# Electricity distribution and underground networks

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A lot of countries have developed an overhead distribution network for many years. Easy to build, not too expensive, that technology has been a good solution to give access to energy to a maximum of inhabitants in a short delay. The medium voltage level (6kV or 10 kV) allows simple solutions, even in polluted areas. The density of consumption was limited, environmental constraints were not significant. But today, these countries are sometimes facing new challenges:

- The density of consumption obliges to build more and more feeders, because of their limited capacity.
- The quality of supply becomes a strong expectation; customers do not accept long outages during storm or snow periods.
- Some environmental constraints are arising with more and more difficulties to build new lines, but also some pressure to suppress existing lines.

Considering that an asset is built for 40 years of life, we must take into account that the technical solution used for a new asset built today must be the right solution during 40 years. So we must answer to the expectations of today but also to those of tomorrow.

For these countries, developing a program for burying MV and/or LV network is an issue that cannot be rejected. Due to the life duration of distribution equipment, such a decision must be taken with a long term vision.

The target of the presentation is to explain all the aspects of such a program : how can we go from an overhead network to an underground system ?

The designs of these 2 types of grids are not similar. Underground network is not an overhead network which is buried. The structure of the network is not the same.

New equipments have to be used, especially for secondary substations and for LV network and customers' connection. Cables and accessories are critical equipments.

The quality of supply that can be obtained with these different networks will be deepened, including effect of structure, repair time, sensitivity to meteorological events.

The approach concerning security and safety is different.

Operating an underground network raises new questions: how to situate and detect a cable? How to localize a fault?
Protection plan is different, due to capacitive current, which is more important in underground network.
If visual impact is reduced, environmental matters have to be managed even in underground structures, for civil work for example.
Maintenance is reduced but more specialized, specifically for old assets.

These new techniques imply new skills and competencies to develop prior to the program.

The cost of the underground solution is a critical point. The common idea is that underground network is expensive. The presentation will show that the situation is more complex. Are the technical solution used to build underground network really optimized? Do we make a clear distinction between a new network and the renewal of an existing network?

The example of what has been done in France will be detailed not as a model but as a feedback experiment useful for all companies having some research on this issue.

A long length of insulated cable is one where the load due to the capacitive current needs to be taken into account in the system design. Typically this would be 40 km for voltages less than 220 kV and 20 km for 220 kV or greater"

This presentation will review more than 40 projects worldwide that have are addressed by the above criteria. It will highlight some of the challenges for implementation, system design and installation. Some of the topics covered being, the feasibility, opportunity for hybrid circuits, new cable designs, reduction in power losses and maintaining the cable route environment. System design issues such reactive power compensation, sheath bonding, impact on the network and the thermal/mechanical forces due to linear expansion with long lengths. Construction issues such as transportation in remote areas, mechanisation of laying, testing and commissioning. Also online monitoring, security, fault location and repair times.

It needs to be acknowledged that information on this topic is still quite limited. Hence the Cigre task force believes that a Technical Brochure could be a very valuable document which could be referenced by any Utility, Government agency or Investor looking to put in to an underground system in lieu of an overhead line in terms of appreciating what can be done or has been done. One of the objectives for such a working group will naturally also be to have a paper on this topic presented at Jicable in June 2015 and discussion at the WETS 15 workshop.

# Alain Doulet

Biography

Alain DOULET is born in 1949. He is graduated from Ecole Supérieure d'Electricité in France in 1971. He joined EDF in 1973 in distribution division. He has been in charge of several technical and operational activities. He joined the Research and Development division in 1988 for 4 years, as customer and consumption department manager, and as deputy head of the network study department. He worked on smart metering and telecommunications programs and on all software used for load flow calculation.
In 1992, he came back to distribution division, in several positions as senior advisor in the head quarters of EDF Distribution. Then in 2004, he became EDF distribution network vice president. Since 2009, he has been working as independent consultant.
He has been specialized in distribution policy and performance, management of the assets, regulation of network access in competitive markets and now smart grids development. In EDF distribution, he has contributed to build the investment program to enhance the quality of supply through modernization and automatisation of the distribution network. He was the technical interface with the french regulator, strongly involved in the grid tariff review.
In 2008, he was appointed as chairman of a working group on functionalities of smart grids, in the European commission task force for smart grids.
He is "emerite member of SEE" since 2011.