PLP Electropar, New Zealand

1 of 19 manufacturing plants - 2,600 employees

Design, Engineering, Manufacturing and IANZ accredited Testing laboratory

PPA Synopsis

Managing utility assets **without** Network Standards and Specifications

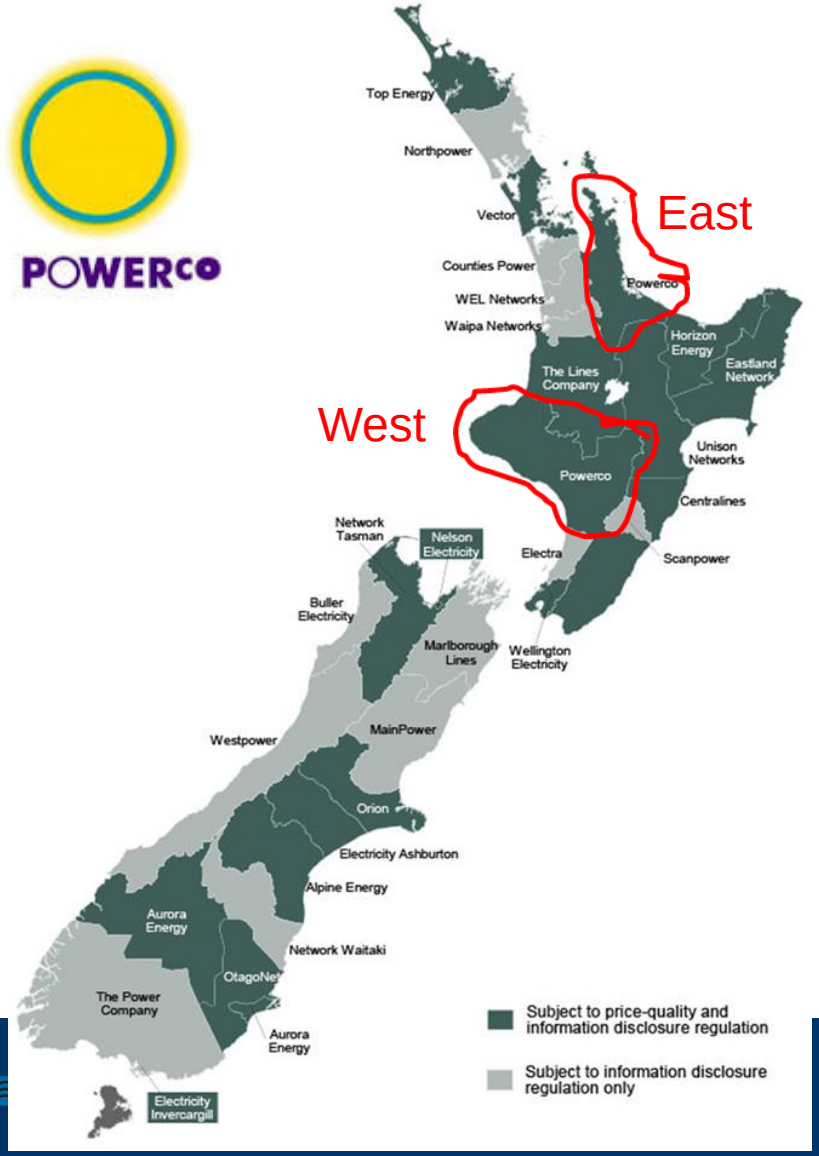
- a look at what utilities have achieved when they **adopt standardisation** of design and equipment;
- the downstream outcomes of **improving network performance**, optimising annual capital and maintenance spend and being able to effectively hold critical spares;
- explore how best to **extend asset life**, improve network performance and other applications to improve resource utilisation
- this discussion will also address the ease of **transferability** and **application** to the Pacific island utilities and communities.

Asset Management practices **vary significantly**

...and as such, this poses a number of challenges;

1) **unavailability** of international **specifications** on maintenance
2) **lack** of uniformity in **equipment replacement criteria** across our industry
3) difficulty finding the right skills to maintain **aging equipment**, let alone **strategic spares**
4) **managing** aging equipment
5) deciding how to **invest** across a **range of priorities**

Sometimes it takes a ‘burning platform’ for Network Standards



- 22,900 km’s of o/h network
- 330,600 – electricity connections
- 104,400 – gas connections
- 5,185km’s – gas lines
- Two Regions – East and West
- Relatively good network with sub-transmission at 33kV and 66kV and 11kV distribution
- Predominantly built in the 1950’s and 1960’s

The fuel for the burning platform – rapid growth

- 1993 - **New Plymouth Energy** merged with **Taranaki Electricity** & formed, TEL
- 1994 - TEL, (Taranaki Energy Limited) acquires the **Hawera Gas Company**
- 1995 - TEL merges with **Wanganui-based Powerco** to become **PowerCo Limited**
- 1997 - purchase Hawera based **Egmont Electricity**
- 1998 - Government passes Electricity Industry Reform Act
  - purchases **Wairarapa Electricity's** network business
- 2000 Powerco merges with **CentralPower**
  - CentralPower former **Manawatu-Oroua Power Board** and **ElectroPower**

...and more growth, but still **NO** standards

- 2001 - Powerco purchases the **Hutt Valley** and **Porirua gas networks**
- 2002 - Powerco purchases Electricity Assets of **United Networks Limited** plus **gas networks**
- 2004 - Powerco purchases **Siemens Energy Services** Tauranga division
- 2005 - Powerco sells its New Zealand contracting business to;
  - **Tenix Alliance**
  - 2015 Tenix NZ is sold to **Downer**

- 12 x Networks later..... purchase and sale of contracting business

.....different Network Asset Managers and Planners – **our networks are different!**

All the networks are completely different – aren't they?

…….they stand poles, string conductor, bury cable and bury gas pipes

And as we know…….they are the same!

What is different is;

- system voltage
- design
- asset age and condition, and environmental factors such as;
- wind speed, terrain, snow
- costal, geothermal, urban and rural, resorts and islands

The **first pass** at standards achieved;

- ✓ product and supplier rationalization
- ✓ development of specifications, some – but by no means all
- ✓ performance requirements – electrical and mechanical, some – but well short of all
- ✓ principal focus primary equipment, secondary equipment significantly lesser focus
- ✓ adopted by ~ 60% of the 29 lines companies in NZ

Today

- 2 x distinct regions - Eastern and Western
- Both regions have separate planning teams – **under review**
- Capital and Maintenance outsourced;
  - – maintenance
  - Capital contestable – Downer Relationships creating success, Northpower electrix, OberTech Group for HV works
  - smaller contractors for LV work
- ‘Design by Jury’ – **changing**

Standards:

- are out of date and in need of “currency”
- acknowledged new standards must drive better network performance
- a view to extend asset life by using condition, location and geography
- tighter focus on specifications and reliability requirements

Standards are live documents – “ and currency is vital”

11kV cables

- Approved Standard refers to General Cables, (GC) as the **exclusive supplier** for **some** of the 11kV cables
- GC closed in December 2016, other suppliers yet to be approved

LV heat shrink

- 3 x suppliers approved
- One has moved out of the NZ market
- Vector does not buy the other product, similar for others in the industry
- Leaving one only supplier who is **very expensive** – any guesses?

Procurement - the absolute lowest total cost of ownership with the greatest possible asset utilisation

- Does your procurement team purchase on **lowest unit price?**
- Is procurement purchasing based on **your network standards** & **performance criteria?**
- When materials **constantly fail** in the field causing **multiple unplanned outages**, what changes do you make?
- Do you check the **materials procured** will perform to the **standards specified** in your tenders?
- Is your organisation **reviewing** the **test reports** and **validating materials** they have purchased?

Are we doing and lifecycle cost and economic analysis?

Comparing a **one time large payment** for a **new asset** vs. **smaller payments** of keeping **an aged asset** or inferior asset with all maintenance, refurbishment and replacement costs, as such;

Ongoing distributed expenses are **converted into their present values** using **inflation** and **discount rates** – consideration for outage costs can also be factored in.

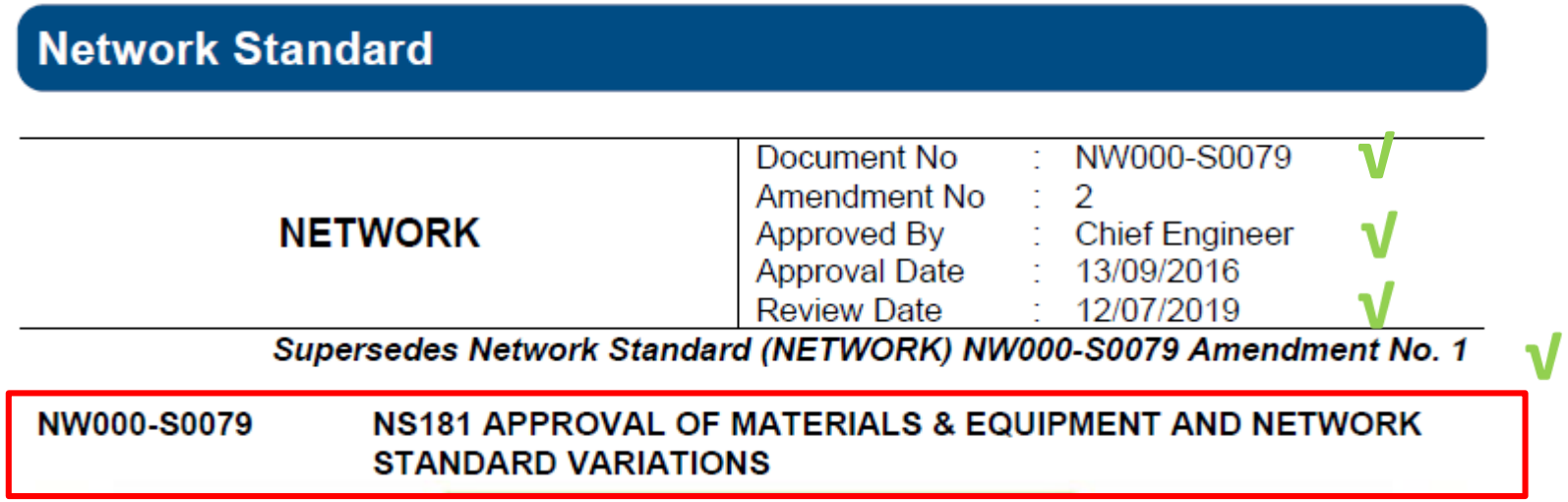
A range of international standards **already exist**;

- ISO 14040 **life cycle assessment** – principles and framework
- IEC 60300-3-3 application guide – **life cycle costing**

Even with standards, there is still variability on how life cycle costing is carried out;

- some exclude **inflation** and **depreciation** rates whilst others do not
- some include **asset disposal** and others don't, and so on

Documentation and Process - fundamental to success



Network Standard

NETWORK	Document No	: NW000-S0079	√
	Amendment No	: 2	
	Approved By	: Chief Engineer	√
	Approval Date	: 13/09/2016	
	Review Date	: 12/07/2019	√

Supersedes Network Standard (NETWORK) NW000-S0079 Amendment No. 1 √

NW000-S0079	**NS181 APPROVAL OF MATERIALS & EQUIPMENT AND NETWORK STANDARD VARIATIONS**

AUSgrid has more than **100 different standards plus amendments** which are **living** documents constantly under review and refinement

Managing approvals needs the utmost rigor

Ausgrid

Scope and Risks Addressed	Material and Equipment Approval	Network Standard Variations Approval
• ALL materials and equipment used in the construction and maintenance of the Network **must be approved by the Asset Management – Network Standards Group** • Approved materials and equipment are included in Australian Utilities approved materials list. • Any variation to the standards (design, construction and maintenance) must be approved by Australian Utilities. • **The standard applies to the procurement of <u>all</u> materials and equipment**	**MANDATORY** approval requirements; • **Inspection of manufacturing facilities;** • **Inspection of testing facilities including:** - documentation of test reports - record keeping - **evidence of electrical and mechanical standards met, e.g. IEEE, etc** • Approval Forms • Validity and Term of Approval	**MAJOR** approval requirements; • **Approval of variations** • Points of contact • Form of approval • **Amendments to Network standards** • Records update • Process Update • **Communication update:** - procurement - field crews incl. training - control room/RTAM group - Network Planners - Planners - Project Managers
Additional Information *see Sections 1 & 2 within*	**Tools and Forms** *Annexures A, B,C & F*	**Tools and Forms** *Annexures B, E & F*

Standards give you ability to reject equipment....

.....sub-standard equipment has **undesirable** impacts such as;

- ✓ safety
- ✓ reliability
- ✓ compatibility or operational issues

This includes, but not limited to situations where materials or equipment are found to be:

- **faulty** or **defective**
- **lesser quality**, as deemed by the utility, **than a sample product** that was submitted **at the time of original approval**
- **different** to what was **approved**
- manufactured at a manufacturing facility **different to what was approved**
- not compliant with the utilities requirements *(e.g. due to **un-notified changes by the manufacture/supplier**).*

Assessed based upon

- **compliance with AUSgrid Network Standards**;
- AUSgrid specifications which include **applicable Australian and International Standards**
- compliance with any other AUSgrid **technical requirements**
- **type testing** in accordance with the specification and **proof of compliance**
- current NATA or equivalent **accreditation of the testing facilities**
- **current ISO quality accreditation** of the design and manufacturing facilities
- manufacturing process controls
- environmental and work health & safety (WHS) impacts of the material or equipment

(incl. compliance with Work Health and Safety Act 2011 and Regulation 2011 (NSW) regarding Safety in Design)

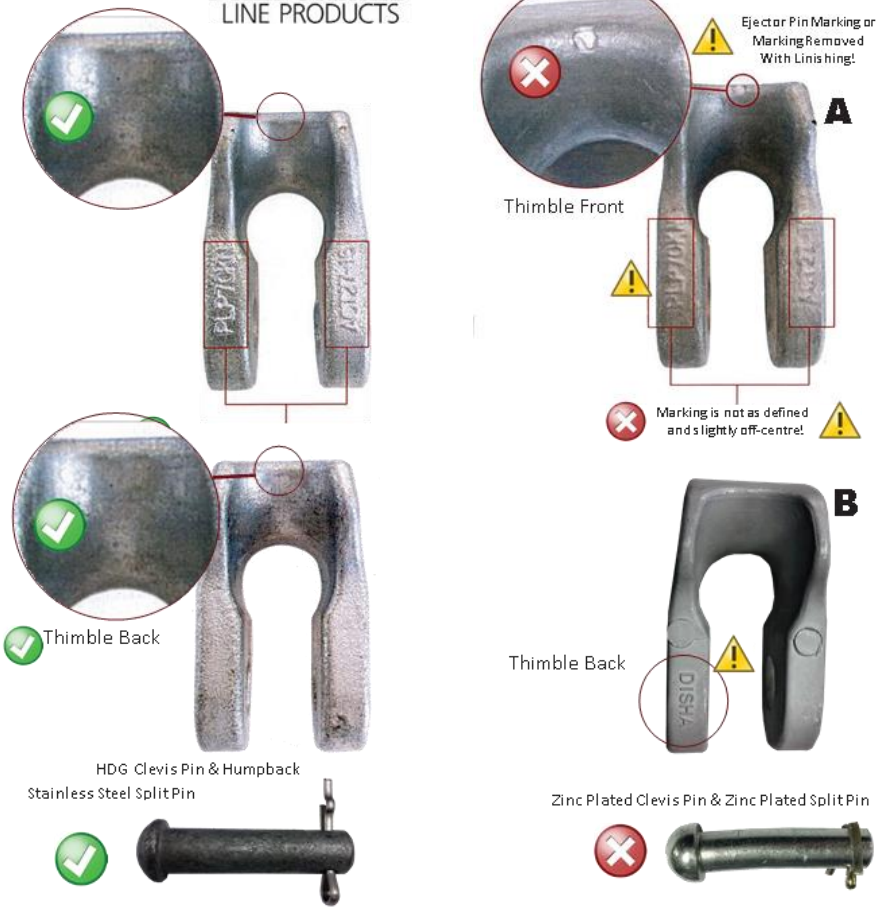
And underpinned with...

- **bankable warranties and guarantees**
- **product and public liability insurances**
- organisational structure and **financial strength** of the supplier
- **life cycle costs** of the equipment when used on AUSgrid's network
- implications regarding AUSgrid **maintenance** and **operations** processes
- **training requirements**

If you get it wrong, the consequences can be catastrophic

PREFORMED LINE PRODUCTS

COUNTERFEIT GOODS



P: +64 9 274 2000 | E: sales@electropar.co.nz | W: www.electropar.co.nz

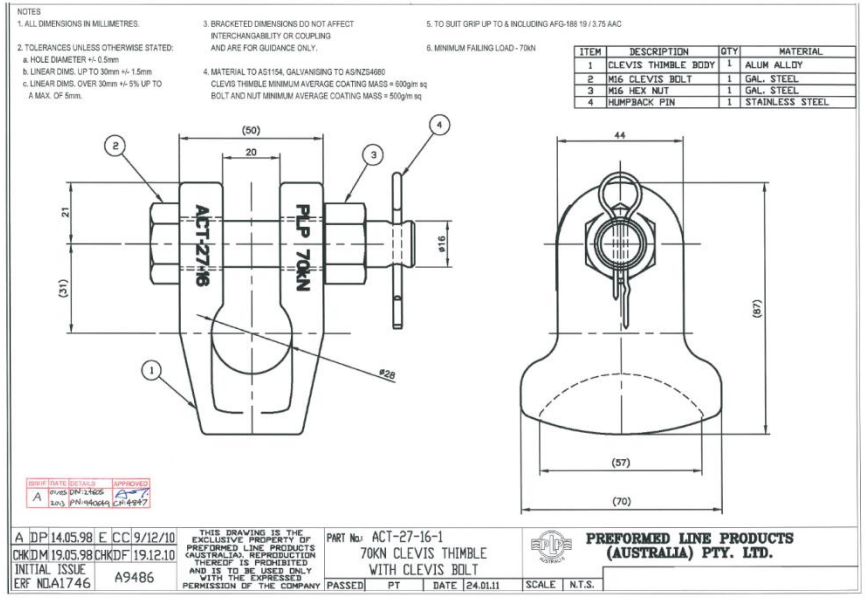
Pacific Island Utility – supplied counterfeit equipment

- **No** specifications
- **No** test certificate
- No materials compliance
- **Failed at 70% of breaking load**
- **Zinc plated pin** instead of galvanised

- **Attached to Transmission Lines**
- **Twice the price** of OEM equipment!

OEM equipment is:

- Material specified
- Corrosion & Mechanical specifications
- Test reports & certification supplied



MATERIAL TO AS1154, GALVANISING TO AS/NZS4680
CLEVIS THIMBLE MINIMUM AVERAGE COATING MASS = 600g/m sq
BOLT AND NUT MINIMUM AVERAGE COATING MASS = 500g/m sq

MINIMUM FAILING LOAD - 70kN

Counterfeit 70kN ACT-27-16

Failed at 51.3kN

Failed mechanical test requirement of AS1154.1 – 2009, section 2 Insulated fittings, clause 2.2. – Mechanical Strength Type Tests

Stainless Steel

Zinc Plated – TTF 3-4 years

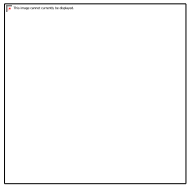
Black Saturday in Feb 2009, bushfire **survivors** secured $500 million

- 119 people died
- More than 1,000 homes destroyed
- 125,000 hectares of total destruction

Victoria has a history of electricity assets causing bushfires, 1969, 1977 and February 2009.

The electricity commission devoted a considerable amount of time to examining **systemic factors associated with the reliability and safety** of Victoria's distribution networks.

The Electricity Commission recommended MAJOR changes



- strengthening its regulatory capacity; and
- **replacing ageing electricity distribution infrastructure** with technology that delivers greatly reduced bushfire risk

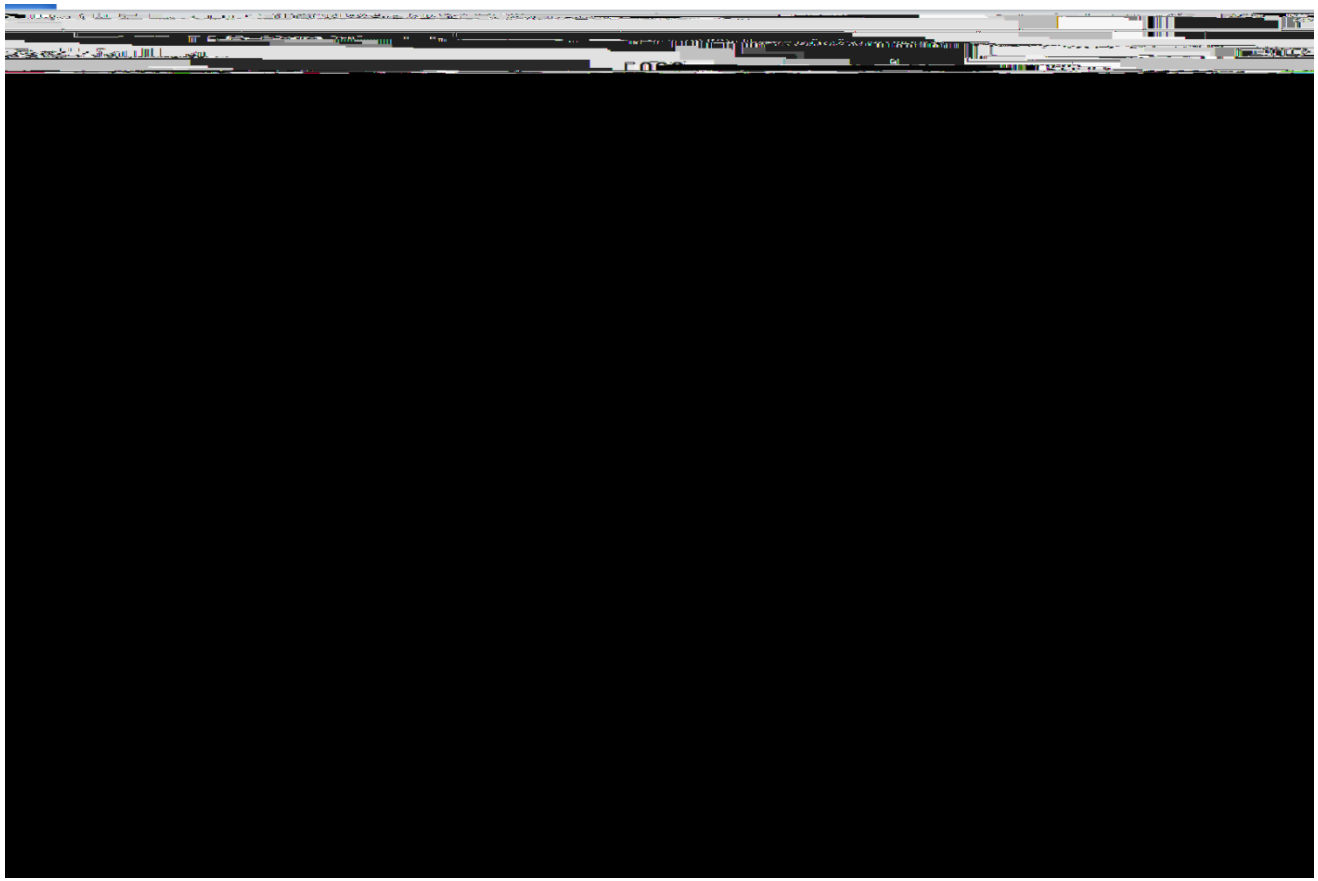
PLUS interim measures aimed at reducing the risk of electricity assets causing bushfires in the short term;

- **reducing** the length of the inspection cycle
- **improving** the efficacy of asset inspection
- **modifying** the operation of automatic circuit reclosers
- **retrofitting** vibration dampers to longer spans of power line; and
- **fitting** spreaders to power lines to minimise clashing

There is **nothing worse** than being told how to run your business!

Pacific Island Tender with limited specifications

Tenders MUST have drawings & specifications otherwise what are you buying?



1) Dulmison part code, if not it will be a copy & faulty

3) & 4) okay but what is the die size for crimping? Incorrect die connection at risk.

6) & 7) what material? If al clad steel this will rust vs. aluminium

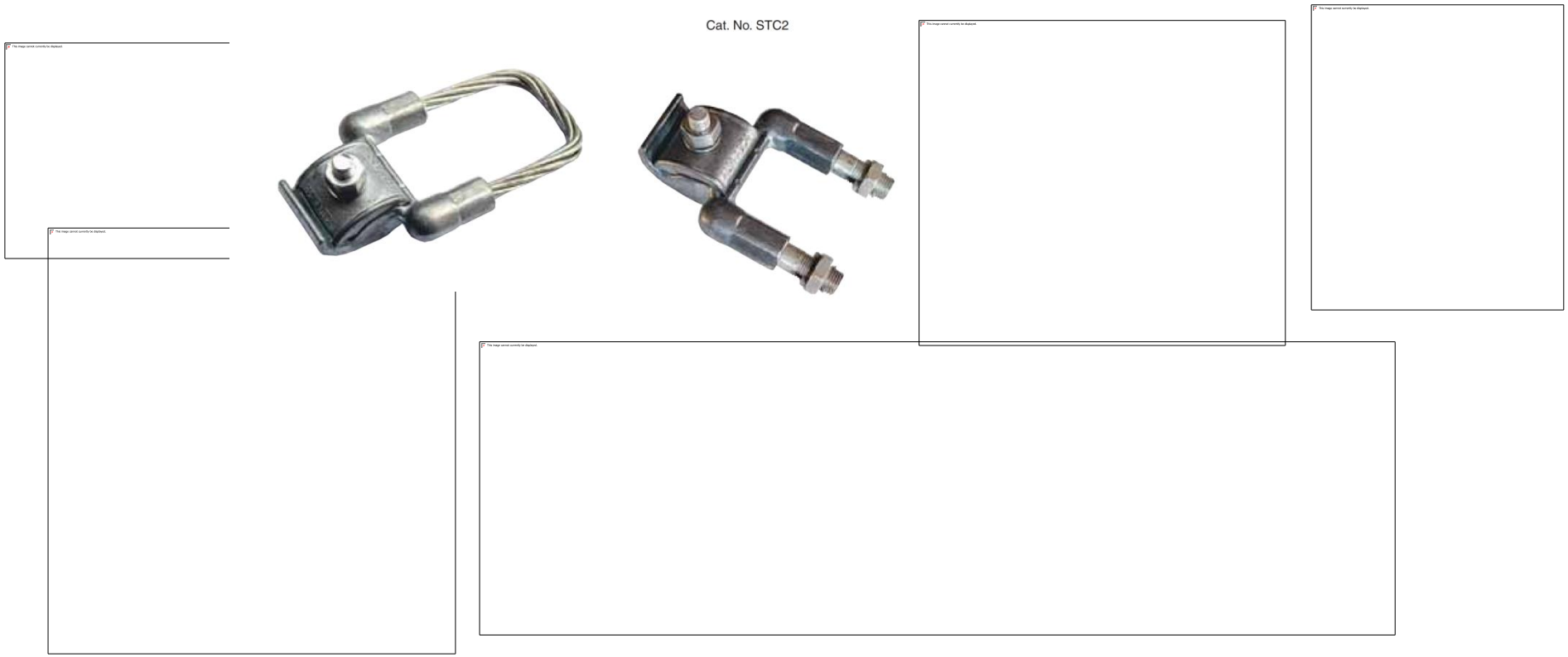
8) & 9) could be M12, M16, M20 Huge variation – price, size & strength

10) & 11) no galvanising specs, if from China this could be painted or Zinc plated

Some Pacific utilities appear blind to equipment standards for line hardware….this is **costing big $ annually** and a major contributor to poor reliability

- Legacy products copied by some **Trading Companies** sourcing from **China** and **India** with **NO** regards to testing and standards
- Confusion in the market over manufacturer brands, such as
  - **Dulmison** part numbers being used even by suppliers/traders who copy the original (type tested) parts e.g.: ACT27-16 , STC2-1 LTD75-1 , AC58-1 , LT48-1
- Procurement buying on **“looks”** instead of on correct test specifications, standards and manufacturer warranties
- When we see som Islands going through 400 connectors per month, that means they are faulty, i.e. to the tune of **$230,000+** each year – this <u>should not</u> be happening

Most focus on larger capital items such as switchgear, transformers and conductor, whilst the **smaller items fly under the radar of control and cost…**

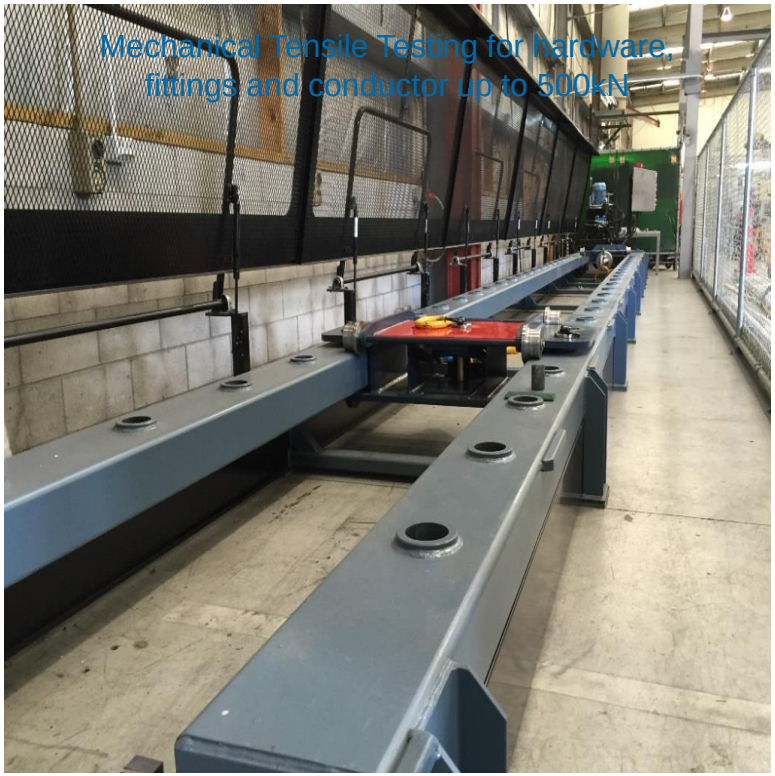


.....we see **millions of dollars** annually being wasted in the Pacific on inferior products, purchased without standards and specifications

Use certified test laboratories and demand inspection

Mechanical Tests: Tensile and Compression

- 0-300kN Vertical test facility
- 10N Minimum tensile or compression
- 0-500kN Horizontal test facility to 20m test length
- Twist, wrap and torsion tests: methods: AS 1222, 1531, 3607
- 30kN Cantilever flex test
- Clamp slip test
- Tension tests on products without strain rate control



Dimensional Tests

- Profile projector
- Vernier callipers
- Micrometers
- Digital and analogue height indicators
- MEL lasers
- Go and No-Go guages

Cyclic Thermal Tests

- Heat cycle of conductors with data logger capability to 240° C

Material Structure Analysis

- Gripo grinder polisher
- Microscope

Ultrasonic Testing

- Ultrasonic flaw and RIF detection

Mechanical Endurance Testing

- Induction shaker force rating 980N
- Frequency range 1.5-3000Hz

Standards

- AS Australian Standards
- ANSI American Standards
- BSI British Standards
- IEC International Standards
- NATA Accredited

Use certified test laboratories and demand inspection

Hardness Tests

- Brinell at 7.35, 4.9, 9.8 and 29.4 kN
- Rockwell testing using B, C scales
- Vickers
- Shore
- Barcol

Prosperity Tests

- Integrity testing of porcelain insulators

Application Oriented Endurance Test

- Fatigue testing of transmission line in-span conductor spacers

Vibration Analysis

- 2 x 30.5m Test spans equipped to measure vibration damper performance
- Vibration analysis measuring:
  - Damper mechanical impedance
  - Damper fatigue
  - Damper efficiency

Galvernising Thickness Test

- Magnetic method

Thermal Shock

- Extreme temperature change test on porcelain insulators

Thermal Endurance

- Prolonged elevated temperature test on spiral vibration dampers

Use certified test laboratories and demand inspection

Heat Cycle Tests

• IANZ Accreditation for IEC61238 (power cables up to 30kV) and IEC61284 (overhead lines).

IANZ is an ILAC Mutual Recognition Authorized Signatory. EPLP can co-accredit IANZ Reports with other ILAC Accreditations such as : NATA(Au)/ CGCRE(Br)/ CNAS(Ch)/ NABL(Id)/ KAN(In)/ SM(Ma)/ PAO(Ph)/ SANAS(SA)/ NSC(Th) / UKAS((UK).

• Lab equipment and methods can be adapted to accommodate other equivalent standards eg. BS3288:1, AS1154.1

Short Circuit Tests

• IANZ Accreditation for IEC61238 (power cables up to 30kV)
• Short circuit 11kV supply via two 400kVA transformers on-site
• Max Output: 25kA@40.6V (~6s duration)
• Temperature monitoring

Magnetic Power Loss Tests

• IANZ Accreditation for IEC61284 (overhead lines)
• Heat units 2 and 4 provide pure sine wave current supply
• Externally calibrated instrumentation and measurement systems

- **Heat Unit 1 – 23kVA Max Output**: 1533A@13.5V or 2000A@9.78V (Continuous) 1932A@13.5V or 2300A@9.78V (Short-term)

- **Heat Unit 2 – 7kVA Max Output**: 1000A@5.85V (Continuous) 1200A@5.85V (Short-term)

- **Heat Unit 3 – 75kVA Max Output**: 2500A@27V (Continuous) 3000A@27V (Short-term)

- **Heat Unit 4 – 25kVA Max** Output: 2500A@10V (Continuous) 3000A@10V (Short-term)

Environmental Electrical Tests

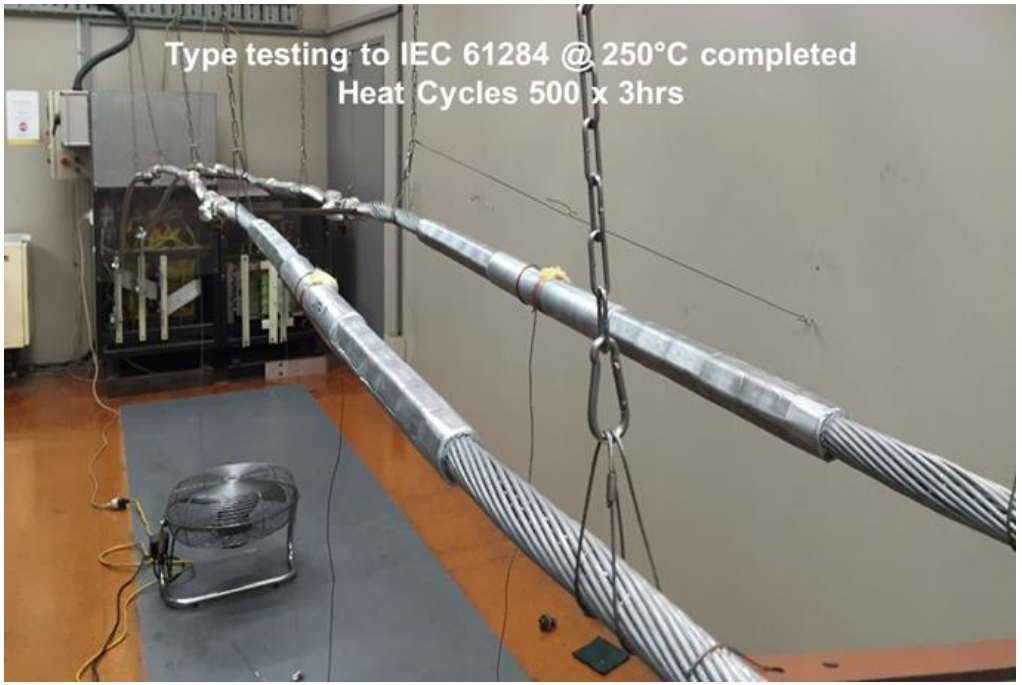
• Programmable environmental chamber -40°C to 100°C
• Tensions up to 100kN
• Up to 6kV

Joint Analysis

• Analysis of ex-service joints to determine failure mechanism(s)
• Availability of live-line instruments and analytical tools including Ohmstik, Voltstik, and Reluctance tester

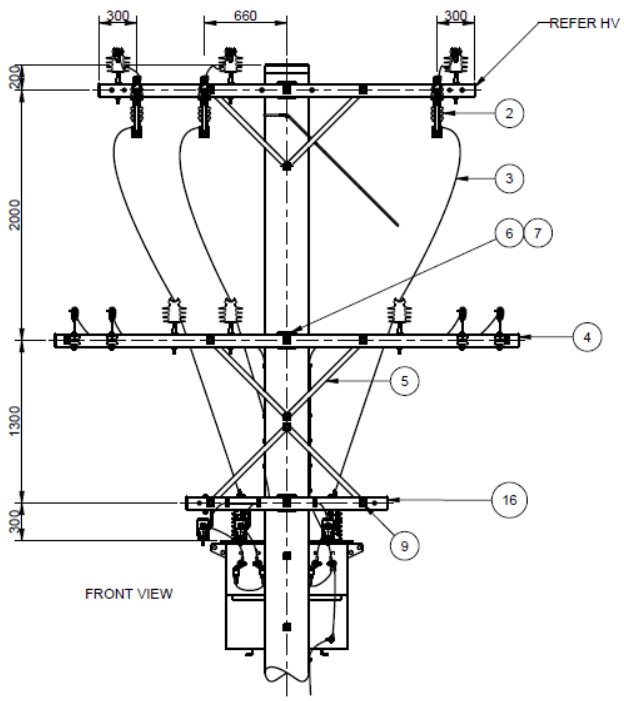
Use certified test laboratories and demand inspection

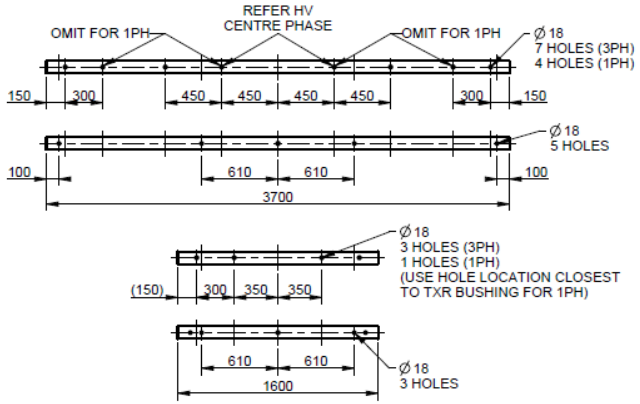
Predictive Modelling on conductor and ACSS compression fittings (asset life and performance)

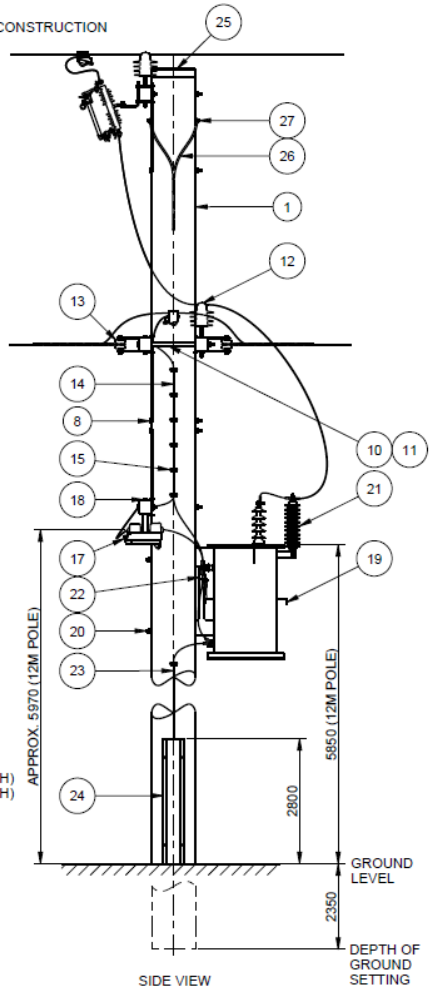


Cyclic Thermal Tests

•Heat cycle of conductors with data logger capability to 250° C







PARTS LIST

ITEM	QTY 3PH	QTY 1PH	DESCRIPTION	REF
1	1	1	POLE 12M HEAVY DUTY	
2	3	2	HV CUTOUT FUSE ASSEMBLY	
3	3	2	HV BRIDGING ASSEMBLY 19/064 (1.63) CU PVC	
4	2	2	CROSSARM 3700x100x100	
5	6	6	CROSSARM BRACE	
6	3	3	CROSSARM GAIN BLOCK	
7	2	2	M16 KING POLE BOLT	
8	2	2	M16 CROSSARM BRACE POLE BOLT	
9	6	6	M16 CROSSARM BRACE BOLT	
10	2	2	20NB HDG PIPE CROSSARM SPACER	
11	2	2	M16 CROSSARM SPACER BOLT	
12	3	2	HV INTERMEDIATE INSULATOR ASSEMBLY	
13	4	2	LV STRAIN/ INTERMEDIATE INSULATOR ASSEMBLY	
14	4	2	LV BRIDGING ASSEMBLY 19/083 (2.11) CU PVC	
15	-	-	SADDLES	
16	1	1	CROSSARM 1600x100x100	
17	3	1	LV MAINS POLE FUSE ASSEMBLY	
18	3	1	LV MAINS POLE FUSE BOLT	
19	1	1	POLE MOUNTED TRANSFORMER	
20	2	2	M20 TRANSFORMER MOUNT POLE BOLT	
21	3	2	HV SURGE ARRESTER ASSEMBLY	
22	3	1	LV SURGE ARRESTER ASSEMBLY	
23	1	1	POLE EARTH ASSEMBLY 19/064 (1.63) CU PVC	
24	1	1	RISER CABLE GUARD	
25	1	1	POLE CAP	
26	1	1	STAY ASSEMBLY	
27	2	2	M12 x 100mm COACH SCREW	

NOTES

1. END OF CROSSARM, BETWEEN POLE AND CROSSARM, AND ALL BOLTS TO BE GREASED.
2. ALL BOLTS TO BE PULLED TIGHT AGAINST CROSSARM / POLE. THREAD IMMEDIATELY BEHIND NUT SHALL BE BURRED TO EFFECTIVELY PREVENT LOOSENING OF NUT.
3. DO NOT USE GROUND STAY IF TRANSFORMER IS MORE THAN 1400kg

REV	REV DATE	DRWN	CHKD	APVD	CHANGE NUMBER	DESCRIPTION
A	27.07.17	YS	AT	AT	5950	1. NEW DRAWING ISSUE

UNITS: MILLIMETERS
DO NOT SCALE
THIRD ANGLE PROJECTION

TOLERANCES
UNLESS NOTED
x ± 1
x.x ± 0.4

QUALITY PLAN

QTY.	LABEL	
0	C	CRITICAL DIMENSION
0	V	VISUAL INSPECTION

ELECTROPAR NEW ZEALAND

PRODUCTION DRAWING TITLE
SUBSTATION
STANDARD, WOOD POLE
POLE MOUNT TXR

DRAWN BY	PART NUMBER	DRAWING NUMBER
YS	SS-POLA	30631

DATE DRAWN	SCALE	SHEET No	ORIGIN	REV
17.05.17	NTS	1 OF 1		A

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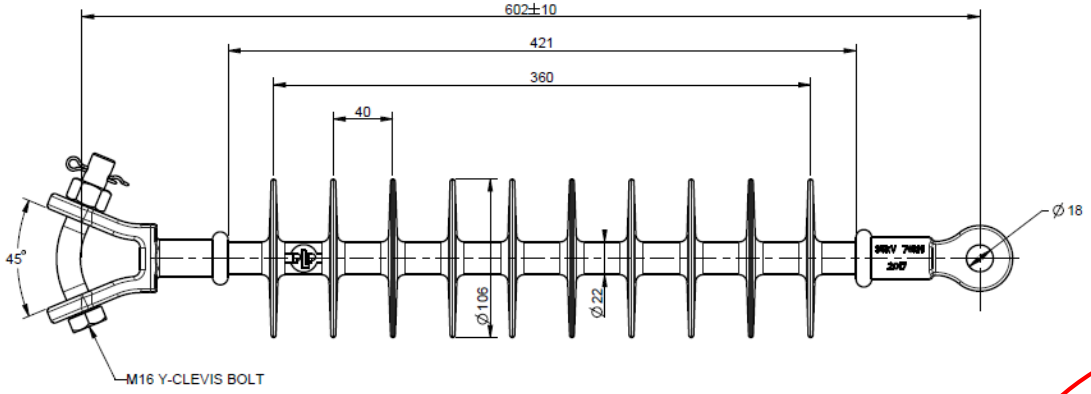
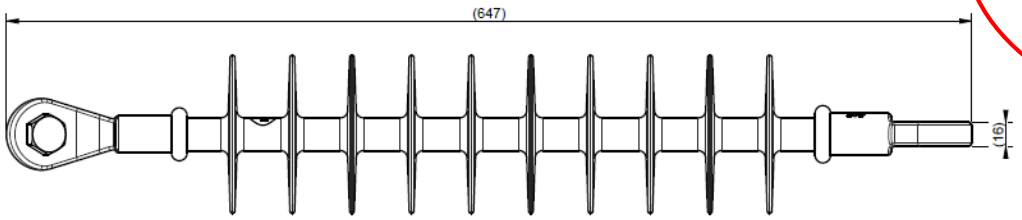
PRODUCT DRAWING

UNRESTRICTED RELEASE

OEM drawings submitted in tenders & inferior product substituted





NOTES

1. NOMINAL RATING: 35kV
2. CREEPAGE DISTANCE: 1160mm
3. DRY ARCING DISTANCE: 465mm
4. SPECIFIED TENSION LOAD: 70kN
5. WITHSTAND IMPULSE VOLTAGE: 200kV
6. POWER FREQUENCY WITHSTAND VOLTAGE: 95kV
7. HOUSING COLOUR: GREY
8. MATERIAL - INSULATOR: HTV SILICONE
   - CORE: FRP
9. END FITTINGS: GALVANISED STEEL ISO 1461
10. REFERENCE STANDARD: IEC 61109

REV	REV DATE	DRAWN	CHKD	APP'D	PURCHASE NUMBER	DESCRIPTION
2	27.07.17	RP	AT	AT	5950	1. NEW DRAWING ISSUE

UNITS: MILLIMETERS

DO NOT SCALE

THIRD ANGLE PROJECTION

TOLERANCES UNLESS NOTED

x ± 1

x.x ± 0.4

ELECTROPAR NEW ZEALAND

PRODUCTION DRAWING TITLE

POLYMER STRAIN INSULATOR
35 kV (HIGH CREEPAGE), 70kN
LR35X-YT

QUALITY PLAN

QTY.	LABEL	
0	C	CRITICAL DIMENSION
0	V	VISUAL INSPECTION

DRAWN BY	PART NUMBER	DRAWING NUMBER
SM	INS-LR35X	30706

DATE DRAWN	SCALE	SHEET No	ORIGIN	REV
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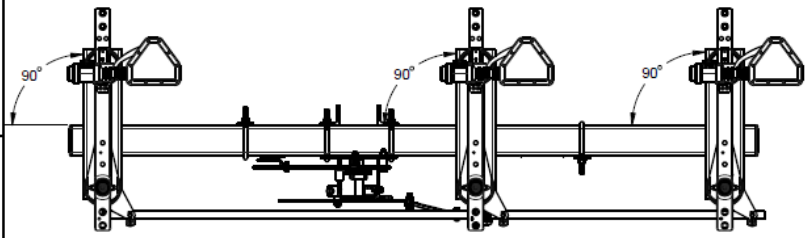
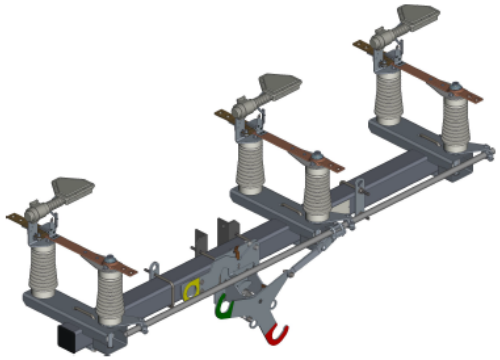
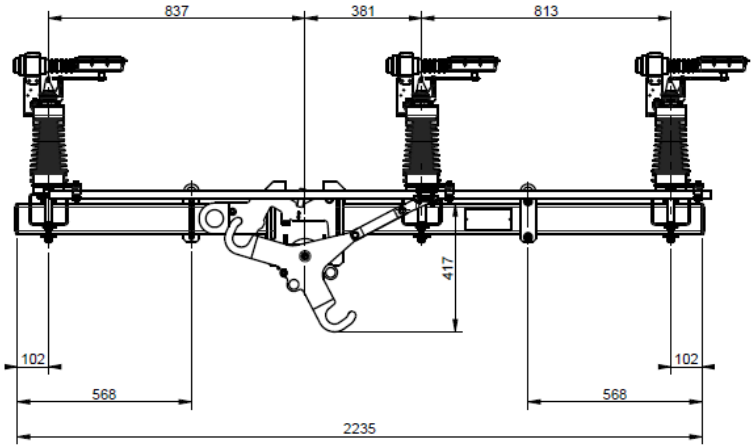
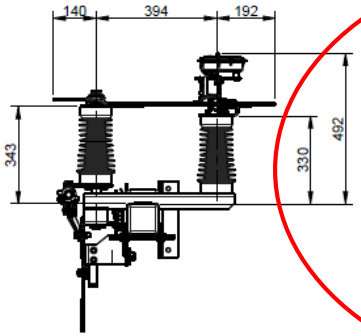
PRODUCT DRAWING

UNRESTRICTED RELEASE









NOTES

1. VOLTAGE - NOMINAL: 25kV
2. VOLTAGE - MAXIMUM: 29kV
3. VOLTAGE - BIL: 150kV: 150kV
4. CURRENT - CONTINUOUS: 900A
5. CURRENT - INTERRUPTING: 900A
6. CURRENT - FAULT PEAK: 65kA
7. CURRENT - FAULT RMS SYMMETRICAL (1s): 25kA
8. CURRENT - FAULT RMS SYMMETRICAL (3s): 20kA
9. CURRENT - FAULT CLOSING PEAK, 2x DUTY CYCLE: 42kA
10. CURRENT - FAULT CLOSING PEAK, 10x DUTY CYCLE: 21kA
11. INSULATORS: CYCLOALIPHATIC
12. OPERATING MECHANISM: HOOK FUSE STICK
13. POLE BRACKET MOUNTING: TOP/ MID POLE

REV	REV DATE		CHKD	APVD	CHANGE NUMBER	DESCRIPTION
A	27.07.17	RP	AT	AT	5950	1. NEW DRAWING ISSUE

UNITS: MILLIMETERS
DO NOT SCALE
THIRD ANGLE PROJECTION
TOLERANCES UNLESS NOTED
x ± 1
x.x ± 0.4
QUALITY PLAN

QTY.	LABEL	
0	C	CRITICAL DIMENSION
0	V	VISUAL INSPECTION

ELECTROPAR NEW ZEALAND

PRODUCTION DRAWING TITLE

S&C OMNI-RUPTER R4 AIR BREAK SWITCH
22kV, HOOK STICK OPERATION
EPS2FS OMNI R4 H2S

DRAWN BY	PART NUMBER	DRAWING NUMBER
LP	SWP-ABS22	30756

DATE DRAWN	SCALE	SHEET No	ORIGIN	REV
16.01.13	NTS	1 OF 1		A

30756 < FILENAME < INTERNAL USE ONLY

"Fit for Purpose" switchgear specifically for coastal and tropical environments

Existing standards and guidelines

ISO 55000, 55001 and 55002 are well-known general asset management standards published in 2014 and are a derivative of **PAS 55** standards originally from the British Standards Institute

- General in nature and targeted at larger assets in electricity, gas , water, road, air and transport, however under ISO 55001 planning for **actions due to asset failures** and subsequent impacts **requires further attention**

- and, more emphasis on **monitoring** and **measuring** asset performance

- Supported with;
- ISO 9001 - Quality Management Systems
- ISO 14001 - Environmental Management System
- ISO 31000 - Risk Management
- ISO/IEC - 19770 IT Asset Management
- ASTM E53 – Asset Management Standards

SCARAB SYSTEMS
TIMO ALEFAIO

- And the list goes on and on....**ONLY** use what your business can effectively handle to improve RoI and Network performance.

- **ENDS –**

Thank you for your time