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SST-1 Update : Installation of Current Leads For PF#3 Coils

Superconducting PF#3 coils are needed for the next step of operation for elongated plasma experiments in SST-1. Top and bottom PF#3 coils bus-bars and current lead joints have been fabricated after the integration of two pairs of leak-tested conventional current leads with current feeder system chamber (CFSC) of SST-1. Two pairs of vacuum barriers are installed to isolate cryostat and CFSC vacuum. Leak testing of supercritical and liquid helium circuits consisting of profiled SS tubes and cryogenic electrical isolators has been carried out after the completion of hydraulic connections.

Cryo-compatible and Paschen leak-tight electrical insulation consisting of Kapton tapes, FRP S-type glass tapes soaked with bisphenol epoxy and accelerator were applied to leak tight the joint boxes, bus-bars and integrated current leads. Most of the low temperature surfaces were covered using superinsulation MLI (Multi-Layer Insulation) to optimize the heat loads. The required temperature sensors, voltage taps, pressure drop transducers and flow meters were installed using newly integrated current leads for health monitoring during SST-1 plasma operations.

Terminal shorting resistors are also being installed at the top of CFSC to optimize the induced voltages on all nine PF coils. This task has been carried out by Magnets, Cryogenics, MESD and Vacuum division.



(L) The installed and insulated current leads and sensors in FSC (Top) A pair of fabricated coil and current lead lap joint (Bottom) Welding job in progress

IPR celebrated its 33rd Annual Day on 11th January 2020 at the IPR main campus with a lot of fun and fanfare. Over 1000 persons, including staff members and their family attended the function which had music by professional artists as well as IPR staff, dance items by staff and their family members and several other entertainment programmes. The function culminated with a grand dinner followed by traditional garba dancing as well as fun filled dancing to DJ music. The OSMY award and several other prizes to IPR staff and their family members for their achievements were awarded during the evening.





Images from the 34th IPR Annual Day function.

National Science Day was celebrated at CPP-IPR on 28th February, 2020. About 350 students and teachers from 20 different schools nearby participated in various events organized at CPP-IPR. Four competitions were organized for the participating students, viz., Quiz competition, Science Model competition, Extempore and Drawing competition. The day-long program was inaugurated by Prof. B. K. Saikia, Acting Centre Director. The occasion was graced by Prof. B. Bhattacharjee, HOD, Dept. of Physics, Gauhati University, as Chief Guest, who addressed the gathering and encouraged the students to have a scientific temperament. Dr. M. Dey, retired Scientist of CPP-IPR also interacted with the students and delivered a talk on the life and works of Dr. Vikram Sarabhai. Posters and audio-visual presentations were displayed featuring various activities of the institute along with the theme ('Women in Science') of this year's science day.



Images from the National Science Day Celebrations at CPP-IPR

IPR participated in the 8th Topical conference on Atomic and Molecular Collisions for Plasma Applications, organized by IIT Roorkee during 3-5 March 2020. Director IPR, Dr. Shashank Chaturvedi was the guest of honour at the inaugural function. He also delivered the inaugural lecture on “*Plasma Chemistry for Modelling Plasmas under Extreme Conditions*”. Dr. Joydeep Ghosh and Dr. Mukesh Ranjan delivered talks on “*Diagnosis of Tokamak Plasma Using Passive Spectroscopy*” and “*Atomic and Molecular Collisions for Plasma Applications in sensing and wettability*” respectively.



(L-R) Dr. Shashank Chaturvedi as the guest of honour at the inauguration of the conference. Dr. Shashak Chaturvedi, Dr. Joydep Ghosh and Dr. Mukesh Ranjan delivering their lectures.

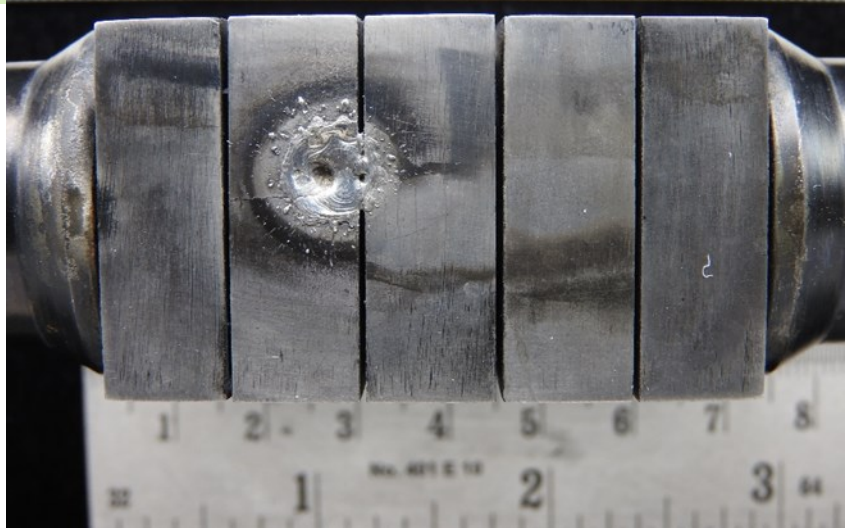
IPR Annual Day



Images from the 33rd IPR Annual Day celebrations held at IPR main campus

For inspection and examination of Plasma Facing Components (small scale and medium scale) and the Plasma facing materials before and after High Heat Flux (HHF) testing or any such type of tests, a visual inspection set-up is established in High Temperature Technologies Division (HTTD) at IPR. Visual inspection set-up consists high illumination (~4000 lux) grazing light source mounted on to table through stainless steel stand (adjustable) along with photographic records facility.

Visual Inspection is a nondestructive testing technique that provides a means of detecting and examining a variety of surface flaws, such as corrosion, surface contamination, surface finish, and surface discontinuities on joints (for example, welds, solder connections, etc.). Visual inspection is also the most widely used method for detecting and examining surface cracks, which are particularly important because of their relationship to structural failure mechanisms. Even when other nondestructive techniques are used to detect surface cracks, visual inspection often provides a useful supplement.



(L) the visual inspection setup (R) Visual Inspection of small scale (~50mm length) W monoblock mock-up after HHF test showing various surface defects such as pinholes, craters of melted zone and re-solidified metal droplets, and cracks.



Visual Inspection of medium scale (~480mm length) W coated CuCrZr mock-up after HHF test.

Outreach : IPR Visits

Educational Visits to IPR/FCIPT – March 2020

Name Of the Institution	Date	Number of visitors
CGPT, Uka Tarsadiya University, Bardoli, Surat	11-Mar-2020	54 B.Tech students (EC, ITC and Mech) and 3 faculty members



Students of the CGPT, Uka Tarsadiya University, Bardoli, Surat, during their visit to IPR

As part of the **Vigyan Samagam** mega-science exhibition, which is currently on at the National Science Center, New Delhi, the ITER week was organized during 3-7 March, 2020. As part of this programme, IPR and ITER-India organized popular talks, quiz programmes and hands-on demonstrations of plasma and its applications at the venue. Popular talks on Plasma and its applications were given by Dr. Ravi A.V. Kumar and Ms. Chhaya Chavda. Dr. Mahinderjit Singh talked about the ITER project, its technical challenges and India's contribution to the project. IPR Outreach Division exhibited several live, hands-on demonstrations of plasma and its applications at the venue, which was visited by several schools from New Delhi.



(L-R) Ms. Chhaya Chavda, Dr. Mahinderjit Singh and Dr. Ravi A V Kumar delivering their popular talks.



(L) View of the audience during the popular talks (R) The ITER-week team @ NSC



Graphics Processing Units (GPUs) offer high performance and massive parallelization but writing scientific applications/codes to fully exploit the performance of GPUs can be a very challenging and difficult task. To help IPR HPC users to reduce the barrier to run their codes on GPU nodes of ANTYA HPC Cluster, IPR Computer Division partnered with NVIDIA and held its first GPU Bootcamp from 12th-14th February 2020 at IPR. 40 participants which included employees, PhD scholars and PDFs attended the Bootcamp. The first day was open for all those with no previous experience with OpenACC directives or GPU programming, and the last two days were only for registered IPR teams with one code per team.

On the first day, participants were introduced to available libraries, programming models, and platforms and learned the basics of GPU programming through extensive hands-on sessions based on sample codes using the OpenACC programming model.

A number of good quality codes (serial as well as parallel) spanning Computational Fluid Dynamics (CFD), Molecular Dynamics (MD) and Particle-in-Cell (PIC) domains were received for the event. On 2nd – 3rd days, 7 teams out of 13 registered teams, each comprising of 3-5 members worked alongside NVIDIA mentors with GPU-programming expertise. IPR teams primarily gained knowledge and expertise about GPU programming and applied that knowledge to port and accelerate their scientific codes on ANTYA GPU nodes. The participants were benefited in the following ways ;

- Learned to profile their codes to find performance bottlenecks or hotspots.
- Gained foundation skills of OpenACC which can be applied to the full code.
- With the help of experienced Mentors, some team members got different insights into their code which helped them in restructuring their code.
- Out of 7 codes, 6 codes were successfully ported on GPUs and some of them even achieved speedup. The code which could not be ported required restructuring and will be ported after resolving the legacy issues in the code.

Around 40 IPR staff who participated in this boot-camp got to learn the potential gains of porting their computational work to GPUs.



The GPU Bootcamp in progress at IPR

The 49th National Safety Week was celebrated at IPR from 4-10 March 2020. The institute organized various competitions during this week to create safety awareness among its employees. Competitions were organized on *Slogan in Gujarati, Hindi & English, Safety Poster, Quiz and Essay Writing in Gujarati, Hindi & English* based on decided themes for the employees of IPR, FCIPT & ITER-India. Demonstration of various fire fighting equipment was conducted for employees as well as security personnel at IPR. Overwhelming response was received from the employees for various competitions.

Concluding Session organised on 9th March. Shri Devendra Modi gave the welcome address which was followed by a talk on “*Effect of RF and Microwave Radiations on Human Body- Facts and Fictions*” by Shri Raj Singh. Dr. P.K. Atrey, Dean (R&D) read out the Safety Message on behalf of Director, IPR. It emphasised that individual contributions are needed to take care of your own safety that of your colleagues and other stake holders. He highlighted that safety is about doing the right thing, even if no one is looking. He also congratulated the winners of various competitions as well as best safety coordinators of IPR. Prizes were also distributed to them. Dean (R&D) also administered the Safety Pledge. Shri D. Modi conducted a Safety Quiz for audience. Shri Sunil Kumar, Chairman-Safety Committee gave the vote of thanks.

Competition	First Prize	Second Prize	Third Prize
Gujarati Slogan	Miteshkumar Patel	Hiteshkumar Patel	Tushar Patel
Hindi Slogan	Shruti Patel	Tejas Parekh	Sandhya Dave / L.N. Gupta
English Slogan	Firozkhan Pathan	Rajnikant Bhatasana	Rajamannar Swamy K. / Murtuza Vora
Poster	Samiran Mukherjee	Rajamannar Swamy K.	-
Quiz	Adam Sanghariyat	Sukriti Hans	Arunsinh Zala
Gujarati Essay Writing	Chirag Bhavsar	Hemantkumar Hadiel	Unnati Patel
Hindi Essay Writing	Sandhya Dave	Pratibha Gupta	-
English Essay Writing	Vishnukumar Chaudhari	Bharat Doshi	Satyaprasad Akkireddy / Gautam Vadolia

The award for best safety coordinators were given to Shri Prakash Parmar, Ms. Smita Parmar and Shri Aroh Srivastava while consolation prize for safety coordinators were given to Dr. Ritesh Sugandhi and Shri Rajiv Sharma.



Dr. A.K. Mohanty, Director BARC visited the ITER site on 13 February 2020. Director General (DG) of ITER Organization Dr. Bernard Bigot welcomed him at the ITER Headquarters before a site tour to witness the progress made by the project. The site visit was followed by meeting with the DG and Indian colleagues working in ITER Organization. Mr. Kalyan Chakravarthy Madala, Counsellor-Atomic Energy (Embassy of India in Paris), Dr. Vinay Kumar (Associate Project Director, ITER-India) and Dr. Prabhat Kumar (Sr. Advisor-Construction Management, ITER Organization) also accompanied Dr. Mohanty.



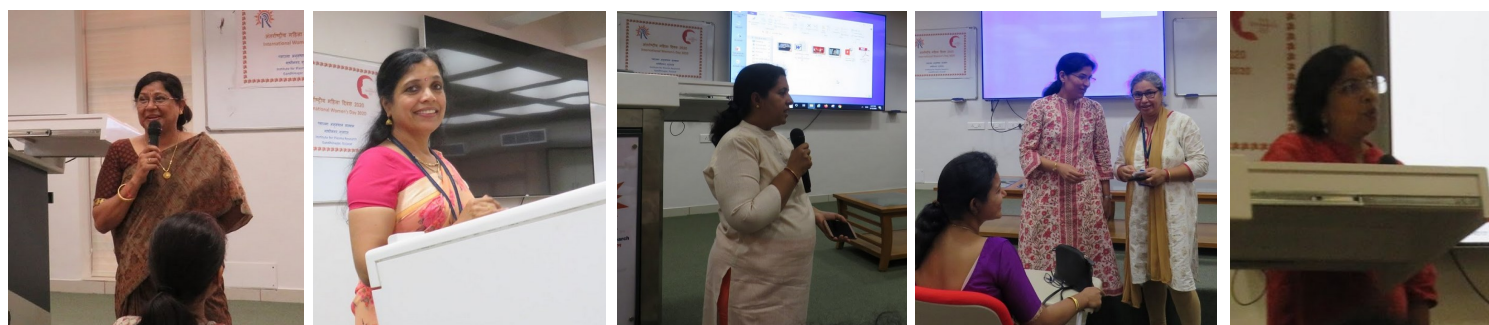
Dr. A.K. Mohanty (Director-BARC, 2nd from left) with ITER DG Dr. Bernard Bigot, Mr. Kalyan Charavarthy Madala (Counsellor-Atomic Energy, Embassy of India Paris), Dr. Vinay Kumar (Associate Project Director, ITER-India) and Dr. Prabhat Kumar (Sr. Advisor-Construction Management, ITER)

International Women's Day 2020 @ IPR

International Women's Day 2020 was celebrated at IPR on 12th March, 2020 as an initiative of the SHWW committee of IPR. Ms. Aparajita Mukherjee conducted an interactive discussion of the guidelines related to the work carried out by SHWW. A short film on "Women Achievers" was also screened. Further, in the programme entitled "Meri Kahani Meri Zubani", many of the women staff members shared their personal, educational and career related experiences for the benefit of younger members of the staff.



(L-R) Ms. Bharathi P, Ms. Chhaya Chavda, Ms. Renu Bahl, Ms. Yashshri Patil and Ms. Aparajita Mukherjee addressing the gathering



(L-R) Ms. Ranjana Gangradey, Dr. Anita V P, Ms. Manika Dey, Ms. Kumudini Tahiliani and Ms. Rachna Rajpal addressing the gathering



IPR's "Women Power"

WHO Recommends The Following Simple Steps To



- Wash your hands frequently**
- Maintain social distancing**
- Avoid touching your eyes, nose and mouth**
- Practice respiratory hygiene**
- If you have fever, cough and difficulty in breathing, seek medical care early**
- Stay informed and follow advice given by your healthcare provider**

“Swachhta-Pakhwada” was observed at IPR during 16-28 February, 2020. This is observed by all Government establishments including all DAE establishments. As part of this drive, All IPR staff members were actively participated in this drive. Activities carried out during the Swachhta Pakhwada include;

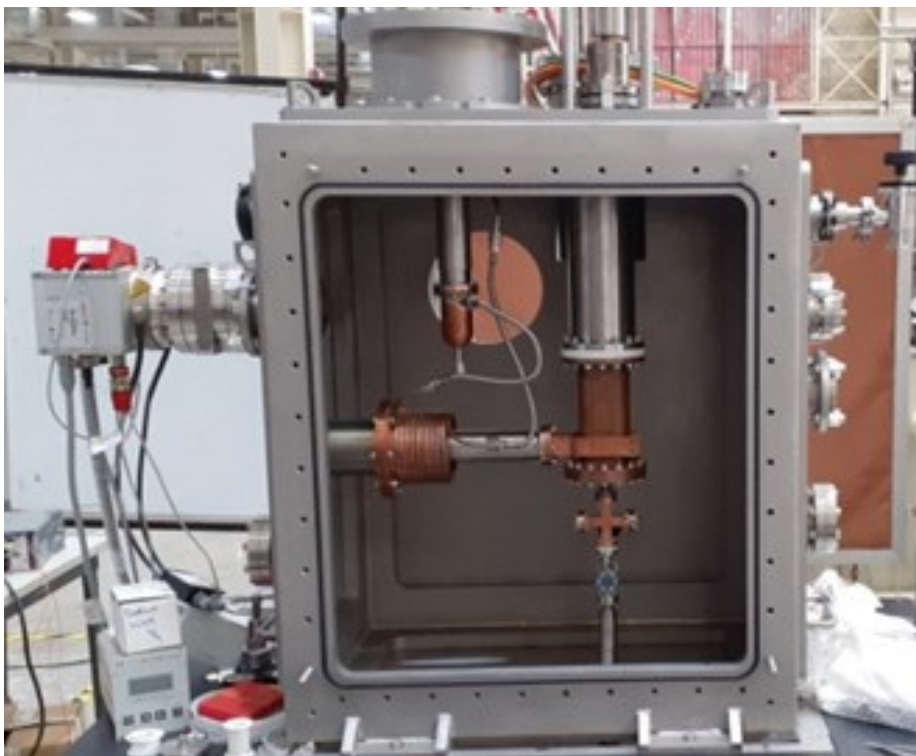
- Removal of all unwanted waste items collected from offices, laboratories and various open spaces of the institute, segregated and disposed off them properly.
- Survey of all the offices, laboratories, canteens, guest houses, kitchens, and lavatories to check proper cleaning and waste disposal.



Injection of solid hydrogen fuel is one of the most promising technologies for the core plasma fueling and disruption mitigation. IPR is currently developing systems based on advanced techniques for exhaust and fueling of fusion plasma machines. A Single Pellet Injector System (SPINS-IND), a pneumatic injector system developed at IPR has been installed on the SST-1 Machine. The system can form pellets of 2 -5 mm size pellet formation which can then be accelerated at the rate of one pellet in 2 minutes. With the goal of achieving the requirement of continuous fueling, with a frequency of 10 pellets per second, an Extruder Type Pellet Injector System (ETPIS) is under development. It is a cryogenic twin screw system having inter-meshing counter-rotating screws rotating at temperature < 12 K. An integrated system is fabricated comprising of twin screw assembly, cold heads, heat exchanger components enclosed in a cuboid-shaped vacuum chamber. Installation of the ETPIS twin screw and vacuum enclosure system is currently under installation at the new R&D lab building at IPR. During installation, the twin-screw assembly of the ETPIS system is cooled down to 80K temperature, and at the same time, screws were rotated at 15RPM by using a servo motor.



Team members (from left): Mr. DivyaRaj Sodha, Dr. Jyoti Shankar Mishra, Mr. Samiran Mukherjee, Ms. Ranjana Gangradey (Team Leader), Dr. Shashi Kant Verma, Mr. Paresh Panchal, Mr. Pratik Nayak and Mr. Vishal Gupta



(L) Inside view of twin screw assembly and heat exchanger (R) The Cryogenic Twin-Screw Extruder System assembled with servomotor (Inset) View of the internal components through the view port.

- ◆ **Mr. Sonu Yadav**, Institute for Plasma Research, Gandhinagar, gave a talk on "Effect of In-homogeneous magnetic field on helicon antenna produced expanding plasma" on 27th February 2020
- ◆ **Mr. Avnish Kumar Pandey**, Institute for Plasma Research, Gandhinagar, gave a talk on "Physics and Application of Sheaths Involving Negative Ions" on 28th February 2020
- ◆ **Dr. Modhuchandra Laishram**, University of Science and Technology of China, Hefei, gave a talk on "Extended hybrid kinetic-magnetohydrodynamic model for burning plasma" on 28th February 2020
- ◆ **Mr. Mayank Rajput**, Institute for Plasma Research, Gandhinagar, gave a talk on "Study of Transmutation, Gas Production and Displacement Damage in Iron, Tungsten and Chromium for D-T Neutron Irradiation" on 2nd March 2020
- ◆ **Mr. Omkar Myatra**, CCFE, Culham and Department of Physics, University of York, UK, gave a talk on "The potentially important role of B in divertor detachment control" on 6th March 2020
- ◆ **Dr. Pradeep Kumar**, Indian Institute of Technology, Mandi, gave a talk on "Computation of Non-Gray Properties of Radiative Heat Transfer and Interaction with Fluid Flow" on 13th March 2020
- ◆ **Mr. Montu Prafulbhai Bhuvra**, Institute for Plasma Research, Gandhinagar, gave a talk on "Magnetic field effects on Cold Hollow Cathode DC Discharge - An Experimental and Modeling Study" on 16th March 2020
- ◆ **Dr. Alamgir Mondal**, Institute for Plasma Research, Gandhinagar, gave a talk on "Effect of magnetic field on the lateral interaction of plasma plumes" on 16th March 2020

Upcoming Events

- ◆ 14th International Topical Meeting on Nuclear Applications of Accelerators (AccApp '20), Vienna, Austria, 5-9 April 2020 <http://accapp20.org>
- ◆ 3rd International Conference on Data-Driven Plasma Science (ICDDPS-3), Okinawa Institute of Science and Technology (OIST), Okinawa, Japan, 19-24 April 2020 <http://www.ppl.eng.osaka-u.ac.jp/ICDDPS3/>
- ◆ Technology of Fusion Energy (TOFE) 2020, Charleston, SC, 20-23 April 2020 <http://tofe.ans.org/>
- ◆ 47th IOP Plasma Physics Conference, London, 21-24 April 2020 <http://plasma2020.iopconfs.org/home>

Know Your Colleague



Mr. Nitin D. Shah joined IPR as a Technical Trainee in 2002 and was subsequently appointed as Engineer-SC in SST-1 Cryogenics Division in 2003. He holds a B. Tech. degree in Mechanical Engineering from Dr. Babasaheb Ambedkar Technological University, Maharashtra and a M. Tech. degree in Mechanical Engineering from SVNIT, Surat. In IPR (2003-2006), he was actively involved in the installation & commissioning of 1.3kW Helium refrigeration cum liquefier plant, IFDCS, WGM, LN2 system and fabrication activities related to various tests. In ITER-India Cryogenics (2007-2017), he was responsible for design, manufacturing and testing of prototype cryo-line as well as design and procurement of cryogenic test facility for ITER-India Cryogenics Laboratory (IICL). Tests for both prototype cryo-lines were successfully completed at IICL in 2015 and 2016. He was also TRO and contract manager for complete scope (design to installation) of approximately 10km network of ITER cryo and warm lines. Since Sept-2017, he is working at ITER organization, where he is in-charge of design, manufacturing, transport, preservation, installation and test related aspects of ITER cryo and warm-lines. As a part of academic activities, he has guided TTP and M. Tech. students, and was reviewer of scientific papers for Indian Journal of Cryogenics and IOP Conf. Series: Materials Science and Engineering.

The IPR Newsletter Team

Ritesh Srivastava	Tejas Parekh	Ravi A. V. Kumar	Priyanka Patel	Dharmesh P	Mohandas K.K.
Suryakant Gupta	Ramasubramanian N.	Chhaya Chavda	Shravan Kumar	Supriya Nair	Harsha Machchhar

Institute for Plasma Research
Bhat, Near Indira Bridge
Gandhinagar 382 428,
Gujarat (India)



Web : www.ipr.res.in
E-mail : newsletter@ipr.res.in
Tel : 91-79-2396 2000
Fax : 91-79-2396 2277