OPTIMIZING CONDITION BASED MAINTENANCE (CBM) TECHNOLOGIES IN OVERHEAD LINES TRAINING METHODOLOGY

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Speaker Biography

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Working Experiences

Training Engineer ILSAS (Overhead Lines & Renewable Energy Unit) (2015-Present)

- ❑Certified International Specialist for Solar Technology BBZ Arnsberg Germany (Handwerksammer Sudwestfalen) and Carl Duisberg Centren.
- ❑Certified Ultrasound Inspection Level 1 (SNT-TC-1A-(2006).
- ❑Certified Infrared Thermographer Level 1 (SNT-TC-1A-(2006).
- ❑Professional Drone Certified Practitioner Civil Aviation Authorities of Malaysia (CAAM).
- ❑Certification in Critical Thinking (Global Association of Applied Neuro Synergy-GAANS).
- ❑Trainer for Low Voltage Liveline Works.
- ❑Training of Trainer (TOT).
- ❑Certified ILSAS Blended Learning Practitioner.
- ❑NIOSH-TNB Safety Passport Holder.
- ❑OGSP-Oil & Gas Safety Passport Holder.
- ❑Training Evaluation : Effective Training & Training Effectiveness / Level 4 Certificate.

Branch Manager TNB Hutan Melintang Perak (2015)

- ❑Change Agent BCRM.
- ❑Tender Committee TNB Teluk Intan.
- ❑Care Ambassador TNB Teluk Intan/TNB Hutan Melintang.
- ❑Committee of TNB Technical Preparation for Sultan Nazrin Shah's Coronation as the 35th Sultan of Perak.

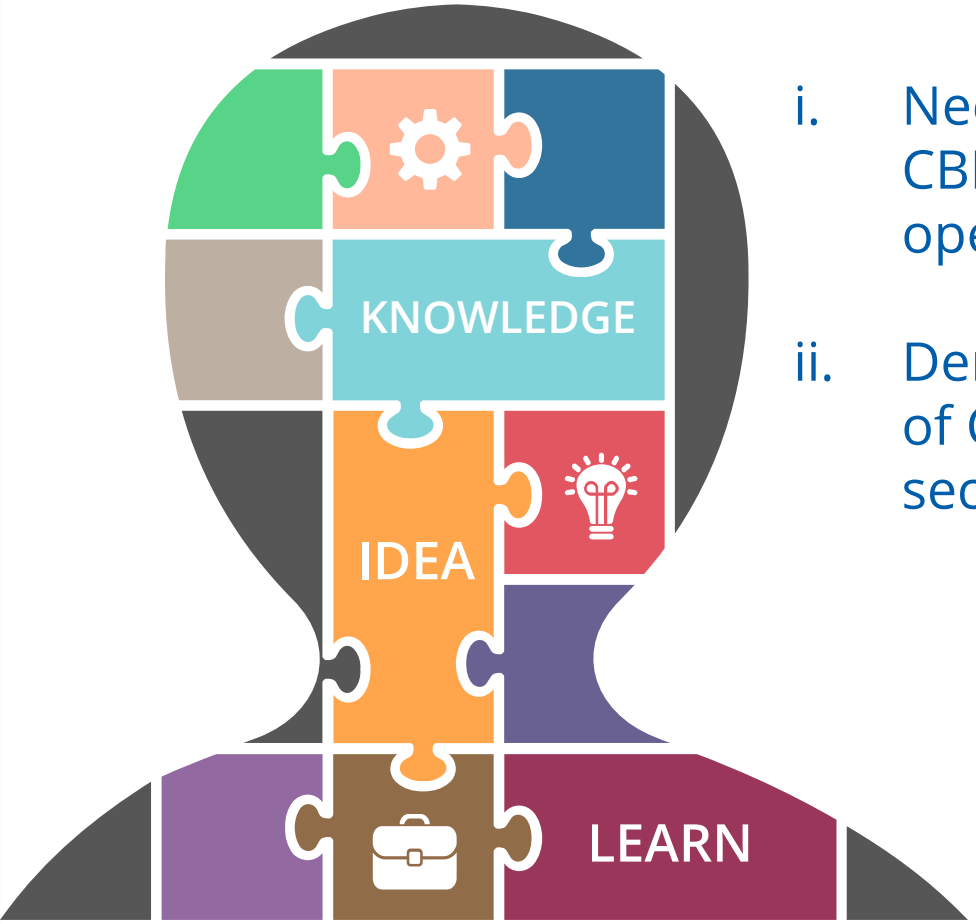
Maintenance Engineer (Overhead Lines & Underground Cable 33kV) TNB Perak (2010-2015)

- ❑Certified Competence Persons (CP) Voltage Level 33kV.
- ❑Certified Ultrasonic Inspection & Diagnosis system for Overhead Distribution (Inspector 101 iNDiSS D&I and INDS-U2 V1 Korea).
- ❑State Tool Coordinator (TC TNB Perak).
- ❑Member of the Management Committee and Disaster Relief (JPBBN) Perak, Perak State Security Council, Department of the Prime Minister.

ABSTRACT

- Maintenance activities in TNB are shifted from Time-Based to Condition Based Maintenance (CBM).
- The implementation of CBM has effectively improved the overhead lines system performance.
- It's crucial to sustain and expand the technical competency level of TNB personnel and external service provider.

At the present…



i. Need on the capability building for CBM's engineer, supervisor and operator in Overhead Lines system.

ii. Demand to expand the understanding of CBM's capability between sections/units in organization.

Overview of overhead line assets

i. The distribution network for electricity in Malaysia operates at three voltage levels; 11, 22 and 33 kV, via overhead lines or underground cables.

ii. Overhead line systems can be classified into two types known as the Medium Voltage Bare Overhead Lines (MVBOH) and the Medium Voltage Aerial Bundled Cables (MVABC).

Overhead Lines Asset in TNB Distribution Network

Description (Overhead lines system)	Route Length (km)
Medium Voltage Bare Overhead Line (MVBOH)	**6,171**
- 11 kV	702
- 22 kV	184
- 33kV	5,285
Medium Voltage Aerial Bundled Cables (MVABC)	**37,469**

*Source: Medium Voltage Bare Overhead Line Handbook

Tower

Tower is usually used in TNB distribution system when standard tubular pole is not suitable to be used to cross the following obstructions:

i. Railway crossing.
ii. Public roads and highways.
iii. Telephone lines.
iv. Power lines.
v. Canals, lakes and rivers

Medium Voltage Bare Overhead Lines (MVBOH) System

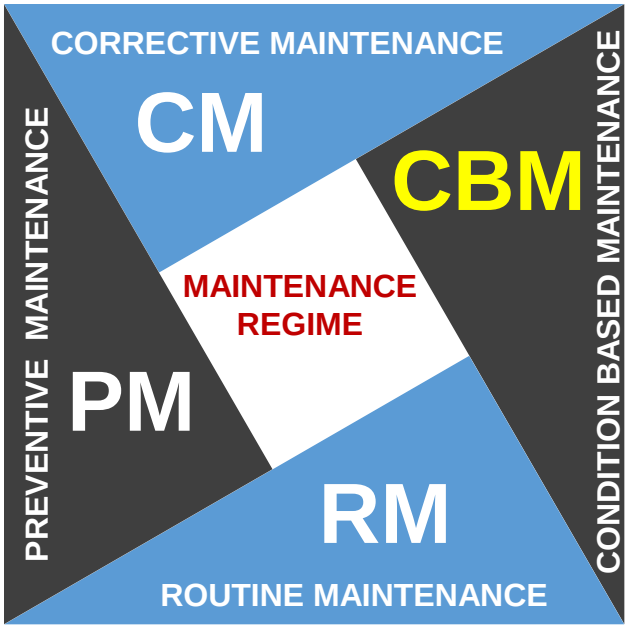
Steel Crossarm

Crossarm provides necessary support to the insulator. The steel work parts are used for the construction of both 11 kV and 33 kV overhead line.

Medium Voltage Aerial Bundled Cables (MV ABC)

The primary objective of implementing Aerial Bundle Cable (ABC) network system is to optimize TNB capital expenditure. MV ABC system more economical compare to Medium Voltage Bare Overhead (MVBOH) or Underground Cable (U/G cable) system.

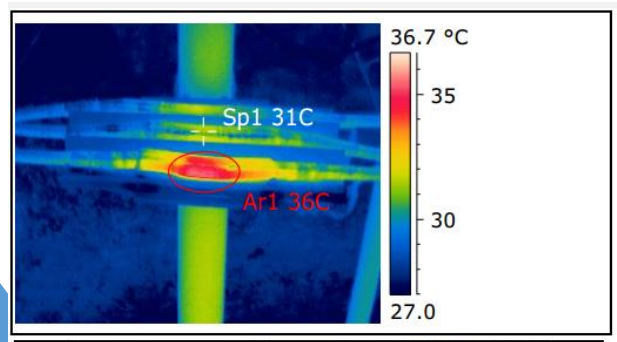
MAINTENANCE REGIME

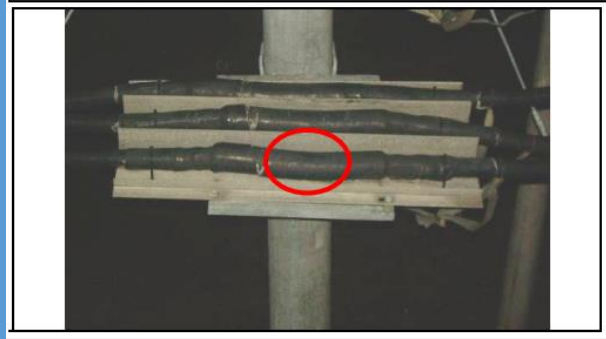


TNB Distribution Network (DN) are effectively maintain the assets through appropriate approaches in term of methods of inspection, testing and maintain according to the industry best practices as well as compliance to safety aspects.

Visual Inspection (VI)

Visual inspection is usually performed using combination of binoculars and digital camera in order to observe the suspected faulty part of the MV BOH or MV ABC system.





Inspection of Infrared Thermography (IRT)

Infrared Thermography is another method commonly used for CBM. When current-carrying equipment is at fault, it operates beyond its normal operating temperature. This temperature rise can be detected based on the thermal radiation concept.

Ultrasound Detection (USD) Method with Monocular

- Ultrasound detection (USD) is one of the most established methods to assess the condition of high voltage equipment.
- This technique employs the detection of sound effects due to ionization of gas molecules within the air vicinity.

Aerial CBM Scanning & Inspection (Helicopter)

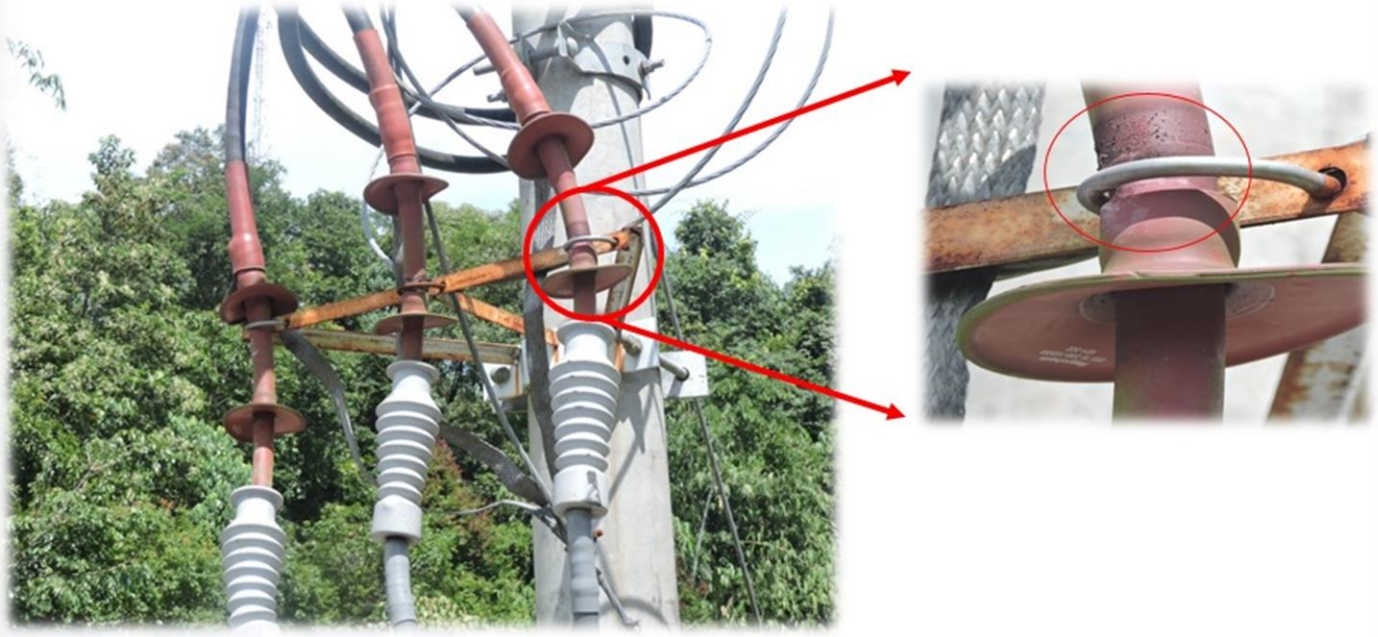
New Way… Aerial CBM Scanning of Overhead Lines (Corona 350 System by Helicopter)

Equipped with:
i.Radiometric IR Camera – Resistance Based Problems.
ii.Corona UV Camera – Insulation Based Problems (Electrical Discharges – Corona, Tracking & Arcing.
iii.HD Video Camera – Surveillance.
iv.GPS Interface
v.Greater Scanning Speed Approximately 400 – 500 Poles per day.

Unmanned Aerial System (UAS)

Scanning and inspection using UAS offers a lot of advantages such as provide 360° view, process scanning much faster rather conventional method, data capture more reliable, cost effective and etc.

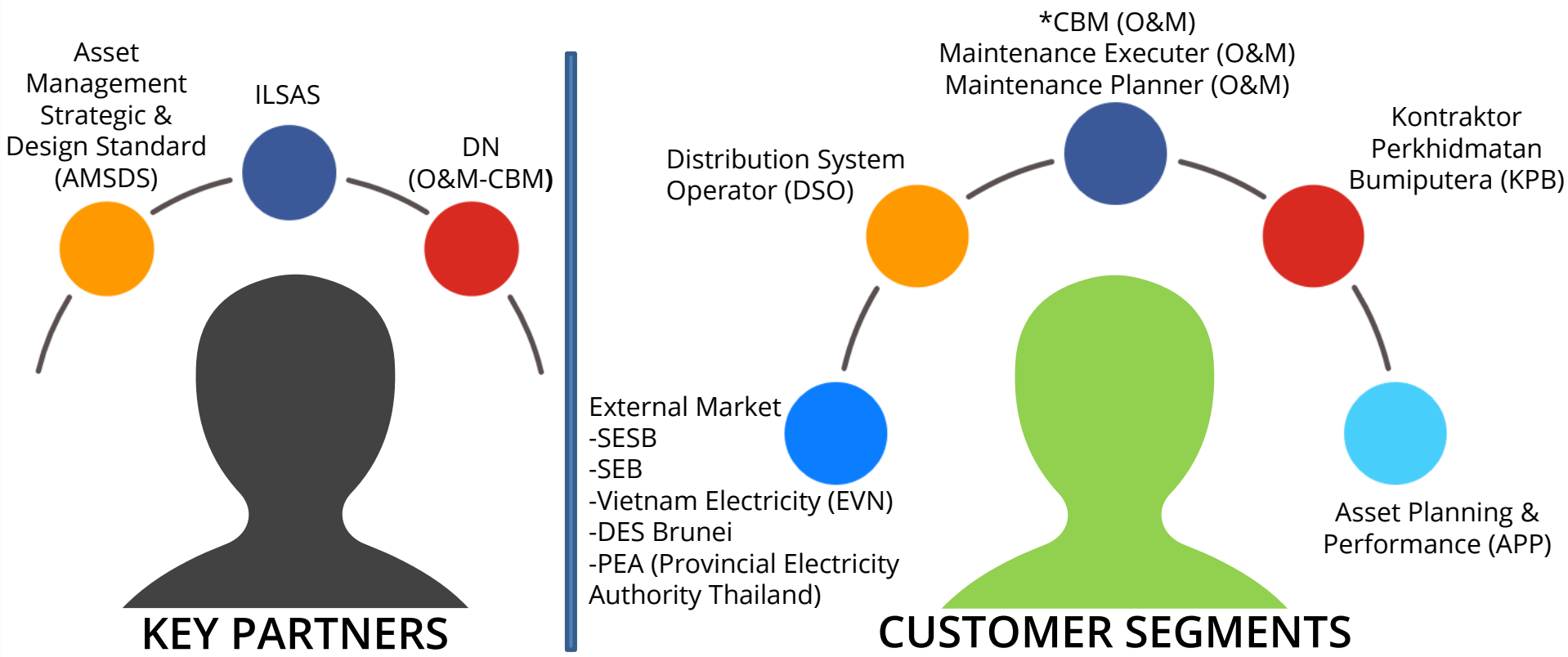
What will happen if TNB staff/Contractor incompetent to conduct CBM's analysis appropriately?



This will impact to reliability of overhead lines system...

It's critical to develop a comprehensive CBM's training…

Key Partners & Customer Segments of CBM‘s OHL



ADDIE MODEL

CBM OVERHEAD LINES SYSTEM

TENAGA NASIONAL

1 ANALYSIS

Determined what caused Condition Based Maintenance (CBM) activities less than required or any room for improvement.

2 DESIGN

Designed based on group of participant:

i. Common technical department:
   - O&M (Maintenance Executor, Maintenance Planner)
   - Asset Development (AD)
   - Distribution System Operator (DSO) & etc

ii. Specific:
   - Condition Based Maintenance (CBM) Unit
   - Kontraktor Perkhidmatan Bumiputera (KPB)

3 DEVELOP

Develop A Curriculum (DACUM) through engaging with Subject Matter Experts (SME):

- AMSDS
- TNB Technical Expert (TE)
- CBM's Operator & Engineer

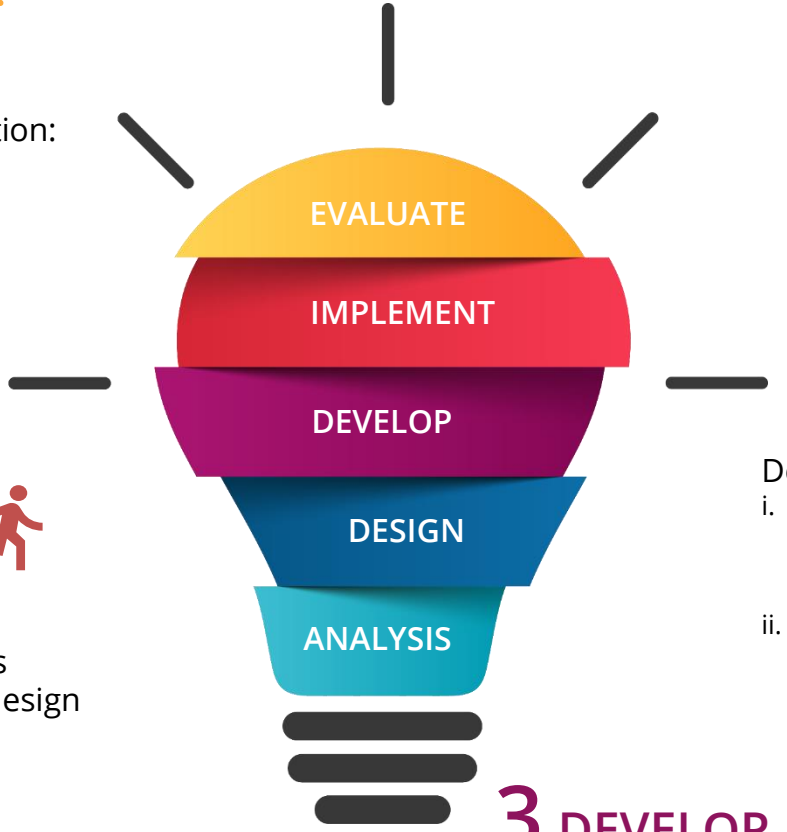
4 IMPLEMENT

Run for 1st trial session.
Provide teaching materials audio & video aids, class design and tools & equipment

5 EVALUATE

Kirkpatrick's Level of Evaluation:

i. Level 1 Evaluation
ii. Level 2 Evaluation
iii. Level 3 Evaluation



Conducted several DACUM session

Encouraging Blended Learning 70:20:10

Experiential learning

comes from experiences employees face at work

70%

Social or peer to peer learning

Mentoring, feedback, and relationships with colleagues

20%

Formal learning

conducted through learning sessions

10%

Inspection of Infrared Thermography (IRT)

Discussion and IR Camera Specifications from various model/brand

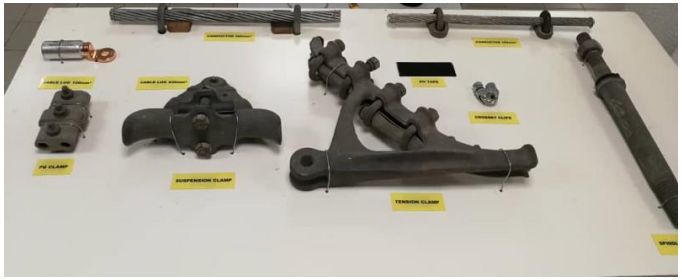
Flir T640

Fluke TI450

Fluke TI95

Therma CAM P60

Emissivity Setting (Lab Experiment)



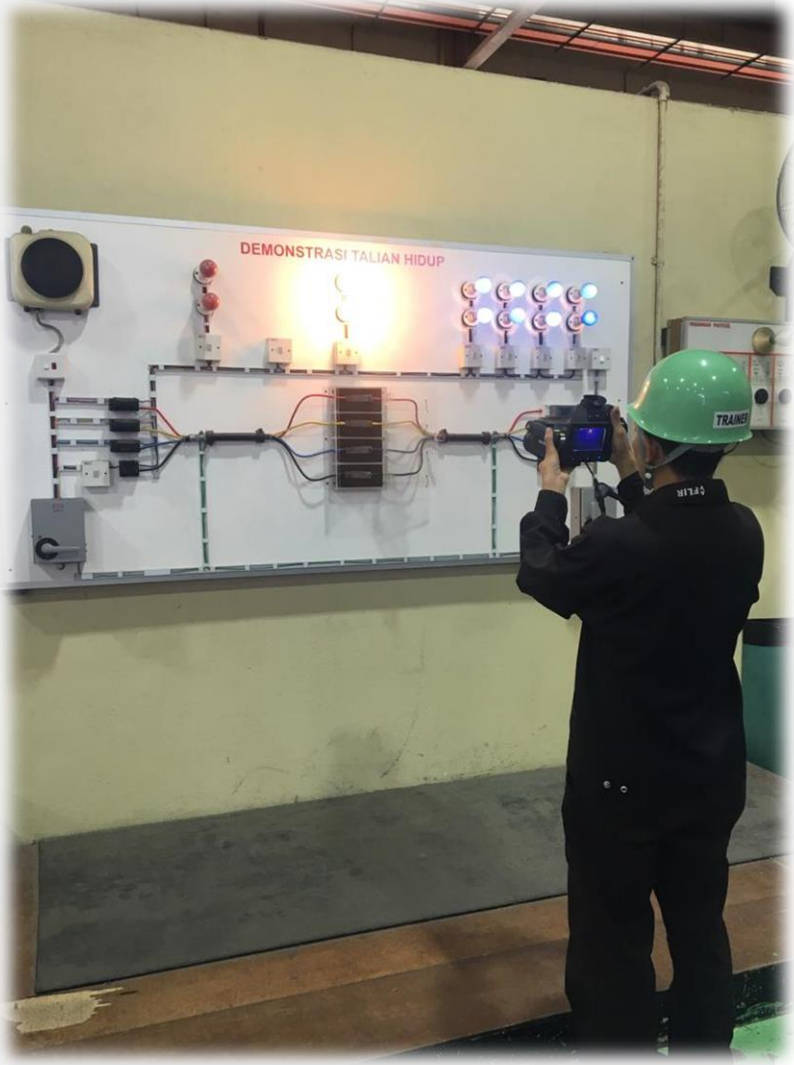
Overhead Lines accessories

Experimental heater

Emissivity values of common materials

Material	Emissivity*	Material	Emissivity*
Aluminum, polished	0.05	Iron, wrought, polished	0.28
Aluminum, rough surface	0.07	Lacquer, Bakelite	0.93
Aluminum, strongly oxidized	0.25	Lacquer, black, dull	0.97
Asbestos board	0.96	Lacquer, black, shiny	0.87
Asbestos fabric	0.78	Lacquer, white	0.87
Asbestos paper	0.94	Lampblack	0.96
Asbestos slate	0.96	Lead, gray	0.28
Brass, dull, tarnished	0.22	Lead, oxidized	0.63
Brass, polished	0.03	Lead, red, powdered	0.93

Inspection of Infrared Thermography (IRT)



IRT Indoor practical presentation

Inspection of Infrared Thermography (IRT)

Outdoor practical:
360° Inspection Method
(ground level CBM)

Inspection of Infrared Thermography (IRT)

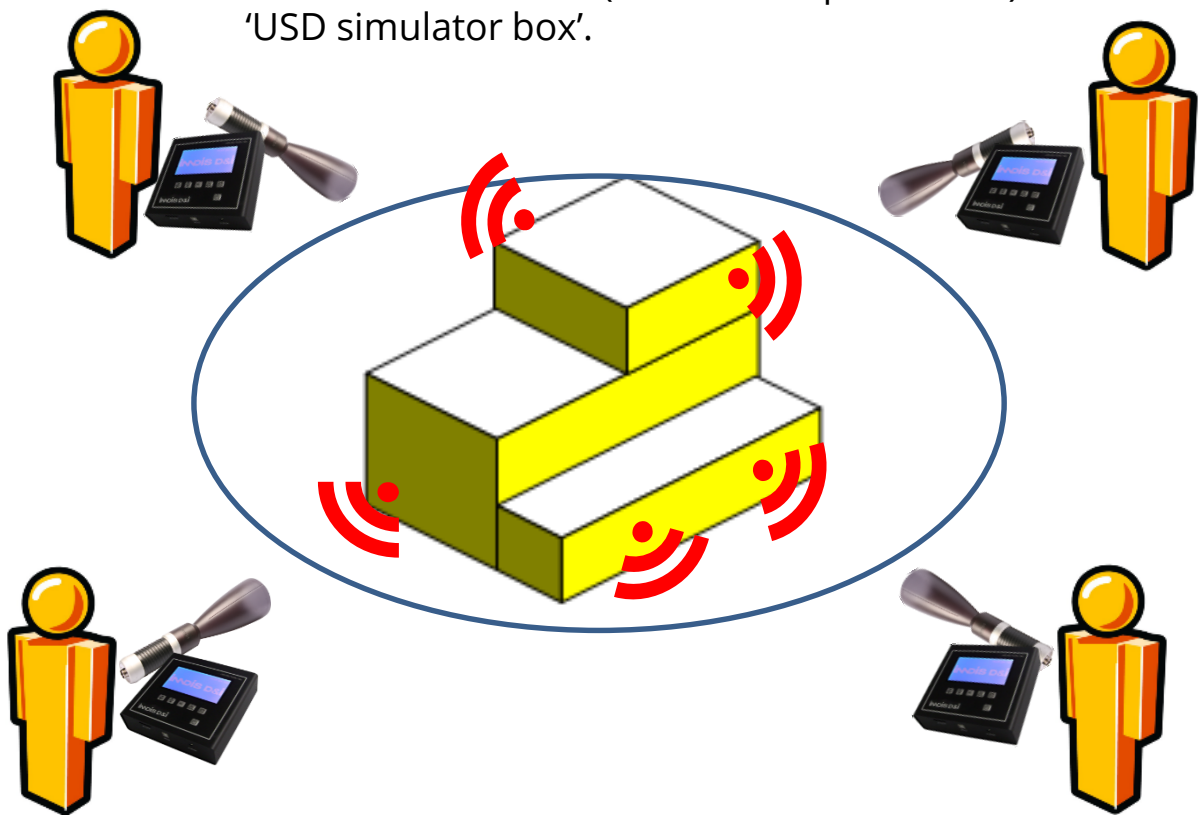
Outdoor practical:

- **360° Inspection Method (Aerial CBM)**
- **Demonstration IRT's inspection using UAS ILSAS (Team SDI)**

Ultrasound Detection (USD) Method

Indoor Experiment:
360° Inspection Method

Demonstrate the basic USD's inspection work and pin pointing procedure effectively with the given ultrasound detector (INDS.U2/Inspector 101) and 'USD simulator box'.



Simulator box

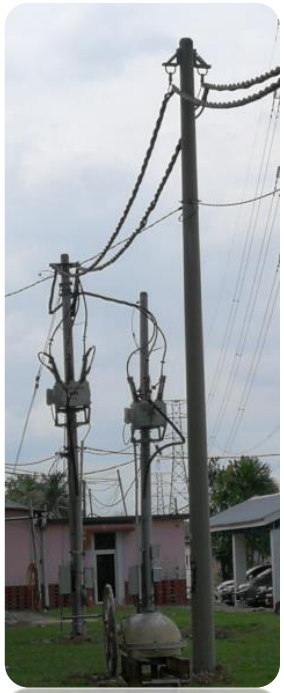
USD Detector

Function wave generator

Ultrasound Detection (USD) Method

Outdoor Experiment: 360° Inspection Method (mock-up)

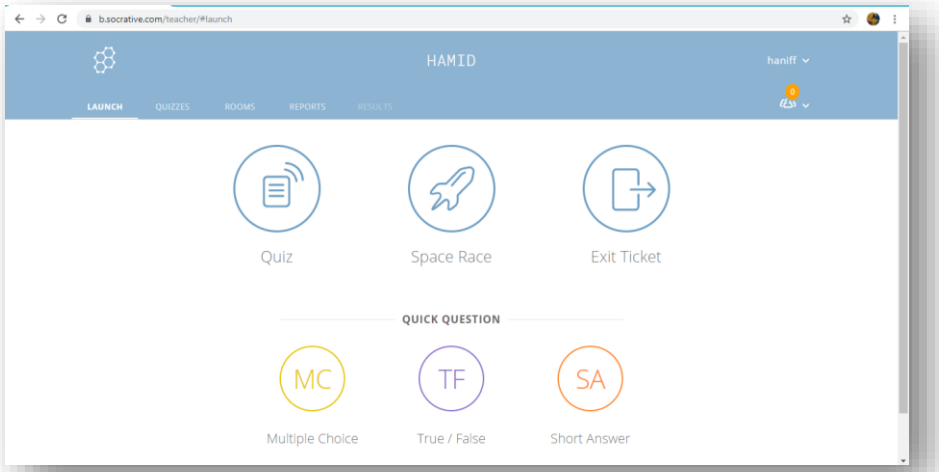
Outdoor Experiment: 360° Inspection Method (energized circuit)



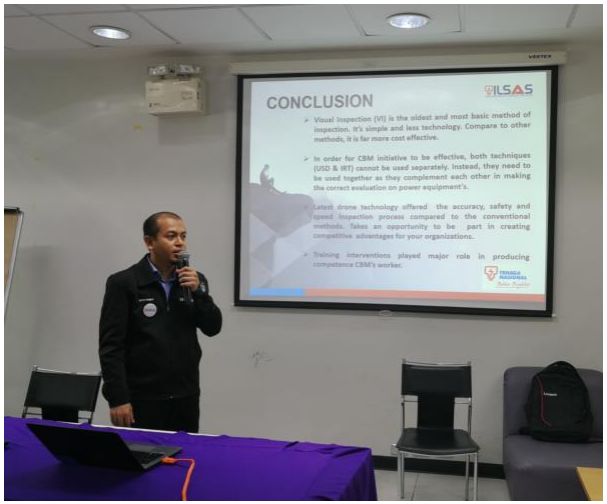
5 EVALUATION

https://lms.tnbilsas.com.my

https://b.socrative.com/teacher



The 7th PEA Work Skills Competition
8th August 2018



BEST PRACTICE PRESENTATION ON INFRARED THERMOGRAPHY & ULTRASOUND DETECTION

TNB

EVNHCMC

SEB

CONCLUSION

Optimizing Condition Based Maintenance (CBM) Technologies in Overhead Line Training Methodology

- Training interventions played major role in development of competent worker.
- Misinterpretation of result due to inadequacy of technical skills might affect the reliability and availability of distribution network components.
- Collaborations between ILSAS, DN (AMSDS) and related parties should be continue to enhance the development of the workforce (win-win situation)

Thank You

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