

ITER Forum website Update 12/14

B.J.Green (18/12/14)

1. Don't get too excited, no one has cracked nuclear fusion yet

http://theconversation.com/dont-get-too-excited-no-one-has-cracked-nuclear-fusion-yet-33132#comment_51484

Aerospace giant Lockheed Martin's **announcement** this week that it could make small-scale nuclear fusion power a reality in the next decade has understandably generated **excitement in the media**. Physicists, however, aren't getting their hopes up just yet.

I recently returned from the International Atomic Energy Agency's **Fusion Energy Conference** in St Petersburg, Russia, the world's leading conference on the development of fusion power. There was no

announcement of research by Lockheed Martin, and the company did not field any scientists to report on their claims.

Lockheed Martin claims that its technology development offshoot, **Skunk Works**, is working on a new compact fusion reactor that can be developed and deployed in as little as ten years. The only technical details it provided are that it is a “high beta” device (meaning that it produces a high plasma pressure for a relatively weak magnetic field pressure), and that it is sufficiently small to be able to power flight and vehicles.

This isn't enough information to substantiate a credible program of research into the development of fusion power, or a credible claim for the delivery of a revolutionary power source in the next decade.

Fusion power

Nuclear fusion, co-discovered by the Australian physicist Sir Mark Oliphant, is the process that powers the sun and stars. If harnessed, it offers the possibility of virtually limitless clean energy. As its name implies, fusion energy is released by joining light atomic nuclei (typically deuterium and tritium,

which are isotopes of hydrogen) within a high-pressure, extremely high-temperature “plasma” contained by magnetic fields.

The attraction of fusion is substantial. Like nuclear fission, the fusion process produces zero greenhouse gases. Unlike fission, which generates radioactive waste as a by-product, fusion is intrinsically clean. The deuterium-tritium reaction produces helium and energetic neutrons – the only waste is generated indirectly, when the neutrons hit the shield of the reactor.

Based on existing technology, fusion power plants could be recycled in 100 years. Research into the use of advanced alloys and ceramics suggests that this period could be made even shorter.

Deuterium, a fuel for fusion, is naturally abundant in water. Any country with access to water automatically has access to deuterium, thereby dramatically reducing geopolitical tensions over energy security. Per kilogram of fuel, fusion releases four times more energy than fission, and a staggering 10 million times more than coal. World deposits of deuterium are enough to power

civilization for millions of years. Access to fuel supply will therefore no longer be an issue, economically or politically.

More importantly, the fusion reaction is inherently safe. Turn off the heating power and the reaction stops. There can be no nuclear chain reactions, no reactor meltdowns, and no explosions.

Contain your excitement

While the rewards of fusion power are substantial, so are the challenges of making it a reality. The deuterium-tritium reaction is the easiest fusion reaction to initiate, yet the optimal temperature needed is 100 million degrees C, which is six to seven times hotter than the core of the Sun.

The key to producing significant fusion power is confining the plasma long enough at a high enough temperature and density for there to be a net power gain.

The international research community is currently working on a new experimental fusion reactor, called **ITER**, which will have a field strength of about 5 Tesla and a radius of 6 m. Overall, the ITER device is 60 m tall, weighs 23,000 tonnes, and has 80,000 km

of niobium tin superconducting strands. Such a device does not fit on the back of a truck.

Despite the difficulties, progress in fusion power has exceeded the spectacular improvement in computer power. In the space of 30 years, power output has increased by a factor of more than a million.

Present-day experiments have a power output of tens of megawatts. ITER will produce 500 megawatts of fusion power.

Lockheed Martin will need to show a lot more research evidence that it can do better than multinational collaborative projects like ITER. So far, its lack of willingness to engage with the scientific community suggests that it may be more interested in media attention than scientific development.

*Matthew Hole is Australia's representative on the IAEA International Fusion Research Council and Chair of the Australian ITER Forum, a consortium of scientists and engineers who support an **Australian participation** in ITER.*

2. UK units cleared for restart after boiler checks

24 November 2014

The UK nuclear regulator has given EDF Energy permission to restart two units at its Hartlepool nuclear power plant and one at its Heysham I plant. The units have been offline since August for investigations into potential cracks in boiler spines.

<http://www.world-nuclear-news.org/RS-UK-units-cleared-for-restart-after-boiler-checks-2411144.html>

In early August, EDF Energy said it had shut down Heysham I unit 1, in northwest England, in June after discovering a fault in a boiler spine and taken the "conservative decision" to halt the second reactor there, and two at its Hartlepool site in the northeast of England, "which are of a similar design." At that time, EDF Energy said it expected the units to remain closed for about two months while investigations are carried out.

After completing inspections of the boilers at the affected units, EDF Energy presented the UK's Office for Nuclear Regulation (ONR) with a safety justification for the restart of Heysham I unit 2 and the two reactors at Hartlepool.

On 21 November, the ONR said it had completed a review of that justification and "is satisfied that EDF has demonstrated the continued safe operation for these reactors."

The reactors are expected to be brought back into operation over the coming weeks.

The ONR said EDF plans to submit a separate safety justification for the restart of Heysham I unit 1. This, it said, "will be subject to independent assessment and will require formal permission from ONR before the reactor can return to service."

EDF Energy expects unit 1 of Heysham I to be restarted by the end of 2014.

Each advanced gas-cooled reactors (AGRs) at Heysham I and Hartlepool has eight boiler units. These boilers are arranged around their associated reactor in four quadrants with each quadrant containing two boilers. Within each boiler are tubes assembled in a coil formation around a central forged metal tube called a boiler spine. The boiler spines support the weight of the tubes around them.

*Researched and written
by World Nuclear News*

3. **Rio pushes for nuclear power in energy debate**

• THE AUSTRALIAN
DECEMBER 02, 2014 12:00AM

Annabel Hepworth

National Business Correspondent

Sydney

Mining giant Rio Tinto has -declared that nuclear energy should not be “summarily precluded” from Australia’s future energy mix.

As the debate over nuclear power is thrown open again, Rio has told the Abbott government’s energy white paper taskforce that it is important to ensure Australia — a major uranium exporter — has the “broadest possible” range of options to bolster energy -security.

“While the government’s current policy is one of not pursuing nuclear energy for Australia at this time, the ongoing need to reduce greenhouse gas emissions means that nuclear energy should not be summarily precluded from consideration in the future energy mix,” Rio Tinto says in a new -submission in response to the energy green paper released in September.

“The lead time for nuclear energy is long, and it would be prudent to start taking steps now towards building the capability to make informed decisions by 2020 on whether nuclear energy should be part of Australia’s energy mix.”

Tony Abbott yesterday said he had “no theological objections” to nuclear power. The Prime Minister said it would be “fine” if a nuclear energy generation proposal was put forward, “but don’t expect a government subsidy”.

This came after Foreign Minister Julie Bishop said on the weekend that nuclear power was an “obvious”

direction for Australia to cut carbon emissions.

The debate comes as a raft of submissions push for debate on nuclear power and companies including BHP Billiton, ANZ, Peabody Energy and Qantas Airways have made fresh submissions weighing into the debate on the nation's energy future.

BHP, which like Rio is a major uranium producer, has told the taskforce that Australia is well--positioned to capitalise on an expected growth in demand.

Despite the 2011 Fukushima accident in Japan, BHP says nuclear power is projected to grow "considerably", particularly as China and India plan expansions of their nuclear facilities.

In its new submission to the taskforce, BHP also says changes are needed to provide "balance" in the industrial relations system.

BHP also takes aim at restrictions on coastal shipping and the Australian Jobs Act, which requires projects worth \$500 million or more to have an Australian industry participation plan to help local firms win work. "It is important to start the discussion of developing Australia's energy resources with the ultimate economic prize in mind," marketing chief Mike Henry said. "Australia has the potential to reap substantial economic gains in meeting future global energy demand which is expected to increase by 30-50 per cent by 2030.

"Meeting this opportunity will require improving Australia's productivity and competitiveness across the energy resources supply chain."

ANZ has told the panel there is a "pressing need" for

reform of electricity pricing and that Australia's domestic gas reserves should be opened further. "Australia's reputation as a source of cost-effective energy has been affected in recent years by higher costs associated with government regulation, higher labour costs compared to energy suppliers in emerging markets and falling productivity," ANZ head of government and regulatory affairs Rob Lomdahl says in the submission. "Improving energy productivity requires reducing costs associated with regulation and ensuring energy supply better reflects demand."

Coal giant Peabody Energy has said that effort should be directed to clean coal technologies including carbon capture and storage, arguing that coal with CCS could be a "low-cost, low-carbon solution".

"We believe that the most economical electricity generation strategy to reduce emissions entails developing and deploying a 'full portfolio' of low carbon technologies, including advanced coal generation, CCS, gas, renewable energy resources, nuclear, efficiency improvements throughout the chain, and fuel switching among other potential technologies," Peabody's president, Australia, Charles Meintjes says.

The government's energy green paper says nuclear energy remains a "serious consideration for future low emissions energy".

Australia has not deployed nuclear power because of government policy, including legal bans, community sentiment, and the abundance of cheap energy. Also,

Australia's glut of electricity generation is expected to last until 2023-24.

4. Nuclear stand "terribly strange"

Jared Owens

The Australian December 9, 2014

http://www.theaustralian.com.au/subscribe/news/1/index.html?sourceCode=TAWEB_WRE170_a&mode=premium&dest=http://www.theaustralian.com.au/business/mining-energy/steven-chu-says-australias-opposition-to-nuclear-power-terribly-strange/story-e6frg9df-1227149095657&memtype=anonymous

This Subscriber-only article reports the former US secretary of energy (and Nobel laureate physicist) Steven Chu in Canberra to receive an Honorary Doctorate at the Australian National University.

5. *NATURE* | NEWS

ITER's new chief will shake up troubled fusion reactor

Bernard Bigot, the next director-general of ITER, plans to reform the decentralized structure of the project.

Declan Butler

21 November 2014

<http://www.nature.com/news/iter-s-new-chief-will-shake-up-troubled-fusion-reactor-1.16396>

A multibillion-euro project to build the world's largest nuclear fusion reactor will soon have a new chief. Bernard Bigot, who was nominated to be director-general of ITER on 20 November, says that he intends to radically reform the management and governance of the troubled project.

Bigot is currently chairman of the French Alternative Energies and Atomic Energy Commission (CEA), and will succeed Japan's [Osamu Motojima, who has been ITER director-general since July 2010](#). The project's current organization has been harshly criticized, and blamed for overruns in the costs of the reactor, and slips in its construction schedule.

Fusion reactors generate energy using the same underlying process as the Sun, by [fusing hydrogen nuclei to make helium](#). A collaboration between the European Union, China, India, Japan, South Korea, Russia and the United States, ITER is designed to show the feasibility of nuclear fusion as a power source on Earth. The device, which is under construction at a site in St-Paul-lez-Durance in southern France, will consist of a [doughnut-shaped reactor called a tokamak](#). The current official cost is at least [€13 billion](#) (US\$16 billion), compared with an [initial price tag of €5 billion](#), but even this later figure is likely to be an underestimate.

The exact cost is difficult to determine. Rather than a single central budget for procuring equipment, member states instead contribute the different parts of the machine in kind, and take responsibility for paying for them in their own currencies. Once built, the reactor is estimated to cost around €280 million to €530 million a year to operate.

Ripe for change

[At a meeting in February](#), the ITER Council, which supervises ITER's work, agreed to seek management reforms in response to a scathing external review of the project. The assessment, an executive summary of which [was leaked by *The New Yorker*](#), described a litany of problems plaguing the project, including bureaucracy, the lack of a "strong project management culture" and unacceptably slow progress.

In particular, the assessment criticized a "weak" leadership team. The next director-general "must be an inspirational leader and manager", with "strong, industrial large-project management experience", the report said.

Bigot says that he will submit an action plan to the ITER Council before the end of January 2015. This will include a proposal to abolish ITER's current, decentralized structure, in which the central ITER Organization is responsible for the design, construction and operation of the reactor, but has no direct control over each of the member state's ITER agencies.

He wants a single tight organization, with the director-general responsible for controlling the entire project — rather like at a multinational company or at CERN, Europe's particle-physics laboratory near Geneva, Switzerland. "We need global management of ITER," he says.

The proposed changes will not be politically easy, Bigot acknowledges. However, he says that there was support for his

plans at a recent informal meeting with the heads of the domestic ITER agencies.

The time is ripe for change, he adds, because ITER has now moved out of the planning phase and into the construction phase, in which strong leadership is required more than ever — for example, to impose firm delivery schedules on the member states.

Serious about reform

After Bigot submits his plan, an ITER Council meeting is expected to be held in February to approve the proposal, and Bigot should be formally appointed immediately after.

However, because Motojima's mandate does not end until July 2015, there will be a "transitional period", says Bigot. This unprecedented early arrival of a new director-general is a signal that the council is serious about accelerating reforms, says one ITER official, who requested anonymity.

Bigot believes that his past experience will hold him in good stead. He was appointed chairman of the CEA, an agency of more than 16,000 scientists, engineers and technicians, [in 2009](#), and has been France's high commissioner for atomic energy [since 2003](#). He has also held a variety of other senior positions, including a stint as director-general of research and technology at the French science ministry.

And Bigot has already worked frequently with ITER officials in the member states. "I'm used to speaking with these people and I believe they trust me," he says. Niek Lopes Cardozo, [a fusion researcher at Eindhoven University of Technology](#) in the Netherlands, says that he holds Bigot "in the highest regard, both as a professional and as a person".

Member states had proposed around 10 candidates to the director general-search committee, but the committee put Bigot forward to the ITER Council as its sole choice.

Another ITER official, who also requested anonymity, says that he has confidence in Bigot's proposed reforms. "If I would not be optimistic, I would not be working in this project. But there is an air of renewed optimism going around at the moment."

Nature doi:10.1038/nature.2014.16396

6. Science Insider

New ITER boss promises to

streamline management and repair ties with the U.S.

By Daniel Clery 21 November 2014 7:45 am

<http://news.sciencemag.org/people-events/2014/11/new-iter-boss-promises-streamline-management-and-repair-ties-u-s>

Yesterday, the ITER fusion project announced that Bernard Bigot, chair of France's Alternative Energies and Atomic Energy Commission, has been appointed its third director-general. Bigot, 64, is trained in physics and chemistry and has held senior positions in government, industry, and academia.

When he takes over from Osamu Motojima sometime next year, Bigot will find an organization under enormous pressure. Construction of the giant tokamak reactor is in full swing at the site in Cadarache, France, and components are being churned out by factories of all the ITER partners—China, the European Union, India, Japan, South Korea, Russia, and the United States. But the cost of construction has ballooned and will likely go much higher than the current official estimate of €13 billion, while the scheduled completion date has slipped repeatedly. To compound its troubles, earlier this year

a management review blasted the project's leadership, management, and governance.

Earlier today, Bigot spoke briefly with *ScienceInsider* between meetings. His comments have been edited for clarity and brevity.

break

Q: ITER has made significant progress in recent years but has also drawn heavy criticism. What do you see as your biggest challenge as director-general?

A: At the ITER council meeting this week we saw lots of progress on the site and at the different fabrication sites worldwide, it was quite impressive. A large number of different components are soon arriving and being assembled.

My most important challenge as director-general will be the management. ITER has a central organization and seven domestic agencies but they are working too much on their own. As I told the ITER council, my role has to be seen as the director-general of the global project—the ITER Organization and the domestic agencies—and we must proceed as a single project. That is my main challenge and, I believe, it is a feeling shared by the council. It will require a real change in how we work. But in my current role I have worked for a long time with all the countries involved

in ITER and we have a trust relationship, which may help.

Q: A major criticism of this year's review was that the management of the ITER Organization is complicated and top-heavy. How will you address that?

A: We have to streamline the management structure. Everyone involved in the project should be the best professional in the right place. Professional capability is key and everyone should work as teammates with no consideration of nationality. We are now in the construction phase and it will be very challenging. We are past the early stages of design and procurement and need now to gather the best professionals for construction and act as a real team.

Q: Few now believe that the official construction schedule is feasible. How will you get ITER back on track?

A: It is another of the main challenges to come up with a definitive, robust schedule that is fully agreed upon by all the parties. The construction needs careful planning and it's clear that the time marked down for the first plasma, 2020, will not be fulfilled. But how much longer will it take? It is what we have to elaborate in the very next months: to have a final robust planning. We have to be realistic.

ITER is a new organization. It is not like CERN—this year celebrating its 60th anniversary—which is settled and stable and operates smoothly. When ITER began it had to start both a new organization and a new project, which makes things more difficult.

Q: ITER has many detractors in the United States who are concerned about its rising cost and sliding schedule. How will you repair ITER's relationship with the United States?

A: I expect that when I take up this position next year, I will go to the United States to meet with the main leaders and explain to them our action plan. All of the ITER members, not only the U.S., are concerned about the delivery of the project. The only way to repair those relationships is to rebuild trust, based on a clear action plan. I hope and expect that this will improve matters rapidly.

Posted in [People & Events](#), [Physics](#), [Policy](#)

7. UK government urged to look at SMR costs

17 December 2014

<http://www.world-nuclear-news.org/NN-UK-government-urged-to-look-at-SMR-costs-1712145.html>

The UK government should encourage the development and deployment of Small Modular Reactors (SMRs), a

parliamentary committee has recommended. However, it says the costs need to be fully understood.

"While we recognize that the nuclear industry's immediate priority is rightly the successful delivery of the UK's current conventional new build program, we also recognize that SMRs - particularly those based on known nuclear technologies - are a viable proposition for future deployment in the UK in the next decade," the Commons Select Committee on Energy and Climate Change said in a report published today.

It suggested, "Small Modular Reactors could potentially have a key role to play in delivering low carbon energy at lower upfront capital cost compared to large conventional nuclear reactors. That said, the commercial viability of SMRs remains unclear."

"It will be important to understand the future cost comparison with large-scale nuclear reactors as well as the comparison with other small-scale energy generation or demand management," the committee said. It recommends the UK government examines the costs of SMRs and determine the conditions required to make them cost competitive.

The report suggests that, in the short-term, deployment of SMRs is likely to be achieved through sharing the costs between the public and private sector. However, it says the government should help establish the right conditions for investment in SMRs, such as "through supporting the regulator to bring forward approvals in the UK, and by setting out a clear view on siting options." It recommends the Department of Energy and Climate Change ensures that the Office for Nuclear regulation is adequately resourced to support SMR developers in the early stages of preparing their designs for approval.

"The government should support the use of existing nuclear sites for the deployment of SMRs. These sites could potentially host a demonstrator module with minimal additional infrastructure requirements and with the support of a skilled local workforce," the committee said.

It noted that, while current SMR designs have predominantly been developed outside of the UK, "there is scope for British industry to develop intellectual property and play a role in the deployment of the first SMRs."

The publication of the committee's report comes two weeks after the National Nuclear Laboratory (NNL) released a feasibility study on the deployment of SMRs in the UK.

The Energy and Climate Change Committee noted that NNL's study "provides a useful preliminary financial analysis but itself acknowledges that a more detailed analysis is required."

*Researched and written
by World Nuclear News*

8. **Scientists sign nuclear entreaty**

15 December 2014

<http://www.world-nuclear-news.org/EE-Scientists-sign-nuclear-entreaty-1512147.html>

More than 60 leading scientists are urging environmentalists to set aside their preconceptions about nuclear power.

In an open letter, they express their support for a recent article titled *Key role for nuclear energy in global biodiversity conservation*.

They wrote that this publication provides "strong evidence for the need to accept a substantial role for advance nuclear power systems with complete fuel recycling" as part of a range of sustainable energy technologies. These should include "appropriate use" of renewables, energy storage and energy efficiency.

"Much as leading climate scientists have recently advocated the development of safe, next-generation nuclear energy systems to combat global climate change ... we entreat the conservation and environmental community to weigh up the pros and cons of different energy sources using objective evidence and pragmatic trade-offs, rather than simply relying on idealistic perceptions of what is 'green'."

The paper was written by Barry Brook, chair of environmental sustainability at the University of Tasmania, and Corey Bradshaw, Hubert Wilkins chair of climate change at the University of Adelaide in the journal *Conservation Biology*.

This assesses the land use, emissions, climate, and cost implications of three previously published but contrasting "storylines" for future energy production. It then uses a multi-criteria decision-making analysis to rank seven electricity-generation sources - coal, gas, nuclear, biomass, hydro, wind, and solar - based on costs and benefits. It also tests the sensitivity of their rankings to bias stemming from philosophical ideals. Irrespective of weightings, they found that nuclear and wind energy had the highest benefit-to-cost ratio.

Next-generation nuclear power and related technologies, based on modular systems with full fuel recycling and inherent safety, "hold substantial yet largely unrecognized prospects" as a replacement for fossil fuels, Brook and Bradshaw wrote. But nuclear power still has an "undeservedly poor reputation" in the environmental community. The letter, with its list of signatories, is published on the conservation blogs ConservationBytes and Brave New Climate.

*Researched and written
by World Nuclear News*