

Issue 094

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The 4th State

Newsletter of the Institute For Plasma Research, Gandhinagar, Gujarat (India)



Atmospheric Plasma Division of IPR

The Atmospheric Plasma Division (APD) is functioning from the Facilitation Centre for Industrial Plasma Technologies campus. APD mainly focuses on harnessing plasma at atmospheric pressure and most of the technologies do not require complex vacuum equipment. Scientists and engineers of APD are involved in the development of several exciting technologies and systems.

One of the major problems that have been addressed is that of safe disposal of bio-medical waste without formation of harmful chemicals and gases. Bio-medical waste consists of a plethora of substances such as infected clothing, blood contaminated cotton, placenta, human anatomical waste, IV-Fluid plastic bottles, gloves, syringes, glass bottles, discarded ampules, needles, metal sharps, metallic implants etc. Conventional techniques of incineration pollute the environment by producing dioxins, furans, PAH, particulate matter, NO_x etc. Also, the tar content is high and the above compounds are carcinogens and can cause life threatening diseases such as cancer and tuberculosis. Modern sanitary landfills encounter different challenges such as the problem of leaching of metals if the landfill is poorly designed, contamination of ground water and costly land and foul smell emanating to nearby residential localities. The plasma based pyrolysis technology has successfully addressed this problem by ensuring that waste is disposed in an environmentally friendly manner. The developed technology offers distinct advantage over other techniques by harnessing the unique characteristics of thermal plasma such as high temperature, ability to form radicals and reactive species in oxygen starved environment. This technology has successfully been demonstrated and harmful dioxins and furans were found to be well within the limits of pollution norms.

This technology has resulted in a series of patents and the technology itself has been recognized for safe disposal of bio-medical waste and published in the Gazette of India, Extraordinary, Part II, Section 3, Sub-section (i)] Government Of India Ministry Of Environment, Forest And Climate Change Notification New Delhi, the 28th March, 2016. Plasma pyrolysis systems have been installed, with the help from various funding schemes, in hospitals and establishments across India. It is the technology that is being used in GIFT city, the first smart city of India. Today, the institute boasts of demonstrating a 1 ton/day capacity waste disposal and the team at APD is already working on a 5 ton/day system. Plasma gasification and energy recovery from plastic and cotton waste have also been addressed successfully.



The R&D prototype of the high capacity plasma pyrolysis system at FCIPT

IPR Administration organized an in-campus vaccination programme against Covid-19 for IPR staff members at IPR main campus on 9th April, 2021. This vaccination drive was carried out by three paramedics from the Secondary health Center (SHC), Sughad. Over 70 staff and their family members received their first dose of the vaccine during the day-long programme.



Images from the vaccination drive conducted by IPR Administration



Dr. Suryakant Gupta of FCIPT was one of the Guest of Honour at the project exhibition of final year UG and PG students of the L.D. Engineering College, Ahmedabad. The event, entitled "*KAIZEN-Continuous improvement*", was held on 19th April, 2021. The aim of the event was to review, mentor and improve the project work done by the students based on understanding of fundamental concept, team work, prototype development, innovations in the project and presentation skills.

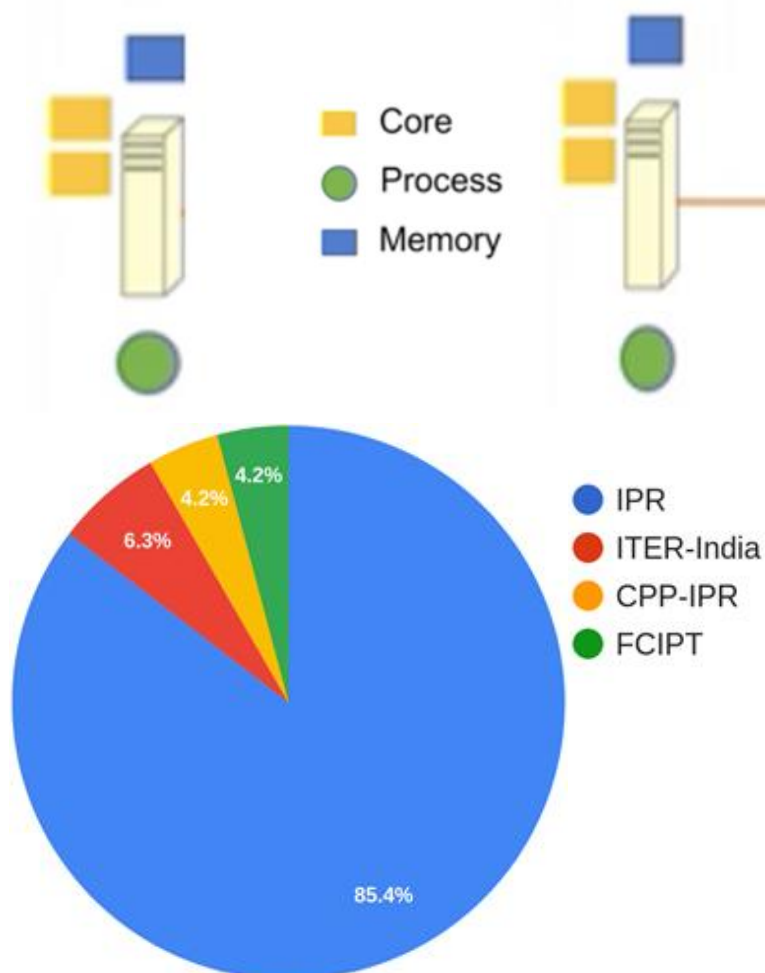
Considering the importance of High-Performance Computing (HPC) facilities capable of achieving tens or hundreds of peta-flops, we are currently at a unique point where there is a need to understand and improve the performance of applications which can reach a significant value of that peak performance. With researchers at IPR having the expertise of writing their own codes, it is important that they are exposed and provided with the tools that are needed to scale these inhouse developed codes to a large no. of CPU cores for performing fast calculations. This workshop was conducted to help the users in making the transition from running serial codes on laptops or workstations to running them on the cluster architecture using the parallel capabilities of the cluster. The HPC team working closely with the HPC users identified the gaps to efficiently write the parallel computing algorithms and planned along with the experts from Locuz Inc. to have a parallel computing workshop covering all related topics.

The main objective was to introduce researchers to exploit the parallel capabilities of the HPC hardware, learning the parallel programming tools and paradigms for CPUs for running their codes in an HPC environment to accelerate their scientific simulation work with the availability of the HPC resources at IPR. This workshop introduced the fundamental concepts of shared memory (OpenMP) and message-passing (MPI) programming models. The Intel optimization tools for understanding the performance of parallel applications were also covered. To get familiar with the main concepts of OpenMP and MPI, and the process of how to build, compare and improve the performance, mostly hands-on lab sessions were carried out. Day-1 and Day-2 focussed on openMP and MPI with lab sessions on profiling such execution modes in some basic tutorial problems. The participants followed a step-by-step approach to learn the concepts and how they can be applied in their scientific codes by using the Intel profiling tools. All the participants were given access to IPR's HPC facility, ANTYA cluster. Day-3 started with introducing the idea version control using git by Dr Arkaprava Bokshi highlighting the various useful features which can immensely help the users in keeping a track of the development cycle of their codes and to avoid any conflict with the collaborators. Later on Day-3, a new Intel tool, OneAPI was introduced which is to build applications across CPU/GPU/FPGA architectures using this single tool only and will replace the existing Intel Cluster Studio which is currently being used in ANTYA.

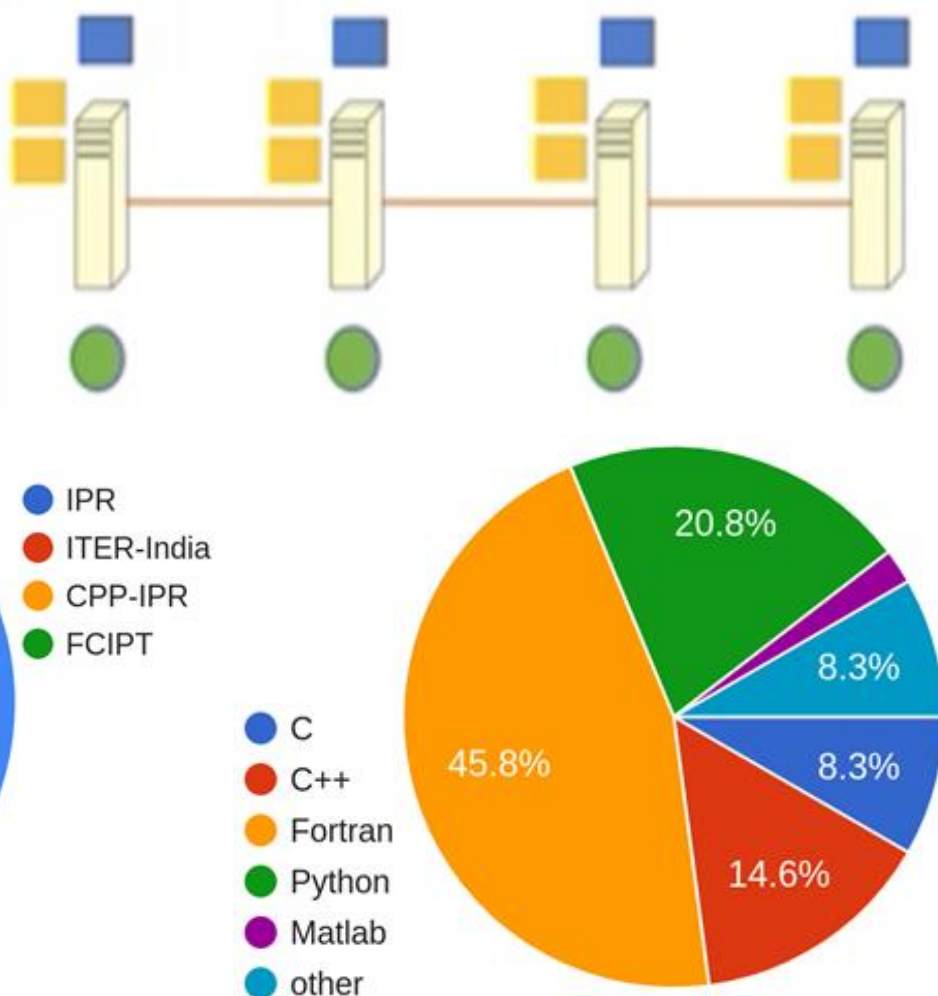
This 3-day workshop was held during 13th, 15th and 16th April 2021. The workshop sessions were completely online and took place in the morning half days using the IPR VC facility, JITS. The workshop brought together more than 35 participants over the course of 3 half-days out of a total of 48 registrations received from various divisions in IPR, FCIPT, CPP-IPR, and ITER-India having expertise with different domains/programming languages.

The workshop material and labs are available here: <https://github.com/mkhpc/hpctraining>

OpenMP (Shared Memory Computing)



MPI (Distributed memory Computing)



(L) Details of the participants (R) Programming backgrounds of the Participants

International Women's Day 2021 was celebrated with great enthusiasm at Institute for Plasma Research, Bhat, Gandhinagar on 8th March 2021. Over 90 women employees attended this programme with most of them attending online due to Covid-19 protocols. In this programme, Ms. Aparajita Mukherjee, Chairperson, SHWW (Sexual Harassment of Women at Workplace) welcomed the participants and emphasized the importance of celebrating Women's Day. This was followed by a motivational talk by Dr. Anitha V.P, who also shared her diverse experience of working as scientist as well as that of the Chief Vigilance Officer for IPR. Fifteen staff members also shared their experiences on the topic "*The challenging path I travelled during Covid-19*".



View of the audience during the International Women's Day meeting at IPR



(L) Dr. Anitha V P. (M) Ms. Aparajita Mukherjee (R) Dr. Ranjana Gangradey



(L) Ms. Priyavandana Rathod (M) Ms. Bhoomi K. Khodiyar (R), Ms. Yashshri Patil



(L) Priyadarshini Gaddam (M) Ms. Snehlata Aggarwal (R) Ms. Ranjana Manchanda



(L) Ms. Chhaya Chavda (M) Ms. Rachna Rajpal (R) Ms. Supriya Nair

हिंदी कार्यशाला

आईपीआर की राजभाषा कार्यान्वयन समिति द्वारा 19 मार्च, 2021 को आईपीआर के स्टाफ सदस्यों के लिए "तकनीकी/वैज्ञानिक कार्य हिंदी में क्यों और कैसे करें?" विषय पर ऑनलाइन हिंदी कार्यशाला का आयोजन किया गया। यह कार्यशाला संस्थान के वरिष्ठ वैज्ञानिक अधिकारियों द्वारा सामूहिक चर्चा एवं विचार-विमर्श के रूप में आयोजित की गई जिसमें डॉ. प्रवीण कुमार आत्रेय, डॉ. विपुल तन्ना, डॉ. सूर्यकान्त गुप्ता, श्री चंदन दनानी एवं श्री राजसिंह ने उक्त विषय पर अपने विचार व्यक्त किये एवं चर्चा की।

श्री राज सिंह, वैज्ञानिक अधिकारी-एच ने सभी श्रोताओं को राजभाषा नीति से परिचित कराते हुए हिंदी में कार्य करने की महत्ता को उजागर किया और सहज रूप से हिंदी में कार्य करने की प्रेरणा दी। डॉ. प्रवीण कुमार आत्रेय, डीन आरएंडडी ने इस बात पर प्रकाश डाला की भारत विविध संस्कृति और विभिन्न भाषाओं का देश है, लेकिन हिंदी भाषा अधिकतर लोगों द्वारा समझी जाती है, इसलिए तकनीकी कार्य में हिंदी का प्रयोग किये जाने से तकनीकी जानकारी से अधिक लोग लाभान्वित होंगे। डॉ. विपुल तन्ना, वैज्ञानिक अधिकारी-एच ने संस्थान में राजभाषा कार्य में हो रही प्रगति की सराहना की और विशेष कर तकनीकी शब्दों के जटिल हिंदी शब्दों का प्रयोग करने के बजाय उसका लिप्यंतरण करने की सलाह दी। डॉ. सूर्यकान्त गुप्ता ने यह यथार्थ उजागर किया की हमारा मूलभूत चिंतन मातृभाषा में सहज होता है। विशेषकर हमें मानसिक रूप से यह भाव लाना चाहिए कि हमारी भाषा अन्य भाषाओं की तरह विकसित है। इस भावना से हमें अपनी भाषा में कार्य करने की प्रेरणा मिलेगी। श्री चंदन दनानी ने तकनीकी शोध-पत्रों का अनुवाद करने, प्रत्येक तिमाही में एक हिंदी सेमिनार का आयोजन करने एवं तकनीकी वर्ग के लिए कंप्यूटर पर हिंदी में टाइपिंग की कार्यशाला आयोजित करने एवं राजभाषा के सुगम प्रयोग हेतु संबंधित सॉफ्टवेयर का इस्तेमाल करने पर जोर दिया। इस कार्यशाला में शामिल श्रोताओं ने भी अपनी समस्याओं को साझा किया एवं सुझाव व्यक्त किये।

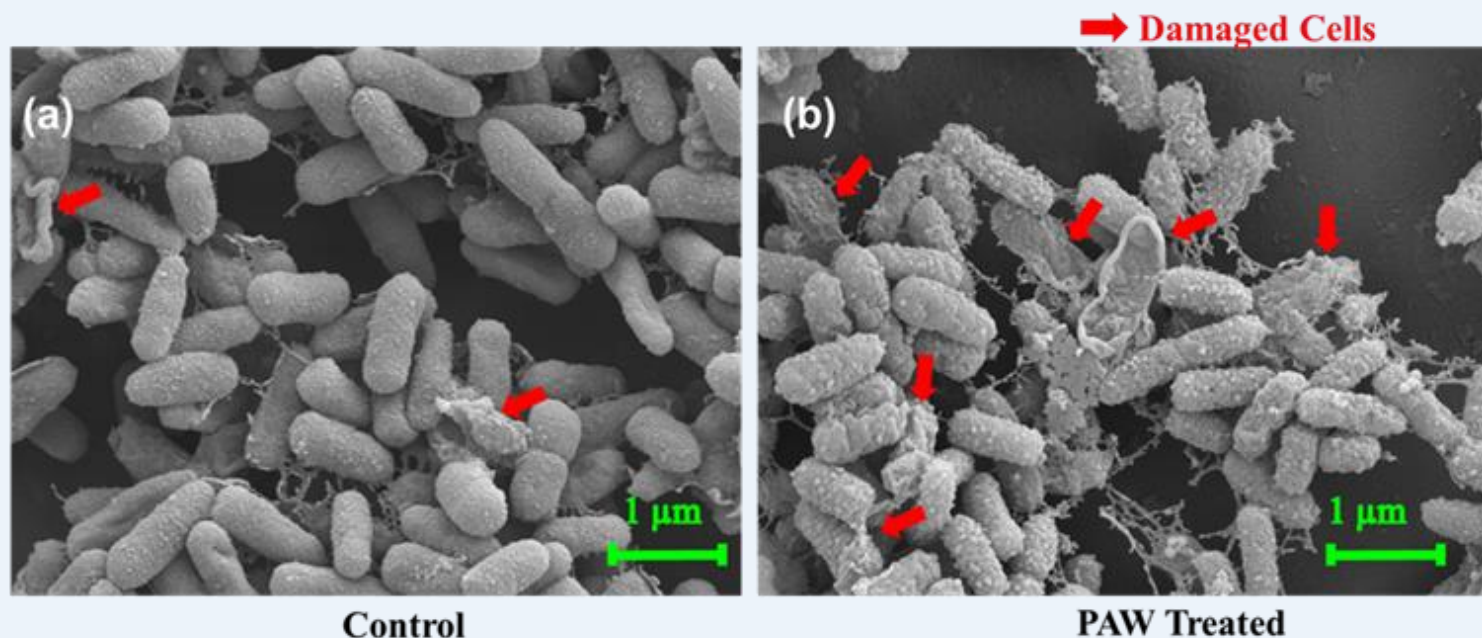
राजभाषा के क्षेत्र में उपलब्धि

नगर राजभाषा कार्यान्वयन समिति की 16वीं छमाही बैठक 16 अप्रैल, 2021 को बड़ौदा एपैक्स अकादमी, गांधीनगर द्वारा माइक्रोसॉफ्ट टिम्स के माध्यम से ऑनलाइन आयोजित की गई, जिसमें डॉ. सुस्मिता भट्टाचार्य, उपनिदेशक, क्षेत्रीय कार्यान्वयन कार्यालय, मुंबई, श्री यशवीर चौधरी, सहायक महाप्रबंधक, बड़ौदा एपैक्स अकादमी, श्री पुनीत कुमार मिश्रा, सहायक महाप्रबंधक, बैंक ऑफ बड़ौदा एवं गांधीनगर स्थित केन्द्र सरकारी कार्यालयों/उपक्रमों/बैंकों/संस्थानों के प्रमुख एवं प्रतिनिधि उपस्थित थे। इस बैठक में नराकास, गांधीनगर स्तर पर राजभाषा के क्षेत्र में श्रेष्ठ कार्यनिष्पादन हेतु वर्ष 2020 के पुरस्कारों की घोषणा की गई। राजभाषा के क्षेत्र में श्रेष्ठ कार्यनिष्पादन हेतु वर्ष 2020 के लिए प्लाज़्मा अनुसंधान संस्थान ने प्रथम पुरस्कार प्राप्त किया है।

होटल प्रबंधन संस्थान, गांधीनगर द्वारा 7 अप्रैल 2021 को आयोजित हिंदी प्रश्नोत्तरी प्रतियोगिता में संस्थान के श्री राजीव शर्मा, वैज्ञानिक अधिकारी-डी ने प्रोत्साहन पुरस्कार प्राप्त किया है। इस उपलब्धि के लिए राजभाषा कार्यान्वयन समिति की ओर से उन्हें हार्दिक बधाई।

राजभाषा के क्षेत्र में श्रेष्ठ कार्यनिष्पादन हेतु हमारा संस्थान प्रगति करते हुए लगातार पुरस्कार प्राप्त कर रहा है। संस्थान में राजभाषा कार्यान्वयन में अपनी महत्वपूर्ण निभाने वाले सभी स्टाफ सदस्य इस उपलब्धि के लिए विशेष रूप से बधाई के पात्र हैं।

Plasma activated water (PAW) has great potential to be used as a chemical-free alternative for disinfection against bacteria, fungi, viruses, etc. IPR has developed a compact, low-cost facility to produce PAW using non-thermal pencil plasma jet (PPJ). The interaction of the PPJ with water leads to formation of various reactive oxygen-nitrogen species (RONS). A detailed study shows that the reactivity and electrical conductivity of PAW can be controlled by optimizing process parameters. PAW with higher reactivity (ORP) has been found to inhibit the growth of bacteria and fungi, while PAW with low ORP value helps in improving seed germination and plant growth. A 6 Log reduction takes place when PAW interacts with *Pseudomonas aeruginosa* and *Staphylococcus aureus* even with few seconds of exposure, and this bactericidal efficacy is retained in long-term. Morphological analysis and fluorescence microscopy shows that PAW exposure with bacteria and fungi damages the outer membrane, due to which intra-cellular material leaks out, resulting in their inactivation.



Morphology of *Pseudomonas aeruginosa* cells (a) control (b) after treatment with PAW

Obituary

Prof. Ratneshwar Jha was a brilliant Plasma Diagnostician and Experimental Physicist, and an amazing mentor for many young researchers. **He played a very significant role in identifying the intermittency first time in ADITYA tokamak edge turbulence, his most cited work in Nuclear Fusion Research!** Later, such intermittency signatures were reported in many fusion devices across the world.

Prof Jha was born on 3rd February 1954, and started his academic journey from a very small village in Bihar to JNU, New Delhi for his M.Sc., Physical Research Laboratory, Ahmedabad for PhD and PDF, and then joined as the Institute for Plasma Research, Gandhinagar as Scientist from 1985 – 2016.

An extraordinary man lived an ordinary life who only believed in hard-work, discipline, clarity of thoughts and integrity.

His struggle with Parkinson's plus after retirement, was a long story of patience and perseverance - a constant smile on his face, no matter what worries went in his mind. A man, whose triumphs were more than his troubles, always practiced simple living with the philosophies of Bhagavat Geeta from the core of his soul.

Prof. Jha has left for heavenly abode on 18th April, 2021. He will always be remembered for his generosity and humble nature.....May his Soul Rest in Peace.....

Dr. Daniel Raju

Prof. Ratneshwar Jha
(3rd Feb 1954 - 18th Apr 2021)

To minimize the imports, research were carried out for the development of indigenous cryopumps at Institute for Plasma Research (IPR), Gandhinagar. During the developments various prototypes were developed for small scale pumping needs (~1,000 l/s) to large scale pumping needs (> 50,000 l/s) for the hydrogen and helium pumping application using liquid helium for the Tokamak plasma and nuclear fusion application.

As a research outcome, from lab to the product, targeting pumping of water vapor and nitrogen/air, the **Cryogenic Vacuum Producing System (CVPS)** was developed. The system is operated using liquid nitrogen as cryogen to cater the above mentioned large pumping needs.

The technology has been patented named as "A Novel Cryogenic Vacuum Producing System (CVPS)" with patent application No. 201821035710. As an application of the developed technology of Liquid nitrogen-based sorption cryopump to pump the cryo-vac chambers, IPR and SAC ISRO signed an MOU on 1st Sept 2017. The first work plan document focused on delivering 3 cryopumps by IPR to SAC. With successful prototype testing, the delivery of 3 cryopumps (Model no. IPR-CP400-Air-80) is done and already installed at cryo-vac chambers in SAC ISRO, Ahmedabad.

The application of the cryogenic vacuum pump is vast. The health care industry, which is advancing with an immense growth of medical explorations, is primarily projected to drive the cryogenic pumps market. A similar situation exists with the escalating demand for cryopumps in pharmaceutical, food, metallurgy industry. The specific characteristic of cryopumps providing a clean vacuum gives it an advantage for the applications in the semiconductor industry. These pumps have immense application in semiconductor and thin-film industry for various processes like sputtering and chemical vapor deposition and various other coating processes. It has immense application in space and aerospace industry to pump large volume cryo-vac chambers, also known as space simulation chambers for testing satellite and its components in a vacuum environment. As discussed the made in India cryopumps are now performing on cryovac chambers at SAC, ISRO.



(L) Inner assembly components of CVPS (M) Cryogenic Vacuum Pumping System -Model no. IPR-CP400-Air-80 (R) The cryopumps being dispatched to SAC-ISRO



The cryo-pump development team with Director IPR before two cryopumps were readied for dispatch

Successful Completion Of All Pressure Tests Of Group Y Cryolines & Warmlines of ITER 8 Cryoplant Area (B50s)

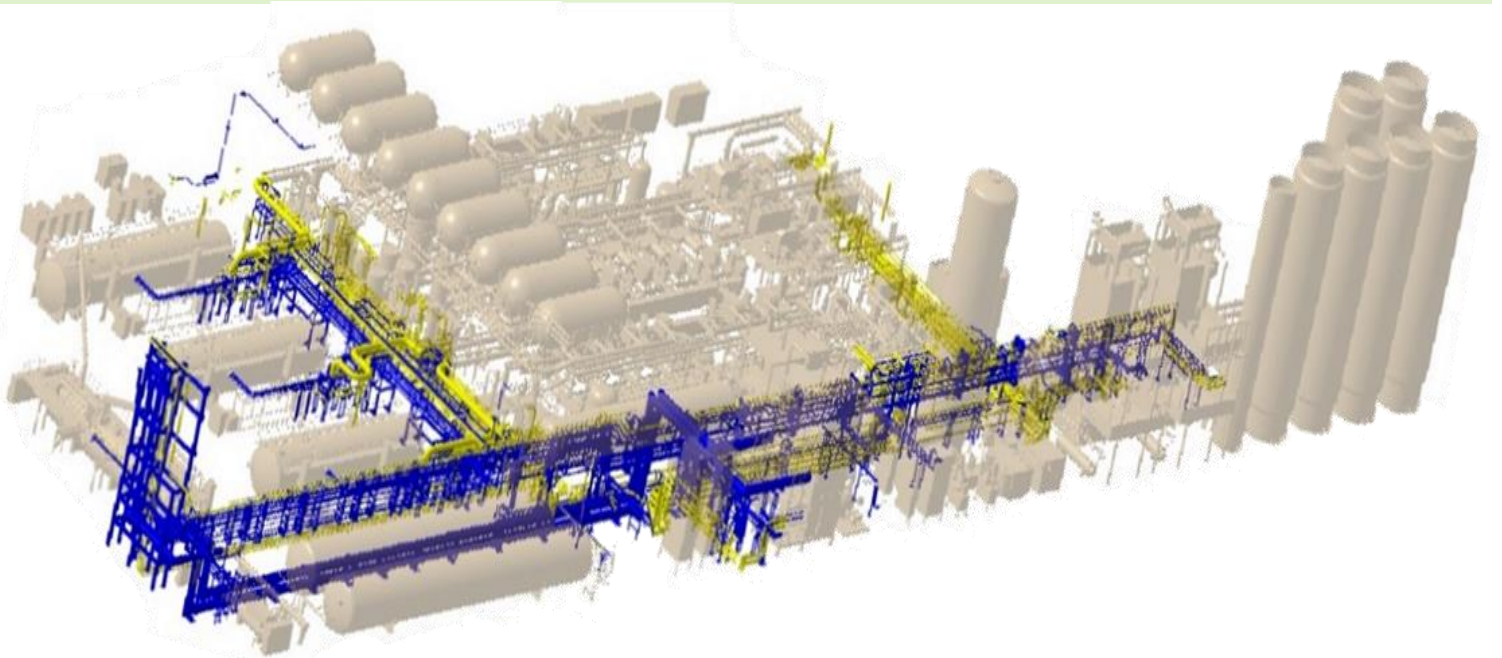
ITER cryolines and warmlines are a complex network of cryogen transfer lines intended to transfer Helium and Nitrogen fluids at temperature levels of 4K, 50K, 80K and 300K to fulfill the requirements of clients like superconducting magnets, cryopumps, current leads etc. ITER cryolines are bifurcated into two groups namely, Group X cryolines and Group Y cryolines. All the cryolines and Warmlines are located in the Tokamak Complex (Building 11), Plant Bridge (PB) and Cryopant area (B50s) of the ITER site.

The contract for the design, fabrication, installation and final acceptance for the Group Y cryolines and Warmlines had been awarded to M/s INOX India Private Limited, Vadodara, India. The pre-installation activities like construction of temporary workshop got initiated in July-2017 and the installation activities of Group-Y cryolines and warmlines at Cryoplant area of ITER site commenced from December 2017 followed by first pressure test of SNS-1 nitrogen cryoline circuit tested on 18th December 2018.

Thereafter, a total of 16 circuits of Group Y cryolines and 48 circuits of warmlines have been successfully pressure tested in Cryoplant area with the last test being performed for longest circuit of WDH-1 warmline on 12th of March 2021.

The energy contained during the pressure test of WDH-1 line was 63 MJ and exclusion zone of 30 m was necessary. The pressure tests have been conducted with good quality in compliance with the IO specified technical specifications, ITER safety (including French law) and quality norms with zero incidents identified for the complete duration since 2018 to 2021. Moreover, the site coordination with on-going activities of other co-actors, considering the exclusion zones of around 30 meters was also the key aspect to achieve this milestone of successfully completing the pressure tests in Cryoplant building.

The ITER cryolines have test pressures ranging from 1.4 MPa (abs.) to 3 MPa (abs.), while the ITER warmlines have test pressure ranging from 0.72MPa (abs.) to 6.2 MPa (abs.). All the pressure tests have been performed using the gaseous Nitrogen at the respective magnitude of pressures mentioned above. The process pipe diameter for the Cryolines range from DN25 to DN450 whereas that of Warmlines range from DN50 to DN700.



All pressure tested circuits (cryolines in blue and warmlines in yellow) in the cryoplant area



(L) The first pressure test of SNS-1 circuit performed on 18-Dec-2018 during night hours (R) INOX and ITER team after successful completion of final pressure test in Cryoplant area on 12-Mar-2021

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Help Defeat the Covid-19 Virus



Click on above image to watch an informative video, an initiative by the Covid Task Force of IPR

Know Your Colleagues



Mr. Chirayu N. Patil, joined IPR at FCIPT as a Technical Assistant – B (Instrumentation and Control) in Feb 2006 and is presently working as a Scientific Officer – D in Atmospheric Plasma Division. He completed AMIE in Electronics and Communication in March 2011. He has been awarded the Outstanding Staff Member of the Year (OSMY) of the Institute for the year 2011. He contributed to the field of automation and instrumentation using PLC and HMI, high frequency - high voltage power supplies and embedded systems in various projects undertaken in FCIPT. He participated in the execution of various projects in the area of application of atmospheric pressure plasma jet, dielectric barrier discharge plasma and plasma torch. Presently he is working in Plasma Pyrolysis project in Atmospheric Plasma Division (APD).

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