

George Passmore
Director Business Performance
Queensland Competition Authority
Level 27, 145 Ann Street
Brisbane QLD 4000

12 September 2019

Dear George,

Aurizon Network Pty Ltd (Aurizon Network) – FY2018 Capital Expenditure Submission

On 31 October 2018 Aurizon Network Clause 2 of Schedule E of Aurizon Network's 2017 Access Undertaking (**UT5**) submitted its FY2018 Capital Expenditure Submission (**FY2018 Capex Claim**), a total of \$212.8 million (**m**) including Interest During Construction (**IDC**), to the Queensland Competition Authority (**QCA**) for approval into the Regulatory Asset Base (**RAB**).

As part of the QCA's assessment of Aurizon Network's FY2018 Capex Claim the QCA engaged AECOM to assess whether the costs attributable to the FY2018 Capex Claim were prudent and efficient in accordance with Clause 2 of Schedule E of UT5.

On 15 August 2019 the QCA notified Aurizon Network of its Draft Decision (**DD**) to not approve \$1.7m of Aurizon Networks FY2018 Capex Claim, primarily related to project IV.00154 FY17 Autotransformer Renewal Project, \$1.4m.

As per Clause 2.3(d)(ii) Schedule E of UT5, Aurizon Network may revise its capital expenditure and/or provide additional information supporting its view that the capital expenditure or revised amount should be included into the RAB, within 20 business days of being given a draft decision.

Aurizon Network seeks to clarify its view that the capital expenditure associated with the Autotransformer Renewal Project, \$1.4m, should be approved by the QCA for inclusion into the RAB and accordingly provides this further submission.

Aurizon Network welcomes the opportunity to discuss any queries the QCA may have and can provide access to the relevant experts to discuss any of the points in this submission. Aurizon Network welcomes the opportunity to discuss with AECOM the information provided within this response.

If you have any questions in relation to this correspondence, please do not hesitate to contact Jenna Cameron on 07 3019 1123 or via email Jenna.Cameron@Aurizon.com.au

Yours sincerely,



Jon Windle
Manager Regulation
Aurizon Network

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2019
Response to Draft Decision
FY18 Capital Expenditure
Claim

Aurizon Network

Response to QCA Draft Decision

IV.00154 - Autotransformer Renewal Project

The QCA Draft Decision (**DD**) is to reject the full \$1.4m of capital expenditure related to the Autotransformer Renewals due to the following:

- Insufficient documentation levels to support the claim;
- Application of a non-mandatory code; and
- The risk assessment not being completed in light of a non-mandatory code.

Aurizon Network believes that the outcome reached in the QCA's DD to deduct the full \$1.4m for the Autotransformer Renewal program in FY18 is unreasonable. Aurizon Network believes that to resolve the rejected capital through additional documentation and unwarranted additional capital expenditure to comply with a non-mandatory Australian Standard, would not materially reduce risk and would result in imprudent capital expenditure.

Further, if this requirement was to be implemented across the complete Autotransformer Renewal Program, it would result in an additional \$8.16m of costs added to the Electric Traction Access Charge (**AT5**), which Aurizon Network has been developing solutions for to address the asset stranding and bypass risk associated within the Electric Traction network. If finalised in its current form, this DD outcome goes against the overall objective of prompting efficient capital expenditure which will promote increased utilisation of the electrical infrastructure.

The QCA Draft Decision (DD) also advises QCA;

*"...Aurizon Network did not provide documentation, beyond verbal confirmation and photographs necessary for AECOM to verify correct connection of oil containment bunds to the earth grid, in accordance with safety standards."*¹

Aurizon Network concludes that the earthing will not impact the extremely low risk associated with these sites, however it will address this item. Aurizon Network intends to complete the connection of the steel reinforcing within the new oil containment bunds to the existing earth grid (estimated at \$10k per site) in a future year and intend to include these associate costs within a future Capex Claim. Aurizon Network will include the earthing for all future renewal sites into the forward-looking autotransformer renewal program. Refer to Appendix C for Aurizon Networks proposed bund wall earth connection arrangement.

Documentation Levels

The QCA stated in its Draft Decision to Aurizon Networks FY2018 Capex Claim:

*"We do not intend to approve any of Aurizon Network's capital expenditure claim of \$1,437,366 for IV.00154 FY17 Autotransformer Renewal Project, given there is currently insufficient documentation to verify the prudence of standard of works, particularly around its assessment of fire and explosion risk."*²

Aurizon Network strongly disagrees that *"there is currently insufficient documentation to verify prudence of standard of works"* as Aurizon Network responded to all of AECOMs Requests for Information (**RFIs**)

¹ QCA Draft Decision of Aurizon Networks FY18 Capital Expenditure Claim, page 3

² Ibid

during its assessment of Aurizon Networks FY18 Capex Claim. A summary of AECOM RFIs and Aurizon Networks responses is detailed within Appendix A.

Aurizon Network considers that the appropriate documentation has been supplied to support the full \$1.4m including evidence to support Aurizon Network's risk tolerance for the given risk level for the Autotransformer sites.

Non-mandatory Code

In its DD, the QCA confirmed that the decision to meet the requirements of a non-mandatory code, rests with Aurizon Network:

*"We recognise there may be reasonable grounds for Aurizon Network to choose a standard of works different to non-mandatory industry standards, where appropriate enquiries on associated risks have been made."*³

Furthermore, AECOM confirmed that the firewalls were not required, however the documentation was not to their expected standards when it came to the level of information for the expected controls to manage the risk:

*We note that AECOM was 'generally satisfied that Aurizon [Network] has justified that fire walls are not required for these trackside [autotransformer] sites' but found 'a lack of documentary evidence to support that the risk mitigation controls are in place and proven to operate'.*⁴

Aurizon Network has provided within this response, Appendix C, detailed asset records prepared by Aurizon Network engineers which illustrate

- Evidence of surge arrestor installation at each of the 3 autotransformer sites (Balook, Dingo and Ambrose-Epala);
- Evidence of new fault locator commissioning checklists at the 3 autotransformer sites;
- Photographs of each of the 3 sites demonstrating the existence of surge arrestors.

Risk Assessments

AECOM recommended in its FY2018 Assessment Report (**Assessment Report**) that:

*"... a risk assessment is undertaken by Aurizon Network for each autotransformer site to determine the requirements for fire and explosion risk protection and then a decision be made on the prudence of standard."*⁵

Aurizon Network considered AECOMs recommendation to undertake another risk assessment and did complete one for (Balook, Dingo and Ambrose-Epala) in June 2019. The additional risk assessment again included assessment against the Standard AS2067:2016 Substations and high voltage installations exceeding 1 kV a.c. The summary outcomes of the risk assessment are detailed in Table 1 below:

³ Ibid

⁴ Ibid

⁵ AECOM, FY18 Capital Expenditure Claim, Assessment Report, page 28

Figure 1. Summary of risk scores listed within the June 2019 Risk Assessment

<u>Risks Identified</u>	<u>1st Score</u> <i>with existing controls</i>	<u>2nd Score</u> <i>assuming proposed controls implemented</i>
1. Catastrophic AT fault resulting in explosion and intense fire	5 - Moderate	5 - Moderate
2. Catastrophic AT fault causing infrastructure damage within the AT site which negatively impacts on operations	3 - Low	2 - Low
3. Catastrophic AT fault causing infrastructure damage external to the AT site which negatively impacts on operations	2 - Low	2 - Low
4. Voltage surge (e.g. lightning) causes catastrophic AT failure	3 - Low	3 - Low

For transparency for this submission a list of the additional proposed controls used for the secondary risk assessment is within Appendix B.

The results from the June 2019 Risk Assessment, clearly demonstrate that additional controls would not reduce the risk to personnel or infrastructure.

Overall, these results are appropriate given that all three June 2019 Risk Assessments concluded that:

- Aurizon Network has never experienced a catastrophic autotransformer explosion since the commencement of electrification in the CQCN.
- The autotransformer population in the CQCN has an estimated 6,300 years of accumulated operation.
- Personnel are only present trackside at an autotransformer site for approximately 0.03% of the year.

Therefore, Aurizon Network considers that installation of fire-resistant barriers at these sites would be imprudent expenditure given the low-level risk scores and therefore not in the best interest of its customers.

Aurizon Network would encourage the QCA and AECOM to review anew the documentation provided during the assessment of Aurizon Networks FY2018 Capex Claim.

AT5

The costs that Access Holders would be likely to pay should Aurizon Network include the fire-resistant barriers in the Autotransformer Renewal Program is detailed below:

Estimated costs to install fire resistant barriers to autotransformers:

Firewall construction estimate:	\$120,000
Number of CQCN autotransformer sites:	65
Cost to install firewalls at the three FY18 renewal sites (Balook, Dingo and Ambrose-Epala):	$\$120,000 \times 3 = \$360,000$
Cost to install firewalls across the CQCN for all trackside autotransformer sites:	$\$120,000 \times 65 = \$7,800,000$
Total cost	$\\$120,000 \times 68 = \\$8,160,000$

As these costs are directly attributable to the electrical infrastructure, the costs would be subsequently included into the Electrical Infrastructure Access Charges (**AT5**).

Since 2011 on the provision of the first AT5 Draft Amending Access Undertaking (**AT5 DAAU**), Aurizon Network has clearly outlined the risks for the electrical infrastructure with any additional costs being included into AT5. These AT5 DAAU's have sought additional measures to protect the electrical infrastructure from bypass and stranding risk.

The inclusion of additional electrical infrastructure costs into AT5 through imprudent expenditure for additional firewalls for all CQCN sites, would add costs and exacerbate the economic problem for the electrical infrastructure.

Aurizon Network considers that the prudence and efficiency of investing to a higher, non-mandatory standard needs to be evaluated by the QCA having regard to the broader economic sustainability of the overhead power system.

In this regard, and in light of other initiatives being undertaken by Aurizon Network to optimise the costs of providing access to the overhead power system, including the 2019 Electric Traction Draft Amending Access Undertaking (**AT5 Charges**), it would not be prudent to install fire-resistant barriers at these sites.

Aurizon Network requests that the QCA and/or AECOM take into consideration this information and positions in making their final decision regarding approval of the FY2018 expenditure for IV.00154 Autotransformer Renewal Project.

Aurizon Network welcomes the opportunity to discuss with AECOM the information provided within this response.

Appendix A – Summary AEOM RFIs and Aurizon Network’s response / information provided

Summary of AECOM RFIs & responses / information provided by Aurizon Networks (AN)

Prudency of Scope (requested by AECOM)	Date AN provided	Prudency of Standard (requested by AECOM)	Date AN provided	Prudency of Cost (requested by AECOM)	Date AN provided	*Other RFIs from AECOM:	Date AN provided
Investment Approval Request	✓ 21/12/2018	As-built drawings	✓ 22/03/2019	Project Program	N/A	- Condition monitoring report from Transaudit	✓ 06/03/2019
Approved business case (growth only)	N/A	Design drawings	✓ 31/10/2018 (original harddrive) and 11/03/2019	Procurement Recommendation	✓ 22/03/2019	- Handover documentation (Site Report for each AT replaced)	✓ 22/03/2019
Project Feasibility Analysis (growth only)	N/A	Certificate of practical completion	✓ 25/03/2019	Tender recommendation or Exemption from Tendering docu	provided 'Concept Investment Approval Request', 22/03/2019 and 'Recommendation to award' 22/03/2019	- Lucy Harrington (AECOM) Sent email 20/03/2019 asking further queries. AN responded & provided info 22/03/2019	✓ 22/03/2019
Project Plan	✓ 31/10/2018 (original harddrive)	Signed-off inspection and test plans	✓ 25/03/2019	Evidence of previous claims	✓ Lucy Harrington (AECOM) advised via email 13/02/2019 that AN do not need to provide as AECOM have reviewed FY17 Capex Claim.	- Meeting held with AECOM, QCA & Aurizon 25.03.19 to close out outstanding RFIs. AN provided responses & info 25.03.19	✓ 25/03/2019
Project Completion Report	✓ 31/10/2018 (original harddrive)	RPEQ Certification	✓ 25/03/2019	Evidence of risk allocations / contingencies	✓ Lucy Harrington (AECOM) advised this can be closed due to providing IAR, 22/03/2019		
Detailed design report	✓ 11/03/2019	Photos of completed works	✓ 31/10/2018 (original harddrive) and 22/03/2019	Pre-tender estimate	✓ 8/03/2019		
Condition assessment report (renewal)	✓ 6/03/2019	Aurizon Standard Specification and drawi	✓ provided 'technical specification doc', 11/03/2019				
Asset Management Plan (renewal)	✓ 11/03/2019	Aurizon Policy Document	N/A				
Access Holder Request (growth only)	N/A	Post-implementation Review	N/A				
Evidence of customer approval (60% or more. Growth only)	N/A						



Fri 22/03/2019 4:25 PM

Cameron, Jenna (Network)

RE: Clarifications - Autotransformers IV.00154

To: 'Harrington, Lucy (Brisbane)'
Cc: Amar Doshi; Woodhead, Ian

Hi Lucy,

See comments below:

From: Harrington, Lucy (Brisbane) <Lucy.Harrington@aecom.com>
Sent: Wednesday, 20 March 2019 4:38 PM
To: Cameron, Jenna (Network) <Jenna.Cameron@aurizon.com.au>
Cc: Amar Doshi <amar.doshi@qca.org.au>; Woodhead, Ian <ian.woodhead@aecom.com>
Subject: Clarifications - Autotransformers IV.00154

Hi Jenna,

Thanks for all the data provided in the transmittal yesterday.

We have couple of clarifications on the information provided for the Autotransformer project yesterday, please:

1. From the photos provided of Balook AT1 and Epala AT1 (attached) it does not appear that bunds have been fitted to these ATs. Can Aurizon Network please confirm that oil containment bunds have been retrofitted at Balook AT1 and Epala AT1, and provide evidence of this (i.e. photos showing extent of the bund)? – [Epala bunding, Dingo AT photo showing bonding to earth grid and a earth grid layout for a TSC](#)



Ambrose-Epala, Dingo AT site
Bunding around...fence-earth grid...

2. Can Aurizon Network please advise why fire walls have not been installed between the control buildings and autotransformers for Balook, Epala and Dingo ATs? – [Discuss this on Monday](#)

3. Can Aurizon Network please confirm that the fence at Dingo Autotransformer Site is connected to the earth grid? – [Yes](#)



Earth grid layout
TSC site.pdf...

I'll update the RFI register with all of these requests/clarifications, just hoping to get them to you as early as we can.

Thanks so much,
Lucy

Lucy Harrington
Senior Consultant – Commercial Advisory
D +61 7 3553 3827
Lucy.Harrington@aecom.com

AECOM
Level 8, 540 Wickham Street, Fortitude Valley, QLD 4006



Mon 25/03/2019 4:02 PM

Cameron, Jenna (Network)

RE: Clarifications - Autotransformers IV.00154

To: 'Lucy.Harrington@aecom.com'; 'Woodhead, Ian'

Cc: 'Chris Peart'; 'amar.doshi@qca.org.au'; Jaganathan, Raj; Nussey, Peter (Network); Jamieson, Scott (Network)

Hi Lucy,

In response to the below query from AECOM:

"Can Aurizon Network please advise why fire walls have not been installed between the control buildings and autotransformers for Balook, Epala and Dingo ATs?"

As previously provided in response to a similar RFI during the FY16 Capex Claim Aurizon Network maintains their position that fire walls are not required at either of these 3 sites, please refer to the attached Site Explosion Risk Report and a letter from Aurizon Network dated 4th September 2017 to the QCA.



AT sites explosion risk_A.pdf 20170904 Capex Claim FY16 - Re...

Kind Regards,



Jenna Cameron

Senior Regulatory Analyst

T 07 3019 1123

M 0488 793 113

Level 4, 900 Ann Street, Fortitude Valley, Qld 4006
Jenna.Cameron@aurizon.com.au / aurizon.com.au



Safety is our core value

From: Harrington, Lucy (Brisbane) <Lucy.Harrington@aecom.com>
Sent: Wednesday, 20 March 2019 4:38 PM
To: Cameron, Jenna (Network) <Jenna.Cameron@aurizon.com.au>
Cc: Amar Doshi <amar.doshi@qca.org.au>; Woodhead, Ian <ian.woodhead@aecom.com>
Subject: Clarifications - Autotransformers IV.00154

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2. **Can Aurizon Network please advise why fire walls have not been installed between the control buildings and autotransformers for Balook, Epala and Dingo ATs?**
3. Can Aurizon Network please confirm that the fence at Dingo Autotransformer Site is connected to the earth grid?

I'll update the RFI register with all of these requests/clarifications, just hoping to get them to you as early as we can.

Thanks so much,
Lucy

Lucy Harrington
Senior Consultant – Commercial Advisory



Mon 25/03/2019 3:31 PM

Cameron, Jenna (Network)

IV.00154 - FY17 Autotransformer Renewal Project & IV.00384 OH Equipment Renewal FY18

To Lucy.Harrington@aecom.com; Woodhead, Ian

Cc Chris Peart; amar.doshi@qca.org.au; Jagannathan, Raj; Nussey, Peter (Network); Jamieson, Scott (Network)

Thank you all for your time today, please see attached information from this afternoons meeting.

IV.00154 - FY17 Autotransformer Renewal Project

- AECOM have requested an autotransformer condition report, from Transaudit portal, for the assets replaced as part of this project.

Transaudit info in transmittal 29.03.2019 - <https://aurizonholdings.sharepoint.com/f:/r/sites/fy18capexclaimv2/Shared%20Documents/10%20Transmittal%2029.03.2019?csf=1&e=3zIPV>

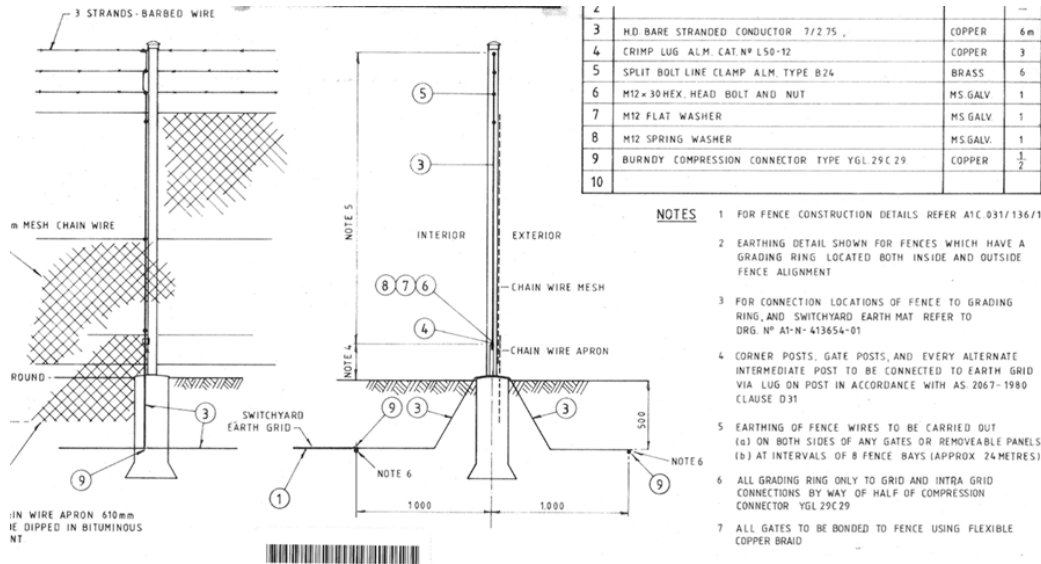
- From the photos provided of Balook AT1 and Epala AT1 (attached) it does not appear that bunds have been fitted to these ATs. Can Aurizon Network please confirm that oil containment bunds have been retrofitted at Balook AT1 and Epala AT1, and provide evidence of this (i.e. photos showing extent of the bund)?

RPEO signed off Civil Drawing for IV154:



5055.003 C01_1...

AT Bund photos in transmittal 29.03.2019 - <https://aurizonholdings.sharepoint.com/f:/r/sites/fy18capexclaimv2/Shared%20Documents/10%20Transmittal%2029.03.2019?csf=1&e=3zIPV>



IV.00384 OH Equipment Renewal FY18



JH_Renewal_Cond...
Report...

Kind Regards,



Jenna Cameron
Senior Regulatory Analyst
T 07 3019 1123
M 0488 793 113

Level 4, 900 Ann Street, Fortitude Valley, Qld 4006
Jenna.Cameron@aurizon.com.au / aurizon.com.au



Safety is our core value

Appendix B – Proposed risk controls from the June 2019 Risk assessment

The risk assessments listed the mitigation controls as:

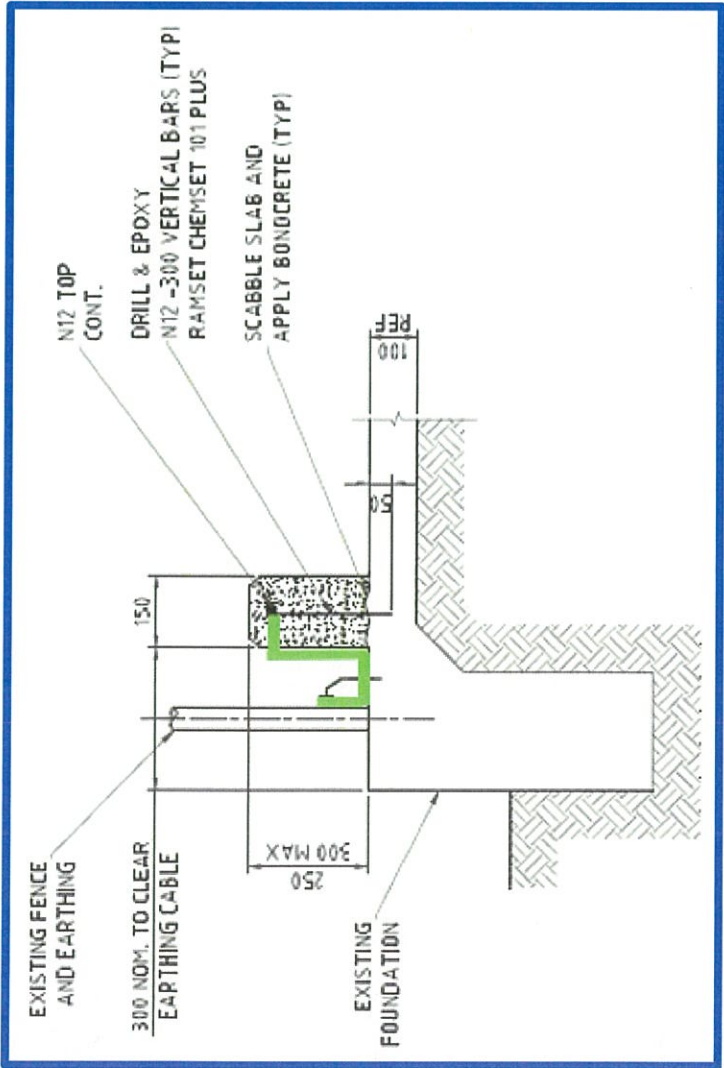
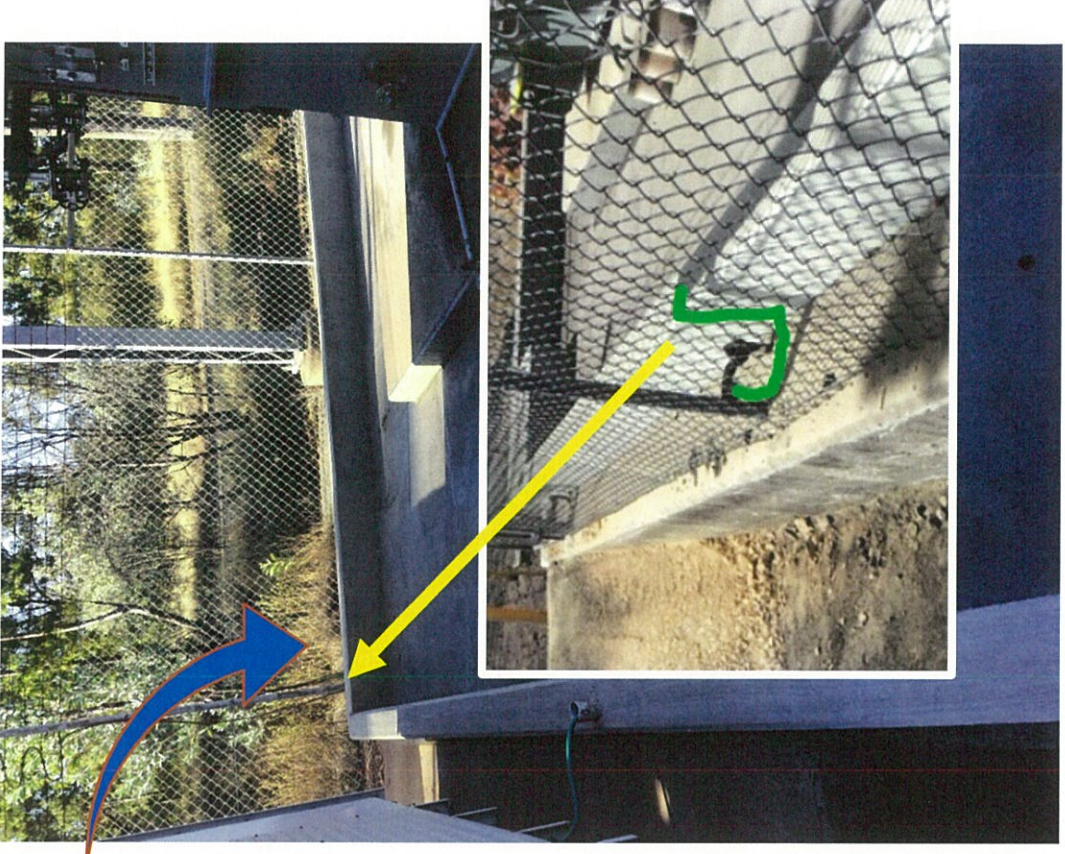
- Robust design (e.g. type test requirements in Spec includes 10 X short circuit tests)
- ECO Control room instruction
- Safe Working Method Statements
- ECOs and NPs are trained to ensure site staff move to a position of safety prior to energising a transformer
- Protective Personal Equipment
- Primary track feeder protection & secondary protection functions (e.g. Fault Locator)
- Oil bunding
- Emergency response procedures
- Remote location of site
- Lightning rods and surge arrestors on adjacent masts
- Redundancy of Auto Transformers

Appendix C – Asset Records

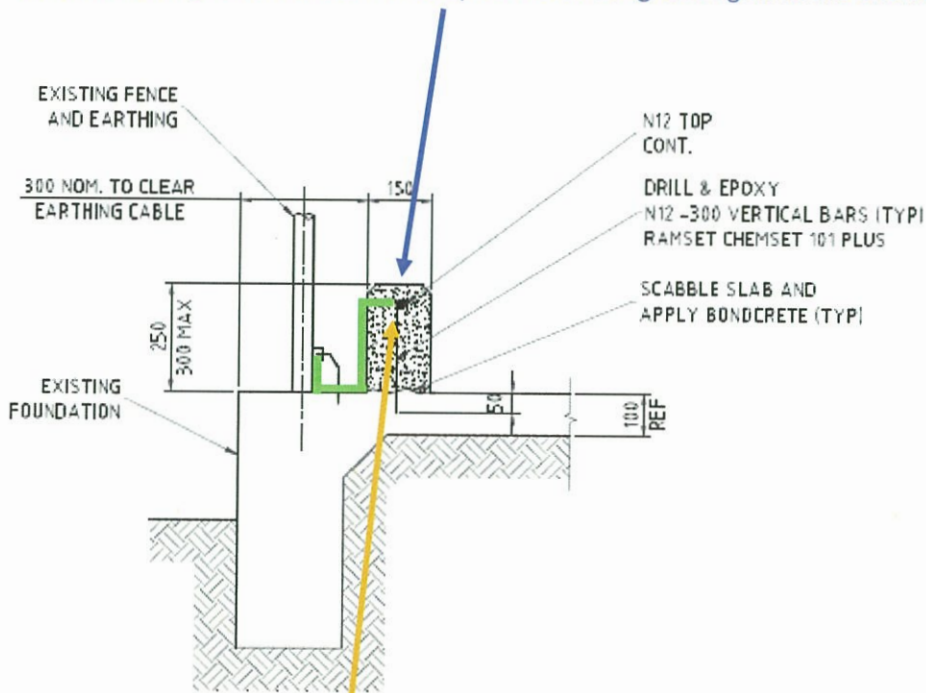
PROPOSED BUND WALL EARTH CONNECTION ARRANGEMENT

Renewed AT Site – Proposed Bund Wall Reinforcement Earthing

Install a suitable Earth Conductor between Bund Wall reinforcing and site Earth Grid.



Cut/chase top of bund wall and expose horizontal N12 reinforcing bar. Clean bar and weld earthing bond to reinforcing bar. Lug earth conductor end and bolt to flat earthing strap. Flat earthing strap to be Hilti fitted for low, safe profile on outside face of bund wall and across existing slab. Bond earth strap to the existing earth grid at the enclosure fence.



Earth Rods & Accessories

4

Protection & Earthing



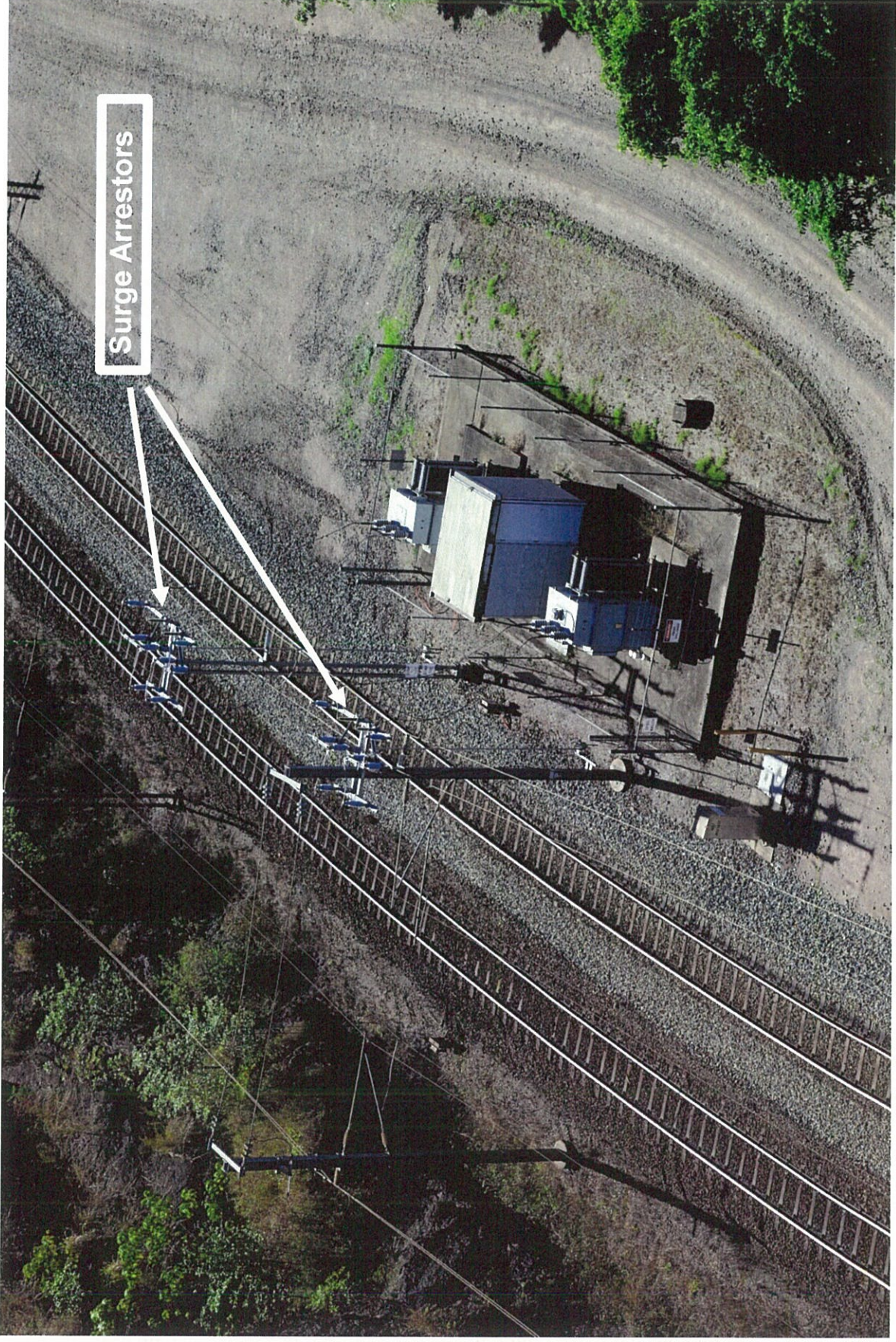
Earthing Bond For Commercial Earthing Installations

The earthing bond system provides an earth connection welded to the steel reinforcement, thus offering a virtually indestructible, stable and low resistance path to earth soil. Please enquire about other sizes available.

Part Number	Description
D-C70	Bonding Cable: 70mm ² 1 sec Short Current Rating: 5kA Weldable Lug Dia: 12mm Terminal Thread: M10 Thread Depth: 20mm Cable Length: 3m
D-C95	Bonding Cable: 95mm ² 1 sec Short Current Rating: 8kA Lug Dia: 16mm Terminal Thread: M10 Thread Depth: 20mm Cable Length: 3m
D-C120	Bonding Cable: 120mm ² 1 sec Short Current Rating: 10kA Lug Dia: 20mm Terminal Thread: M10 Thread Depth: 20mm Cable Length: 3m

FIREWALL RISK ASSESSMENT EVIDENCE OF SURGE ARRESTOR INSTALLATION AT THE 3 AT SITES

Typical AT Site – Surge Arrestors Highlighted

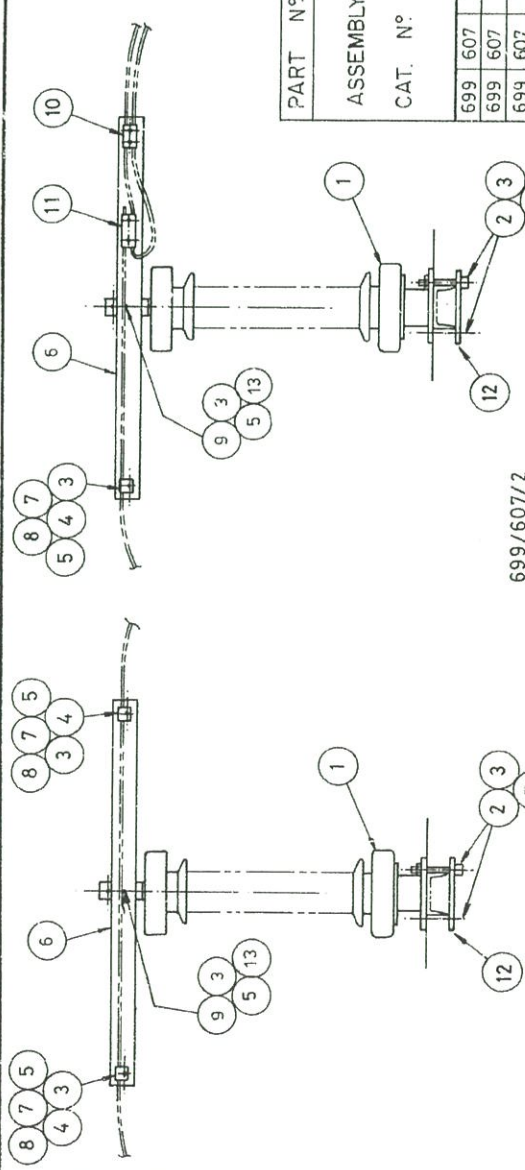


Typical AT Site – Surge Arrestors Highlighted



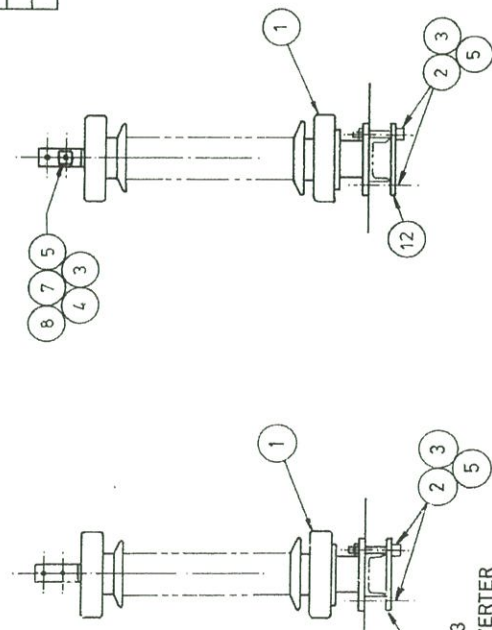
BALOOK AT SITE

BALCOOK AT



699/607/1
SURGE DIVERTER - FITTED WITH SPREADER BAR -
SUIT 19/4.22 AAC

699/607/2
SURGE DIVERTER -
FITTED WITH SPREADER BAR -
19/4.22 AAC / 2-37/77.67 CU CONVERSION



699/607/3
SURGE DIVERTER
- PLAIN

699/607/4
SURGE DIVERTER -
FITTED WITH LINE CLAMP
SUIT 19/4.22 AAC

PART N°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25														
ASSEMBLY	621	26	1	802	216	121	801	201	016	801	209	016	801	215	216	649	41	1	5	802	216	118	802	216	112	621	102	1	621	125	8	168	209	212	668	263	1		
CAT. N°	699	607	1	699	607	2	699	607	3	699	607	4	1	2	5	3	15	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
SUB ASSEMBLY																																							

699/607/A3

QUEENSLAND RAILWAYS CHIEF ELECTRICAL ENGINEER'S BRANCH

MAIN LINE ELECTRIFICATION

SURGE DIVERTER ASSEMBLIES

699/607/A3

SHEET NUMBER OF 1

SCALE N.T.S.

DRAWN C.B/S 10-85

CHECKED Y.P.P. 15.1.86

SUBMITTED M.H.S. 16.1.86

RECOMMENDED J. Ferguson

APPROVED P. Pithers

DATE 22-4-86

DATE 24-4-86

CITRA

ND 5/93

PART 2 WAS 802/216/121

ORIGINAL ISSUE

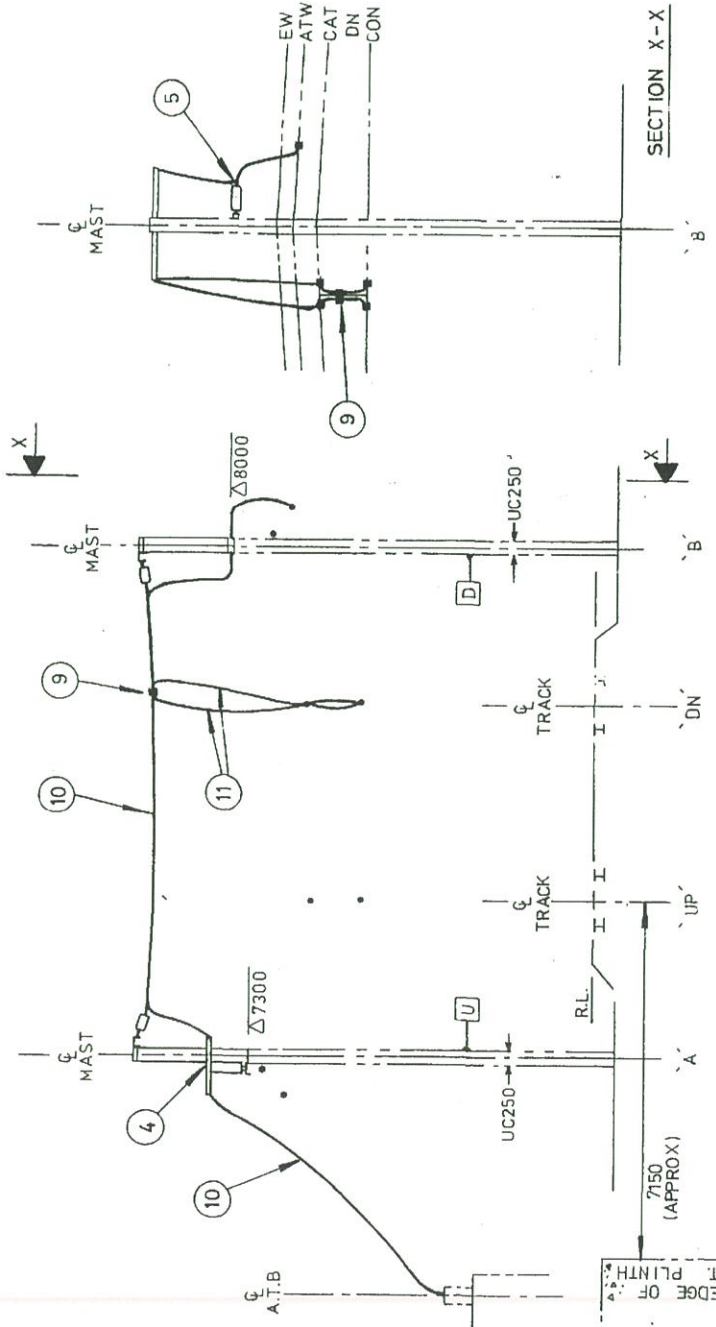
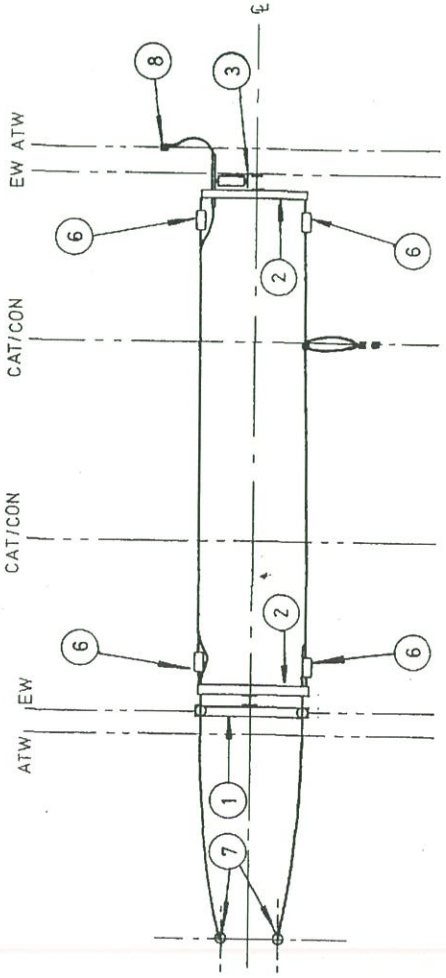
REV DESCRIPTION

DRAWN APPR. DATE

SWITCHING DATA SHEET

LAYOUT GA075077 LOCATION | GA 76.775
775
21

KEY	
ATW	AUTOTRANSFORMER WIRE
CAT	CATENARY
CON	CONTACT
OR	OUT OF RUNNING
IR	IN RUNNING
ATB	AUTOTRANS. BUSHING
EW	EARTH WIRE



SECTION X-X

ITEM	REF	QTY	REVISIONS
1	573-216-001	1	1 31-JUL-86
2	573-208-001	2	2 HEIGHTS ADDED
3	573-215-025	1	0 22-JAN-86
4	699-607-001	2	1 ORIGINAL ISSUE
5	699-590-005	1	2 11 JAN 87
6	699-493-021	2	AS FITTED
7	632-001-003	2	
8	621-125-004	1	
9	699-531-002	1	
10	148-045-998	40	
11	648-058-997	100	

ITEM	REF	QTY
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100		

All dimensions in mm.
All heights refer RL.

NOTE 1
MINIMUM INSTALLED ELECTRICAL CLEARANCES
PHASE TO EARTH: 300mm
PHASE TO PHASE: 500mm

NOTE 2
UNLESS INDICATED OTHERWISE ALL DIMENSIONS FOR VERTICAL POSITIONING ARE TO THE UNDERSIDE OF SLIP

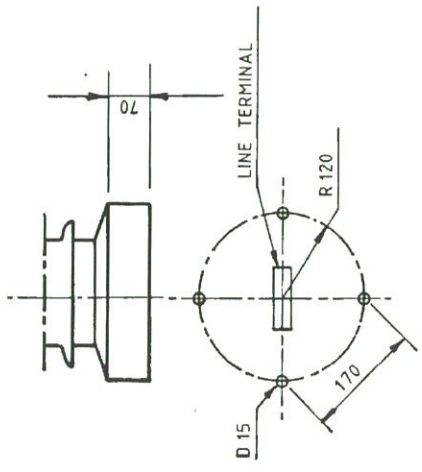
CITRA / ELRAIL
87 SOUTH BRISBANE
ELECTRIFICATION OF MAJOR RAILWAYS - STAGE II
RAILWAYS 4000

QUEENSLAND RAILWAYS
APPR: *MP*
GA.76.7758
Contract CEE 130

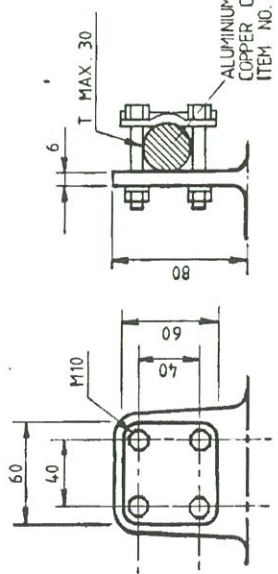
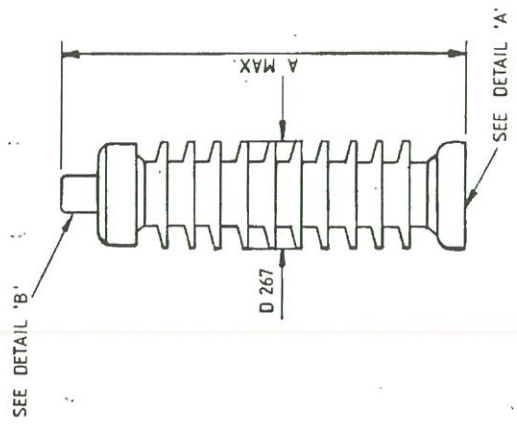
DINGO AT SITE

DWG NO AT

- NOTE.
1. SURGE ARRESTER SHALL BE SUPPLIED AS PER Q.R. SPEC DOE 154/061
 2. FIXING BOLTS, NUTS & WASHERS SHALL BE SUPPLIED WITH ARRESTER
 3. M12 x 120 lg. FIXING BOLTS C/W ONE NUT & ONE FLAT WASHER
BOLTS NUTS & WASHERS TO BE HOT DIP - GALV.



DETAIL 'A'
DRILLING PLAN FOR ARRESTER
WITHOUT INSULATING BASE



LINE TERMINAL
TYPE 'A' CAT. No. LB 910 314 - A

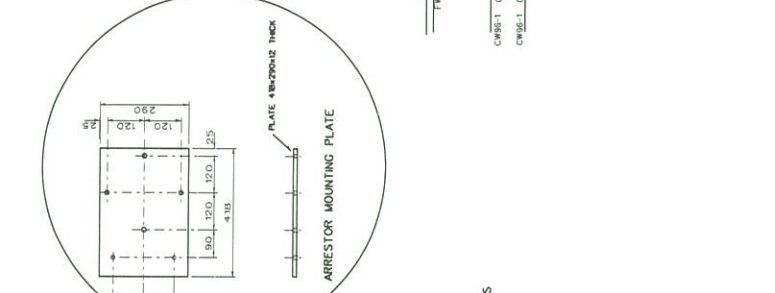
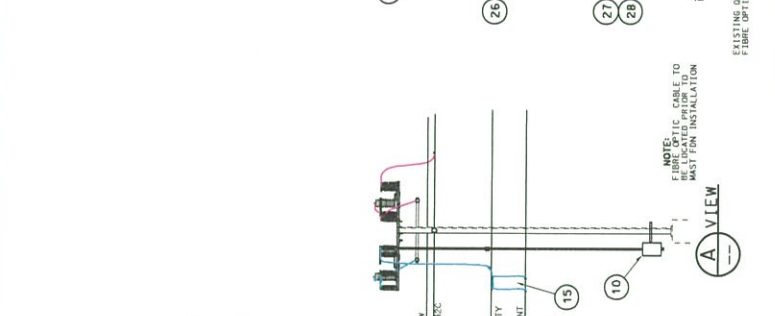
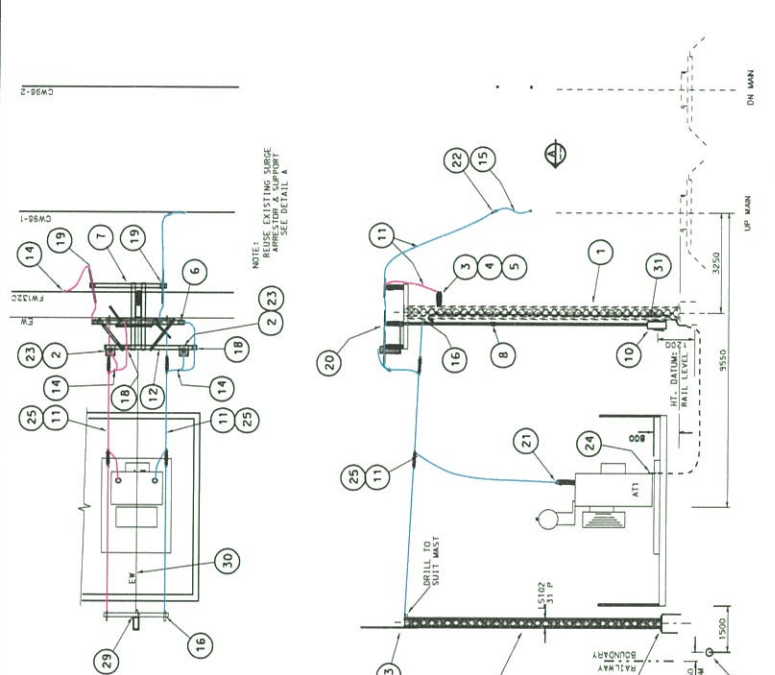
TYPE	A MAX. (mm)	CREEPAGE DISTANCE (mm)	MASS (kg)
52A3	740	1385	50

DRAWING APPROVED
FOR CONSTRUCTION

421/020/001	SURGE ARRESTER	ASEA CAT No. XAQ 52 A3 / 435
MARK No.	DESCRIPTION	APPROVED TYPE

		ELECTRIC POWER TRANSMISSION	
SOCIETA' ANONIMA ELETTIFICAZIONE S.P.A. MILANO - ITALY		QUEENSLAND RAILWAYS	
ELECTRIFICATION OF MAJOR COAL-CARRYING RAILWAYS 50/25 kV - 50 Hz ALTERNATING CURRENT OVERHEAD TRACTION WIRING			
RECOMMENDED BY 	APPLIED BY 	DATE 22-8-88	V B
DRN 	CHO 	DATE 4-1-88	JOB NO 2184
ISSUE OF TRANSPARENCY		SCALE 421/020/A3	NTS

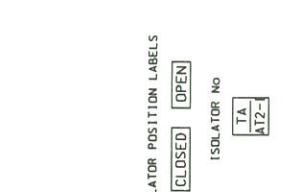
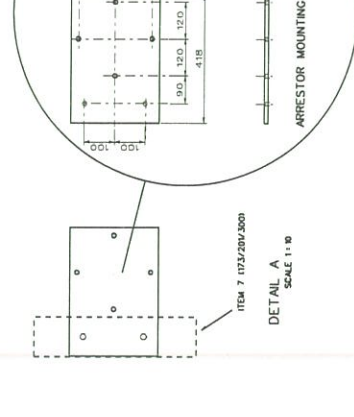
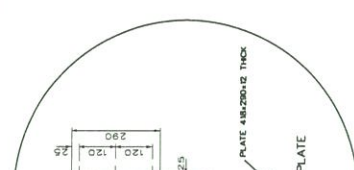
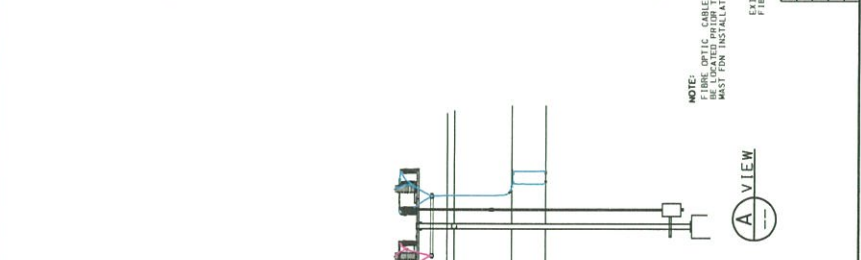
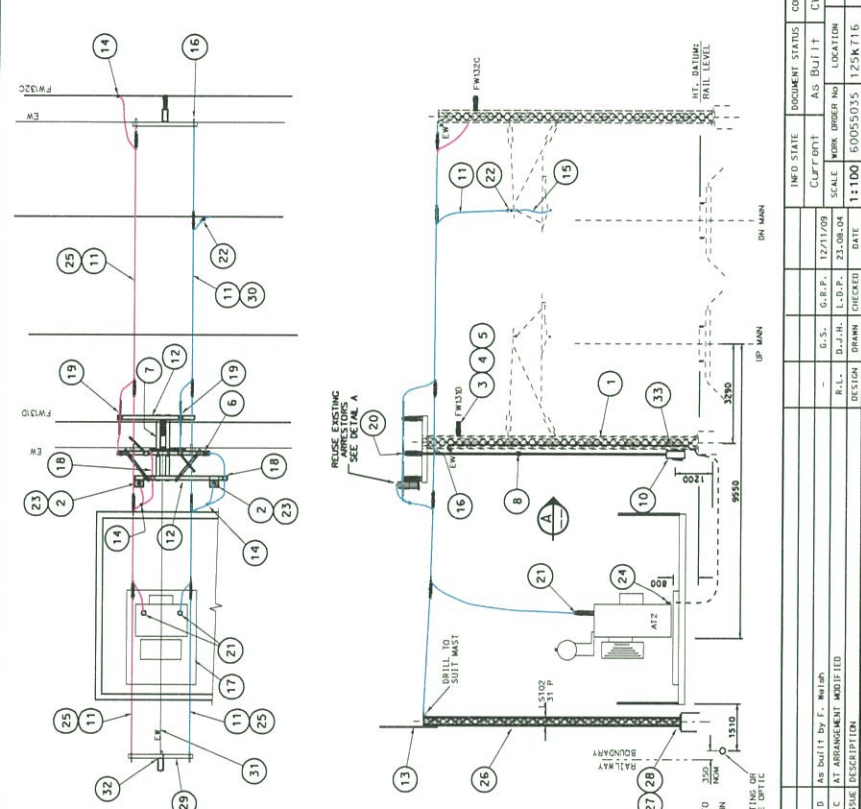
LABEL	GROUP	REFERENCE	QTY.	ISSUE	DESCRIPTION
1	E	135/121/33	1	C	LEST MAST 31 PANELS
2	E	142/114/2	2	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
3	E	170/261/127	1	C	FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
4	E	182/114/2	2	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
5	E	183/252/2	2	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
6	E	189/633/2	2	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
7	E	191/113/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
8	E	195/101/100	100	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
9	E	197/44/9/9/9	9	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
10	E	175/215/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
11	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
12	E	173/201/250	250	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
13	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
14	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
15	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
16	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
17	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
18	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
19	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
20	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
21	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
22	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
23	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
24	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
25	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
26	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
27	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
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29	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
30	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
31	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
32	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
33	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
34	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
35	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
36	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
37	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
38	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
39	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
40	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
41	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
42	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
43	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
44	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
45	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
46	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
47	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
48	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
49	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
50	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
51	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
52	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
53	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
54	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
55	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
56	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
57	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
58	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
59	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)
60	E	181/11/1	1	C	1000mm x 1000mm (1000 X 1000) FIBRE OPTIC SUPPORT PHOTO BRACKET (RB)



INFO STATE	DOCUMENT STATUS	CONSTR LENGTH	CROSS SECTION
AS BUILT BY F. WEIHER	AS BUILT	CW125-126	CW/125/706
G.S. 12/11/09	SCALE	1:100	STAGE
D.J.H. 23.08.04	SCALE	1:100	FINAL
R.L.	DATE	125K106	
DRAWN	CHECKED	60055035	
ISSUE DESCRIPTION			

SHEET 1 OF 1
 DRAWN BY: F. WEIHER
 CHECKED BY: D.J.H.
 DATE: 23.08.04
 SCALE: 1:100
 PROJECT: 125K106
 SHEET NO: 60055035
 CROSS SECTION: CW/125/706
 PRINTED BY: JOHN DEAN
 PRINT DATE: 25/07/2018

ITEM NO.	QTY.	DESCRIPTION
1	1	LSWR MAST 31 PANEL
2	2	CIRCUIT BREAKER 1250A
3	2	CIRCUIT BREAKER 630A
4	1	FEEDER SUPPORT PIVOT BRACKET TO RIG
5	1	FEEDER SUPPORT PIVOT BRACKET TO RIG
6	1	LSWR MAST 31 PANEL
7	1	LSWR MAST 31 PANEL
8	1	LSWR MAST 31 PANEL
9	1	LSWR MAST 31 PANEL
10	1	LSWR MAST 31 PANEL
11	1	LSWR MAST 31 PANEL
12	1	LSWR MAST 31 PANEL
13	1	LSWR MAST 31 PANEL
14	1	LSWR MAST 31 PANEL
15	1	LSWR MAST 31 PANEL
16	1	LSWR MAST 31 PANEL
17	1	LSWR MAST 31 PANEL
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29	1	LSWR MAST 31 PANEL
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31	1	LSWR MAST 31 PANEL
32	1	LSWR MAST 31 PANEL
33	1	LSWR MAST 31 PANEL



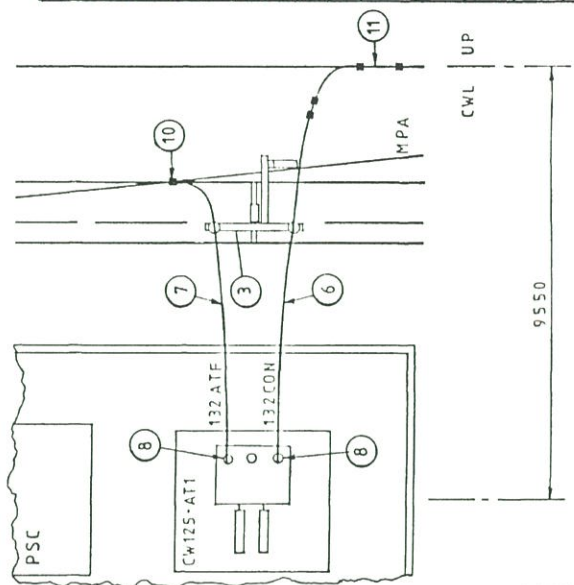
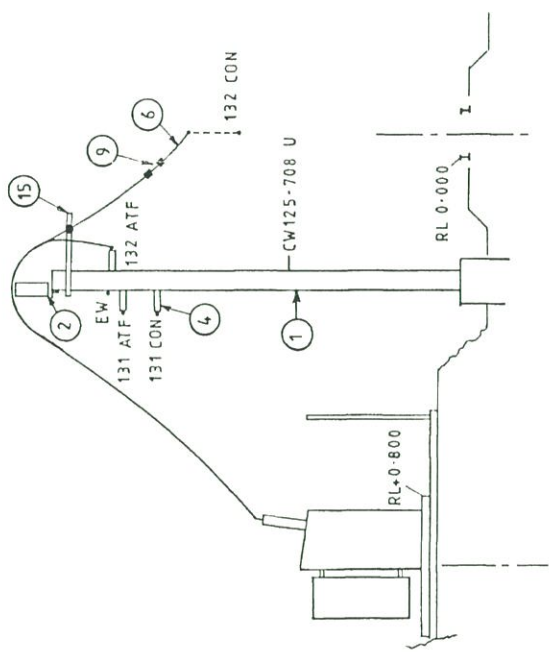
INFO STATE	DOCUMENT STATUS	CONSTR. LENGTH	CW125-126
CLIFF/GRY1	AS BUILT	STAGE	FINAL
G.S.	G.R.P.	DATE	12/11/08
R.L.	D.J.H.	SCALE	1:100
C	AT ARRANGEMENT MODIFIED	WORK ORDER NO.	60055035
ISSUE DESCRIPTION	DESIGN	DATE	12/5/08
		CHECKED	12/5/08
		DRAWN	12/5/08
		DATE	12/5/08
		SCALE	1:100
		LOCATION	125K T16
		AS BUILT	CW125-126
		CONSTR. LENGTH	CW125-126
		CONSTR. LENGTH	CW125-126
		CROSS SECTION	CW/125/716
		SHEET	1 OF 1
		PRINTED BY	J. Martin

AUTO-TRANSFORMER DATA SHEET		WIRE NO	LINE	STAGE	TENSION LENGTH	DRAWING NO
TRYPHINIA				1	CW125-126	CW125/706/U
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49
50	51	52	53	54	55	56

REFERENCE	QTY.	ISSUE	DESCRIPTION
1	1	08	LS 127 MAST 33 PANELS
2	2	08	SURGE DIVERTER
3	1	08	SURGE DIVERTER SUPPORT
4	4	08	STANDARD FEEDER INSULATOR
5	3	08	FEEDER INSULATOR SUPPORT PIVOT BKT.
6		08	37/2-50 HOC WIRE
7		08	19/4-22 AAC WIRE
8	2	08	COMPRESSION TERMINAL STRAIGHT PALM
9	2	08	CTA-210-1-120144 - 19/4-22 AAC BI-METALLIC P.G. CLAMP
10	1	08	P.G. CLAMP BETWEEN TWO 19/4-22 AAC
11	1	08	JUMPER ASS. AT SYSTEM FEED POINT
12	4	08	PERFORMED SIDE TIE
13	1	08	EARTH WIRE SUSPENSION CLAMP
14	1	08	LS MAST ANTI-CLIMBING DEVICE
15	1	08	FDR. INSULATOR SUPPORT (1600 LG.)
16	1	08	BRACKET SUPPORT FOR FDR. INSUL.

NOTES

- A MINIMUM CLEARANCE OF 300mm SHALL BE MAINTAINED BETWEEN:
 - Active conductors, masts and/or associated steelwork.
 - Active conductors and earth.
- MINIMUM DISTANCE BETWEEN ALL 50/25 kV FEEDERS SHALL BE 600mm.
- THIS DATA SHEET IS TO BE USED IN CONJUNCTION WITH REFERENCE DRAWING — ATW/CW125 714



ALLOC.	P.V.L.	ELECTRIC POWER TRANSMISSION PTY LTD	
CHECKED	R.L.	SYDNEY PERTH BRISBANE	
AS FIT	SA	1/02/09	
REV	DESCRIPTION	INIT DATE	
B	AS BUILT	P.V.L.	15-4-87
A	FOR CONSTRUCTION	P.V.L.	23-10-86
REVISIONS			
QUEENSLAND RAILWAYS CHIEF ELECTRICAL ENGINEER BRANCH			
DRAWING NO CW/125/706/U			

**AUTO-TRANSFORMER
DATA SHEET
TRYPHINIA**

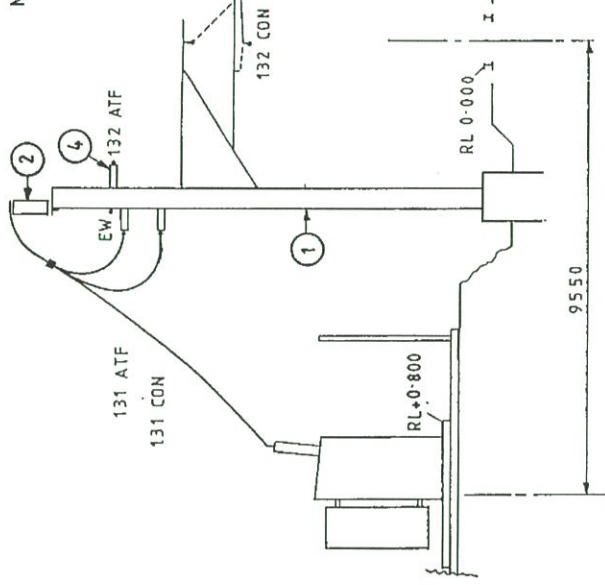
WIRE NO	LINE	STAGE	TENSION LENGTH	DRAWING NO
		1	CW 96	124-9-126-5
01	01	01	01	01
02	02	02	02	02
03	03	03	03	03
04	04	04	04	04
05	05	05	05	05
06	06	06	06	06
07	07	07	07	07
08	08	08	08	08
09	09	09	09	09
10	10	10	10	10
11	11	11	11	11

REFERENCE	QTY.	ISSUE	DESCRIPTION
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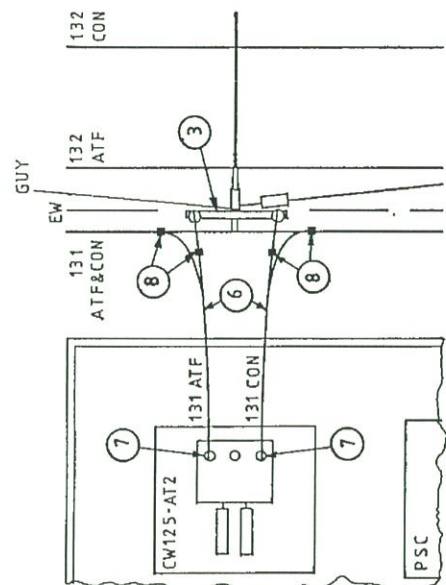
1	336/180/033	1	LS180 MAST 33 PANELS
2	421/020/001	2	SURGE DIVERTER
3	370/244/180	1	SURGE DIVERTER SUPPORT
4	421/014/002	3	STANDARD FEEDER INSULATOR
5	370/261/180	3	FEEDER INSULATOR SUPPORT BRACKET
6	448/045/998		19/4-22 AAC WIRE
7	421/131/001	2	COMPRESSION TERMINAL-STRAIGHT PALM CTA-210-1-120144 — 19/4-22 AAC
8	499/530/008	4	P.G. CLAMP BETWEEN TWO 19/4-22 AAC
9	421/141/001	3	PREFORMED SIDE TIE

10	426/011/001	1	EARTH WIRE SUSPENSION CLAMP
11	379/201/180	1	LS MAST ANTI-CLIMBING DEVICE

NOTES
 1. A MINIMUM CLEARANCE OF 300mm SHALL BE MAINTAINED BETWEEN:-
 (a) Active conductors, masts and/or associated steelwork.
 (b) Active conductors and earth.
 2. MINIMUM DISTANCE BETWEEN ALL 50/25KV FEEDERS SHALL BE 600mm.
 3. THIS DATA SHEET IS TO BE USED IN CONJUNCTION WITH REFERENCE DRAWING — ATW/CW125 714



WEST ELEVATION



PLAN

NOTE. FEEDER INSULATOR HEIGHTS AS APPLICABLE TO 29 PANEL MAST.

REV	DESCRIPTION	INIT	DATE
C	AS BUILT	P.V.L.	15-4-87
B	ITEM 3 ALTERED	P.V.L.	27-10-86
A	FOR CONSTRUCTION	P.V.L.	23-10-86

REVISIONS

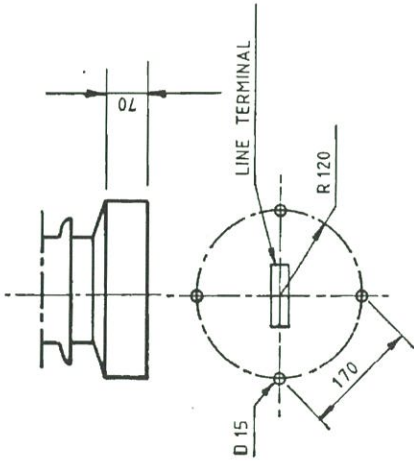
ALLOC.	P.V.L.	ELECTRIC POWER TRANSMISSION PTY LTD
CHECKED		SYDNEY PERTH BRISBANE
AS FIT		

QUEENSLAND RAILWAYS
 CHIEF ELECTRICAL ENGINEER BRANCH
 LOCATION CW125 71B 800
 STRUCTURE NO CW/125/716/U
 DRAWING NO 124-9 - 126-5

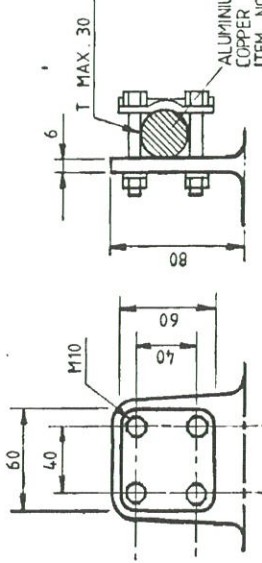
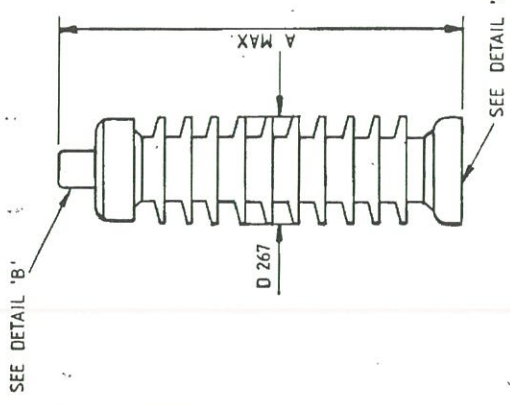
EPALA (AMBROSE) AT SITE

EPALA 07

- NOTE**
1. SURGE ARRESTER SHALL BE SUPPLIED AS PER Q.R. SPEC DOE 154/061
 2. FIXING BOLTS, NUTS & WASHERS SHALL BE SUPPLIED WITH ARRESTER
 3. M12 x 120 lg. FIXING BOLTS C/W ONE NUT & ONE FLAT WASHER
 4. BOLTS NUTS & WASHERS TO BE HOT DIP - GALV.



DETAIL 'A'
DRILLING PLAN FOR ARRESTER
WITHOUT INSULATING BASE



LINE TERMINAL
TYPE 'A' CAT. No. LB 910 314 - A

TYPE	A MAX. (mm)	CREEPAGE DISTANCE (mm)	MASS (kg)
52A3	740	1385	50

DRAWING APPROVED FOR CONSTRUCTION

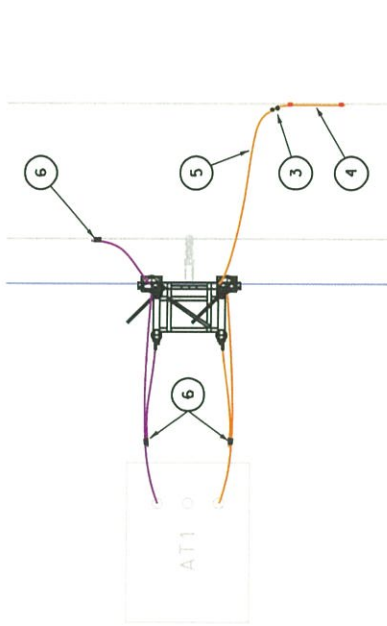
4.21/020/001	SURGE ARRESTER	ASEA CAT No. XAQ 52 A3 / 435
MARK No.	DESCRIPTION	APPROVED TYPE

1	CD	AMENDMENT	DATE	DRN	VB	DATE	4-1-88	JOB NO	2184	SCALE	NTS
1	CD	ISSUE OF TRANSPARENCY	DATE	DRN	VB	DATE	4-1-88	JOB NO	2184	SCALE	NTS
<p>ELECTRIC POWER TRANSMISSION PT LTD.</p> <p>SRE SOCIETA' ANONIMA ELETRIFICAZIONE S.P.A. - MILANO - ITALY -</p> <p>QR QUEENSLAND RAILWAYS</p> <p>ELECTRIFICATION OF MAJOR COAL-CARRYING RAILWAYS 50/25 kV - 50 Hz ALTERNATING CURRENT OVERHEAD TRACTION WIRING</p> <p>RECOMMENDED BY: [Signature]</p> <p>APPROVED BY: [Signature]</p> <p>DATE: 22-8-88</p> <p>DRN: [Signature]</p> <p>VB: [Signature]</p> <p>DATE: 22-8-88</p> <p>CD: [Signature]</p> <p>END: [Signature]</p> <p>SURGE ARRESTER</p>											
<p>4.21/020/A3</p>											

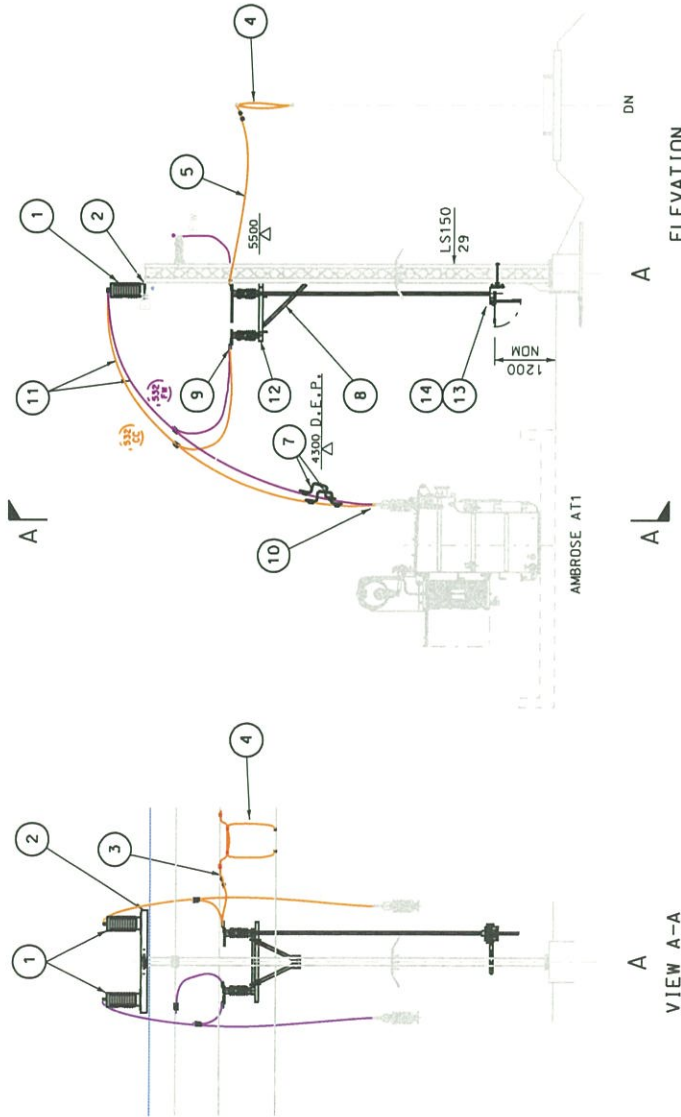
ISOLATOR POSITION LABELS

OPEN CLOSED

ISOLATOR NUMBER LABEL
 EP AT1-I



PLAN

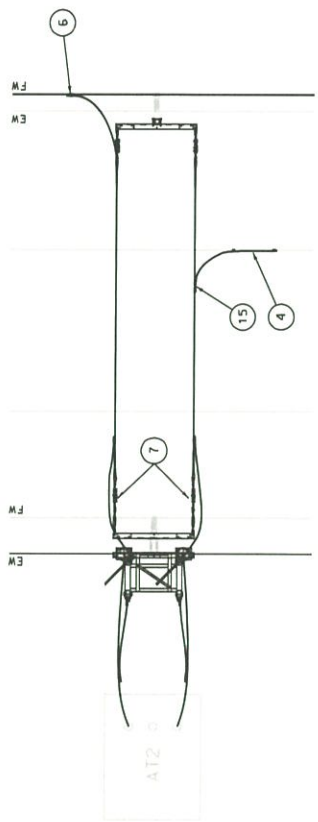


VIEW A-A

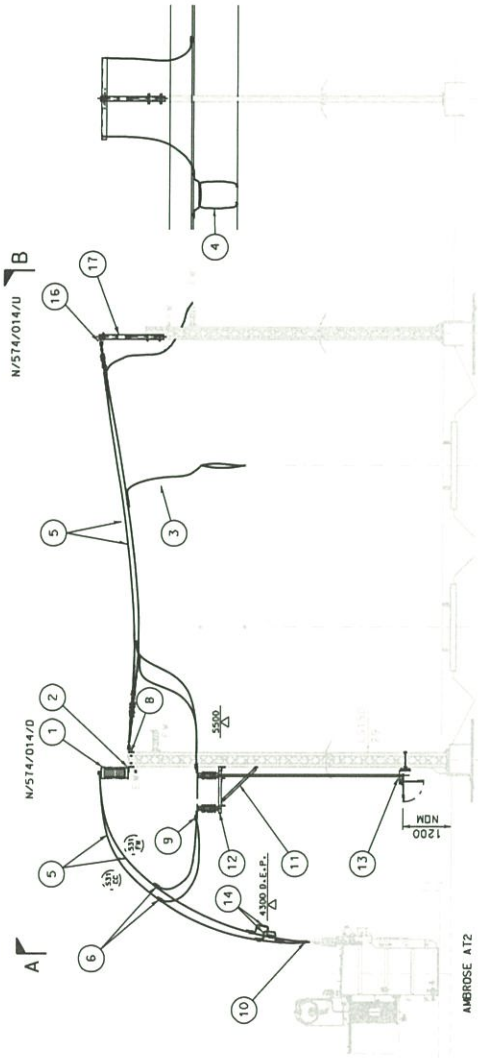
LABEL	GROUP	REFERENCE	QTY.	ISSUE	DESCRIPTION
1	E	423/204/ 1	2	A	SURGE DIVERTER
2	E	370/244/ 1	1	A	POUNTING ARRANG FOR SURGE DIVERTER
3	E	448/ 78/998	3	A	WIRE 37/2.5 HDC (In UNITS)
4	E	499/530/ 4	1	A	JUMPER ASSEMBLY AT CATENARY SYSTEM
5	E	448/ 45/998	20	A	WIRE 19/4.22 AAC BARE
6	E	499/530/ 8	1	A	P.G. CLAMP BETWEEN TWO 19/4.22 AAC
7	E	129/ 4/ 1	2	C	DEP. ASSEMBLY
8	E	370/250/152	1	C	SWITCH SUPPORT ASSEMBLY FOR LS152 H
9	E	632/ 1/ 1	4	C	FEEDER TO ISOLATOR TERMINAL PALM
10	E	632/ 1/ 3	2	C	TERMINAL PALM 19/4.22 TO TRANSFR
11	E	448/ 45/998	40	C	WIRE 19/4.22 AAC BARE
12	E	305/104/ 2	1	C	2 POLE MAN OP ISOL INDRM 800A
13	E	699/585/ 1	1	C	OPEN-CLOSED MANUAL ISOLATOR ASSY.
14	E	148/852/ 1	1	C	BLANK CUSTOM ISOLATOR NUMBER LABEL
14	E	148/853/ 2	1	C	ISOLATOR POSITION LABEL - "OPEN"
14	E	148/853/ 3	1	C	ISOLATOR POSITION LABEL - "CLOSED"
14	E	648/852/ 1	-1C	C	ISOLATOR NUMBER LABEL - SECTION 01
14	E	648/853/ 2	-1C	C	ISOL. POSITION LABEL - SECTION 02
14	E	648/853/ 3	-1C	C	ISOL. POSITION LABEL - SECTION 03

D AS BUILT - MARKED UP BY D.WILSON (LOR) 29/09/12		SCALE		DOCUMENT STATUS		ENGINEERING & PROJECT DELIVERY	
C	ADD ISOLATOR TO ATs	1:100	As Built	AURIZON ACN: 128669974 ABN: 47 56847 294			
B	AS BUILT		LOCATION	ELECTRICAL PROGRAM			
A	FOR CONSTRUCTION		STAGE	SWITCHING DATA SHEET			
ISSUE	DESCRIPTION		FINAL	N/574/005/D			
CAD FILE PATH: ...N573-574\N_574_005_D*002.dgn			SHEET		2 OF 2		
			DATE		5/12/2016		
			CHECKED		VERIFIED		
			DESIGN		DRAWN		
			J.D.		F.M.		
			G.M.		R.L.		
			S.Mc.		R.L.		
			14/10/16		INFO STATE		
			Current		CONSTR LENGTH		
			574K005.0		N573-574		
			574K005.0		574K005.0		
			FINAL		F FINAL		
			DATE		5/12/2016		
			PRINT DATE: 5/12/2016		PLOTTED BY: Josh Dollos		

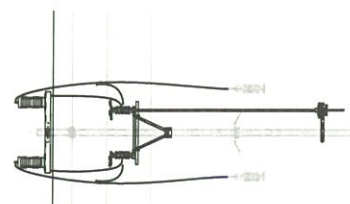
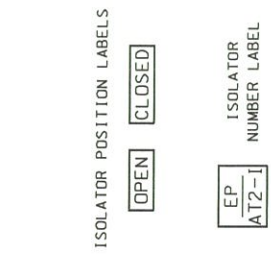
GROUP	REFERENCE	QTY.	ISSUE	DESCRIPTION
1	421/204/1	1	4	SIZE INDICATOR
2	370/244/1	1	A	MOUNTING BRACKET FOR SURGE DIVERTER
3	448/18/998	5	A	WRE 37/2.5 HOC (IN PARTS)
4	489/530/4	1	A	JUMPER ASSEMBLY AT CAT/CON SYSTEM (SUPERSEDED)
5	448/18/998	50	A	WRE 17/4.22 AAC BARE
6	499/530/8	3	A	P.L.C. CLAMP BETWEEN TWO 17/4.22 AAC (SUPERSEDED)
7	199/483/2	2	A	ACROSS TRACK FEED TERMINATION
8	448/202/150	1	A	ACROSS TRACK FEEDER SUPPORT L5154 (SUPERSEDED)
9	448/45/398	40	A	WRE 17/4.22 AAC BARE
10	632/1/1	4	C	P.L.C. CLAMP BETWEEN TWO 17/4.22 AAC (SUPERSEDED)
11	421/131/3	2	A	FEEDER TO ISOLATOR TERMINAL PALM
12	632/1/3	2	C	COMP. LUG 17/4.22 AAC 90 DEG PALM 50MM HOLE CENTRE
13	370/250/152	1	C	TERMINAL PALM 17/4.22 TO TRANSFR
14	305/104/2	1	C	2 POLE MAN DP 65L INDRIP 800A
15	699/985/1	1	C	OPER-CLOSED MANUAL ISOLATOR ASSY.
16	648/853/2	-1	C	ISOL POSITION LABEL - SECTION 01
17	648/853/3	-1	C	ISOL POSITION LABEL - SECTION 02
18	648/853/4	-1	C	ISOL POSITION LABEL - SECTION 03
19	148/852/1	1	C	BLANK CUSTOM ISOLATOR NUMBER LABEL
20	148/853/2	1	C	ISOLATOR POSITION LABEL - "OPEN"
21	148/853/3	1	C	ISOLATOR POSITION LABEL - "CLOSED"
22	129/4/1	2	A	DEF ASSEMBLY
23	499/530/10	1	A	BI-METALLIC PG AI 17/4.22-37/2.5 HOC (SUPERSEDED)
24	169/10/1	1	C	ANGLE 120X120X2000 90X75 HOLES
25	802/216/116	2	C	DRILL HEAD 20X1.5 HOLES CLAMP (SUPERSEDED)
26	801/209/16	2	C	PHG GALV ROUND WASHER
27	803/201/16	2	C	CHAMFER NUT PH8
28	474/309/16	1	C	SWS 102X124X3MM8 INSUL SUPP BRK
29	468/308/152	4	C	BACKING FLAT FOR L5154 (SUPERSEDED)
30	802/216/132	4	C	BOLT HEX PH8X90
31	801/201/16	4	C	PH8 GALV HEX NUT
32	801/209/16	4	C	PH8 GALV ROUND WASHER



PLAN



ELEVATION



VIEW A-A

VIEW B-B

<table border="1"> <tr> <td>AS BUILT - MARKED UP BY D. WILSON (LDR) 29/09/12</td> <td>INFO STATE</td> <td>25/11/16</td> <td>SCALE</td> <td>1:100</td> </tr> <tr> <td>ADD ISOLATOR TO AT2</td> <td>CURRENT</td> <td>AS BUILT</td> <td>STAGE</td> <td></td> </tr> <tr> <td>AS BUILT</td> <td>CONSTR LENGTH</td> <td>LOCATION</td> <td></td> <td></td> </tr> <tr> <td>FOR CONSTRUCTION</td> <td>NS13-574</td> <td>574K014-0</td> <td>FINAL</td> <td></td> </tr> </table>	AS BUILT - MARKED UP BY D. WILSON (LDR) 29/09/12	INFO STATE	25/11/16	SCALE	1:100	ADD ISOLATOR TO AT2	CURRENT	AS BUILT	STAGE		AS BUILT	CONSTR LENGTH	LOCATION			FOR CONSTRUCTION	NS13-574	574K014-0	FINAL		<table border="1"> <tr> <td>ENGINEERING & PROJECT DELIVERY ELECTRICAL PROGRAM</td> <td rowspan="2">SWITCHING DATA SHEET N/574/014/D</td> </tr> <tr> <td>SHEET 2 OF 2</td> </tr> </table>	ENGINEERING & PROJECT DELIVERY ELECTRICAL PROGRAM	SWITCHING DATA SHEET N/574/014/D	SHEET 2 OF 2
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SHEET 2 OF 2																								
<table border="1"> <tr> <td>DRAWN</td> <td>DESIGN</td> <td>CHECKED</td> <td>VERIFIED</td> <td>DATE</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>	DRAWN	DESIGN	CHECKED	VERIFIED	DATE						<table border="1"> <tr> <td>PRINT DATE: 05/12/2016</td> </tr> </table>	PRINT DATE: 05/12/2016												
DRAWN	DESIGN	CHECKED	VERIFIED	DATE																				
PRINT DATE: 05/12/2016																								

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FIREWALL RISK ASSESSMENT EVIDENCE OF NEW FAULT LOCATOR COMMISSIONING CHECKLISTS AT THE 3 AT SITES

BALOOK AT SITE



INSPECTION TEST AND PLAN
POWER SYSTEM EQUIPMENT RENEWAL - Board Changeout

QMS
DOCUMENT NUMBER: F.272.1.34.004
VERSION: 1.2 DATE: 02/07/2018

Project:		PS-Fault Locator Upgrade		Element Number:		IV.00004.E.R.12.07.30		
Start Site:		Wandoo FS		References:		SAF/STD/0141/ELE/NET AS_NZS 3000_2007 Commissioning Test Schedule		
Finish Site:		Balook TSC		Created by:		Aidan Haynes		
Lot Number:		4.1		Approved by:		Rory Dexter		
Item NO	Inspection Characteristics	Acceptance Criteria		Testing Method		Inspectorate Sign/Date		Documentation
		Specification Reference		Frequency	Position			
1	WHSMP	SAF/STD/0141/ELE/NET Section 7.5 Clause (c)	Approved WHSMP	Receive WHSMP from Principal Contractor	Once	Engineer (H)	<i>A Haynes</i> 12/07/2018	Approved WHSMP
2	Construction Design Drawings	SAF/STD/0141/ELE/NET Section 7.5 Clause (a)	IFC Design required. i.e. QRFL settings, etc	Receive approved design	Once	Engineer / Electrician (H)	<i>RBenn</i> 20/7/18	IFC Design Drawings
4	Testing and Verification	AS_NZS 3000_2018 Section 8	Pass Results as Per Testing Specifications	Visual/ Measurement	Once per QRFL	Electrician (H) (T)	<i>RBenn</i> 20/7/18	QRFL Change out Chek Sheet
5	Commissioning Test	Commissioning Test Schedule	Correct Operation	Test all board operations as per Commissioning Test Schedule	Once per QRFL	Design rep / Electrician (H) (T)	<i>RBenn</i> 20/7/18	Commissioning Test Schedule

CONFORMANCE CERTIFICATION

The Installer certifies that:

- (a) The installation conforms in all respects with the standards and requirements specified in he contract documents.
- (b) All necessary documentation proving conformance of the installation are attached herewith

Signed: *A Haynes* Name, Position: Aidan Haynes, Rotational Engineer

Date: 30/07/2018

H: Hold point IFC: Issued For Construction NCR: Non-Conformance Report Version 1.0
 W: Witness point QA: Quality Assurance RFC: Request For Clarification 08/04/2018
 T: Test point ITP: Inspection and Test Plan
 RS: Report to be submitted GEO: Geotechnical Requirement

CHECK SHEET - INSTALLATION OF QRFL 3 - ELECTRICAL

LOCATION:	AT 76.783		
SCHEME / PROJECT:	PS-Fault Locator Upgrade IV.00004.E.R.12.07.30		
MASTER LOCATION:	Wandoo FS	TYPE:	Slave
BOARD SERIAL. NO:	493187	LOT:	4.1

INSTALLATION ACTIVITY						(V)RESULT	INITIAL	DATE	INSPECTION TYPE	
1	QRFL Board dimension and alignment check					/	PLB	20-7-18	Measure	
2	Connections from QRFL to Terminal Strip as per drawings					/	PLB	20-7-18	Visual	
3	Jumpering as per Drawings					/	PLB	20-7-18	Visual	
4	Shorting links inserted into the CT circuit					/	PLB	20-7-18	Visual	
5	Polarity					/	PLB	20-7-18	Measure	
6	Correct Circuit Connections, point to point testing					/	PLB	20-7-18	Measure	
7	Site cleaned up - redundant equipment removed and disposed of.					/	PLB	20-7-18	Visual	
DEFECT / NOTE									COMPLETED BY	DATE COMPLETED

	NAME:(CAPITAL)	SIGNATURE: (FULL)	INITIALS:	DATE:
Sup 1:	_____			
Sup 2:	_____			
Sup 3:	_____			

Commissioning Test Schedule – Slave Unit



Version	Date	Details	Author	Reviewed	Approved
1.0	5/4/18	Original Issue	Rebecca Green	John Batalibasi	Peter Nussey

Site Name: Balook AT Date: 20-7-18
 Section: Wandoo-Balook Time: 0953
 Unit Type: Slave Unit Number: 1
 Serial Number: 493187

Warning: Apply shorting link across AT(s) CT terminals before installation and Commissioning work.

Item Number	Description	Expected Outcome	Tick if complete
1	Contact ECO to seek approval to commission stating that the QRFL will be operated		/
2	Check QRFL label is correct		/
3	Open all knife connectors on QRFL		/
4	Ensure connections are correctly terminated including:		
	DC power connections		/
	CTs		/
	VTs		/
	V23 communication		/
	Ethernet – if available		N/A
	Alarm and trip I/O's		/
5	Close power knife connectors (terminals 2, 3, 5 and 6) and power the unit	Power LED and screen on	/
6	Firmware Versions and Settings Ensure all settings applied are as per the settings schedule document for the relevant site. See attached settings document.		/
7	V23 Communications		
	View QRFL idle screen	V23 displaying online	/
		V23 light flashing	/
		Correct dBm values shown (approximately -11 and -15) Tx: <u>-4.9</u> Rx: <u>-9.9</u>	/

8	RTU Communications (Verify QRFL Comms Status Activity)		
8.1	Diagnostic Command		
	Request diagnostic (D) to the master QRFL at FS (Unit 0) from ECO	Unit resets. If slave does not reset, send D again only once. If the slave still does not reset, the test is failed.	/
		Clears FL Diagnostics window from any error	/
	Request diagnostic (D) to the sub-master QRFL (unit 9) from ECO	Unit should not reset	/
8.2	Start Command		
	Request start from master unit from ECO	The QRFL screen should change and display measurement information	/
		SCADA indicates 'Data Scan Received' from current master	/
8.3	Trips and alarms received by RTU		
	Close EXTALV knife connector (terminals 24 and 26) on QRFL		/
	Activate external battery charger fail contact	SCADA indicates Battery Charger Failed	/
	Release external battery charger fail contact	SCADA shows alarm normal	/
	Close EXTALW knife connector (terminals 27 and 29) on QRFL		/
	Activate oil temperature high alarm contact at source by increasing temperature	SCADA shows AT Oil Temp high	/
	Release oil temperature high alarm contact at source	SCADA shows alarm normal	/
	Close EXTALX knife connector (terminals 30 and 32) on QRFL		/
	Activate oil temperature trip condition at source	SCADA will display AT Oil Temperature Trip	/
		FS & TSC circuit breaker open. Check ECO receives FS & TSC CB open	/
	Release oil temperature trip condition at source	SCADA shows alarm reset	/
	Close EXTALY knife connector (terminals 33 and 35) on QRFL		/
	Activate explosion vent trip contact at source	SCADA will display AT Explosion Vent Trip	/
		FS & TSC circuit breaker open. Check ECO receives FS & TSC CB open	/
Release explosion vent trip contact at source	SCADA shows alarm reset	/	
8.4	V23		
	Remove V23 (QRFL-QRFL comms) cable	Verify ECO receives AT offline	/
	Plug the cable back in	Unit should reset	/

		SCADA alarms should turn off and everything display normally	/
	Request start to master	Check Tx and Rx levels Tx: <u>-5</u> Rx: <u>-10.2</u>	/
9	Ethernet Communications		
	Navigate to idle screen and check the correct IP address, subnet mask, gateway and NTP server are displayed	Ethernet displaying as online (if connected via Ethernet)	N/A
		IP address: <u>172.28.194.73</u> Subnet: <u>255.255.255.248</u> Gateway: <u>172.28.194.76</u> NTP: <u>10.69.160.13</u>	/
9.1	Web Interface – if Ethernet available at slave unit		
	Log on to the QRFL jump box, open chrome and enter the IP address in the format 'https://ipaddress:8080/general'		N/A
	Change a setting on the QRFL (e.g. RTU timeout)		N/A
	Download an event log from the Event Log webpage		N/A
	Download a fault log from the Fault Log webpage		N/A
10	24V Transient Fault Simulation		
	Voltage recorded at 24V input	<u> </u> V	N/A
11	Current Injection Testing		
	Calibrate at 1A <u>1.01</u>	Adjust gain if required. <u>Gain = 1981</u> Fault locator screen: <u>1013</u> A	/
	Inject:		
	0.5 A: <u>0.51</u> A	Fault locator screen: <u>515</u> A	/
	1 A: <u>1.0</u> A	Fault locator screen: <u>1006</u> A	/
	2 A: <u>2.0</u> A	Fault locator screen: <u>2004</u> A	/
	3 A: <u>3.02</u> A	Fault locator screen: <u>3022</u> A	/
	4 A: <u>4.0</u> A	Fault locator screen: <u>4003</u> A	/
	5 A: <u>5.02</u> A	Fault locator screen: <u>5027</u> A	/
	6 A: <u>6.03</u> A	Fault locator screen: <u>6031</u> A	/

11	Random Fault Location Calculation Check		
	Inject current and request start from ECO. Current injected: <u>.76</u> A	ECO reading: <u>762</u> A Fault location: <u>76.21</u> km Site km: <u>76.78</u>	✓
12	Download logs via USB	Event and fault logs downloaded for day/s of testing	N/A

Warning: Remove shorting link across AT(s) CT terminals after Installation and Commissioning work is complete.

Commissioning complete:

P. Adams

Date: 2017 1 18

Date: 1 1

DINGO AT SITE



**INSPECTION TEST AND PLAN
POWER SYSTEM EQUIPMENT RENEWAL**

QMS
DOCUMENT NUMBER: F.272.1.34.004
VERSION: 1.2 DATE: 07/07/2018

Project:	PS-Fault Locator Upgrade			Element Number:	IV.00004.E.R.12.07.30			
Start Site:	Dingo FS			References:	SAF/STD/0141/ELE/NET AS_NZS 3000_2007 Commissioning Test Schedule			
Finish Site:	Umolo TSC			Created by:	Aidan Haynes			
Lot Number:	8.3			Approved by:	Rory Dexter			
Item NO	Inspection Characteristics	Specification Reference	Acceptance Criteria		Testing		Inspectorate Sign / Date	Documentation
			Method	Frequency	Position	Sign / Date		
1	WHSMP	SAF/STD/0141/ELE/NET Section 7.5 Clause (c)	Approved WHSMP	Receive WHSMP from Principal Contractor	Once	Engineer (H)	<i>Haynes</i> 30/07/18	Approved WHSMP
2	Construction Design Drawings	SAF/STD/0141/ELE/NET Section 7.5 Clause (a)	IFC Design required, i.e. QRFL settings, etc	Receive approved design	Once	Engineer / Electrician (H)	<i>Haynes</i> 30/07/18	IFC Design Drawings
4	Testing and Verification	AS_NZS 3000_2018 Section 8	Pass Results as Per Testing Specifications	Visual/ Measurement	Once per QRFL	Electrician (H) (T)	<i>[Signature]</i>	QRFL Installation Chek Sheet
5	Commissioning Test	Commissioning Test Schedule	Correct Operation	Test all board operations as per Commissioning Test Schedule	Once per QRFL	Design rep / Electrician (H) (T)	<i>[Signature]</i>	Commissioning Test Schedule

CONFORMANCE CERTIFICATION

The Installer certifies that:

- (a) The installation conforms in all respects with the standards and requirements specified in he contract documents.
- (b) All necessary documentation proving conformance of the installation are attached herewith

Signed: *Haynes* Name, Position: Aidan Haynes, Rotational Engineer

Date: 8/11/2018


H: Hold point	IFC: Issued For Construction	NCR: Non-Conformance Report	Version 1.0	F.272.1.34.004
W: Witness point	QA: Quality Assurance	RFC: Request For Clarification	08/04/2018	
T: Test point	ITP: Inspection and Test Plan			
RS: Report to be submitted	GEO: Geotechnical Requirement			

CHECK SHEET – INSTALLATION of QRFL 3 - ELECTRICAL

LOCATION:	AT Dingo		
SCHEME / PROJECT:	PS-Fault Locator Upgrade IV.00004.E.R.12.07.30		
MASTER LOCATION:	Dingo FS	TYPE:	Slave
BOARD SERIAL. NO:	477168	LOT:	8.3

INSTALLATION ACTIVITY		(V)RESULT	INITIAL	DATE	INSPECTION TYPE
1	Check Enclosure Pre-Drill holes dimension and alignment	✓	PB	22/08/18	Measure
2	Enclosure glands secure	✓	PB	22/08	Visual
3	QRFL Board dimension and alignment check	✓	PB	22/08	Measure
4	Terminal Strip available and numbered	✓	PB	22/8	Visual
5	Connections from QRFL to Terminal Strip as per drawings	✓	PB	22/8	Visual
6	Jumpering as per Drawings	✓	PB	22/8	Visual
7	Record Earth Fault Loop Impedence of VT install (EFLZ)	—	PB	22/8	Record
8	Check CT cable, no kinks, obvious wear	✓	PB	22/8	Visual
9	Megger result for Insulation AT1 - 7220M AT2 - 7220M	✓	PB	22/8	Record
10	Continuity Test AT1 - 0.4Ω AT2 - 0.4Ω	✓	PB	22/8	Record
11	Shorting links inserted into the CT circuit	✓	PB	22/8	Visual
12	Redundant Equipment disconnected and removed.	✓	PB	22/8	Visual
13	QRFL Cabinet - Cable tray installed	—	PB	22/8	Visual
14	Cables installed - compliant with AS3000 - cable labels fitted	✓	PB	22/8	Visual
15	Insulation resistance of installed cables tested and compliant	ALL 7220M	PB	22/8	Record
16	Wiring terminated (bootlace terminals)- wiring numbers fitted	✓	PB	22/8	Visual
17	Relevant 50kV Circuit Breaker OPENED by ECO	—	PB	22/8	Visual
18	5FL relays installed - wiring terminated as per drawings	—	PB	22/8	Visual
19	CT circuits checked for continuity - jumpering / shorting links positioned correctly	✓	PB	22/8	Visual
20	Continuity Test of earthing system	✓	PB	22/8	Measure

21	Insulation resistance >0.5Mohm @ 250V DC	✓	PB	22/8	Measure	
22	Polarity	✓	PB	22/8	Measure	
23	Correct Circuit Connections, point to point testing	✓	PB	22/8	Measure	
24	Check circuit breaker rating adequate for cable current carrying capacity	✓	PB	22/8	Measure	
25	Site cleaned up - redundant equipment removed and disposed of.	✓	PB	22/8	Visual	
DEFECT / NOTE					COMPLETED BY	DATE COMPLETED

	NAME:(CAPITAL)	SIGNATURE: (FULL)	INITIALS:	DATE:
Sup 1:	PHILIP BROWN		PB	22/08/18
Sup 2:				
Sup 3:				

Commissioning Test Schedule – Slave Unit

Version	Date	Details	Author	Reviewed	Approved
1.0	5/4/18	Original Issue			

Site Name: DINGO AT

Date: 22/08/18

Section: 141 142

Time: _____

Unit Type: _____

Unit Number: 1

Serial Number: 477168

Warning: Apply shorting link across AT(s) CT terminals before Installation and Commissioning work.

Item Number	Description	Expected Outcome	Tick if complete
1	Contact ECO to seek approval to commission stating that the QRFL will be operated		✓
2	Check QRFL label is correct		✓
3	Open all knife connectors on QRFL		✓
4	Ensure connections are correctly terminated including:		
	DC power connections		✓
	CTs		✓
	VTs		✓
	V23 communication		✓
	Ethernet – if available		✓
	Alarm and trip I/O's		✓
5	Close power knife connectors (terminals 2, 3, 5 and 6) and power the unit	Power LED and screen on	✓
6	Firmware Versions and Settings Ensure all settings applied are as per the settings schedule document for the relevant site. See attached settings document.		✓
7	V23 Communications		
	View QRFL idle screen	V23 displaying online	✓
		V23 light flashing	✓
		Correct dBm values shown (approximately -5 and -14) Tx: <u>0.5</u> Rx: <u>-10.3</u>	✓

8	RTU Communications (Verify QRFL Comms Status Activity)		
8.1	Diagnostic Command		
	Request diagnostic (D) to the master QRFL at FS (Unit 0) from ECO	Unit reset. If slave does not reset, send D again only once. If the slave still does not reset, the test is failed.	✓
		Clears FL Diagnostics window from any error	✓
Request diagnostic (D) to the sub-master QRFL (unit 9) from ECO	Unit should not reset	✓	
8.2	Start Command		
	Request start from master unit from ECO	The QRFL screen should change and display measurement information	✓
		SCADA indicates 'Data Scan Received' from current master	✓
8.3	Trips and alarms received by RTU		
	Close EXTALV knife connector (terminals 24 and 26) on QRFL		✓
	Activate external battery charger fail contact	SCADA indicates Battery Charger Failed	✓
	Release external battery charger fail contact	SCADA shows alarm normal	✓
	Close EXTALW knife connector (terminals 27 and 29) on QRFL		✓
	Activate oil temperature high alarm contact at source by increasing temperature	SCADA shows AT Oil Temp high	✓
	Release oil temperature high alarm contact at source	SCADA shows alarm normal	✓
	Close EXTALX knife connector (terminals 30 and 32) on QRFL		✓
	Activate oil temperature trip condition at source	SCADA will display AT Oil Temperature Trip	✓
		FS & TSC circuit breaker open. Check ECO receives FS & TSC CB open	NA
	Release oil temperature trip condition at source	SCADA shows alarm reset	✓
	Close EXTALY knife connector (terminals 33 and 35) on QRFL		✓
	Activate explosion vent trip contact at source	SCADA will display AT Explosion Vent Trip	✓
		FS & TSC circuit breaker open. Check ECO receives FS & TSC CB open	NA
	Release explosion vent trip contact at source	SCADA shows alarm reset	✓
8.4	V23		
	Remove V23 (QRFL-QRFL comms) cable	Verify ECO receives AT offline	✓

	Plug the cable back in	Unit should reset	✓
		SCADA alarms should turn off and everything display normally	✓
	Request start to master	Check Tx and Rx levels Tx: _____ Rx: _____	✓
9	Ethernet Communications		
	Navigate to idle screen and check the correct IP address, subnet mask, gateway and NTP server are displayed	Ethernet displaying as online (if connected via Ethernet) IP address: <u>172.28.192.225</u> Subnet: _____ Gateway: <u>172.28.192.230</u> NTP: _____	✓
9.1	Web Interface – if Ethernet available at slave unit		
	Log on to the QRFL jump box, open chrome and enter the IP address in the format 'https://ipaddress:8080/general'		NA
	Change a setting on the QRFL (e.g. RTU timeout)		NA
	Download an event log from the Event Log webpage		NA
	Download a fault log from the Fault Log webpage		NA
10	Current Injection Testing		
	Calibrate at 1A <u>1.0</u>	Adjust gain if required. <u>1994</u> Fault locator screen: <u>1000</u> A	✓
	Inject:		
	0.5 A <u>0.505</u>	Fault locator screen: <u>507</u> A ECO reading: _____ A	✓
	1 A <u>1.0</u>	Fault locator screen: <u>1000</u> A ECO reading: _____ A	✓
	2 A <u>2.04</u>	Fault locator screen: <u>2041</u> A ECO reading: _____ A	✓
	3 A <u>3.02</u>	Fault locator screen: <u>3019</u> A ECO reading: _____ A	✓
	4 A <u>3.99</u>	Fault locator screen: <u>4003</u> A ECO reading: _____ A	✓

11	Random Fault Location Calculation Check		
	Inject current and request start from ECO. Current injected: <u>810</u> A	ECO reading: <u>810</u> A 180A AT DIMCO TSC	Fault location: <u>139.78</u> km Site km: <u>140.9</u> Accuracy: _____
12	Download logs via USB	Event and fault logs downloaded for day/s of testing	

Warning: Remove shorting link across AT(s) CT terminals after Installation and Commissioning work is complete.

Commissioning complete:

P. BROWN

Date: 22/08/18

Date: / /

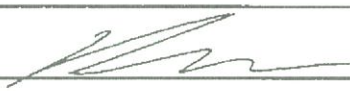
EPALA (AMBROSE) AT SITE

CHECK SHEET – INSTALLATION of QRFL 3 - ELECTRICAL

LOCATION:	AT Epala		
SCHEME / PROJECT:	PS-Fault Locator Upgrade IV.00004.E.R.12.07.30		
MASTER LOCATION:	Raglan FS	TYPE:	Slave
BOARD SERIAL. NO:	477224	LOT:	10.2

	INSTALLATION ACTIVITY	(V)RESULT	INITIAL	DATE	INSPECTION TYPE
1	Check Enclosure Pre-Drill holes dimension and alignment	✓	PB	28-09-18	Measure
2	Enclosure glands secure	✓	PB	28.09	Visual
3	QRFL Board dimension and alignment check	✓	PB	28.09	Measure
4	Terminal Strip available and numbered	✓	PB	28.09	Visual
5	Connections from QRFL to Terminal Strip as per drawings	✓	PB	28.09	Visual
6	Jumpering as per Drawings	✓	PB	28.09	Visual
7	Record Earth Fault Loop Impedence of VT install (EFLZ)	NA	PB	28.09	Record
8	Check CT cable, no kinks, obvious wear	✓	PB	28.09	Visual
9	Megger result for Insulation AT1 - >220M AT2 - >220M	✓	PB	28.09	Record
10	Continuity Test AT1 - 0.4Ω AT2 - 0.5Ω	✓	PB	28.09	Record
11	Shorting links inserted into the CT circuit	✓	PB	28.09	Visual
12	Redundant Equipment disconnected and removed.	✓	PB	28.09	Visual
13	QRFL Cabinet - Cable tray installed	✓	PB	28.09	Visual
14	Cables installed - compliant with AS3000 - cable lables fitted	✓	PB	28.09	Visual
15	Insulation resistance of installed cables tested and compliant	ALL >220MΩ	PB	28.09	Record
16	Wiring terminated (bootlace terminals)- wiring numbers fitted	✓	PB	28.09	Visual
17	Relevant 50kV Circuit Breaker OPENED by ECO	NA	PB	28.09	Visual
18	5FL relays installed - wiring terminated as per drawings	NA	PB	28.09	Visual
19	CT circuits checked for continuity - jumpering / shorting links positioned correctly	✓	PB	28.09	Visual
20	Continuity Test of earthing system	✓	PB	28.09	Measure

21	Insulation resistance >0.5Mohm @ 250V DC	✓	PB	28.09	Measure	
22	Polarity	✓	PB	28.09	Measure	
23	Correct Circuit Connections, point to point testing	✓	PB	28.09	Measure	
24	Check circuit breaker rating adequate for cable current carrying capacity	✓	PB	28.09	Measure	
25	Site cleaned up - redundant equipment removed and disposed of.	✓	PB	28.09	Visual	
DEFECT / NOTE					COMPLETED BY	DATE COMPLETED

	NAME:(CAPITAL)	SIGNATURE: (FULL)	INITIALS:	DATE:
Sup 1:	P. BROWN		PB	28.09.18
Sup 2:				
Sup 3:				

Commissioning Test Schedule – Slave Unit

Version	Date	Details	Author	Reviewed	Approved
1.0	5/4/18	Original Issue			

Site Name: EPALA AT

Date: 28.09.18

Section: 531 532

Time: _____

Unit Type: _____

Unit Number: 1

Serial Number: 477224

Warning: Apply shorting link across AT(s) CT terminals before Installation and Commissioning work.

Item Number	Description	Expected Outcome	Tick if complete
1	Contact ECO to seek approval to commission stating that the QRFL will be operated		✓
2	Check QRFL label is correct		✓
3	Open all knife connectors on QRFL		✓
4	Ensure connections are correctly terminated including:		
	DC power connections		✓
	CTs		✓
	VTs		✓
	V23 communication		✓
	Ethernet – if available		✓
	Alarm and trip I/O's		✓
5	Close power knife connectors (terminals 2, 3, 5 and 6) and power the unit	Power LED and screen on	✓
6	Firmware Versions and Settings Ensure all settings applied are as per the settings schedule document for the relevant site. See attached settings document.		✓
7	V23 Communications		
	View QRFL idle screen	V23 displaying online	✓
		V23 light flashing	✓
		Correct dBm values shown (approximately -5 and -14) Tx: <u>-5.1</u> Rx: <u>-10.9</u>	✓


8	RTU Communications (Verify QRFL Comms Status Activity)		
8.1	Diagnostic Command		
	Request diagnostic (D) to the master QRFL at FS (Unit 0) from ECO	Unit reset. If slave does not reset, send D again only once. If the slave still does not reset, the test is failed.	✓
		Clears FL Diagnostics window from any error	✓
	Request diagnostic (D) to the sub-master QRFL (unit 9) from ECO	Unit should not reset	✓
8.2	Start Command		
	Request start from master unit from ECO	The QRFL screen should change and display measurement information	✓
		SCADA indicates 'Data Scan Received' from current master	✓
8.3	Trips and alarms received by RTU		
	Close EXTALV knife connector (terminals 24 and 26) on QRFL		✓
	Activate external battery charger fail contact	SCADA indicates Battery Charger Failed	✓
	Release external battery charger fail contact	SCADA shows alarm normal	✓
	Close EXTALW knife connector (terminals 27 and 29) on QRFL		✓
	Activate oil temperature high alarm contact at source by increasing temperature	SCADA shows AT Oil Temp high	✓
	Release oil temperature high alarm contact at source	SCADA shows alarm normal	✓
	Close EXTALX knife connector (terminals 30 and 32) on QRFL		✓
	Activate oil temperature trip condition at source	SCADA will display AT Oil Temperature Trip	✓
		FS & TSC circuit breaker open. Check ECO receives FS & TSC CB open	NA
	Release oil temperature trip condition at source	SCADA shows alarm reset	✓
	Close EXTALY knife connector (terminals 33 and 35) on QRFL		✓
	Activate explosion vent trip contact at source	SCADA will display AT Explosion Vent Trip	✓
		FS & TSC circuit breaker open. Check ECO receives FS & TSC CB open	NA
Release explosion vent trip contact at source	SCADA shows alarm reset	✓	
8.4	V23		
	Remove V23 (QRFL-QRFL comms) cable	Verify ECO receives AT offline	✓

	Plug the cable back in	Unit should reset	✓
		SCADA alarms should turn off and everything display normally	✓
	Request start to master	Check Tx and Rx levels Tx: <u> </u> Rx: <u> </u>	✓
9	Ethernet Communications		
	Navigate to idle screen and check the correct IP address, subnet mask, gateway and NTP server are displayed	Ethernet displaying as online (if connected via Ethernet) IP address: <u>172.28.192.33</u> Subnet: <u> </u> Gateway: <u>172.28.192.38</u> NTP: <u> </u>	NA ✓
9.1	Web Interface – if Ethernet available at slave unit		
	Log on to the QRFL jump box, open chrome and enter the IP address in the format 'https://ipaddress:8080/general'		NA
	Change a setting on the QRFL (e.g. RTU timeout)		NA
	Download an event log from the Event Log webpage		NA
	Download a fault log from the Fault Log webpage		NA
10	Current Injection Testing		
	Calibrate at 1A <u>1.00</u>	Adjust gain if required. Fault locator screen: <u>1000</u> A	✓
	Inject:		
	0.5 A <u>0.51</u>	Fault locator screen: <u>509</u> A ECO reading: <u>—</u> A	✓
	1 A <u>1.00</u>	Fault locator screen: <u>1000</u> A ECO reading: <u>—</u> A	✓
	2 A <u>2.00</u>	Fault locator screen: <u>2001</u> A ECO reading: <u>—</u> A	✓
	3 A <u>3.02</u>	Fault locator screen: <u>3018</u> A ECO reading: <u>—</u> A	✓
	4 A <u>4.00</u>	Fault locator screen: <u>3997</u> A ECO reading: <u>—</u> A	✓

11	Random Fault Location Calculation Check		
	Inject current and request start from ECO. Current injected: <u>830</u> A	ECO reading: <u>831</u> A Fault location: <u>573.61</u> km Site km: <u>574.00</u> Accuracy: _____	✓
12	Download logs via USB	Event and fault logs downloaded for day/s of testing	N/A

Warning: Remove shorting link across AT(s) CT terminals after Installation and Commissioning work is complete.

Commissioning complete:

PHILL BROWN 

Date: 28/09/18

Date: / /