

Electrical Power Engineering



By



Associate Prof. / Mohamed Ahmed Ebrahim Mohamed

Consultant of New and Renewable Energy Systems

E-mail: mohamedahmed_en@yahoo.com

mohamed.mohamed@feng.bu.edu.eg

Web site: <http://bu.edu.eg/staff/mohamedmohamed033>





Lecture (1)





Course Code: EPE 223

Study Hours: 4 Lect. + 2 Tut





Assessment:

Final Exam: 67% .

Midterm: 20% .

Year Work & Quizzes: 13%.

Textbook:

Hadi Saadat, Power System Analysis



Syllabus

1

- Introduction.

2

- Fundamentals of electrical power engineering.

3

- A.C and D.C power transmission.

4

- A.C and D.C power distribution.

5

- Interconnections of power systems.

6

- Transmission and distribution system.

7

- Substations and circuit breakers.

Cont.

8

- Overhead lines.

9

- Cable Systems.

10

- Transformers.

11

- Connection of "green-energy" generation to power systems.

12

- Protection of individuals, equipment and power system installations.

13

- Protective devices and insulation co-ordination.

14

- Generation of high voltage systems.

Cont.

15

- Natural Causes for over voltages.

16

- Overvoltages and insulation coordination.

17

- Earthing system.

Engineering Definition

What is Engineering?

Engineering is the application of math and science by which properties of matter and the sources of energy in nature are made useful.

Engineering Design Definition

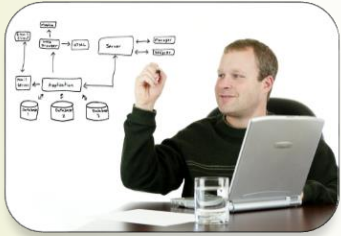
What is Design?

So, Engineering design is.....

Applications & Examples

Why Engineering Design?

Betterment of society through



Design



Manufacturing



Research & Development



Management



Continual Improvement



Logistics

Engineer Definition

Who is Engineer?

Creative

```
graph TD; A[Creative] --> B[Iterative]; B --> C[Integrated]; C --> D["Innovation is the key  
Oven Story!!!!!!!!!!"]
```

Iterative

Integrated

**Innovation is the key
Oven Story!!!!!!!!!!**

So, Engineer is.....

Engineering Process Cycle

The engineering process cycle is achieved by following 10 stages.

- 1-Identify the problem/product innovation
- 2-Define the working criteria/goals
- 3-Research and gather data
- 4-Brainstorm / generate creative ideas
- 5-Analyze potential solutions

Engineering Process Cycle

6-Develop and test models.

7-Make the decision.

8-Communication and specify.

9-Implement and commercialize.

10-Perform post-implementation review and assessment.

Electricity
Changes
Life style

Six key questions



What is the electrical energy?

How do we produce electric energy?

Why do we think the electrical energy is important?

What are the resources of electrical energy?

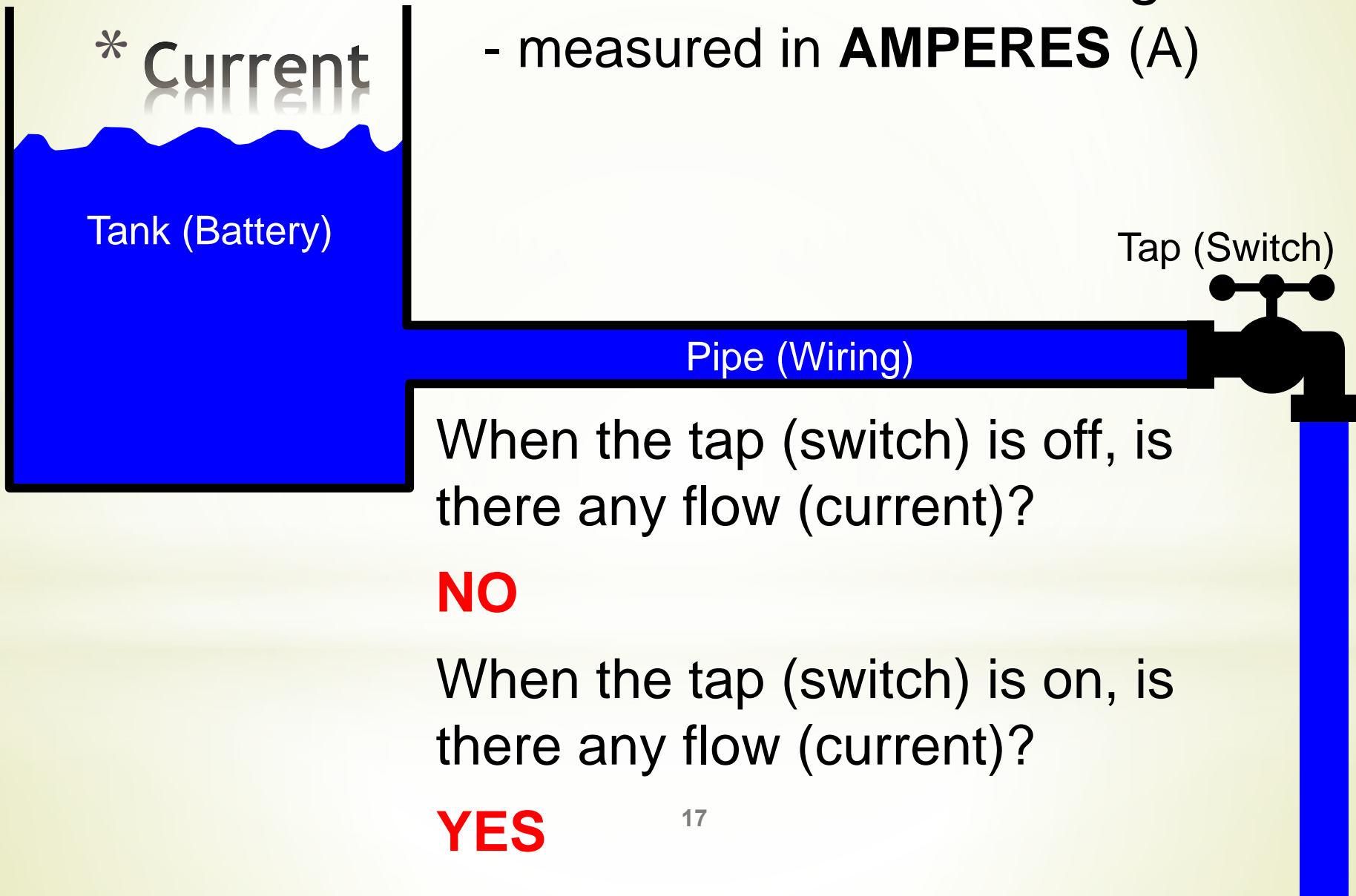
What about renewable energy resources?

What about the concept of smart grid?

What is the electric energy?

- * It is one of the most important energy forms*
- * Energy cannot be created or destroyed.*
- * In all devices and machines, including electric circuits, energy is transferred from one type to another.*

The *flow* of electric charge
- measured in **AMPERES (A)**



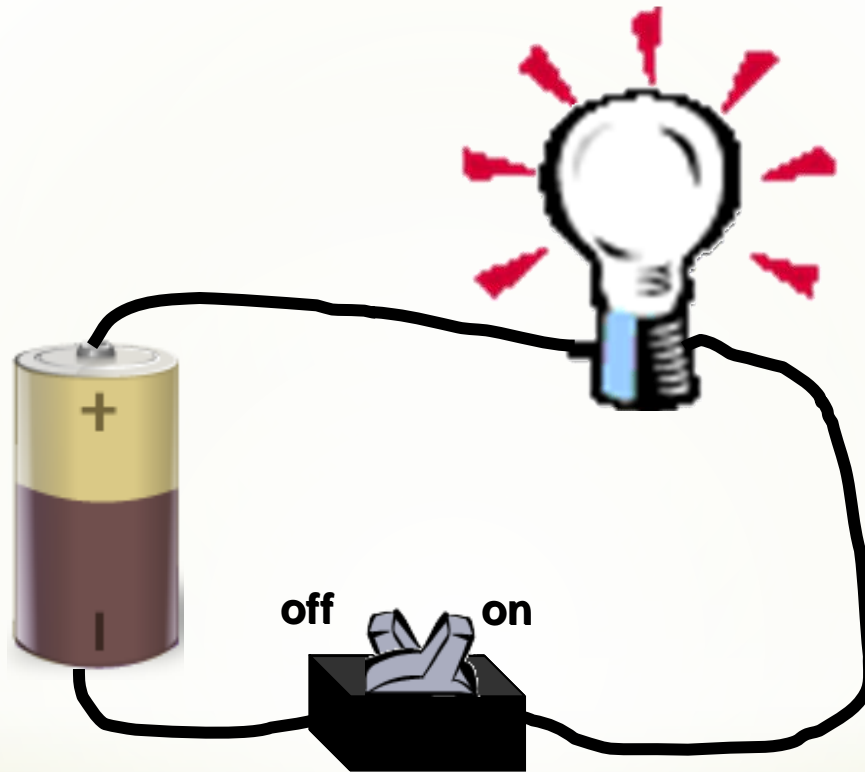
When the tap (switch) is off, is there any flow (current)?

NO

When the tap (switch) is on, is there any flow (current)?

YES

Current in a Circuit



When the switch is off, there is no current.

When the switch is on, there is current.



How do we produce electric energy?

Magnetic field + movable conductor = electricity

*Edison and Swan



Nearly 40 years went by before a really practical DC (Direct Current) generator was built by Thomas Edison. In 1878 Joseph Swan, a British scientist, invented the incandescent filament lamp and within twelve months Edison made a similar discovery in America.

*Edison and Swan...continued

Swan and Edison later set up a joint company to produce the first practical filament lamp. Prior to this, electric lighting had been crude arc lamps.

Edison used his DC generator to provide electricity to light his laboratory and later to illuminate the first New York street to be lit by electric lamps, in September 1882. Edison's successes were not without controversy, however - although he was convinced of the merits of DC for generating electricity, other scientists in Europe and America recognized that DC brought major disadvantages.

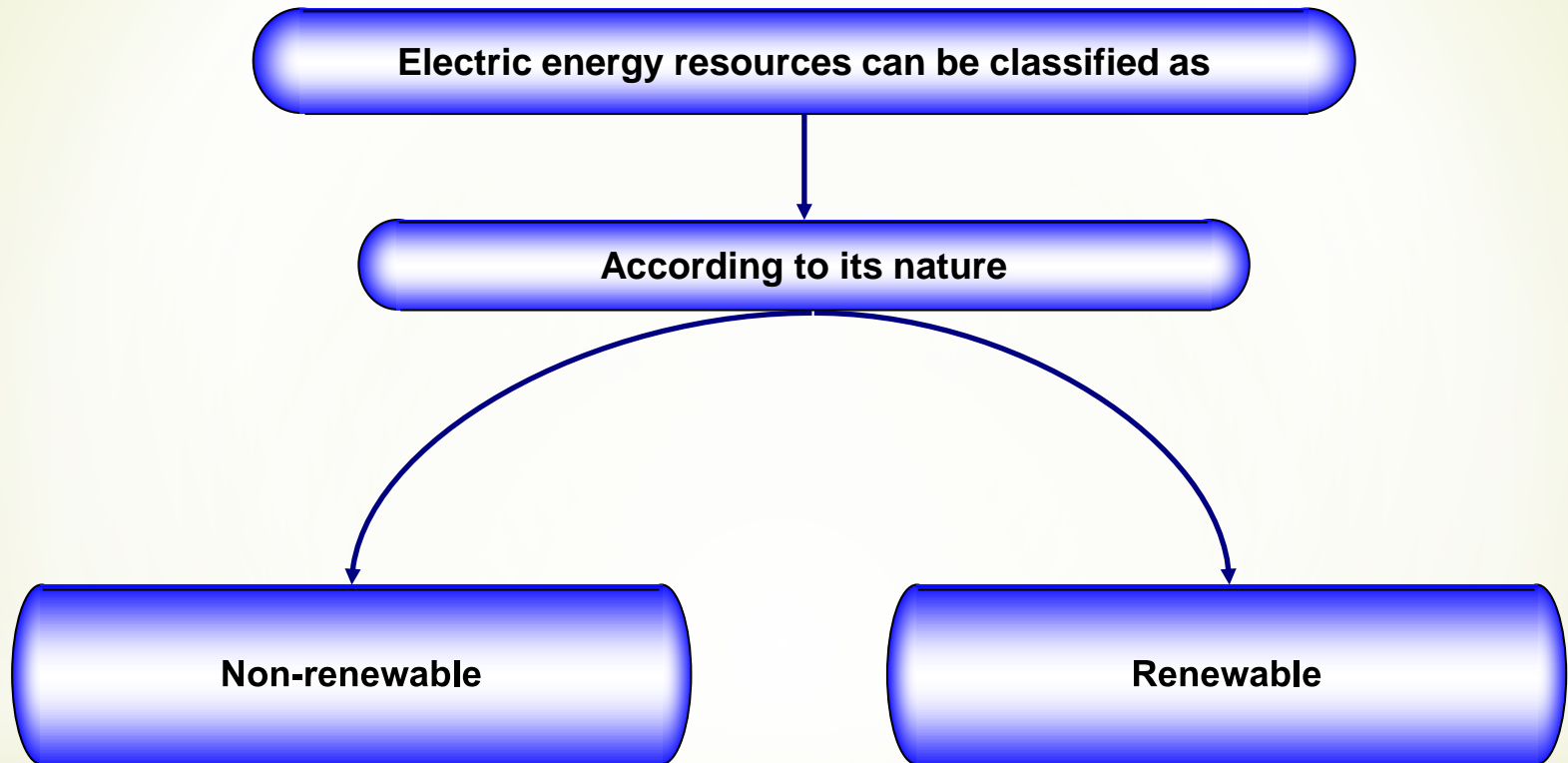
Electric energy changes the life style

** We can say that the electric energy is the source of life*

** Imagine life without electricity!!!!!!!!!!!!*



Classification of electrical energy resources



Most of our electricity comes from the burning of the fossil fuels coal and gas.



Example: Energy Dilemma

The fact
X 2
Energy demand

VS.

The need
÷ 2
Co2 emissions

Result

Frequent power outages

Rising energy prices

Climate change

Conflicts for resource access & control

Proposed Solution

The fact
New and
Renewable
Energy
Production

with

The need
Energy
Control

Result

Result

Productive
& Green

Reliable

Efficient

Safe

Classifications of main drivers behind the focus on renewable energy

Environmental drivers

- ❖ *Limiting green house gas (GHG) emissions*
- ❖ *Avoidance of the construction of new transmission circuits and large generating plants*

Commercial drivers

- ❖ *General uncertainty in electricity markets favours small generation schemes*
- ❖ *DG is a cost effective route to improved power quality and reliability*

National/regulatory drivers

- ❖ *Diversification of energy sources to enhance energy security*
- ❖ *Support for competition policy*

Problem Definition

- ➔ 1- Renewable energy resource is a highly variable power source, and there are several methods of characterizing this variability.
 - A. The most common method is the power duration curve.
 - B. Another method is to use a statistical representation.
- ➔ 2- In the power system the objective is to generate and deliver power as **economically** and **reliable** as possible while maintaining the voltage and frequency within permissible limits

What about the concept of smart grid?

THE SMART GRID

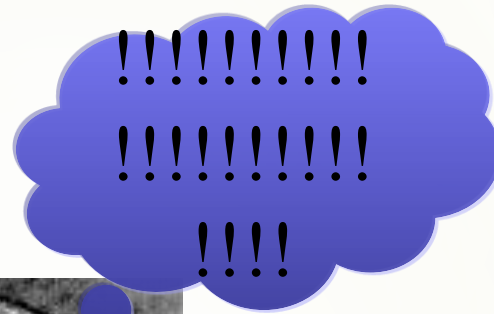


Source: European Technology Platform SmartGrids

Smart Grid Definition

- * A smart grid is a modern electric system.
- * It uses communications, sensors, automation and computers to improve the flexibility, security, reliability, efficiency, and safety of the electricity system.
- * It offers consumers increased choice by facilitating opportunities to control their electricity use and respond to electricity price changes by adjusting their consumption.

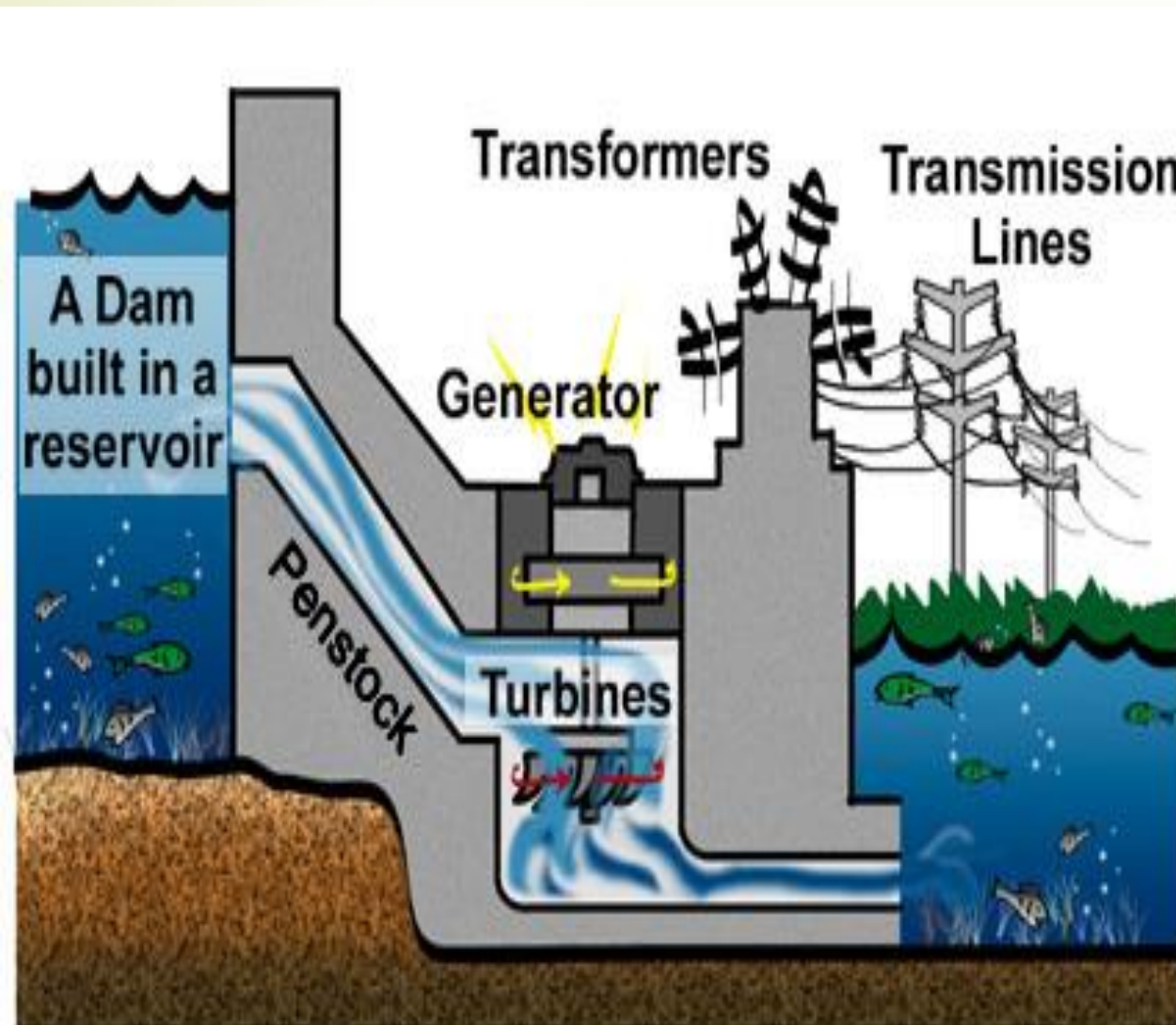
What can Edison say about the electricity today?



Activity (1)

TYPES Of Power plants

Hydroelectric Power Plants



*Theory of Operation

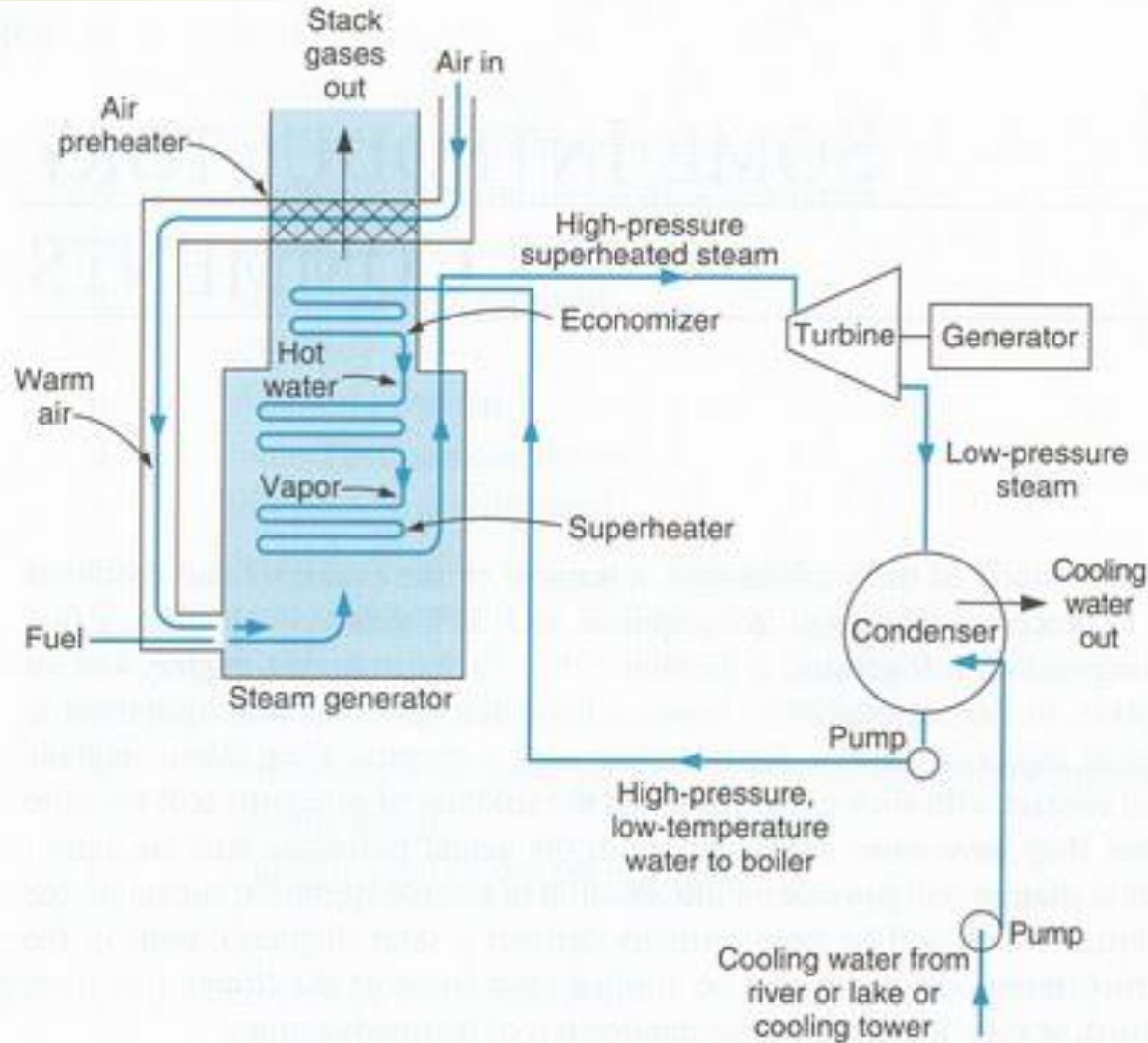
Hydroelectric Power Plants

* Advantages of hydroelectric power plant

* Disadvantages of hydroelectric power plant



Steam Power Plants



***Theory of Operation**

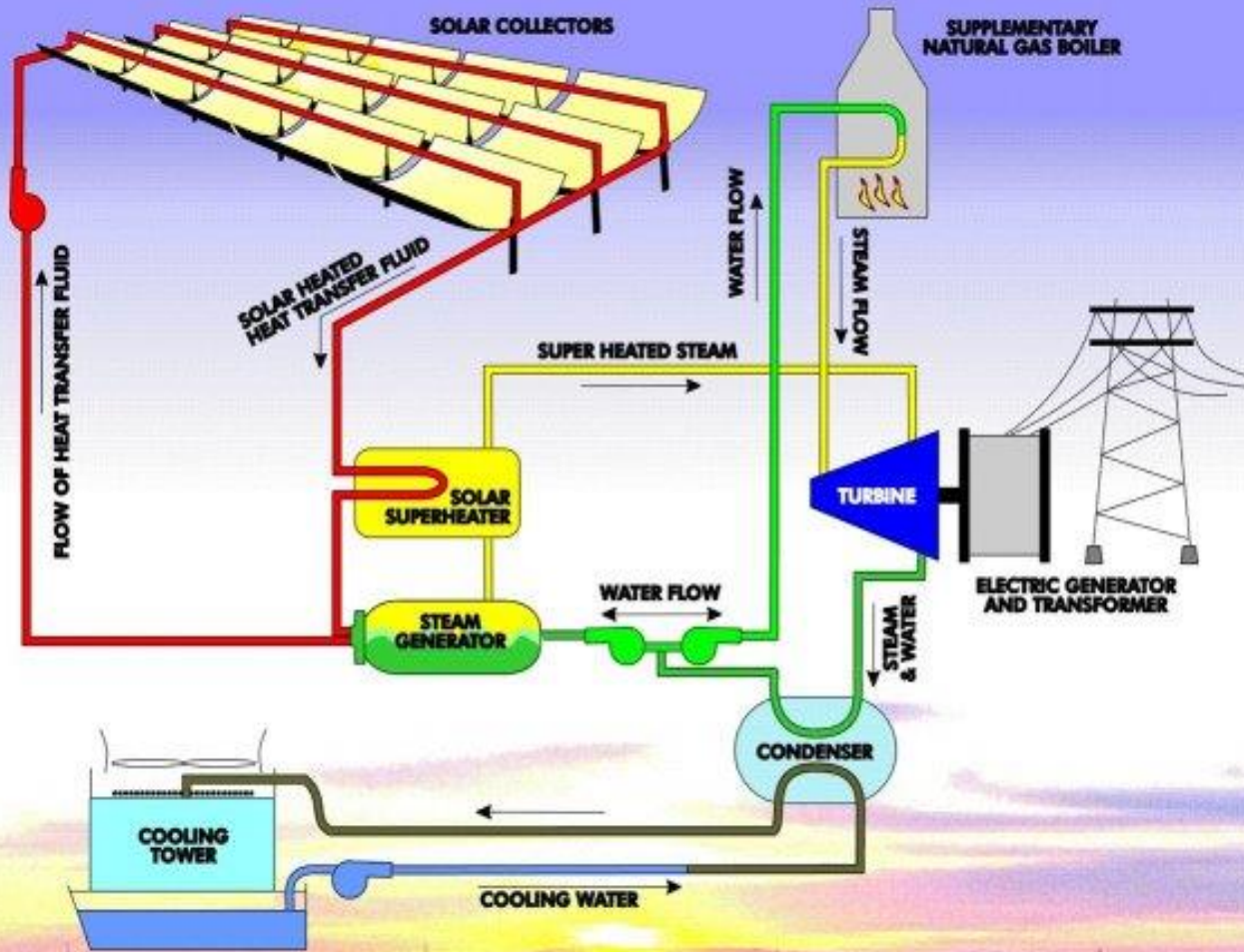
Steam Power Plants

* Advantages of Steam Power Plants

* Disadvantages of Steam Power Plants



Solar Power Plants

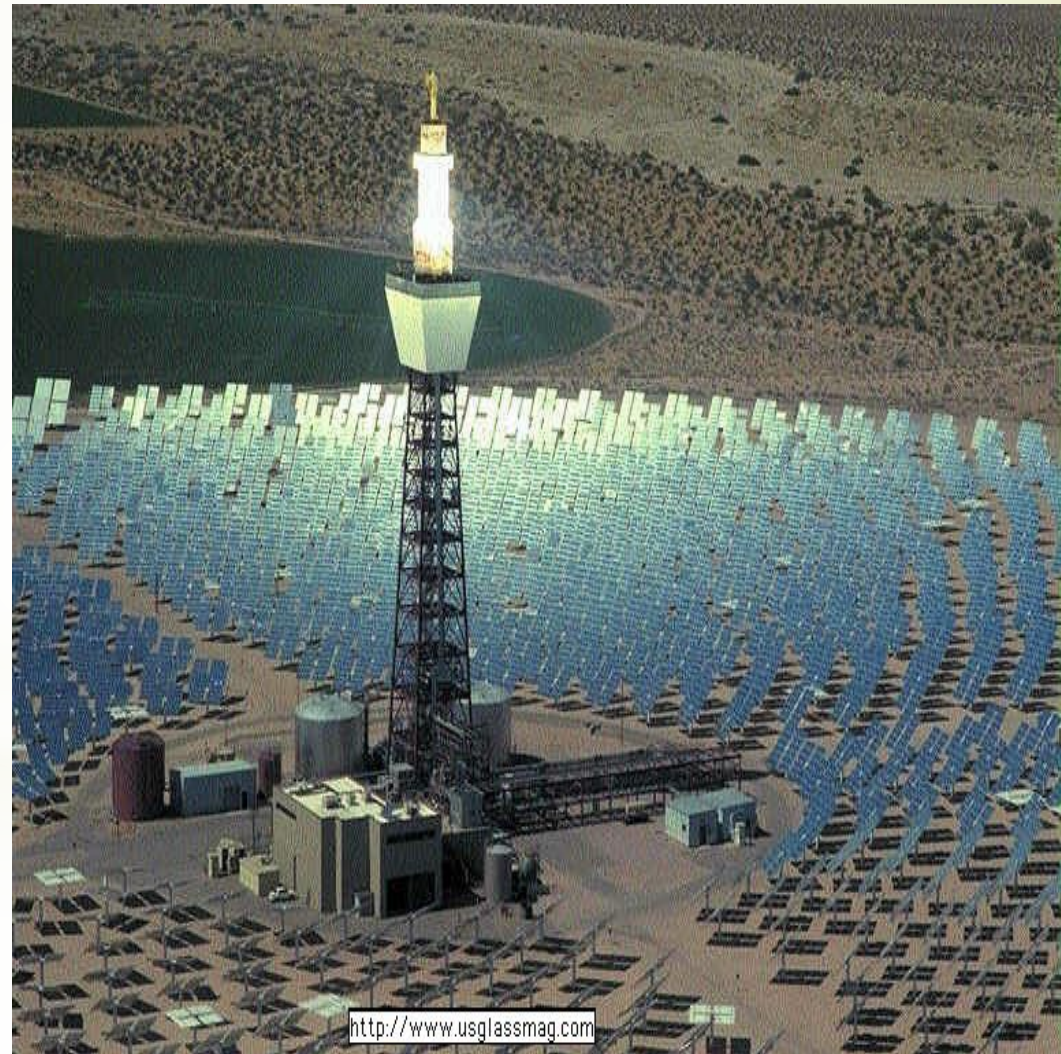


*Theory of operation

Solar Power Plants

*Advantages of Solar Power Plants

*Disadvantages of Solar Power Plants



Diesel Power Plants



***Theory of
Operation**

Diesel Power Plants

* Advantages of Diesel Power Plants

* Disadvantages of Diesel Power Plants



Gas turbine Power Plants

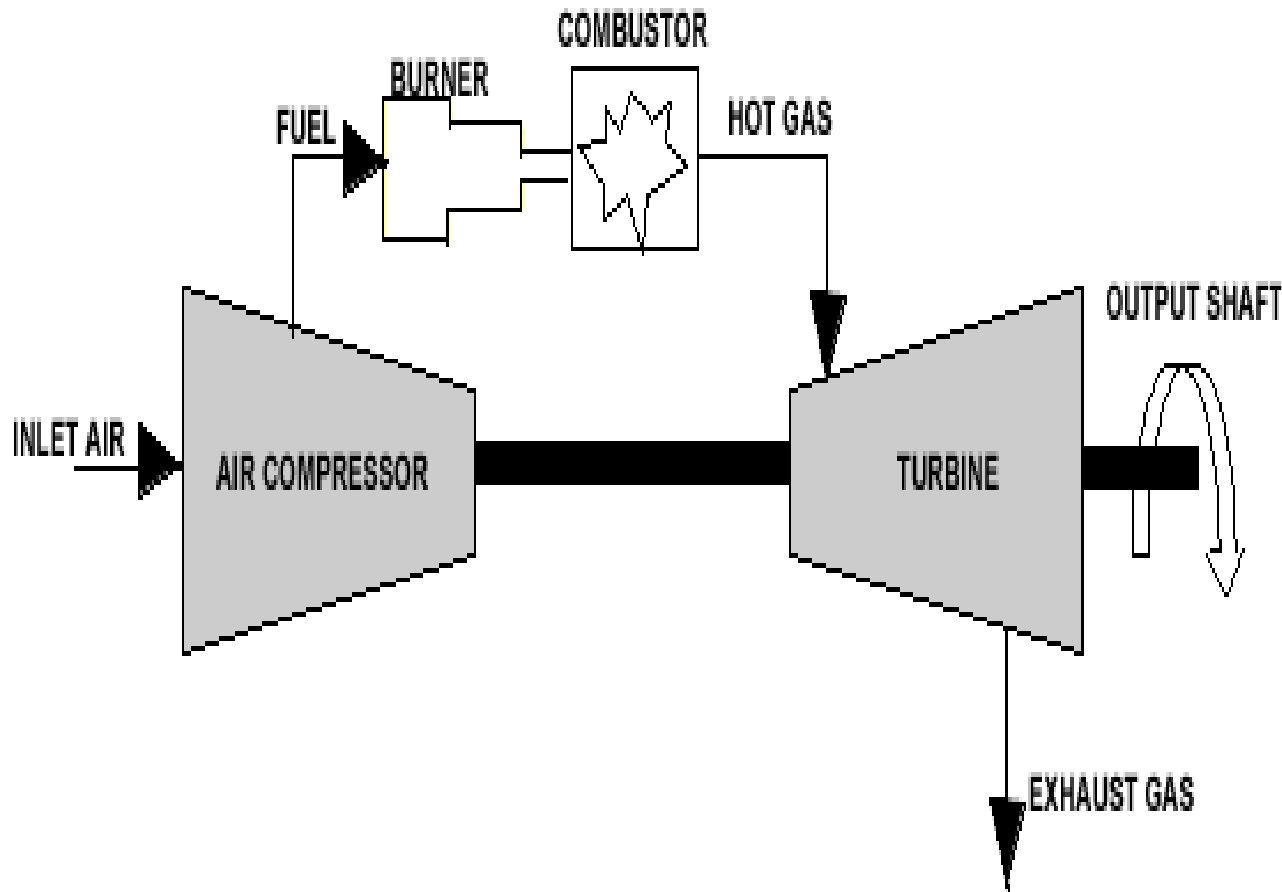


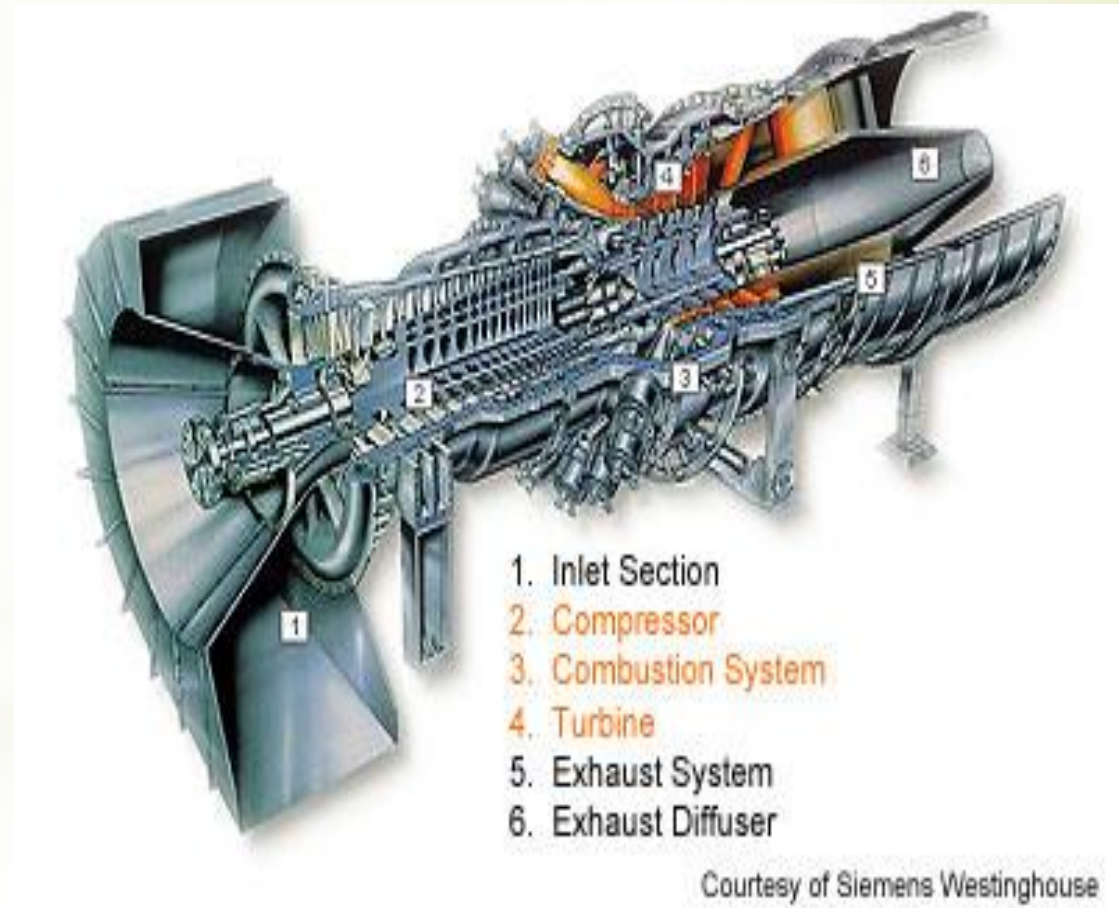
DIAGRAM OF TYPICAL LARGE GAS TURBINE

*Theory of operation

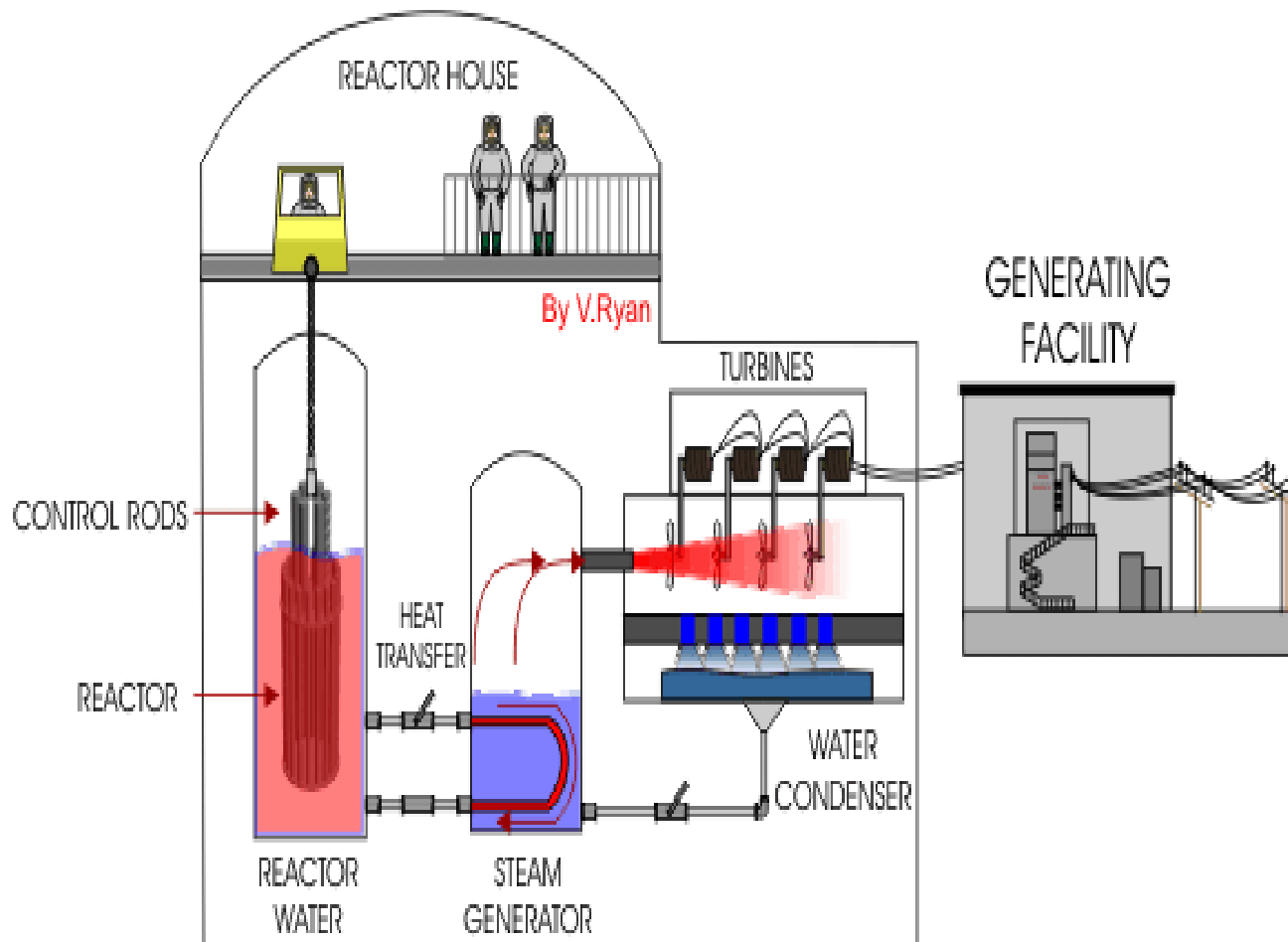
Gas turbine Power Plants

* Advantages of
Gas-turbine Power
Plants

* Disadvantages of
Gas-turbine Power
Plants



Nuclear Power Plants



***Theory of Operation**

Nuclear Power Plants

*Advantages of nuclear power plant

*Disadvantages of nuclear power plant



Activity (2)

**Thank You
For Your Attention**



*Mohamed Ahmed
Ebrahim*