PROGRAM SUMMARY

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Electrotechnical ElectroConsumption Systems Technology

Program Overview:

Electric power supply is the most important commodity for national development. With electrical energy the people are empowered to work from the domestic level and the cottage industries, through the small-scale and medium industries to employment in the large-scale manufacturing complexes. In these days, depriving people of electric power is tantamount to castration. Electric power generation may be through one of the following sources of energy:

I. Coal, oil or natural gas
II. Hydro power (water turbine)
III. Nuclear power (steam turbine)
IV. Solar-wind or water-wave turbine
V. Solar thermal generator
VI. Solar voltaic generator

Coal, oil, gas and hydro power are abundant in Nigeria. Presently Nigeria mostly employs gas-fired and hydroelectric turbines for bulk generation, oil being too expensive and coal-fired stations having gone moribund. Coal, the progenitor of the Industrial Revolution in Europe, is still the main source of energy in most of the industrialised countries of the world. However, coal-fired stations have the problem of pollution in the emission of carbon gases which deplete the ozone layer thereby causing global warming. Coal is likely to be overtaken by nuclear energy. Nuclear power stations have their problems of hazardous radiation and in disposal of radioactive wastes, not to mention sophistication in operation and maintenance.

The most abundant, cleanest and safest energy source is solar power, particularly in the tropical countries. The temperate countries, like France, Denmark and Japan, curiously enough, are most advanced in the utilization of solar energy. The tropical countries, like Nigeria, must invest heavily in research and development on the exploitation of solar energy, because herein lies their salvation. The viable option is a hybrid system combining wind power as fairly available at day and night, with solar thermal or solar voltaic generation which is available during the day.

The maximum solar radiation power reaching Nigeria's land surface (area: 924,000 square kilometres) is about 600 Megawatts per square kilometre, peaking at noon and declining to zero at sunset. If only a small fraction of this power is captured, by way of wind turbine, solar thermal or voltaic generators, it would satisfy Nigeria's needs for domestic consumption and industrialization. The Sahara desert, with a sparsely populated land area of about 9,100,000 square kilometres, receiving a maximum of about 700 Megawatts per square kilometre, is bound to be the power house for Africa if not of the world. The harnessing of solar energy by Africans is a do-or-die affair in this twenty-first century.

Maximum power consumption or peak demand depends on the population and industrialization of a country. If the maximum supply meets the peak demand, there is a surplus otherwise there is a shortfall. Supply, demand and losses are related by the equation:

supply – demand = supply – actual needs – losses = surplus

losses = heat losses + wastages + diversions

In Nigeria, the power supply system is run with a shortfall where demand exceeds supply.

Power generation, transmission and distribution involve flow of currents with heat losses in conductors. Heat losses can be minimized through better design, construction and maintenance. Wastages, resulting from lack of control, misuse, abuse, negligence or ignorance, may be eliminated through effective education and public enlightenment. Diversions, as willful and.

fraudulent practices, like illegal connections and official thefts, may be stopped by legislation, regulation, supervision and prosecution offenders.

For the installations of Power Holding Company of Nigeria (PHCN), Independent Power Projects (IPP) of the States and the Rural Electrification Schemes, financial capital injection to increase power generation, should go hand-in-hand with campaigns aimed at checking wastages and diversions. By watching these losses, a shortfall may be reduced to zero or even turned into a surplus, without increasing supply. A surplus energy may be used for greater industrialization or sold to an external consumer at a profit. To the consumer, the advantages in eliminating wastages are reduction in electricity bill, increased longevity in the usage of electrical appliances and lessening of accidents and fire risks.

Electrical power is generated in kilowatts (kW) and energy is supplied and sold to the consumer in unit of kilowatt-hour (kWh), with profit if:

cost per unit to the consumer – production cost per unit = profit per kWh

The production costs include personnel and overhead costs plus depreciation. In Nigeria, the tendency is for the personnel and overhead costs to escalate. Failure to replace obsolete equipment and machinery will result in decrease of power generation. The cumulative effect is that production costs would increase in order to maintain supply and the costs to the consumer would also increase in order to break even. There may even be increase in tariff without any corresponding increase in power generation. No power supply system could be operated at a profit if the production costs are not kept under control.

Profit, in an enterprise, is the ingredient necessary for growth and economic development. Any enterprise, not operated at a profit, would dwindle and eventually fade away; external funding or privatization could only postpone the evil day. The profits from the sale of electrical energy may be ploughed back into the supply system to improve manpower and machinery, to enhance safety and security, create jobs and generate more power.

Government's promise to generate 6,000 MW, or even more power, is achievable this year, given the installed capacity of PHCN and ability of staff of the Company to deliver. In fact, Nigeria, through the old Electricity Corporation of Nigeria, the former Niger Dams Authority and the defunct Nigerian Electric Power Authority, had the best trained technical and professional staff in Africa. Now, the PHCN is saddled with a plethora of non-technical staff and hampered by officialdom. Power generation, transmission and distribution should be a knowledge-based integrated and controlled system – a technical and economic undertaking - devoid of politics. Failure to use its human and material resources and to nurture and keep an efficient and dedicated work force, in the power sector, has turned Nigeria into the world's biggest importer of generators.

Use of private generators to supplement external supply or cutting down demand (by load shedding or closing shop), to reduce shortfall, is not only inimical to social, economic and technological development

but verging on criminality. The low distribution voltages and disruptions, due to frequent switching off and on, are deleterious to sensitive equipment, especially those with moving parts. That the Nigerian power sector has persistently been erratic and running with a shortfall, in spite of heavy funding and despite the availability of abundant coal, natural gas, hydro power and inexhaustible solar power, remains not only a challenge but a shame to the Nigerian scientists, engineers and technologists.

Needs Assessment: Nigeria, in its development objective to rank amongst the top 20 economies of the world by the year 2020, targets an ambitious 40,000MW of electricity generation. With a population surpassing 160 million, Nigeria's current maximum electricity generation capacity, estimated at approximately 5,500 MW, is inadequate to meet the unsuppressed demand estimated at approximately 10,000 MW. Only about 41% of the population currently has access to electricity; and for that segment of the population, only 30% of its needs are currently met. To meet the generation targets set for 2020, significant private sector investment is required in the supply chain, including generation, gas to power infrastructure and distribution networks. The reform of the power sector started in 2005 with the enactment of the Electric Power Sector Reform Act (EPSRA) and was accelerated in 2010 with the Power Sector Reform Roadmap. Nigeria faces a range of challenges implementing the Power Sector Reform Roadmap, and providing comfort for private sector investment into its privatised power market is one of the main challenges.

Introduction

The main objective of any power utility in the new competitive environment would be to supply customers with electrical energy as economically as possible with a higher degree of reliability and quality. The ability of the power system to provide an adequate supply of electrical energy is usually designated by the term of reliability. The concept of power-system reliability is extremely broad and covers all aspects of the ability of the system to satisfy the customer requirements [1].

The reliability of an electric power system can be increased by additional system investment. This obviously increases the cost associated with electric power. Power utilities have, therefore, to satisfy two conflicting requirements: (1) supply of electric power at an acceptable level of reliability and (2) supply of electric power at a reasonable cost. Maintaining an acceptable level of reliability at an affordable cost is, therefore, a very important aspect of modern power system management [2].

The performance of a power plant by way of its efficiency and reliability, and other operating factors has definite socioeconomic significance both on the company operating the plant as well as the nation at large. However, without adequate and reliable electricity supply, socioeconomic transformation would remain a mirage [3].

On a global scale, reliable electric power availability has been observed as effective and indispensable machinery for the rapid industrial and economic growth of any nation [4]. Therefore, by its importance in the society and its necessity for national economic growth, electrical energy supply is expected to be available 24 h a day. Based on this importance, it is expected that electric power utilities throughout the world must ensure they meet customer demands at a reasonable level of service reliability.

A modern power system is complex, highly integrated and very large. In order to meet customer demands, the system can be divided into appropriately subsystems or functional areas that can be analyzed separately [5]. These functional areas are generation, transmission and distribution. Reliability studies are carried out individually and in combinations of the three areas. This study work is limited to the evaluation of the generation reliability.

Generation system reliability focuses on the reliability of generators in the whole electric power system where electric power is produced from the conversion process of primary energy (fuel) to electricity before transmission. The generation system is an important aspect of electricity supply chain and it is crucial that enough electricity is generated at every moment to meet demand. Generating units will occasionally

fail to operate and the system operator has to make sure that enough reserve is available to be operated when this situation arises 6, 7.

Generating stations form an important and integral part of the overall power system and their reliability is reflected in the reliability of the overall national supply. Reliability of a generating station is a function of the reliability of the constituent-generating units. Accurate estimates of generating unit reliability are needed for generating capacity planning and to aid improved criteria for future designs and operations. Reliability assessment of a generating system is fundamentally concerned with predicting if the system can meet its load demand adequately for the period of time intended 8.

Improving the availability of existing units is as important as improving the reliability expectation of units during the planning phase. The two are mutually supportive; design reliability impacts major changes in existing units, and information about operating availability is important to the system designers in both developing and developed countries.

OBJECTIVE ENGR CHRISTIAN A.E : Desire an Electrical installation position offering extensive knowledge of modern electrical, procedures and a profound ability to work on almost all types

I firmly believe that my education, skill-set, intensive training and extensive experience make me a suitable candidate for the advertised position. I have an in-depth knowledge of distribution boards and am looking to expand my experience within a role that combines new builds as well as maintenance contracts. As an electrical engineer with year's experience designing and developing LV to HV systems at a mining company, I have the ability to analyze complex engineering problems and recommend solutions. I'm driven, hardworking and can complete all projects to an excellent standard, on time and on a budget. I'm looking forward to taking the next step in my career with an international player in the mining market.

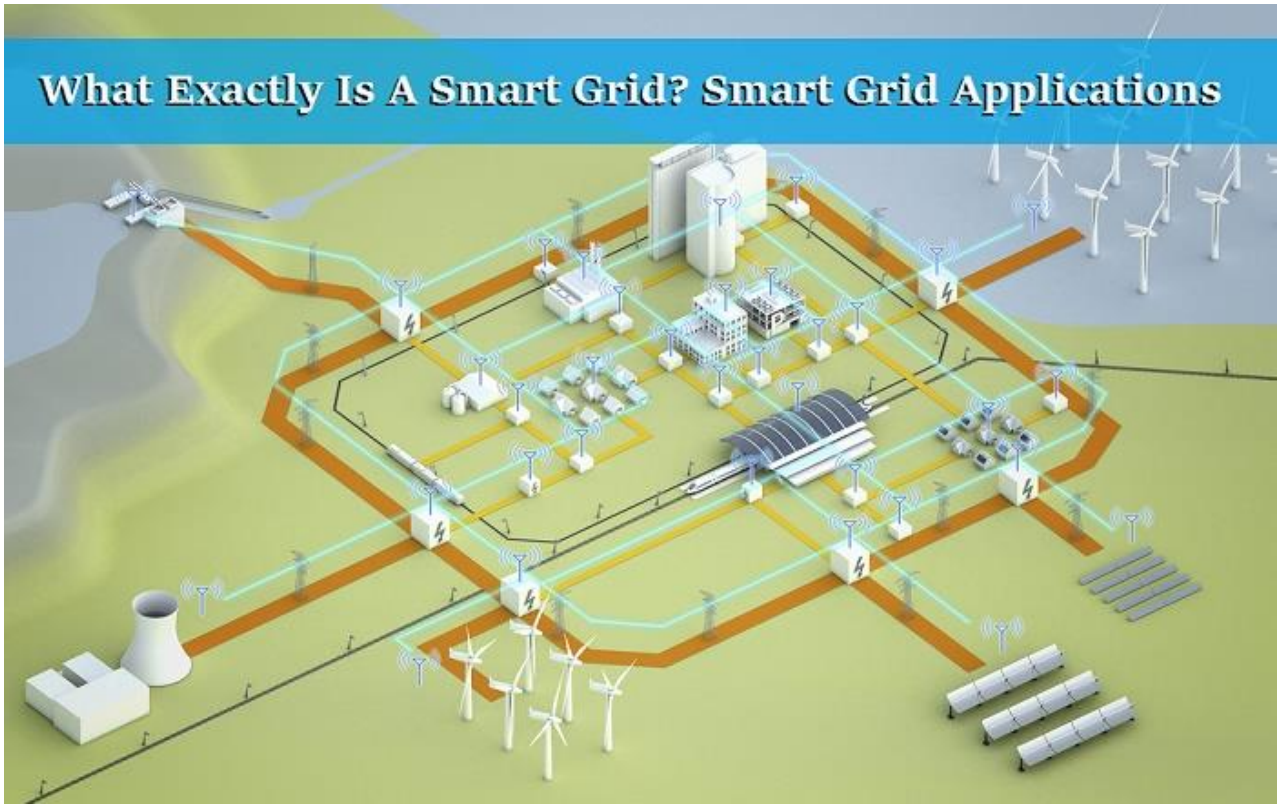
1.1 Smart Grid & Their Application in the Grid System

Table of Contents

What is Grid?

Concept of smart grid is quite in the news and market but majority of the people actually don't know that what exactly are the things which make a grid smart?

The term "Grid" refer to an "Electric Grid" basically describes a complete network which includes transmission lines, transformers, distribution substation all accessories that are used for delivery of electricity from generation plants to home and commercial scale.



The very first grid was built in decade of 1885-1895 and the with the passage of the time number of grids kept on increasing that's why by now there are about more than 9200 grids all over the world which are providing about 1 million Megawatt power to the consumers.

As evolution has a direct relation with time so for an efficient functionality of grid, digital technology has been introduced in grid system. This new digital technology enables two way communications which guarantees the direct link between utilities and all consumers.

What is a Smart Grid Then?

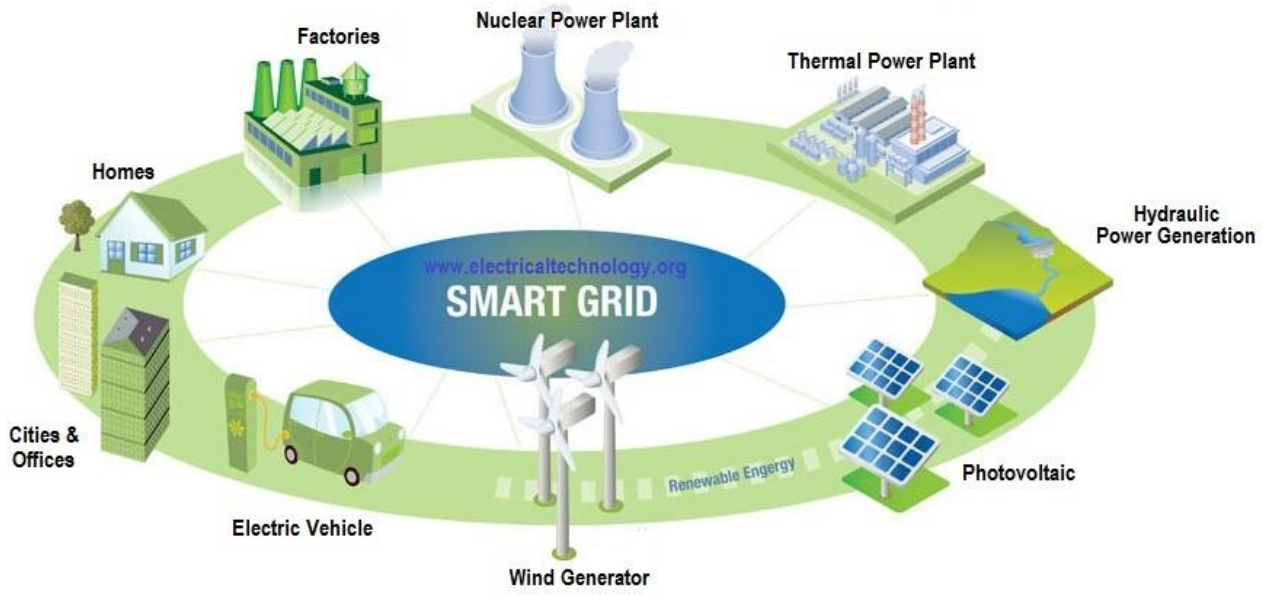
In simple words, an automation system between utility and consumers. This smart grid consist of advance digital system, automation, computer and control which make sure to perform a duplex "two way" communication between the power provider and load consumer.

In a typical electrical grid system, electricity provider only will know the power failure when a costumer call them. But in case of smart grid system, if electric supply fails, service provider will automatically respond to the affected area because the components of smart grid provides enough data i.e. from the power transformer, main transmission and distribution system and finally, to the home supply system (you may say the utility meter).

What Things Make a Grid "Smart"?

According to the Department of Energy (United States), Four types of advance technology will transform a typical electrical grid into Smart Grid which are as follow:

1. Fully automated and Integrated two way communication between the overall components of an electric grid.
2. Automatic Control for power distribution, faults and repairs.
3. Advance management panel, decision support software and mechanism.
4. Accurate sensing and measurement technologies.



Upgraded technology of smart grids has well-organized automation equipment and control system, whose response is accurate to meet the rapidly increasing demand for electricity. Time when these smart grids were not implemented all utilities companies were bound to send their respective workers to take meter reading and acquire data related to consumer.

What does a Smart Grid do?

Smart grid performs lots of smart jobs □ . Some **advantages of a smart grid** are stated follow:

Efficient Transmission and Distribution of Electric Power. Quickly restore electric power after power failure due to faults. Lower cost for operation, maintenance, management and electricity for both utilities and consumers. Lower electric power tariff and rates due to reduced peak demand. Provide better options of integration of renewable energy for self power generation systems. Improve the security and protection.

Applications of a Smart Grid System.

Deployment of Digital Technology in smart grids ensures the reliability, efficiency and accessibility to the consumers regarding all utilities which count towards the economic stability of the nation. Right at the start of transition time it become perilous to execute testing, to improve the technology by up gradation, developing and maintaining standards on a standard threshold and also application of these efficient grids serve all these problems

Basic applications of smart grids are

- They improve the adeptness of transmission lines
- Quick recovery after any sudden breakage/disturbance in lines and feeders
- Cost Reduction
- Reduction of peak demand
- They possess the ability to be integrated with renewable energy sources on a large level which leads to sharing of load and reduction of load on large scale

Summery

In these days disruption of power supply is very common issue faced by majority in which any fault in feeder or main distribution lines lead to a complete blackout due to which whole system will be out of order and functionality of industries will be stopped.

But smart grid system has capability to secure the system on the spot by handling emergencies because they possess the ability of automatic rerouting in case of any fault current . Smart Grids are not only providing the link between consumers and utilities moreover they enable users to handle their electricity usage systematically like we use online banking from anywhere any time.

Management of electricity in well-organized matter will clearly lead to cost reduction. One of the interesting application is smart meters. With the help of smart meters we need not to wait a whole month to get electricity bill rather we can see reading and receive bill daily online which will obviously save money for consumers and save electricity or power for whole country which will provide support in economical stability of the country.

Coming toward the precautions as this system has wide range of technical data and equipment along with automation equipments and protocols, so most important thing will be to ensure whether the system is properly installed because, if there will be no loop holes in deployment of this technology, smart grids on global level will bring revolution in power sector same as internet did transformation in the World of IT.

What is a Smart Grid Then? In simple words, an automation system between utility and consumers. This smart grid consist of advance digital system, automation, computer and control which make sure to perform a duplex "two way" communication between the power provider and load consumer.

In a typical **electrical grid system**, electricity provider only will know the power failure when a costumer call them. But in case of smart grid system, if electric supply fails, service provider will automatically respond to the affected area because the components of smart grid provides enough data i.e. from the power transformer, main transmission and distribution system and finally, to the home supply system (you may say the utility meter).

1.2 Typical AC Power Supply system (Generation, Transmission and Distribution) scheme and Elements of Distribution System (a complete note With Diagrams)

The lines network between Generating Station (Power Station) and consumer of electric power can be divided into two parts.

- **Transmission System**
- **Distribution System**

We can explore these systems in more categories such as Primary transmission and secondary transmission. Similarly primary distribution and secondary distribution. This is shown in the below image (One Line or Single Line diagram of Typical AC power System Scheme).

It is not necessary that the entire steps which are sown in the above image must be included in the other power schemes. There may be difference. For example, there is no secondary transmission in many schemes, in some (small) schemes there is no transmission, but only distribution.

1. **Generating Station**
2. **Primary transmission**
3. **Secondary transmission**
4. **Primary Distribution**
5. **Secondary Distribution**

Generating Station:

The place where electric power produced by the parallel connected three phase alternators/generators is called Generating Station (i.e. power plant).

The Ordinary power plant capacity and generating voltage may be 11kV, 11.5 kV 12kV or 13kV. But economically, it is good to step up the produced voltage from (11kV, 11.5kV Or 12 kV) to 132kV, 220kV or 500kV or greater (in some countries, up to 1500kV) by Step up transformer (power Transformer).

Primary Transmission:

The electric supply (in 132kV, 220 kV, 500kV or greater) is transmuted to load center by three phase three wire (3 Phase – 3 Wires) overhead transmission system.

also read: Power Factor

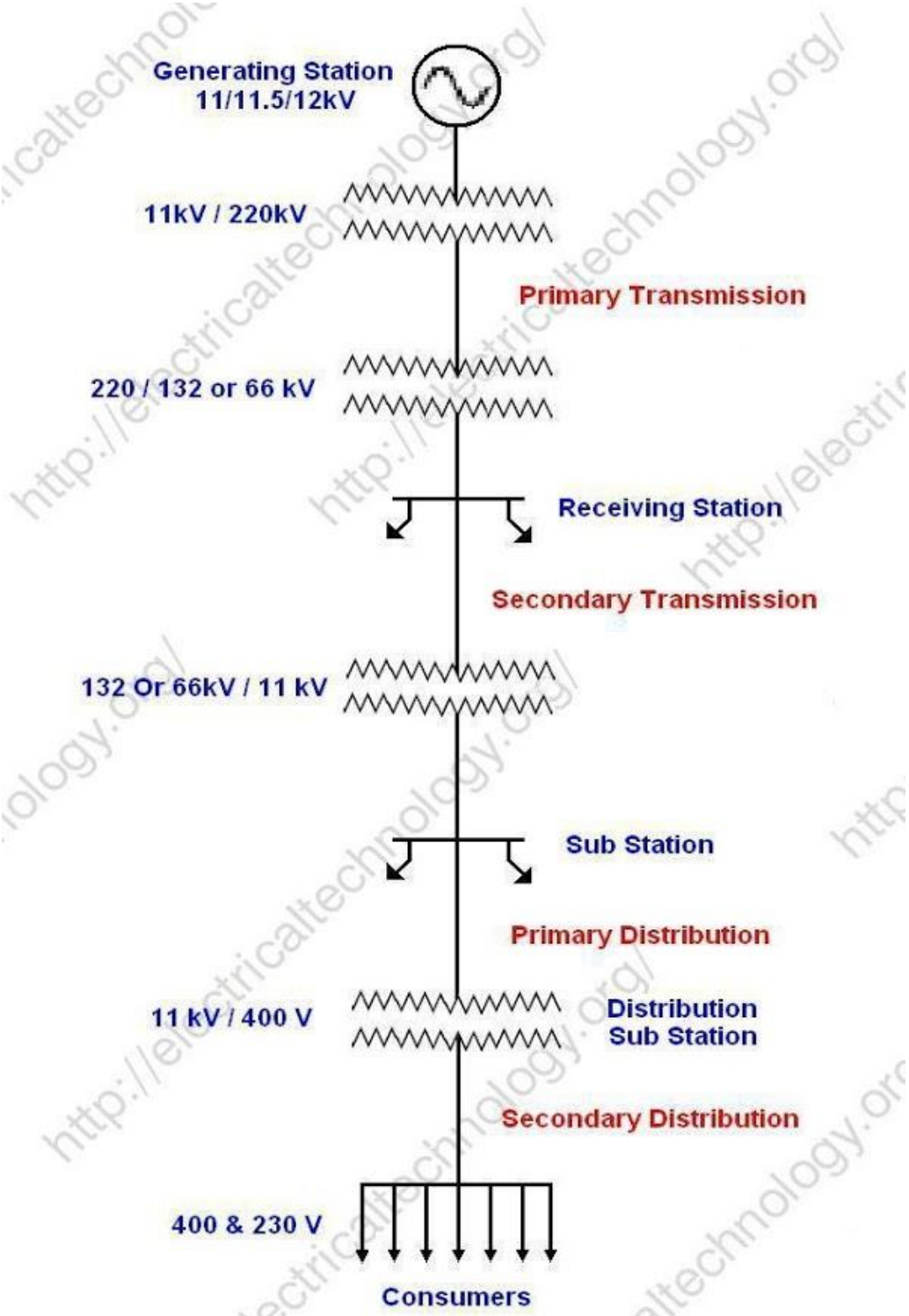
Secondary Transmission:

Area far from city (outskirts) which have connected with receiving station by line is called Secondary transmission. At receiving station, the level of voltage reduced by step-down transformers up to 132kV, 66 or 33 kV, and Electric power is transmit by three phase three wire (3 Phase – 3 Wires) overhead system to different sub stations. So this is a Secondary Transmission.

Primary Distribution:

At a sub station, the level of secondary transmission voltage (132kV, 66 or 33 kV) reduced to 11kV by step down transforms.

Generally, electric supply is given to those heavy consumer which demands is 11 kV, from these lines which caries 11 kV (in three phase three wire overhead system) and they make a separate sub station to control and utilize this power.



Typical AC Power Supply System Scheme

By: Engr Wasim Khan

In other cases, for heavier consumer (at large scale) their demand is about 132 kV or 33 kV. they take electric supply from secondary transmission or primary distribution (in 132 kV, 66kV or 33kV) and then step down the level of voltage by step-down transformers in their own sub station for utilization (i.e. for electric traction etc).

Secondary Distribution:

Electric power is given by (from Primary distribution line i.e.11kV) to distribution sub station. This sub station is located near by consumers areas where the level of voltage reduced by step down transformers 440V by Step down transformers.

These transformers called Distribution transformers, three phase four wire system ((3 Phase – 4 Wires)). So there is 400 Volts (Three Phase Supply System) between any two phases and 230 Volts (Single Phase Supply) between a neutral and phase (live) wires.

Residential load (i.e. Fans, Lights, and TV etc) may be connected between any one phase and neutral wires, while three phase load may be connected directly to the three phase lines.

Elements of Distribution System

Secondary distribution may be divided into three parts

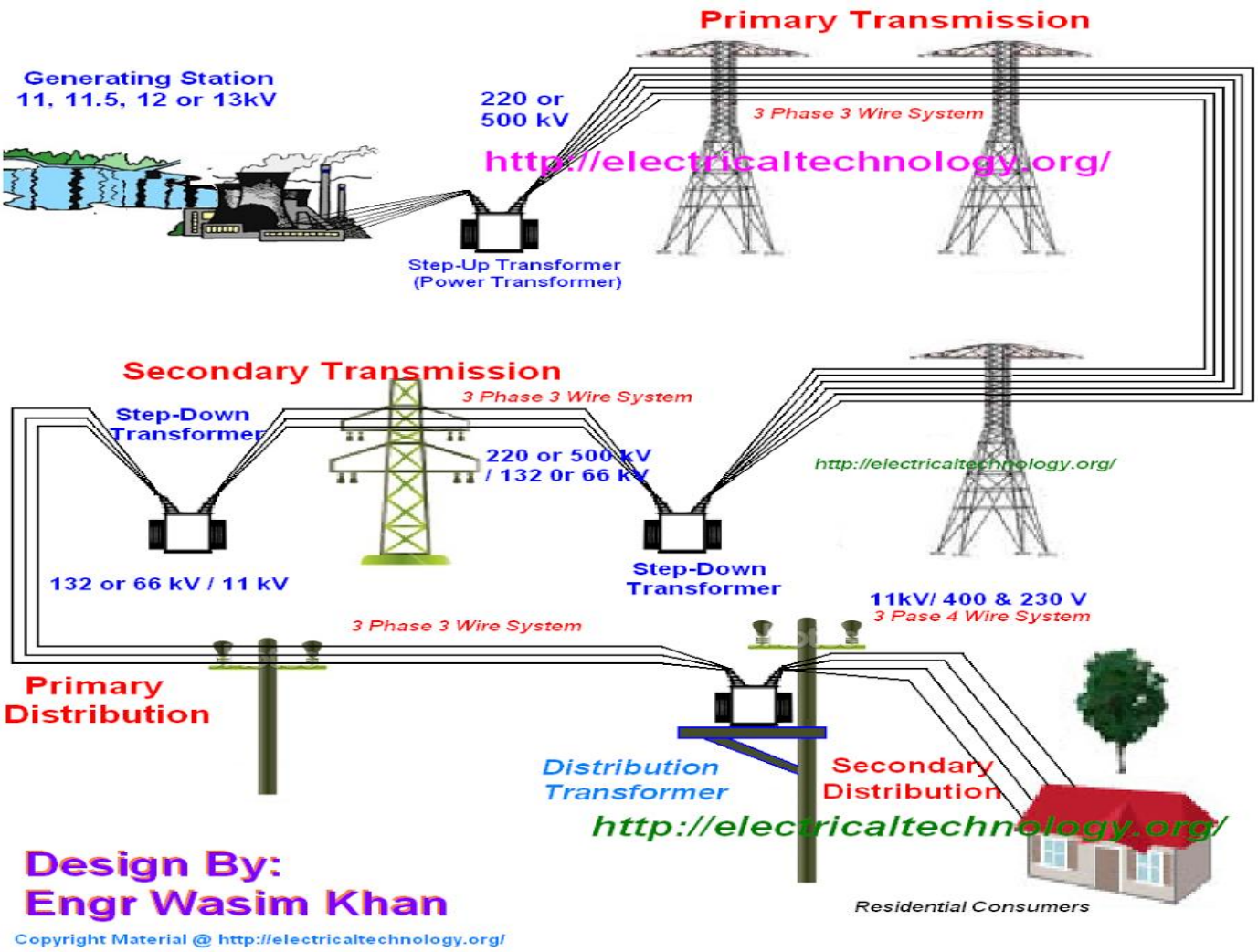
1. **Feeders**
2. **Distributors**
3. **Service Lines or Service Mains**

Service Lines or Service Mains:

The Normal cable which is connected between Distributors and Consumer load terminal called Service Line or Service Mains.Here is a a complete Typical AC Power Supply system scheme, in other words, the above whole story in below image.

Distributors:

Those taping which extracted for supply of electric power to the consumers or those lines, from where consumers get electric supply is called distributors.As shown in fig 2.Current is different in each section of the distributors while voltage may be same. The selection of distributors depends on voltage drop and may be design according voltage drop. It is because consumers get the rated voltage according rules.



INTRODUCTION

Nuclear energy is becoming well developed as a source of energy. Compared to other sources of energy like solar energy, and hydroelectricity, nuclear energy is more stable in that its power supply is stable. Power generated by hydroelectric power plant is always dependent on the volume of water in a dam. Likewise the energy generated by the solar panels depends on the amount of sun it receives.

While the amount of energy generated by hydroelectric power plant and solar panels fluctuates, nuclear energy is not like that. The main raw material for nuclear energy is a radioactive element. The nucleus of a radioactive element is unstable in its ways. Its nucleus will keep on splitting spontaneously until it attains stability. During that process energy is released and such phenomenon is called radioactivity.

To understand better how the energy produced by a radioactive element is harnessed to give us electricity, let's see how the radioactive elements produces the energy in their nucleus. Remember that the nucleus of these elements are never stable. They'll keep on splitting until they attain stability, that's if they can. The process will lead to the release of energy, emission of gamma ray, beta ray, and alpha particle.

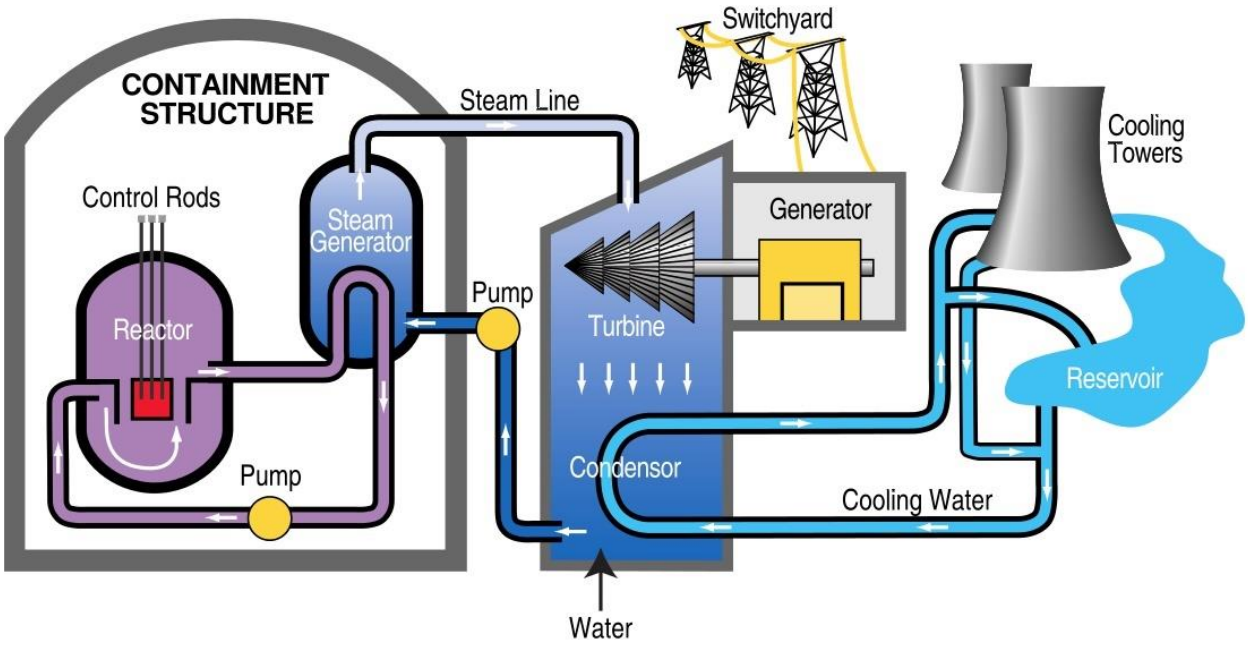
1.3 **NUCLEAR FISSION** Nuclear fission occurs when the nucleus of a radioactive element (Radium, Uranium) is bombarded with a stream of fast moving neutron. This process results in the splitting of a radioactive element into a relatively heavy nucleus which is accompanied by energy release.

NUCLEAR FUSION

While nuclear fission involves the bombardment of a heavy nucleus to give two relatively heavy nucleus, nuclear fusion releases energy when two lighter nucleus fuses together to form a heavier nucleus. Nuclear fusion results from bombardment of two lighter nucleus with fast moving neutrons.

HOW ELECTRICAL ENERGY IS GENERATED USING NUCLEAR ENERGY?

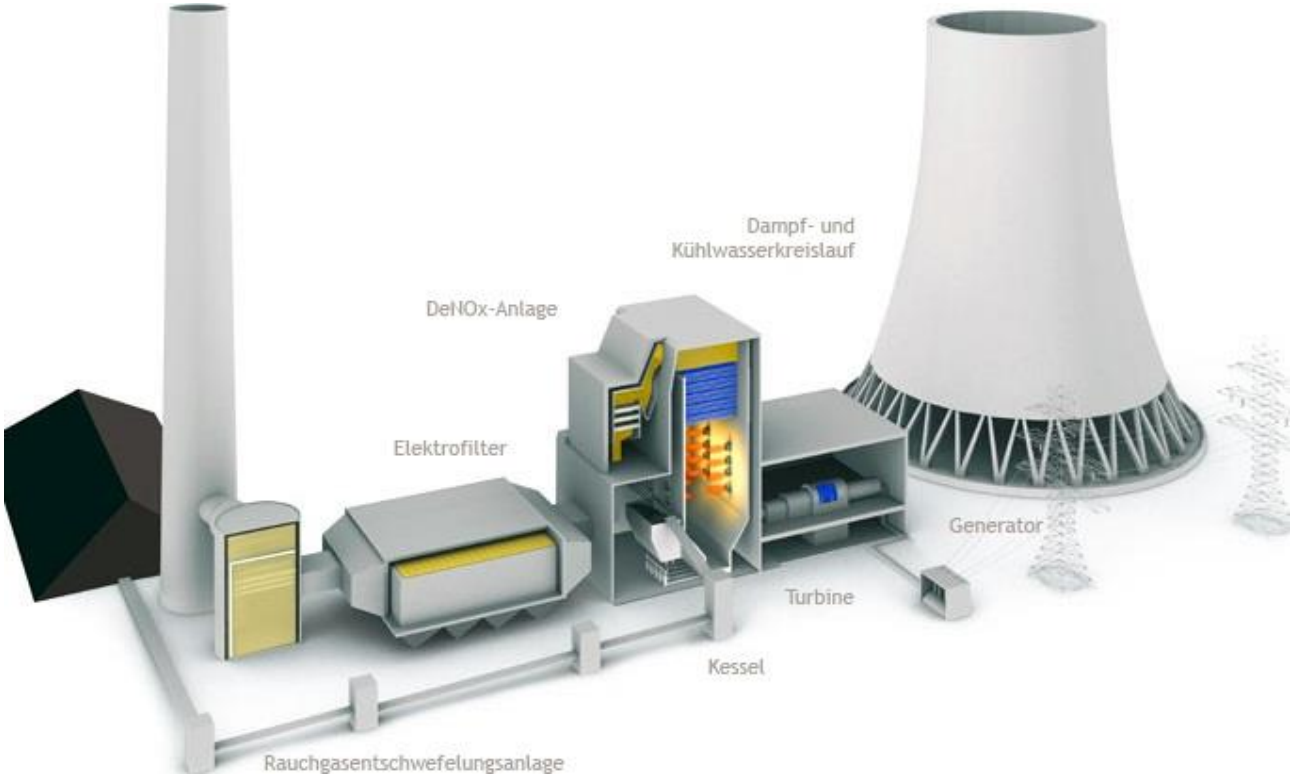
The earlier types of nuclear power station generated electricity through the fission of Uranium – 235. A block of graphite (carbon) is placed at the core of the nuclear reactor to reduce or minimize the speed of the neutrons. The reason why the velocity of the neutrons have to be minimized is because only at a low velocity can the neutrons penetrate the nucleus of the Uranium – 235 atom. There are tabular channels passing through the graphite block.



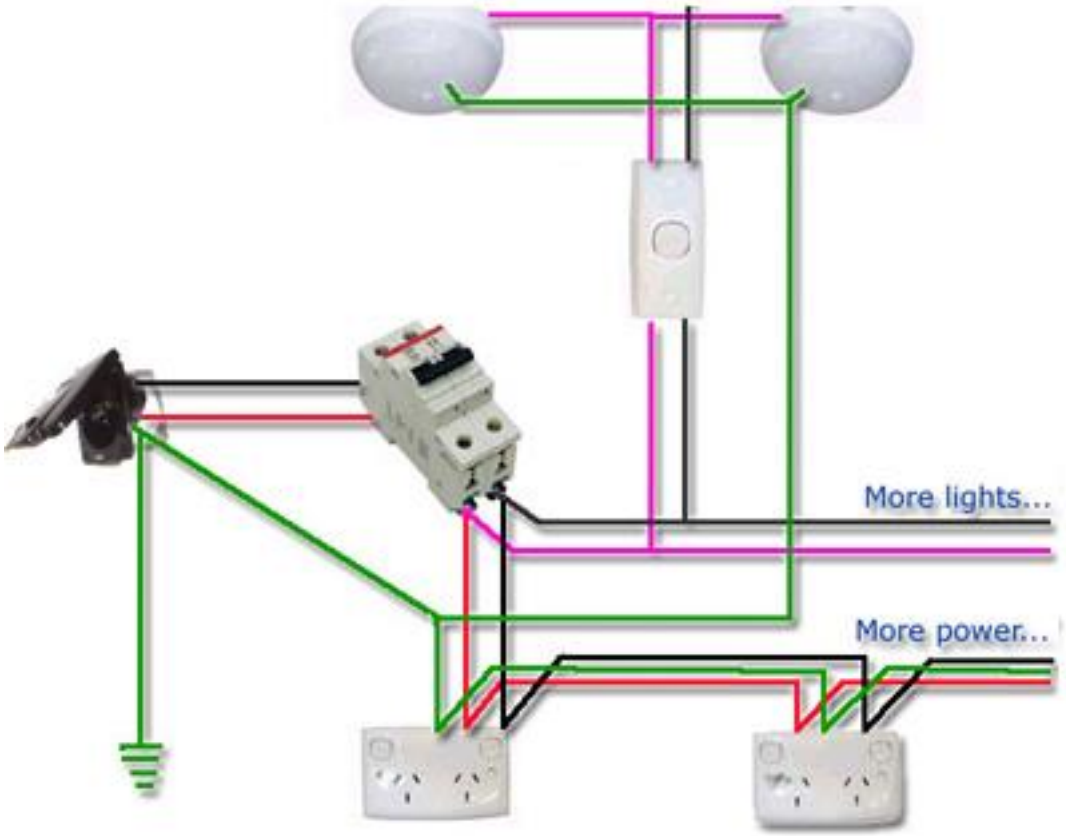
HOW ELECTRICITY IS GENERATED FROM NUCLEAR ENERGY?

1.4 We offer a wide range of commercial electrical services:

- Electrical troubleshooting
- New equipment electrical installation
- Lighting service and retrofit
- Emergency lights and exit signs retrofit to a updated Canadian Electrical Code
- Electrical inspections for commercial buildings
- Tenant improvement projects
- Rewiring
- LED lighting retrofit
- Electrical permit



As a renewable energy source, hydro power plants play a key role in conserving the world's natural resources. is the world’s leading supplier of nearly every product in the power and automation scope of supply for hydro power plants – from plant automation systems and electrical balance of plant to generator circuit breakers, power transformers, switchgear, motors and drives..


More lights...
More power...


3C
MOTOR 20
2C
3E
MOTOR 22
2E
2F

Dry Type Transformers versus Oil Filled Transformers

Before going to the mark difference between Dry Type Transformer and Oil Filled Transformer, it is worth to have some discussion on Dry Type Transformer.

Dry Type Transformer:

Dry Type Transformers find use in locations where the use oil Filled Transformers increases the fire hazard such as shopping malls, Hospitals, residential complexes etc. In dry type transformers air is used as the cooling medium instead of oil.

Different types of luminaires will be presented in the following. For all models, numerous sizes and outputs are available. With this variety, practically all lighting tasks in public and private architecture can be solved.

High mast lighting as a concept in area lighting is being preferred over conventional lighting, especially where large areas are to be illuminated without the need for numerous lighting columns that under certain circumstances can be a hazard to movement. This possible because the high mast lighting system achieves very large space to height ratios.

High-mast lighting is deal for many areas, particularly complicated or multi-level road systems. Industrial or commercial areas, docks, airports, stations, car parks and even some hazardous areas. All of these areas require the best possible lighting with minimum interference from the installation itself combined with ease of maintenance.

Areas of Application

- Airports & Sea Ports
- Railway Yards
- Industrial Flood Lighting
- Car Parks & Junctions
- Sports Arenas / Stadiums
- Hotels

Advantages of Nezone High Mast Poles

- Ease of Installation
- Galvanized for Longer Life
- Maintenance Free
- Sleek and Beautiful Design

There are many different **types of street lamps** in lighting field. LED street lamp is a Luminescent lighting system which is used on roads, streets and public squares. It usually starts to shine at night or in the dark, and goes out after dawn.

The basic function of street lamp is illumination, it also can be applied to Art Work, Landmark, Signpost, Telephone Booth, Message Board, Mailbox, Advertisement Lamp Box, etc. Street Lights are used outdoors, so the luminaries must be sealed for waterproof and dustproof. The temperature of the water vapor inside the lamps will exceed 100 ℃ in extreme circumstances after the seal.

Structure Composition:

LED street light is made up of lamps, electrical appliances, light sources, lamp poles, lamp arms, flanges, built-in fitting.

types of street lamps:

1, Classification by street Lamp height: high pole street light, middle pole lamp, road light, garden street lamp, lawn lamp.

2, According to the lamp post material Division: hot-dip galvanized iron street lamp, hot-dip galvanized steel street lamp and stainless-steel street light.

3, Sort by light source: sodium lamp, LED street lamp, energy-saving street light, new Xenon lamp.

4, Classification by shape: Chinese street lamp, antique street light, landscape lamp, single arm street lamp, double arms street lamp.

5, Divided by power supply mode: grid lamp and solar street light, scenery complementary street lamp.

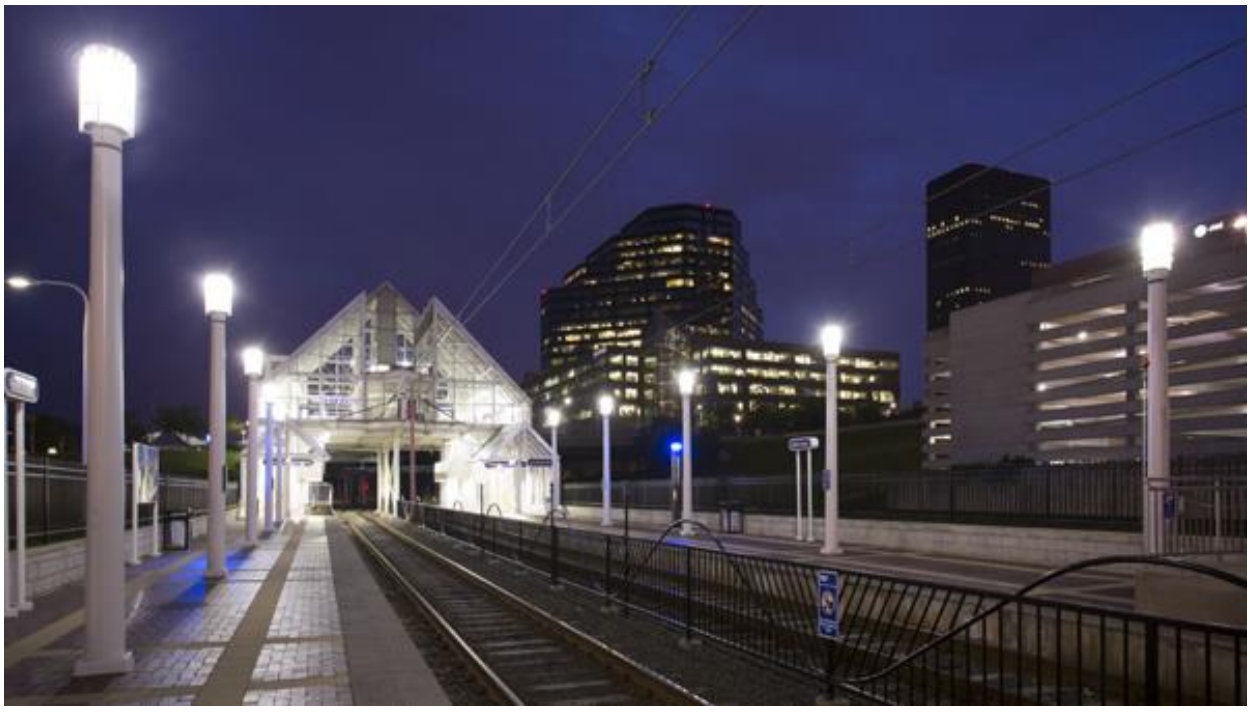
6, Classifying on the basis of the method of CIE: there are three indexes to divide types of street lamps.

① Light Projection: indicates that the light emitted by the luminaire is spread vertically along the road. It is divided into short, medium and long projection street lights.

② Light Extension: indicates the extent to which the light emitted by a luminaire spreads horizontally across the road. It includes narrow, normal, wide lamps.

③ Light Control: indicates the degree to which a luminaire controls glare. It is divided into 3 kinds which are called limited, medium, strict street lamps.

We hope you can choose your suitable **types of street lamps** through these six classifications.



Solar-powered lighting is self-contained, off-grid, can be used in remote installations, and is unaffected by power outages.


GROUND CONTROL