Water is needed to cool the reactors in nuclear power plants. Cold water from lakes and rivers is used for this process. As a result of this a lot of hot water is generated. It's called thermal pollution since organisms die when temperatures rise [1].
Low-level radioactive waste is waste, which is spent nuclear fuel or highly radioactive waste produced if spent fuel is reprocessed. High levels of radioactive contamination – unlike low levels – may pose major risks to people and the environment. People can be exposed to potentially lethal radiation levels [5].

Figure 1 shows a diagram "Sources of Radiation". As can be seen, nuclear industry which is yellow – only 1% of the global pollution. The most – is radon (42%). But others sources wasn't considered in this paper.

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Tarasenko, S.S., Shestakova, V.V., Chesnokova, I.A.

Employing electric resonance for reducing transmission losses

National Research Tomsk Polytechnic University

Abstract

The subject of the paper is power transmission losses caused by reactance losses. Possible solution to the problem with resonance-based equipment is considered and necessary calculations are presented.

Key words: resonance, transmission losses, power line, reactive impedance, compensation, frequency, reactive impedance, capacitor bank, overvoltage, shunt reactor, power line phases.

Introduction

Reducing power transmission losses is one of the most important issues of modern power engineering. There are different reasons for transmission losses, one of which is reactance losses, causing hazardous overvoltage. To solve this problem various devices have been developed and resonance-based equipment is considered to be one of the most efficient and promising.

Theoretical foundation.

Resonance is a sharp increase in the amplitude of forced oscillations when impressed frequency is close or equal to the natural frequency of the oscillatory system. Resonance can be of two types: mechanical resonance and electric resonance.

Mechanical and electrical resonance have some common features: in both cases resonance occurs when impressed frequency coincides with fundamental frequency of the system. Impressed frequency is equal to the source frequency, while natural frequency of any electric system depends on the relation between inductance and circuit capacitance. Electric resonance is divided into acceptor resonance and parallel resonance. In case of acceptor resonance inductance and capacitance are connected in series, in case of parallel resonance they are connected in parallel.

Devices employing the properties of electric resonance are widely applied in power engineering to reduce transmission losses and prevent overvoltage hazardous for electrical insulation equipment at substations.

For better understanding of the device construction and operating principles the equivalent circuit and real variables of a three-phase overhead transmission line are to be examined. Any power transmission line can be presented as a line of infinite active and reactive impedances and conductivities evenly aligned. In the given paper a simplified method for calculating series compensation is considered. The power line is presented as an equivalent-Pi with series coil resistance *(R)* and inductance *(X)*. Capacitive susceptance *(B)* is divided and inserted at the sending and receiving ends of line (fig.1):

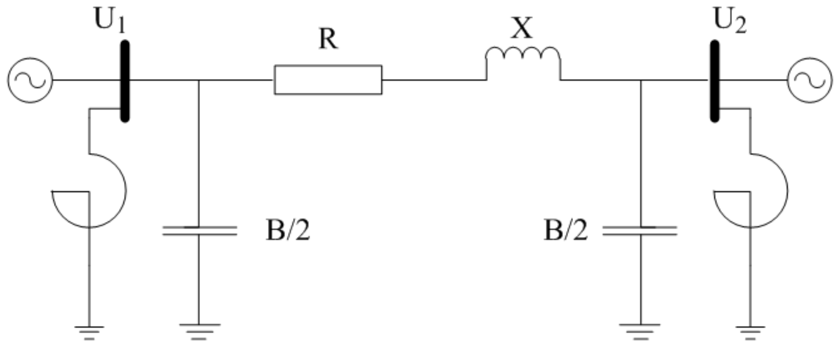

Fig.1.

Calculations

For further calculations we will consider a 500 kV overhead transmission line with a definite set of parameters:

power line voltage-margin *U= 575-500 kV*.

capacitive conductivity per square kilometer $b_o= 3,62\cdot10^{-6}$ *S*.

specific charge capacitance $q_o= 0,905$ *Mvar*.

inductance $X_L = 0,35$ *ω/km*.

coil resistance R_o = 0,02 *ω/km*.

line length *l = 500 km*.

It must be noted that power line coil resistance is more than 10 times less than inductance. Therefore major transmission losses account for reactive impedance $X = X_o l$. Reactive impedance can be compensated if a bank of capacitors will be inserted in the split of the power line. The required capacitor bank will be calculated with the acceptor resonance formula at the industrial circular frequency: $\omega L = 1/\ \omega C$ or $X_o\ l = 1/\ \omega C$. Thus, $C= 1/\ (\omega\ X_o\ l) = 1/\ (314\cdot\ 0{,}35\cdot 500) =18{,}2$ μF.

The capacitor bank inserted into the split of the power line is called a series compensator (dotted line in fig.1).

Every power line has a certain charge capacity of $Q = q_o\ l$. Therefore, a power line is a reactive power source. It can result in end-overvoltage (substation bus bars) hazardous in some modes to electric insulation.

To prevent overvoltage shunt reactors are successfully used in power engineering. Shunt reactors are heavy-gauge bus duct coils embedded in concrete. Due to their simple and robust construction dry shunt reactors are the most cost-effective means to provide for the power line capacity compensation.

Shunt reactors are inserted between power line phases and ground and provide power line compensation (fig.1). Evidently, in this case parallel resonance (current resonance) occurs.

We shall determine capacitive susceptance of the power line being examined:

$$B = b_0 L, B = 3{,}62 \cdot 10^{-6} \cdot 500 = 1{,}810 \cdot 10^{-3} \text{ S.}$$

Knowing the power line capacitive susceptance, we shall find out charge capacity of the power line at rated voltage:.

$$Q_l = U^2 B, Q_l = 500000^2 \cdot 1{,}81 \cdot 10^{-3} = 4{,}525 \cdot 10^8 \text{ Var.}$$

In case of open transmission line (zero transmission capacity), power line charge capacity is equal to reactor charge capacity, i.e. $Q_l = Q_r$.

Now we shall deduce resistance from the reactor charge capacity formula: $Q_r = U^2 \frac{1}{x_r}$, from here. $x_r = \frac{U^2}{Q_r}, x_r = \frac{25 \cdot 10^{10}}{4{,}525 \cdot 10^8} = 552$ ω.

Now we shall determine cumulative inductance of two reactors, necessary for full compensation of the power line charge capacity:

$$L_r = \frac{x_r}{\omega} = \frac{x_r}{2\pi f} = \frac{552}{2 \cdot 3.14 \cdot 50} = 1{,}76 \text{ H.}$$

Conclusion

Therefore, installation of a capacitor bank and two shunt reactors with the calculated values will ensure full reactance compensation and power line conductivity, considerably reduce transmission losses, and prevent hazardous overvoltage.

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Tashirev, I.A.

AC/DC Transmission

National Research Tomsk Polytechnic University.

Abstract

Disputes between supporters of AC and DC take place since the time of Tesla and Edison. Which is better? In this paper we try to understand this poll. First, we consider the advantages and disadvantages of AC and DC. Next, consider the option of combined AC and DC. In conclusion, we can conclude which of the two options would be preferable.

Introduction.

Consumption of electricity is an essential life process of modern society. Electricity is used everywhere, starting with the largest industrial facilities, ending appliances in our homes. Energy consumption is growing every year, increases the amount of power transmitted over power lines. This greatly affects the stability of the power system. Increasingly, there are questions about transmission of electric power. Nikola Tesla and Thomas Edison divided technical society into two parts, which are still in their irreconcilable views: direct current or alternating current. Which is better?.

Comparison between AC and DC transmission system (with their advantages and disadvantages)

Electric Power can be transmitted in both AC and DC. But there are some advantages and disadvantages of both systems. So it is important that we discuss technical advantages and disadvantages of both AC and DC Systems.