INDUSTRIAL VISIT

VISITED INDUSTRY:NFC(NUCLEAR FUEL COMPLEX)

LOCATION OF THE INDUSTRY:NFC INDUSTRY, ECIL,

Moula ali, Hyderabad, Telangana :500062

DATE OF INDUSTRY VISIT:13-02-2019

DEPARTMENT:CHEMICAL ENGINEERING

YEAR:ENGINEERING 3rd YEAR

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INTRODUCTION:

The nuclear fuel complex(NFC) was established in 1971 as a major industrial unit of Indian's department of atomic energy,for the supply of nuclear fuel bundles and reactor core components. It is a unique facility where natural and enriched fuel, zirconium alloy cladding and reactor core components are manufactured under one roof.

HISTORY:

NFC is a unit of department of atomic energy,Government of India. The complex is responsible for the supply of nuclear bundles and reactor core components for all the nuclear power reactors in India. It is a unique facility where the natural and enriched uranium fuel, zirconium alloy cladding and reactor core components are manufactured under one roof starting from the raw materials.

PRINCIPLE OF PRODUCTION:

As the power generated is low,then the per capita energy consumption is becoming low. There is insufficient power supply for all the people.

$$\text{Per capita energy consumption} = \frac{\text{Power generated}}{\text{Total population.}}$$

since power generated by coal,thermal,tidal,solar energy is very less and it is inadequate for human usage. So by using nuclear energy they have been manufacturing uranium bundles which are used in generating electricity.

PRODUCT:

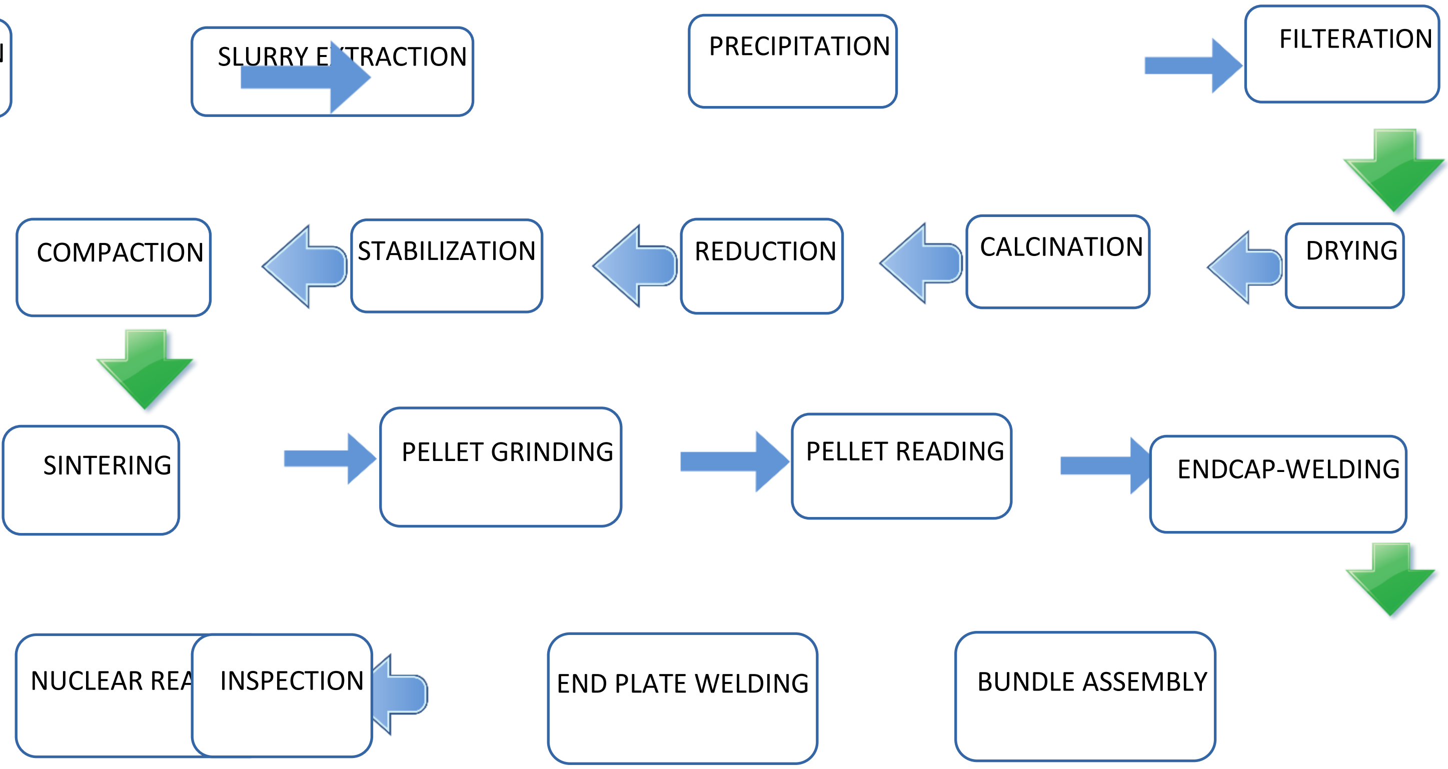
Uranium Bundles

RAW MATERIALS:

Magnesium di- uranate(MDU)

Sand containing Zirconium

FLOW CHART:



These are steps involved in the manufacturing of uranium rods which are used for the electricity generation.

HOW ENERGY IS GENERATED:

A nuclear power plant is much similar to a coal fired thermal plant except the way heat is produced to raise steam. At the heart of a nuclear power plant is the fission reaction in the nuclear fuel, usually uranium, that takes place in the reactor core. To be simplistic, in a nuclear fission, a neutron hits the nucleus of an atom of the uranium fuel and splits it, in which two or three neutrons are released and used to cause fission in other uranium atoms. Fission of a single atom of uranium yields energy equal to 200 MeV (million electron volts) in comparison to only 4eV in the oxidation of one carbon atom.

Therefore, on equal weight basis the total energy from the nuclear fission of 1 ton of uranium is about as much as that produced from 2.5 million tones of coal combustion. Natural uranium consists of two forms (isotopes) of uranium U-238, (99.3%) and U-235 (0.7%). It is the less abundant U-235 that leads to fission reactions. U-235 is the only natural isotope that can be made to undergo fission by thermal (slowed) neutrons. However concentration of U-235, as compared to U-238 can be increased by the process called enrichment. An enrichment of about 3 to 4 percent provides considerable flexibility in the design and operation of nuclear reactors although slowing down of neutrons still remains a necessity.

The surplus neutrons produced in the chain reactions are allowed to interact with other atoms to produce even more neutrons. In such a case, the reaction will continue over a time, until fuel is depleted. However, not all the atoms are available to fission other U-235 nuclei as some of them 'escape' or are absorbed by the surrounding materials. Three scenarios may be envisaged, considering such a neutron economy. First, if more than one neutron is available for reaction, the rate of fission increases with time and the reaction is 'super critical'. Second, exactly one neutron is available for fission reaction such that reaction rate is constant and the reaction is 'critical'. Third, less than one neutron is available for reaction and number of fission decreases with time or the reaction is 'sub critical'. In a nuclear reactor, an increase in the number of neutron is allowed initially to reach the required reactor power and then maintained at that level. The reaction rate is lowered to reduce power level or to shut down the reactor by decreasing the number of available neutrons e.g. by inserting a neutron absorbent like boron or cadmium.

Fission neutrons have energy and must be slowed down to enhance the chances of inducing further fissions. This slowing down of neutrons is accomplished by a 'moderator', ideally a substance having low neutron absorption. Such reactors which use thermal (slowed down) neutrons by their repeated collision with moderator are called thermal reactors. The pressurized heavy water reactor (PHWR), mainstay of India's nuclear power program, is a thermal reactor using natural uranium as fuel and heavy water as moderator and coolant.

MAKING OF NUCLEAR FUEL:

Natural Uranium is mined at jaduguda in Jharkhand. It is converted into nuclear fuel assemblies at Nuclear Fuel Complex. A 220 MW PHWR fuel assembly contains about 15.2kg of natural uranium dioxide. Uranium dioxide pellets generate heat while undergoing fission and also generates fission products. Fission products are radioactive and should be contained and also not allowed to mix with coolant water. Hence the UO_2 pellets are contained in Zirconium alloy tubes with both the ends are completely sealed.

Unlike other fuels, nuclear fuels 'burn' without any obvious change in the size, shape or appearance of the elements. They do not give rise to bulky ash or harmful fumes. In a nuclear power station such a assembly produces as much electricity as that of 15 wagon loads (i.e about 380 tonnes) of coal. A 220 MWe reactor unit contains 3,672 fuel assemblies like this. They normally stay in the reactor for about 18 months before being replaced. Careful design and scrupulous quality control guard against failures in service.

There is no combustion in uranium fuel and a fuel assembly comes out of the reactor in the same way as it went in. However, there is one important difference, When a fuel assembly is removed from the reactor after about 18 months of use, it contains radioactive by-products as a result of the fission process. Because of this radioactivity, the fuel assembly is handled by remote controlled fuel assembly loading/unloading machine to transfer it for storage in a water-filled pool inside the station. This machinery also feeds new fuel assembly into the reactor. The water cools the used fuel and, along with steel and concrete shielding, protects station workers from radiation. After a period of storage under water, the spent fuel assembly are taken in shielded containers to the reprocessing plant. In this plant, operated largely by remote control through heavy shielding.

OATH OF THANKS:

We are really thankful to our honorable Vice chancellor Dr. A. Ashok sir for your immense support for making our industrial successful event. We are also express our gratitude to our respected administrative officer -Venkat swamy sir ,dean of academics -Sainath sir, and chief wardens for enormous cooperation for organising our industrial tour. We also express our sincere thanks to our respected HOD-Nandhini mam for your enormous efforts for making this industrial visit a grand success. We also extend our thanks to our faculty members. We also acknowledge our sincere gratitude to Anil kumar sir- NFC scientific officer and vijay kumar sir for your hospitality and your patience for making us understanding the manufacturing process.