6. Load calculation

- **Following loads to be calculated**

  Lighting

  Power

  Equipment (Kitchen, Copy machine, etc..)

  Air condition units

  Other services (Water pumps, elevators, etc..)

6.1. Demand factor (Utilization factor) – Ku:

Demand Factor (Ku) = Maximum demand / Total connected load

6.2. Diversity Factor – Ks:

Diversity Factor (Ks) =

Diversity occurs in an operating system because all loads connected to the System are not operating simultaneously or are not simultaneously operating at their maximum rating.

7. Selection of transformer.

After diversity maximum demand = 218 kVA

Consider 10% future demand = 22 kVA

Total demand with future loads = 240 kVA

Selected Transformer capacity = 250 kVA

8. Selection of Generator.

Important items to be considered prior to the selection

- Minimum generator set load/capacity – it shall be more than 30% from the rated value.
- Maximum allowable step voltage dip.
- Maximum allowable step frequency dip.
- Altitude and temperature.
- Duty cycle - Standby power, Prime power or utility paralleling (Continuous power).
- Electrical characteristics – Number of phase, voltage, frequency.
- System power factor
- Type of the load - Linear loads and non linear loads.
- Low inertia load, High inertia load

9.2. Voltage drop along the cable.

Depend upon the impedance of the cable, the magnitude of the load current and the load power factor.

Permissible voltage drop = ΔVp (V)

ΔVt = Tabulated voltage drop mV/A/m

Calculated voltage drop = ΔVc (V) = V1-V2 = (ΔVt /1000) x Ib x L

9.3. Shot circuit withstand ability of the cable.

Short circuit temperature limit depend upon energy produced during the short circuit condition.

- Purpose of Calculating Short Circuit

Determine whether the protective device have adequate breaking capacity.

Determine whether the conductors of the circuit protected thermally.

$K^2S^2 = I^2sc.\ t$ - Adiabatic Equation

$S = (Isc \sqrt{t})/ K$

t – Duration of Short Circuit K – Factor Depending on the Cable type

S – Conductor Cross sectional area Isc – Short Circuit current (A) rms

The minimum size of the cable should satisfy the above three requirements.

Specimen Calculation for the cable from MDB to SDB-GF

a) Total Load of the SDB-GF – 55.8 kVA

Length of the cable from MDB to SDB-GF- 35 m

System Voltage - 400 V

Design ambient temperature - 30 ^{0}C

Cable installation method – Installed in air " REFERENCE METHOD E" (Page-261)

- Short circuit calculation is done from point to point of the installation.
- Equivalent impedance of the up stream is used to calculate the fault level of any selected point of installation.

$$If = U / / Z$$

$$Z =$$

$$R=R1 + RS \quad X=X1+XS$$

U – Line to Line r.m.s voltage I_f – Fault Current Line to Ground

R_l – Line resistance Rs – Source resistance

X_l – Line impedance Xs – Source impedance

R – Total up stream resistance X – Total up stream impedance

- Calculation of SCL at source end When system is on transformer

Transformer Data:

Capacity: 250 kVA , Copper Loss: 3700 W, Usc = 5%

Pc = sqr (I2) . Rs

Rs = Pc / SQ(P/V) = 3700 x 400 x 400 /(250x250x1000x1000) = 0.009472 Ohms

Rs = 9.472 m Ohm

Zs = U . V / I = 0.05 x 400 / (250 x 1000 /400) = 0.032 Ohm = 32 m Ohm

Xs = sqrt(sqr(Zs) – sqr(Rs)) = 30.56 m Ohm

Short Circuit power at Transformer level = Psc = P/Usc = 250 x 1000 / 0.05 = 5,000,000 VA

= 5 MVA

Therefore short circuit current = Isc = Psc / sqrt (3) / V = 5000000/1.732/400 = 7,217 A

= 7.2 kA

- Calculation of SCL at source end when system is on Generator

Generator Data:

Capacity: 300 kVA , Generator Sub-Transient Reactance % (Xd): 15.53 %

R : X = 0.1

Xs = Xd . Sqr (V) / P

Xs = (15.53 / 100) x 400 x 400 /(300 x 1000) = 0.0828 Ohms

Xs = 82.82 m Ohm

Rs = Xs x 0.1 = 8.28 m Ohm

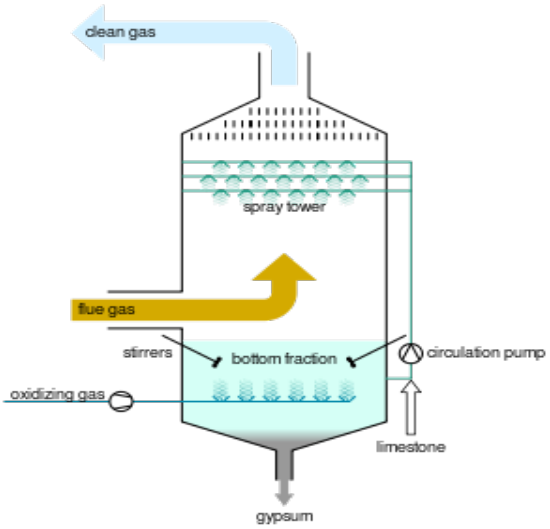
Zs = sqrt (sqr(Rs) + sqr(Xs))

= sqrt (sqr(8.28) + sqr(82.82)) = 83.23 m Ohm

Isc = V / sqrt(3). Zs = 400 / 17.32 / 83.23 = 2.77 kA

Highest SCC is when the system is on Transformer, rest of the calculation starts from there

Figure 7desulferlization process



10.5. GGH process

In this process treated gas absorb heat by flue gas and it's helps to goes upper top of furnace. Now we can't see any smoke on top of the furnace. But when the generator start to operate all sulfur separate process stop and then we can see black smoke on top of the furnace.

10.6. Turbine

When supply steam is stopped the middle long axel can lab because of high & weight of axel. So it's not stay without rotation normally rotation speed is 5 rpm for a 5 years' time there were repair called over role. As a generator must rotate at constant synchronous speed according to the frequency of electric power system the most common speed is 3000RPM for 50hz and 3600RPM for 60hz

10.7. Generator

As a cooling method hydrogen used to cool generator, between rotor & stator air gap including hydrogen for it. They have another plant to generate hydrogen for cooling process.

10.8. Transformer

There are 3 transformers each one 360kva capacitor. Actually it's the 3rdd largest transformer in SL. There also SSP called transformers used to supply inside load. Power step down transformers.

There also wind turbine system which supply 65MW-30MW consumption to CEB.

Transmission line which goes from plant

- Anuradhapura 1 line 220kv
- NewChilaw 2 lines 220Kv

10.9. Key facts about Coal fired electrical production

- Coal combustion in boiler requires air around 1.6 billion cubic meter of air in hour is delivered by air fans into the furnace.
- The boiler for typical 500MW units produce around 1600 tons per hour of system at a temperature of 540 to 600C.The steam pressure is 200bar.
- Heat transformer from the hot combustion gases to the water in the boiler takes place due to radiation an convention