



Department of Atomic Energy
Nuclear Fuel Complex
Hyderabad – Pazhayakayal – Kota



IAEA
International Atomic Energy Agency

Online Webinar

Management of the Indian Nuclear Fuel Fabrication Facilities during COVID – 19 Pandemic

Dr. Dinesh Srivastava
Distinguished Scientist
Chairman & Chief Executive

Outline



- ❖ Introduction
- ❖ Fulfillment of NFC commitment
- ❖ Infrastructure development
- ❖ Covid-19 protection plan during production
- ❖ New norm post covid-19
- ❖ Summary.

Fuel Bundles Manufactured at NFC



**220 MWe PHWR
(RAPS 3&4)**



**540 MWe PHWR
(TAPS 3&4)**



**160 MWe BWR
(TAPS 1&2)**



**19 Element Bundle
16.5 kg in Weight**



**37 Element Bundle
23.8 kg in Weight**



**6 × 6 BWR Bundle
203 kg in Weight**

PHWR Fuel Manufacturing Process

- ❖ Dissolution
- ❖ Solvent Extraction
- ❖ Precipitation
- ❖ Drying
- ❖ Calcination
- ❖ Reduction
- ❖ Stabilization

- ❖ Precompaction
- ❖ Granulation
- ❖ Final Compaction
- ❖ Sintering
- ❖ Centreless Grinding
- ❖ Washing & Drying
- ❖ Stacking

- ❖ End Machining
- ❖ Appendage Welding
- ❖ Graphite Coating
- ❖ Vacuum Baking
- ❖ Pellet Loading
- ❖ End Cap Welding
- ❖ End Machining
- ❖ Element Inspection
- ❖ End Plate Welding

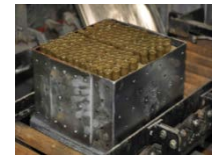
MDU / SDU /
HTUP / UOC



Nuclear Grade
UO₂ Powder



UO₂ Green
Pellets



UO₂ Green
Pellets



PHWR Fuel Bundle



Washed and
Dried Frit



Nuclear Grade
ZrO₂ Powder



Zircaloy
Ingots



Fuel Tubes &
Components



- ❖ Dissolution
- ❖ Solvent Extraction
- ❖ Precipitation
- ❖ Filtration
- ❖ Drying
- ❖ Calcination
- ❖ Grinding
- ❖ Blending

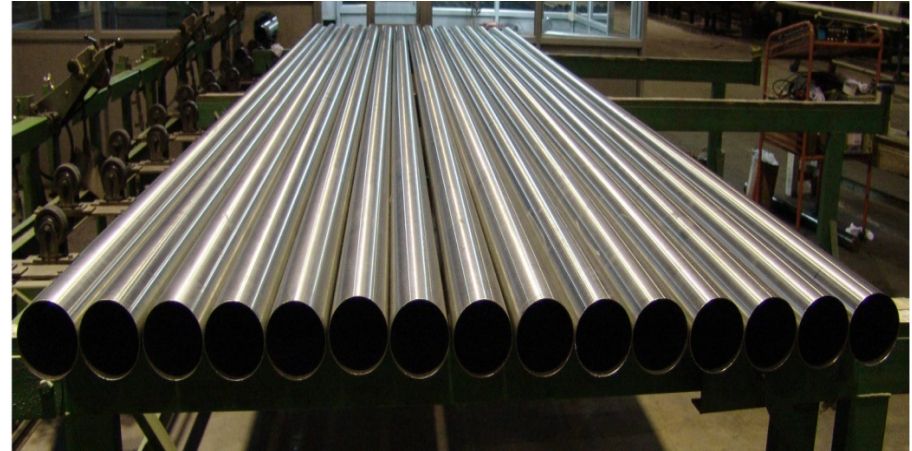
- ❖ Coking
- ❖ Chlorination
- ❖ Reduction
- ❖ Vacuum Distillation
- ❖ Sponge Handling

- ❖ Compaction
- ❖ Alloying
- ❖ EB Welding
- ❖ Melting
- ❖ Billet Preparation
- ❖ Extrusion
- ❖ Pilgering
- ❖ Swaging
- ❖ Annealing
- ❖ Machining

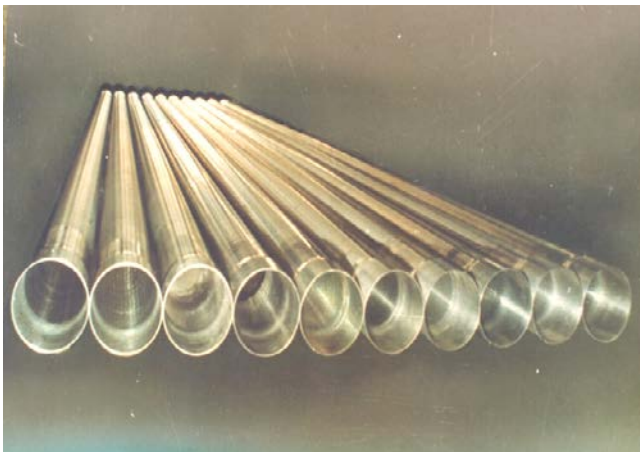
Seamless Tubes Manufacturing in NFC



Seamless Tubes – In a wide range of sizes and in different shapes



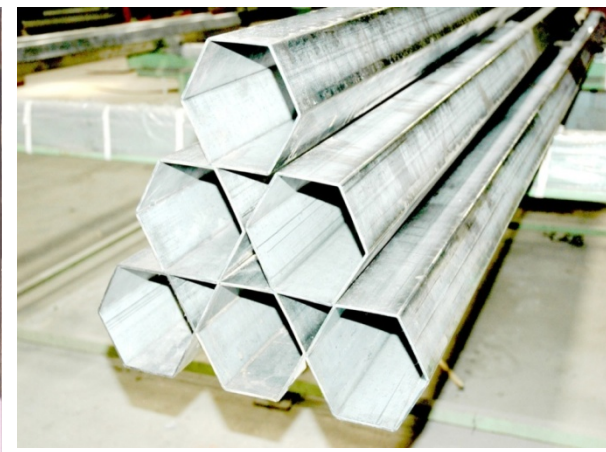
Zr-2.5%Nb Pressure Tubes



Zircaloy 4 Calandria Tubes



Zircaloy-4 square tubes for BWRs



Hexagonal Tubes for PFBR

Challenges faced during COVID – 19 Pandemic

- ❖ India presently operates 23 nuclear reactors
- ❖ NFC supplies fuel and core structural for reactors

Nationwide lockdown to counter COVID-19 pandemic posed significant challenge to sustain regular activities at NFC

- ❖ Sustenance of fuel supply to reactors
- ❖ Resumption of Production Activities after lock down
- ❖ Maintaining Industrial and radiological safety
- ❖ House-keeping & Covid-19 Sanitization works
- ❖ Employee Awareness drives on COVID-19 Pandemic
- ❖ COVID-19 Safety Infrastructure Development

Adapting to “New Normal” in NFC



Ensuring Fuel Supply to Nuclear Reactor Sites During Lockdown Period

- ❖ Nearly 300 MTe of PHWR Fuel dispatched between 24th March to 30th June, during strict lock down period
- ❖ 32 nos. of BWR Fuel Assemblies also dispatched



- **Special permission from Local Authorities**



- **Container trucks and Security Convoy**




- **Manpower for fuel dispatch and safety checks**



- **Travel time 2 to 7 days**



- **Co-ordination with reactor sites for fuel receipt and unloading**



- **Different crew-consignments to mitigate post-delivery quarantine requirements**

Resumption of Fuel Production Activities

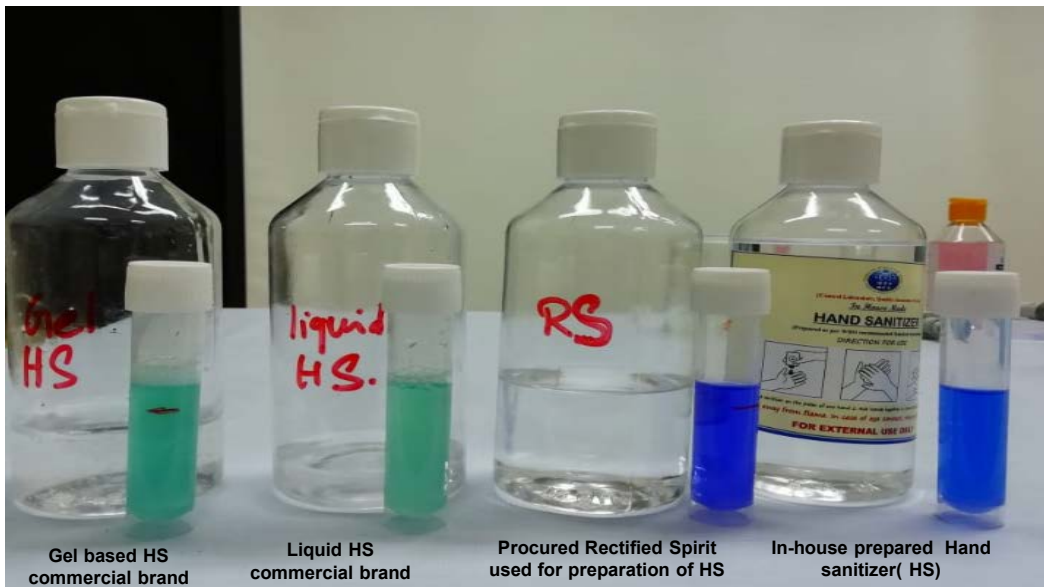
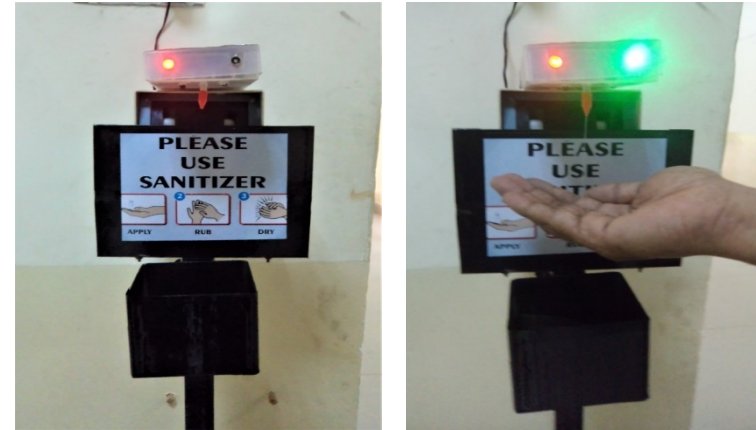
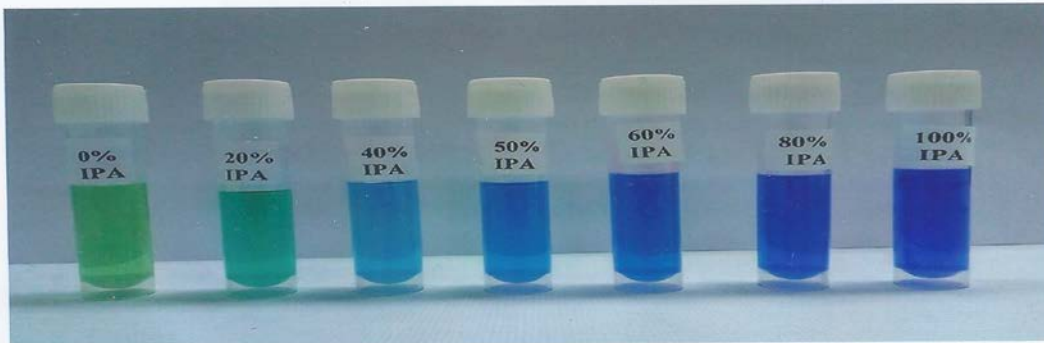
- ❖ Obtaining permission from Local Police Commissionerate for Emergency personnel for essential services.
- ❖ **Fuel production** for Fuel dispatch to operating Reactors.
- ❖ **Transport Arrangement** in absence of public transport
- ❖ **Operation of essential utility services** like power, compressed air, DM water, LPG, Ammonia etc and managing **High Temperature Sintering Furnaces etc.**
- ❖ Monitoring of safety procedures to restart various plants.
- ❖ **Overhauling and interlock testing** of critical production equipments like rotary furnaces, positive pressure dissolution tanks, ventilation systems etc..

QA Activities During Lock down

- ❖ QC Check and clearance of approximately 7500 nos. of PHWR Fuel Bundles and 36 nos. of BWR Fuel Assemblies
- ❖ 12 nos. of 220 MWe Cobalt Absorber Assemblies inspected and dispatched to Reactor Site
- ❖ Inspection of 40 nos. of 220 MWe Calandria Tubes and Spools

Self – Reliant Technologies

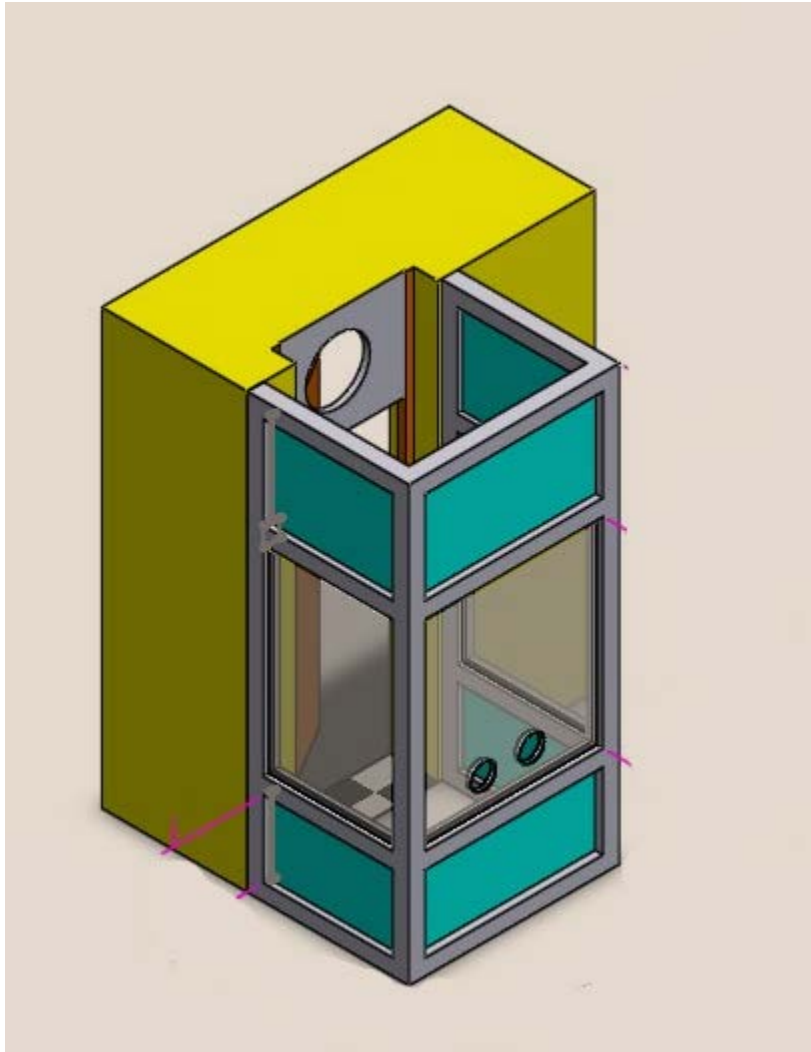
Visual Detection of Alcohol in Hand Sanitizers



In-house Production of Hygiene Materials

- ❖ 100,000 Litres of Sodium Hypochorite solution
- ❖ 4000 Litres of Alcohol based Hand Sanitizers
- ❖ 1000 Litres of Alcohol based disinfecting solutions

Self – Reliant Technologies



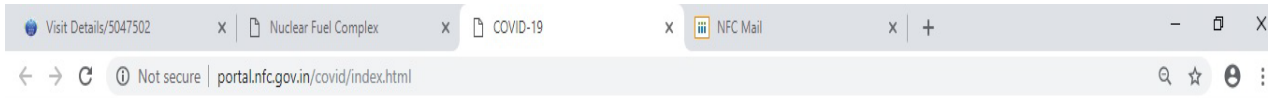
Testing Booth for Suspected COVID Patients

Equipped with

- ❖ Stethoscope
- ❖ Two way speakers for communication between doctor and patient
- ❖ Mist based sanitisation system
- ❖ HEPA filter based exhaust system

**Installed and Commissioned
at al Health Centre**

Employee Awareness Programme



नाभिकीय ईंधन सम्मिश्र
NUCLEAR FUEL COMPLEX
हैदराबाद - Hyderabad

COVID-19 : Be careful, not fearful

CORONAVIRUS PREVENTION

use soap wash your hands at least 20 seconds wear mask

avoid gathering avoid handshake maintain social distance

नाभिकीय ईंधन सम्मिश्र / NUCLEAR FUEL COMPLEX

Covid-19 : Instructions

0:00 / 0:40

Covid-19 : Do's & Don'ts

0:00 / 1:15

PROTECT YOURSELF AND OTHERS FROM GETTING SICK

COVID-19 INFORMATION

- 📄 COVID -19 Guidelines for the employees - Hindi version
- 📄 COVID -19 Guidelines for the employees - English version
- 📄 COVID -19 Guidelines for the employees - Telugu version
- 📄 Standard Operating Procedure for COVID-19 related cases
- 📄 Advisory for preventive measures to contain the spread of COVID-19

COVID-19 Information Page in NFC Website



COVID-19 PREVENTION
Stay Protected! Stay safe from Coronavirus!

SYMPTOMS

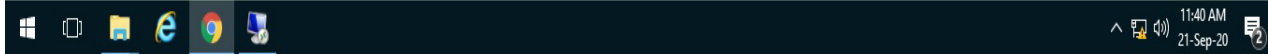
- 1 Fever
- 2 Cough
- 3 Difficulty in Breathing

ATTENTION

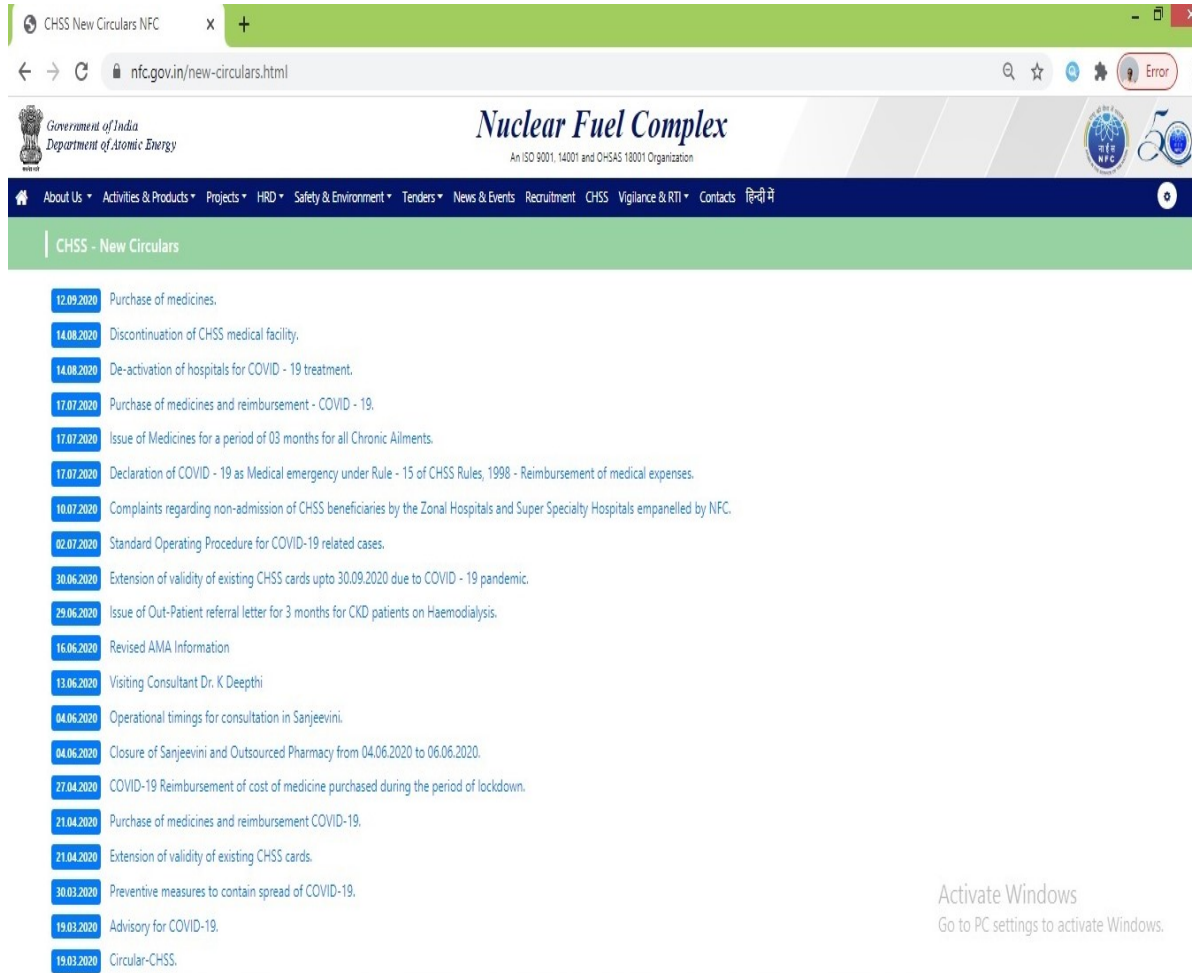
- 1 Always wear masks in work area
- 2 Wash your hands frequently
- 3 Keep a distance (2 m)
- 4 Cover your nose and mouth while sneezing
- 5 Boost your Immune System
- 6 Avoid Spitting
- 7 Consult a doctor if you have any symptoms

OHC, NFC : Contact numbers 3051 / 4261 / 108 OHC, NFC : Contact numbers 3092 / 4302 / 104

NUCLEAR FUEL COMPLEX

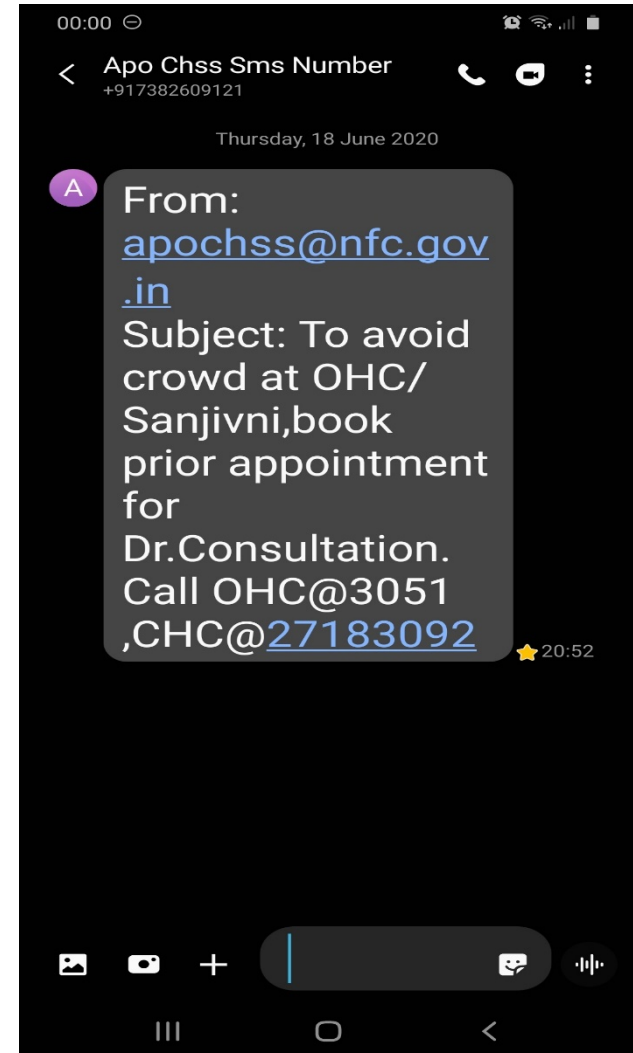


Employee Awareness Programme



The screenshot shows the website of the Nuclear Fuel Complex (NFC), Government of India, Department of Atomic Energy. The page is titled "CHSS - New Circulars" and lists various medical updates on COVID-19. The updates are dated from 19.03.2020 to 12.09.2020. The list includes:

- 12.09.2020 Purchase of medicines.
- 14.08.2020 Discontinuation of CHSS medical facility.
- 14.08.2020 De-activation of hospitals for COVID - 19 treatment.
- 17.07.2020 Purchase of medicines and reimbursement - COVID - 19.
- 17.07.2020 Issue of Medicines for a period of 03 months for all Chronic Ailments.
- 17.07.2020 Declaration of COVID - 19 as Medical emergency under Rule - 15 of CHSS Rules, 1998 - Reimbursement of medical expenses.
- 10.07.2020 Complaints regarding non-admission of CHSS beneficiaries by the Zonal Hospitals and Super Specialty Hospitals empanelled by NFC.
- 02.07.2020 Standard Operating Procedure for COVID-19 related cases.
- 30.06.2020 Extension of validity of existing CHSS cards upto 30.09.2020 due to COVID - 19 pandemic.
- 29.06.2020 Issue of Out-Patient referral letter for 3 months for CKD patients on Haemodialysis.
- 16.06.2020 Revised AMA Information
- 13.06.2020 Visiting Consultant Dr. K Deepthi
- 04.06.2020 Operational timings for consultation in Sanjeevini.
- 04.06.2020 Closure of Sanjeevini and Outsourced Pharmacy from 04.06.2020 to 06.06.2020.
- 27.04.2020 COVID-19 Reimbursement of cost of medicine purchased during the period of lockdown.
- 21.04.2020 Purchase of medicines and reimbursement COVID-19.
- 21.04.2020 Extension of validity of existing CHSS cards.
- 30.03.2020 Preventive measures to contain spread of COVID-19.
- 19.03.2020 Advisory for COVID-19.
- 19.03.2020 Circular-CHSS.



The screenshot shows an SMS message from "Apo Chss Sms Number" (+917382609121) dated Thursday, 18 June 2020. The message content is:

From: apochss@nfc.gov.in
Subject: To avoid crowd at OHC/ Sanjivni,book prior appointment for Dr.Consultation. Call OHC@3051 ,CHC@27183092

Medical Updates on COVID-19

Modifications in Personnel Entry



Employee Welfare



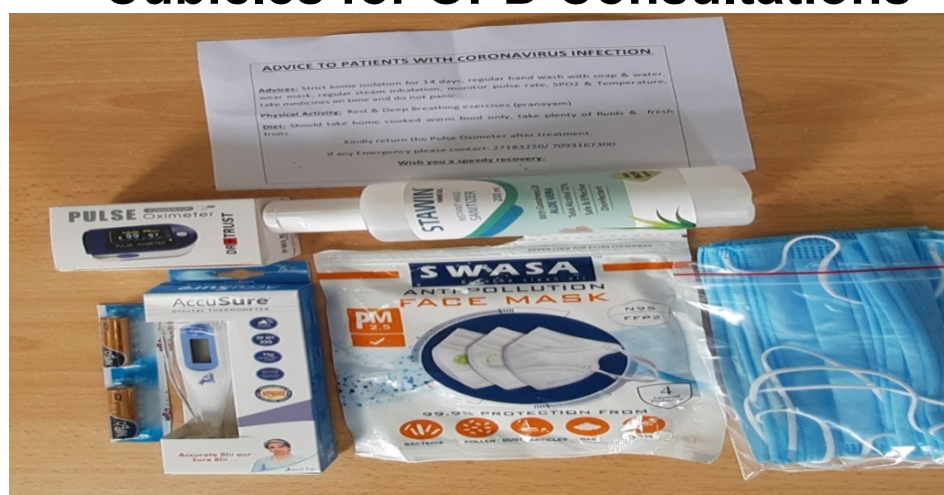
Drug Dispatch Counter



Cubicles for OPD Consultations



Covid-19 OPD



COVID-19 Home Care Kit

Sanitization Drives



Sanitization of Office Building



Sanitization of Office Rooms



Sanitization of Canteen



Sanitization of Vehicles

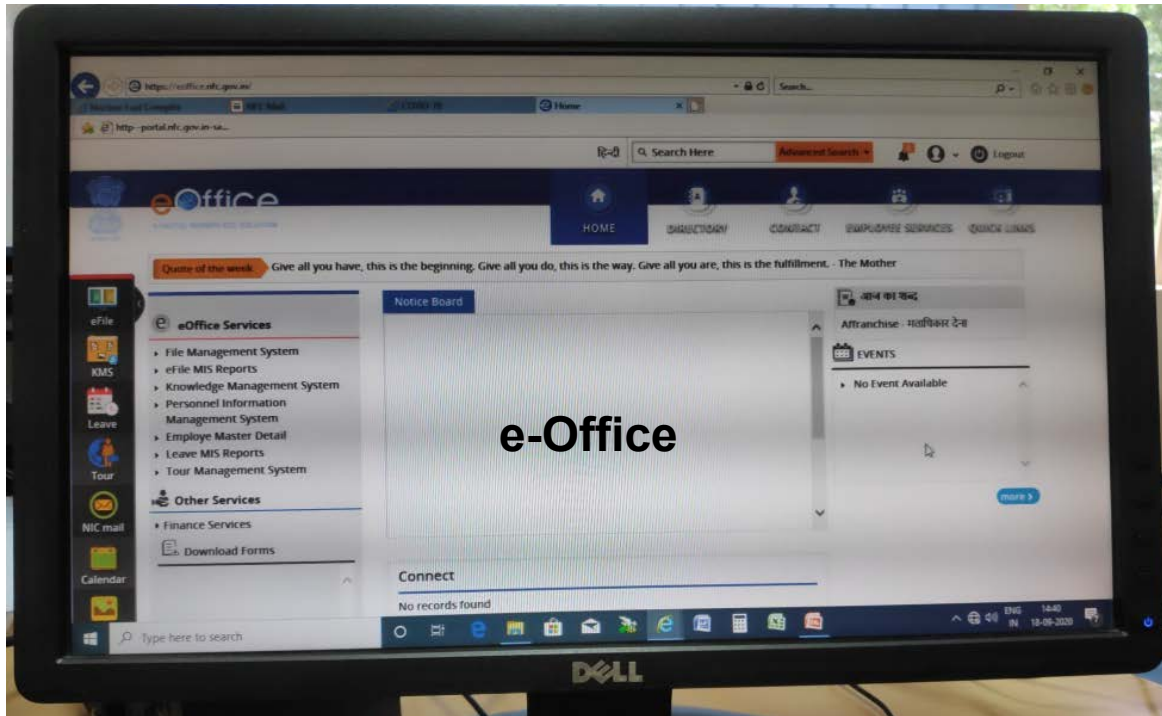


UV Sanitization Box for Files



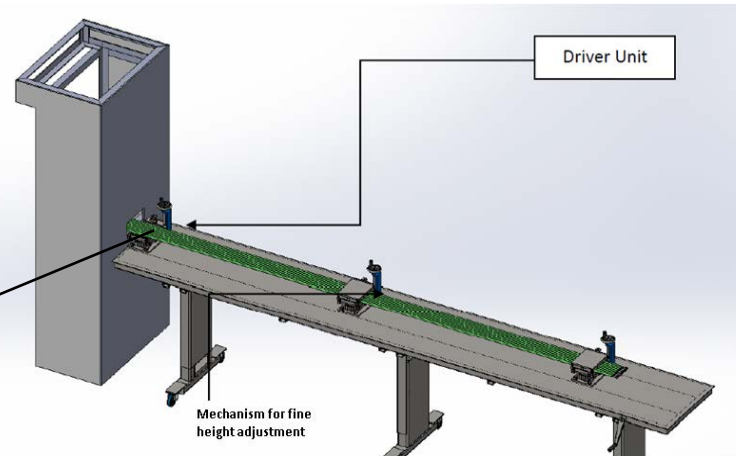
Make-shift Hands-free Wash Basins

E-governance Drive

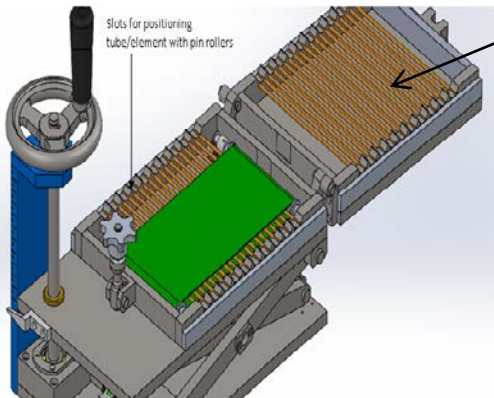


- ❖ Implementation of a cloud based digital workplace solution for efficient workflow
- ❖ Promotes paperless working and reduces human interaction

Technological Developments

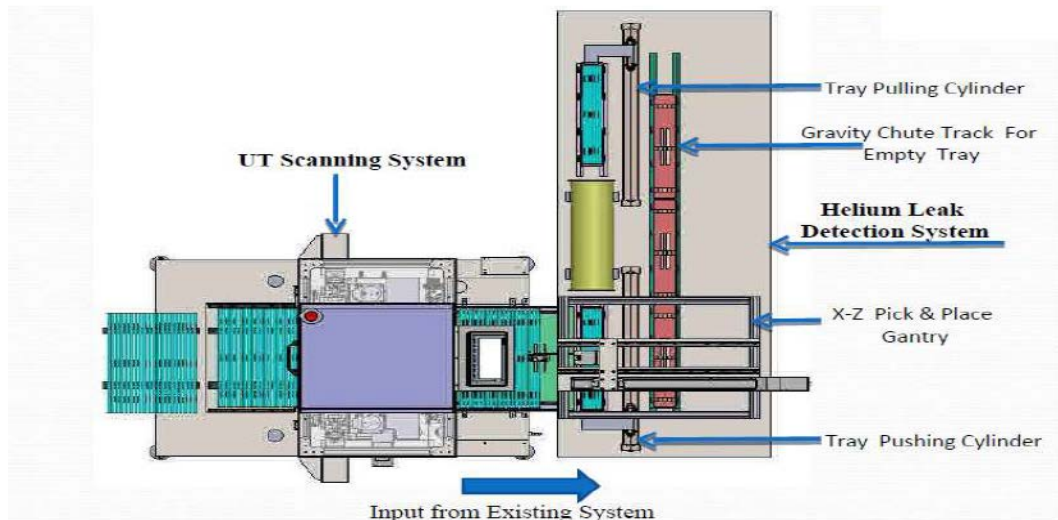


Auto Element Rotation System For BWR Elements at X-ray station



Element Rotating Mechanism

Integrated Station For Helium Leak Testing And Ultrasonic Testing For PHWR Fuel Elements



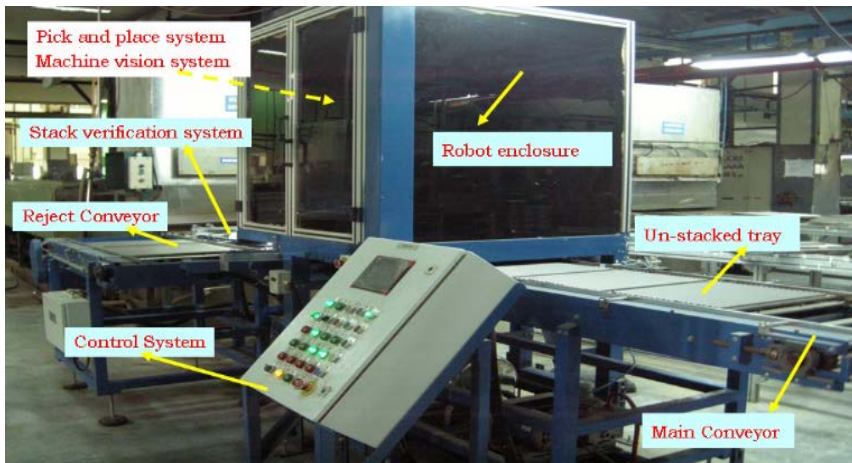
Automated Radioactive Material Handling



Automated Boat Transfer using AGV



Automated Pellet Feeding to CG Machine



Automated Pellet Stacking Machine

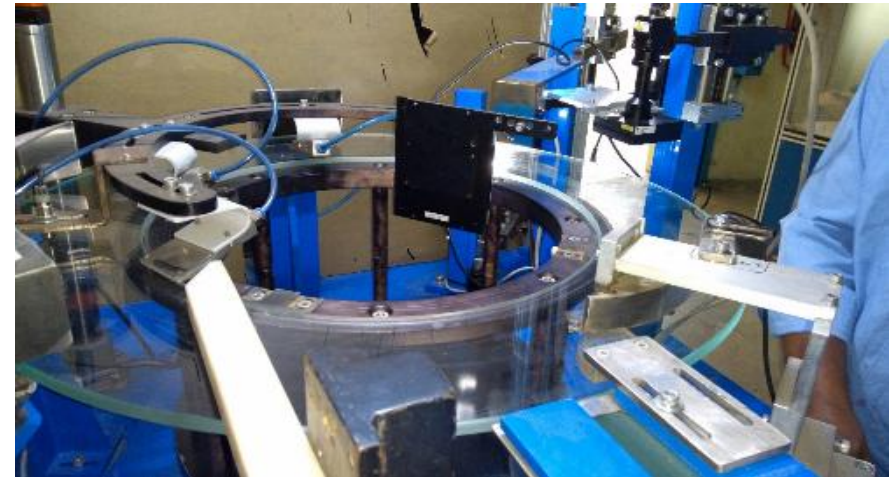


Automated Pellet Loading System

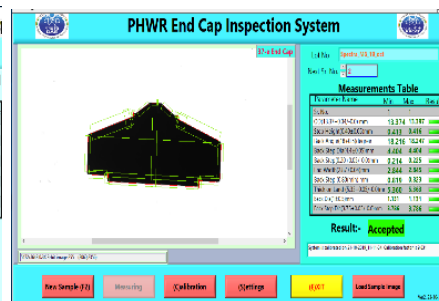
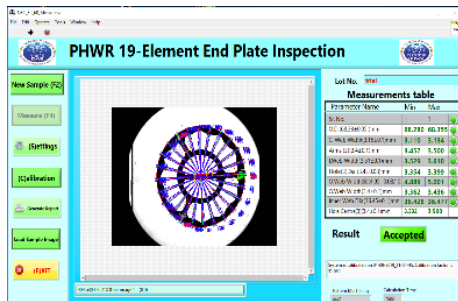
Automated Clad & Zr Component Inspection System



PHWR Fuel End Plate and Profile End Cap Visual Inspection System



Automated Machine Vision System for Bearing and Spacer Pad



- ❖ Huge quantity (1.4 Crore) components are being inspected for two times
- ❖ Improving Reliability
- ❖ The system is capable of finding the surface defect, missing of coins and dimensional deviation
- ❖ Considerable reduction in manpower

Summary

- ❖ During complete lockdown period Fuel dispatches to Reactor sites were ensured. Essential services in the plant were maintained.
- ❖ A massive effort was put on place to manage plant with Covid-19 being around.
- ❖ NFC was one of the first plant in department of atomic energy to restart the production.
- ❖ A robust operating procedure was developed and since June 2020 full production has been ensured.
- ❖ No industrial and radiological related safety issues were reported so far even with Covid-19 constraints.

Thank You

