Australian ITER Forum Website News Update 8/18

B.J.Green (13/8/18)

1. David Gann named new UKAEA Chair | 19/07/2018

http://www.ccfe.ac.uk/news_detail.aspx?id=456

Sam Gyimah, Minister of State for Universities, Science, Research and Innovation, today announced the appointment of Professor David Gann CBE as the new Chair of CCFE's operator, the UK Atomic Energy Authority (UKAEA).
David Gann will take up his post on 1st August, taking over from Professor Roger Cashmore.
David Gann is Imperial College London's Vice President, leading on innovation, and is a member of Imperial's President's Board. He has played a central role in substantial growth at Imperial College, notably in the **new White City campus** and new ventures such as **ThinkSpace**.
He is a chartered civil engineer with a PhD in Industrial Economics and was Deputy Principal at the Imperial College Business School. He retains roles as Professor of Innovation and Technology Management at Imperial College's Business School. He is the author of eight books on innovation, entrepreneurship and technology management, which have been published in seven languages.
UKAEA is responsible for leading the commercial development of fusion power and related technology. UKAEA manages the UK fusion programme at CCFE, which is a global hub for scientific talent. In recent years UKAEA's research has created emerging spin-out industries in areas such as robotics, material sciences and reactor design, reinforcing the UK's position as a world-leader in fusion research and development.
The Chair is responsible for leading the UKAEA Board's strategy and ensuring that its objectives are achieved.
Sam Gyimah said: "The UK is a world-leader in nuclear technology and innovation and I am delighted that Professor David Gann will be the new Chair of the UKAEA Board.
"His extensive experience in growing businesses and academic institutions will be crucial to the continued success of our nuclear industry. I want to thank Professor Roger Cashmore for his outstanding service to UKAEA. His commitment and dedication to the mission since 2010 has been invaluable in our cutting-edge work towards commercial success in nuclear fusion."
David Gann said: "I look forward to working with the extraordinarily talented team at UKAEA, and with the wider science and technology community, with the UK positioned as a global leader in fusion technology, providing a future source of sustainable energy.

"Coming from a highly collaborative academic institution, I am excited by the prospect of UKAEA enhancing its global ties with industry and academia. These are exciting times, with the UK's expertise in atomic energy leading to innovation in a range of technologies in robotics and new materials, which also have a wider set of industrial uses."
Image credit: Imperial College London

2. *Energy Secretary Visits General Atomics*

Perry reviews DOE-supported advanced nuclear fission, fusion and HED physics programs

San Diego, CA – July 18, 2018: Since taking office, Secretary of Energy Rick Perry has championed his department's critical role in supporting scientific research, nuclear security, and the future of the U.S. energy sector. Perry got an up-close look at how Department of Energy (DOE)-funded programs interact with private industry to address those challenges on a visit to General Atomics (GA) Wednesday.

http://www.ga.com/energy-secretary-visits-general-atomics

The secretary began the day with a visit to the facility where GA is developing accident tolerant fuel (ATF) rod cladding for current nuclear reactors as part of DOE's ATF initiative. Manufactured from an advanced silicon-carbide composite known as SiGA™, GA's ATF cladding can withstand far higher temperatures than current metal designs. This will help extend the life of current reactors by reducing operating costs and significantly reducing the risk of core damage from loss-of-coolant accidents, while also paving the way for advanced reactors that can greatly exceed the capabilities of the current fleet.

Perry then visited the DIII-D National Fusion Facility, which has been operated by GA for DOE since the 1980s. DIII-D – the largest magnetic fusion research facility in the U.S. – is a world-class user facility capable of carrying out a wide range of fusion experiments. DIII-D hosts collaborators from more than 100 institutions worldwide, including seven DOE national laboratories. The magnetic fusion program at GA has led to vital scientific discoveries and spinoff technologies that have advanced the state of the art in a wide variety of fields.

After DIII-D, Perry toured the laboratories where GA manufactures precision targets and other components for the National Nuclear Security Administration's Inertial Confinement Fusion (ICF) program. GA supplies nearly 90% of the ICF targets used by the NNSA and university scientists studying the extreme conditions of high-energy-density that occur in nuclear weapons and stellar interiors.

“General Atomics has maintained a valuable and productive partnership with the DOE and its predecessor agencies on a wide variety of research for our entire existence,” Jeffrey Quintenz, Senior Vice President of General Atomics’ Energy Group said. “We are very proud to give Secretary Perry a first-hand look at the work we are doing for the Department, to provide the opportunity to meet some of our dedicated scientists and engineers, and to describe some of the important advances we expect over the next decade.”

Finally, Perry visited GA’s Magnet Technologies Center in Poway, where the company is fabricating the Central Solenoid (CS) for the ITER fusion reactor under construction in France. The CS is the heart of ITER, and the 5-story, 1,000-ton magnet will drive 15 million amperes of electrical current to stabilize the fusion plasma. The completed CS will power ITER in its quest to prove that nuclear fusion – the process that powers the stars – can provide virtually limitless safe, clean and renewable energy for the world.

About General Atomics: *General Atomics pioneers advanced technologies with world-changing potential. GA has been at the cutting edge of energy innovation since the dawn of the atomic age – for more than 60 years. With scientists and engineers continually advancing the frontier of scientific discovery, GA is serving our growing planet’s needs through safe, sustainable, and economical solutions across a comprehensive array of key energy technologies.*

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3. No more zigzags: Scientists uncover mechanism that stabilizes fusion plasmas

July 18, 2018 by John Greenwald, Princeton Plasma Physics Laboratory
https://phys.org/news/2018-07-zigzags-scientists-uncover-mechanism-stabilizes.html

Sawtooth swings—up-and-down ripples found in everything from stock prices on Wall Street to ocean waves—occur periodically in the temperature and density of the plasma that fuels fusion reactions in doughnut-shaped facilities called tokamaks. These swings can sometimes combine with other instabilities in the plasma to produce a perfect storm that halts the reactions. However, some plasmas are free of sawtooth gyrations thanks to a mechanism that has long puzzled physicists.

Researchers at the U.S. Department of Energy's (DOE) Princeton Plasma Physics Laboratory (PPPL) have recently produced complex simulations of the process that may show the physics behind this mechanism, which is called "magnetic flux pumping." Unraveling the process could advance the development of fusion energy.

Fusion drives the sun and stars

Fusion, the power that drives the sun and stars, is the fusing of light elements in the form of plasma—the hot, charged state of matter composed of free electrons and atomic nuclei—that generates massive amounts of energy. Scientists are seeking to replicate fusion on Earth for a virtually inexhaustible supply of power to generate electricity.

The flux pumping mechanism limits the current in the core of the plasma that completes the magnetic field that confines the hot, charged gas that produces the reactions. This development, found in some fusion plasmas, keeps the current from becoming strong enough to trigger the sawtooth instability.

Spearheading the research that uncovered the process was physicist Isabel Krebs, lead author of a *Physics of Plasmas* paper describing the mechanism that was published last September and made into a DOE Office of Science highlight in June that summarizes the findings. Krebs, a post-doctoral associate, used the PPPL-developed M3D-C1 code to simulate the process on the high-performance computer cluster at PPPL, working closely with theoretical physicists Stephen Jardin and Nate Ferraro, developers of the code. "The mechanism behind magnetic flux pumping had not been understood," Jardin said. "Isabel's paper describes the process."

Hybrid scenarios

In the PPPL simulations, magnetic flux pumping develops in "hybrid scenarios" that exist between standard regimes—which include high-confinement (H-mode) and low-confinement (L-mode) plasmas—and advanced scenarios in which the plasma operates in a steady state. In hybrid scenarios, the current remains flat in the core of the plasma while the pressure of the plasma stays sufficiently high.

This combination creates what is called "a quasi-interchange mode" that acts like a mixer that stirs up the plasma while deforming the magnetic field. The mixer produces a powerful effect that maintains the flatness of the current and prevents the sawtooth instability from forming. A similar process maintains the magnetic field that protects the Earth from cosmic rays, with the molten liquid in the iron core of the planet serving as mixer.

The mechanism also regulates itself, as the simulations show. If the flux pumping grows too strong, the current in the core of the plasma stays "just below the threshold for the sawtooth instability," according to Krebs. By remaining below the threshold, the current keeps the plasma temperature and density from zigzagging up and down.

The simulations could lead to measures to avoid the troublesome swings. "This mechanism may be of considerable interest for future large-scale fusion experiments such as ITER," Krebs said. For ITER, the major international fusion experiment under construction in France, creation of a hybrid scenario could produce flux pumping and deter sawtooth instabilities

One way to develop the hybrid scenario will be for operators of ITER to experiment with the timing of the neutral beam power that will heat the ITER plasma to fusion temperatures. Such experiments could lead to the combination of plasma current and pressure that produces sawtooth-free operation.

Explore further: Simulations of magnetically confined plasmas reveal a self-regulating stabilizing mechanism

More information: I. Krebs et al, Magnetic flux pumping in 3D nonlinear magnetohydrodynamic simulations, *Physics of Plasmas* (2017). DOI: 10.1063/1.4990704

4. LLNL Fusion Scientists Receive Awards

https://lasers.llnl.gov/news/nif-people
Two Laboratory plasma physicists have received national recognition for their work in magnetic and laser fusion.

Max Fenstermacher

Magnetic fusion physicist Max Fenstermacher has been awarded the 2018 John Dawson Award for Excellence in Plasma Physics Research from the American Physical Society. He is cited jointly with Todd Evans of General Atomics and Richard Moyer of the University of California, San Diego.

Fenstermacher's team was cited "for the first experimental demonstration of the stabilization of edge localized modes in high-confinement diverted discharges, by application of very small edge-resonant magnetic perturbations, leading to the adoption of suppression coils in the ITER design."

ITER is an international nuclear fusion research and engineering megaproject, which will be the world's largest magnetic confinement plasma physics experiment.

The Dawson award recognizes a particular recent outstanding achievement in plasma physics research. The award consists of $5,000 to be divided equally in the case of multiple recipients, and includes a certificate citing the contributions made by the recipient or recipients to be presented at an award ceremony at the Division of Plasma Physics annual meeting banquet.

Fenstermacher, Evans and Moyer performed experiments that proved edge magnetic plasma instabilities in toroidally confined fusion plasmas, known as Edge Localized Modes or "ELMs," can be stabilized by applying small 3D magnetic perturbation fields.

ELM stabilization was predicted and confirmed experimentally by an international team of physicists in the DIII-D tokamak at General Atomics and published in a 2004 issue of *Physical Review Letters* and a 2006 issue of *Nature Physics*. Analysis of DIII-D data showed a correlation between the effectiveness of ELM mitigation and the width of the region in the plasma edge where the induced magnetic islands overlapped. The analysis suggested a threshold width of island overlap to achieve full ELM stabilization.

This threshold was used to make the initial predictions of the magnetic perturbation amplitude required to suppress ELMS in the ITER tokamak, which in turn guided the design of a proposed set of internal ELM control coils for ITER, currently under construction in France. These results have since been reproduced in tokamak experiments in South Korea, China and Germany. The suppression of these edge plasma instabilities is critically important for preventing damage to vacuum vessel walls of high power fusion reactors such as ITER. Based on the success of this approach, the ITER organization added a set of internal 3D perturbation coils similar to those in DIII-D in the baseline design of the device.

Critical System

“I’m honored to be part of the team recognized for our pioneering work on ELM control with 3D magnetic fields in the DIII-D tokamak,” Fenstermacher said. “The period from 2004-10 was an intense time of experimentation and attempts to extrapolate the results, as the ITER project grappled with the difficult decision of whether to add expensive ELM control coils to the device. I very much appreciate the recognition from the APS-DPP that our work was essential to the decision to add the coils, which are now viewed as a critical system to assure ITER’s success.”

Fenstermacher has been a physicist in the Magnetic Fusion Energy Program at LLNL since 1988. He graduated with a double major in mathematics and physics from Kalamazoo College and completed his master’s degree and Ph.D. in nuclear engineering (plasma physics) at the University of Michigan. He began his career in 1983 on location at LLNL as a member of the TRW plasma physics group supporting the MFTF-B tandem mirror. In 1988, he became a member of the LLNL staff, supporting the Microwave Tokamak Experiment (MTX) to couple the ALCATOR-C tokamak to a Free Electron Laser (FEL). Since 1994, he has been located off-site as a member of the LLNL experimental team at the DIII-D National Fusion Facility in San Diego.

Fenstermacher is a member of Phi Beta Kappa, Tau Beta Pi and the APS. He serves as a U.S. representative to the ITER Science and Technical Advisory Committee, has been the chair of the ITPA ELM Control working group since 2008, and has served for eight of the last 10 years as the experimental coordinator for the DIII-D tokamak program at General Atomics.

Bruce Cohen

LLNL retiree Bruce Cohen was selected as the recipient of the 2018 IEEE Nuclear and Plasma Sciences Society’s Charles K. Birdsall Award for “contributions to the numerical simulation of plasmas, particularly multiple time-scale methods and to their application to diverse plasma physics problems, from laser-plasma interactions to tokamaks.”

The Birdsall Award recognizes outstanding contributions in computational nuclear and plasma science, with preference given to areas within the broadest scope of plasma physics encompassing the interaction of charged particles and electromagnetic fields.

“I am elated to receive the IEEE NPSS Birdsall Award,” Cohen said. “It is very gratifying to have one’s research career in physics recognized with this award. I am very thankful to my supervisors and colleagues at LLNL and DOE for creating a great environment and supporting my work for the past 42 years. I have a special connection to Ned Birdsall as he was one of my professors at UC Berkeley and on my Ph.D. thesis committee, and I worked with him on a number of projects at Berkeley and later at LLNL.”

Cohen received his bachelor’s degree in physics with distinction and honors at Harvey Mudd College and his master’s degree and Ph.D., both in physics, from UC Berkeley.”

He worked as a physicist at LLNL from August 1976 to his retirement in January 2017. He was a group leader for Theory and Computations in the Fusion Energy Sciences Program at LLNL from 2007 to 2016 after being the deputy group leader from 1998 to 2016. He was elected an American Physical Society Fellow in the Division of Plasma Physics in 1987 and served as an associate editor for both the *Journal of Computational Physics* and *Physical Review Letters*.

Cohen has served on numerous committees for the American Physical Society Division of Plasma Physics and the Department of Energy's Office of Science, Fusion Energy Sciences. His research has addressed plasma and computational physics topics in magnetic confinement fusion, laser fusion, space and astrophysical plasmas, radio-frequency heating of plasma, parametric instabilities, nonlinear beat-wave processes, linear and nonlinear theory of microinstabilities and turbulent transport, and the application and development of particle and fluid plasma simulation and multiple-time-scale computational methods. He has authored or coauthored more than 160 refereed journal publications and chapters in two books.

5. 06 August 2018

Cryoplant equipment arrives at ITER Neutral Beam Test Facility

http://fusionforenergy.europa.eu/mediacorner/newsview.aspx?content=1258

The trucks transporting the equipment of the cryoplant that will cool down MITICA, the second experiment of the prestigious ITER Neutral Beam Test Facility, have reached Padua. It's a humid hot summer afternoon, in stark contrast to the cold temperatures that will be produced by the "refrigerator" of this experiment.
Consorzio RFX, in collaboration with F4E, ITER Japan, and ITER International Organization are the Parties contributing to MITICA (Megavolt ITER Injector and Concept Advancement). The tests carried out there will help scientists test the potential of a Neutral Beam Injector (NBI) prototype that will feed directly towards the design and manufacturing of the NBI used in ITER.
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MITICA requires a cryogenic system to cool down the cryogenic pump in order to maintain the necessary vacuum during operation. F4E in collaboration with Air Liquide, have been working together since autumn 2016 to manufacture the components of the MITICA cryoplant. In July 2018, more than 90% of its equipment has been completed. The overall budget of the contract is in the range of 6 million EUR and the cryoplant is expected to be ready by April 2019. Grigory Kouzmenko, F4E Technical Officer, explains that "…the teams on the ground have started installing the components and they are expected to conclude this stage by October 2018. From November until spring next year, the phases of commissioning and testing should be concluded."

The cryoplant will supply helium at -196 °C to cool down the thermal shields and at -269 °C it will cool down the cryopanels, which will absorb the gas used to neutralise the high-energy beams. Periodically, warmer gas at room temperature or at 127 °C will flow through the cryopanels to extract any gas stored. In spite of the fact that the cryoplant is based on conventional equipment, it is enhanced with sophisticated auxiliary systems to cope automatically with a wide range of operational conditions.

Benoît Hilbert, Managing Director of Air Liquide advanced Technologies, explains that "...in addition to the ITER Cryogenic system that Air Liquide is responsible for delivering; it is also contributing to cryoplant system of the ITER Neutral Beam Test Facility in Padua, Italy. In close collaboration with F4E, the manufacturing and delivery of equipment was completed in June. Next, we will procced with the installation of the piping interconnections which involve more than 20 vacuum lines."

6. 30 July 2018

Winding is over for ITER's sixth Poloidal Field coil

http://fusionforenergy.europa.eu/mediacorner/newsview.aspx?content=1257

Six massive superconducting magnets, known as Poloidal Field (PF) coils, will embrace the ITER machine from top to bottom to shape and contribute to the stability of the superhot plasma. Europe is responsible for the production of five of these coils. One of Europe's coils, however, the heaviest and lowest of all PF coils, is manufactured in China. Following an agreement between F4E and The Institute of Plasma Physics of the Chinese Academy of Sciences (ASIPP), and in line with the ITER project's spirit of collaboration, ASIPP and F4E have joined forces to manufacture the sixth PF coil, in Hefei (China).

At the end of June, ASIPP celebrated a major milestone by completing the winding of the conductor lengths needed for the coil. The sixth PF coil consists of nine pairs of windings, known as Double Pancakes (DPs). It has been a long journey since the fabrication of the first pre-dummy DP in February 2016, followed by a dummy Double Pancake, before going ahead with the production of the first DP in February 2017.

The winding of each DP took around one month. Basically, it involved winding two superconducting cable lengths which eventually take the form of a spiral. Each turn of superconductor had to be electrically insulated from the adjacent turn with a combination of Kapton and fibre glass tapes.

Furthermore two helium inlets had to be carefully fabricated to allow cold helium to flow inside the coil. The whole process was rigorously controlled to ensure the DP is fabricated in line with the technical requirements by a dedicated team of specialist technicians and engineers.

"ASIPP have been very collaborative with F4E and have reached this milestone due to the hard work, professionalism and attention to detail of their teams" explain Carlo Sborchia and Peter Readman, F4E Technical Officers following the production in China.

It is expected that by the end of September all nine DPs will be fully impregnated paving the way for stacking, an activity where they will be placed one of top of each other, connected electrically and hydraulically. Then the nine DPs will become one solid component, known as the "Winding Pack" (WP), it will be ground insulated and impregnated. The final assembly of the WP will take place before shipment to the ITER site in France, which is expected before mid-2019.

7. 0 July 2018

Antimatter seeks inspiration in fusion

http://fusionforenergy.europa.eu/mediacorner/newsview.aspx?content=1255

The Facility for Antiproton and Ion Research FAIR is an international accelerator facility under construction. The facility will use antiprotons and ions to solve some of the most perplexing mysteries of matter and will carry out experiments in the area of high density plasma physics. The facility is being built in Darmstadt, Germany, by partners from Finland, France, Germany, India, Poland, Romania, Russia, Slovenia and Sweden that signed an international treaty, the FAIR Convention, in March 2014. It should be ready in few years' time and is expected to host more than 3000 scientists from about 50 countries.

Dr. Sonia Utermann and Felix Arndt from FAIR (Facility for Antiproton and Ion Research) visited Fusion for Energy on 17-18 July 2018 to meet F4E colleagues and exchange best practices in the procurement of high technology components for big science facilities. Discussions focused in particular on F4E practices in pre-procurement analysis, indexation, open software, export control, and in-kind procurement. The FAIR colleagues were hosted by Leonardo Biagioni, F4E Head of Contracts & Procurement, and Victor Saez, Head of Market Intelligence. Dr. Utermann thanked them sincerely for welcoming them to Barcelona and underlined that “F4E experience in procurement is extremely useful for us and would be of great help for improving our practices”.

8. Mirror image gives 'spectacular' view of JET's plasma | 02/08/2018

http://www.ccfe.ac.uk/news_detail.aspx?id=459

Remarkable views of the JET plasma are now being achieved – from cameras located outside the machine hall!

New cameras installed on the exterior of JET's bioshield wall use mirrors to capture detailed views from the heart of the plasma (see video).

A sophisticated engineering project has moved the diagnostics camera system out of the Torus Hall to prevent neutron damage in high power Deuterium-Tritium operations. The system will be commissioned over the coming months.

. Multiple camera systems covering two separate lines of sight – which help scientists discover more about plasma behaviour and its effect on components of the tokamak – now lie behind the bioshield following the CDT-2 project (Cameras Compatible with Deuterium-Tritium Operation, Phase 2). Two optical relay systems ensure the images are reflected to the camera systems (40m and 30m away of optical path respectively from their previous location) and that the picture isn't hindered by the 3 metre-thick bioshield.

Without the cameras being relocated, any live pictures from inside the vessel would be "as clear as a white cat in a snow storm", according to Guy Matthews, lead scientist on the project.

Past experience suggests that during JET's forthcoming Deuterium-Tritium operations, the neutron dose will be such that the cameras would only last for one high performance pulse if left in their previous locations.

The mostly EUROfusion-funded project saw engineers drill two openings in the bioshield wall to allow clear lines of sight. The perspectives from the two groups of cameras are known as Wide Angle View (WAV), which views the cross section of the tokamak at Octant 5, and Divertor View (DIR) which covers the divertor tiles at the same octant.

Camera diagnostics in JET are used for variety of functions – whether that be operational, for machine protection, or for scientific reasons. For operation, the experiment session leaders need views of the plasma during a pulse and measurements of the temperature of the in-vessel plasma-facing components to ensure there is no damage to the materials. Scientific cameras are used for the simulation of plasmas, in addition to monitoring impurities and measuring heat fluxes to in-vessel components.

A new three storey optical lab has been attached to the Torus Hall wall to house the new camera clusters, while, in the hall itself, new structures have been built to support the large relay mirrors which enable the light beams to weave their way around existing JET equipment.

Three EUROfusion associations have been involved in the project – CCFE, CIEMAT (Spain) and the Wigner Research Centre for Physics (Hungary).

Engineering analysis for the supporting structures and mirror holders was carried out by John Williams with support from Ruben Otín and Neelam Gupta.

Itziar Balboa, who leads the viewing and thermal measurements group and was tasked with leading the CDT-2 team from July 2015, said: “It is like looking down a rabbit hole from across a field but with lots of trees in the way.

“A thorough stress analysis was carried out to assess the suitability of the supporting structures and mirror holders including the level and impact of eddy forces.”

Eddy currents are induced by the magnetic fields and can distort the mounting frames and cause unacceptable movement of the mirror relays. It was essential to produce a design which was compatible for all sorts of operational scenarios within JET.

The first data has already been recorded in the first JET pulses of 2018. Scott Silburn, who is responsible for the fast cameras and wide angle infra-red, said: “The first images from CDT-2 are quite spectacular and there's a lot excitement about what we do with the new capabilities in the upcoming JET experiments.”

The CDT-2 project has required a large diverse and highly skilled team including: Tim May-Smith, David Croft, Mike Stamp, Vaughan Thompson, Keith Pepperell, Alexander Huber, Christian Perez von Thun, Joao Figueiredo, Ian Pearson, Jonathan Naish, Richard Naish, Rob Fenn, Chris Rose, Brian Austin, Paul Carman, Dave Kinna, Graham Jones, Nigel Archer, Padraig Monagham, Steve Collins, Brian Wilson, James Clayton, Eddie Brianton, Steven Foley, James Pickard, Pedro Carvalho, Paolo Puglia, Valentina Huber, Marcus Price, Juuso Karhunen, Cliff Marren, David Hepple, Steve Whetham, Neil Conway, Klaus-Dieter Zastrow, Ana Manzanares, Eduardo de la Cal, Gabor Kocsis and Gabor Bodnar.

9. Energy Secretary Rick Perry cheers on fusion energy, science education at PPPL

By
Jeanne Jackson DeVoe
August 10, 2018

https://www.pppl.gov/news/2018/08/energy-secretary-rick-perry-cheers-fusion-energy-science-education-pppl

The Princeton Plasma Physics Laboratory's (PPPL) mission of doing research to develop fusion as a viable source of energy is vital to the future of the planet, U.S. Energy Secretary Rick Perry said during an Aug. 9 visit.

"It's important not just to PPPL, not just to the DOE (Department of Energy) but to the world," Perry told staff members during an all-hands meeting. "If we're able to deliver fusion energy to the world, we're able to change the world forever."

Perry received a standing ovation from the audience in the Melvin B. Gottleib Auditorium following the brief speech and question-and-answer session.

Perry, the 14th U.S. Secretary of Energy, was governor of Texas from 2000 to 2015. He was twice a candidate for president. Before becoming governor, he was elected lieutenant governor in 1998 and served two terms as Texas Commissioner of Agriculture and three terms in the Texas House of Representatives. A graduate of Texas A&M University, he served in the Air Force from 1972 to 1977.

A tour of NSTX-U and Science Education Laboratory

Before the all-hands meeting, Secretary Perry toured PPPL accompanied by Princeton University President Christopher L. Eisgruber, Princeton University Vice President for PPPL Dave McComas, and PPPL Director Steven Cowley, and Princeton Site Office Head Pete Johnson. The group first visited the National Spherical Torus Experiment-Upgrade (NSTX-U) test cell, where they learned about PPPL's flagship experiment. Stefan Gerhardt, head of Experimental Research Operations, told Perry that numerous scientists at other national laboratories and universities and institutions around the world collaborate on the experiment when it is operating.

The group then visited the Science Education Laboratory where they met with Science Education staff, graduate students and summer research interns. Program leader Shannon Greco told Perry about PPPL's Young Women's Conference for 7th -to-10th-grade girls, as well as PPPL's high school internships, college internships through the DOE's Science Undergraduate Laboratory Internship (SULI) and Community College Internship and other programs. Arturo Dominguez, Science Education Program Leader, showed Perry the Remote Glow Discharge Experiment (RGDX), which allows anyone in the world to learn about plasma through a remote access plasma experiment.

"The coolest job"

In introducing Perry to a packed crowd in the Auditorium and cafeteria, Cowley noted that Perry has called the job of being Energy Secretary "the coolest job" he's ever had.

In his remarks, Eisgruber said PPPL's mission intersects with the University's mission. "Princeton University has always been a place of innovation, a place where we tackle problems in novel and innovative ways," he said. "Cracking the code on fusion could crack the code on the energy future of the world. Princeton University is proud to be part of that endeavor."

Perry teased Cowley about the director's recent knighthood. Perry said that he often visits England but prefers the hot climate of Texas. He was stationed near Cambridge while in the Air Force and his father served in England as well.

Perry gave a bit of his own history. He grew up on a tenant farm 16 miles from the nearest post office and 200 miles from Fort Worth. He rarely left home until he went to Texas A&M University. After serving in the Air Force, he went on to become the governor of Texas, which he said has the 12th largest economy in the world, for 14 years. Perry said being governor was "the best job he ever had." But being Secretary of Energy is "the coolest," he said, because "I get to work with some of the coolest people in the world."

A shout out to Science Education staff

Perry was particularly impressed by PPPL's science education programs. He gave a shout out to Shannon Greco, a program leader in Science Education, and Deedee Ortiz, the program manager. "When I go back to Texas, I'm going to know there are people here that are passionate, that are potentially changing the world with what you do with that program," Perry said.

Science education programs should not only be funded adequately but should also be better publicized so that Americans "understand how important it is for us to have this pipeline of engineers and scientists and technicians coming in." We're at a juncture in this world, particularly when it comes to nuclear and energy and fusion energy, when we have to make sure that we have the brain power," he added. "That's one of our great challenges."

Discussing ITER views

At the end of his remarks, Perry answered questions from PPPL staff. The first question was how he views the international ITER experiment in the south of France, which is funded by the United States and other countries. Perry said that the project was "poorly managed" and "was not well run" in the past. However, Bernard Bigot, the current director-general of the ITER Organization, "has done a very good job managing the construction of it and now they're on track," Perry said. He said he recently visited the site and feels "more comfortable" with the progress of the experiment. However, "That's not to say all is well and here's the check and fill out whatever amount you need."

Perry was also asked his thoughts about the private efforts such as TAE Technologies (formerly Tri Alpha Energy) to develop fusion energy, and whether the DOE would expand funding for such private enterprises. Perry said that he couldn't comment on TAE specifically but he is generally "a big believer, a big supporter of public/private partnerships." "There are people who don't think the government needs to do anything," he said. "I'm not one of those. We need to be smart about it, we need to be thoughtful about it, we need to bring Steve Cowley in and have him say, "this one looks pretty good."

Perry said that fusion energy is just one example of scientific research supported by the DOE that could change the future. "We think about fusion and clean energy and harnessing the power of the sun and the stars but all of these things come along when America really focuses on science and technology and we fund it and celebrate it," he said. "That's the beauty and greatness of what this is all about."

PPPL, on Princeton University's Forrestal Campus in Plainsboro, N.J., is devoted to creating new knowledge about the physics of plasmas — ultra-hot, charged gases — and to developing practical solutions for the creation of fusion energy. The Laboratory is managed by the University for the U.S. Department of Energy's Office of

Science, which is the largest single supporter of basic research in the physical sciences in the United States, and is working to address some of the most pressing challenges of our time. For more information, please visit science.energy.gov(link is external).

10. Workshop advances plans for coping with disruptions on international ITER facility

By
John Greenwald
August 3, 2018
https://www.pppl.gov/news/2018/08/workshop-advances-plans-coping-disruptions-international-iter-facility

The sixth Annual Theory and Simulation of Disruptions Workshop at the U.S. Department of Energy's (DOE) Princeton Plasma Physics Laboratory (PPPL) made substantial progress toward planning a system for mitigating disruptions on ITER, the international experiment under construction in France to demonstrate the feasibility of fusion power. Disruptions, the sudden loss of heat in plasma that halts fusion reactions, can seriously damage ITER and other doughnut-shaped fusion facilities called tokamaks, and are among the major challenges facing the international experiment.

Design of a disruption mitigation system for ITER is a primary responsibility of U.S. fusion scientists, said Amitava Bhattacharjee, head of the Theory Department at PPPL and organizer of the June 16-19 workshop attended by some 35 U.S. and international physicists.

Fusion, the process that powers the sun and stars, is the fusing of light elements in the form of plasma — the hot, charged state of matter composed of free electrons and atomic nuclei — that generates massive amounts of energy. Scientists are seeking to replicate fusion on Earth for a virtually inexhaustible supply of energy to generate electricity.

Topics discussed during the three-day event covered theoretical and experimental research on issues ranging from runaway electrons — searing laser-like beams of high voltage and current that can damage tokamaks — to machine-learning software for predicting disruptions in time to tame them. "Controlling disruptions, particularly runaway electrons, is among the most important challenges confronting ITER," Bhattacharjee said. "Working closely with our colleagues at ITER, we must develop a plan over the next few years for a reliable disruption mitigation system for this facility."

Shattered pellet injection

A key method outlined during the workshop is injection of shattered pellets, composed of elements such as boron or beryllium, to control ITER disruptions. The technique has chiefly been tested on the DIII-D national fusion facility that General Atomics operates for the DOE in San Diego, and important results from this facility were presented by DIII-D scientists. United Kingdom's Joint European Torus (JET), the largest and most powerful tokamak in operation today, will begin shattered pellet testing in December.

Workshop presenters included Daniele Carnevale of the University of Rome Tor Vergata, who discussed control of runaway electron beams on the Frascati Tokamak Upgrade (FTU) in Frascati, Italy, and the TCV tokamak in Lausanne, Switzerland, two medium-sized fusion facilities. Carnevale said the experiments demonstrated improved control of runaway electrons through use of a fast-control feedback system that held the plasma in place, but full control of runaways has yet to be achieved. Feedback control will next be tested on JET, he said.

Among theory speakers was physicist Dylan Brennan of PPPL and Princeton University, who serves as principal investigator of the Simulation Center for Runaway Electron Avoidance and Mitigation (SCREAM). The two-year-old center combines simulations and data from worldwide experiments to explore the causes and solutions for runaway electrons. Brennan said the group has developed a rigorous way to couple large codes that simulate runaway electron generation with codes that simulate disruptions. Such coupling requires coordination of experts in these codes, he said.

Simulation tools are rapidly advancing, according to Bhattacharjee. Such tools are being developed to simulate and predict the behavior of plasmas in ITER. "Predictive capability is what we must have for ITER," he pointed out. "ITER cannot be used for learning about disruptions — it must avoid or mitigate disruptions and operate successfully."

PPPL, on Princeton University's Forrestal Campus in Plainsboro, N.J., is devoted to creating new knowledge about the physics of plasmas — ultra-hot, charged gases — and to developing practical solutions for the creation of fusion energy. The Laboratory is managed by the University for the U.S. Department of Energy's Office of Science, which is the largest single supporter of basic research in the physical sciences in the United States, and is working to address some of the most pressing challenges of our time. For more information, please visit science.energy.gov(link is external).

11. Newest supercomputer to help develop fusion energy in international device

By
John Greenwald
July 25, 2018

https://www.pppl.gov/news/2018/07/newest-supercomputer-help-develop-fusion-energy-international-device

Scientists led by Stephen Jardin, principal research physicist and head of the Computational Plasma Physics Group at the U.S. Department of Energy's (DOE) Princeton Plasma Physics Laboratory (PPPL), have won 40 million core hours of supercomputer time to simulate plasma disruptions that can halt fusion reactions and damage fusion facilities, so that scientists can learn how to stop them. The PPPL team will apply its findings to ITER, the international tokamak under construction in France to demonstrate the practicality of fusion energy. The results could help ITER operators mitigate the large-scale disruptions the facility inevitably will face.

Receipt of the highly competitive 2018 ASCR Leadership Computing Challenge (ALCC) award entitles the physicists to simulate the disruption on Cori, the newest and most powerful supercomputer at the National Energy Research Scientific Computing Center (NERSC) at Lawrence Berkeley National Laboratory. NERSC, a U.S. Department of Energy Office of Science user facility, is a world leader in accelerating scientific discovery through computation.

Model the entire disruption

"Our objective is to model development of the entire disruption from stability to instability to completion of the event," said Jardin, who has led previous studies of plasma breakdowns. "Our software can now simulate the full sequence of an ITER disruption, which could not be done before."

Fusion, the power that drives the sun and stars, is the fusing of light elements in the form of plasma — the hot, charged state of matter composed of free electrons and atomic nuclei — that generates massive amounts of energy. Scientists are seeking to replicate fusion on Earth for a virtually inexhaustible supply of power to generate electricity.

The award of 40 million core hours on Cori, a supercomputer named for Nobel Prize-winning biochemist Gerty Cori that has hundreds of thousands of cores that act in parallel, will enable the physicists to complete in weeks what a single-core laptop computer would need thousands of years to accomplish. The high-performance computing machine will scale up simulations for ITER and perform other tasks that less powerful computers would be unable to complete.

On Cori the team will run the M3D-C1 code primarily developed by Jardin and PPPL physicist Nate Ferraro. The code, developed and upgraded over a decade, will evolve the disruption simulation forward in a realistic manner to produce quantitative results. PPPL now uses the code to perform similar studies for current fusion facilities for validation.

The simulations will also cover strategies for the mitigation of ITER disruptions, which could develop from start to finish within roughly a tenth of a second. Such strategies require a firm understanding of the physics behind mitigations, which the PPPL team aims to create. Together with Jardin and Ferraro on the team are physicist Isabel Krebs and computational scientist Jin Chen.

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12. Safety review sought for new Japanese reactor

10 August 2018

Share

Chugoku Electric Power Company has initiated the regulatory process for starting up unit 3 at its Shimane nuclear power plant by applying to the Japanese regulator for a review to assess its compliance with revised safety standards. Construction of the 1373 MWe advanced boiling water reactor (ABWR) is nearing completion.

http://www.world-nuclear-news.org/Articles/Safety-review-sought-for-new-Japanese-reactor?feed=feed

Construction of Shimane 3, in Japan's Shimane prefecture, started in December 2005. In February 2011 - a month before the accident at the Fukushima Daiichi plant - Chugoku announced that fuelling and start-up of the reactor had been delayed by three months, from March 2011 until June 2011, owing to a fault with the control rod drive mechanism. Commercial operation had correspondingly been put back from December 2011 to March 2012.

Following the Nuclear Regulation Authority's (NRA's) approval of the basic design earthquake ground motion for unit 2 at the Shimane site, Chugoku announced in February this year that it would seek to start up unit 3.

Under Japan's revised nuclear regulations, plant operators are required to apply to the NRA for: permission to make changes to the reactor installation; approval of its construction plan to strengthen the plant; and, final safety inspections to ensure the unit meets new safety requirements. Operators are required to add certain safety-enhancing equipment within five years of receiving the NRA's approval of a reactor engineering work programme.

In May, Chugoku requested permission from the Shimane prefectural government and the Matsue city government to apply to the NRA for safety conformity inspections of Shimane 3.

Having received those consents yesterday, Chugoku announced it has today submitted its application to the NRA for those checks, initiating the regulatory process for starting up Shimane 3.

Chugoku becomes the second Japanese utility to apply to the NRA for pre-operation safety inspections for a new nuclear power reactor since the Fukushima Daiichi accident. The first was Japan Electric Power Development Corp (J-Power), which applied in December 2014 for inspections of unit 1 at its Ohma nuclear power plant, also an ABWR, being built in Aomori prefecture. However, with construction of Shimane 3 more advanced than Ohma 1, Shimane 3 is likely to be the first new reactor to begin operating in Japan.

Researched and written by World Nuclear News

13. Haiyang AP1000s reach commissioning milestones

09 August 2018

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Milestones in the commissioning of the AP1000s under construction at the Haiyang nuclear power plant in China's Shandong province were met on 8 August. Unit 1 achieved first criticality, while fuel loading started at unit 2.

http://www.world-nuclear-news.org/Articles/Haiyang-AP1000s-pass-commissioning-milestones?feed=feed

Unit 1 of the Haiyang plant attained first criticality - a sustained chain reaction - at 10.42am yesterday, State Nuclear Power Technology Corporation (SNPTC) announced. The reactor is now in "a state of stable low-power operation", it said, adding that after completing a series of low-power physics tests, the unit's turbines will be driven for the first time using nuclear-generated steam and grid connection work will commence.

Synchronisation to the electricity grid will be followed by gradual power ascension testing until all testing has been safely and successfully completed at 100% power.

The loading of the 157 fuel assemblies into the core of Haiyang 1 began on 21 June. The unit is expected to begin operating by year-end.

SNPTC also announced the loading of fuel assemblies into Haiyang unit 2 began at 3.26pm yesterday following approval from the National Nuclear Safety Administration and the Ministry of Ecology & Environment. Haiyang 2 is expected to start up next year.

In September 2007, Westinghouse and its partner the Shaw Group received authorisation to construct four AP1000 units in China: two at Sanmen and two more at Haiyang in Shandong province. Construction of Sanmen 1 began in April 2009, while first concrete for Sanmen 2 was poured in December 2009. Construction of Haiyang 1 and 2 began in September 2009 and June 2010, respectively.

Sanmen 1 was the world's first AP1000 to start up, achieving first criticality on 22 June and grid connection on 2 July. Fuel has already been loaded into Sanmen 2 and the unit has been authorised to attained first criticality. That unit is expected to begin operating by the end of this year.

Four AP1000 reactors were also being built in the USA - two each at Vogtle and Summer. However, construction of the two Summer units was suspended last August.

Researched and written by World Nuclear News

14. Pickering relicensed to 2028

09 August 2018

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The Canadian Nuclear Safety Commission (CNSC) yesterday announced its decision to grant a new ten-year operating licence for Ontario Power Generation's (OPG) Pickering plant. The plant is scheduled to operate until the end of 2024.

http://www.world-nuclear-news.org/Articles/Pickering-relicensed-to-2028?feed=feed

OPG applied to the CNSC for a licence renewal for the six-unit plant in August 2017, following the government of Ontario's approval in January 2016 of the plant's continued operation to 2024 to ensure a reliable source of low-carbon electricity while major refurbishment work is under way at OPG's

Darlington plant. The first two units - Pickering 1 and 4 - are planned to close in 2020, with units 5-8 closing in 2024. Pickering 2 and 3 have remained in safe shutdown since 1997.

The CNSC said its decision following a two-part public hearing earlier this year was based on OPG's stated intent to cease commercial operations at Pickering on 31 December 2024. This is to be followed by post-shutdown activities and stabilisation work to 2028. The commercial operation of any Pickering reactor unit beyond 2024 would require further authorisation from the Commission, it said.

Pickering's new licence will run from 1 September 2018 to 31 August 2028. The CNSC has also authorised the company to operate units 5-8 up to a maximum of 295,000 equivalent full power hours.

OPG President and CEO Jeff Lyash said the company was "very pleased" with the regulator's decision, which he said would save Ontario's electricity customers up to CAD600 million (USD460 million) and preserve 7500 jobs across the province.

"Today's decision reflects our continued investment in Pickering to improve its already strong performance, and the dedication of our staff to nuclear safety and ensuring safe and reliable operations to 2024," he said.

Ontario's 18 nuclear units - eight at Bruce, four at Darlington and six at Pickering - provide over 60% of the province's electricity. The four Darlington units are undergoing a multi-year CAD12.8 billion refurbishment with the first unit, Darlington 2, scheduled for completion in 2026. Six of the eight Candu units at Bruce are also to undergo refurbishment in a CAD13 billion programme beginning in 2020.

Researched and written by World Nuclear News

15. Fuqing 5 enters system commissioning phase

09 August 2018

Share

Installation of the control room has been completed at the demonstration Hualong One being constructed as unit 5 of the Fuqing
http://www.world-nuclear-news.org/Articles/Fuqing-5-enters-system-commissioning-phase?feed=feed

nuclear power plant in China's Fujian province.

http://www.world-nuclear-news.org/Articles/Fuqing-5-enters-system-commissioning-phase?feed=feed

The final display panel of the control room was installed on the morning of 4 August, China Nuclear Industry 23 Construction Company announced on 7 August. The company said this was six days ahead of schedule and marks the reactor's transition from the installation phase to the system commissioning phase.

In November 2014, China National Nuclear Corporation announced that the fifth and sixth units at Fuqing will use the domestically-developed Hualong One pressurised water reactor design, marking its first deployment. The company had previously expected to use the ACP1000 design for those units, but plans were revised in line with a re-organisation of the Chinese nuclear industry. China's State Council gave final approval for construction of Fuqing units 5 and 6 in April 2015.

The pouring of first concrete for Fuqing 5 began in May that year, marking the official start of construction of the unit. Construction of unit 6 began in December the same year. The dome of unit 5 was installed on the containment building in May last year and the reactor pressure vessel was installed in January this year.

Fuqing 5 and 6 are scheduled to be completed in 2019 and 2020, respectively.

Construction of two Hualong One (HPR1000) units is also under way at China General Nuclear's Fangchenggang plant in the Guangxi Autonomous Region. Those units are also expected to start up in 2019 and 2020. Two HPR1000 units are under construction at Pakistan's Karachi nuclear power plant. Construction began on Karachi unit 2 in 2015 and unit 3 in 2016; the units are planned to enter commercial operation in 2021 and 2022. The HPR1000 has also been proposed for construction at Bradwell in the UK, where it is undergoing Generic Design Assessment.

Researched and written by World Nuclear News

16. Call for UK government to back small nuclear projects

08 August 2018

Share

Government support is required in order to stimulate private investment in the development of small-scale nuclear power projects in the UK, according to a report produced by an independent advisory group.

http://www.world-nuclear-news.org/Articles/Call-for-UK-government-to-back-small-nuclear-proje?feed=feed

The UK's Department for Business, Energy and Industrial Strategy set up an Expert Finance Working Group (EFWG) in January as part of the Advanced Nuclear Technologies initiatives announced by Energy Minister Richard Harrington in December 2017. The remit of the group was to independently advise the government on the potential for small nuclear reactor projects to raise private investment in the UK that could enable their future commercial deployment.

The EFWG on Small Nuclear Reactors yesterday released its findings and recommendations in a report, titled *Market framework for financing small nuclear*.

The chair of the group, Fiona Reilly, said in the preface to the report: "Despite the increase in global activity and interest in small nuclear there remains a market failure in getting technologies and projects to commercial delivery, and in particular in securing sufficient financing for projects from the private sector."

She added, "In developing its recommendations for a market framework, the EFWG thoroughly reviewed the risks associated with small nuclear, considering who is best able to manage such risks, the consequences of the risks and how the consequences can be managed."

The report notes that small nuclear projects range from micro-generation projects through to 600 MWe reactors. The costs of such projects range from GBP100 million (USD129 million) to GBP2.5 billion. As such, each project will have its own structure and risks. However, the group said it believes that its recommendations apply to all the different potential small reactors being considered for development by 2030.

According to the EFWG, some of the barriers to small nuclear projects which the UK government can assist with are "relatively straightforward", such as making sites and Generic Design Assessment (GDA) slots available.

"Some require the same support that any industry needs to bring innovation forward," it said. "Others are more fundamental around a lack of understanding/misunderstandings around nuclear and the need to get the first projects across the line to create the market."

The group makes a number of recommendations on how the government can help create the right market framework for the commercialisation of small nuclear projects. It says, "Government should enable the small nuclear sector through a clear policy and a market framework, rather than down-selecting technologies." The report also calls for the government to work with stakeholders from the energy, nuclear and finance sectors to develop a common understanding of the risks associated with such projects.

"For those technologies capable of being brought to market by 2030, government should focus its resources on bringing first-of-a-kind projects to market by reducing the cost of capital and sharing risks," the EFWG suggests. "This could be done through assisting with the financing of such projects through a new infrastructure fund and/or direct equity and/or government guarantees. The government could also provide funding support mechanisms such as a Contract for Difference, a Power Purchase Agreement or potentially a Regulated Asset Base model."

The group also recommends the government works with the country's nuclear regulators - the Office for Nuclear Regulation and the Environment Agency - to review regulatory processes to develop "an optimised and flexible approach and through the Generic Design Assessment process allow the market to down-select technologies".

The government should also establish an advanced manufacturing supply chain initiative - as it did with offshore wind - to bring forward existing and new manufacturing capability in the UK and "to challenge the market on the requirement for nuclear specific items, particularly balance of plant, thereby reducing the costs of nuclear and the perceived risks associated with it".

"In short, the EFWG notes that private finance will not come forward to develop first-of-a-kind small nuclear projects without some government support in helping to remove the barriers to the development," the report states. "By following the recommendations set out, government would be creating a similar environment to the early days of wind and solar commercial development in the UK by creating a market whereby the small nuclear sector can develop and over time bring in more and more private sector financial involvement to create a sustainable industry and to in turn bring down the costs of energy."

The UK government launched the first phase of an small modular reactor (SMR) competition in 2016 to identify the best value SMR design for the UK. A decision on how to proceed with the second phase has yet to be made.

Ihttp://www.world-nuclear-news.org/Articles/Turbine-equipment-installed-at-Leningrad-II-2?feed=feed

ndustry welcomes recommendation

"This report confirms small reactors have real potential to be a financially viable addition to the existing nuclear programme," said Peter Haslam, head of policy at the Nuclear Industry Association. "Not only could small reactors bring value for money to the consumer, they also have the potential to create a lucrative export market, with a major benefit for British engineering companies and the wider supply chain."

He added, "The report sets out how small reactors can be cost competitive, and we hope the financial sector will recognise this. Small reactors could make a significant contribution to bolstering energy security while tackling climate change, and we hope to see government taking forward the recommendations as soon as possible."

World Nuclear Association Director General Agneta Rising said: "We welcome this report's support for the development of small modular reactors to enable them to contribute to the goal of nuclear generation providing 25% of the world's electricity supply by 2050."

She added, "The report's recognition that a market approach is needed that will allow small modular reactors to compete in a level playing field with other low-carbon generation, and that regulatory processes need to adopt an optimised and flexible approach, are consistent with the reforms that are urgently required, as identified by global nuclear industry's Harmony programme."

Researched and written by World Nuclear News

17. Turbine equipment installed at Leningrad II-2

07 August 2018

Share

Installation of the main equipment for the turbine of unit 2 of the Leningrad Phase II nuclear power plant in northwest Russia has been completed and according to schedule, state nuclear corporation Rosatom said yesterday.

http://www.world-nuclear-news.org/Articles/Turbine-equipment-installed-at-Leningrad-II-2?feed=feed

The stator, separators, superheaters, deaerator, turbine condensers, high- and low-pressure heaters and heat exchangers have all been installed, it said. The shaft of the turbine has been aligned and three bridge cranes have been successfully operated, it added. The turbine building consists of four platforms, a total area of almost 25,000 square meters, more than 5000 tonnes of pipes and nearly 4000 valves.

Work will now start on insulation, low-current and electrical installation works as well as the laying of external and internal engineering networks, it said. In total, 71 technological systems will be housed in the turbine building of the unit.

Alexander Chebotarev, head of construction at the plant, said that personnel are working with established cooperation and successful experience of similar operations with unit 1, which is now at the final stage of commissioning.

“This enables us not only to keep to schedule, but in some areas even to shorten the time required," he said.
The existing Leningrad plant site has four operating RBMK-1000 units, while Leningrad-II will have four VVER-1200 units.

Leningrad II-1 is the second VVER-1200 reactor, following the launch in 2016 of Novovoronezh 6. Start-up operations of the new Leningrad unit began on 8 December last year, when the first fuel assemblies were loaded into the reactor core. The reactor was brought to the minimum controllable power level on 6 February and connected to the grid on 9 March. It entered the final stage of its commissioning on 26 March.

Researched and written by World Nuclear News