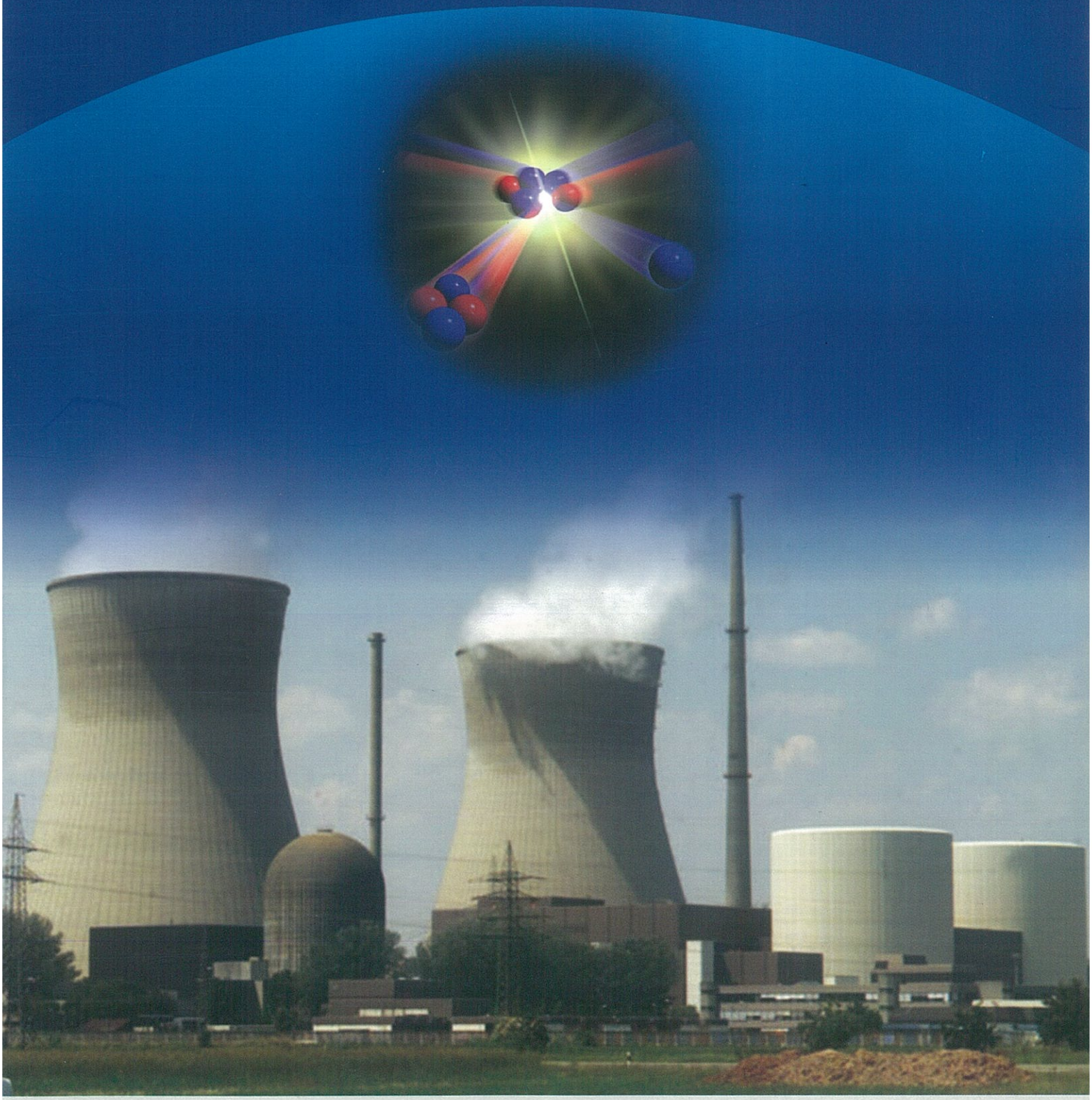
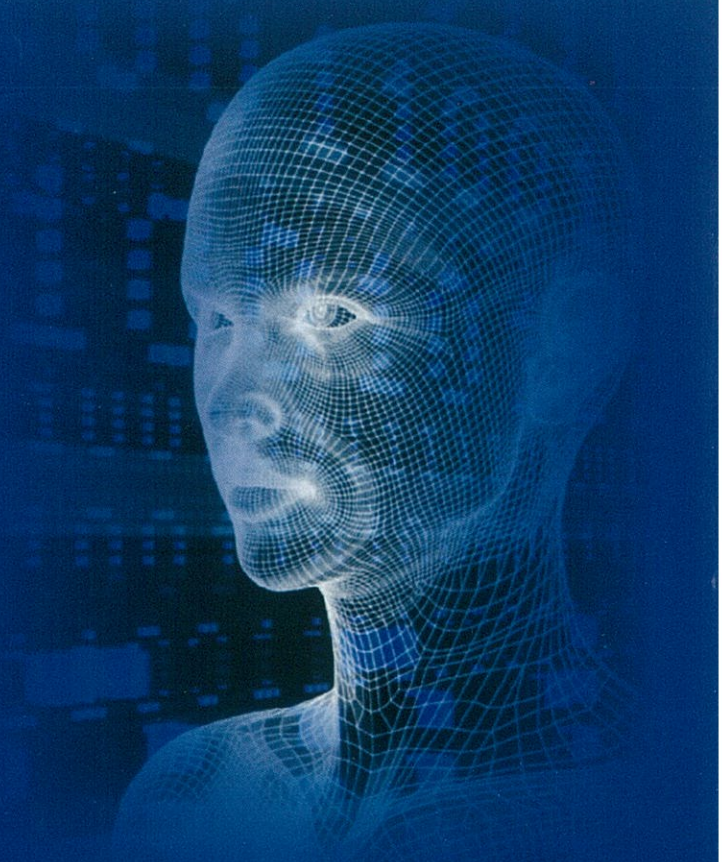
AVASARALA

Avasarala Technologies Limited

Nuclear Sector



AVASARALA



Avasarala was started as a project consultancy company in 1985 by 8 Technocrats under the leadership of our beloved Chairman Shri. Avasarala Mangapathi Rao. All promoter Directors are Technocrats with decades of experience in Mechanical, Electrical & Electronics Verticals. The prime idea was to lend the technical expertise to the Indian machinery manufacturing industry. In a hope to capitalize the latent potential in this segment, AVASARALA forayed into manufacturing in the year 1986. It began the Design, Development, Fabrication, Machining and Assembly of Special Purpose Process Machinery, Development of Custom Built equipments and Automation Systems for diverse clients and applications needs in the Indian & Global arena.

During the tenure of its growth, Avasarala have executed many challenging projects with many of them with the State of the Art Manufacturing Technologies.

During the process of developing equipments, Avasarala have acquired certain critical Technologies by entering into Technology Transfer Agreements with most strategic sectors of Indian Industries.

Leveraging its capabilities as a technically versatile company, it diversified its business interests to allied areas. Today, Avasarala has grown into a diverse corporate entity with Nuclear Sector being one among them.

Avasarala has experience in Building Equipments & providing Services for Nuclear Power Projects in the following Areas

A. Fuel Fabrication

B. Reactor

C. Spent Fuel Handling

A. Fuel Fabrication

- Equipments & Systems
- Components Supply

B. Reactor

- **Manufacturing**
  - Critical NSSS (Nuclear Steam Supply System) Equipments
- **Services**
  - Nuclear Power Plant Installation
  - Life Extension
  - Engineering, Procurement & Construction

C. Spent Fuel Handling

- Equipments & Systems
- Engineering, Procurement & Construction

A. Fuel Fabrication

Equipments / Systems

Fuel Bundle End Plate Welding System

Purpose - For Resistance welding of End Plate on Fuel bundles of 540 MWe Nuclear Reactors.

PHWR fuel bundles are about a half meter in length and 10 cm in diameter. These bundles consists sintered (UO_2) pallets in Zirconium alloy tubes, welded to Zirconium alloy end plates.

Hightlights

- Turnkey Project from Concept to Commissioning
- First Time Development for 540 MWe Fuel Bundles
- Elimination of operator to lift and move Loaded Fixture – 32 Kgs and Welded Bundle – 25 kgs
- Distorsion free welding in pre-programmed sequence
- Indigenously developed Pick and Place Electro-Pneumatic Robot.
- Modular Grab Unit in Robot to handle Loaded Fixture and Welded Bundle

Double Stranded Pilgering Machine

Design, Manufacture, Supply and Installation & Commissioning of Tube Reducing Mill

Function: To reduce the wall thickness, Outer Diameter & increase the length of Zircaloy & Stainless Steel Tubes as per following Specifications.

Ingoing Tubes:

OD (Max) - 25mm, Wall Thickness (Max) - 2.5mm, Length -1.5 to 5.5m

Outgoing/Reduced Tubes:

OD - 10 to 20mm, Wall Thickness - 0.2 to 1.5mm, Length - Max 5m

Mill Contains:-

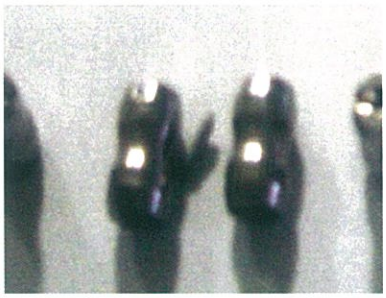
- Roll Stand assembly
- Rocker arm & Saddle assembly
- Feed & Turn Check assembly
- Mandrel rod Check assembly
- Feed & Turn Gear box
- Inlet & Outlet Check Assembly
- Tube clamping, mandrel rod clamping Clutch engage & disengage and Hood operation done by hydraulics.

Components Supply

Fuel Pin Components

Procurement of Material, Manufacturing, Inspection and supply of Fuel Pin Components
Manufacture & Supply of 50,000 sets made of various grades of Special Steels

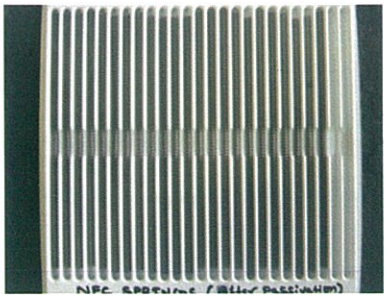
Top Plug
SS 316 LN



Middle Plug
SS 316 LN

Spring Support
SS 316 LN

Bottom Plug
SS 316 LN



Springs
Alloy A-286

Spacer wire
MDN 316 Ti (15 cr - 15 Ni)

B. Reactor

Manufacturing

Avasarala has supplied Critical Equipments to various Nuclear Power Plants in India.

NSSS Equipments for PHWR

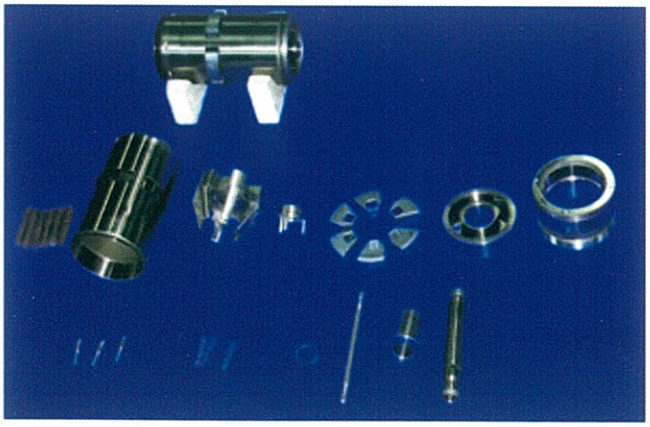
Equipment	Plants
Sealing & Shielding Plugs	RAPP 5&6, NAPS 1, KAPP 3&4
Fuelling Machine	RAPP 5&6, RAPP 7&8
Radiation Shielding Windows	RAPP 5&6, KAIGA 3&4
Reactivity Control Mechanisms	TAPS 3, KAPP 3&4
Cadmium Sandwich Rods	KAPP 3&4, RAPP 7&8
Rolon Shielding	RAPP 7&8

Sealing & Shielding Plugs for Nuclear Reactor

Sealing plugs & shielding plugs are the Critical Sub Assemblies of a Pressurized Heavy Water Reactor, which are used in the Fuelling Process in the nuclear reactors. Avasarala has manufactured & supplied total quantity of 2000 sets.

The function of the Sealing Plug is to close both ends of Reactor coolant channels and prevent escape of Heavy Water from the End Fittings, which are located at both ends of each coolant channel assembly.

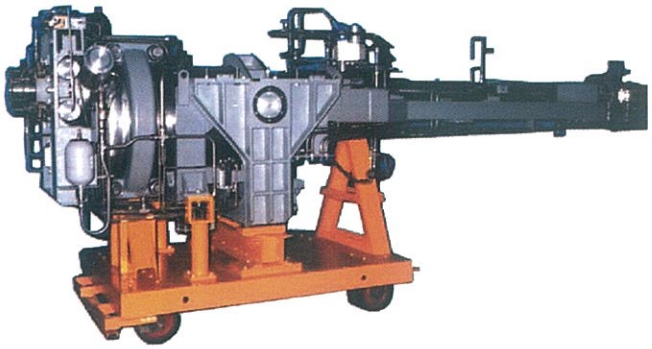
The function of the Shielding Plug is to provide shielding at both ends of coolant channel and also to provide a means of locating and stopping the fuel columns moving when sealing plugs are withdrawn during fuel changing.

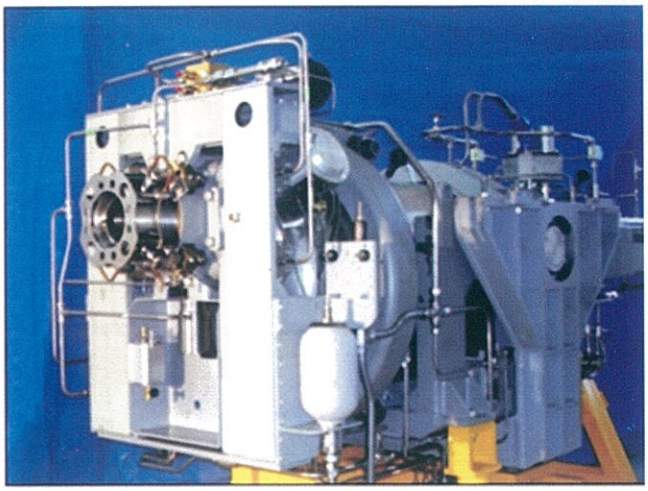


Criticalities involved

- Sourcing of special grade Stainless Steel Like 17-4 PH
- High accuracy of Manufacturing
- Interchangeability of components
- Establishment of Processes like
  - Broaching
  - Electrolysing
  - Nickel Plating
- Development of Fixtures
- Finish Grinding to close Tolerances
- Development of Testing Procedures to meet Operating Temp. & Pressure.

Fuelling Machine Head





The fuelling machine head is used to refuel and to remove the spent fuels from the reactor core in nuclear power generating station. Two machines are required for each reactor. This machine is designed for fuelling of 220 MWe Pressurized Heavy Water Reactors. Avasarala has supplied Total 4 Nos of Fuelling Machine Head.

This machine operates in the Radiation zone and all the sequence of operations are controlled remotely.

The machine weighs about eight tons and most of its components are manufactured Out of Stainless Steel and Special Alloy Steels.

Uniqueness of Fuelling Machine Head:

Critical materials used in the equipment

a. Stainless Steel 304 & 304L
b. Precipitation Hardening Steel 17-4 PH
c. Aluminum Bronze
d. Steel IS 2062
e. Air Hardening Tool Steel
f. Inconel
g. Stellite 3

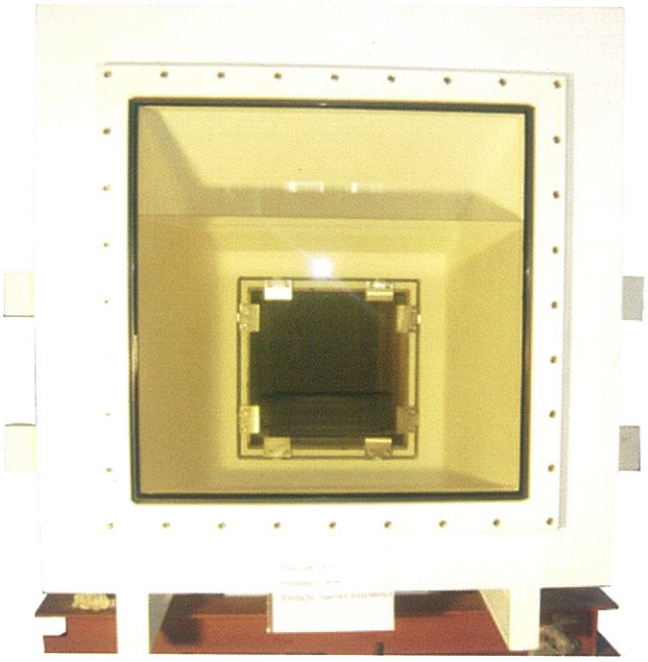
- This machine operates under high pressure and all the components are pressure tested at 1.5 to 2 times the operating pressure.
- 12 position Indexing mechanism with accurate positioning.
- Telescopic arrangement for Ram movement by using Hard Chrome plated Tubes.
- Water Lubricated Bearings are used to operate in corrosive and radiation areas.

  Metallic sealing at the joints for holding very high pressure without leakage.

Criticality in the manufacture of Fuelling machine Head:

- The manufacture of components needs very accurate machining process.
- Development of Special process like Hard Chromium Plating, Tube ID Plating, Nitriding and Precipitation Hardening.
- Establishment of process for complete manufacture of Ram Tubes involving Hard Chromium Plating on 3-mtr lengths Stainless Steel Tube.
- Development of source for Water Lubricated Bearings
- Establishing the source for precision Indexer components.
- Establishment of metrology facilities for precision measurements.
- Qualification of personnel for process like Welding, Tubing and precision assembly.

Radiation shielding windows



Manufacture & Supply of Radiation Shielding Windows

Radiation Shielding Windows used in nuclear installations as viewing devices, which allow direct viewing into radioactive areas while also providing adequate protection to the operating personnel. Avasarala has manufactured & supplied total 176 Nos of Radiation Shielding Windows of various sizes.

The windows are oil filled type. The window consists of Window Frame with cover glasses sealed by gaskets on hot and cold side of the window. A pack of shielding glasses is assembled in the Removable Glass Module.

They are assembled utilizing various types of glass blocks of densities ranging from 2.5 gm/cc to 5.2gm/cc.

Glass blocks of 2.5 gm/cc are borosilicate type whereas the higher density glasses are lead glasses with varying amounts of lead content.

The combination of glasses to be used in each window is worked out depending on the radiation-shielding requirement and also for achieving optimum optical characteristics. These are then assembled in custom designed carbon steel / steel-concrete composite housing employing carefully selected components and special techniques of assembly.

Specifications

Material of construction: Structural Steel as per IS 2062 Grade-B

Surface finish : Sand blasting (IS: 1477 part II) & Painting.

Outside: Amercoat Dimetcoat No.6 – Inorganic Zinc Primer and Amercoat 90 paint (250 - 350 Mic.).

Inside: Oil Resistant Amercoat 346 paint (250-350 Mic.)

Colour : White

Length: 1.9 Mtr.

Height: 1.85 Mtrs.

Width: 1.8 Mtrs.

Weight after assembly : 9.12 Tons

Assembly of Glass using Fixture

Assembly Room

Rope Sheave Drive Mechanism

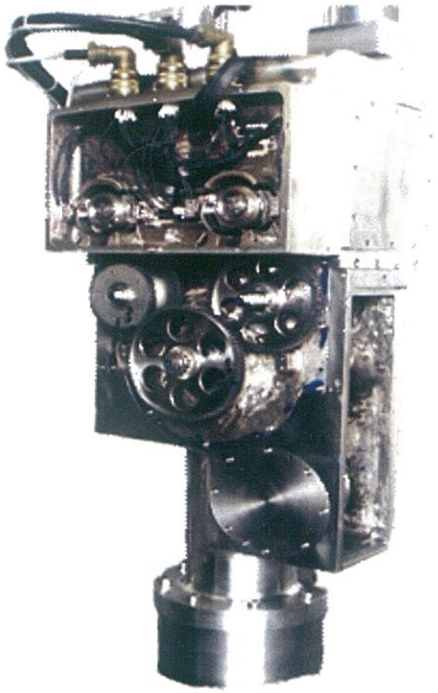
Manufacture, inspection, testing, qualification, packing and delivery of Drive Mechanisms required for regulating rods and absorber rods of 220 MWe Atomic power projects.

Brief description of the equipment: -

Each 220 MWe pressurized heavy water reactor employs regulating rods consisting of upper element and lower element at 2 locations and absorber rods at 4 locations for reactor control.

Drive mechanisms are the drive units of these rods. These drives operate the rods by Stainless Steel wires rope. At each location, the three wire ropes holding the upper and lower elements are wound on three sheaves in a single drive mechanism. Two electric motors through respective worm gear units.

Sets of gears rotate the sheaves and thus drive the rods up and down.



Project criticalities:

- Establishment of thin walled castings
- The casting to be of 100% radiograph quality as per ASTM E-94, ASTM E-186, ASTM E 280, ASTM E – 446, and was defect free.
- All the gears and shafts were made of 17-4 PH steel as per ASTM A 564, which has high strength to weight ratios.
- All the bought out were to be radiation compatible and special scouring were required.
- Use of "ETFE insulated" Nuclear Grade cables
- The product called for accelerated full life cycle test of 2,00,000 cycle at ambient temperature and 1,00,000 cycles at 65 degree C, with coolant flow circuit to simulate reactor coolant flow.
- Creation of a 14-meter high structure with the required coolant circuit and heating furnace for simulating Reactor Conditions.
- Helium leak test was carried out on the assembled casing to 1.0 Kg/cm2. Special silicon carbide shaft seals were used to ensure this.

Sodium Purification Circuit Cold Traps

Design, Manufacture & Supply of Sodium Cold Traps

SN	Cold Traps Description	Size	Weight in Tons	Quantity
1	ISPC/ SSPC Cold Traps	OD 2.83m x 5300 Lg x 16 mm	23	3
2	PSPC Cold Traps	OD 1.45m x 4940 Lg x 6 mm	7.6	2
3	SGDHR Cold Traps	OD 0.61m x 2500 Lg x 6 mm	1.17	2

Critical Activities Involved :

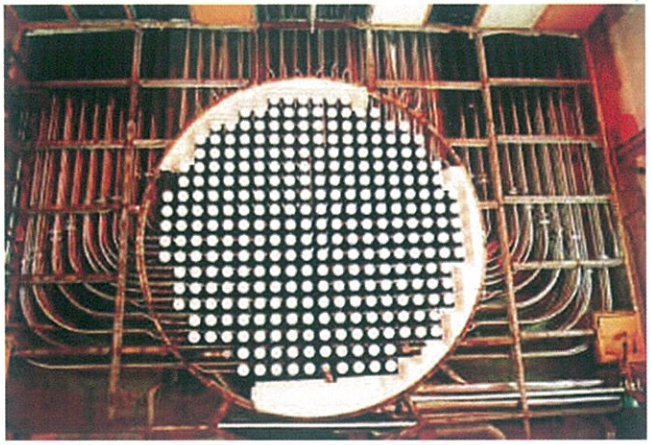
- Rolling of SS 304LN Plates of thickness 06 to 20 mm
- Forming of dished ends with thickness 08 to 34 mm
- Welding of Shells and Nozzles as per ASME Section –III
- Radiography testing of all butt joints and Ultrasonic Testing joints where ever RT is not possible.
- Finalization of Knitted Wire Mesh and Design to meet Customer requirement.
- Braze Welding of C11000 Copper Fins external to the SS 304LN Cold Trap instead of Brazing technique.
- Facility creation for Lead Pouring activity.
- Nuclear clean hall facility creation for Assembly of Wire mesh into the Cold Trap.
- Laying of Heating Cables on the Cold Trap.

Auto Braze Welding of Cold Trap

Installation of Feeder Pipe Spools

The coolant Channels are connected to the reactor headers through Feeder Piping. There are 306 Coolant Channels. Each Coolant Channel assembly has two HPFC (High Pressure Flange Coupling) hubs, one in north vault & one in South vault. The other half of HPFC hub is welded to the feeder Piping elbow and the feeder piping connects the coolant channel assembly and reactor header (Inlet & Outlet Header).

Scope of Work: Cutting, removal, replacement, disposal, fabrication, inspection, testing and erection of feeder pipe spools & welding at the respective locations inside the fuelling machine vaults.



Criticality:

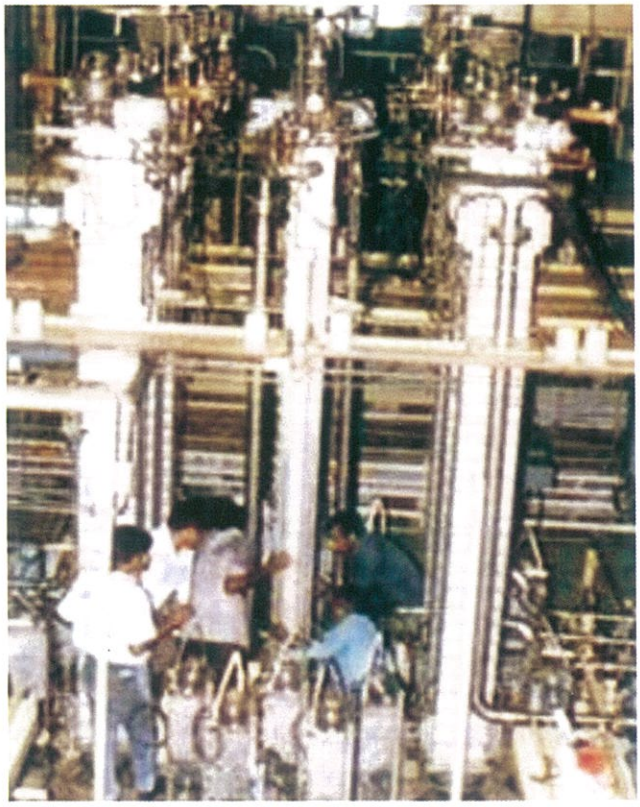
- The End Fitting Assemblies are located with a pitch length of 228 mm; the gap available was very small to run the Feeder Piping.
- Maintaining 10 mm gap between pipes for Thermal Expansion

Installation of Reactivity Mechanism

- The Reactivity Mechanism Assembly consists of: -
- Regulating and Absorber rod Assembly
- Primary Shut off system and shim rod assembly
- Secondary shut down system assembly
- Central thimble assembly
- Ion chamber assembly

Nuclear reactors use a chain reaction to induce a controlled rate of nuclear fission in fissile material, releasing both energy and free neutrons. A reactor consists of an assembly of nuclear fuel (a reactor core), usually surrounded by a neutron moderator such as water, graphite, or zirconium hydride, and fitted with mechanisms such as control rods that control the rate of the reaction. This mechanism used to lower or lift the control rods in to the reactor.

Total weight : 5 Tons
Height : 14 meters
Height of Lifting : 18 meters

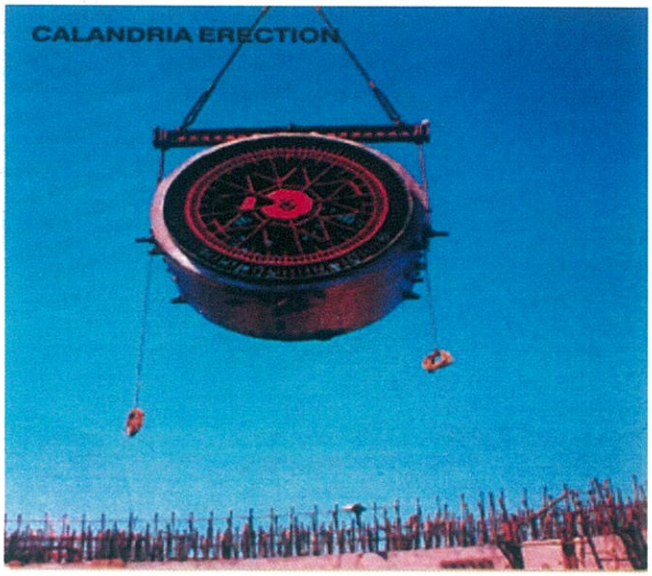


The following activities are in the scope of work:

- Handling & transportation of all the above-mentioned components.
- Cleaning of all the above-mentioned components.
- Passivation & inspection of all the mentioned SS components as per the procedures.
- Erection of all the above-mentioned components as per the procedure.
- Fit-up & tack welding of all the above-mentioned components as per the procedure.
- SS x SS welding by GTAW process done in the same Project

Services - Installation

Installation of Calandria & Endshield



650 Tons crane and tractor trailor of Boom Height of 30m is used to lift the End Shield and Calandria inside the Reactor Building of 112m heights.

Calandria is the reactor Core of the Pressurised Heavy Water Reactor. Size of the Calandria: 5.5m dia of approx weight 25MT. Material of construction: SS 304L of hollow cylindrical shape. End shields are two end of Calandria. These are filled with Carbon steel balls for Radiation Protection .

Scope of work includes:

- Grit Blasting and Zinc metallizing of Calandria vault & hatch Beam liners
- Cleaning and filling of Carbon Steel balls in to the End shield
- Cover welding of two end shields
- Installation of two End shield and Calandria Assembly in Reactor Building.
- Optical Alignment of Calandria with End shields
- Welding of Calandria with End shields (02-Joints)
- Cleaning & Passivation of Calandria – End Shield Assembly
- Welding of Calandria Key structure and Ion chamber assembly
- Liner work inside Calandria Vault
- Installation, Alignment, Welding and Inspection of Calandria Vault Top hatch beams
- Non-destructive Test examination of Weld Joints like Dye penetrate test of in-situ weld joints & radiography examination of welds.

Highlights:

- Size: 5.5 meter, Weight: 110 Tons, Height of Lifting: 32 meters
- Mobile Crane used: 650 Tons, Validation of lifting devices, Precision installation & Alignment
- Sequential welding of SS to SS by Qualified Welders, Simultaneous working in both vaults.
- Validation through optical instruments, Zero defect execution, CS ball filling of 45 tons & Radiometry test.

Services - Life Extension

En Masse Coolant Channel Replacement

Scope of Work:

- Scope includes establishment of all infrastructure, mock up, training removal of coolant channel including disposal into the tile holes and concreting/aggregate, reinstallation of new coolant channel assembly and other works.
- Removal/Reinstallation/Repair of Calandria Tube Sheet plugs from the Calandria at locations where Calandria tubes have been removed.

Criticality:

- Removal of the most irradiated components having a radiation of 100 R to 700 R.
- Pressure tube cutting on all channels
- 303 numbers of Coolant Channel assemblies.
- About 2125 numbers of manpower requirements for successful completion.
- Anti Torque Collar hardware installation

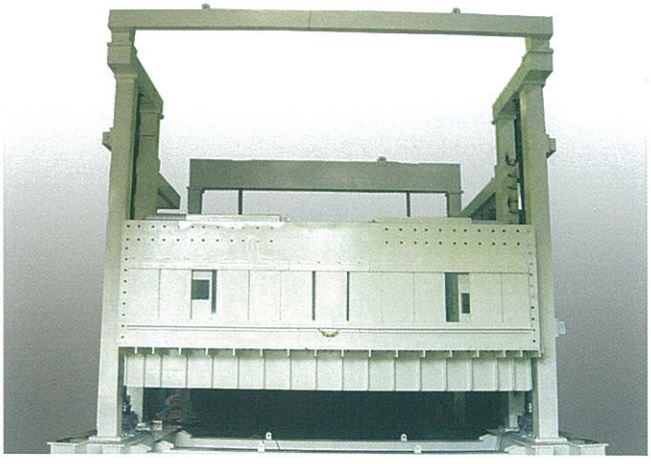
- Installation of shield plug and seal plug
- Clean room condition.
- Work in the radiation areas.

Self-Elevating Platform

The Self Elevating Platform is a fabricated structure for use in Fuelling Machine vault during the removal and reinstallation phase of en-masse coolant channel replacement work. The platform also provides radiation shielded working space for use of tool and equipment at the requisite coolant channel location. The platform moves in vertical direction. Ball Screws and Motors control the movement.

Highlights:

- Compatibility for flask handling in restricted space
- Heavy tonnage 80 tons for 1 Nos.
- Conceptualization, Animation & 3D FEA
- Ball screw drive for precision movement
- 5750 mm long imported, special ball screw.
- Electrical Synchronization of all four motors
- Design Validation & Manufacture,
- Compatibility to work in radiation area.
- PLC controlled automatic operation with provision for remote camera viewing.
- Modular design for ease of installation in F/M vault area.



Manufacturing Criticality:

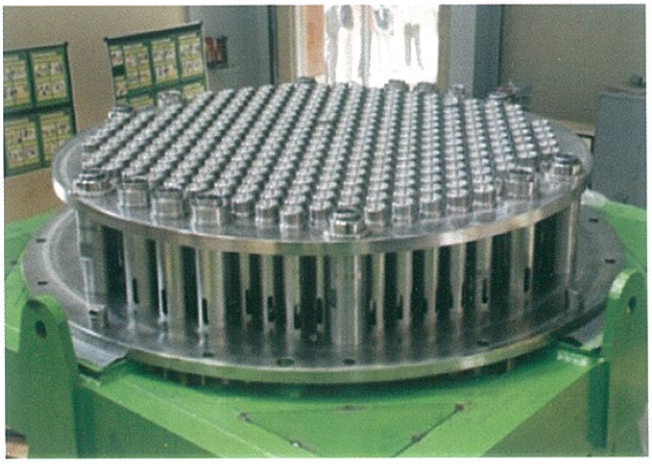
- Heavy Fabrication & high dimensional Accuracies
- Manufacturing a modular Structure to take in to the Vault
- Synchronization of all 4 Vertical Lift motors
- Sourcing of Special Ball Screw

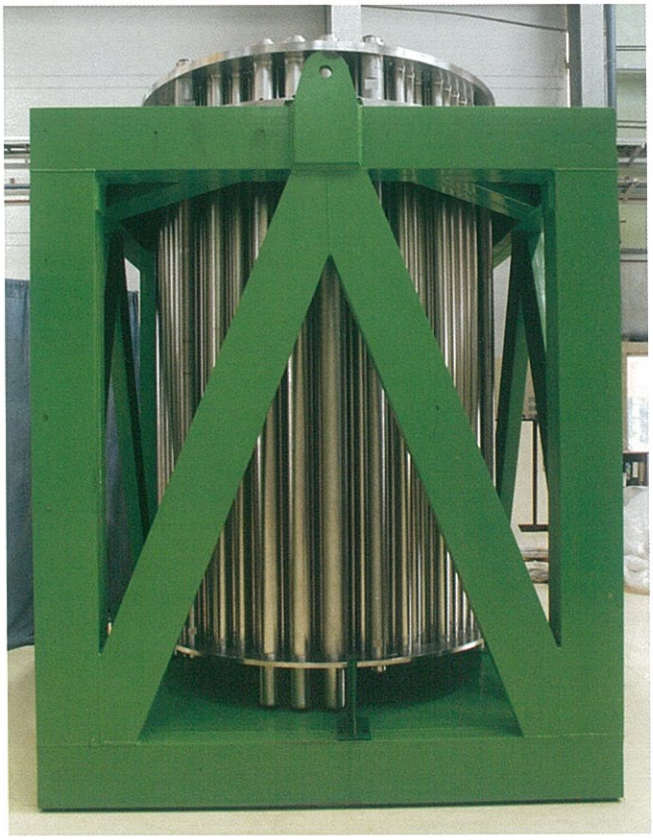
C. Spent Fuel Handling

Equipments/Systems

Storage Module and Alignment Mechanism

Design, fabrication / manufacturing, assembly, testing & Supply of Storage modules



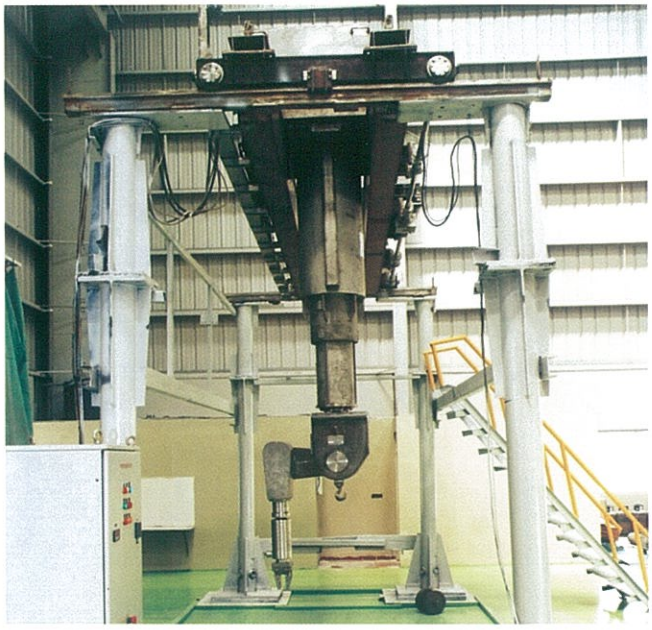


Critical activities:

- Procurement of 100 / 50 / 26 mm thick SS 316 L Plates.
- Rolling of SS 316L Plates of thickness 26 / 28mm
- Forming of dished ends with thickness 28 mm
- Welding of Shells as per ASME Section –III / IX.
  Shell Dimension
  ID 2300 mm x 5041 mm Ht. x 26 mm thk.
- Radiography testing of all butt joints and Ultrasonic Testing joints where ever RT is not possible.
- Development of forgings (SS 431) of size Dia. 2600mm x 1000 mm thick involving Radiography and Ultrasonic testing.
- Development of ring forgings (SS 431) to size 2400 mm OD x 2000 mm ID x 70 mm thk. with hardness of 400 BHN.
- Machining of Grid Plates with 300 bores of size 76H12 with positioning accuracy of 25 microns. Size of Grid plate Dia.2300 mm x 40 mm thk.
- Qty. 07 Nos. One Grid Plate Assembly consists of 03 Nos. of individual Grid Plates and the all the bores of the plates should be in line.

Power Manipulator

- Remotely Operable i.e. Operating from outside the dissolver Cell
- 7 Axes Operation
- Pay load – 100kg
- Highly Radioactive with max Temp of 60 degree Celsius
- Telescopic Boom
- Three axes Cartesian Position
- Four axes Articulated Arm
- Finger 2 gripper with 150mm opening
- Length of LT Travel : 11,500 mm
- Span between Rail Support: 6600 mm
- Radiography for all Welds



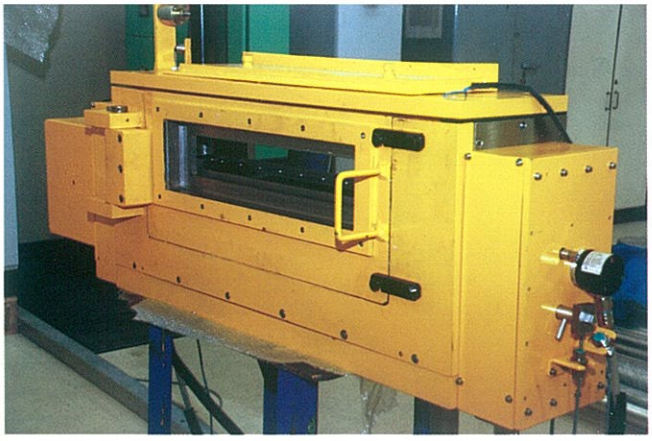
Linear Auto Sampler System

Used for Liquid sample collection from hot cells. Avasarala has supplied3 Nos of Linear Auto Sampler System till date.

- Manual Loading with Remote control Operation
- 50 mm Shielded Enclosures
- Overall Dimensions: 946 X 260 X 460 mm
- Total Weight of LAS (with Enclosure) : 1580 Kgs

Material of Construction:

- SS 304 L Plates
- IS 2062 Plates
- SS 316 Round Rod for Lead Screw
- SS Cladding on 50 mm & 150 mm plates



Maintenance Vehicle

Manufacture, Installation and Commissioning of "Maintenance Vehicle for Maintenance of Remote Head Metering Pumps"

This maintenance vehicle is fabricated completely out of Stainless Steel 304 L. Few components like Rails and Wheels will be fabricated out of SS 316L.

Total Weight of the System : 2000 Kgs

Remotely Operable & Manual Operation

Radioactive with Max Temperature of about 60 degree Celsius

RECOGNITION

Recognitions for Avasarala's technical excellence have come from different quarters including the Govt. of India CSIR award in process industry category.

WHIRLPOOL OF INDIA LTD
Pondicherry

EXCELLENCE AWARD

AVASARALA AUTOMATION, BANGALORE

The management of Whirlpool of India Limited
takes great pleasure in recognising
your excellent performance in the area of
TIMELY SUPPORT ON DEVELOPMENT OF TOOLS FOR NEW PROJECT
We appreciate your hard work, Commitment and dedication

Date 26.12.2001 Head (Washer Unit)

Indian Nuclear Society
"Industrial Excellence Award"

SIATI Award
for Excellence in Aerospace
Indigenisation 2001

ELCINA Award
Indigenisation of Capital
Machinery 1987 & 1996

National Award
R & D efforts in Tungsten
Manufacturing 1998

Corporate Centre, Bangalore

Future Plans

As a part of its growth strategy, Avasarala is planning to build a integrated Heavy Machining & Fabrication Facility very close to Chennai Port. It has already acquired 30 Acres of Land with a sea front. The land is located 9 km from Ennore Port at Chennai

Above picture shows the artistic view of proposed Heavy Fabrication & Machining Facility at Chennai. Later we have plan to have our own Jetty for sea Transportation of Heavy Equipments.

AVASARALA

Avasarala Technologies Limited

Corporate Centre

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