

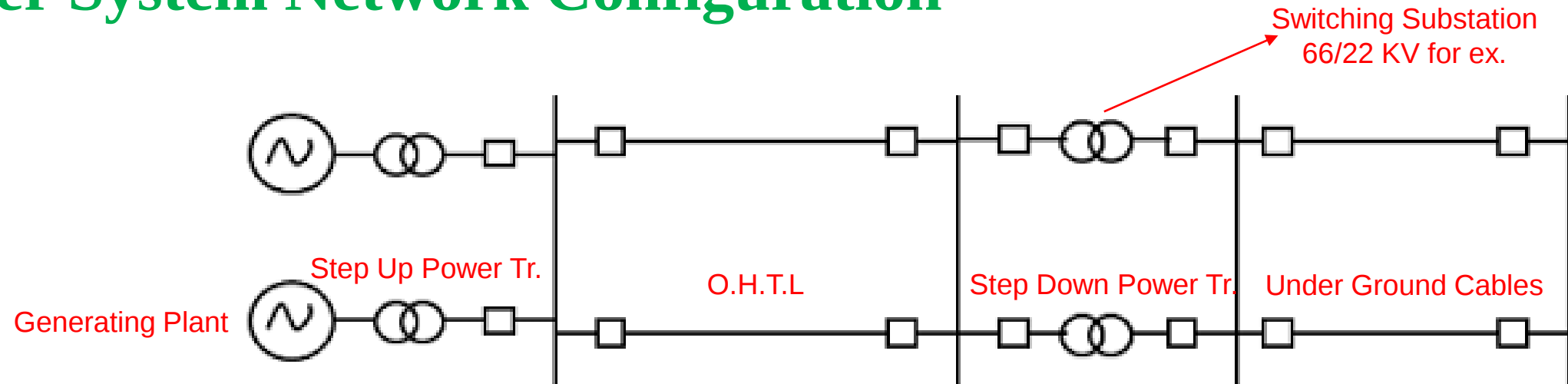
# Building Design Concept

Load Estimate, zoning, and Conceptual SLD

# Points to be discussed

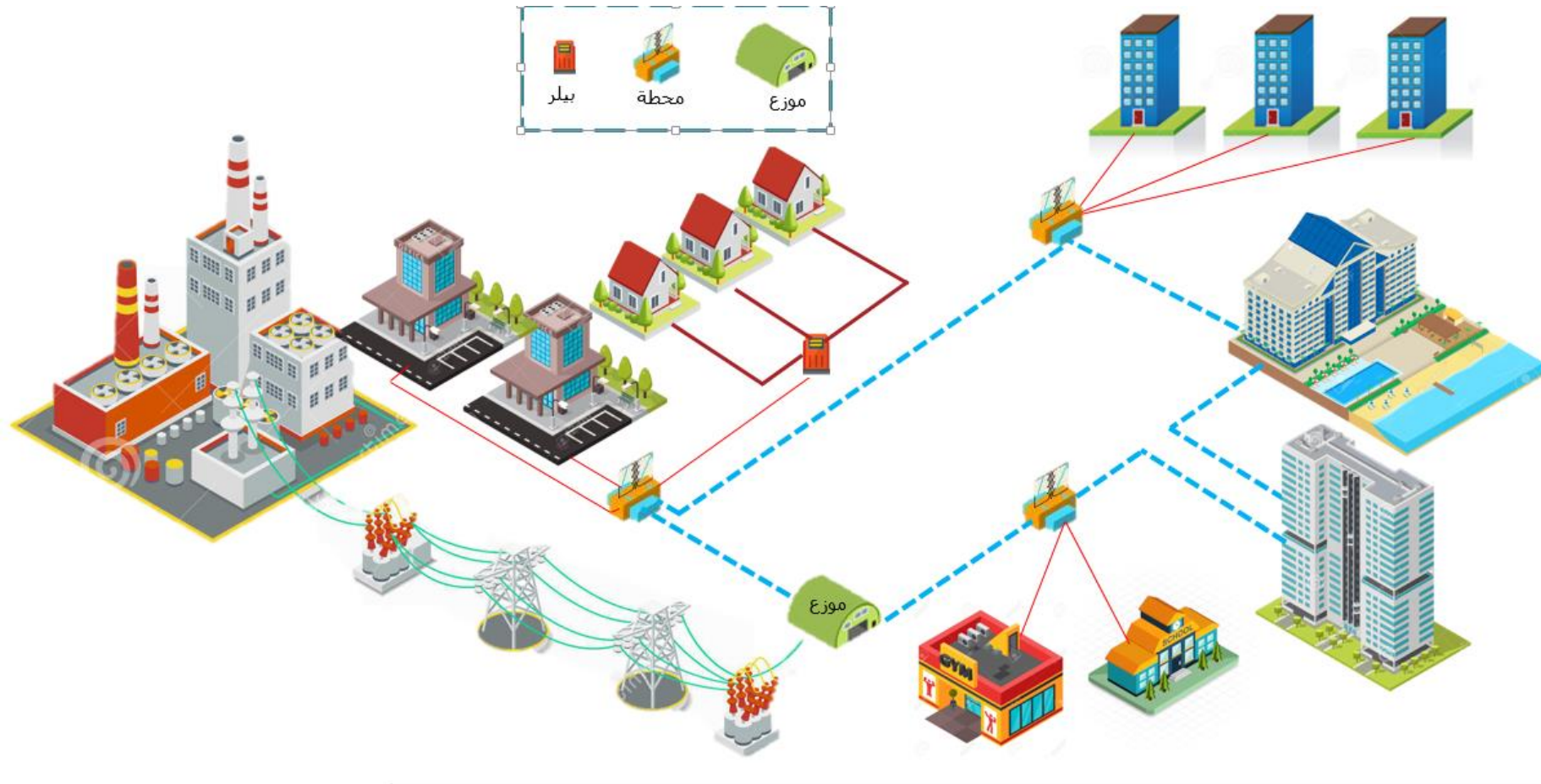
- Egyptian network
- Design Phases
- Building Application
- Load Estimation
- Zoning
- Conceptual SLD

# Power System Network Configuration



| Generation           | Transmission / Sub transmission |        | Distribution         |
|----------------------|---------------------------------|--------|----------------------|
| Medium Voltage 24 kV | Extra High Voltage              | 765 kV | Medium Voltage 33 kV |
| 21 kV                |                                 | 400 kV | 22 kV                |
| 15 kV                |                                 | 220 kV | 11 kV                |
| 13.8 kV              | High Voltage                    | 132 kV |                      |
|                      |                                 | 110 kV |                      |
|                      |                                 | 66 kV  |                      |

# Electrical Infra Structure



# Network Architecture

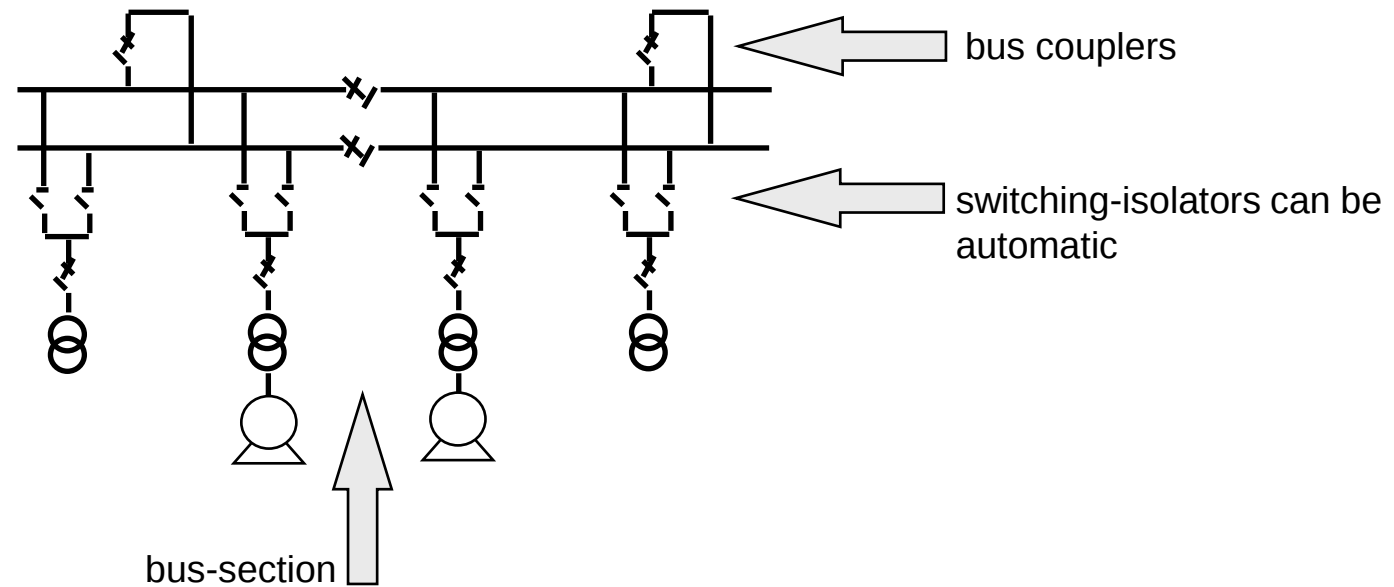
## ■ Double busbar or parallel feeders

### ✓ Advantages:

- each feeder connected to two busbars
- each busbar is sectionalizable
- operation complicated by supply possibilities

### ✓ Satisfactory for:

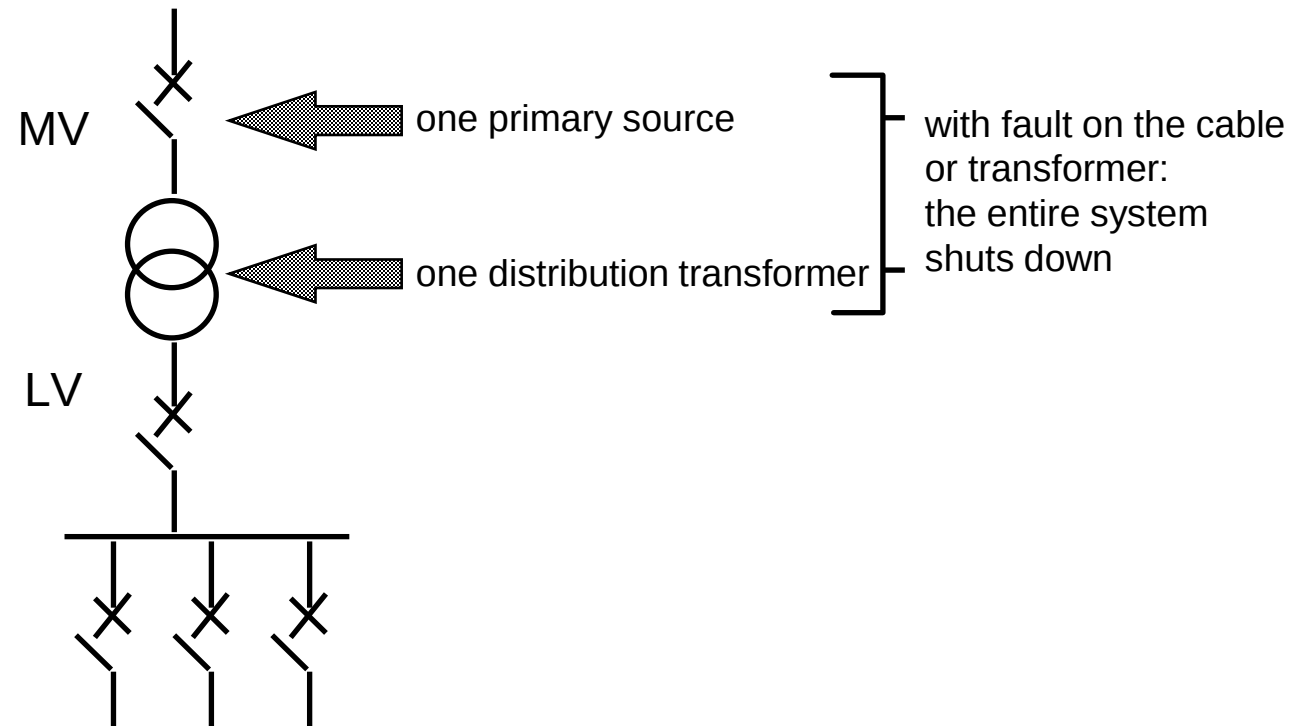
- off-shore, chemical, heavy industrial plants



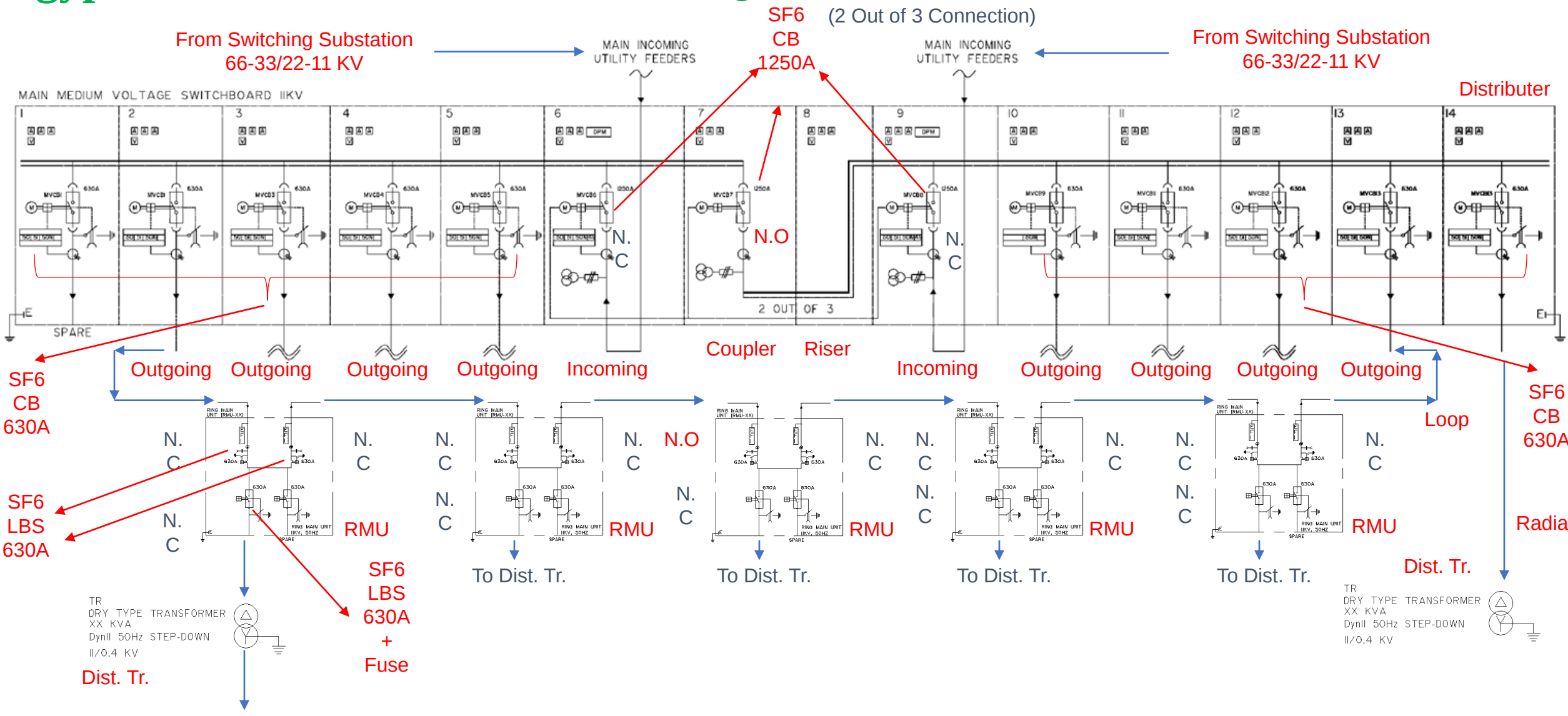
# Network Architecture

## ■ Simple radial system (or single-line service)

- ✓ Low investment
- ✓ Satisfactory for:
  - small industrial installation
  - rural distribution, difficult-access areas



# Egyptian 22 or 11 KV network



# Design Phases

- **Concept Design (30%)**
  - ✓ Load Estimate
  - ✓ Categorization of Tie-in
  - ✓ Bulk Equipment(Up stream)
  - ✓ Zoning (Down Stream)
  - ✓ Block Diagram
  - ✓ Space Program
- **Schematic Design (60%)**
  - ✓ Lighting
  - ✓ Small Power
  - ✓ Routing
- **Detailed Design (100%)**
  - ✓ Panel Schedule
  - ✓ Cable Sizing
  - ✓ Earthing
  - ✓ Lightning



# 1-Load Estimate

- Power Density ( $VA/m^2$ )
  - ✓ Overall Method
  - ✓ Load Break Down Method
    - Type
    - Space application
  - ✓ Exact Method
- Areas
  - ✓ Plot Area
  - ✓ Foot Print Area
  - ✓ Built Up Area
- Loads
  - ✓ Connected Load
  - ✓ Demand Load
  - ✓ Coincident load



Ground Floor - 1746 sqft.



First Floor - 1347 sqft.

# Regulations Example

## ■ According to Egyptian Electrical Company Regulation:

برجاء التفضل بالإحاطة بأن معاملات التثنت والمقننات التصميمية للأحمال الكهربائية حاليا للمدن الجديدة

كالتالى :-

١- ٦ ك.ف.أ لكل ١٠٠ م٢ بالنسبة للإسكان الفاخر

٢- ٤ ك.ف.أ لكل ١٠٠ م٢ بالنسبة للإسكان المتوسط

٣- ١٠ ك.ف.أ لكل ١٠٠ م٢ بالنسبة للمباني التجارية والإدارية

٤- معاملات التثنت عند السكنى فقط عند المحولات والموزعات ومحطات المحولات وقيمة (٠,٨) عند كل منهم

وتفضلوا بقبول وافر الاحترام

التصميمات

مدير عام تصميمات ومقاييسات شرق

٩/٥٨  
٢٠١٦

رئيس قطاع التصميمات والتنفيذ الذاتى

مهندسة /

٩/٥٨  
٢٠١٦  
"مى حسين"

رئيس قطاعات الشئون الفنية  
والمشرف على قطاعات الشبكات  
مهندس /

"أحمد أمين حسين"

٣٥٢  
٢٠١٦ / ١٠ / ٢

# Regulations Example

## ■ Saudi Code (DPS)

| Code | Customer Category                        | Loads included*                             | VA/m <sup>2</sup> |
|------|------------------------------------------|---------------------------------------------|-------------------|
| C3   | Furnished Flats                          | (Lights + Air Conditioning + Power Sockets) | 175               |
| C4   | Hotels                                   | (Lights + Air Conditioning + Power Sockets) | 240               |
| C5   | Malls                                    | (Lights + Air Conditioning + Power Sockets) | 255               |
| C6   | Restaurants                              | (Lights + Air Conditioning + Power Sockets) | 235               |
| C7   | Offices                                  | (Lights + Air Conditioning + Power Sockets) | 220               |
| C8   | Schools                                  | (Lights + Air Conditioning + Power Sockets) | 180               |
| C9   | Mosques                                  | (Lights + Air Conditioning + Power Sockets) | 185               |
| C10  | Mezzanine in Hotel                       | (Lights + Air Conditioning + Power Sockets) | 100               |
| C11  | Common Area/Services in Buildings        | (Lights + Power Sockets)                    | 60                |
| C12  | Public Services Facilities               | (Lights + Power Sockets)                    | 50                |
| C13  | Indoor Parking                           | (Lights + Vans + Gates + Safety Systems)    | 30                |
| C14  | Outdoor Parking                          | (Lights)                                    | 5                 |
| C15  | Streets Lighting                         | (Lights)                                    | 5                 |
| C16  | Parks & Garden                           | (Lights + Water Distributor)                | 4                 |
| C17  | Open Spaces                              | (Lights)                                    | 3                 |
| C18  | Hospitals\Medical Facilities             | (Lights + Air Conditioning + Power Sockets) | 250               |
| C19  | Medical Clinics                          | (Lights + Air Conditioning + Power Sockets) | 225               |
| C20  | Universities/High Educational Facilities | (Lights + Air Conditioning + Power Sockets) | 245               |
| C21  | Light Industries                         | (Lights + Motors + Power Sockets + AC)      | 280               |
| C22  | Workshops                                | (Lights + Power Sockets)                    | 80                |
| C23  | Cooling Stores                           | (Lights + Chillers + Power Sockets)         | 260               |
| C24  | Warehouses                               | (Lights + Vans + Power Sockets)             | 70                |
| C25  | Community Halls                          | (Lights + Air Conditioning + Power Sockets) | 230               |
| C26  | Recreational Facilities                  | (Lights + Air Conditioning + Power Sockets) | 200               |
| C27  | Farms\Agricultural Facilities            | (Lights + Power Sockets)                    | 130               |
| C28  | Fuel Stations                            | (Lights + Power Sockets)                    | 90                |
| C29  | Bulk Factories                           | (Lights + Power Sockets)                    | 295               |

| Code | Customer Category                        | DF   |
|------|------------------------------------------|------|
| C1   | Normal Residential Dwelling              | 0.60 |
| C2   | Normal Commercial Shops                  | 0.70 |
| C3   | Furnished Flats                          | 0.70 |
| C4   | Hotels                                   | 0.75 |
| C5   | Malls                                    | 0.70 |
| C6   | Restaurants                              | 0.70 |
| C7   | Offices                                  | 0.70 |
| C8   | Schools                                  | 0.80 |
| C9   | Mosques                                  | 0.90 |
| C10  | Mezzanine in Hotel                       | 0.75 |
| C11  | Common Area/Services in Buildings        | 0.80 |
| C12  | Public Services Facilities               | 0.75 |
| C13  | Indoor Parking                           | 0.80 |
| C14  | Outdoor Parking                          | 0.90 |
| C15  | Streets Lighting                         | 0.90 |
| C16  | Parks & Garden                           | 0.80 |
| C17  | Open Spaces                              | 0.90 |
| C18  | Hospitals\Medical Facilities             | 0.80 |
| C19  | Medical Clinics                          | 0.70 |
| C20  | Universities/High Educational Facilities | 0.80 |
| C21  | Light Industries                         | 0.90 |
| C22  | Workshops                                | 0.90 |
| C23  | Cooling Stores                           | 0.90 |
| C24  | Warehouses                               | 0.70 |
| C25  | Community Halls                          | 0.80 |
| C26  | Recreational Facilities                  | 0.80 |
| C27  | Farms/ Agricultural Facilities           | 0.90 |
| C28  | Fuel Stations                            | 0.70 |
| C29  | Bulk Factories                           | 0.90 |

# Codes Example

## ■ IEEE: Lighting Vs (Area)

**Table 4—Prescriptive Unit Lighting Power Allowance (ULPA) (W/ft<sup>2</sup>) — Gross Lighted Area of Total Building**

| Building Type or Space Activity             | 0 to 2000 ft <sup>2</sup> | 2001 to 10 000 ft <sup>2</sup> | 10 001 to 25 000 ft <sup>2</sup> | 25 001 to 50 000 ft <sup>2</sup> | 50 001 to 250 000 ft <sup>2</sup> | >250 000 ft <sup>2</sup> |
|---------------------------------------------|---------------------------|--------------------------------|----------------------------------|----------------------------------|-----------------------------------|--------------------------|
| <b>Food Service</b>                         |                           |                                |                                  |                                  |                                   |                          |
| Fast Food/Cafeteria                         | 1.50                      | 1.38                           | 1.34                             | 1.32                             | 1.31                              | 1.30                     |
| Leisure Dining/Bar                          | 2.20                      | 1.91                           | 1.71                             | 1.56                             | 1.46                              | 1.40                     |
| Offices                                     | 1.90                      | 1.81                           | 1.72                             | 1.65                             | 1.57                              | 1.50                     |
| Retail*                                     | 3.30                      | 3.08                           | 2.83                             | 2.50                             | 2.28                              | 2.10                     |
| Mall Concourse<br>Multiple-Store<br>Service | 1.60                      | 1.58                           | 1.52                             | 1.46                             | 1.43                              | 1.40                     |
| Service Establishment                       | 2.70                      | 2.37                           | 2.08                             | 1.92                             | 1.80                              | 1.70                     |
| Garages                                     | 0.30                      | 0.28                           | 0.24                             | 0.22                             | 0.21                              | 0.20                     |
| <b>Schools</b>                              |                           |                                |                                  |                                  |                                   |                          |
| Preschool/<br>Elementary                    | 1.80                      | 1.80                           | 1.72                             | 1.65                             | 1.57                              | 1.50                     |
| Jr. High/High<br>School                     | 1.90                      | 1.90                           | 1.88                             | 1.83                             | 1.76                              | 1.70                     |
| Technical/<br>Vocational                    | 2.40                      | 2.33                           | 2.17                             | 2.01                             | 1.84                              | 1.70                     |
| Warehouse/Storage                           | 0.80                      | 0.66                           | 0.56                             | 0.48                             | 0.43                              | 0.40                     |

NOTE: This prescriptive table is intended primarily for core-and-shell (i.e., speculative) buildings or for use during the preliminary design phase (i.e., when the space uses are less than 80% defined). The values in this table are not intended to represent the needs of all buildings within the types listed.

\*Includes general, merchandising, and display lighting.

# Codes Example

- IEEE:  
General socket vs (Occupancy):

**Table 5—Typical Appliance/General-Purpose Receptacle Loads (Excluding Plug-in-Type A/C and Heating Equipment)**

| Type of Occupancy                                | Unit Load (VA/ft <sup>2</sup> ) |      |         |
|--------------------------------------------------|---------------------------------|------|---------|
|                                                  | Low                             | High | Average |
| Auditoriums                                      | 0.1                             | 0.3  | 0.2     |
| Cafeterias                                       | 0.1                             | 0.3  | 0.2     |
| Churches                                         | 0.1                             | 0.3  | 0.2     |
| Drafting rooms                                   | 0.4                             | 1.0  | 0.7     |
| Gymnasiums                                       | 0.1                             | 0.2  | 0.15    |
| Hospitals                                        | 0.5                             | 1.5  | 1.0     |
| Hospitals, large                                 | 0.4                             | 1.0  | 0.7     |
| Machine shops                                    | 0.5                             | 2.5  | 1.5     |
| Office buildings                                 | 0.5                             | 1.5  | 1.0     |
| Schools, large                                   | 0.2                             | 1.0  | 0.6     |
| Schools, medium                                  | 0.25                            | 1.2  | 0.7     |
| Schools, small                                   | 0.3                             | 1.5  | 0.9     |
| Other Unit Loads:                                |                                 |      |         |
| Specific appliances — ampere rating of appliance |                                 |      |         |
| Supplying heavy-duty lampholders — 5 A/outlet    |                                 |      |         |

# Codes Example

## ■ IEC: Simultaneity factor

Simultaneity factor for distribution boards. [Guide page A18](#)

| number of circuits | factor of simultaneity |
|--------------------|------------------------|
|--------------------|------------------------|

Assemblies entirely tested

|         |     |
|---------|-----|
| 2 and 3 | 0.9 |
|---------|-----|

|         |     |
|---------|-----|
| 4 and 5 | 0.8 |
|---------|-----|

|         |     |
|---------|-----|
| 6 and 9 | 0.7 |
|---------|-----|

|             |     |
|-------------|-----|
| 10 and more | 0.6 |
|-------------|-----|

|                                                     |   |
|-----------------------------------------------------|---|
| Assemblies partially tested<br>in every case choose | 1 |
|-----------------------------------------------------|---|

<sup>(1)</sup> in industrial installations, this factor may be higher.

<sup>(2)</sup>  $I_B = \text{motor } I_n + 1/3 I_d$  (starting current)

Simultaneity factor according to circuit function. [Guide page A18](#)

| circuit function | Simultaneity factor |
|------------------|---------------------|
|------------------|---------------------|

|          |   |
|----------|---|
| lighting | 1 |
|----------|---|

|                                 |   |
|---------------------------------|---|
| heating and<br>air conditioning | 1 |
|---------------------------------|---|

|                |                           |
|----------------|---------------------------|
| socket-outlets | 0.1 to 0.2 <sup>(1)</sup> |
|----------------|---------------------------|

|                                          |  |
|------------------------------------------|--|
| lifts <sup>(2)</sup> and catering hoists |  |
|------------------------------------------|--|

|                               |   |
|-------------------------------|---|
| - for the most powerful motor | 1 |
|-------------------------------|---|

|                           |      |
|---------------------------|------|
| - for the following motor | 0.75 |
|---------------------------|------|

|                  |      |
|------------------|------|
| - for the others | 0.60 |
|------------------|------|

# Codes Example

## ■ IEC: Simultaneity factor

Simultaneity factors for an apartment block

| Number of consumers downstream | Simultaneity factor |
|--------------------------------|---------------------|
| 2 to 4                         | 1                   |
| 5 to 9                         | 0.78                |
| 10 to 14                       | 0.63                |
| 15 to 19                       | 0.53                |
| 20 to 24                       | 0.49                |
| 25 to 29                       | 0.46                |
| 30 to 34                       | 0.44                |
| 35 to 39                       | 0.42                |
| 40 to 49                       | 0.41                |
| 50 and more                    | 0.40                |

Application of the simultaneity factor ( $k_s$ ) to 5-storey apartment block.

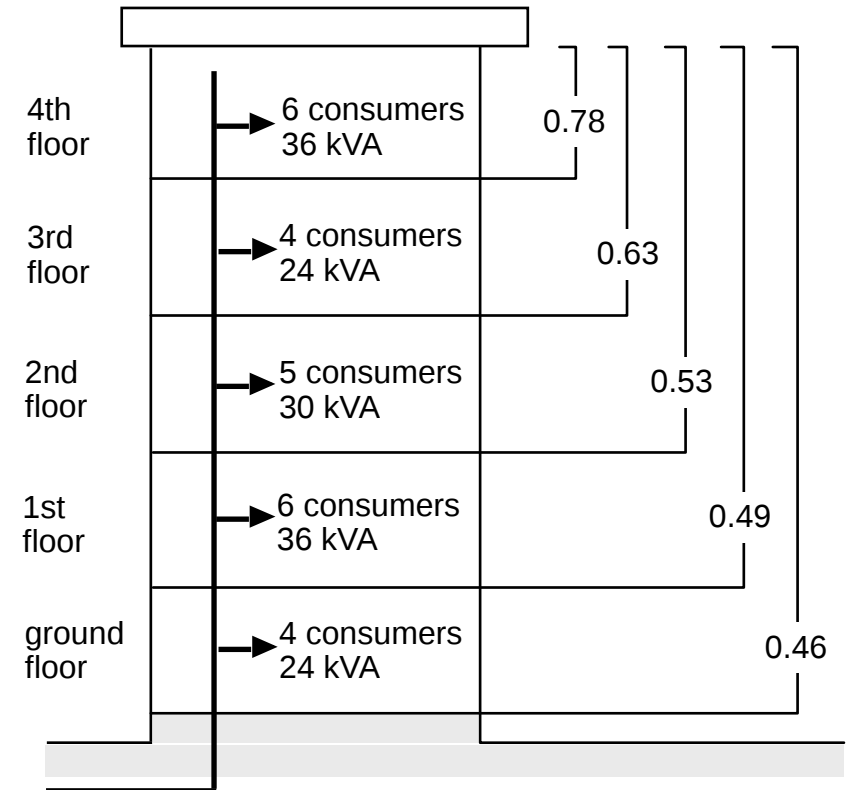
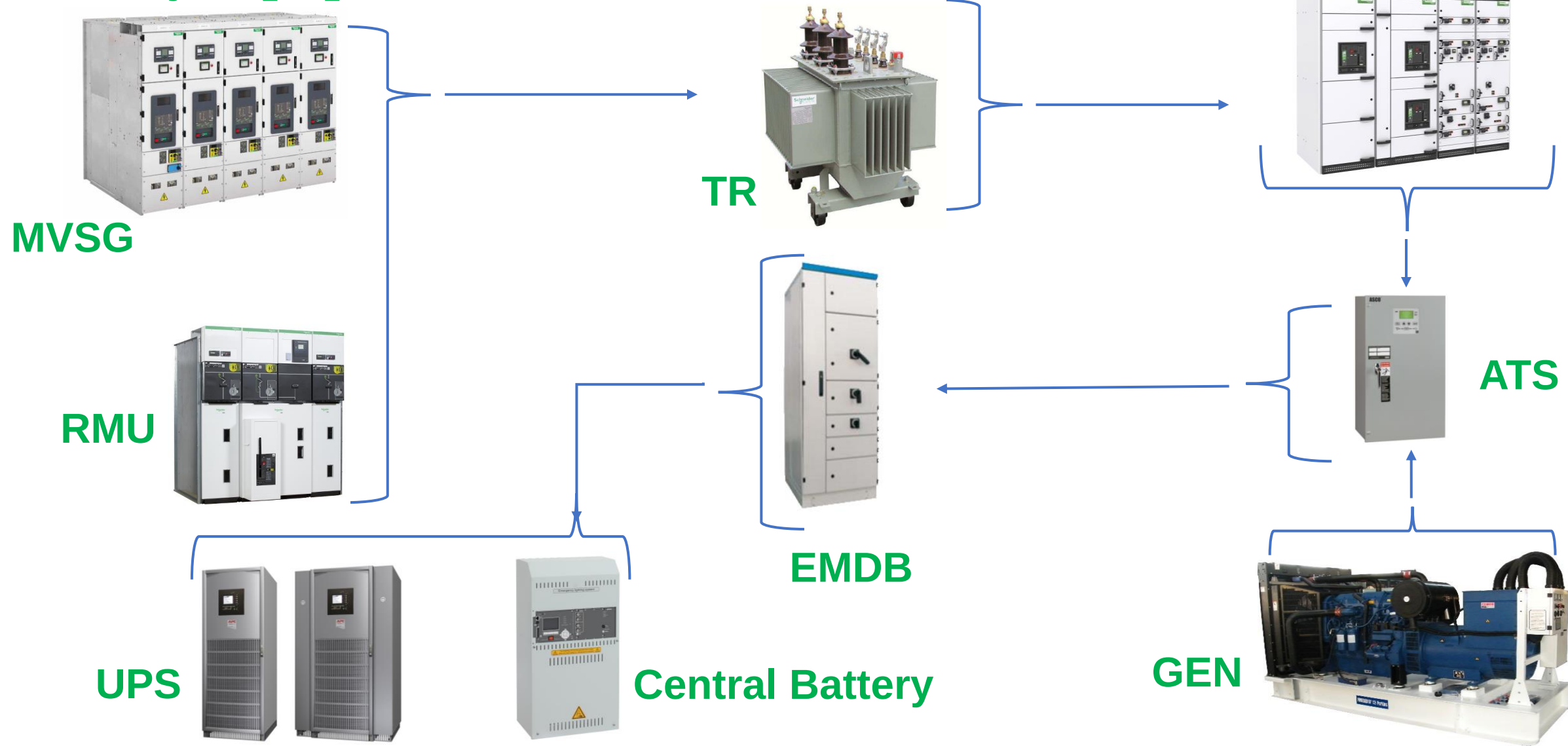


Fig. B15: IEC 364

## 2-Categorization of Tie-In

- Low voltage
  - ✓  $X < 100 \text{ KVA}$
  - ✓  $100 \text{ KVA} < x < 200 \text{ KVA}$
  - ✓  $200 \text{ KVA} < x$
- Medium voltage:(Residential)
  - ✓ One transformer
  - ✓ Two transformers
  - ✓ Three Transformers
- Medium voltage:(Admn.-Comm.)
  - ✓  $x < 1.6 \text{ MVA}$
  - ✓  $1.6 \text{ MVA} < x$

# 3-Bulky Equipment



TR

MDB

MVSG

RMU

ATS

EMDB

UPS

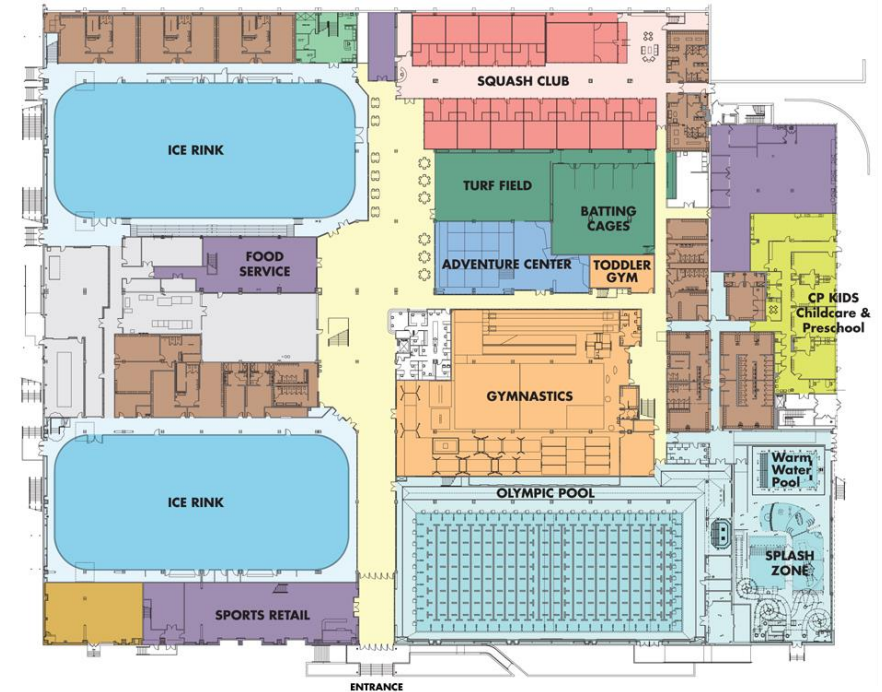
Central Battery

GEN



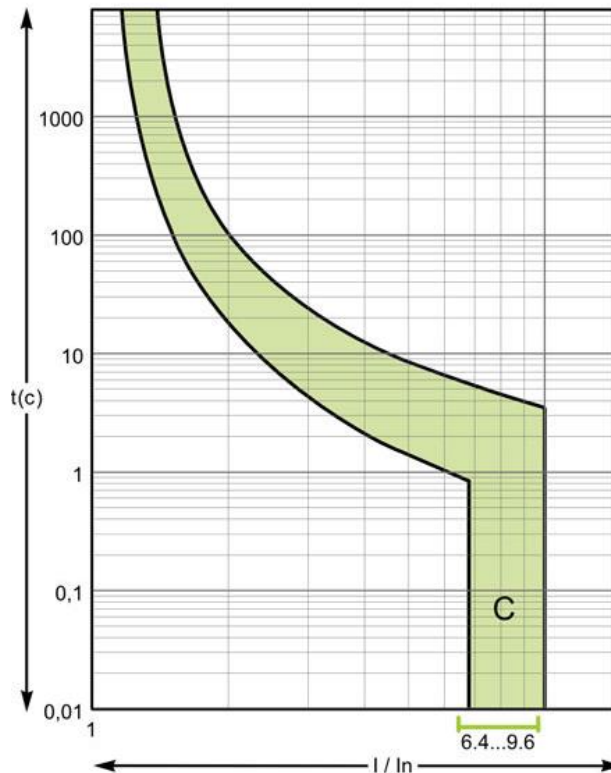
## 4-Zoning

- Building Conditions
- Sufficient Electrical Rooms
- Voltage Drop
- Branch Circuit Maximum Permitted Length



# 4-Zoning

## ■ Branch Circuit Max Permitted Length



**Fig. G49 :** Maximum length of copper-conductor circuits in metres protected by C-type circuit-breakers

| Rated current of<br>circuit-breakers (in A) | c.s.a. (nominal cross-sectional-area) of conductors (in mm <sup>2</sup> ) |      |      |      |     |     |     |     |     |
|---------------------------------------------|---------------------------------------------------------------------------|------|------|------|-----|-----|-----|-----|-----|
|                                             | 1.5                                                                       | 2.5  | 4    | 6    | 10  | 16  | 25  | 35  | 50  |
| 6                                           | 100                                                                       | 167  | 267  | 400  | 667 |     |     |     |     |
| 10                                          | 60                                                                        | 100  | 160  | 240  | 400 | 640 |     |     |     |
| 16                                          | 37                                                                        | 62   | 100  | 150  | 250 | 400 | 625 | 875 |     |
| 20                                          | 30                                                                        | 50   | 80   | 120  | 200 | 320 | 500 | 700 |     |
| 25                                          | 24                                                                        | 40   | 64   | 96   | 160 | 256 | 400 | 560 | 760 |
| 32                                          | 18.0                                                                      | 31   | 50   | 75   | 125 | 200 | 313 | 438 | 594 |
| 40                                          | 15.0                                                                      | 25   | 40   | 60   | 100 | 160 | 250 | 350 | 475 |
| 50                                          | 12.0                                                                      | 20   | 32   | 48   | 80  | 128 | 200 | 280 | 380 |
| 63                                          | 9.5                                                                       | 16.0 | 26   | 38   | 64  | 102 | 159 | 222 | 302 |
| 80                                          | 7.5                                                                       | 12.5 | 20   | 30   | 50  | 80  | 125 | 175 | 238 |
| 100                                         | 6.0                                                                       | 10.0 | 16.0 | 24   | 40  | 64  | 100 | 140 | 190 |
| 125                                         | 5.0                                                                       | 8.0  | 13.0 | 19.0 | 32  | 51  | 80  | 112 | 152 |

# 5-Block Diagram

