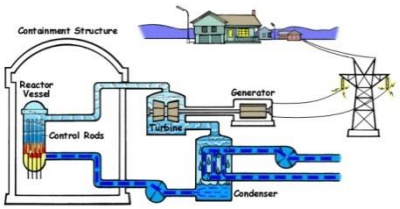

بسم الله الرحمن الرحيم

Thermal Power Stations II



Lecture (9)

on

Pollutants and their Treatmentsystem

By

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Environmental Issues in Coal Based Power Generation

Air Pollution: High particulate matter emission levels due to burning of inferior grade coal which leads to generation of large quantity of fly ash. Emissions of SO_2, NOx & Green house gas (CO_2) are also matter of concern.

Water Pollution : Mainly caused by the effluent discharge from ash ponds, condenser cooling /cooling tower, DM plant and Boiler blow down.

Noise Pollution : High noise levels due to release of high pressure steam and running of fans and motors

Land Degradation : About 100 million tonnes of fly ash is generated by use of coal far energy production. The disposal of such large quantity of fly ash has occupied thousands hectares of land which includes agricultural and forest land too.

Air Pollution

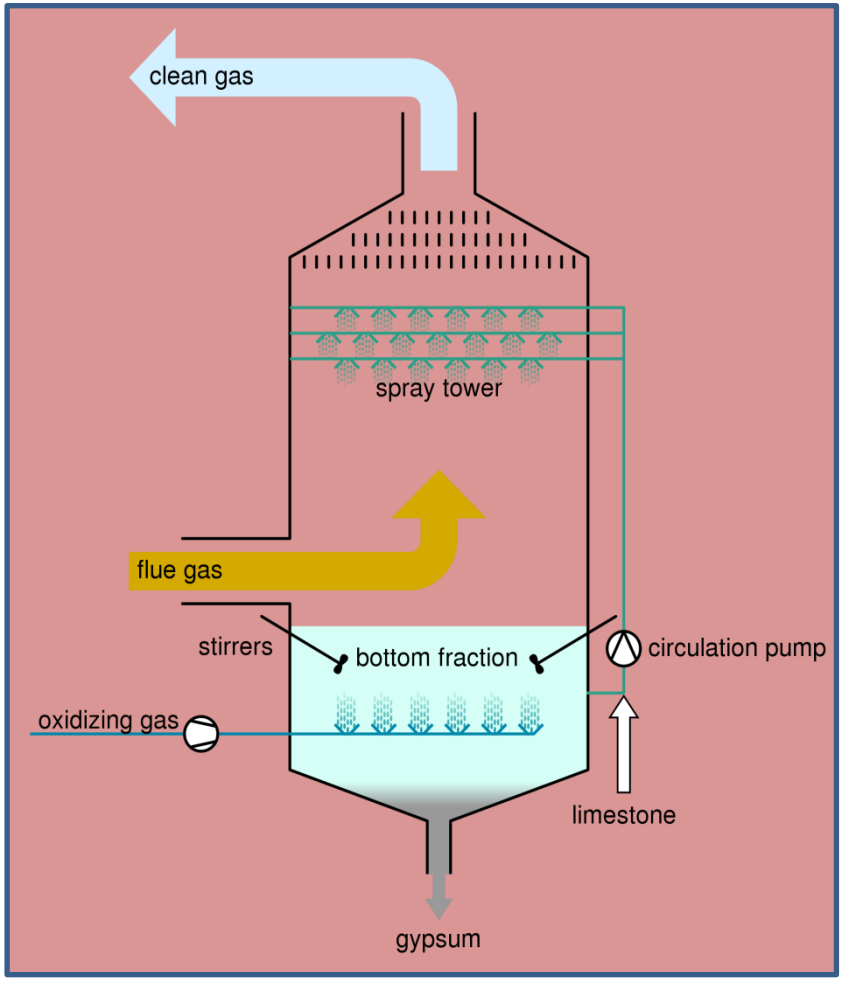
An important environmental aspect of energy generation is the air pollution. It is necessary to limit the extent of air pollution to maintain the air quality at a reasonable and acceptable level and protect public health and welfare. The air pollution by thermal plants can be sub-divided into **stack emissions** and **cooling tower emissions**.

Air Pollution – Stack Emissions

Thermal plants using fossil fuels emit a number of harmful substances like sulphur oxides (sulphur dioxide, sulphur trioxide, stilphates and sulphuric acid), nitrogen oxides (nitric oxide, nitrogen dioxide), particulates, hydrocarbons, carbon monoxide and traces of organic compounds. Out of these, sulphur dioxide. nitrogen dioxide and particulates cause the maximum pollution problems.

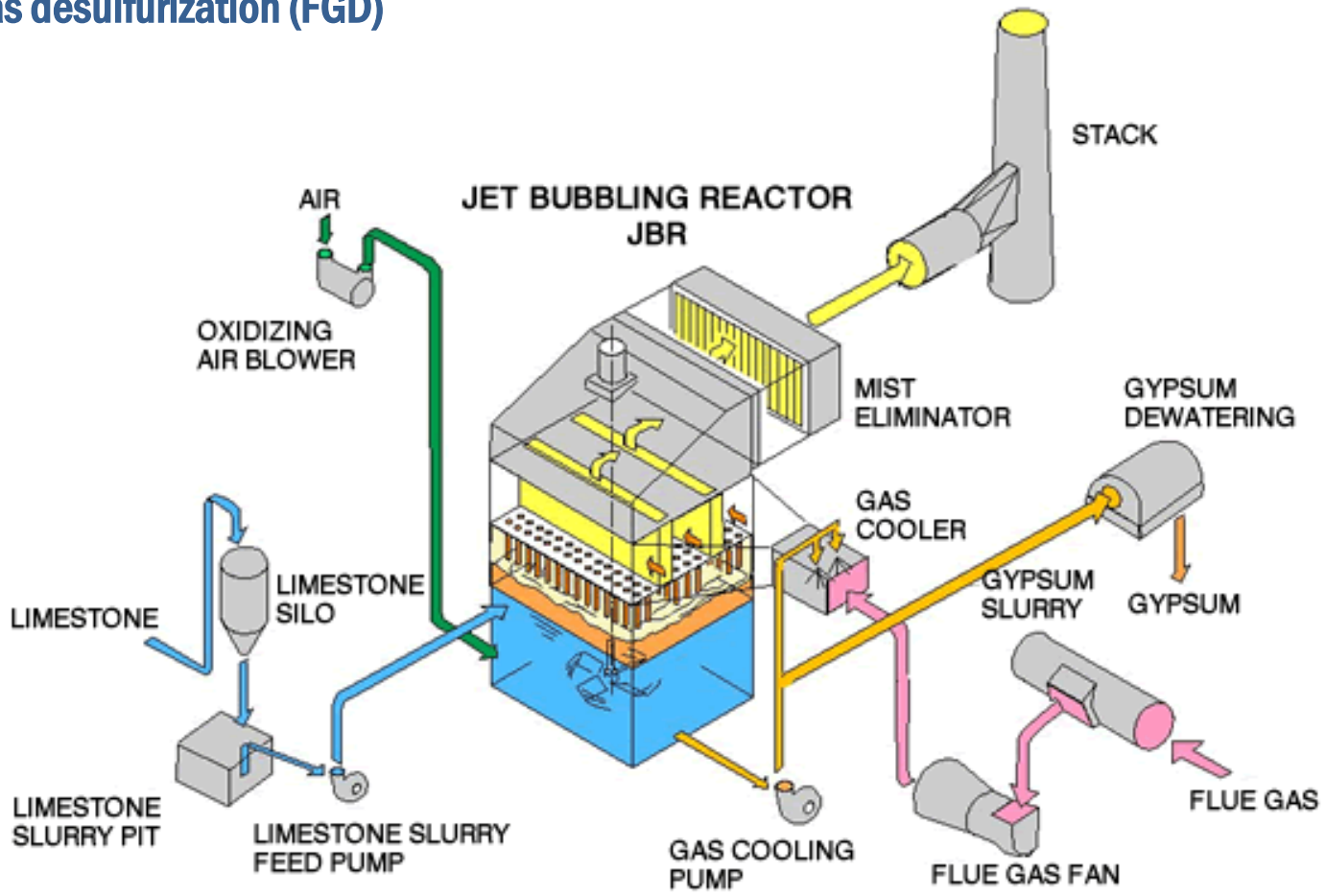
Air Pollution - Treatment

Flue-gas desulfurization (FGD) is a set of technologies used to remove sulfur dioxide (SO_2) from exhaust flue gases of fossil-fuel power plants, and from the emissions of other sulfur oxide emitting processes.



Air Pollution - Treatment

Flue-gas desulfurization (FGD)



Air Pollution - Treatment

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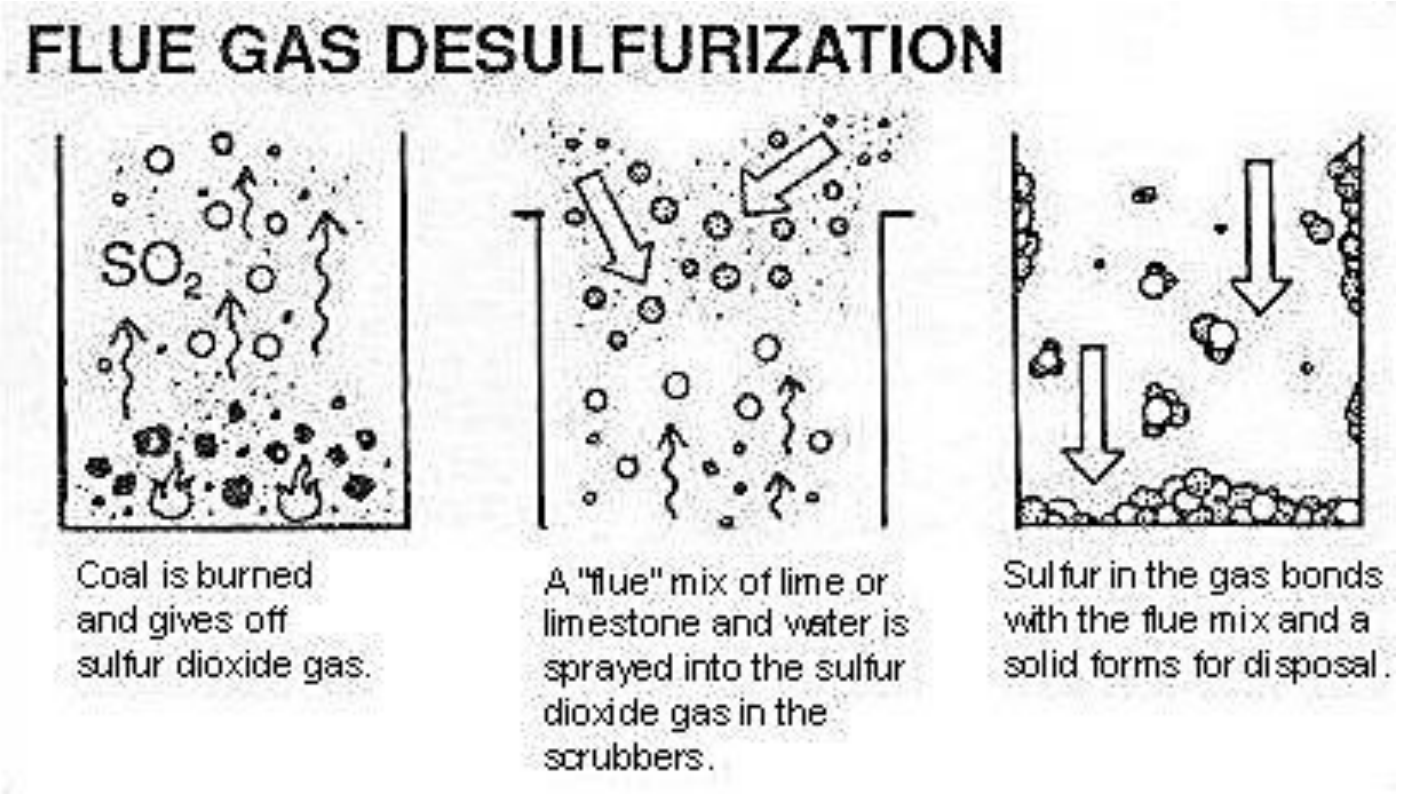
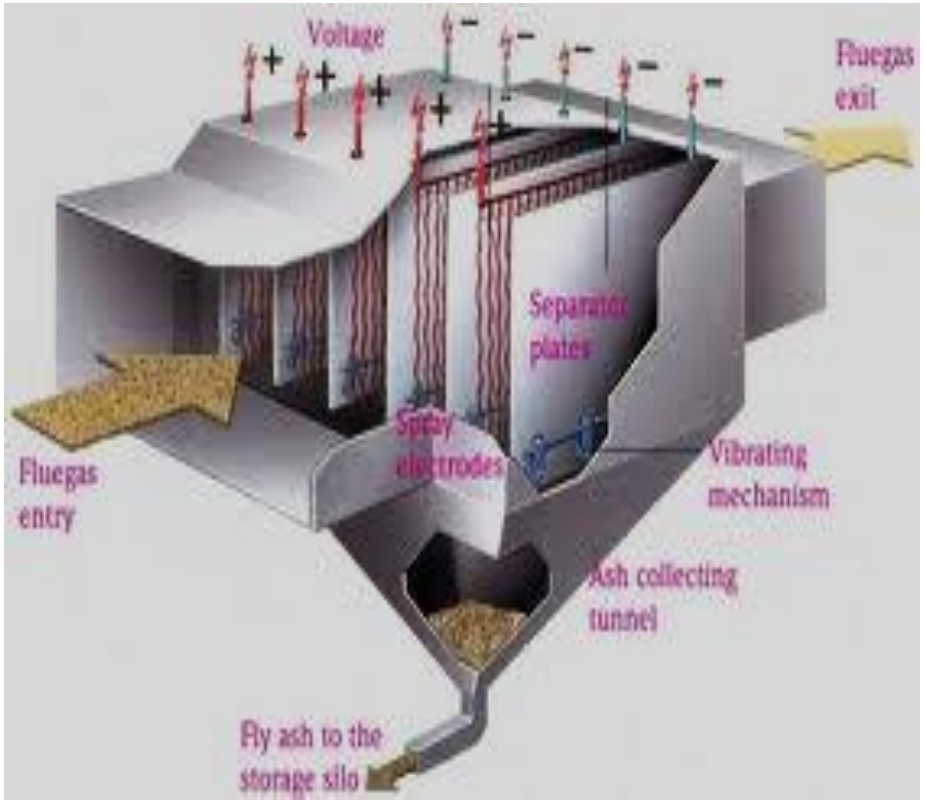


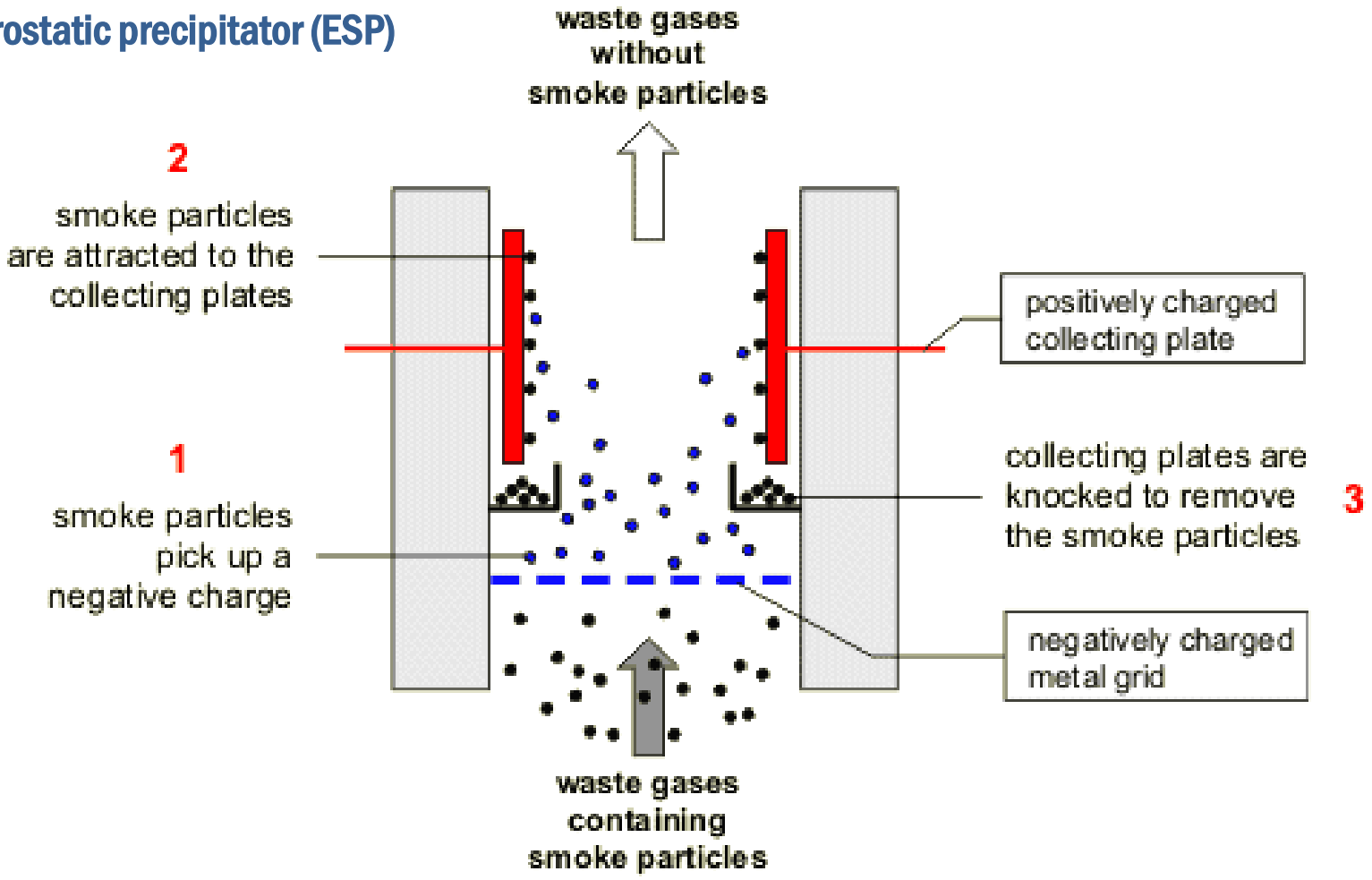
Air Pollution – Treatment

Electrostatic precipitator (ESP), or electrostatic air cleaner is a particulate collection device that removes particles from a flowing gas (such as air) using the force of an induced electrostatic charge.



Air Pollution - Treatment

Electrostatic precipitator (ESP)



Air Pollution – Cooling Tower Impacts

At most of power plant sites, water is scarce and cooling towers have to be used. Cooling towers are huge hyperbolic structures measuring more than 100m in height and use natural air draft (created by tower's height and shape) for cooling the water. Under unfavorable meteorological conditions the tower plume can produce drift deposits and fog and even alter the climate of the region in which they are situated.

Air Pollution – Cooling Tower Impacts

Drift deposits

When the surrounding air cannot absorb moisture, some droplets of circulating water escape from the tower. The droplets, called drift, carry with them salts and chemicals. The amount of drift emitted from a ·modern cooling tower may be around 0.002% of circulating water. Upon being deposited, the salt and chemicals can damage vegetation, cause weathering and corrosion of metals and may even change soil properties.

Air Pollution – Cooling Tower Impacts

Fog

The cooling tower water when added to atmosphere may condense and form fog at ground level. The wind conditions may cause concentration of dense fog over a small area decreasing the visibility in that area.

Visible plumes

Cooling tower may even produce visible plumes. Cold weather and high humidity are most conducive to formation of long visible plumes.

Air Pollution – Aquatic Impacts

When a nearby river or estuary is available, its water can be used by power plants for cooling. Utilization of an open cooling system involves the withdrawal, use and discharge of water back to source. The impacts of these processes on aquatic life include thermal effects, chemical contamination, entrainment, entrapment, oxygen sag etc.

Air Pollution – Aquatic Impacts

Thermal Effects

The water temperature in the region of discharge can produce long term effects on aquatic life. The bottom aquatic dwellers are most prone to heat-plume impact because of their immobility and constant exposure. Fish become sluggish at higher temperatures and have difficulty in obtaining food. The species reproduction can be adversely affected. To minimize the thermal effects, discharge designs should include optimal mixing and offshore, submerged heat diffusers.

Air Pollution – Aquatic Impacts

Chemical contamination

Water drawn from rivers and lakes contains a number of substances which cause corrosion and scaling in condenser. To remove these impurities some chemicals are added. These chemicals, discharged along with hot water into the source, cause chemical contamination. Because of elevated temperature the metabolic rate of organism is increased and the chemical reactions of pollutants are speeded up. Chlorine residuals are harmful to aquatic life. The other chemicals may also be toxic.

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Air Pollution – Aquatic Impacts

Entrapment

Entrapment is caused by hydraulic forces in the stream prior to flow of stream through the screens. These forces can restrict movement of aquatic life and can cause the death of some species due to starvation, exhaustion or asphyxiation. Proper design, location and capacity of intake structures can reduce the entrapment effect.

Air Pollution – Aquatic Impacts

Entrainment

Eggs and newly hatched fish are sometimes entrained into the plant along with intake water. During passage through the cooling system these organisms are subjected to thermal, mechanical and chemical stresses. These stresses may be lethal.

Miscellaneous effects

The increased temperature of water reduces the maximum oxygen carrying capacity of water. This causes excessive biota growth and metabolic rates. A temporary increase in water turbidity during the construction stage of the plant may, also result.

Nuclear Plant Impacts

The most important emissions from a nuclear plant are heat and a trace of radioactivity. The environmental aspects of heat dissipation have been discussed in previous sections. It is necessary to ensure that the operating staff and people residing in the vicinity of nuclear plants are not over exposed to nuclear radiations. Risk to public can be minimized by intense safety design and by auxiliary systems that control radioactive release from normal operations as well as accidents.

Nuclear Plant Impacts

Health physics

Nuclear radiations can cause damage to living cells by ionization process. Radiations enter our body through breathing, eating, drinking or cuts. Some radiations are speedily excreted while others remain in the body and cause damage. The damage may take the form of sudden death or illness such as leukemia, anemia, cancer or congenital abnormalities. International Commission on Radiological Protection has prescribed maximum level of radiation to which workers and public can be exposed.

Nuclear Plant Impacts

Health physics

The work of Health Physics Organization in a nuclear installation as under:

1. Environmental Control

Checking of radiation levels periodically both inside the plant and in the surrounding areas. specifying precautionary measures, estimating the probable exposure of staff to radiation, analyzing the dangers of radiation, marking of zones etc.

2. Personnel Monitoring

Measuring and recording the radiation dose received by plant staff. Photographic films which are sensitive to radiations are used for this purpose.

3. Biological Monitoring

Carrying out routine checks on medical condition of workers.

Nuclear Plant Impacts

Nuclear wastes

Three actions result in nuclear wastes. **Firstly**, fission products may be released to primary coolant due to a defective fuel element. **Secondly**, fission products may originate in a primary coolant as a result of the fissioning of 'tramp' uranium on fuel surfaces.

Thirdly, activation of corrosion products, chemicals and coolant may occur.

The gaseous effluent can consist of fission product noble gases, iodine and tritium in water vapor form. Around fifty fission and activation products may be present in liquid effluent. Solid wastes can result from processing liquid streams in the form of spent demineralizer resins, evaporation and sludge tank residues, filter trappings and miscellaneous contaminated objects like rags, clothing, tools etc.

Nuclear Plant Impacts

Nuclear waste disposal

Radioactive wastes can contaminate air and water and cause biological damage. Assured means of isolation of the waste from environment is necessary for long periods. Various methods for disposal of nuclear waste are:

1. Storage of solid wastes in concrete tanks at site, Combustible materials are segregated and burnt with a high degree of filtration of flue gases. The highly active liquid wastes which contain over 99% of fission products present the biggest problem. They are stored in stainless steel tanks with secondary containment and shielding. Facilities for transfer of liquid waste to spare tanks in the event of leakage are necessary. The storage structures have useful life considerably shorter than the duration of radioactive hazard and this aspect makes the cost of storage high. Attempts have been made to solidify the liquid waste to reduce tank requirements.

Nuclear Plant Impacts

Nuclear waste disposal

2. **Dilution and subsequent disposal of liquid waste in rivers and sea.** Through ion exchange treatment, the radioactivity of liquid is reduced to acceptable levels so that it can be safely disposed off in rivers and seas.
3. **Burial of solid wastes in ground.** Burial grounds must be isolated from public. Water should not be allowed to soak in burial grounds lest it should cause radioactive contamination of drinking water.
4. **Disposal of solid material at sea in sealed containers.**
5. **Discharge of gaseous waste to atmosphere at high level after filtration and treatment.**


Thank You