**Exercises on High Voltage Engineering (Mar 13, 2025):**

**Exercise 2-5:** Under the impulse voltage, why is the electrical strength of the gap expressed not only by the 50% breakdown voltage, but also by the voltage-time characteristic? Please use the curve in Figure 2-27(a) of this textbook to draw the voltage-time characteristic curve of 4m air gap within 10μs with voltage as the vertical axis and time as the horizontal axis.

**Exercise 2-6:** How are the voltage-time characteristics of the air gap obtained in laboratory?

**Exercise 2-7:** What is the relation between the electric field distribution and voltage-time characteristics of a gas gap?

**Exercise 2-9:** When actually measuring the electrical strength of an air gap under impulse voltage, how to determine its 50% discharge voltage *U*50? With *U*50, how to determine the withstand voltage of this air gap for a certain withstand probability?

**Exercise 2-12:** It is known that the maximum surface field stress of the ground wire is 13.9kV/cm, the radius of the ground wire is *r*=0.53cm, the maximum field stress of the split conductor is 23.3 kV/cm in phase A, 25.2 kV/cm in phase B, and the radius of the conductor is *r*=1.18cm. Please estimate whether the corona occurs under the following atmospheric conditions (the field stress given in the question is the peak value, surface roughness coefficient is *m*=0.82)?

(1) Standard reference atmospheric conditions; (2) *t*=35℃, *p*=99.9kPa.

**Supplementary Exercise 1:** According to the experimental curve in Figure 2-41 of the textbook, please draw the relationship between the gap breakdown field strength and the air pressure when the electrode distance *d*=2.0cm and *d*=0.5cm respectively.

**Supplementary Exercise 2:** According to the experimental curve in Figure 2-42 of the textbook, please calculate the gap breakdown voltage and the corresponding breakdown strength when the gap distance is 2mm, 5mm, 10mm and 30mm respectively.

**Supplementary Exercise 3:** As a commonly used internal dielectric gas for high voltage equipment, what are the advantages and disadvantages of SF6? Why are countries trying to develop alternative gases of SF6 in recent years? What are the measures for reducing the total amount of SF6?

**Supplementary Exercise 4:** In the selected topic document on OHLs-1, some photos of the self-supporting tower, tension tower and guyed tower of overhead transmission line are given.

(1) What is the main role of the tension tower? What are the main advantages and disadvantages of a guyed tower?

(2) What is the main function of insulators in the overhead line?

**Supplementary Exercise 5:** A ±500kV HVDC project with a transmission distance of 1000km and the rated power of 3 GW. 4-split conductor is used. The aluminum cross section for each split conductor is 685mm2 on pages 25-26 of the selected topic document on OHLs-1, and the HVDC project runs 5000h per year at rated power with the conductor temperature of 20℃, please calculate how many kWh is lost per year by the resistance of this OHL. For each split conductor, if the aluminum cross-section of 806mm2 is adopted, please calculate again the annual resistance loss of the OHL under the same operating conditions.