REPORT ON NUCLEAR FUEL COMPLEX INDUSTRIAL VISIT

Nuclear Fuel Complex, Hyderabad is an industrial unit of the Department of Atomic Energy, Government of India. NFC is the only organization in India which caters to the fuel requirements of nuclear power reactors. It was conceived in late 60's as a pivotal industrial arm of the Department of Atomic Energy with the mandate to fuel the nuclear power program of Govt. of India. An ISO certified organization, NFC is the only organization in the world today to have a comprehensive manufacturing cycle from ore to core, involving processing of both Uranium & Zirconium streams under the same roof.

NFC's specialty lies in the manufacturing of nuclear fuel bundles for Pressurized Heavy Water Reactors (PHWR), Boiling Water Reactors (BWR) and Fast breeder reactors; many reactor core components, various tubes, high purity special materials; etc.

It has developed state-of-art facilities and process technologies with several innovations in the field of nuclear fuel production and fabrication. The organization is thus playing a catalyst's role in nation building. The complex also symbolizes the strong emphasis on self-reliance in the Indian Nuclear Power Program.

What is done in NFC?

NFC has different types of production facilities which include **Zirconium Oxide Plant** for processing of Zircon to nuclear grade Zirconium oxide; **Zirconium Sponge Plant** for conversion of

Zirconium oxide to nuclear grade sponge metal; **Melt Shop Plant** for production of zirconium alloys; **Extrusion and Piercing Plant** for hot extrusion and expansion of different alloys and special materials into various shapes and sizes; **Zircaloy Fabrication Plant** for producing various zirconium alloy tubes, sheet, rod and wire products; **Uranium Oxide Plant** for processing crude uranium concentrates to pure uranium di-oxide powder; **Ceramic Fuel Fabrication Plant** for producing Uranium oxide pellets and assembling of the fuel bundles for the PHWRs; **BWR Fuel Fabrication Plant**; **Fast Reactor Facility Plant** for fabrication of components and sub-assemblies for Fast Breeder Reactors; **Special Materials Plant** for producing a number of high purity materials; **Stainless Steel Tube plant** for producing seamless tubes of stainless steel and other alloys.

Zirconium Pilletes and Zirconium Powder

History of NFC:

Dr. Homi Jehangir Bhabha conceived the Nuclear Program in India. Dr Bhabha established the Tata Institute of Fundamental Research (TIFR) for carrying out nuclear science research in 1945 and Atomic Energy Commission was constituted in 1948. To intensify the effort to exploit nuclear energy for the benefit of the nation, Dr Bhabha established the Atomic Energy Establishment, (AEET), Trombay, Mumbai in January 1954. AEET was subsequently renamed as Bhabha Atomic Research Centre (BARC). Initial lab scale experiments to make nuclear fuel were conducted at BARC.

A team of Sr. Scientists were constituted to visit Bangalore, Madras and Hyderabad to search for a suitable site. The senior committee, after detailed scrutiny, recommended to Dr. Bhabha the choice of Hyderabad for the location of Nuclear Fuel Complex. The Andhra Pradesh Government has allotted land to the Department of Atomic in the year 1968. In 1968, NFC Board was created under the Chairmanship of Dr. Vikram Sarabhai for setting up of few production plants, common facilities and any other facility required at Hyderabad. Also, the objective of setting-up of NFC was to create an organization to meet the future requirements of fuel for the nuclear power program.

Dr. Dinesh Srivastava, the Distinguished Scientist and Chief Executive of NFC, is a Metallurgical Engineer from the University of Roorkee. He joined the 28th batch of BARC Training School, Mumbai in 1984. Subsequently, he was posted to BARC, Mumbai and served in various capacities for more than three decades. He has obtained Doctorate degree from the Indian Institute of Science (IISc), Bengaluru. He has contributed exclusively in the development of advanced structural materials of extreme strategic value for Nuclear Energy program in India. He has published more than 150 research papers.

Vision

To contribute towards India's self-reliance endeavour in nuclear fuels fabrication and to accelerate India's three stage nuclear power program for sustainable and clean energy with continued commitment in our march to excellence. To be partner in **"Make in India"** mission by contributing in strategic programs of India.

Mission

- To meet the quality requirements of customers.
- To protect environment including prevention of pollution.
- To prevent injury and ill health by providing safe condition and following safe practices.
- To comply with the applicable statutory requirements.

- To Strive to continually improve Quality, Environmental and Occupational Health & Safety performance through technological & administrative measures and by enhancing awareness among employees.

Products:

Zirconium Alloy:

Zirconium alloys are solid solutions of zirconium or other metals, a common subgroup having the trade mark **Zircaloy**. Zirconium has very low absorption cross-section of thermal neutrons, high hardness, ductility and corrosion resistance. One of the main uses of zirconium alloys is in nuclear technology, as cladding of fuel rods in nuclear reactors, especially water reactors. A typical composition of nuclear-grade zirconium alloys is more than 95 weight percent zirconium and less than 2% of tin, niobium, iron, chromium, nickel and other metals, which are added to improve mechanical properties and corrosion resistance.

The water cooling of reactor zirconium alloys elevates requirement for their resistance to oxidation-related nodular corrosion. Furthermore, oxidative reaction of zirconium with water releases hydrogen gas, which partly diffuses into the alloy and forms zirconium hydrides. The hydrides are less dense and are weaker mechanically than the alloy; their formation results in blistering and cracking of the cladding – a phenomenon known as hydrogen embrittlement.

Zirconium Alloys

Zirconium Oxychloride

Zirconium (IV) Oxychloride Octahydrate (Zirconyl Chloride Octahydrate) is a water-soluble zirconium compound used as a reagent in the formation of zirconia thin films, a intermediate for other zirconium-based salts and catalysts, a cross-linking agent, and an additive to titanium dioxide pigments to increase durability.

Zirconium Oxychloride (ZOC) is produced from zircon sand. It is the starting point for the manufacture of all other zirconium chemicals or zirconium dioxides and can also be used directly in applications like Tio 2 pigment coating. It is white or slightly yellow crystal.