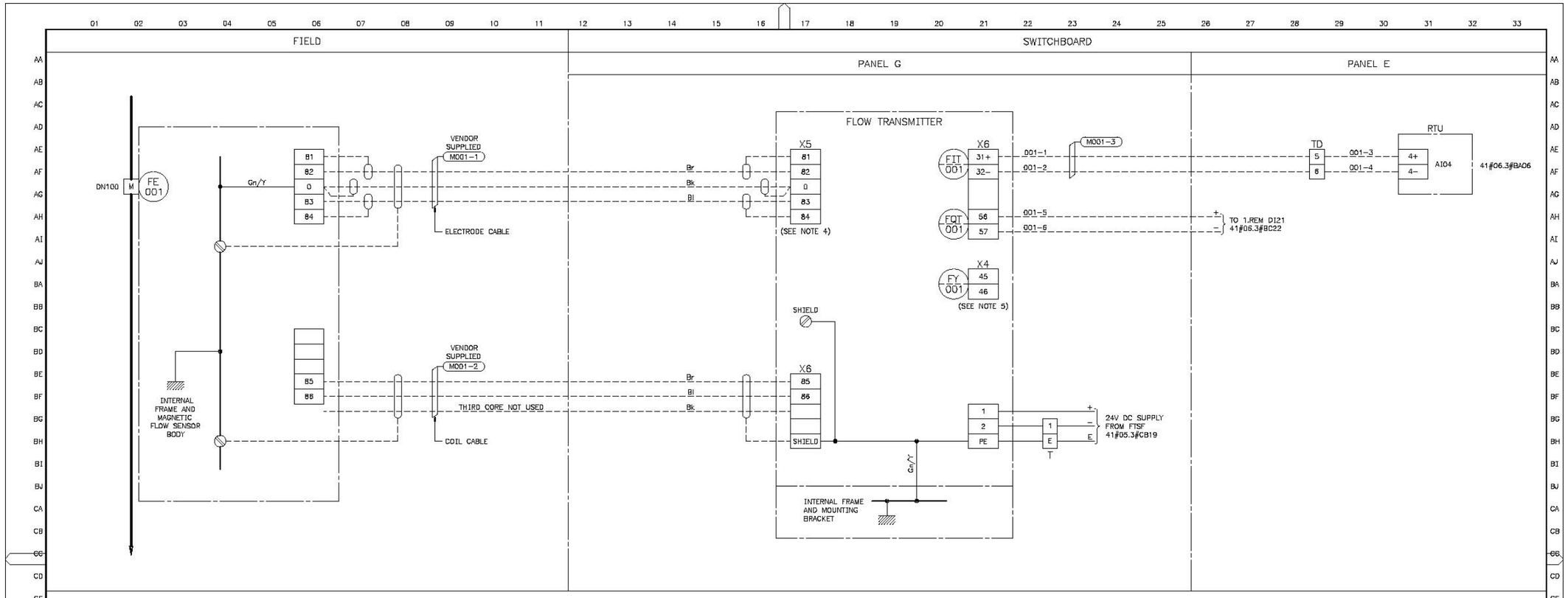
WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
BUILDING LIGHT AND POWER LAYOUT

ORIGINAL SHEET SIZE A1

FILE | PLAN DRAWING-26-1 | CAD | ISSUE A | PROJECT | MF

STANDARDS\APPROVED\DS24\DS24 DRAWING-026-001-01A 12:25 06/03/2019 memorys0/WS27103



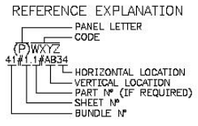
INSTRUMENT SCHEDULE

TAG	DEVICE	INPUT RANGE	OUTPUT RANGE	RESISTANCE (OHMS)	CONTACTS N/O	CONTACTS N/C	POWER SUPPLY	MANUFACTURER	MODEL	REMARKS
FE001	MAGNETIC FLOW SENSOR	0–20L/s	FIT001	–	–	–	–	SIEMENS	SITRANS MAG 5100W, 7ME6580–3TN14–2AA1, DN100	PN16 (AS4087), COMPOSITE ELASTOMER LINING, IP68 SUBMERSIBLE KIT
	EARTHING RING	–	–	–	–	–	–	SIEMENS	FAU BW186–0100, DN100	
FIT001	FLOW TRANSMITTER	FE001	RS485	–	–	–	240V 50Hz	SIEMENS	SITRANS F M MAGFLO, MAG 5000, 7ME6920–1AA10–1AA0	IP67
FQT001	FLOW TOTAL TRANSMITTER	100L	1 PULSE	–	–	–				
M001–1	FLOW TRANSMITTER ELECTRODE CABLE	–	–	–	–	–	–	SIEMENS	A5E01181847 : 10m	DOUBLE SHIELDED, 3 x 0.25mm^2 CABLE
M001–2	FLOW TRANSMITTER COIL CABLE	–	–	–	–	–	–			

CODE SCHEDULE

FTSF	FLOW TRANSMITTER SUPPLY FUSE
PE	POTENTIAL EARTH
REM	REMOTE TERMINAL UNIT EXPANSION MODULE
RTU	REMOTE TERMINAL UNIT

REFERENCE EXPLANATION



GENERAL NOTES

1. DRAWN NO POWER, NO FAULTS AND NO WATER CONDITION
2. UNLESS OTHERWISE SHOWN 240V AC CONTROL CABLING MINIMUM 0.75mm^2 Cu PVC V75 OR LSFLEX R–125
3. A BONDING CABLE SHALL BE INSTALLED ACROSS THE MAGNETIC FLOW SENSOR
4. THE ELECTRODE CABLE SCREENS ARE CONNECTED TO THE BODY OF THE FLOW TRANSMITTER HEAD AT THE FLOW TRANSMITTER HEAD END ONLY. X5 TERMINALS B1, 0 AND B4 ARE NOT EARTHED BUT ARE CAPACITIVELY COUPLED INTERNALLY FOR RF SUPPRESSION PURPOSES
5. FLOW REVERSE DIRECTION RELAY (WHERE REQUIRED). PROGRAM TRANSMITTER FOR CURRENT OUTPUT BIDIRECTIONAL, DIGITAL OUTPUT BIDIRECTIONAL PULSE AND RELAY OUTPUT DIRECTION/LIMIT

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
81C						

DESIGN SURVEY NONE | VERTICAL DATUM NONE | COORDINATE SYS NONE | DES CALC | DES CHD | ASCON SURVEY NONE | DES REF | DRN | Q.C. CHD | NORTH POINT

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SENIOR TECHNICAL ADVISOR – ELECT
APPROVED 01/04/2019
N H JOHNSON (SIGNED)
SNR PRINCIPAL ENGINEER – ELECT

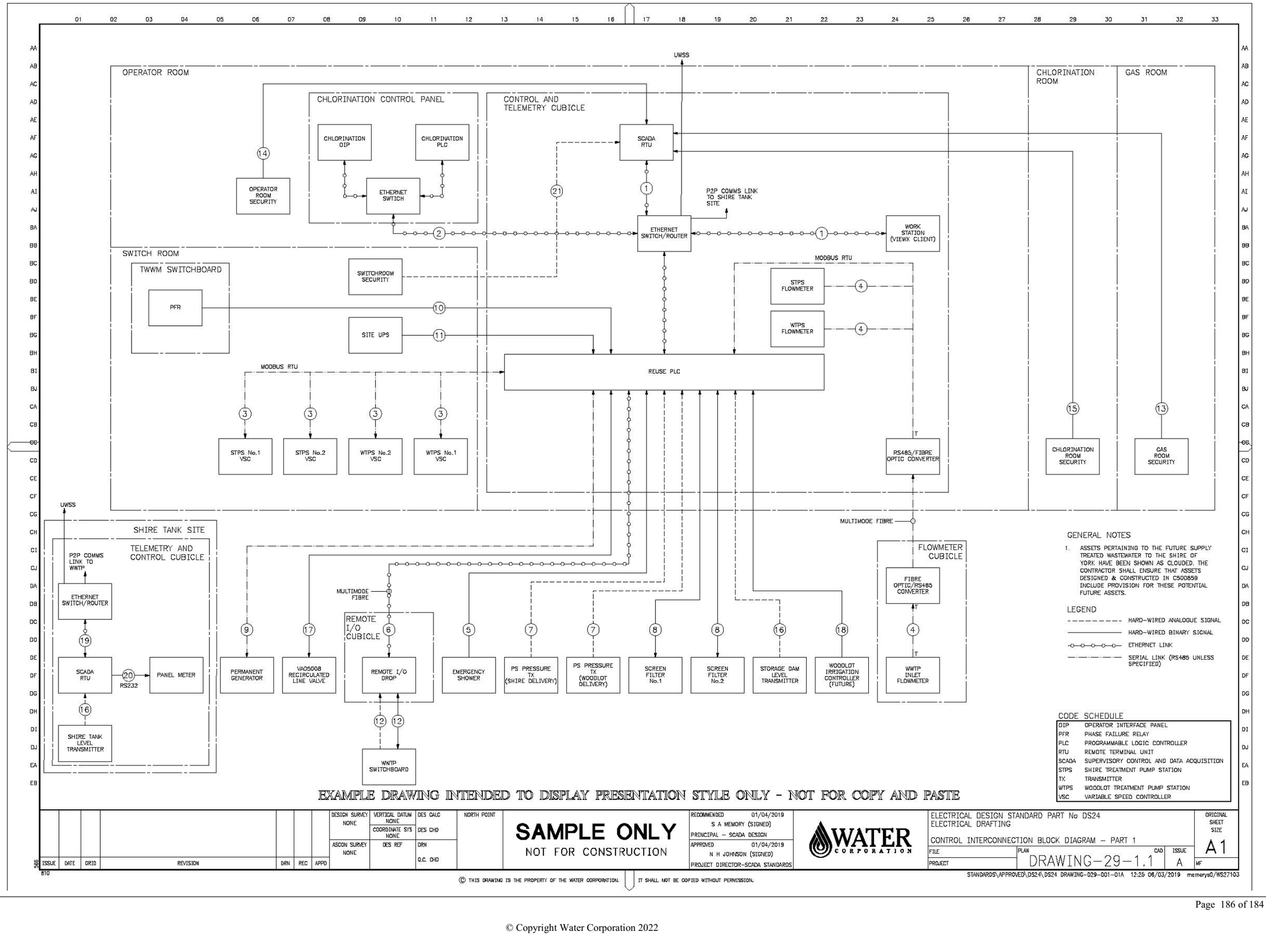
WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
LOOP DIAGRAM
FLOW (FIT001)

FILE | PLAN DRAWING–28–1 CAD | ISSUE A | PROJECT

ORIGINAL SHEET SIZE A1

STANDARDS\APPROVED\DS24\DS24 DRAWING–028–001–01A 12:25 06/03/2019 memorys0/WS27103



(1) SCADA SIGNALS

DIGITAL INPUTS

WWTP INLET FLOW TRANSMITTER FAULT
STPS FLOW TRANSMITTER FAULT
WTPS FLOW TRANSMITTER FAULT
EMERGENCY SHOWER OPERATING FLOW HIGH ALARM
SHIRE DELIVERY PRESSURE TRANSMITTER FAULT
SHIRE DELIVERY PRESSURE ALARM HIGH HIGH
SHIRE DELIVERY PRESSURE ALARM LOW LOW
WOODLOT DELIVERY PRESSURE TRANSMITTER FAULT
WOODLOT DELIVERY PRESSURE ALARM HIGH HIGH
WOODLOT DELIVERY PRESSURE ALARM LOW LOW
REMOTE RESET ENABLE
STATION RUN ENABLE
VOLTS HEALTHY
POWER SUPPLY UNIT
STATION OVERRIDE STOP
STPS ALTERNATE DUTY
STPS STANDBY CALL
STPS UNIT 1 ON DUTY A
STPS UNIT 2 ON DUTY A
STPS STANDBY LATCHED
STPS DUTY A CALL
STPS UNIT 1 AUTO CALL
STPS UNIT 2 AUTO CALL
STPS UNIT 1 CALLED
STPS UNIT 2 CALLED
STPS UNIT 1 RUNNING
STPS UNIT 2 RUNNING
STPS UNIT 1 MOTOR FAULT
STPS UNIT 2 MOTOR FAULT
STPS UNIT 1 AVAILABLE
STPS UNIT 2 AVAILABLE
STPS UNIT 1 INCOMPLETE START
STPS UNIT 2 INCOMPLETE START
STPS UNIT 1 ELECTRICAL FAULT
STPS UNIT 2 ELECTRICAL FAULT
STPS UNIT 1 MOTOR OVERTEMPERATURE
STPS UNIT 2 MOTOR OVERTEMPERATURE
STPS UNIT 1 STARTED
STPS UNIT 2 STARTED
STPS UNIT 1 LOW FLOW FAULT
STPS UNIT 2 LOW FLOW FAULT
STPS UNIT 1 ON NORMAL
STPS UNIT 2 ON NORMAL
STPS UNIT 1 RUN
STPS UNIT 2 RUN
STPS UNIT 1 MOTOR FAULT RESET
STPS UNIT 2 MOTOR FAULT RESET
WTPS UNIT 1 ON NORMAL
WTPS UNIT 2 ON NORMAL
WTPS UNIT 1 RUN
WTPS UNIT 2 RUN
WTPS UNIT 1 CALLED
WTPS UNIT 2 CALLED
WTPS UNIT 1 MOTOR FAULT RESET
WTPS UNIT 2 MOTOR FAULT RESET
WTPS OVERRIDE STOP
WTPS ALTERNATE DUTY
WTPS STANDBY CALL
WTPS UNIT 1 ON DUTY A
WTPS UNIT 2 ON DUTY A
WTPS STANDBY LATCHED
WTPS DUTY A CALL
WTPS UNIT 1 AUTO CALL
WTPS UNIT 2 AUTO CALL
WTPS UNIT 1 RUNNING
WTPS UNIT 2 RUNNING
WTPS UNIT 1 MOTOR FAULT
WTPS UNIT 2 MOTOR FAULT
WTPS UNIT 1 AVAILABLE
WTPS UNIT 2 AVAILABLE
WTPS UNIT 1 INCOMPLETE START
WTPS UNIT 2 INCOMPLETE START

GENERAL NOTES

1. EXCLUDES STANDARD CHLORINATION MODULE.
2. SIGNALS DERIVED FROM SHIRE TANK SITE.

WTPS UNIT 1 ELECTRICAL FAULT
WTPS UNIT 2 ELECTRICAL FAULT
WTPS UNIT 1 MOTOR OVERTEMPERATURE
WTPS UNIT 2 MOTOR OVERTEMPERATURE
WTPS UNIT 1 STARTED
WTPS UNIT 2 STARTED
WTPS UNIT 1 LOW FLOW FAULT
WTPS UNIT 2 LOW FLOW FAULT
GRINDER RUNNING
GRINDER MOTOR FAULT
GRINDER AVAILABLE
GRINDER INCOMPLETE START
GRINDER ELECTRICAL FAULT
GRINDER MOTOR OVERTEMPERATURE
GRINDER STARTED
GRINDER ALARM
GRINDER FAULT
PRIMARY POND AERATOR 1 RUNNING
PRIMARY POND AERATOR 1 MOTOR FAULT
PRIMARY POND AERATOR 1 AVAILABLE
PRIMARY POND AERATOR 1 INCOMPLETE START
PRIMARY POND AERATOR 1 ELECTRICAL FAULT
PRIMARY POND AERATOR 1 MOTOR OVERTEMPERATURE
PRIMARY POND AERATOR 1 STARTED
PRIMARY POND AERATOR 1 ALARM
PRIMARY POND AERATOR 1 FAULT
PRIMARY POND AERATOR 2 RUNNING
PRIMARY POND AERATOR 2 MOTOR FAULT
PRIMARY POND AERATOR 2 AVAILABLE
PRIMARY POND AERATOR 2 INCOMPLETE START
PRIMARY POND AERATOR 2 ELECTRICAL FAULT
PRIMARY POND AERATOR 2 MOTOR OVERTEMPERATURE
PRIMARY POND AERATOR 2 STARTED
PRIMARY POND AERATOR 2 ALARM
PRIMARY POND AERATOR 2 FAULT
SCREEN FILTER NO.1 CLEANING IN PROGRESS
SCREEN FILTER NO.1 FILTER FAULT / ALARM
SCREEN FILTER NO.2 CLEANING IN PROGRESS
SCREEN FILTER NO.2 FILTER FAULT / ALARM
SITE UPS BATTERY CHARGED
SITE UPS BATTERY LOW
SITE UPS FAULT
SITE UPS BYPASSED
GENERATOR MODE
GENERATOR STATE
GENERATOR BATTERY
GENERATOR FUEL
GENERATOR CONDITION
STATION STARTING
STATION ALARM
STATION FAULT
RESET WAITING
SITE KWH TOTAL
SITE KVAH TOTAL
VA61308 OPENED
VA61308 CLOSED
VA61308 FAULT
REMOTE I/O UPS BATTERY OPERATING
REMOTE I/O UPS CHARGING
REMOTE I/O UPS FAULT
415V VOLTS ON

DIGITAL OUTPUTS

SCREEN FILTER NO.1 FLOW SWITCH
SCREEN FILTER NO.1 PAUSE
SCREEN FILTER NO.1 REMOTE FLUSH
SCREEN FILTER NO.2 FLOW SWITCH
SCREEN FILTER NO.2 PAUSE
SCREEN FILTER NO.2 REMOTE FLUSH
STATION REMOTE INHIBIT
SCADA STANDBY LATCH RESET
PRIMARY POND AERATOR 1 SCADA RESET
PRIMARY POND AERATOR 1 SCADA START
PRIMARY POND AERATOR 1 SCADA STOP
PRIMARY POND AERATOR 1 SCADA START INHIBIT
PRIMARY POND AERATOR 2 SCADA RESET
PRIMARY POND AERATOR 2 SCADA START
PRIMARY POND AERATOR 2 SCADA STOP
PRIMARY POND AERATOR 2 SCADA START INHIBIT
GRINDER SCADA RESET
GRINDER SCADA START
GRINDER SCADA STOP
GRINDER SCADA START INHIBIT

STPS UNIT 1 SCADA RESET
STPS UNIT 1 SCADA START
STPS UNIT 1 SCADA STOP
STPS UNIT 1 SCADA START INHIBIT
STPS UNIT 2 SCADA RESET
STPS UNIT 2 SCADA START
STPS UNIT 2 SCADA STOP
STPS UNIT 2 SCADA START INHIBIT
WTPS UNIT 1 SCADA RESET
WTPS UNIT 1 SCADA START
WTPS UNIT 1 SCADA STOP
WTPS UNIT 1 SCADA START INHIBIT
WTPS UNIT 2 SCADA RESET
WTPS UNIT 2 SCADA START
WTPS UNIT 2 SCADA STOP
WTPS UNIT 2 SCADA START INHIBIT
STPS MODE – PRODUCTION
STPS MODE – MANUAL
STPS MODE – OFF
WTPS MODE – IRRIGATE
WTPS MODE – MANUAL
WTPS MODE – OFF
VA61308 AUTO
VA61308 MANUAL
VA61308 OFF
VA61308 OPEN
VA61308 CLOSE
SHIRE TANKS LEVEL TRANSMITTER FAULT
GENERATOR SCADA MANUAL START
GENERATOR SCADA MANUAL STOP

ANALOGUE INPUTS

WWTP INLET FLOW TRANSMITTER FLOW RATE
WWTP INLET FLOW TRANSMITTER FLOW TOTALISED
STPS FLOW TRANSMITTER FLOW RATE
STPS FLOW TRANSMITTER FLOW TOTALISED
WTPS FLOW TRANSMITTER FLOW RATE
WTPS FLOW TRANSMITTER FLOW TOTALISED
SHIRE DELIVERY PRESSURE
WOODLOT DELIVERY PRESSURE
STPS UNIT 1 SPEED
STPS UNIT 2 SPEED
WTPS UNIT 1 SPEED
WTPS UNIT 2 SPEED
STORAGE DAM LEVEL
FUEL LEVEL
COOLANT TEMPERATURE
GENERATOR BATTERY VOLTAGE
FREQUENCY
OIL PRESSURE
SPEED
SITE KW INSTANT
SITE KVA INSTANT
SITE KVAR INSTANT

ANALOGUE OUTPUTS

SHIRE TANK LEVEL AND STPS STOP SETPOINT
SHIRE TANK LEVEL AND STPS START SETPOINT
SHIRE TANK LEVEL
STPS PRODUCTION TIME
STPS PRODUCTION FLOW RATE
GRINDER START SETPOINT
GRINDER LAG SETPOINT
AERATION ON/OFF SETPOINT
AERATION CYCLE SPLIT SETPOINT
AERATOR DUTY SELECTOR – CYCLE SETPOINT
AERATOR DUTY SELECTOR – AERATOR 1 DUTY SETPOINT
AERATOR DUTY SELECTOR – AERATOR 2 DUTY SETPOINT
AERATOR DUTY SELECTOR – OFF SETPOINT
STPS FLOW SETPOINT
STPS PRODUCTION TIME SETPOINT
STPS FLOWMETER LOW LOW SETPOINT
STPS FLOWMETER LOW SETPOINT
STPS FLOWMETER HIGH HIGH SETPOINT
STPS FLOWMETER HIGH SETPOINT
WTPS FLOWMETER LOW LOW SETPOINT
WTPS FLOWMETER LOW SETPOINT
WTPS FLOWMETER HIGH HIGH SETPOINT
WTPS FLOWMETER HIGH SETPOINT
WTPS FLOW SETPOINT
VA61308 RECIRCULATION INTERVAL SETPOINT
VA61308 RECIRCULATION DURATION SETPOINT

(2) CHLORINATION SYSTEM SIGNALS (NOTE 1)

SERIAL INPUTS

TWW FLOW RATE (MEASURED)

SERIAL OUTPUTS

CHLORINATION FAULT

(3) VARIABLE SPEED CONTROLLER SIGNALS

DIGITAL INPUTS

UNIT * RUN
UNIT * MOTOR FAULT RESET

DIGITAL OUTPUTS

UNIT * AVAILABLE
UNIT * FAULT
UNIT * ON NORMAL
UNIT * RUNNING
UNIT * LOW FLOW
UNIT * MOTOR THERMISTOR RELAY (MTHR)

ANALOGUE INPUTS

UNIT * SPEED

(4) FLOWMETER SIGNALS

SERIAL OUTPUTS

FLOW RATE
FLOW TOTAL

(5) EMERGENCY SHOWER SIGNALS

DIGITAL INPUTS

EMERGENCY SHOWER OPERATING FLOW HIGH SWITCH

(6) REMOTE I/O DROP

ANALOGUE INPUTS

GRINDER MOTOR CURRENT
AERATOR 1 MOTOR CURRENT
AERATOR 2 MOTOR CURRENT

DIGITAL INPUTS

GRINDER ON NORMAL (CSS)
GRINDER AVAILABLE (AVR)
GRINDER RUNNING (LC)
GRINDER MOTOR THERMISTOR RELAY (MTHR)
GRINDER MOTOR FAULT (MPAR)
AERATOR 1 ON NORMAL (CSS)
AERATOR 1 AVAILABLE (AVR)
AERATOR 1 RUNNING (LC)
AERATOR 1 MOTOR THERMISTOR RELAY (MTHR)
AERATOR 1 MOTOR FAULT (MPAR)
AERATOR 2 ON NORMAL (CSS)
AERATOR 2 AVAILABLE (AVR)
AERATOR 2 RUNNING (LC)
AERATOR 2 MOTOR THERMISTOR RELAY (MTHR)
AERATOR 2 MOTOR FAULT (MPAR)
REMOTE I/O UPS BATTERY OPERATING
REMOTE I/O UPS CHARGING
REMOTE I/O UPS FAULT

DIGITAL OUTPUTS

GRINDER RUN (CR)
GRINDER MOTOR FAULT RESET (MRRR)
AERATOR 1 RUN (CR)
AERATOR 1 MOTOR FAULT RESET (MRRR)
AERATOR 2 RUN (CR)
AERATOR 2 MOTOR FAULT RESET (MRRR)

(7) PRESSURE TRANSMITTER SIGNALS

ANALOGUE OUTPUTS

PRESSURE

(8) SCREEN FILTER

DIGITAL INPUTS

FLOW SWITCH
PAUSE

DIGITAL OUTPUTS

CLEANING IN PROGRESS
FILTER FAULT/ALARM

(9) PERMANENT GENERATOR

DIGITAL INPUTS

GENERATOR START
GENERATOR STOP

DIGITAL OUTPUTS

GENERATOR MODE
GENERATOR STATE
GENERATOR BATTERY
GENERATOR FUEL
GENERATOR CONDITION

ANALOGUE OUTPUTS

FUEL LEVEL
COOLANT TEMPERATURE
GENERATOR BATTERY VOLTAGE
FREQUENCY
OIL PRESSURE
SPEED
SITE KW INSTANT
SITE KVA INSTANT
SITE KVAR INSTANT

(10) TWWM SWITCHBOARD

DIGITAL INPUTS

STPS UNIT 1 SELECTED DUTY (DSS 1)
STPS UNIT 1 ALTERNATE DUTY (DSS 3)
STPS UNIT 2 SELECTED DUTY (DSS 5)
STPS TEST LEVEL A
STPS STANDBY FAULT DISABLE
REMOTE RESET DISABLE (RRDL)
LOCAL RESET (RPB)
WTPS UNIT 1 SELECTED DUTY (DSS 1)
WTPS UNIT 1 ALTERNATE DUTY (DSS 3)
WTPS UNIT 2 SELECTED DUTY (DSS 5)
WTPS TEST LEVEL A
WTPS STANDBY FAULT DISABLE

DIGITAL OUTPUTS

415V VOLTS ON
STPS UNIT 1 ON NORMAL (CSS 4)
WTPS UNIT 1 ON NORMAL (CSS 4)

DIGITAL OUTPUTS

UPS BATTERY LOW
UPS FAULT
UPS BYPASSED
VOLTS ON
UPS BATTERY CHARGED

(12) WWTP SWITCHBOARD

ANALOGUE OUTPUTS

GRINDER MOTOR CURRENT
AERATOR 1 MOTOR CURRENT
AERATOR 2 MOTOR CURRENT

DIGITAL OUTPUTS

GRINDER ON NORMAL (CSS)
GRINDER AVAILABLE (AVR)
GRINDER RUNNING (LC)
GRINDER MOTOR THERMISTOR RELAY (MTHR)
GRINDER MOTOR FAULT (MPAR)
AERATOR 1 ON NORMAL (CSS)
AERATOR 1 AVAILABLE (AVR)
AERATOR 1 RUNNING (LC)
AERATOR 1 MOTOR THERMISTOR RELAY (MTHR)
AERATOR 1 MOTOR FAULT (MPAR)
AERATOR 2 ON NORMAL (CSS)
AERATOR 2 AVAILABLE (AVR)
AERATOR 2 RUNNING (LC)
AERATOR 2 MOTOR THERMISTOR RELAY (MTHR)
AERATOR 2 MOTOR FAULT (MPAR)

DIGITAL INPUTS

GRINDER RUN (CR)
GRINDER MOTOR FAULT RESET (MRRR)
AERATOR 1 RUN (CR)
AERATOR 1 MOTOR FAULT RESET (MRRR)
AERATOR 2 RUN (CR)
AERATOR 2 MOTOR FAULT RESET (MRRR)

(13) GAS ROOM SECURITY SIGNALS

DIGITAL OUTPUTS

GAS ROOM FIRE (THERMAL)
GAS ROOM SECURITY BREACHED

(14) OPERATOR ROOM SECURITY SIGNALS

DIGITAL OUTPUTS

CONTROL ROOM FIRE (THERMAL)
CONTROL ROOM SECURITY BREACHED
CONTROL ROOM SECURITY DISARMED

(15) CHLORINATION ROOM SECURITY SIGNALS

DIGITAL OUTPUTS

CHLORINATION ROOM FIRE (THERMAL)
CHLORINATION ROOM SECURITY BREACHED

(16) GENERIC LEVEL TRANSMITTER

ANALOGUE OUTPUTS

LEVEL

(17) VA05008 RECIRCULATE LINE VALVE

DIGITAL INPUTS

AUTO/MANUAL/OFF
OPEN/CLOSE

DIGITAL OUTPUTS

OPENED
CLOSED
VALVE FAULT

(18) WOODLOT IRRIGATION CONTROLLER

DIGITAL INPUTS

WTPS STOP REQUEST
WTPS CALL TO RUN

(19) SHIRE TANK SCADA SIGNALS

DIGITAL INPUTS

SECURITY ALARM
TELEMETRY FAILURE
BATTERY CHARGER SUPPLY FAULT
BATTERY CONDITION ALARM
SHIRE TANKS LEVEL TRANSMITTER FAULT
SHIRE TANK LEVEL TRANSMITTER 1 SELECTED DUTY ON
SHIRE TANK LEVEL TRANSMITTER 2 SELECTED DUTY ON
SHIRE TANK LEVEL TRANSMITTER ALTERNATE DUTY ON

DIGITAL OUTPUTS

SHIRE TANK LEVEL TRANSMITTER 1 SELECTED DUTY
SHIRE TANK LEVEL TRANSMITTER 2 SELECTED DUTY
SHIRE TANK LEVEL TRANSMITTER ALTERNATE DUTY

ANALOGUE INPUTS

SHIRE TANKS LEVEL
SHIRE TANK PS START SETPOINT
SHIRE TANK PS STOP SETPOINT

(20) PANEL METER SIGNALS

ANALOGUE INPUTS

SHIRE TANKS LEVEL

ANALOGUE OUTPUTS

SHIRE TANK PS START SETPOINT
SHIRE TANK PS STOP SETPOINT

(21) SWTICHROOM SECURITY

DIGITAL OUTPUTS

SWITCHROOM FIRE (THERMAL)
SWITCHROOM SECURITY (BREACH)
SWITCHROOM SECURITY (DISARM)

AERATOR 1 MOTOR FAULT RESET (MRRR)
AERATOR 2 RUN (CR)
AERATOR 2 MOTOR FAULT RESET (MRRR)

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
810						

DESIGN SURVEY NONE | VERTICAL DATUM NONE | DES CALC | NORTH POINT
ASCON SURVEY NONE | COORDINATE SYS NONE | DES CHD
DES REF | DRN | Q.C. CHD

SAMPLE ONLY
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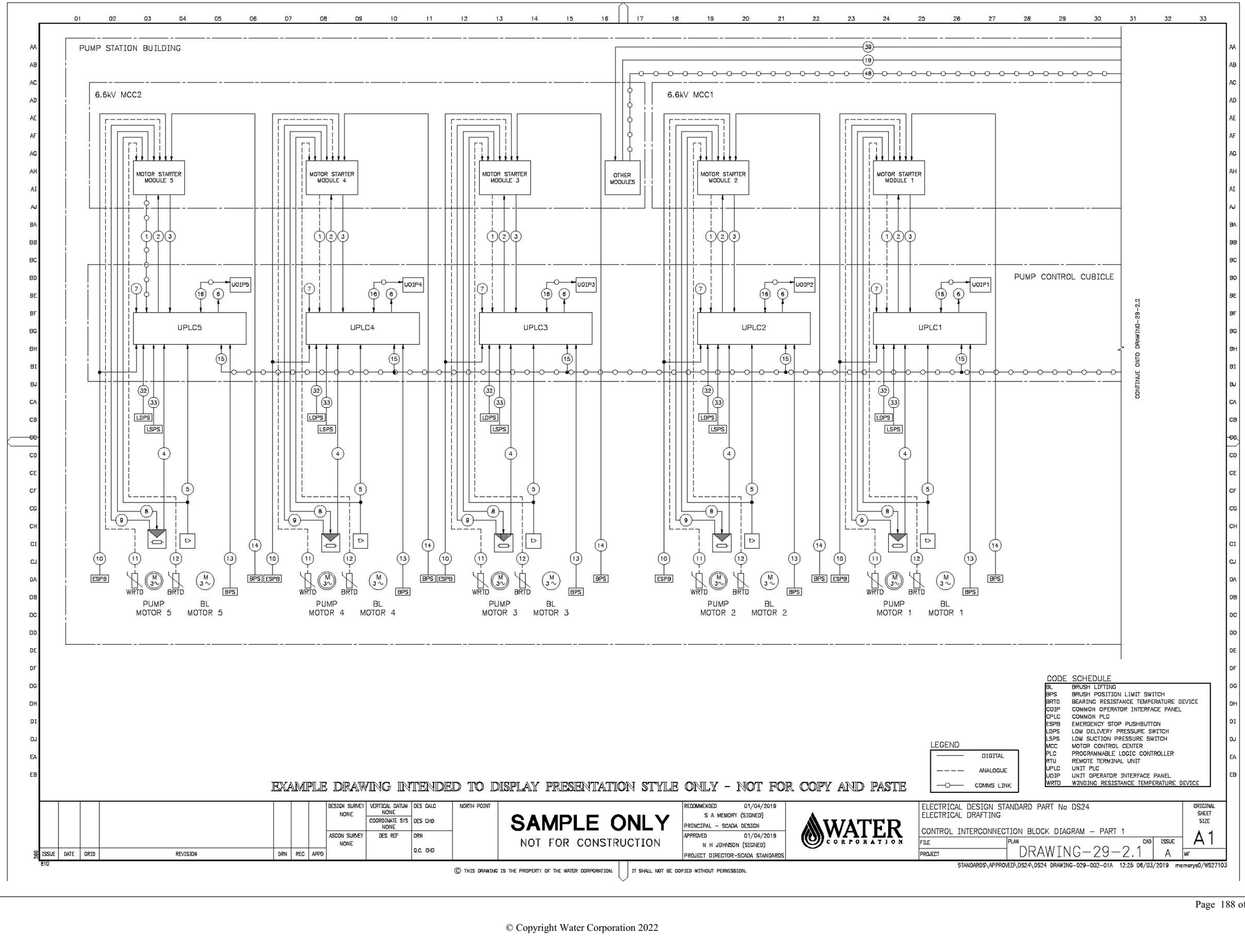
RECOMMENDED 01/04/2019 S A MEMORY (SIGNED) PRINCIPAL – SCADA DESIGN
APPROVED 01/04/2019 N H JOHNSON (SIGNED) PROJECT DIRECTOR–SCADA STANDARDS

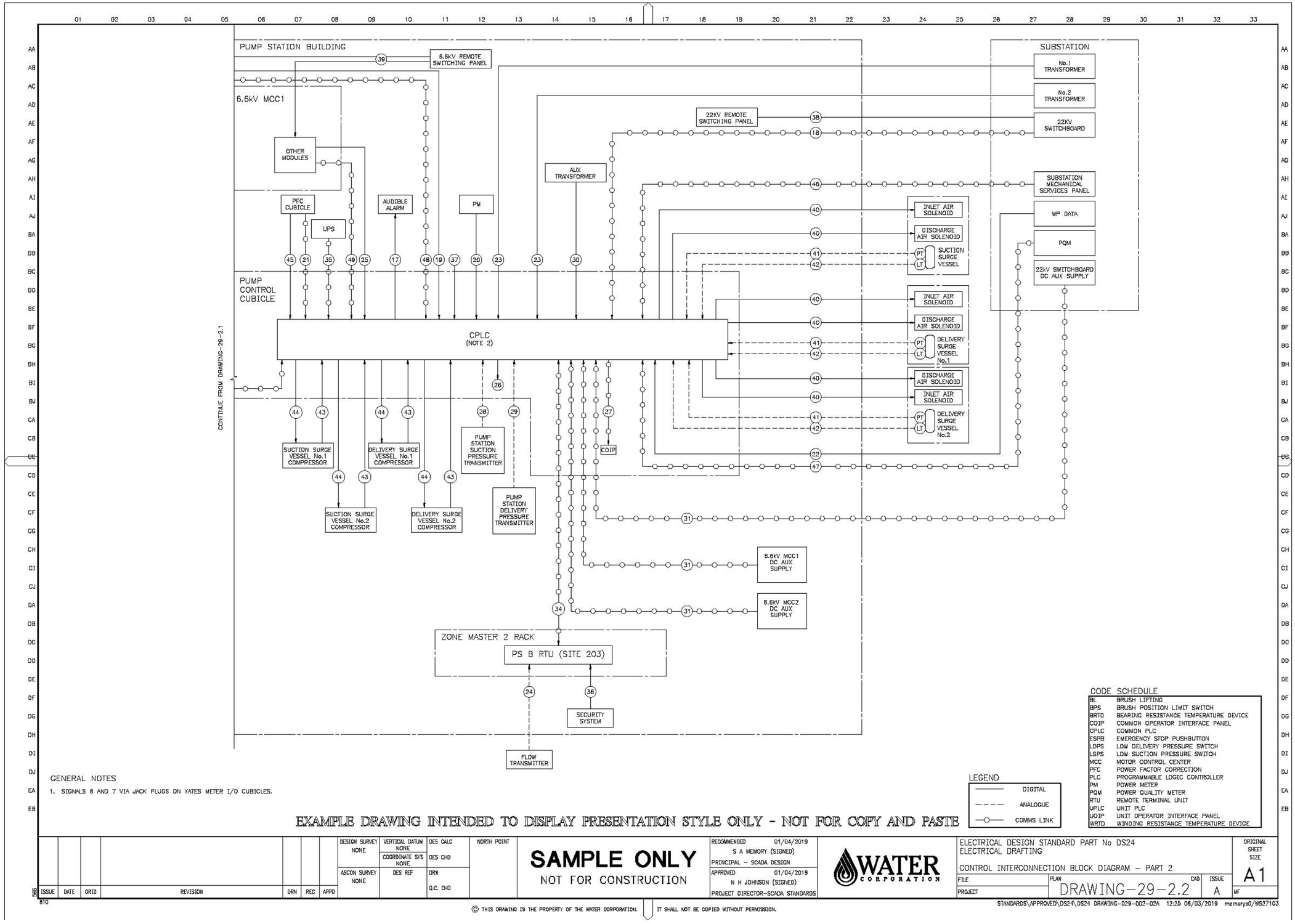
WATER CORPORATION

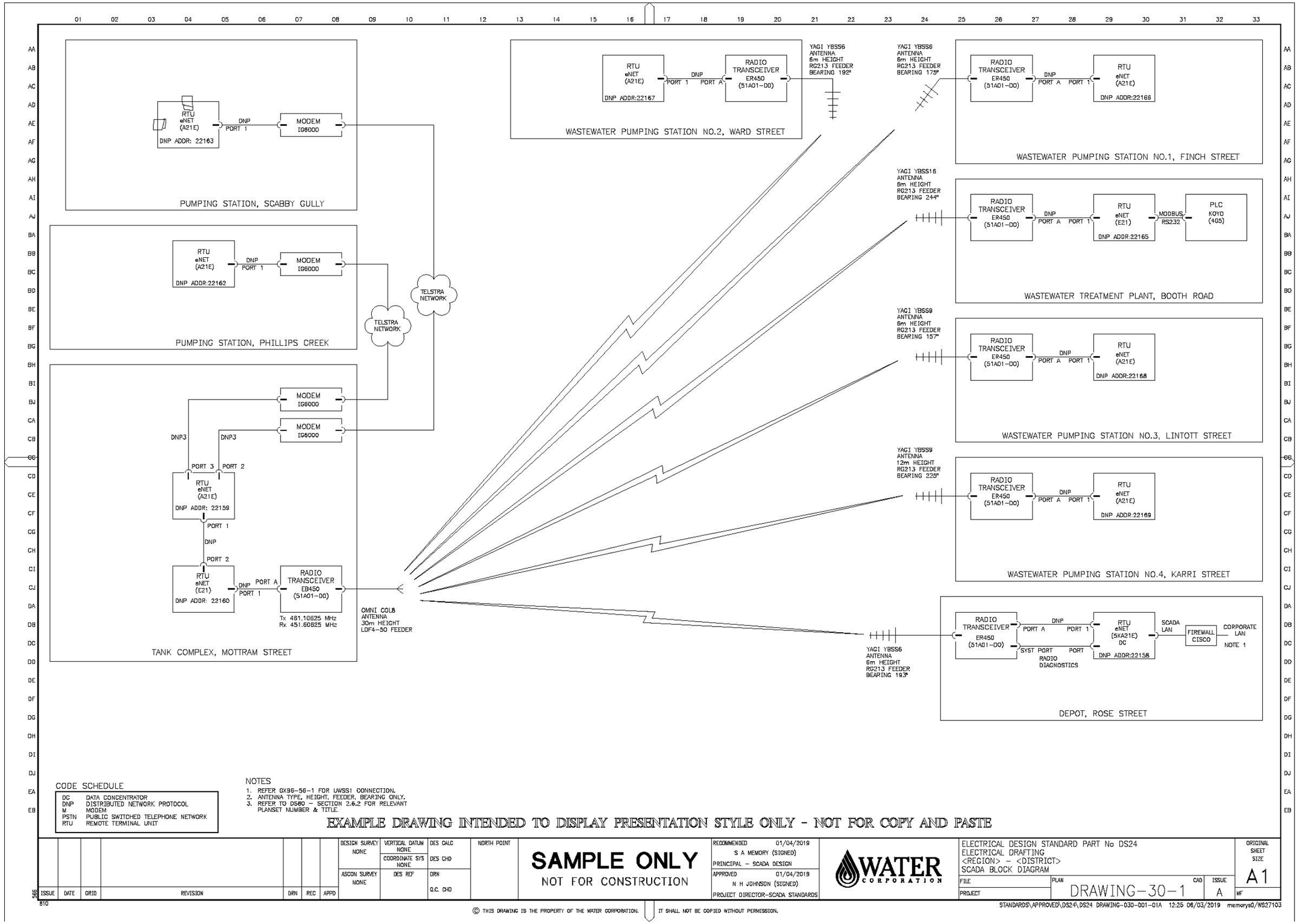
ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
CONTROL INTERCONNECTION BLOCK DIAGRAM – PART 2

FILE | PLAN CAD | ISSUE | ORIGINAL SHEET SIZE
PROJECT | DRAWING–29–1.2 | A | A1
MF

STANDARDS\APPROVED\DS24\DS24 DRAWING–029–001–02A 12:25 06/03/2019 memorys0/WS27103







CODE SCHEDULE

DC	DATA CONCENTRATOR
DNP	DISTRIBUTED NETWORK PROTOCOL
M	MODEM
PSTN	PUBLIC SWITCHED TELEPHONE NETWORK
RTU	REMOTE TERMINAL UNIT

NOTES
1. REFER GX98-56-1 FOR UWSS1 CONNECTION.
2. ANTENNA TYPE, HEIGHT, FEEDER, BEARING ONLY.
3. REFER TO DS80 – SECTION 2.6.2 FOR RELEVANT PLANSET NUMBER & TITLE.

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD

DESIGN SURVEY NONE	VERTICAL DATUM NONE	DES CALC
	COORDINATE SYS NONE	DES CHD
ASCON SURVEY NONE	DES REF	DRN
		Q.C. CHD

NORTH POINT

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N H JOHNSON (SIGNED)
PROJECT DIRECTOR-SCADA STANDARDS

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
<REGION> – <DISTRICT>
SCADA BLOCK DIAGRAM

ORIGINAL SHEET SIZE A1

FILE
PROJECT
PLAN DRAWING-30-1
CAD
ISSUE A
MF

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RADIO

SITE NAME (LOCAL SITE)	ADJACENT SITE (REPEATER RADIO /LINK RADIO)	RADIO LICENCE TYPE/ OPERATING MODE	RADIO LICENCE NUMBER	Tx FREQUENCY (MHz)	Rx FREQUENCY (MHz)	BEARING (deg)	DISTANCE (km)	ANTENNA HEIGHT (m)	ANTENNA GAIN (dBi)	RADIO POWER OUTPUT (dBm)	EXPECTED RSL LOCAL SITE (dBm) (SEE NOTE 1)	EXPECTED RSL ADJACENT SITE (dBm) (SEE NOTE 1)	RECEIVER SENSITIVITY FOR BER OF1.0EE-6 (dBm)	FADE MARGIN LOCAL SITE (dB)	FADE MARGIN ADJACENT SITE (dB)	FEEDER SPECIFICATION	FEEDER LENGTH (m)	ANTENNA SPECIFICATION
EXAMPLE FOR RADIO SITES (BASE RADIO)																		
TANK COMPLEX, MOTTRAM STREET	VARIOUS	PT TO MULTI-PT (V,PT)	1145111	461.10625	451.60625	N/A	N/A	30	6	30	N/A	N/A	-110	N/A	N/A	LDF4-50	40	RFI COLB
EXAMPLE FOR RADIO SITES (OUTSTATION RADIO)																		
WWPS NO 1, FINCH STREET	TANK COMPLEX, MOTTRAM STREET	PT TO MULTI-PT (V,TOD)	1145111	451.60625	461.10625	175	2.38	6	9	30	-74	-74	-110	36	36	RG-213	6	RFI YBSS6-61

NEXT G

SITE NAME	ADJACENT SITE (NEXT G BASE STATION)	BEARING (deg)	ANTENNA HEIGHT (m)	ANTENNA GAIN (dBi)	ANTENNA SPECIFICATION (SEE NOTE 2)	FEEDER SPECIFICATION	FEEDER LENGTH (m)	EXPECTED RSCP (dBm) (SEE NOTE 1)
EXAMPLE FOR NEXT G SITES WITH YAGI ANTENNA								
Onslow Cane River	TELSTRA NEXT G ONSLOW	280	20	10	RFI YBS809-81	LDF4-50	30	-70
EXAMPLE FOR NEXT G SITES WITH OMNI-DIRECTIONAL ANTENNA								
Warren Rd WWPS	TELSTRA NEXT G MT O'BRIEN / CADOUX NORTH	N/A	2	3	MAXON CJLA30-BD170	N/A	N/A	-75

CODE SCHEDULE

BER	BIT ERROR RATE
PT TO MULTI-PT (V,PT)	POINT TO MULTI-POINT LICENSE, VERTICALLY POLARISED ANTENNA, RADIO PERMANENTLY TRANSMITTING
PT TO MULTI-PT (V,TOD)	POINT TO MULTI-POINT LICENSE, VERTICALLY POLARISED ANTENNA, RADIO TRANSMITS ON DATA
PT TO PT (V,PT)	POINT TO POINT LICENSE, VERTICALLY POLARISED ANTENNA, RADIO PERMANENTLY TRANSMITTING
PT TO PT (V,TOD)	POINT TO POINT LICENSE, VERTICALLY POLARISED ANTENNA, RADIO TRANSMITS ON DATA
PT TO PT (H,PT)	POINT TO POINT LICENSE, HORIZONTALLY POLARISED ANTENNA, RADIO PERMANENTLY TRANSMITTING
PT TO PT (H,TOD)	POINT TO POINT LICENSE, HORIZONTALLY POLARISED ANTENNA, RADIO TRANSMITS ON DATA
RSCP	RECEIVE SIGNAL CODE POWER
RSL	RECEIVE SIGNAL LEVEL

NOTES
1. THE EXPECTED RSL AND RSCP VALUES ARE DESIGN VALUES. FOLLOWING COMMISSIONING, THE EXPECTED RSL VALUES SHALL BE REPLACED WITH RECORDED VALUES.
2. NEXT G ANTENNA WILL ALWAYS BE VERTICALLY POLARISED.

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	DRID	REVISION	DRN	REC	APPD
81G						

DESIGN SURVEY NONE | VERTICAL DATUM NONE | COORDINATE SYS NONE | ASCON SURVEY NONE | DES REF | DES CALC | DES CHD | DRN | Q.C. CHD | NORTH POINT

SAMPLE ONLY
NOT FOR CONSTRUCTION

RECOMMENDED 01/04/2019
S A MEMORY (SIGNED)
PRINCIPAL – SCADA DESIGN
APPROVED 01/04/2019
N H JOHNSON (SIGNED)
PROJECT DIRECTOR-SCADA STANDARDS

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
<REGION> – <DISTRICT>
COMMUNICATIONS DETAILS

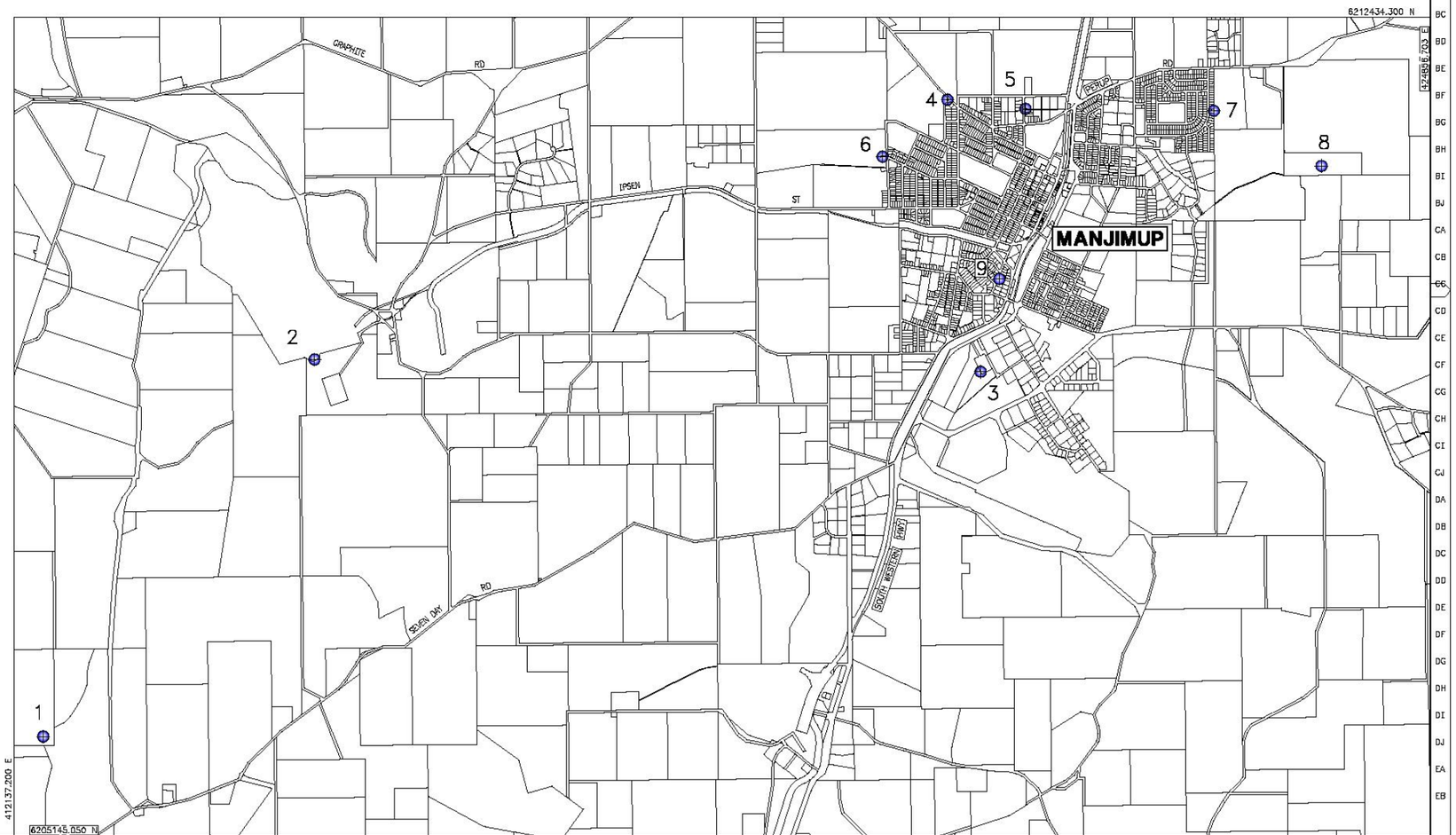
FILE | PLAN DRAWING-30-2 | CAD | ISSUE A | PROJECT | MF

ORIGINAL SHEET SIZE A1

STANDARDS\APPROVED\DS24\DS24 DRAWING-030-002-01A 12:25 06/03/2019 memorys0/WS27103

SITE NO.	SITE NAME	FUNCTIONAL LOCATION	SITE DRAWING PLANSET	EASTING	NORTHING
1	Pumping Station, Scabby Gully	W0046056	43218	412402.229	6206029.449
2	Pumping Station, Phillips Creek	W0046052	46573/28173	414838.543	6209386.473
3	Tank Complex, Mottram Street		-	420820.512	6209276.556
4	Wastewater Pumping Station No1, Finch Street Manjimup	S0044877	52509	420521.199	6211698.044
5	Wastewater Pumping Station No2, Ward Street Manjimup	S0044893	BB52	421222.562	6211616.81
6	Wastewater Pumping Station No3, Lintott Street Manjimup	S0044887	AG27	419938.173	6211191.091
7	Wastewater Pumping Station No4, Karri Street Manjimup	S0044882	EW55/51568	422913.407	6211599.463
8	Wastewater Treatment Plant, Booth Rd Manjimup	S092-001-003	ED06	423879.111	6211109.507
9	Depot, Rose Street	-	-	420988.867	6210103.937

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE



ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
810						

DESIGN SURVEY NONE | VERTICAL DATUM NONE | DES CALC
COORDINATE SYS MGA94-50 | DES CHD
ASCON SURVEY NONE | DES REF | DRN | Q.C. CHD

NORTH POINT

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RECOMMENDED 01/04/2019
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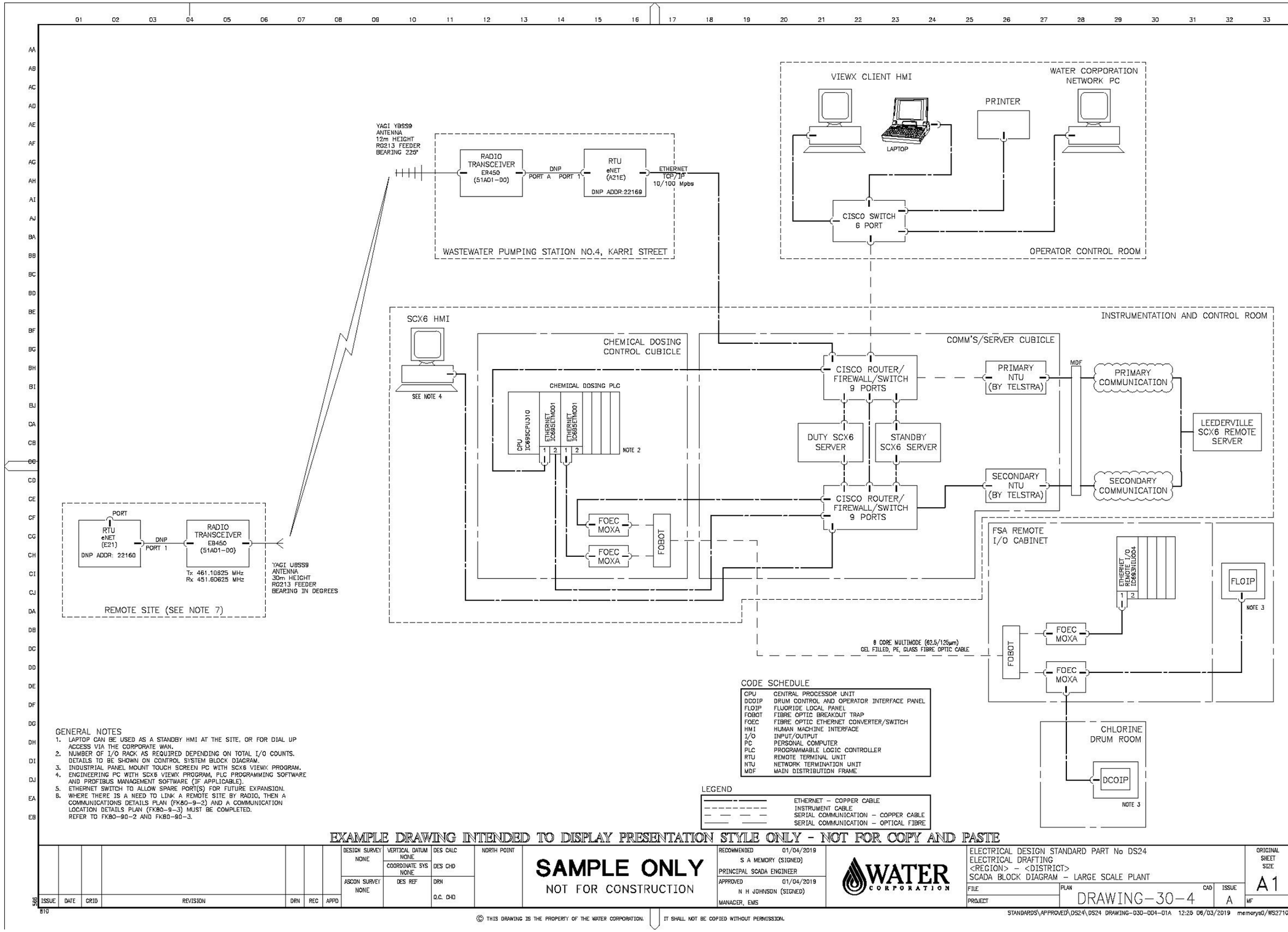
PRINCIPAL – SCADA DESIGN
APPROVED 01/04/2019
N H JOHNSON (SIGNED)
PROJECT DIRECTOR–SCADA STANDARDS

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
<REGION> – <DISTRICT>
COMMUNICATIONS LOCATION PLAN

FILE | PLAN DRAWING-30-3 | CAD | ISSUE A | ORIGINAL SHEET SIZE A1
PROJECT | MF

STANDARDS\APPROVED\DS24\DS24 DRAWING-030-003-01A 12:25 06/03/2019 memarys0/WS27103



CODE SCHEDULE

CPU	CENTRAL PROCESSOR UNIT
DCOIP	DRUM CONTROL AND OPERATOR INTERFACE PANEL
FLOIP	FLUORIDE LOCAL PANEL
FOBOT	FIBRE OPTIC BREAKOUT TRAP
FOEC	FIBRE OPTIC ETHERNET CONVERTER/SWITCH
HMI	HUMAN MACHINE INTERFACE
I/O	INPUT/OUTPUT
PC	PERSONAL COMPUTER
PLC	PROGRAMMABLE LOGIC CONTROLLER
RTU	REMOTE TERMINAL UNIT
NTU	NETWORK TERMINATION UNIT
MDF	MAIN DISTRIBUTION FRAME

LEGEND

- ETHERNET – COPPER CABLE
- INSTRUMENT CABLE
- SERIAL COMMUNICATION – COPPER CABLE
- SERIAL COMMUNICATION – OPTICAL FIBRE

GENERAL NOTES

1. LAPTOP CAN BE USED AS A STANDBY HMI AT THE SITE, OR FOR DIAL UP ACCESS VIA THE CORPORATE WAN.
2. NUMBER OF I/O RACK AS REQUIRED DEPENDING ON TOTAL I/O COUNTS. DETAILS TO BE SHOWN ON CONTROL SYSTEM BLOCK DIAGRAM.
3. INDUSTRIAL PANEL MOUNT TOUCH SCREEN PC WITH SCX6 VIEWX PROGRAM.
4. ENGINEERING PC WITH SCX6 VIEWX PROGRAM, PLC PROGRAMMING SOFTWARE AND PROFIBUS MANAGEMENT SOFTWARE (IF APPLICABLE).
5. ETHERNET SWITCH TO ALLOW SPARE PORT(S) FOR FUTURE EXPANSION.
6. WHERE THERE IS A NEED TO LINK A REMOTE SITE BY RADIO, THEN A COMMUNICATIONS DETAILS PLAN (FKB0-9-2) AND A COMMUNICATION LOCATION DETAILS PLAN (FKB0-9-3) MUST BE COMPLETED. REFER TO FKB0-90-2 AND FKB0-90-3.

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ISSUE	DATE	CRID	REVISION	DRN	REC	APPD

DESIGN SURVEY NONE | VERTICAL DATUM NONE | COORDINATE SYS NONE | DES CALC | DES CHD | DRN | D.C. CHD | NORTH POINT

ASCON SURVEY NONE | DES REF

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RECOMMENDED 01/04/2019 S A MEMORY (SIGNED) PRINCIPAL SCADA ENGINEER

APPROVED 01/04/2019 N H JOHNSON (SIGNED) MANAGER, EMS

WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
<REGION> – <DISTRICT>
SCADA BLOCK DIAGRAM – LARGE SCALE PLANT

FILE | PLAN DRAWING-30-4 | CAD | ISSUE A | ORIGINAL SHEET SIZE A1 | PROJECT | MF

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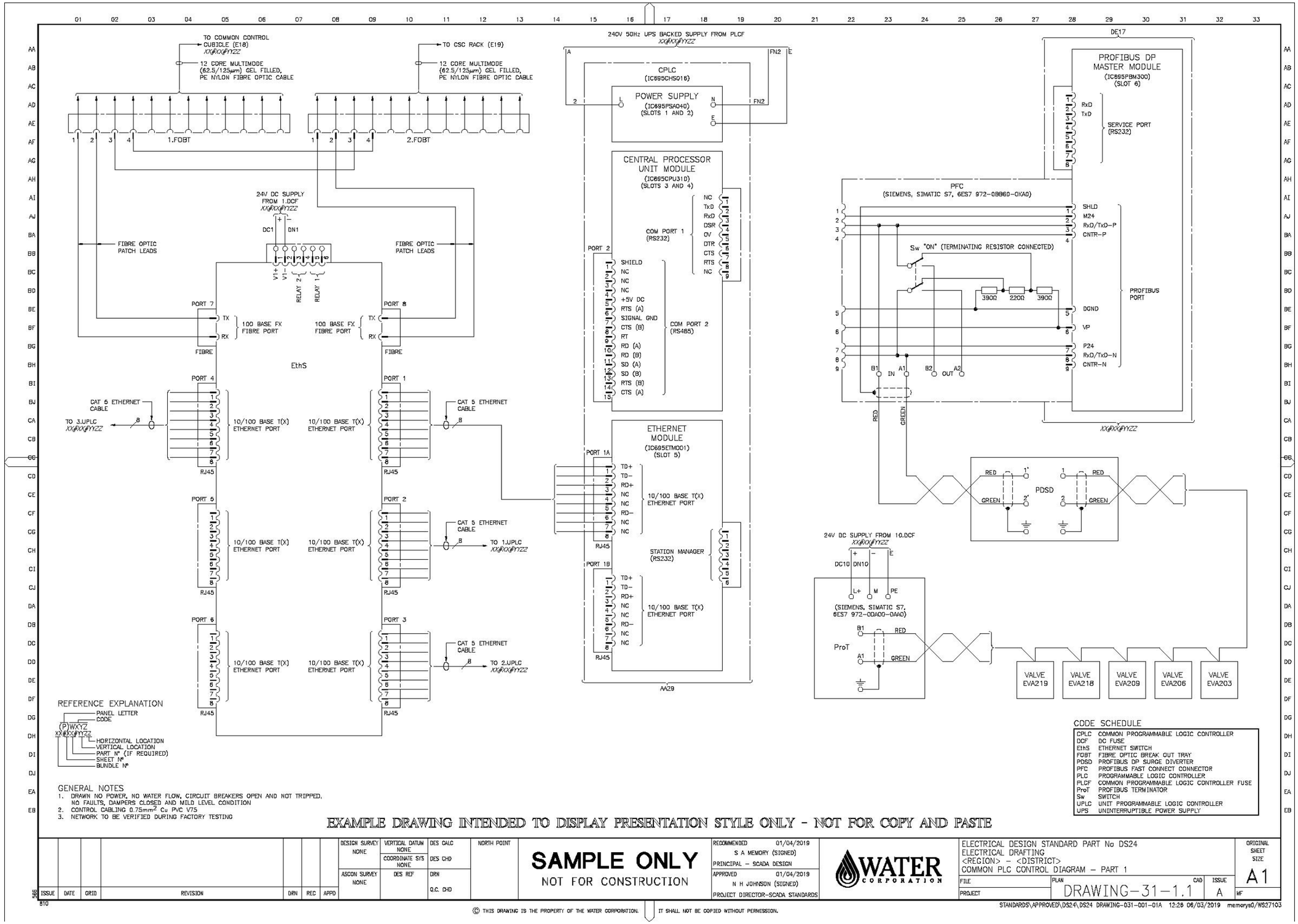

CODE SCHEDULE

CPLC	COMMON PROGRAMMABLE LOGIC CONTROLLER
DCF	DC FUSE
EthS	ETHERNET SWITCH
FOBT	FIBRE OPTIC BREAK OUT TRAY
PDSD	PROFIBUS DP SURGE DIVERTER
PFC	PROFIBUS FAST CONNECT CONNECTOR
PLC	PROGRAMMABLE LOGIC CONTROLLER
PLCF	COMMON PROGRAMMABLE LOGIC CONTROLLER FUSE
ProT	PROFIBUS TERMINATOR
Sw	SWITCH
UPLC	UNIT PROGRAMMABLE LOGIC CONTROLLER
UPS	UNINTERRUPTIBLE POWER SUPPLY

GENERAL NOTES
1. DRAWN NO POWER, NO WATER FLOW, CIRCUIT BREAKERS OPEN AND NOT TRIPPED, NO FAULTS, DAMPERS CLOSED AND MILD LEVEL CONDITION
2. CONTROL CABLING 0.75mm² Cu PVC V75
3. NETWORK TO BE VERIFIED DURING FACTORY TESTING

EXAMPLE DRAWING INTENDED TO DISPLAY PRESENTATION STYLE ONLY - NOT FOR COPY AND PASTE

ISSUE	DATE	GRID	REVISION	DRN	REC	APPD
810						

DESIGN SURVEY NONE	VERTICAL DATUM NONE	DES CALC	NORTH POINT
	COORDINATE SYS NONE	DES CHD	
ASCON SURVEY NONE	DES REF	DRN	
		Q.C. CHD	

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APPROVED 01/04/2019 N H JOHNSON (SIGNED) PROJECT DIRECTOR–SCADA STANDARDS

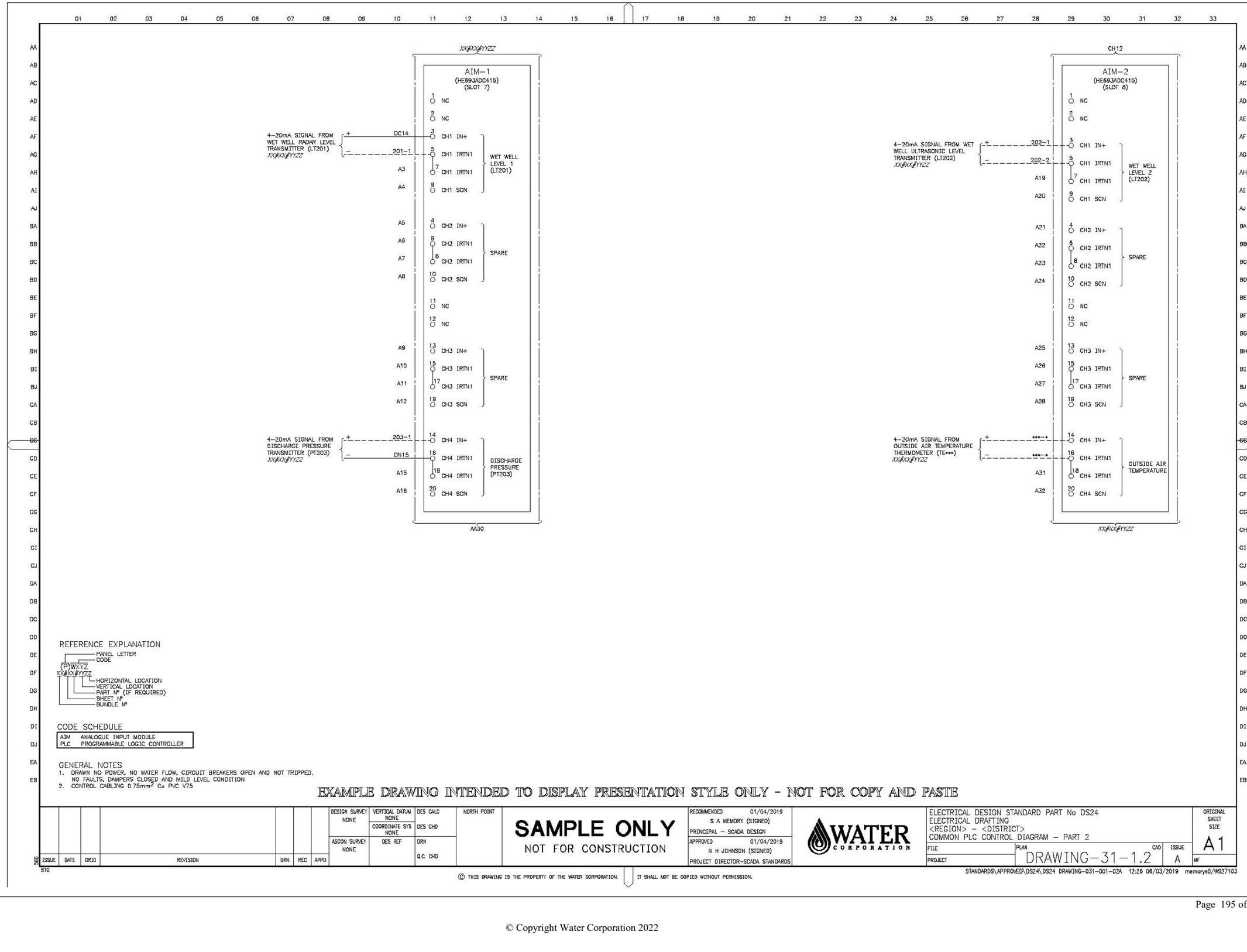
WATER CORPORATION

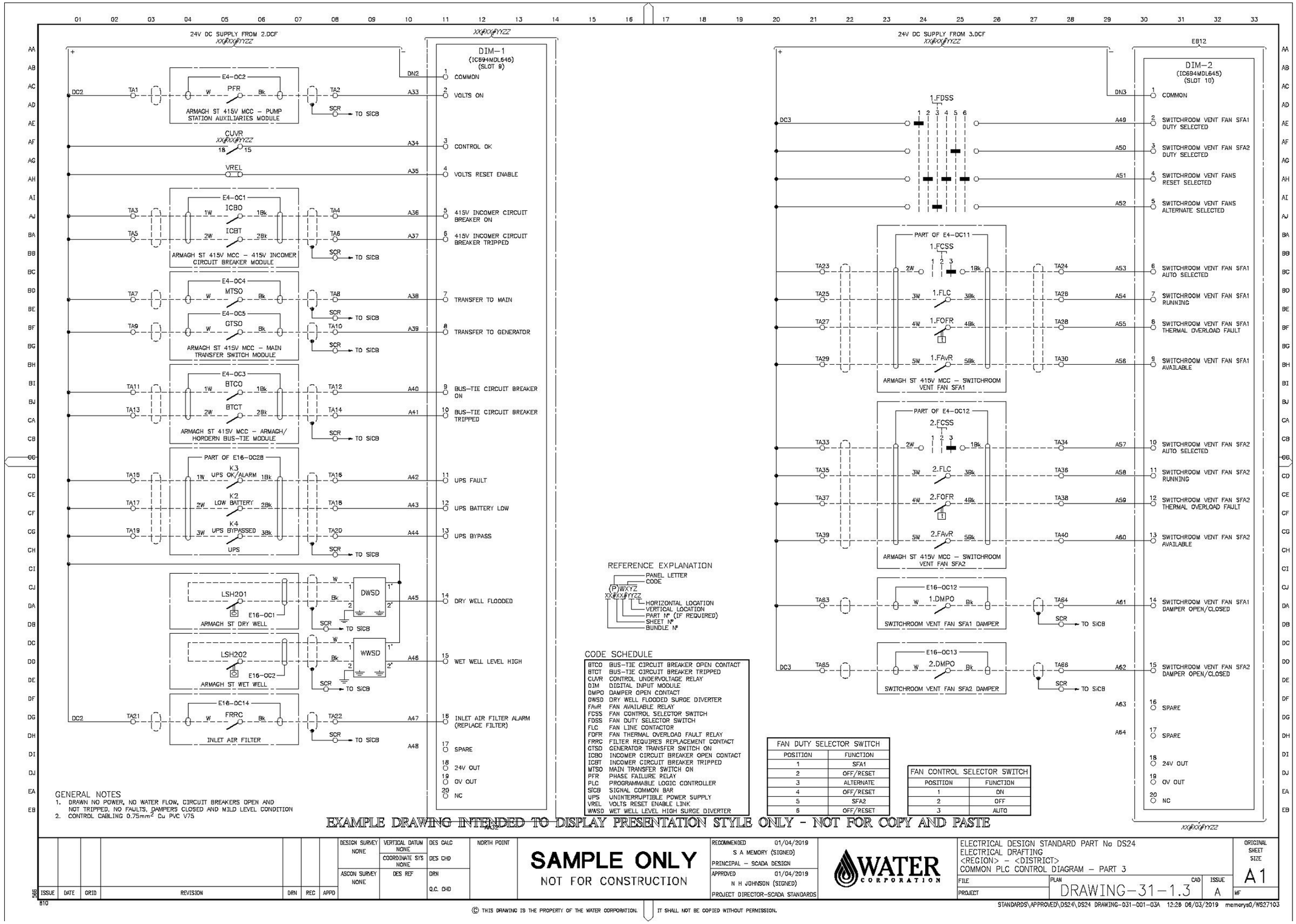
ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
<REGION> – <DISTRICT>
COMMON PLC CONTROL DIAGRAM – PART 1

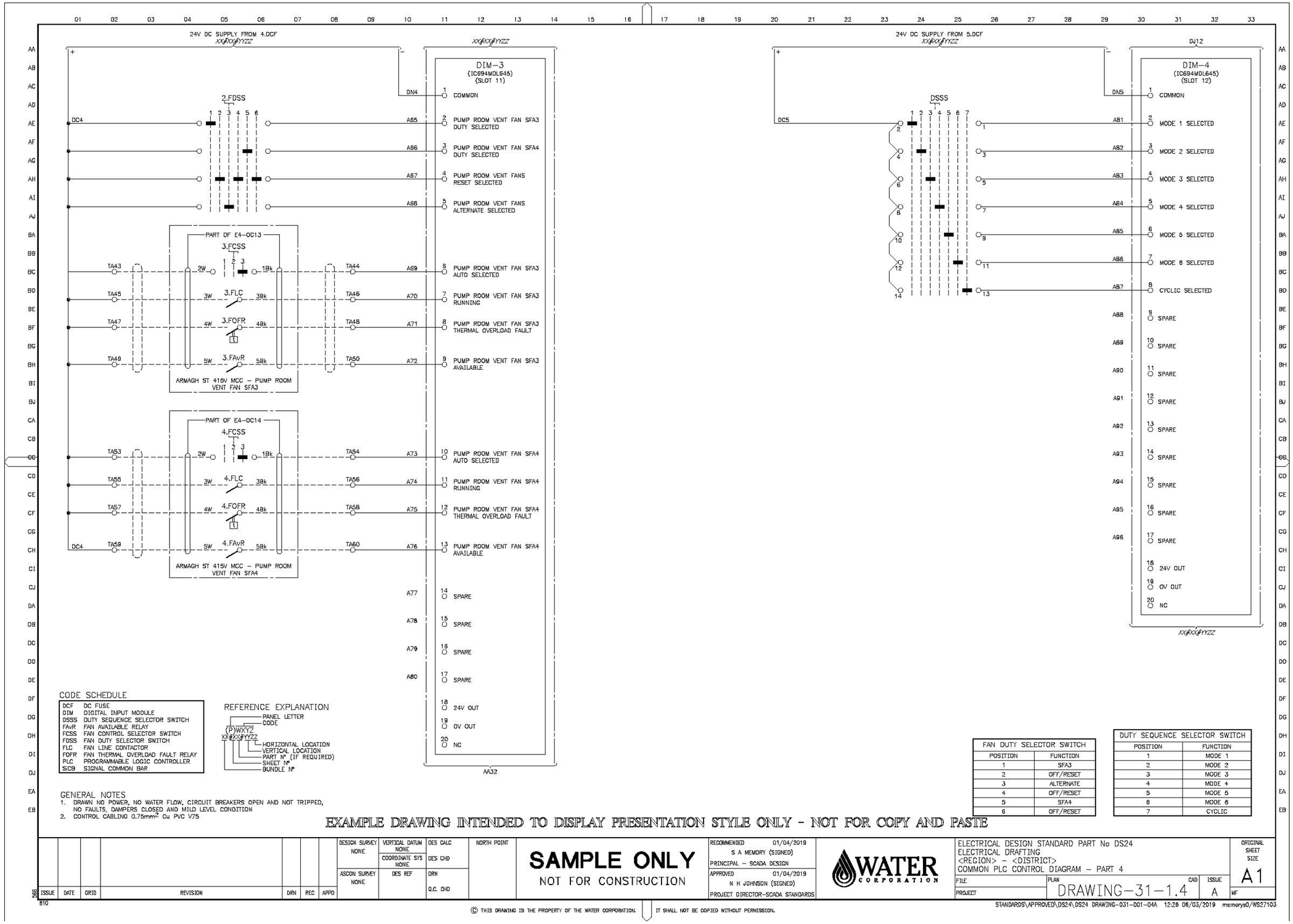
ORIGINAL SHEET SIZE A1

FILE | PLAN DRAWING–31–1.1 | CAD | ISSUE A | MF
PROJECT

STANDARDS\APPROVED\DS24\DS24 DRAWING–031–001–01A 12:28 06/03/2019 memorys0/WS27103







CODE SCHEDULE

DCF	DC FUSE
DIM	DIGITAL INPUT MODULE
DSSS	DUTY SEQUENCE SELECTOR SWITCH
FAvR	FAN AVAILABLE RELAY
FCSS	FAN CONTROL SELECTOR SWITCH
FDSS	FAN DUTY SELECTOR SWITCH
FLC	FAN LINE CONTACTOR
FOFR	FAN THERMAL OVERLOAD FAULT RELAY
PLC	PROGRAMMABLE LOGIC CONTROLLER
SICB	SIGNAL COMMON BAR

REFERENCE EXPLANATION

(P)WXYZ
XX#XX#YYZZ
- PANEL LETTER
- CODE
- HORIZONTAL LOCATION
- VERTICAL LOCATION
- PART Nº (IF REQUIRED)
- SHEET Nº
- BUNDLE Nº

GENERAL NOTES
1. DRAWN NO POWER, NO WATER FLOW, CIRCUIT BREAKERS OPEN AND NOT TRIPPED, NO FAULTS, DAMPERS CLOSED AND MILD LEVEL CONDITION
2. CONTROL CABLING 0.75mm² Cu PVC V75

FAN DUTY SELECTOR SWITCH

POSITION	FUNCTION
1	SFA3
2	OFF/RESET
3	ALTERNATE
4	OFF/RESET
5	SFA4
6	OFF/RESET

DUTY SEQUENCE SELECTOR SWITCH

POSITION	FUNCTION
1	MODE 1
2	MODE 2
3	MODE 3
4	MODE 4
5	MODE 5
6	MODE 6
7	CYCLIC

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ISSUE	DATE	GRID	REVISION	DRN	REC	APPD

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NORTH POINT

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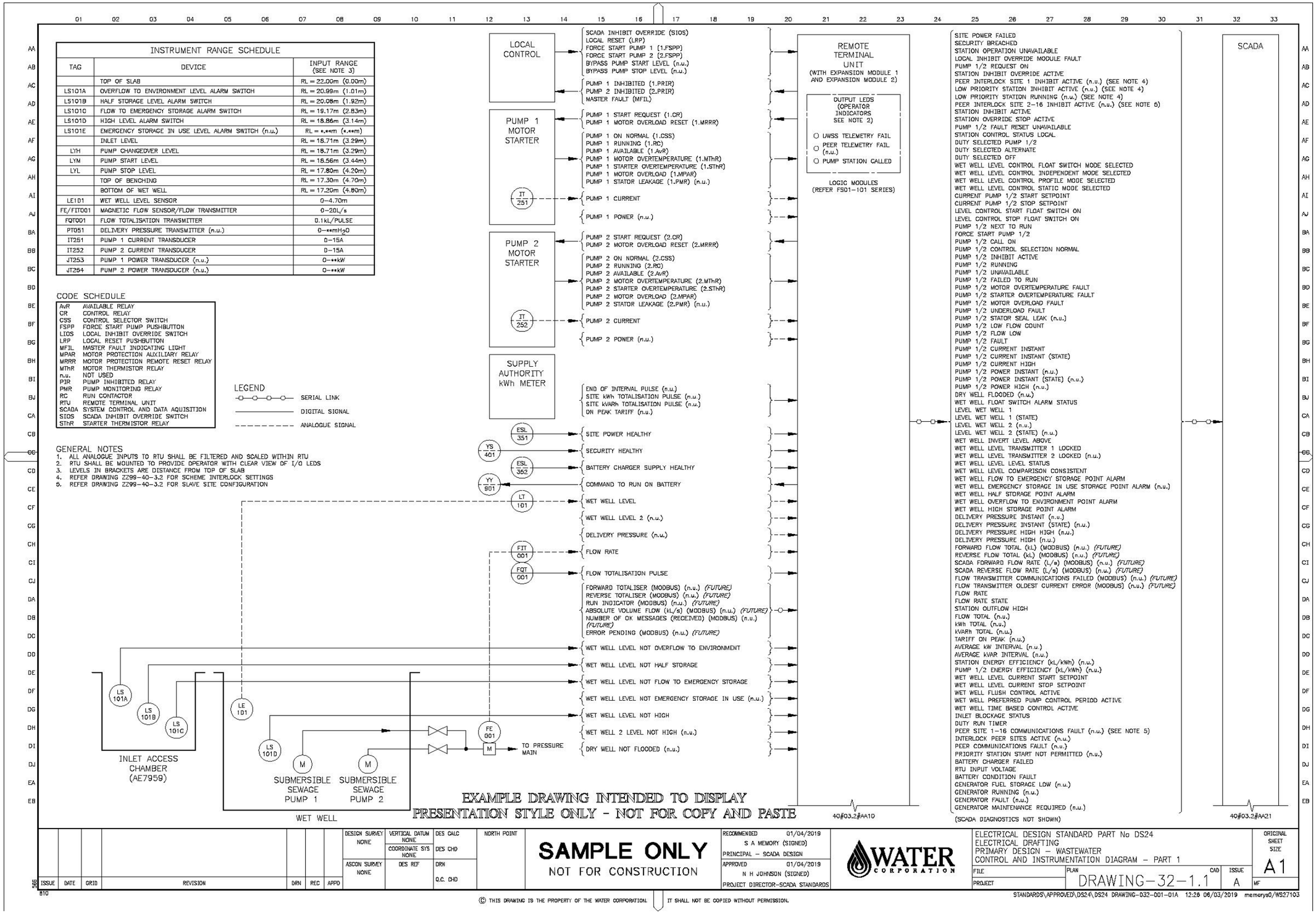
APPROVED 01/04/2019 N H JOHNSON (SIGNED) PROJECT DIRECTOR–SCADA STANDARDS

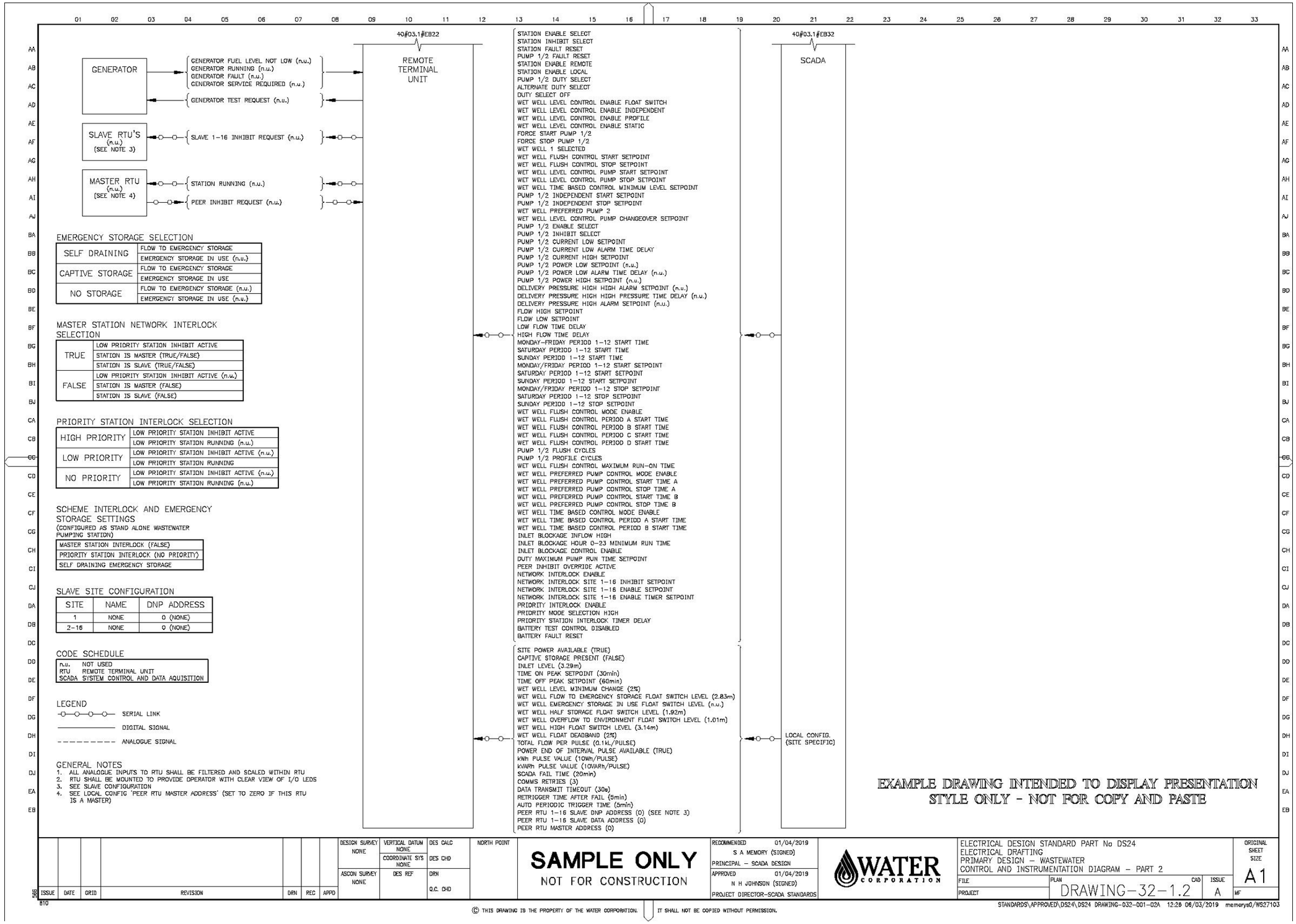
WATER CORPORATION

ELECTRICAL DESIGN STANDARD PART No DS24
ELECTRICAL DRAFTING
<REGION> – <DISTRICT>
COMMON PLC CONTROL DIAGRAM – PART 4

FILE | PROJECT | PLAN DRAWING–31–1.4 | CAD | ISSUE A | ORIGINAL SHEET SIZE A1 | MF

STANDARDS\APPROVED\DS24\DS24 DRAWING–031–001–04A 12:28 06/03/2019 memorys0/WS27103





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