Power Distribution System

Fall 2021-Session 2019

Final Term

Time= 105 min.

Mark=40

Question #1:

CLO3(5+6+7)   (12/18).

I- Compare Voltage drop and power losses among three phase and Two-Phase Plus Neutral (Open- Wye) Laterals. (5)

II- Describe Economic justification of capacitor installment in given domains:(6)
a. Benefits due to released transmission Capacity
b. Benefits due to Reduced Energy Losses

III- Assume that the NP&NL Utility Company is presently operating at 90% power factor. It is desired to improve the power factor to 99%. To study the power factor improvement, several load flows run have been made and the results are summarized in the following table. (7)
Using the relevant additional information given in Table

Summary of Load Flows

Comment	At 90% PF	At 99% PF
Total loss reduction due to capacitors applied to substation buses, kW	496	488
Additional loss reduction due to capacitors applied to feeders, kW	84	72
Total demand reduction due to capacitors applied to substation buses and feeders, kVA	21,824	19,743
Total required capacitor additions at buses and feeders, kvar	9,512	2,785

CLO4(12+10)

Question#2:

I-Briefly answer questions

a. Compare H-Type and SL-Type underground Cables? (3)
b. Is charging current high in cables? If yes, justify your answer? (2)
c. List down advantages of External Pressure Cables? (3)
d. Derive expression for capacitance Grading? (4)

II-Case Study: (10)

NPC Company wants to upgrade overhead distribution system with underground cables and have provided some specifications for designing of 5 km log underground distribution system cables, insulation of a single core cable is 950M-ohm/Km. If core diameter is 3cm and resistivity is 6×10^{14} ohm-cm. Voltage of single-phase system is 33Kv, 50Hz and relative permittivity is asphalt is 3-5* with maximum gradient dielectric stress is 44 KV/cm

    a. Find insulation thickness
    b. Find capacitance of cable per meter
    c. Charging Current
    d. Phase voltages and line to line voltages
    e. Find most economical core diameter of cable which is working on 33KV but possible dielectric stress must not exceed 44KV/cm in design.
    f. Power factor of circuit 0.09 and supply voltages are 33KV, Find cable power factor

*Choose relative permittivity as average value of range.

responsibility factors of 1.0 and 0.9 for capacitors installed on the substation buses and on feeders, respectively. Determine the following:

    a. The resulting additional savings in kilowatt losses at the 98% power factor when all capacitors are applied to substation buses.
    b. The resulting additional savings in kilowatt losses at the 98% power factor when some capacitors are applied to feeders.
    c. The total additional savings in kilowatt losses.
    d. The additional savings in the system kilovoltampere capacity.
    e. The additional capacitors required, kvars.
    f. The total annual savings in demand reduction due to additional capacitors applied to substation buses and feeders, $/year.
    g. The annual savings due to the additional released transmission capacity, $/year.
    h. The total annual savings due to the energy loss reduction, $/year.
    i. The total annual cost of the additional capacitors, $/year.
    j. The total net annual savings, $/year.
    k. Is the 98% power factor the economic power factor?