

PRACTICES ON MAINTENANCE & REPLACEMENT OF CABLE FOR UTILITIES



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Seminar Electrical Design, Installation & Safety First for A Lasting Cable

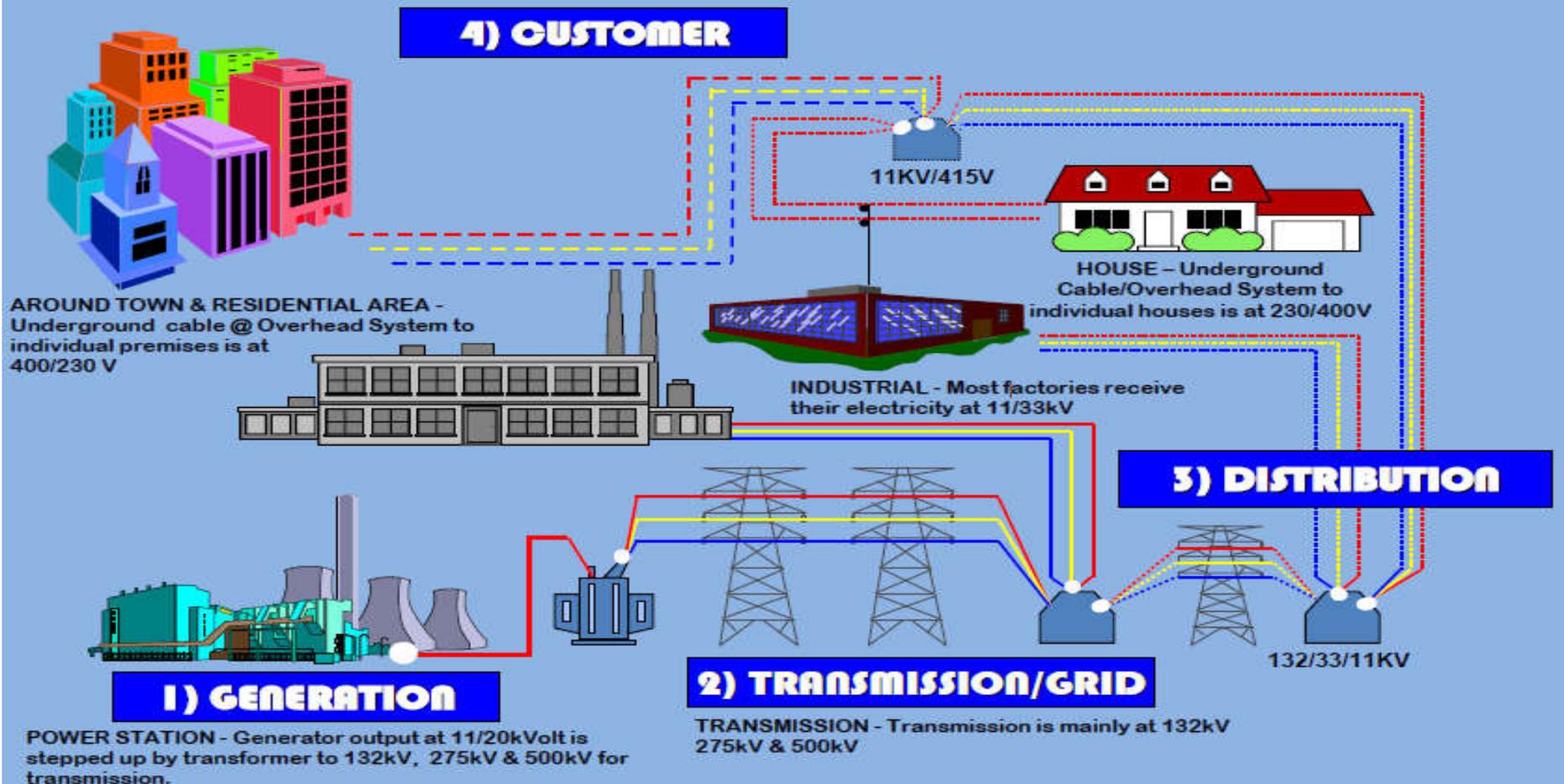
PRESENTATION OUTLINE

- ❑ TNB SYSTEM ENERGY FLOW
- ❑ TNB SYSTEM PERFORMANCE
- ❑ UNDERGROUND CABLE :-
 - CONSTRUCTIONS
 - MAINTENANCES
 - REPLACEMENT
- ❑ SUMMARY



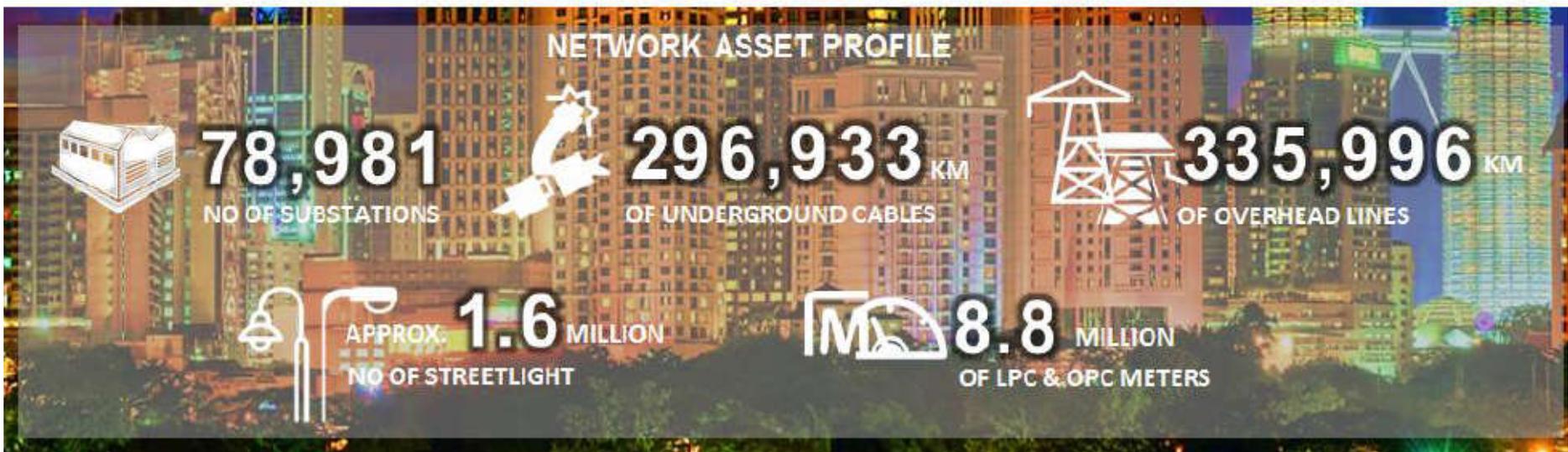
TNB SYSTEM ENERGY FLOW

ALIRAN SISTEM ELEKTRIK TENAGA NASIONAL BERHAD



TNB SYSTEM ENERGY FLOW

FACTS AT A GLANCE



*as at 31 Aug 2017

- TNB Distribution system performance is monitored in line with international performance index of SAIDI, SAIFI and CAIDI
- Starting from 2018, TNB Financial Year is adjusted to follow calendar year (January to December) instead of from September to August.
- Interim FY is introduced to measure performance of 4 months transition period (Sept 17 to Dec 17).

TNB SYSTEM ENERGY FLOW

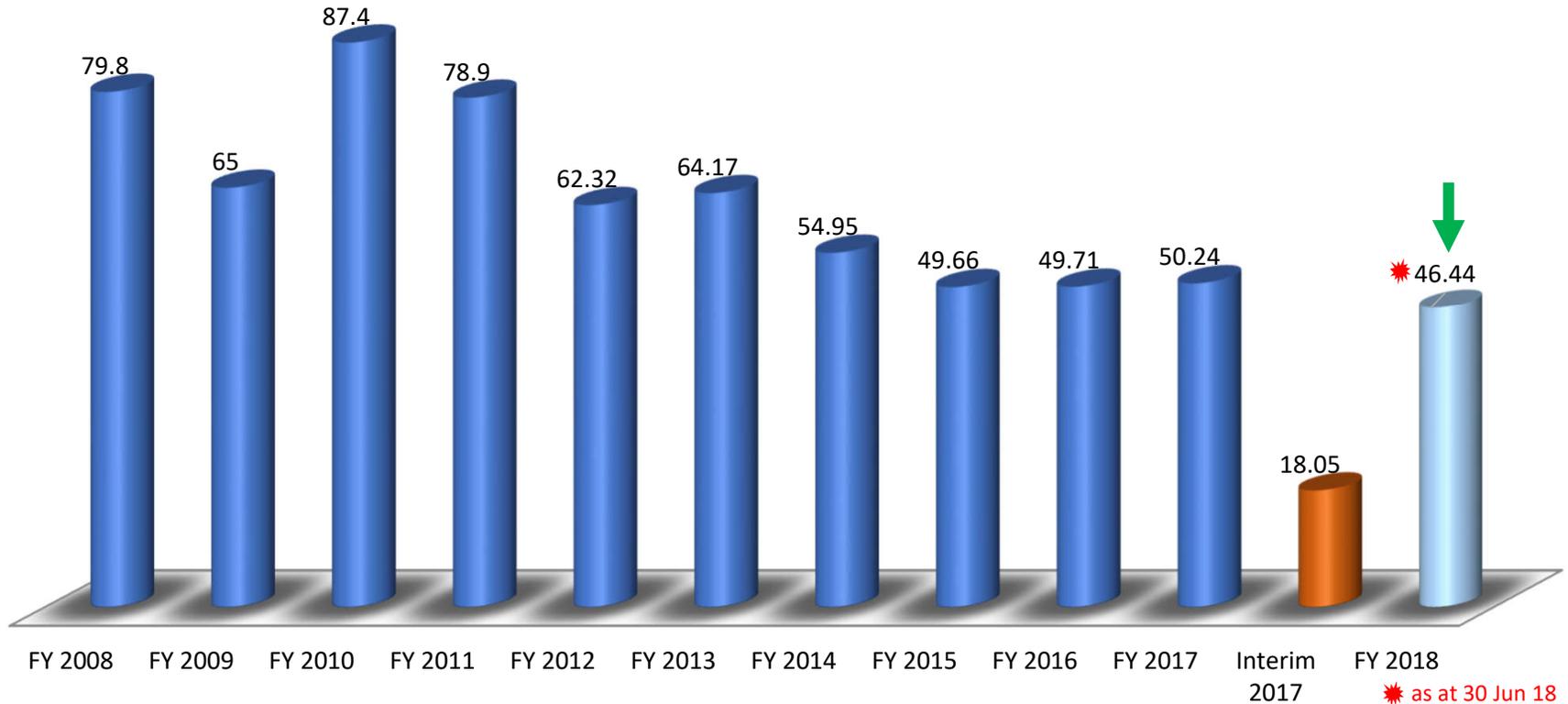


Network Statistic	Number as at 31 Aug 2017
Distribution Customer Numbers (Total)	8.5 million
Maximum Demand (MW)	17,571 MW
Total Transformer Capacity (MVA)	111,162
Pencawang Pembahagian Utama (PPU) (number)	881
<i>Stesen Suis Utama (SSU) (number)</i>	376
<i>Pencawang Elektrik (P/E) (number)</i>	77,724
Power Transformers (number)	1,599
Distribution Transformers (number)	81,501
Switchgears (number)	114,667
Medium Voltage Overhead (km)	21,969
Medium Voltage Underground (km)	164,844
Low Voltage Overhead (km)	314,027
Low Voltage Underground (km)	132,089

2 TNB SYSTEM PERFORMANCE



SAIDI (min/cust/year)

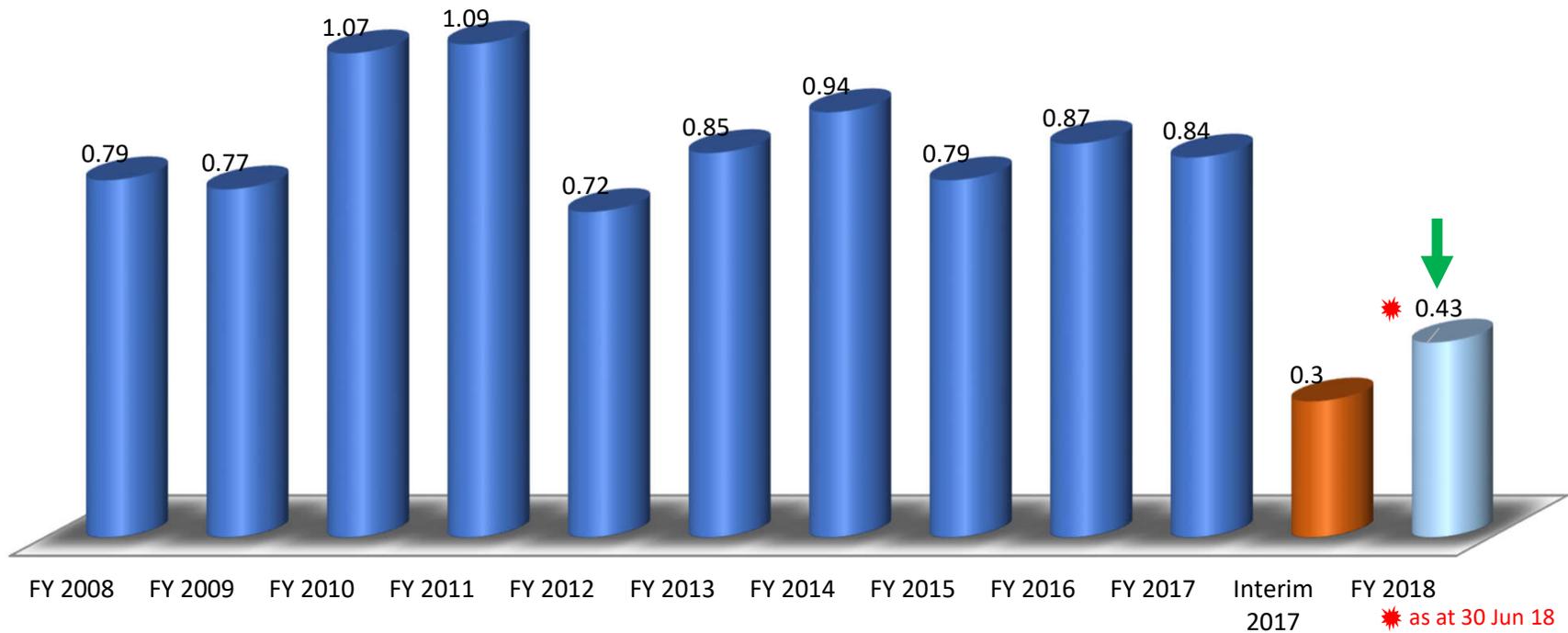


- SAIDI - System Average Interruption Duration Index".
- Annualized FY 2018 SAIDI shows downward trend with 7.5% lower than FY 2017

2 TNB SYSTEM PERFORMANCE (cont')



SAIFI (min/cust/year)



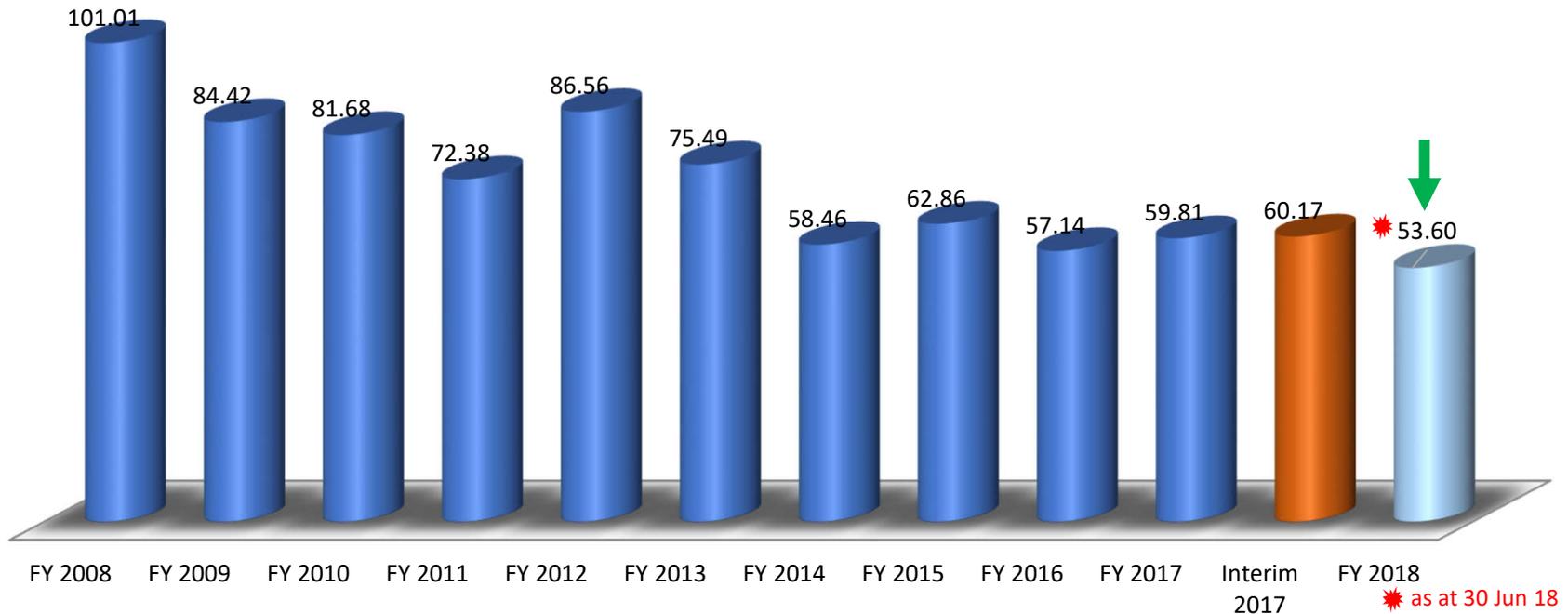
- SAIFI - System Average Interruption Index“
- “Annualized FY2018 SAIFI also shows downward trend”

2 TNB SYSTEM PERFORMANCE (cont')



- System performance for Distribution Network (TNB DN) been monitored in term of SAIDI, SAIFI and CAIDI indexes.
- Starting from 2018, Financial Year (FY) for TNB DN is considered from January to December.
- Interim FY is introduced to measure performance of 4 months transition period (Sept 17 to Dec 17).

CAIDI (min/cust/year)



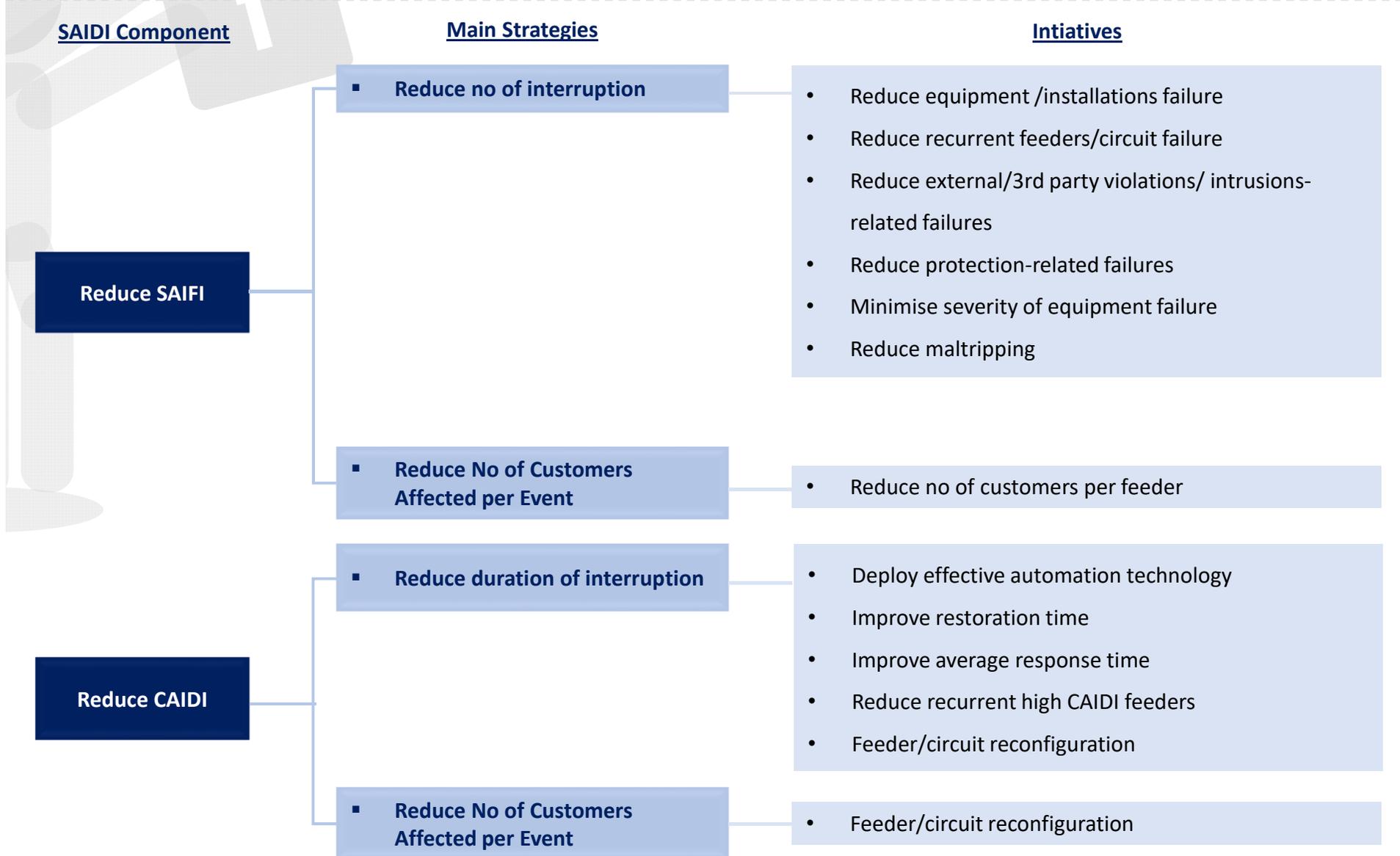
- "CAIDI " Customer Average Interruption Duration Index".
- "Annualized FY2018 CAIDI shows downward trend with 11% lower than FY 2017"
- Strategies to further improve CAIDI are mainly focusing on the following area;
 - ✓ reduce duration of interruption
 - ✓ reduce no of customers affected per event

3 Main Core Strategic Focus & Solution

- " Main strategies to reduce SAIDI are supported by the following initiatives"
- " All strategic initiatives are to support TNB's SAIDI 50 target"

SAIDI 50 activities

1



3 UNDERGROUND CABLE ACTIVITIES :-

" Main strategies for UG Cable to reduce SAIDI are supported by the following initiatives"

Main Core Strategic Focus & Solution



1. UNDERGROUND CABLE SYSTEM CONSTRUCTION

- " TNB Cable Installation Guideline"
- Latest *Arahan* and *Pekeliling* from TNB
- "Pre-commissioning Inspection And Test" (PIAT)



2. UNDERGROUND CABLE SYSTEM MAINTENANCE

- TNB Distribution Division Maintenance Manual : Underground Cable System
 - ✓ UG Cable Condition Based Maintenance
 - ✓ UG Cable Preventive Maintenance
 - ✓ UG Cable Corrective Action Maintenance



3. UNDERGROUND CABLE REPLACEMENT

- Asset Replacement Policy Dist. Div: MV PILC Cable
- UG Cable System Improvement

3 Main Core Strategic Focus & Solution

- " Main strategies to reduce SAIDI are supported by the following initiatives"
- " All strategic initiatives are to support TNB's SAIDI 50 target"



Main Core Strategy	Initiatives	Objectives/Impacts
UNDERGROUND CABLE SYSTEM CONSTRUCTION	Do It Right First Time at : <ul style="list-style-type: none"> • Earlier Stage Design - Planning Unit • Standard Installation-Construction Unit 	<ol style="list-style-type: none"> 1. "To ensure all work are executed based on existing rules and standards"
	UG Cable Site Construction according to TNB Guideline	<ol style="list-style-type: none"> 1. To ensure, end product of UG cable project laying can be energize without any defect. 2. New UG cable during MSVT project will solved existing system constrains. 3. New system will give a supply to customer without failure.
	PIAT	<ol style="list-style-type: none"> 1. "Identify non compliance to be rectified before commissioning of the system"
	Proper Project Handing Over	<ol style="list-style-type: none"> 1. Easier to trace and arrange asset replacement in the future.

3 Main Core Strategic Focus & Solution

- " Main strategies to reduce SAIDI are supported by the following initiatives"
- " All strategic initiatives are to support TNB's SAIDI 50 target"



Main Core Strategy	Initiatives	Objectives/Impacts
UNDERGROUND CABLE SYSTEM MAINTENANCE	TNB Distribution Division Maintenance Manual : Underground Cable System	<ol style="list-style-type: none"> 1. To ensure every UG Cable asset to be maintenance and inspect following this Guidelines. 2. This manual will guide users to do UG cable testing in the right way. 3. Our UG cable asset will sustain long in TNB system and give a good result on reliability.
	UG Cable Condition Based Maintenance (CBM) <ul style="list-style-type: none"> • Online PD Scanning • Online Thermography • Offline PD Mapping • Offline Insulation Resistance Test • Tan Delta, DS, MWT 	<ol style="list-style-type: none"> 1. Online or Offline testing to help user analyse and diagnose condition of energize cable. 2. CBM is a world wide practices. 3. A lot of information can be gain from CBM about UG Cable health and condition that will help us to plan futher action of asset replacement before it fail.

3 Main Core Strategic Focus & Solution



- " Main strategies to reduce SAIDI are supported by the following initiatives"
- " All strategic initiatives are to support TNB's SAIDI 50 target"

Main Core Strategy	Initiatives	Objectives/Impacts
<p style="text-align: center;">UNDERGROUND CABLE MAINTENANCE</p>	<p>UG Cable Preventive Maintenance</p> <ul style="list-style-type: none"> • Cable route patrolling • Cable / Accessories replacement • Link Box inspection • Hi-pot Test 	<ol style="list-style-type: none"> 1. Activities / action on UG cable or accessories to ensure any irregular finding during CBM been repaired before it fail. 2. Patrolling activities is to ensure no digging activities on cable route without TNB supervision. 3. Link Box inspection is to ensure condition of link box in a good condition to ensure safety to public.
	<p>UG Cable Corrective Action Maintenance</p> <ul style="list-style-type: none"> • Immediately repair any defect occurred on UG cable or accessories 	<ol style="list-style-type: none"> 1. Non repaired defect will give a system constrain and will effect system reliability.

3 Main Core Strategic Focus & Solution



- " Main strategies to reduce SAIDI are supported by the following initiatives"
- " All strategic initiatives are to support TNB's SAIDI 50 target"

Main Core Strategy	Initiatives	Objectives/Impacts
UNDERGROUND CABLE REPLACEMENT	Asset Replacement Policy Dist. Div.: MV PILC Cable <ul style="list-style-type: none"> • PILC UG Cable Replacement activities done in several stages. 	<ol style="list-style-type: none"> 1. To ensure only a good condition of UG cable in TNB system. 2. Malaysian cable manufacture have stop their production of PILC cable and difficult for TNB to have spare part for repair in the future. With that migration to XLPE is the best decision for reliability of Electric Supply.
	UG Cable System Improvement based on: <ul style="list-style-type: none"> • CBM report • Reconfigured system 	<ol style="list-style-type: none"> 1. To ensure only a good condition of UG cable in TNB system.



3 UNDERGROUND CABLE :-

Additional Strategic



4. Embarking on new technology;

- Online PD scanning
- 3C 500MMP 11KV CABLE

5. Enhance technical competency

- Maintenance Cable Testing Handholding
- Distribution Conference (DICON)

6. Compliances

- Post mortem/handholding session
- Penilaian Amalan Kejuruteraan (PAK)

4 Embarking on new technology

New Technology

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- TNB Distribution Network actively explore on new technology to mitigate issues related to system performance.
- Latest technologies that been ventured is Online PD Scanning.

1. **Online PD scanning** is introduced to mitigate recurrence issues of cable failure.

Online measurement - No supply interruption during measurement

Ideal for in-service screening of large populations of cables.

Simple and safe test – 10 min per cable. Clamp at earth braid

Method is 100% non-destructive

Avoid cable breakdown – repair defect before it fail

Quick quality check of cable and accessories installed by contractor

Benefit from Online PD Scanning ;

- Increase Number of section cable Health Screening test
- Easier to prioritize which section cable to be outage for PD mapping
- Increase Hit Rate of PD mapping
- Successfully identify potential cable fault and reduce number of cable failure.

- TNB Distribution Network actively explore on new technology to mitigate issues related to system performance.
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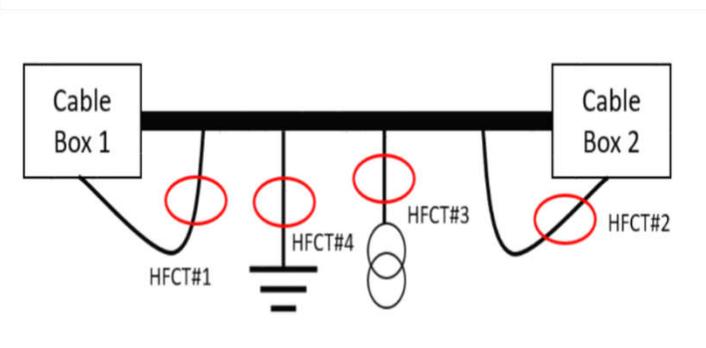
1. **Online PD scanning** is introduced to mitigate recurrence issues of cable failure.



ONLINE PD SCANNING RESULT



ONLINE PD SCANNING CONNECTION



5 Enhance technical competency

- TNB Distribution Network actively do a handholding activities to technical staff in a different field

1. **Handholding activities** is a platform to help users in the ground to perform their job in the right way.

Handholding Online PD Scanning - Increase Hit Rate PD Mapping

Handholding Offline PD Mapping- Increase Hit Rate PD mapping and reduce No. of UG Cable failure.

Handholding IR Test – To ensure the data capturing during Shut Down can help in prioritize SD for offline PD Mapping.

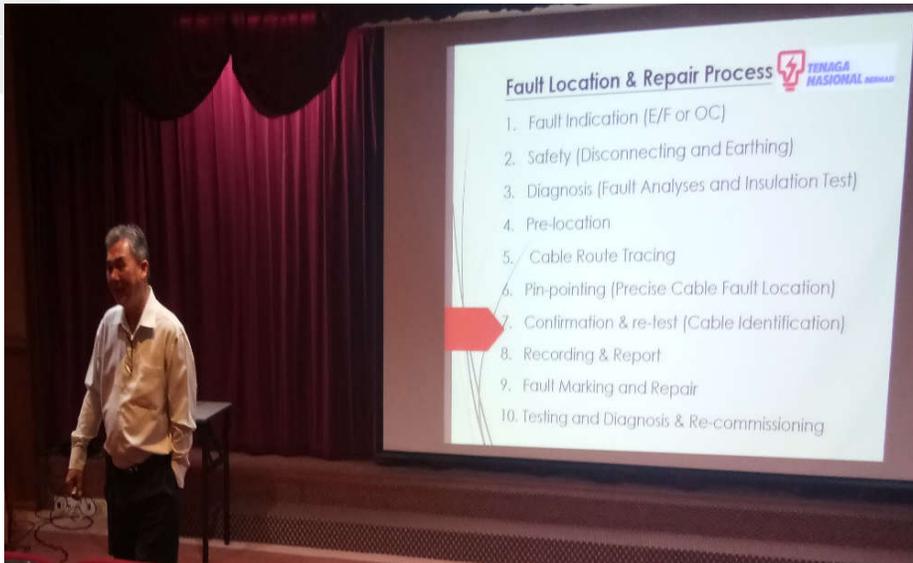
Handholding Cable Identification- To ensure users do the identification to cable correctly to avoid electrical accident.

Handholding Fault Locating – To ensure any fault occurred in UG cable been identified immediately with correct way.

Benefit to TNB

- Hit Rate no. of PD mapping was increased more than 30%
- No incident or wrong cable spiking recorded since handholding done.
- Increase competency of Fault Locating Team.

5 Enhance technical competency



- TNB Distribution Network actively do an audit activities at site.

1. **Compliance activities** is a platform to help users in the ground to perform their job in the right way.

Pematuhan Amalan Kejuruteraan – Awareness to Ground users why need to follow TNB Standard Guideline for any installation.

Jointing Audit - To ensure competence Jointer made the joint and no workmanship issues during joint construction.

PIAT – To ensure all cable installation follow TNB Guideline.

Post Mortem on Joint failure – To identified failure root cause and plan for mitigation plan.

Forensic Investigation – To investigate any major failure relate to UG cable .

Benefit to TNB

- Increase competency among Staff
- Awareness to all parties to follow TNB guideline.
- To ensure all job been done by competence.







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Background:

- Aged, 34 years old
- Married with four kids
- Degree in Electrical Power from Universiti Teknologi Malaysia
- Start working with TNB since 2007.
- Experienced with UG cable maintenance more than 10 years.
- Current position in Distribution Division Headquarter as Assistance UG Cable Technical Expert.