Comparative Recertification

Keith Jones & Tom Stewart

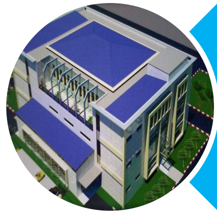
MEP and ATH Forum

Wellington 8 February 2017

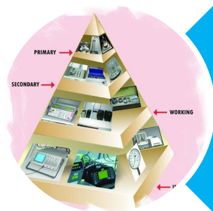
Callaghan Innovation

1035184

MSL



Measurement Standards Laboratory of New Zealand



National Metrology Institute

Provide for *scientifically* accurate measurements

- physical standards & calibration
- training & advice

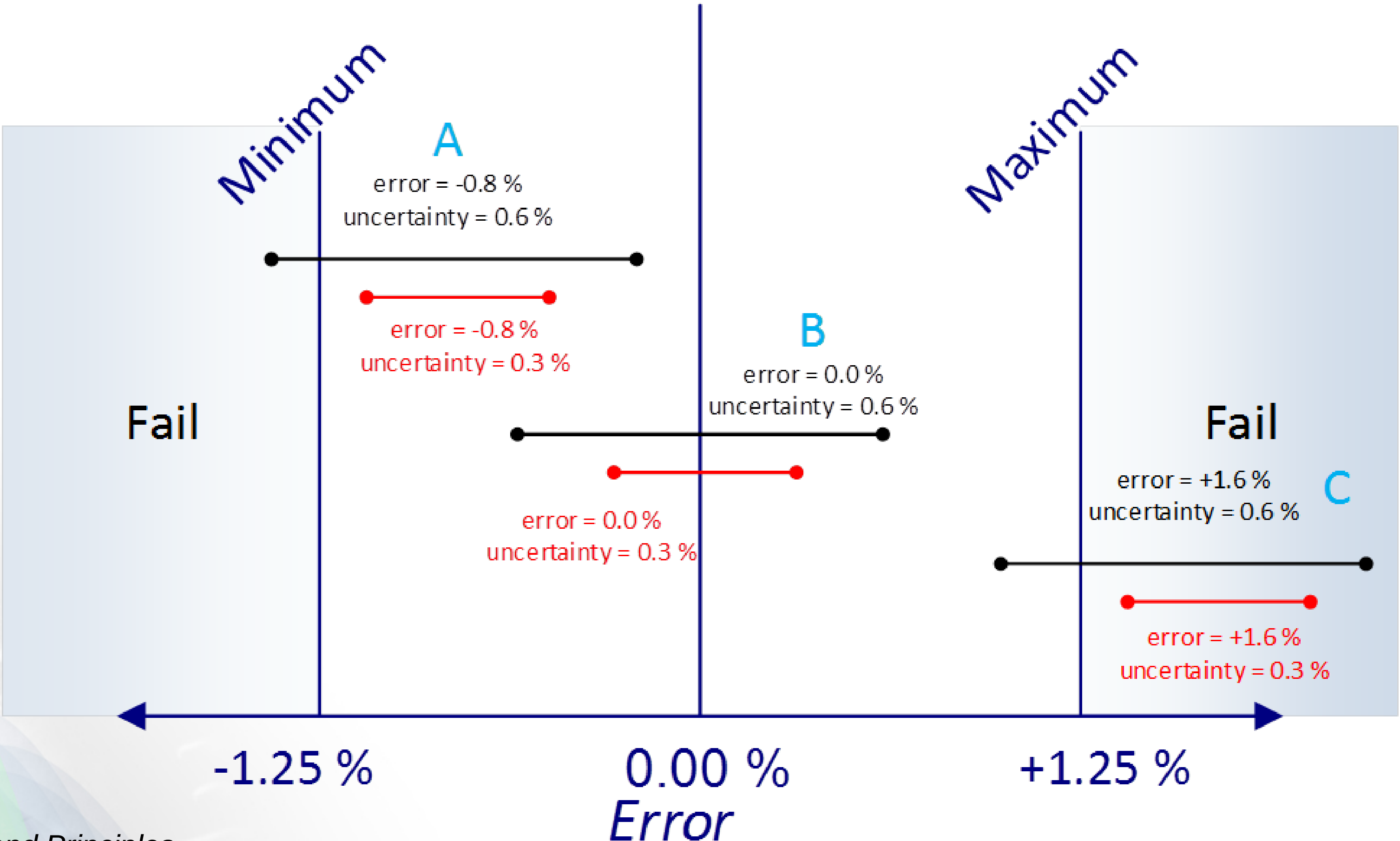
Not a regulator

Content

- Aims and Principles
- Technical
- +Issues

Accuracy Requirements

- Table 1 schedule 10.1



Schedule 10.1, Table 1

Defining Characteristics				Associated Requirements of active energy metering							
Metering installation category	Primary voltage (V)	Primary current (I)	Measuring transformers	Metering installation certification type	Accuracy tolerances		Selected component metering installation minimum IEC class (more accurate components may be used)		Metering installation certification and inspection		
					Maximum permitted error	Maximum site uncertainty	Meter	Current Transformer	Maximum metering installation certification validity period	Maximum sample inspection and recertification period	Inspection period
1	V < 1kV	I ≤ 160A	None	NHH or HHR	± 2.5%	0.6%	2	N/A	180 months	84 months	120 months ± 6 months
2	V < 1kV	I ≤ 500A	CT	NHH or HHR	± 2.5%	0.6%	2	1	120 months	N/A	120 months ± 6 months
3	V < 1kV	500A < I ≤ 1200A	CT	HHR only	± 1.25%	0.3%	1	0.5	120 months	N/A	60 months ± 3 months
	1kV ≤ V ≤ 11kV	I ≤ 100A	VT & CT				N/A	N/A			
	11kV < V ≤ 22kV	I ≤ 50A					N/A	N/A			
4	V < 1kV	I > 1200A	CT	HHR only	± 1.25%	0.3%	N/A	N/A	60 months	N/A	30 months ± 3 months
	1kV ≤ V ≤ 6.6kV	100A < I ≤ 400A	VT & CT								
	6.6kV < V ≤ 11kV	100A < I ≤ 200A									
	11kV < V ≤ 22kV	50A < I ≤ 100A									
5	1kV ≤ V ≤ 6.6kV	I > 400A	VT & CT	HHR only	± 0.75%	0.2%	N/A	N/A	36 months	N/A	18 months ± 1 month
	6.6kV < V ≤ 11kV	I>200A									
	V > 11kV	I > 100A									
	V > 22kV	Any current									

Accuracy of What?

Accuracy in the measurement of energy delivered in any 12 month period…

- metering installation designed to meet this goal
- all participants have a % guarantee on their dollars at risk

Outcome focus

- future-proof approach
- minimum prescription as to how to achieve the desired outcome

Advantage for Users?

Users (including consumers) know the maximum allowed error in the measurement of energy they use

- don‘t need to know technical details about their metering installations
- maximum allowed error the same regardless of usage pattern

Confident that metering is not distorting pricing

Disadvantages?

Designing and certifying metering installations can be more complicated

- need to know usage pattern, climate
- better characterisation of metering components
- or simplify by using more accurate equipment

Technical Challenge

How accurate is an IEC class 1 meter?

- in the calibration laboratory?
- in actual use?

IEC Specification

- Guaranteed in-use performance

Power Factor:	unity		0.5 inductive	
Class:	2	1	2	1
Maximum % error shift permitted for:				
base error	2.0	1.0	2.5	1.5
voltage variation	1.0	0.7	1.5	1.0
frequency variation	0.8	0.5	1.0	0.7
variation of harmonics	1.0	0.8	1.0	0.8
temperature variation	0.1	0.05	0.15	0.07
Combined maximum permissible % error	2.6	1.5	3.2	2.1

Technical

Simplified Uncertainty

The term 'combined maximum permissible error' applies to a combination of error and uncertainty

- better accuracy could likely be proved using advanced calculations
- See MSL Technical Guide 33 – Electricity Metering: Advice for Class B Approved Test Houses for more detail

Fit for Purpose

- Can use performance specifications for simpler accuracy calculations
  - test/calibration reports must confirm compliance with specification

MSL Technical Guide 33

Electricity Metering: Advice for Class B Approved Test Houses

Introduction

The New Zealand requirements for revenue electricity metering are given in Part 10 of the Electricity Industry Participation Code ('the code') [1]. The code continues to be revised regularly, but the essential requirements for ensuring the accuracy of metering installations have not

leads to us representing our knowledge of the error as a range of values (an error interval). In Fig. 1 the range of values is represented as a horizontal line showing values extending from the measured error minus the uncertainty to the measured error plus the uncertainty. In a statistical sense this means that we are willing to bet that the actual error of the metering site lies somewhere on the horizontal line.

msl.irl.cri.nz (➔Training and Resources ➔ Technical Guides)

Importance of Testing

In practice meters are usually designed to perform better than the minimum IEC requirements

- improved specifications supported by type-test results and calibration

Current Transformer

- How accurate is an IEC class 0.5 CT?
  - (in terms of power measurement)

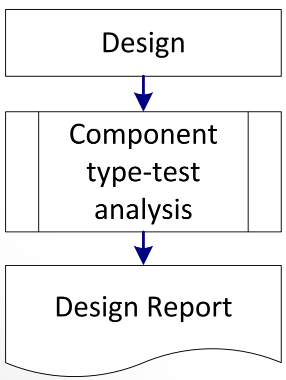
Power Factor:	unity		0.8		0.5	
Class:	1.0	0.5	1.0	0.5	1.0	0.5
Maximum %error shift permitted for:						
base error	1.0	0.5	1	0.5	1	0.5
phase displacement	0.0	0.0	1.4	0.7	3.1	1.6
Combined maximum permissible %error	1.0	0.5	1.7	0.8	3.3	1.6

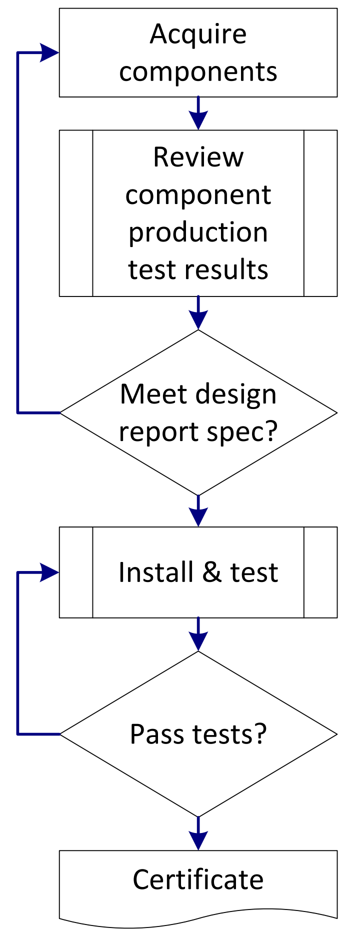
Technical

Approved Test Houses

- ATHs resolve these problems

design ➔ *certification*

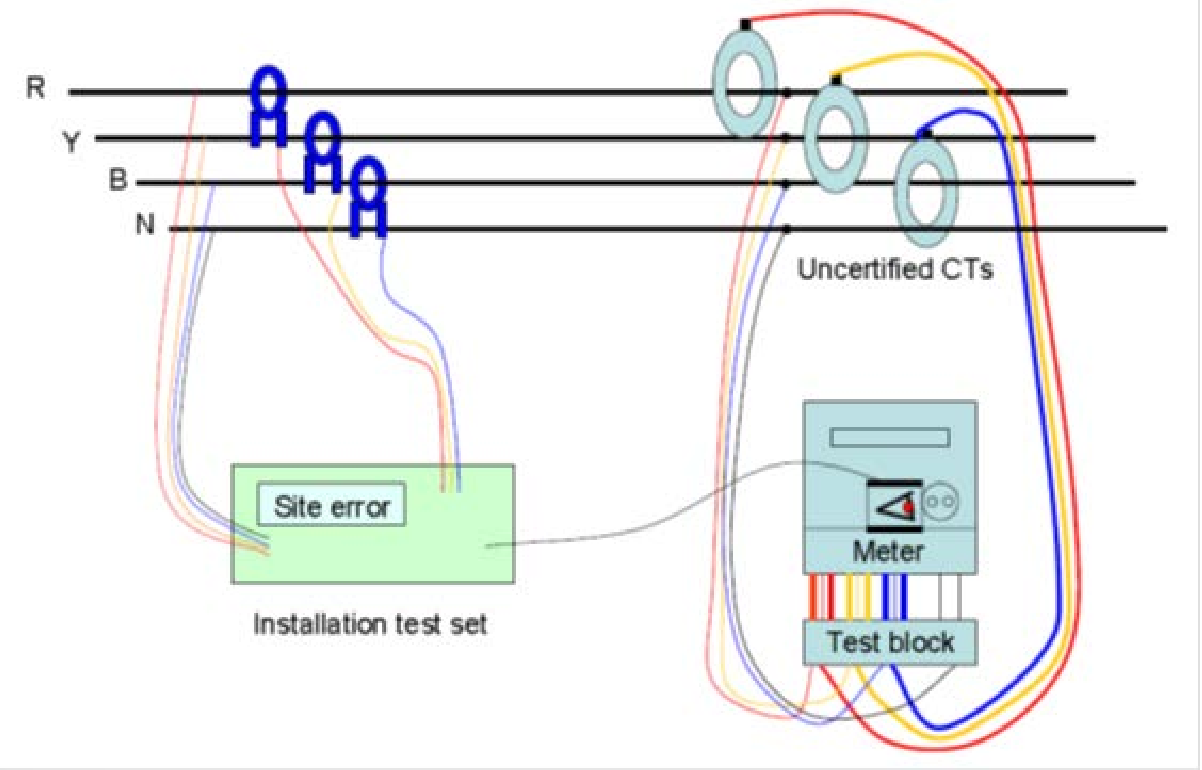




Technical

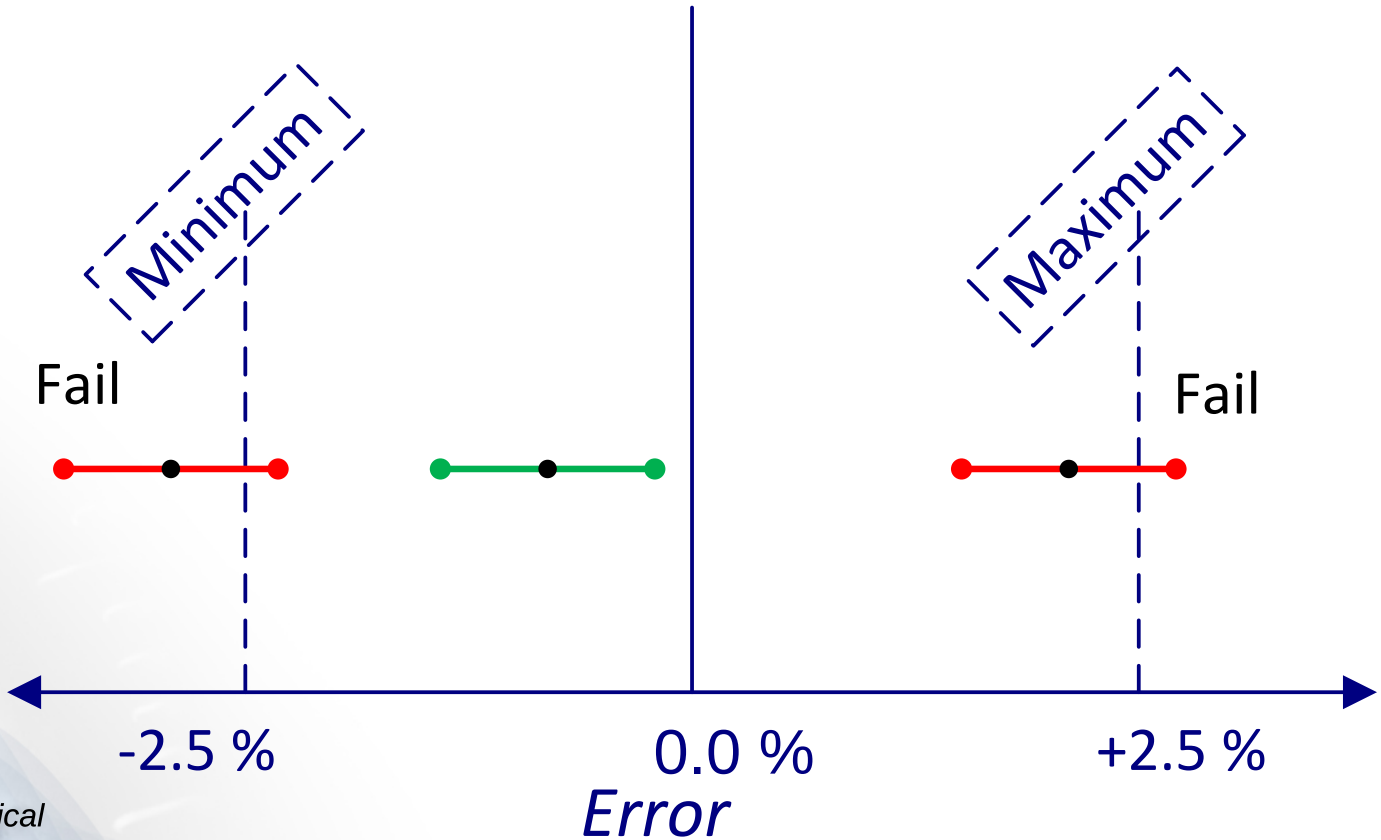
Comparative Recertification

- When in-situ current transformers cannot be disconnected for calibration purposes
- Comparative recertification is for cat 2 sites
  - Connect a standard meter with clamp CTs



Category 2 site

- ±2.5 % max error
- 0.6 % max uncertainty



Technical

The Right Field Equipment

- Choose clamp CT with minimum phase displacement

clamp CT	typical		high performance	
Power Factor:	unity	0.5 inductive	unity	0.5 inductive
Uncertainty for:				
clamp CT ratio	0.3	0.3	0.1	0.1
clamp CT phase effect	0.0	1.5	0.0	0.15
Portable meter	0.2	0.2	0.2	0.2
Portable standard total	0.4	1.5	0.2	0.3

phase displacement

typical clamp CT 0.5°

high performance clamp CT 0.05°

Technical

Enough Resolution

Need 1000 or more counts from both meters to make sure that digital resolution is 0.1% or better

- time taken depends on prevailing load

Pass or Fail?

Available information

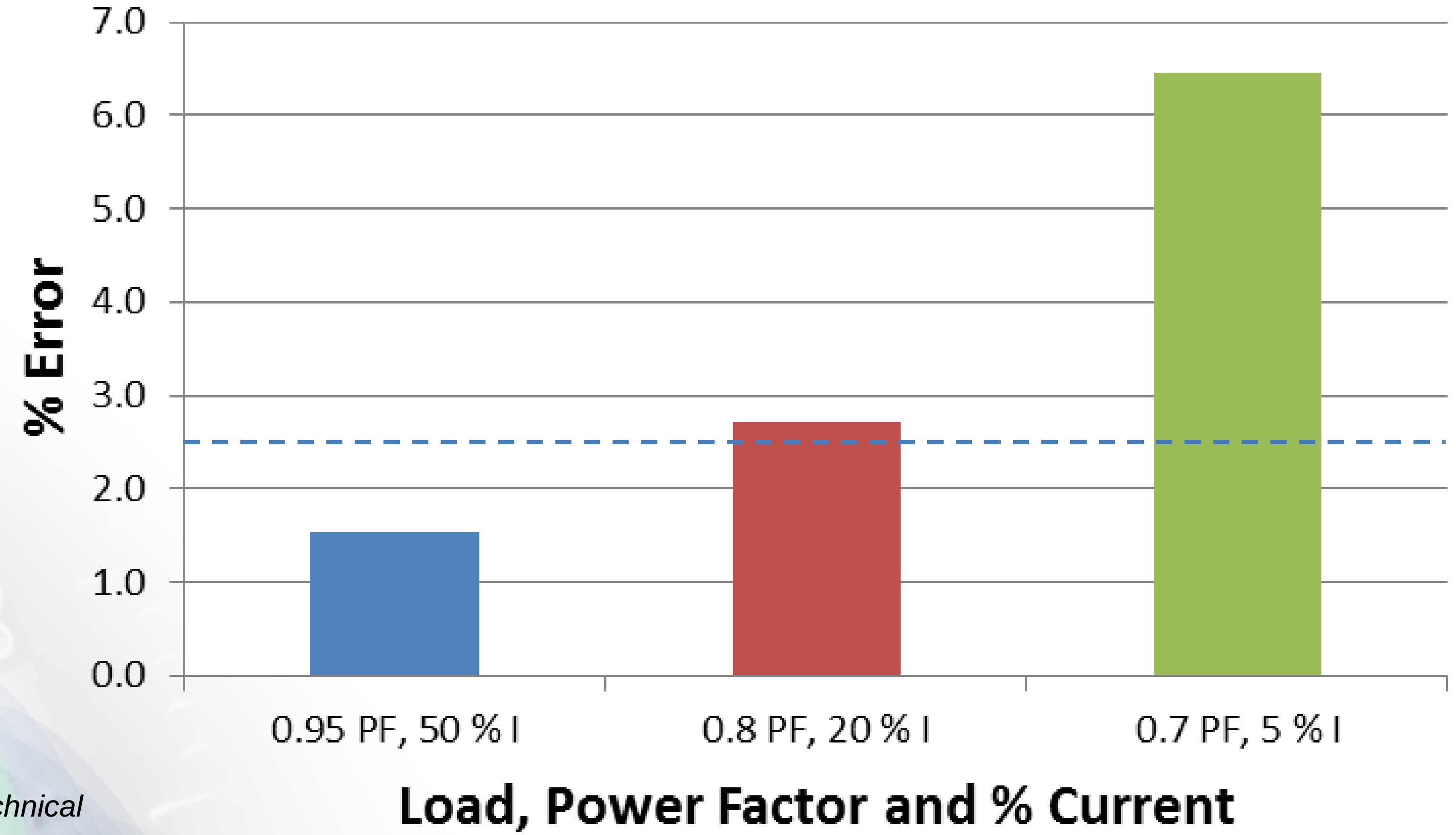
- one measured *difference* at the load at the time of the measurement
- an estimate of the maximum likely error of the field equipment

Decision

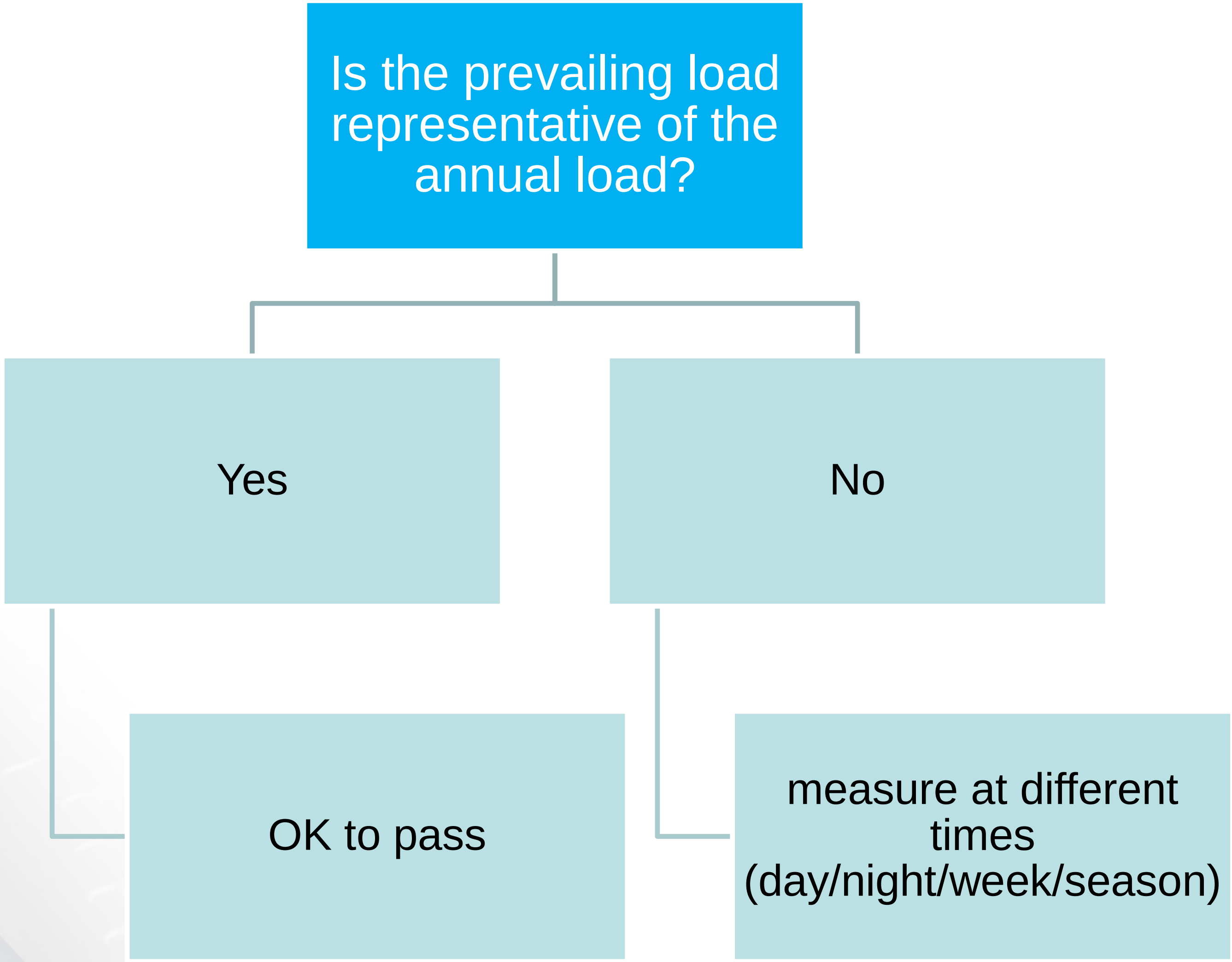
- Set *test limit* to 2.5% - field equipment max error (e.g. 1.9 % for 0.6% equipment error)
- Pass if *difference* less than or equal to *test limit*

Prevailing Load

- Accuracy of metering installation varies with the actual load.

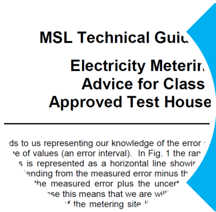


Experience & Judgement



Technical

Summary



Maximum error specifications of instruments can replace more detailed calculations

Choose clamp CTs with small phase displacements at relevant current

Minimise resolution errors with adequate measurement time

No simple rule for coping with limitations of prevailing load – judgement needed

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Traceable Electrical Energy Metering Workshop
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