

## 5 Technologies to boost efficiency in the Transmission & Distribution system

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**Abstract**— These instructions give you guidelines for improving the efficiency of transmission & distribution system. One example of efficiency measures aimed primarily at the utilities that operate the Transmission and distribution system is an initiative underway at the US department of energy to implement new efficiency standards for distribution transformers. These are the grey cylinders you see perched atop utility poles in residential neighborhoods, and the metal housed units placed on cement pads at ground level.

**Keywords**— HVDC, FACTS, GIS, HTS CABLES, WAMS, transmission efficiency, Super conductors

### INTRODUCTION

NOWADAYS the losses in the transmission and distribution lines are increased due to so many reasons. And due to the lack of the nonconventional energy sources it is important to save the energy. Most of the losses are occurring in electrical field are in power flow from generating end to the consumer end. So it is more important to save that losses as possible as possible and save our nonconventional energy sources. Now just moving in our topic...

There are over 40 million distribution transformers in service today in the US. They are among the most ubiquitous and the most standardize pieces of electrical equipment, and for that reason make a prime target for improvements that can be propagated across large areas.

The proposed standards will have a relatively modest impact on the efficiency of given transformer, around 4% overcurrent models. However when this incremental gain is multiplied across the thousands of units operated by even a small utility, the result is impressive.

There are other initiatives at the distribution level, but if we focus our attention on the measures that have the greatest potential for improving efficiency, we inevitably must look to transmission.

**There are numerous technologies that are already being applied to boost efficiency in transmission, and still more that have yet to reach full commercial implementation.**

In the following sections, we explore some of these technologies:

1. HVDC- High voltage direct current
2. FACTS (Flexible AC transmission systems) Devices
3. Gas-Insulated substations (GIS)
4. Superconductors / HTS Cables
5. Wide area monitoring systems

The above sections are explained in detail below:

### 1. HVDC- HIGH-VOLTAGE DIRECT CURRENT

Most of the transmission lines that make up the North American transmission grid are high-voltage alternation lines. In India also, Most of the transmission lines are alternating current lines. By the Way,

**Direct current (DC) transmission offers great advantages over AC, however:**

- a) **The DC transmission lines have 25% of lower line losses as compared to the AC transmission lines.**
- b) **DC transmission has two to five times the capacity of an AC line at the similar voltage.**
- c) **Ability to precisely control the flow of power.**



*Figure 16 A 350 kV ABB HVDC Light transmission system that stabilizes weak power networks in Namibia also enables power trading in the expansive region of southern Africa.*

Historically, the relatively high cost of HVDC terminal stations relegated the technology to being used only in long-haul applications like the Pacific DC Inertia, which connects the vast hydro power resources of the Columbia River with population centers of southern California. With the advent of new type of HVDC, invented by ABB and dubbed HVDC light, the benefits of DC transmission are now being realized on much shorter distances.

The cross sound cable connecting Long Island and Connecticut is one example of this technology.

#### **FACTS (FLEXIBLE AC TRANSMISSION SYSTEMS) DEVICES**

A family of power electronics devices known as Flexible AC transmission systems, or **FACTS**, provides a variety of benefits for increasing transmission efficiency. Perhaps the most immediate is their ability to allow existing AC lines to be loaded more heavily without increasing the risk of disturbances on the systems.



*Figure 17 ABB Flexible AC transmission systems (FACTS) installation in Canada*

Actual results vary with the characteristics of each installation, but industry experience has shown FACTS devices to enhance transmission capacity by 20-40%. FACTS devices stabilize voltage, and in so doing remove some of the operational safety constraint

that prevent operators from loading a given line more heavily. In addition to the efficiency gains, these devices also deliver a clear reliability benefit.

### **GAS INSULATED SUBSTATIONS**

Most substations occupy large areas of land to accommodate the design requirements of the given facility. However each time power flows through a substation to step down the voltage. More energy is lost as the power flows through the transformer, switches & other equipment's. The efficiency of lower voltage lines coming out of the substation is also markedly lower than their high voltage counterparts.

If power can be transmitted at higher voltage to a substation that is closer to where the energy will be consumed, significant efficiency improvements are possible.

Gas insulated substations essentially take all of the equipment you would find in an outdoor substation and encapsulate it inside of metal housing. The air inside is replaced with a special inert gas, which allows all of the components to be much closer together without the risk of the flashover.



*Figure 18 World's one of the largest SF6 gas insulated switchgear installation, at Three Gorges Dam in China: ELK-3 GIS, 73 bays, 550 kV*

The result is that it is now possible to locate a substation in the basement of a building or other confined space so that the efficiency of high voltage transmission can be exploited to the fullest content.

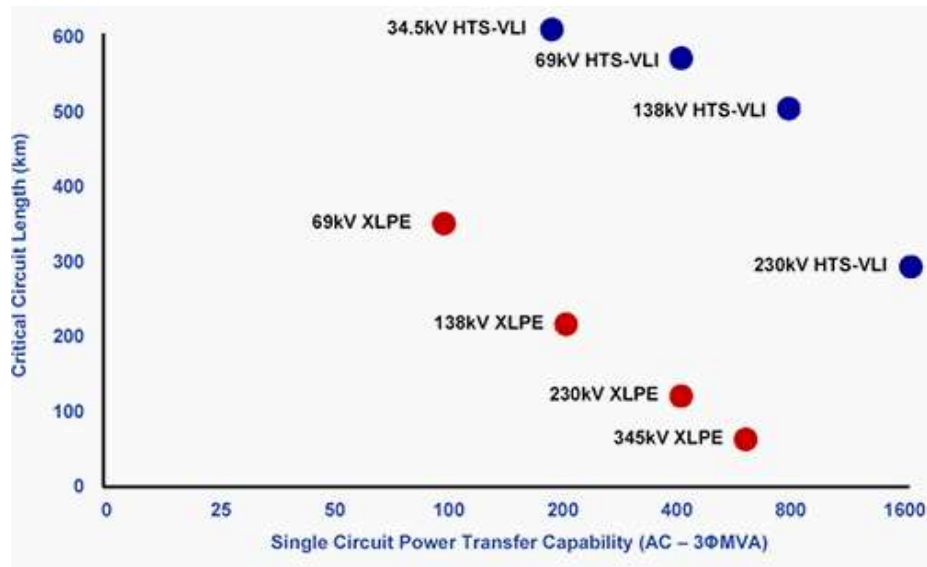
### **SUPERCONDUCTORS / HTS CABLES**

Superconducting materials at or near liquid nitrogen temperature have the ability to conduct electrically with nonzero resistance.

So-called high temperature super conducting cables now under development which still require some refrigeration can carry three to five times the power of conventional cables.

The losses in HTS cables are also significantly lower than the losses in conventional lines. Even when the refrigeration cost is included. A major vendor of superconducting conductors claim that the HTS cable losses are only a half a percent (0.5%) of the transmitted power compared to 5-8% of traditional power cables. Superconducting materials can also be used to replace the copper winding of transformers to reduce losses by as much as 70% compared to current designs.





### WIDE AREA MONITORING SYSTEM

Much of the transmission system could feasibly be operated at a higher loading, were it not for reliability concerns. However, if operators given the ability to monitor grid conditions more precisely & in real time, some of this constraint would remove.

One example to relates to the simple fact that when transmission lines heat up, the metals becomes pliable and the line sag, which can cause a short circuit if they come in contact with a tree or other grounding objects.

Wide area monitoring system has many promising capabilities, one of which is line thermal monitoring. With this functionality transmission operators could conceivably change the loading of transmission lines more freely by virtue of having a very clear understanding of how close a given line really is to its thermal limits.



Figure 19 Wide Area Monitoring System

### CONCLUSION

The transmission and distribution (T&D) system includes everything between a generation plants to end- use site. Along the way, 1433

some of the energy supplied by the generator is lost due to the resistance of the wires that is line loss and equipment that the electricity passes through. The loss is mainly depends upon the type of transmission and wire resistance. For better transmission we need some special transmission method and good conductor that's what here we are showing some better methods for transmission and distribution from this all methods we can reduce the T&D losses

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