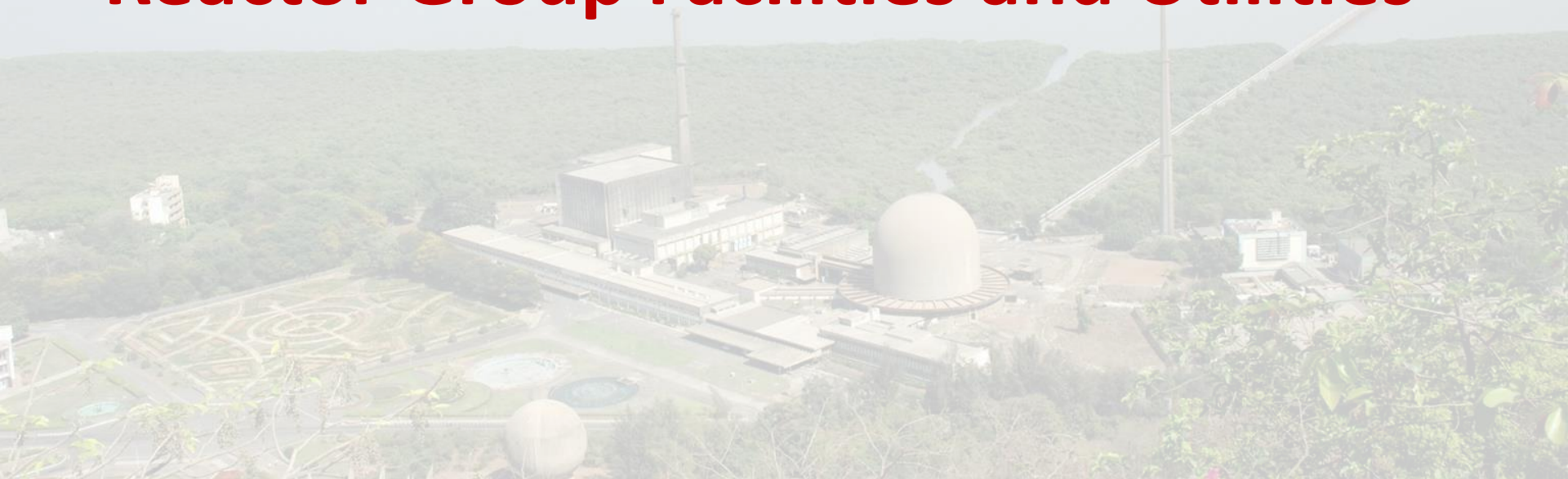




# Reactor Group Facilities and Utilities



# Facilities available with RRMD

# Motor Testing Station

Motor test station facility consisting of following items:

- Power panel for testing of motors up to 30 KW at load and motors up to 125 KW at no load
- Load Panel consisting of isolating switches, starters and protection units.
- Control desk consists of three phase motorized auto transformer, PC fixed in the control desk, Power analyzer and measuring and indicating instruments for the motor testing facility.
- Adjustable base frame suitable for testing up to 125KW motors with anti-Vibration mounting
- Load testing facility (dynamo meter)



Motor Test Panel

# Electrical Maintenance Workshop and Relay Testing Facility

Electrical workshop is equipped with following facilities:

- Motor re-winding facility
- Motor/ Switchgears Test station
- Lighting and power supply board preparation station
- Overhauling test setup like Heating oven

## Relay Testing Facility

There are around 400 protection relays for the equipment at Dhruva, Cirus and other facilities. These relays need to be calibrated and tested periodically. Relay testing lab caters following functions:

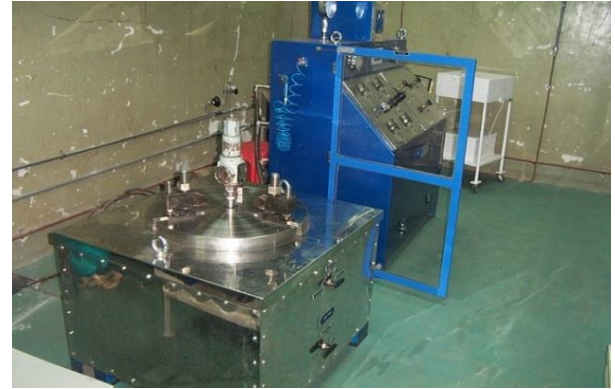
- Testing of all type protection relays
- All electrical components testing like timer, counter etc.
- PLC system testing
- Test data storage and display
- Operator friendly arrangement in test bench layout



Relay Testing Lab

# Relief & Safety Valve Test Facility

1. Type of Tests that can be performed are
  - Seat leak test, Set Pressure test/Pop test
  - Back Pressure test
2. Sizes of safety relief Valves that can be tested
  - Flanged Valves from ½" to 6"
  - Screwed Valves form ½" to 2"
3. Pneumatic & Hydro test Bench.
  - Hydraulic Testing from 0 to 200 bar
  - Pneumatic Testing (with external Nitrogen Cylinder) from 0-120 bar



Relief Valve Test Facility at Dhruva

# Calibration Lab for Instruments

## Calibration Lab for Field Instruments

Calibration Lab facility provide platform for calibration of all Field Instruments of Research Reactors (~1000 Nos. of pressure, level, flow & temperature instruments).

## Standard Calibration Lab for Test instruments

Calibration of all the test instruments for process parameters from research reactors are carried out at Cirus Standard Calibration Lab against standard instruments with better accuracies.



Cirus Standard Calibration Lab



Dhruva Calibration Lab

# Testing and performance evaluation facility for Neutron Detectors

Testing and performance evaluation facility for Neutronic Detectors at Critical Facility: This facility is utilised for taking performance characteristics of Neutronic detectors e.g. B-10 Lined Uncompensated Ion Chambers, B-10 Counters, Fission Counters, He-3 detectors etc.



D-9/D-10 locations in reflector region



Signal cables coming out in the Reactor Pit

# TPLC-32 based System Development & Board Test Facility and Welding Shop

## TPLC-32 based System Development and Board Test Facility at Dhruva

TPLC-32 based System Development and Board Test Facility was established at Dhruva to test various configurations of TPLC-32 based systems. This facility also serves as offline test set-up for TPLC-32 based RTLS, SULS and AAS of Dhruva.



TPLC-32 based Board Test Facility

## Welding Shop - The welding Shop consists of:

- 2 Portable welding machines,
  - 2 inverter welding machines,
  - 1 plasma cutting machine,
  - 2 transformer welding machines
- Gas cutting sets



Welding Equipment



# Machine shop and LASER Alignment tools for Pumps & fans

Dhruva and Cirus Machine shop consists of:

- Multiple Lathes,
- One Bandsaw,
- One Shaping machine,
- One Radial Drilling machine,
- One Milling machine, Pedestal Grinder,
- Power Hacksaw machines & Hydraulic Press for catering to fabrication works required for Research Reactors.



Work Shop (Machine shop)

LASER Alignment tools for Pumps & fans

LASER V-belt pulley Alignment tool  
LASER shaft Alignment tool is available at Dhruva.



LASER Alignment tools for Pumps & fans

# Hydraulic torque wrenches and Video Conference Facility

## Hydraulic torque wrenches

Machine is Useful with cassettes for nuts 30 to 65 mm A/F sizes.

## Video Conference Facility

Video Conferencing Facility is absolutely functional for inter department and also outside for engaging in meetings with high quality of audio & video.



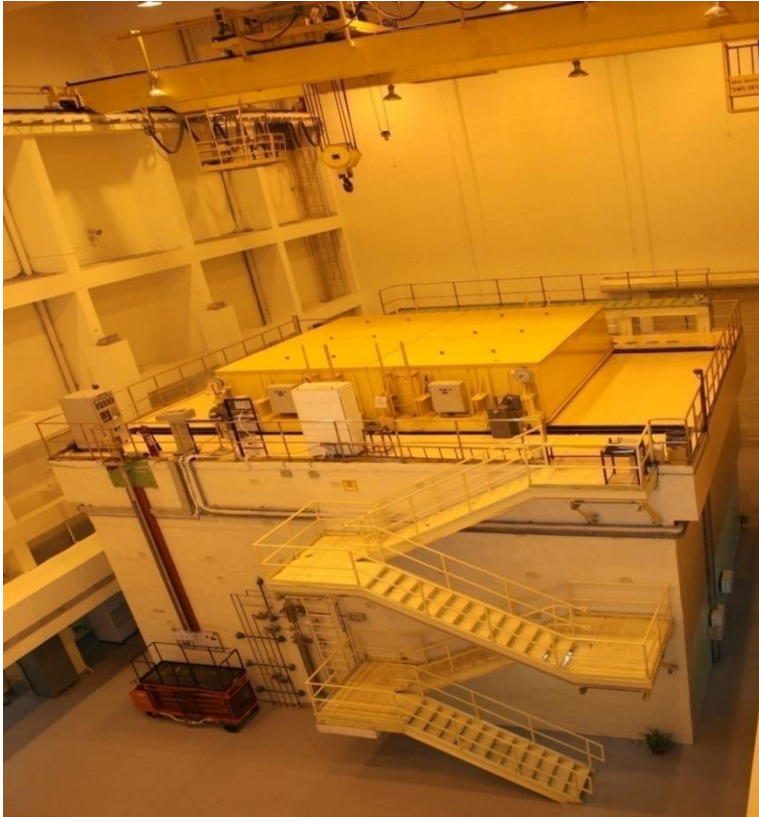
Hydraulic torque wrenches

# Facilities available with ROD

## High Flux Research Reactors at Trombay

	Apsara	Cirus	Dhruva	Apsara-U
Reactor Type	Pool type	Tank	Tank	Pool Type
Date of criticality	Aug 4, 1956	July 4, 1960	Aug 8, 1985	Sept, 2018
Nominal Power	1 MW <sub>th</sub>	40 MW <sub>th</sub>	100 MW <sub>th</sub>	2 MW <sub>th</sub>
Fuel	HEU (U-Al )	Nat U	Nat U	U <sub>3</sub> Si <sub>2</sub> -Al (LEU)
Fuel Inventory	4.5 Kg U-235	10 Ton	6.5 Ton	28 Kg
Th N flux n/cm <sup>2</sup> .sec	1.0 x10 <sup>13</sup>	6.7x10 <sup>13</sup>	2.0x10 <sup>14</sup>	6.1x10 <sup>13</sup>
Fast N flux n/cm <sup>2</sup> .sec	4.5 x10 <sup>12</sup>	1x10 <sup>12</sup>	5x10 <sup>12</sup>	1.3x10 <sup>13</sup>
Moderator/coolant	H <sub>2</sub> O/H <sub>2</sub> O	D <sub>2</sub> O/H <sub>2</sub> O	D <sub>2</sub> O/D <sub>2</sub> O	H <sub>2</sub> O/H <sub>2</sub> O
Shutdown Devices	Cadmium plates	B <sub>4</sub> C Filled rods	Cadmium annular rods	Hafnium plates

# Critical Facility for AHWR



- Tank type reactor with Fuel assemblies suspended over Girders having adjustable pitch.
  - 61 lattice locations ; 24.5 cm pitch
  - 19 pin NU cluster as standard fuel
  - Heavy water as moderator; no coolant
  - Power: 100 W; Neutron Flux :  $10^8$  n/cm<sup>2</sup>/sec
  - Shut down system: 6 shut off rods
  - Reactivity control: Moderator level control
- AHWR Test fuel : Central 9 positions for AHWR cluster
- Graphite reflector at bottom
  - Large Irradiation space in Graphite Reflector for irradiation of Large and irregular shape objects, Radiation Detectors

## Utilization of Critical Facility



Photographic view-core

- ❖ Validation of the physics design parameters of AHWR Type Fuel – Adjustable Pitch of fuel assemblies, Different core configuration possible
- ❖ Testing neutron Detectors
- ❖ Activation of samples (*Soil, Geological rock, Biological sample and Metallic alloys*) for neutron activation analysis (NAA)



Detector Installation



Sample installation

Inside bottom Graphite reflectors, large space (150 cm × 10 cm × 10 cm) is available for irradiation of irregular samples. The samples can be installed & removed manually. Activated sample can be availed within few minutes after activation for subsequent analysis. Large size samples (up to 500 g) after packing in polythene can be activated.

# Facilities in Dhruva Reactor



Dhruva Reactor Hall

## **Neutron Beam Holes:**

100mm Tangential and Radial Beam Holes, 300 mm dia Beam Holes, 100 mm Through Tubes

## **Facilities for Bulk Production of radio-isotopes:**

On-Power Tray rods for frequent Loading unloading of samples, Special Tray rod in Fuel positions for long term irradiation of Target, Slug Rods for Irradiation of Target material of Special Shape and Size, Adjuster Rods utilised for Production of Co-60 with High Specific Activity

## **Facility for Neutron Activation:**

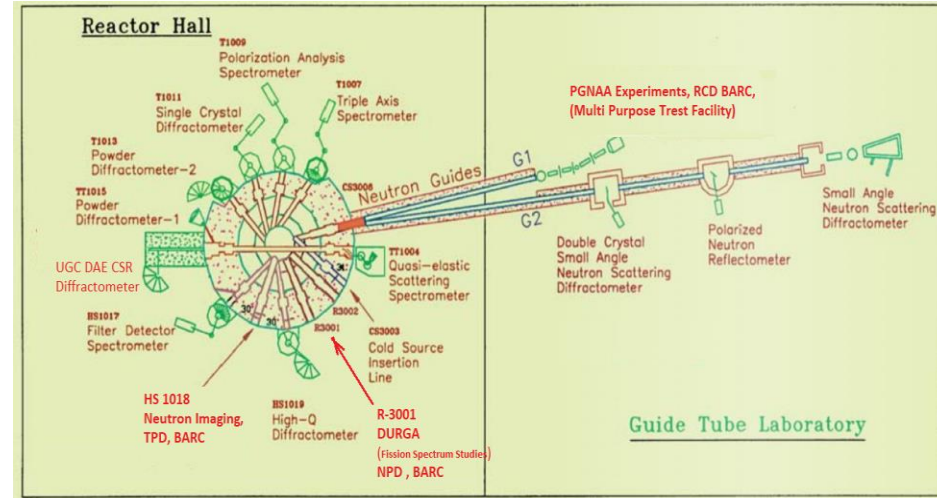
Pneumatic Carrier Facility, Self serve Facility, Irradiation in Isotope Tray rods

## **In core Testing of Fuel and material for power reactor design**

Special Fuel Assemblies in Normal fuel positions, Experimental Assemblies in normal fuel positions

# Neutron Beam Holes

- Four 100 mm dia tangential & four 100 mm dia radial beam holes
  - Instrumented Setup for Neutron scattering
- Five 300 mm diameter radial beam holes
  - Neutron Radio Grapy Facility
  - DURGA facility (*prompt Gamma rays spectroscopic study*)
  - CTIF (*for studying variation of mechanical properties under irradiation*)
  - Guide Tube Laboratory (4 exit Ports)
    - PGNAA Experiments
    - Neutron Scattering Experiments
- Two through tubes of 100 mm diameter providing four experimental ports.
  - UGC–DAE SCR consortium
  - Self serve Facility



Schematic of Guide Tube Laboratory



# Advanced Neutron Imaging Beam line at HS-3018

## Beam characteristics

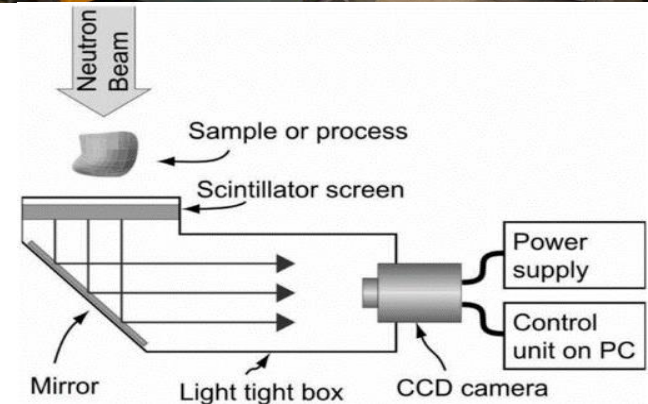
Beam parameter	Value
<i>Thermal neutron flux</i>	$4 \times 10^7 \text{ n/s-cm}^2$
<i>L/d ratio (collimation)</i>	160
<i>Cadmium ratio</i>	250
<i>Beam diameter</i>	120mm



Experimental Hutch

## Advanced Collimator for Imaging

- Sapphire single crystal as neutron filter
- Bismuth single crystal as neutron filter and for gamma absorption
- Dual collimator for absorption and phase contrast imaging
- High cadmium ratio – predominantly thermal neutron beam



Schematic of setup

# Advanced Neutron Imaging Beam line at HS-3018

## Potential Applications

- Hydrogen fuel cell research for future automobile sector
- Heavy metal intake in crops/plants for agriculture sector
- Growth study of genetically modified seeds
- Fault analysis / aging (residual stress) of engineering components (example: train wheels, bridge columns)
- Study of archaeological artifacts

## Archaeological Applications



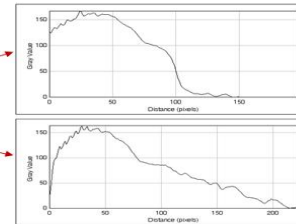
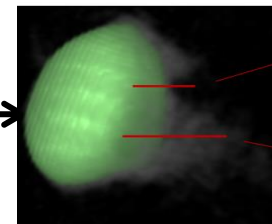
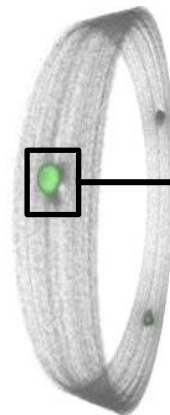
Photograph of Buddha statue



Neutron tomography of Buddha statue  
- (R) Wax remnants on surface due to bronze casting process detected

## Reactor Engineering Applications

### Hydride blisters in Zircaloy Pressure tube

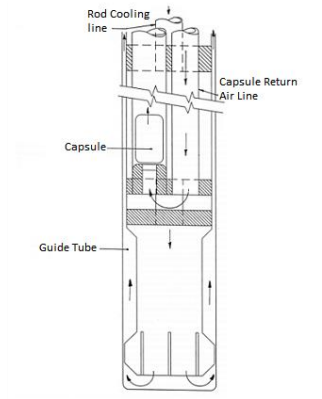
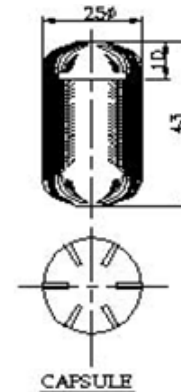


3D volume profile of hydride distribution  
in surrounding zirconium

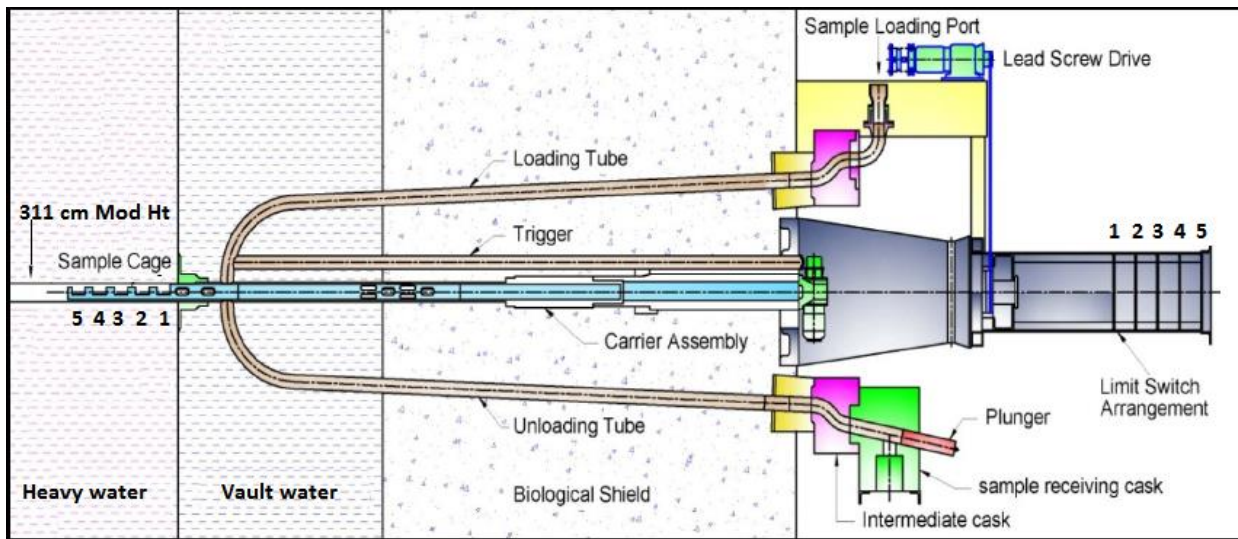
# Pneumatic Carrier Facility (PCF)

- NAA of short-lived isotopes (half-life of the order of seconds) requires a facility, which permits samples to be placed in position for irradiation as well as for counting in a **very short time after irradiation**.
- This requirement can only be fulfilled if the samples are sent into the reactor directly from the counting laboratory, received back after completion of irradiation time and analysis of sample is taken up immediately in the same laboratory.
- PCF is designed to achieve such requirement
- PCF is extensively used for
  - **Trace element determination by NAA**
  - **Determination of uranium by SSNTD**
  - **Sample irradiated : 1900**

Max. neutron Flux	$9.7 \times 10^{13}$ n/cm <sup>2</sup> /sec
Irradiation Time	Max 999.9 sec (60 s)
Capsule Material	Polypropylene
Capsule Size	25 mm Dia (OD) X 38 mm Length



# SELF SERVE Facility TT-1116



Schematic of the Self Serve Facility



SELF SERVE BALL WITH CAPSULE

SELF SERVE Facility in Through Tube - 1116 for short term irradiation of targets ( Few Hrs to couple of Days)

Thermal neutron flux ranges from  $3.2E+12$  to  $1.50E+13$  n/cm<sup>2</sup>/s  
The facility is in regular use since May 2017

# Tray Rods for Isotope Production

- **Two nos. of “On-power” tray rod positions (H-7 and K-09)**
  - Tray rod removal/Installation possible in Reactor Operation
  - In H-07, tray section can be loaded with 90 regular sample Capsules (Every Monday Sample changes)
  - In K-09 tray section can contain 2 Xenon containers & 72 regular capsules (Every Friday Sample Changes)
- **Addition Tray rods in fuel Channel position**
  - Commonly called “Off Power Tray rods” as these can be removed only during Reactor Shut down
  - Standard Tray section in which 90 sample Capsules can be loaded
  - Governed by available reactivity and Special Requirements

## Major Isotopes Produced

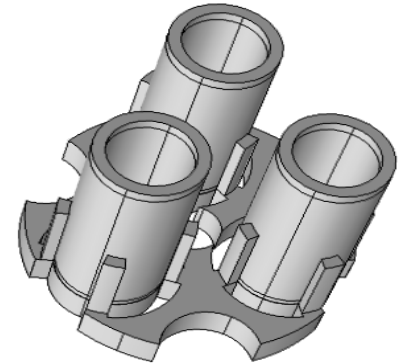
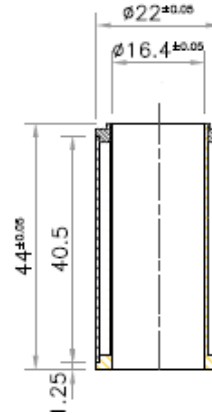
$\text{Mo}^{99}$ ,  $\text{I}^{131}$ ,  $\text{P}^{32}$ ,  $\text{Sm}^{153}$ ,  $\text{Lu}^{177}$ ,  $\text{I}^{125}$ ,  
 $\text{Br}^{82}$ ,  $\text{Co}^{60}$ ,  $\text{Ir}^{192}$ ,  $\text{S}^{35}$



Sample capsule (L) and Tray Section (R)

# Adjuster Rod

- Air cooled Adjuster rods
- Tray section containing Capsules(Co) Can be inserted and take out of active core as and when required through electrically driven headgear
- Specially designed Capsules contaminating Pallets
- Production of Co-60 with high specific activity( 250 Ci/gm)
- CANs redesigned for direct packing into standard cobalt pencil (Ready to use source).
- 39 Zircolloy CANs with 10 gm cobalt pellets (1mm X 1mm cylindrical bids) in each CAN



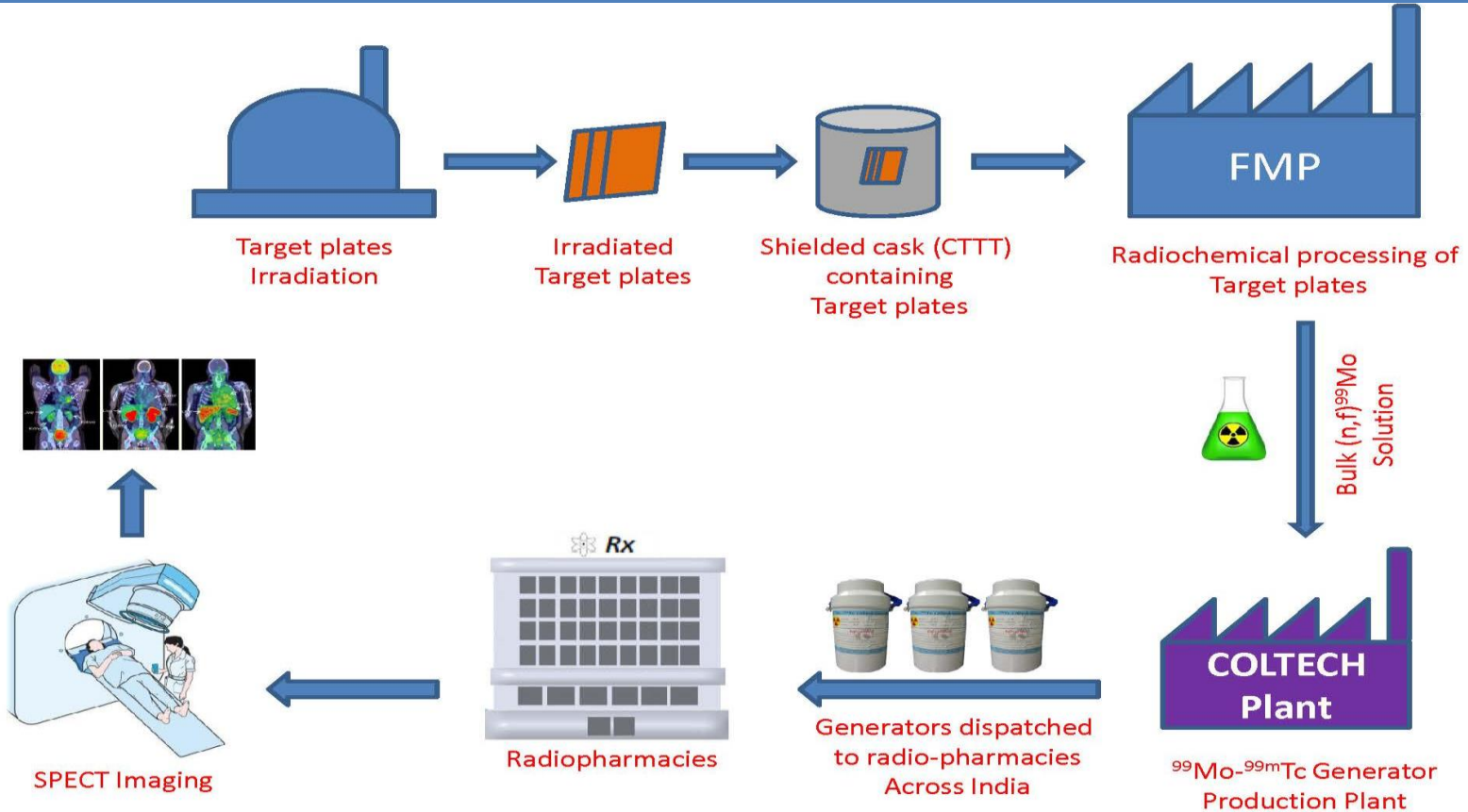
## Fission Moly Production at Dhruva

- Technetium-99m ( $^{99m}\text{Tc}$ ) is used in approximately 85% of nuclear medicine diagnostic imaging procedures.
- Specific activity of ( $n\ \gamma$ ) is very low ( $\sim 1\ \text{Ci/g}$ )
- For Fission Moly Sp activity is  $\sim 20\ \text{kCi/g}$ .
- Target: 300 curies/week
- Design and testing FM isotope tray rod completed, Handling are being carried out
- In house fabrication of target plate/container completed
- Processing plant commissioned erected at FMP, BRIT (south Gate BARC)
- Irradiation in both Dhruva and Apsara-U reactors.



Target Plate & Fission Moly Tray Rod of Dhruva

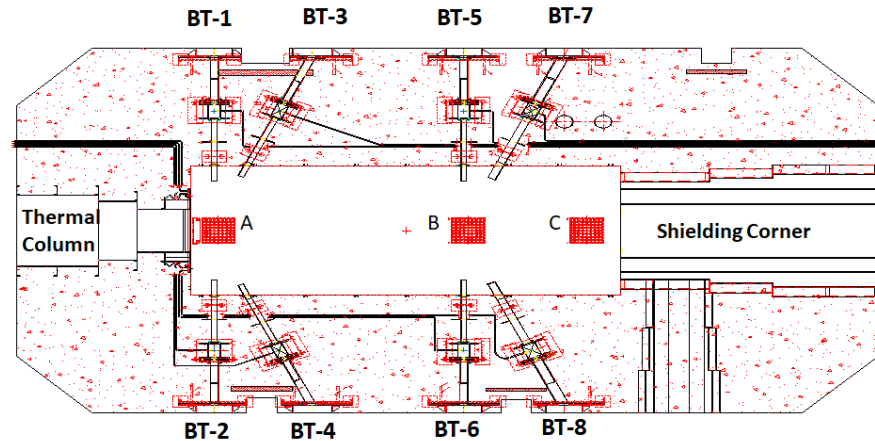
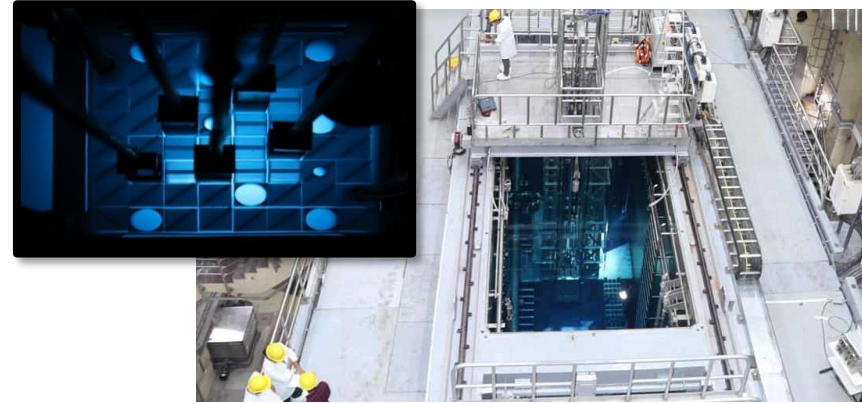
# Production and use of Fission Moly





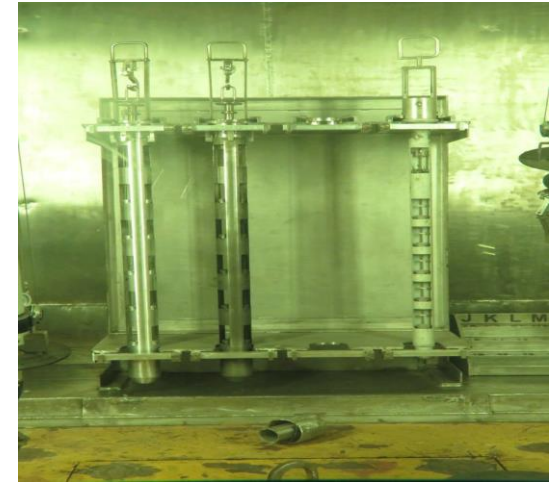
# Facilities – Apsara-U

- Operation at rated 2 MW power with high availability (~90%) and safety standard.
- A **versatile** facility with
  - Flexibility of operating the reactor at **three different** positions in the reactor pool,
  - **Easy access to the core**; facilitating installation of Assemblies in core for different experiments and irradiations
- Isotope Tray rod and TRF
- Shielding corner
- Thermal Column
- 8 Nos of Beam Tubes



# Material Irradiation-Apsara-U

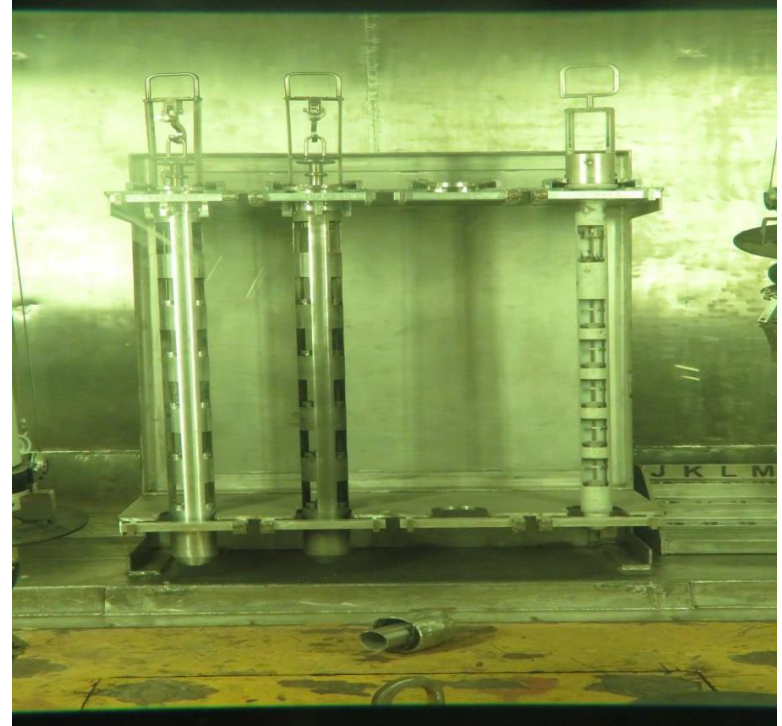
- Offers fast neutron flux ( $> 1 \text{ MeV}$ ) of about  $1.5\text{E}+13 \text{ n/cm}^2/\text{s}$
- Material Irradiation (Zr,SS, Al) at in-core irradiation position
  - will cause radiation damage of about 1 dpa/year,  
*(very useful for studying mechanical as well as physical properties of material under irradiation before using them in power reactors).*
  - Irradiation testing of AL-SS joint Test specimen, RPV steel samples were carried out in standard capsule in Tray rods.
  - Material testing of Low Alloy steel is being planned.
- **8 irradiation positions in Apsara-U**
  - 7 out-of-core irradiation positions
  - 1 in-core irradiation position
  - 110 samples can be irradiated at a time
  - Special Tray Rod 15 capsules of target material.
- **Production of radioisotopes:**  $^{64}\text{Cu}$ ,  $^{99}\text{Mo}$ ,  $^{153}\text{Sm}$ ,  $^{156}\text{Ho}$ ,  $^{47}\text{Sc}$  etc.
- **Utilization of Higher fast neutron flux: Carrier free  $^{64}\text{Cu}$  radioisotope.**
  - Promising isotope with its application in theranostics.
  - After extensive trials, it has been approved for human use by regulator.



Isotope Tray rods

## Facilities – Apsara-U

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Isotope Tray rods

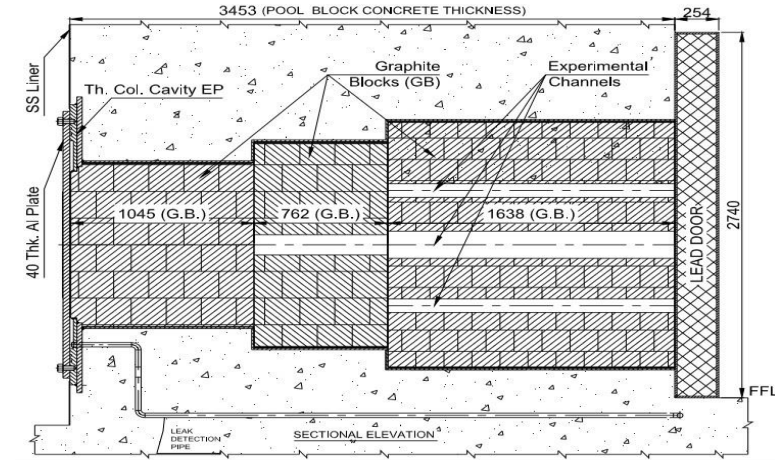
# Thermal Column – Apsara-U

## Setup

- Located at A-Position of Reactor Pool
- Graphite Blocks Stacked in Thermal Column.
- 4 Experimental holes.
  - $\phi_{Th (Max)}$ :  $1.0E+08$  to  $1.0 E+09$  n/cm<sup>2</sup>/sec
  - Cadmium ratio > 2000

## Utilization

- testing various types of neutron & Gamma detectors
- Neutron activation analysis (INAA)
- Radiochemical neutron activation analysis (RNAA)
  - for analysis of major, minor and trace elements in variety of matrices such as geological, biological, environmental and high purity materials.



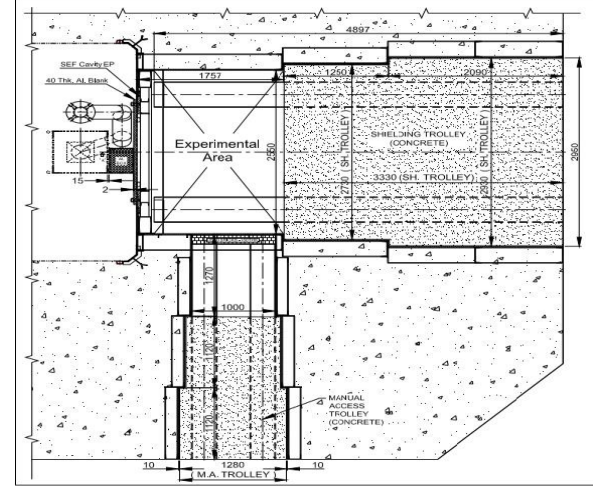
# Shielding Experimental Facilities – Apsara-U

## The Setup:

- Located at C-Position of Reactor Pool
- Flux:  $\sim 10^{10}$  n/cm<sup>2</sup>/sec

## Utilization:

- Shielding experiments
  - for measurements of neutron and gamma attenuation in various shield models over wide energy ranges.
  - To study the shielding adequacy, shielding thickness optimization etc.



# Beam Tube Utilization – Apsara-U

## Utilization of Beam Tube ( 8 beam Tubes)

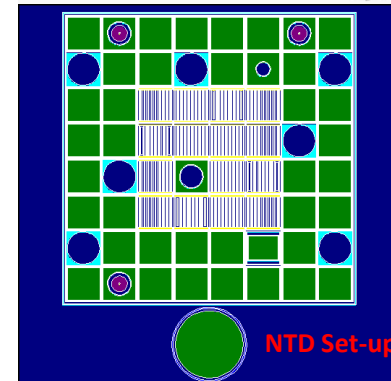
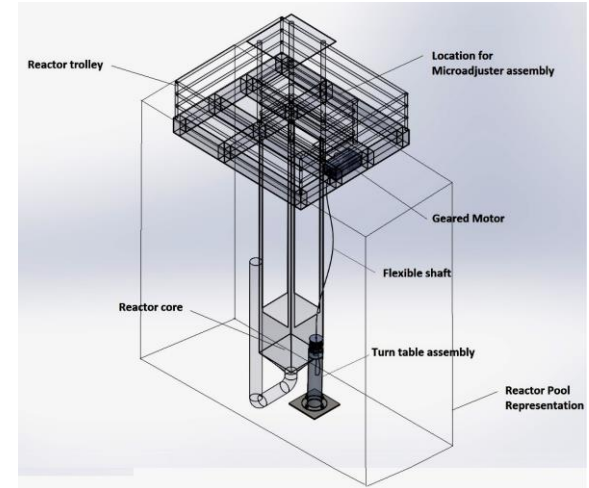
- Installation of Facility of Neutron imaging and depth profile of different materials (at beam tube#7)
- A single crystal alignment facility (at beam tube#6)
  - Neutron detector testing facility (at beam tube#8)
- PGNAA Facility (at beam tube#5)



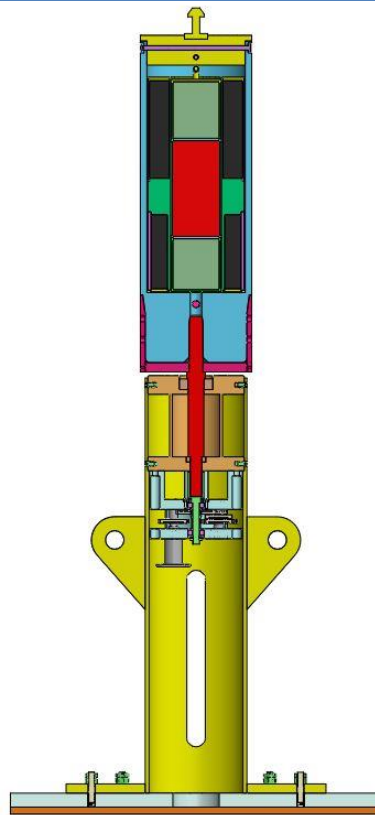
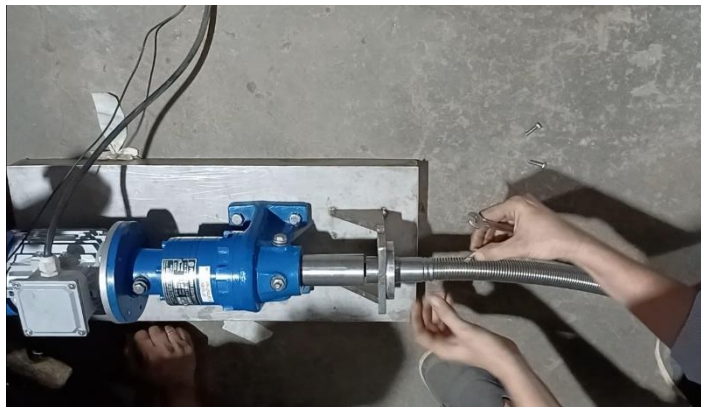
# Silicon NTD Facility – Apsara-U

- NTD technique results into uniform dopant concentration/ uniform resistivity
- Silicon ingot of 4” to 8” diameters are irradiated for NTD
- The NTD Setup for Apsara-U has been designed for NTD of 8” diameter Ingot
- The setup will be commissioned with irradiation of 4” diameter Ingot

Thermal neutron flux at irradiation location	$2.0 \times 10^{12}$ nv
Ingot Size	100 mm (4”) dia, 206 mm long
Irradiation time	70 hr
Cooling Time	7 Days



# Silicon NTD Facility – Apsara-U



**Flexible shaft**





# Facilities available with RRSD

# NDT Instruments

## Ultrasonic Thickness Gauge

This instrument is used to measure wall thickness of metallic plates. For thickness measurement paint, if any, has to be removed and smoothening of surface is required for proper contact of probe with surface. In this thickness measuring technique, couplant has to be provided between probe and surface. Couplant used is generally grease, oil and water.

## Ultrasonic Flaw Detector

This instrument is also ultrasonic based. It is used for volumetric examination of material. It is generally used for examination of weld soundness as well as raw material examination before fabrication of any engineering components. Different types of probes are required for examination of different welds / components. The instrument can also be used for measuring thickness of metallic objects.



**Ultrasonic Thickness Gauge**

**Ultrasonic Flaw Detector**

# NDT Instruments

## Eddy Current Testing Machine

Eddy Current Testing technique can be used for limited volumetric examination of material. This technique is extensively used for health assessment of heat exchanger tubes. ISIS is using this machine for health assessment of heat exchangers tubes. For health assessment of heat exchangers tubes, bobbin probe suitable to specific diameter and material needs to be fabricated and a calibration tube made of same dimension and material as tube with standard defects needs to be made. ISIS is having facility to inspect only nonferrous tubes.

## Liquid Penetrant Testing

Liquid Penetrant Testing (LPT) technique is used for detection of discontinuities / cracks which are open to surface of the material. This technique is extensively used for weld inspection. Material to be inspected needs to be cleaned thoroughly before inspection. Porous material cannot be inspected using this technique.



Eddy Current Testing Machine

Liquid Penetrant Testing

# NDT Instruments

## Portable X-Ray Machine for Industrial Radiography

Radiographic testing is used for volumetric examination of material. ISIS is in possession of a portable x-ray machine for radiography which can be used for inspection of material / weld of around 10 mm steel equivalent. It is trolley mounted X-Ray machine of around 200 kg weight.

## Remote Visual Radiation Resistant Inspection Camera

Visual inspection is very common and one of the most powerful tools of non-destructive testing. Visual inspection may be direct or indirect. Areas where approach for visual inspection is not possible, help of remote visual camera may be taken. ISIS is having a Radiation Resistant Camera for remote visual inspection of components having very high radiation field. The camera is water resistant and it can be used underwater inspection also.



Industrial X-Ray Machine



RR Camera

## NDT Instruments



Portable noise level measuring instrument



Ultrasound based distance measuring instrument



Lux meter, used for measuring light intensity (Illuminance measurement)

# Instruments used for Health Assessment of Reinforced Cement Concrete Structures



Ultrasonic Pulse Velocity (USPV)  
Testing Instrument for quality checking  
of an RCC structure



Rebound Hammer Tester for surface hardness  
checking of RCC structures



Vibration Meter-2050

Vibrometer for displacement measurement, velocity measurement and acceleration measurement of vibration in a rotodynamic equipment. This instrument gives bearing spikes also which provides early indication of bearing failure in an rotodynamic equipment.

# Instruments used for Health Assessment of Reinforced Cement Concrete Structures

## FFT Analyser

FFT analyser is used for vibration signals recording and analysis of recorded signals to predict the rotodynamic equipment health. Signal analysis provides tentative problem in a rotodynamic equipment.



# Instruments used for Chemical Analyses

## Infrared Spectrometry Systems using FTIR



Jasco 4000



Vertex 70v Bruker



Invenio-S



Liquid cell



Gas Cell



ATR: single bounce



ATR: Multi Bounce

Specifications	Jasco 4000	Vertex 70v Bruker	Invenio-S Bruker
Source	Lanthanum Oxide	Lanthanum Oxide	Silicon carbide
Beam Splitter	KBr	KBr	KBr
Detector	DLaTGS	DLaTGS and MCT	DLaTGS
Spectral Range	Mid IR	Mid IR	Mid IR
Spectral Resolution	$> 0.5\text{cm}^{-1}$	$> 0.2 \text{ cm}^{-1}$	$> 0.5\text{cm}^{-1}$
Analysis Mode	Transmission	Transmission; Reflectance	Transmission; Reflectance



# Instruments used for Chemical Analyses

Gas Chromatograph



AGC GC Series 600



Bellingham RFM-870

Temperature Control Refractometer for Analysis of isotopic purity of heavy water by Refractometry in RCS

- Temperature controlled
- Refractive index range 1.30 – 1.70
- Sample volume of sample is required (<1ml)

Specifications	AGC GC Series 600
Carrier Gas	Helium (High Purity)
Column	Molecular sieve and porous polymer
Detector	Thermal Conductivity Detector (TCD)
Sample	Gaseous radiolytic product of moderator cum coolant ( $D_2+H_2$ , $O_2$ ) and other impurities ( $N_2$ , $CO_2$ etc.)
Detection limit	>0.02%(v/v)

# Instruments used for Chemical Analyses

## UV-VIS Spectrophotometer

Specifications	Shimadzu-1800
Wavelength	200 – 1100 nm
Mode	Photometrics; Spectrum; Quantitation; Kinetics; Time Scan; Multi-Component Quantitation; Multi Wavelength Measurement
Detector	Silicon photodiode
Sample	Trace elements (e.g. Fe, Silica, Cl <sup>-</sup> , B, Al, Peroxide etc. in aqueous phase)
Analysis Range	ppb

Analysis	Method	$\lambda_{\text{max}}(\text{nm})$	Molar absorptivity, $\epsilon$ (lit.mol <sup>-1</sup> .cm <sup>-1</sup> )	Lowest quantification Limit (ppm)
Iron	Ortho-phenanthroline	512	$1.12 \times 10^4$	0.05
Silica	molybdosilicic acid	830	$1.95 \times 10^4$	0.01
Chloride	Murcuric thiocyanate	465	$3.1 \times 10^3$	0.2
Boron	Boron-curcumin	560	$1.8 \times 10^5$	0.01
Aluminium	Aluminon	528		0.2
Peroxide	Oxidation of KI	350	$2.81 \times 10^3$	1.0



# Instruments used for Chemical Analyses

## **Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES): HORIBA make Ultima Expert LT**

### Specifications of HORIBA make Ultima Expert LT

Radio Frequency (RF) Generator	: Solid State
RF Frequency	: 40.68 MHz
RF Power	: 800 – 1550 watts (Adjustable)
Detector	: Dual PMT detectors
Dynamic range	: $> 10^5$
Focal length	: 1 m
Spectral coverage	: 160- 800 nm
Spectral Resolution	: $< 5$ pm in UV & $< 10$ pm in visible range
Sample analysis mode	: Sequential
Software	: ICP Neo (Windows based)



# Instruments used for Chemical Analyses

## Viscometer SVM 3001

- SVM 3001 Anton Parr viscometer is available in RCS
- Instrument is calibrated using different ASTM standard
- Density, Dynamic Viscosity and Kinematic Viscosity can be measured at different temperature ranging from  $-60^{\circ}\text{C}$  to  $135^{\circ}\text{C}$
- Viscosity range:  $0.2 \text{ mm}^2/\text{s}$  to  $30\,000 \text{ mm}^2/\text{s}^*$  and Density range:  $0.6 \text{ g}/\text{cm}^3$  to  $3 \text{ g}/\text{cm}^3$
- Viscosity index of oils is obtained by measuring kinematic viscosity at two different temperatures
- Quality of the oils are tested by measuring viscosity index and compared with the certificate given by the suppliers

## Types of samples measured by the SVM 3001 instruments

- Standard and base oils
- Fresh and used lubrication oil (e.g. engine, crankcase oil, gear oil, ATF. etc.)
- Mineral oil, white oil, heat transformer oil etc.
- Hydraulic liquids (hydraulic oil, break fluids)
- Edible oil, vegetable oils
- Fuels (diesel, bio diesels, jet fuels, marine/bunker fuels)



**Viscometer SVM 3001**

# Instruments used for Chemical Analyses

## Karl Fischer titrator

Metrohm make 917 Coulometer with generator electrode without diaphragm

Specifications	Metrohm make 917 Coulometer
Sample	Water content in transformer oil, diesel etc.
Range of Analysis	10 $\mu$ g to 200 mg absolute water in liquids samples



Karl Fischer titrator

## Turbidity-meter

**Nephelometer:** WATTS Brand HF Scientific make M100+ Nephelometer

**Sample analysis in RCS by Nephelometer:** Analysis of various water sample to get first-hand information about the presence of insoluble particles.



Turbidity meter

# Instruments used for Chemical Analyses

## Ionic Conductivity meters: Temperature controlled

- (1) WTW Cond 7310
- (2) Thermo Scientific Orion Versa star Pro



**Thermo Scientific Orion  
Versa star Pro**



**WTW Cond 7310**

### Calibration of Thermo Scientific Orion Versa star Pro (Auto temperature compensation mode)

Sr. No.	Description	Electrode 1 ZZ1-12288				Electrode 2 YO1- 16126	
		mV	pH	mV	pH		
		1	Buffer 1 (pH: 4.01 @ 25°C)	160.1	4.01	161.4	4.01
2	Buffer 2 (pH: 7.0 @ 25°C)	-15.0	7.0	-14.9	7.0		
3	Buffer 3 (pH: 10.01 @ 25°C)	-190.5	10.01	-187.6	10.01		