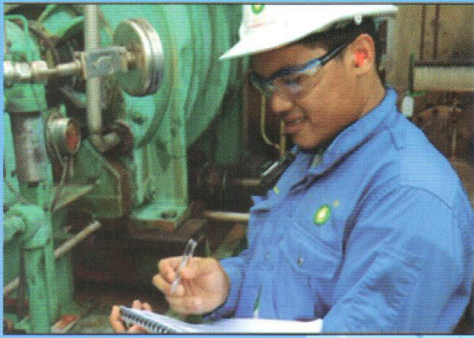


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## Outlook of Employment and Competition

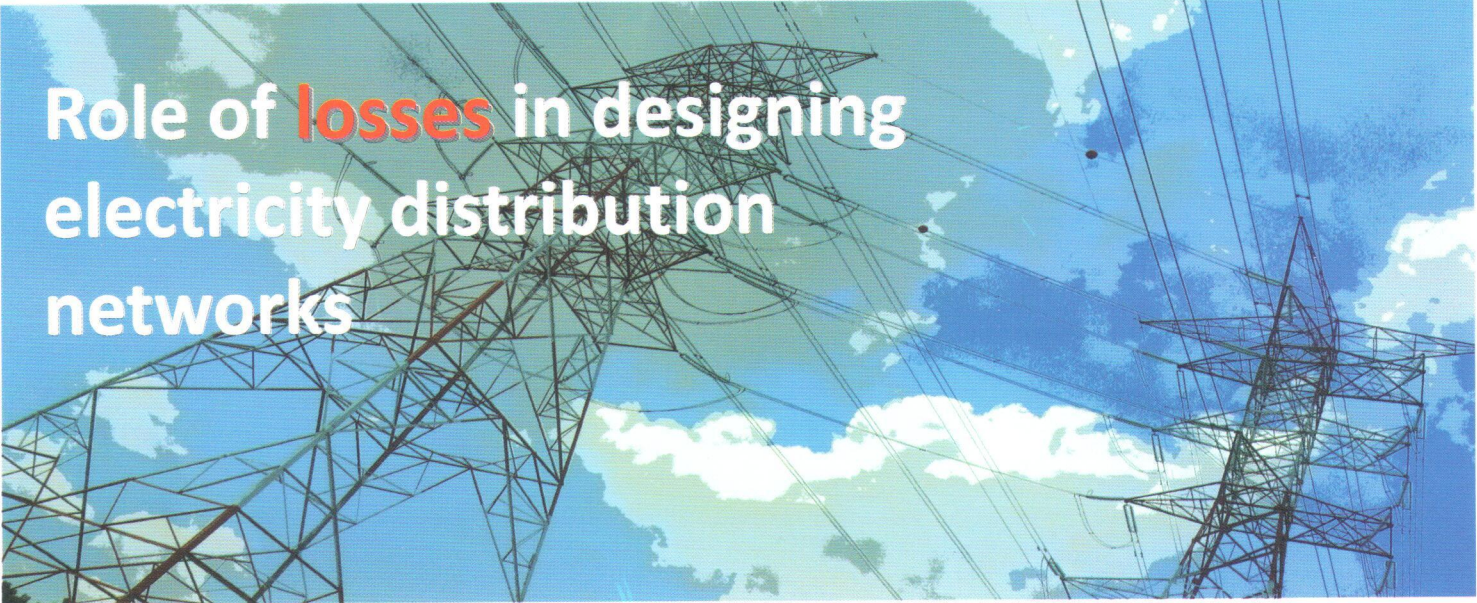
## Losses of electricity distri- bution network

## IET Visit to BEM

**JUNE 2013**



ORIGINAL CONTRIBUTION



# Role of losses in designing electricity distribution networks

The role and economics of future distribution network design are fundamentally changing. One of the key elements of network design that is yet to be fully incorporated in the design guideline is the life-cycle consideration of network losses, particularly on determining the optimal cable rating in distribution system.

**TNB estimated the annual financial cost of losses to be up to RM 2.5 billion for 2012**

In 2012, the total Transmission and Distribution (T&D) system losses recorded by Tenaga Nasional Berhad (TNB), Malaysia power utility, was 8.25% [1]. This translates into an estimated annual financial cost of between RM2.0 to RM2.5 billion to TNB. It means a 1% reduction in T&D losses could result in annual saving of between RM250 to RM300 million to TNB. In addition, it should be noted that the proportion of distribution system losses is significantly higher than the losses in a transmission system. Figure 1 shows the proportion of TNB's T&D losses in 2012.

It can be observed that the distribution losses is contributing to approximately 80% of the total T&D losses, with only 20% from the transmission system. Figure 2 gives a better insight into the breakdown of transmission and distribution losses in Malaysia electricity network. The high proportion of distribution losses is driven by the lower network voltage used and the extensive distribution networks which connect millions of consumers across the wide geographical area. As a result, the effort to reduce system losses should be emphasizing more on the distribution level.

In Malaysia, the distribution system consists of network at voltage levels of 33kV, 22kV, 11kV, 6.6kV and 400/230V.

In 2002, TNB's T&D losses level is in the range of 12%. This includes both technical and non-technical losses. The high level of T&D losses has gained serious attention from TNB and special team has been formed to tackling this issue in a more effective way.

Figure 3 shows the historic T&D losses for Malaysia electricity network. As can be seen from the figure, the T&D losses in Malaysia is consistently over 10% before 2007.

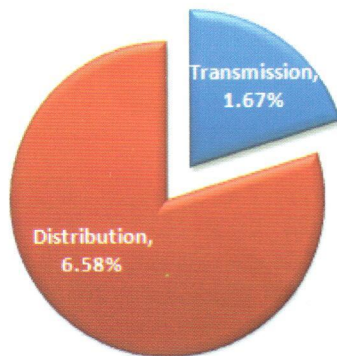


Figure 1: Proportion of TNB's (T&D) system losses in 2012.

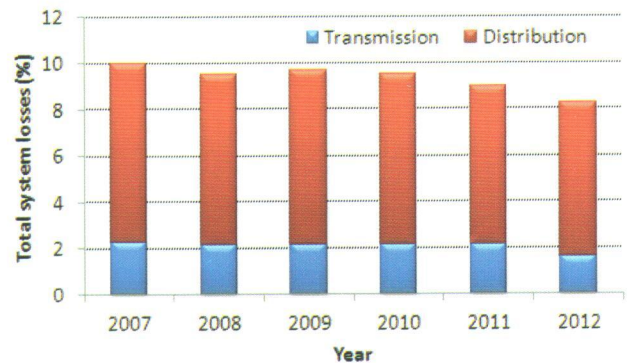
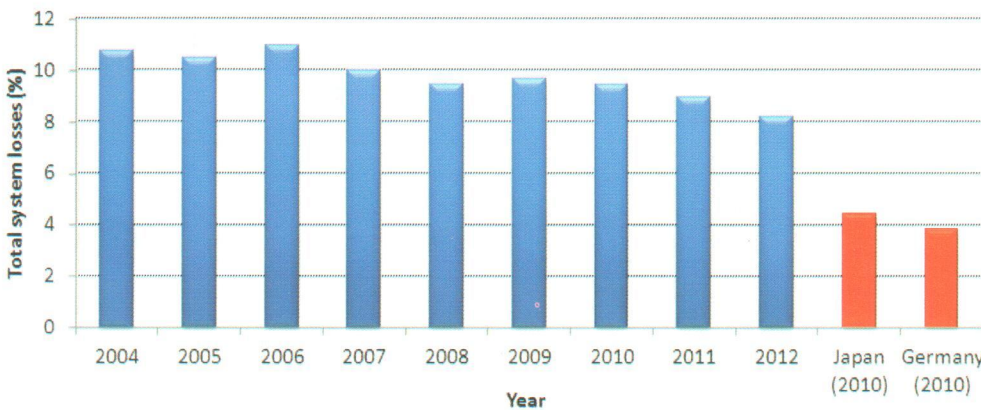


Figure 2: Breakdown of T&D losses in Malaysia.



However, the performance of total system losses has improved significantly from 10% in 2007 to 8.25% in 2012. Driven by the previous success in losses reduction initiative, TNB is committed to further reduce system losses, with a target of 5% at the distribution level. The specific T&D losses target set by TNB is 6-7% by 2015. However, a comparison between the level of T&D losses in Malaysia with

The study suggested that the optimal utilization of the 11kV cable should be quite low and in the range of 20-40%. This means the utility should install cables with rating of approximately 2.5 to 5 times of the peak demand. A preliminary study was conducted by the researcher at Universiti Teknikal Malaysia Melaka (UTeM) by utilizing the similar methodology [4].



Japan and Germany [2], which are two of

the highest T&D losses performance countries in the world, indicates that Malaysia still has greater room for improvement, as illustrated in Figure 3.

Given the crucial role of losses in distribution network design and TNB's commitment to achieve the 5% distribution losses target, it is therefore important to develop procedures and methodologies that can achieve optimal level of losses.

A recent study in the UK investigated the optimal level of losses by trading off the investment cost against the cost of circuit losses over the technical life-span of the cable [3].

In addition, the actual cable price from the local vendor and the actual Malaysia electricity price were used in the study. The optimal utilization was found to be in the range of 30-40%, which is in general agreement with the study conducted in the UK.

This suggests that a higher cable rating should be selected in designing the Malaysia distribution network (11kV in this case), apart from satisfying relevant safety and quality standards. Further investigation on the optimal utilization of cables and lines for 132kV,

33kV and 0.4kV in Malaysia is currently being carried out at UTeM.

Figure 4 shows the overall cost breakdown of 11kV cable in Malaysia. In this example, the 95mm<sup>2</sup> cable has the minimum rating to meet the peak demand. As expected, it has the lowest capital cost, but with the highest total cost, driven by the highest proportion of the cost of losses. In this respect, if the cost of losses is taken into consideration, the

**higher cable rating should be selected in designing the Malaysia distribution network apart from satisfying relevant safety and quality standards.**

300mm<sup>2</sup> cable has the overall minimum cost. Therefore, the design should select the 300mm<sup>2</sup> cable in order to achieve optimal level of losses, which leads to a minimum overall total cost. To conclude, this highlights the paramount importance of establishing procedures and methodologies that consider the role of losses in determining the optimal utilization of cables in Malaysia.

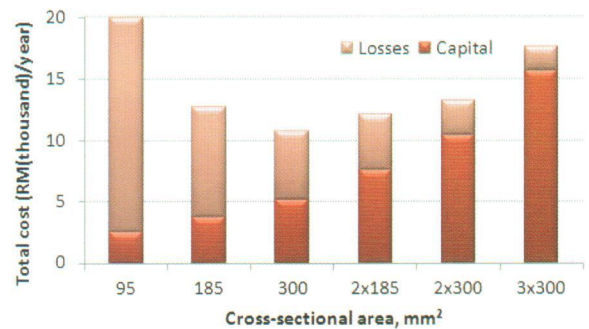


Figure 4: Breakdown of the total 11kV cable cost.

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- [1] Tenaga Nasional Berhad, Annual Report 2012.
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- [3] N. Jenkins, J.B. Ekanayake and G. Strbac, *Distributed Generation*, The Institution of Engineering and Technology, London, United Kingdom, 2010.
- [4] S. Y. Low, C. K. Gan, "The Impact of Losses in Cable Selection for Distribution Circuit in Malaysia," *2013 IEEE 7<sup>th</sup> International Power Engineering and Optimization Conference (PEOCO)*, Langkawi, Malaysia, June 2013.



Dr. Gan Chin Kim graduated from Imperial College, UK, and is currently a Senior Lecturer at Universiti Teknikal Malaysia Melaka. His research interests are distribution network design, integration of renewable energy and smart/micro-grid. He can be contacted at [cckgan@utem.edu.my](mailto:cckgan@utem.edu.my).