Name = Jawad Shah   ID = 15550   Subject = Power Generation & Utilization

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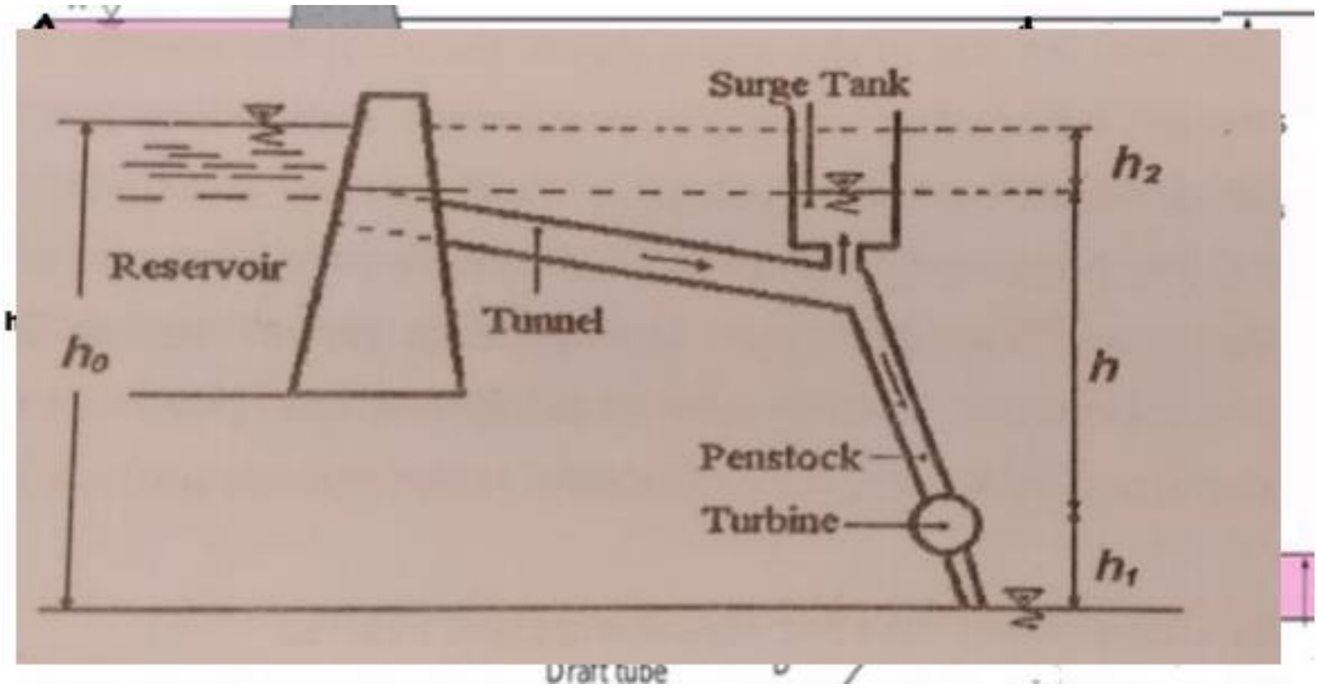
Q1.(a)

Ans:



Reservoir : Reservoir are built across the rivers to store the water, The water stored on upstream side of dam can be carried by penstocks to the power house.

Tunnel : It is a canal which allow the water to flow from reservoir to penstock.

Surge Tank : Surge tank is a cylindrical tank which is open at the top to control the pressure in penstock.

Penstock : penstock are like large pipe with some slope which carries water to turbine with some pressure.

Turbine : It is a devive which converts hydraulic energy into mechanical energy and then further convert mechanical energy into electrical by coupling shaft of turbine with generator.

Q1.(b)

Ans:

Given Data:

Available volume at pondage: $V = 5 \times 10^5\ m^3$

Available head: $h = 100m$

Hydraulic efficiency: 85% = 0.85

Electrical e efficiency= 94% = 0.94

Required:

Capacity of generator to be installed in the power station?

Solution:

Overall efficiency= 0.85 x 0.94= 0.80

Now to find E by using formula E=npghV

$E = 0.8 \times 1000 \times 9.81 \times 100 \times 5 \times 10^5$

$E = 3.92 \times 10^{11}$ W-s

Q2.(a)

Ans:

Turbine: A rotary mechanical device which extracts energy from a "fluidflow" and converts it into useful work

Types of Turbines :

Impulse Turbine : The impulse turbine generally uses the velocity of the water to move the runner. The water stream hits each bucket on the runner

Reacion Turbine : develops power from the combined action of pressure and moving water.The runner is placed directly in the water stream flowing over the blades rather than striking each individually.

Types of Impulse Turbines :

Pelton Turbine

Cross-flow Turbine

Types of Reaction Turbine :

Propeller Turbine

Francis Turbine

Kinetic Turbine

Parameters for Selection of Turbine : There are some parameters used for selection of a turbine whicha are given below

1 Net Head

2 Range of Discharge through turbine

3 Rotational Speed

4 Cost

Q2.(b)

Given Data :

Head = h= 190m

Discharge = q= 2.2 m^3/s

Overall efficiency = 85% = 0.85

Solution

So for 190m jet pelton wheel turbine is suitable so from the given table

ns= 85.49/(h)^0.243

= 85.49/(190)^0.243

$ns = 23.88rpm$

Now output power = P

$P = npqgh$

$P = 0.85 \times 1000 \times 2.2 \times 9.81 \times 190 = 3485.5$ KW

$n = ns \times \underline{h}\ ^{5/4}\ /\sqrt{P} = 23.88 \times (190)^{5/4}\ /\sqrt{3485.5} = 285.32$ rpm

$Ns = 120f/P$

So $P = 120 \times 50/285.32 = 21.02$ poles

Now Diameter

$D = 38.567 \times \sqrt{h} / n = 38.567 \times \sqrt{190}/250 = 2.12m$

Now Jet Diameter

$q = \pi dj^2 /4\ vj$

$vj = \sqrt{2gh} = \sqrt{2 \times 9.81 \times 190} = 61.05$ m/s

$dj = \sqrt{4q/\pi vj} = \sqrt{4 \times 2.2/3.14 \times 61.05} = 0.214m$ or 2.14cm

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Q3.

Nuclear Fuel Cycle :

Uranium Mines and Mills:

It’s the first and starting stage of Nuclear Fuel Cycle in which Uranium is usually mined by either surface or from underground depending on the depth. after that the mined uranium ore is sent to a mill which is located close to the mine. At the mill the ore is crushed and ground to a fine slurry and leached in sulfuric acid to allow the separation of uranium from the waste rock. which is then recovered from solution as uranium oxide (U308) concentrate.

Conversion to UF6 :

Uranium needs to be in the form of a gas before it can be enriched, the U308 Is converted into the gas uranium hexafluoride (UF6) here.

Enriching :

Uranium is enriched to at least 3% for a power plant. There are Two Methods of Enriching

Gaseous Diffusion Method

UF6 (hexafluoride) gas heated, where U-238 is heavier than U-235 on that way both the elemnts separate from each other.

Hexafluoride Gas can be separated into two streams

1.Low velocity U-238

2.High Velocity U-235

Centrifuge Method

Gas spun in centrifuge and Lighter U-235 will separate from heavier U-238

Fuel Conversion :

Enriched Uranium transported to a fuel fabrication plant where it is converted to uranium dioxide (UO2) powder and then pressed into small pellets. Which are inserted into thin tubes usually of a zirconium alloy or stainless steel to form fuel rods. The rods are then sealed and assembled in clusters to form fuel assemblies for use in the core of the nuclear reactor**.**

Reactor:

The reactor core consists of fuel rods and control rods. Fuel rods contain enriched uranium Control rods are inserted between the fuel rods to absorb neutrons and slow the chain reaction. Neutrons produced during fission in the core are moving too fast to cause a chain reaction. A moderator is required to slow down the neutrons, Two types of moderators are used to slow down the reaction

1 Light VS heavy water

2 Boiling water reactor

Reprocessing :

Spent fuel still contains approximately 96% of its original uranium, of which the fissionable U-235 content has been reduced to less than 1%. Spent fuel comprises waste products and the remaining 1% is plutonium produced while the fuel was in the reactor Reprocessing extracts useable fissile U-238 Most of the spent fuel can be reprocessed.

Solidified Waste Storage :

In the U.S., no high-level nuclear waste is ever disposed of it sits in specially designed pools resembling largeswimming pools (water cools the fuel and acts as a radiation shield) or in specially designed dry storage containers. Spent nuclear fuel must be isolated for thousands of years After 10,000 years of radioactive decay, according to EPA standards, the spent nuclear fuel will no longer pose a threat to public health.