The articles "*New Energy Times* Uncovers Serious Discrepancies in ITER Fusion Facts" and "The $21 Billion ITER Lie" have been withdrawn. Archival copies of those articles are here and here.

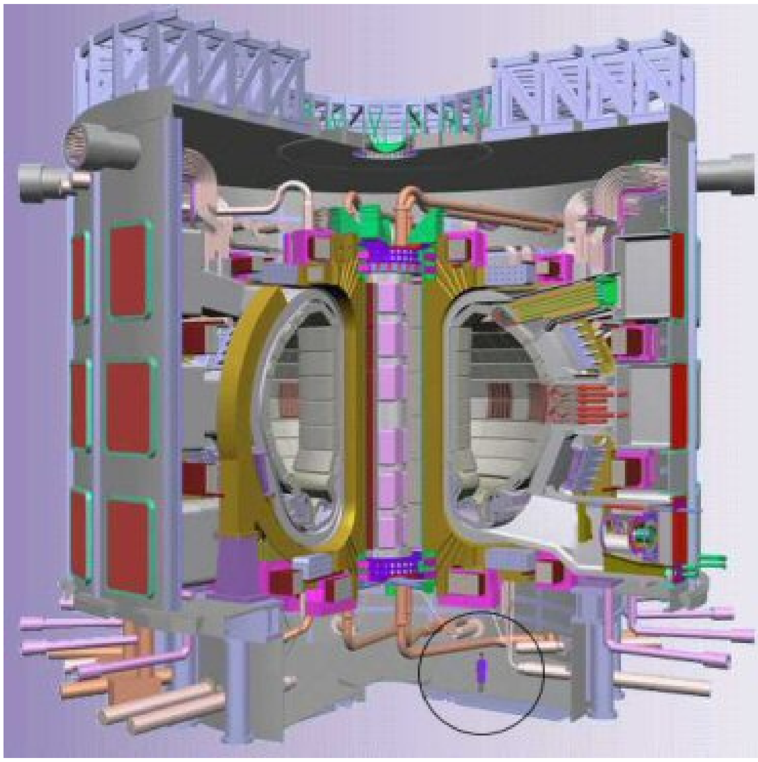
After extensive e-mail conversations between Steven B. Krivit, publisher and senior editor of *New Energy Times*, and Laban Coblentz, communication head of ITER, Coblentz failed to identify any error in either of the articles. Coblentz did, however, disagree with the goal of ITER as we presented it in our articles. However, the main goal of ITER, as we said in our articles, is identical to the main goal reported on the ITER Web site. Our new article offers readers Coblentz's perspective on this matter. Coblentz also said that the word "lie" was unwarranted.

The two articles have been replaced by a new, more extensive article, "The Selling of ITER," along with a supplementary document that provides excerpts from congressional testimony discussing ITER.

New Energy Times Uncovers Serious Discrepancies in ITER Fusion Facts

news.newenergytimes.net/

Invalid Date



Dec. 14, 2016 – By Steven B. Krivit –

Synopsis : *Representatives of the International Thermonuclear Experimental Reactor (ITER) claim that the world's largest fusion reactor, when complete, will produce 500 megawatts of thermal energy and that it will produce 10 times more energy than is put in. It will not. In fact, at best, the $21 billion reactor likely will have a net power balance close to zero, not 500 MW. Rather than 10 times the power input, the output likely will be equal or close to the total power input. Based on the same underlying misunderstanding, the 1997 Joint European Torus (JET) fusion experiment, which fusion proponents say achieved 65 percent of break-even, actually came only within 2 percent of total system breakeven.*

While I was doing research for my book *Fusion Fiasco*, primarily about the 1989 "cold fusion" fiasco, I came across conflicting information about thermonuclear fusion research that was difficult to believe. This information has a direct and significant impact on the International Thermonuclear Experimental Reactor (ITER), under construction now in Cadarache, France.

At an estimated cost of $21 billion, ITER is the most expensive science experiment on Earth. Financial and technical support for the project comes from the European Union, China, India, Japan, South Korea, Russia and the United States. As this article shows, that support has been based on a massive discrepancy between the stated progress of fusion research and the actual progress.

Members of the public and government representatives have agreed to fund ITER based on the hope that the reactor will lead to a source of clean, greenhouse-gas-free energy. Experimentally and theoretically, the principal of controlled thermonuclear fusion is sound. Scientists believe that fusion is the process that powers the sun. The primary challenge in fusion research has been to sufficiently emulate the conditions on the sun. However, creating those conditions on Earth — confining ionized hydrogen isotopes close enough, densely enough, and long enough for a sustained fusion reaction — has been daunting.

For many years, fusion scientists have been enthusiastic about progress they have claimed to make. The primary goal has always been to produce more energy than the fusion reaction consumes, even for just a brief moment. But throughout this time, scientists have been content simply to achieve break-even: getting out as much energy as is consumed.

It has been widely reported that scientists working in the U.K. at the Culham Centre for Fusion Energy came very close to break-even in a 1997 experiment at their Joint European Torus (JET) fusion reactor. Here's an example reported in the *New Yorker* by Raffi Khatchadourian:

> more than a megawatt of fusion power. The trial fell short of breakeven, but the scientists estimated that, with the ideal tritium mixture, their plasma would have produced more energy than was put into it—for the first time, in theory, a net gain. Several years later, they set out to confirm their estimate, and succeeded in producing a sixteen-megawatt plasma, a record, though they still narrowly missed breakeven. As Chiocchio put it, "There was really this impression that we were very close to the target."

Raffi Khatchadourian, "A Star in a Bottle," The New Yorker, March 3, 2014. The article did not explain that there were two definitions of "break-even," that the reactor produced only 2 percent of total system break-even, that much more power than that used to heat the plasma was required to operate the reactor, and that the reactor consumed 98% of the total power that was put into it.

Here's an example reported by Charles Seife in his book *Sun in a Bottle*:

> JET got 6 watts out for every 10 it put in. It was a record, and a remarkable achievement, but a net loss of 40 percent of [power] is not the hallmark of a great power plant. Scientists would claim — after twiddling with the definition of the [power] put into the system — that the loss was as little as 10%. This might be so, but it still wasn't breakeven; JET was losing energy, not making it.

Charles Seife, Sun in a Bottle: The Strange History of Fusion and the Science of Wishful Thinking, Penguin Books, 2009

As Seife indicates, the conventional understanding is that JET came 65% of the way to producing as much power as the system consumed. Despite the fact that Seife dedicated his book to critiquing fusion research, he, like every other science journalist, was misled by the fusion promoters' use of confusing terminology.

In fact, JET did not come anywhere close to making as much power as it consumed. The real fusion power output from JET was only 2 percent of the total system power input.

Here is how this stunning discrepancy and false impression have taken root: Fusion proponents have knowingly perpetuated a misunderstanding between the concepts of ***system power input*** and ***fusion power input***. Sometimes, they use the term ***plasma power*** instead of ***fusion power***.

System power input is the total power level required to operate all required components of a fusion reactor. ***Fusion power input*** is a small subset of system power input; it refers only to the input power required to heat the core of the reactor. Every nonspecialist who has written about fusion has not realized the distinction between the two concepts and has inadvertently misreported these facts.

The typical claim by fusion promoters is that the 1997 experiment at JET set a world record of 16 megawatts of power and that it produced 65 percent of its input power. At face value, one of these numbers cannot be correct. If the experiment produced 16 MW of net power, then the output/input ratio would be greater than 100 percent. In fact, both numbers are gross misrepresentations, and the underlying truth has been hidden simply by omission.

Nick Holloway, the media manager for the Communications Group of the Culham Centre for Fusion Energy, which operates the Joint European Torus, gave me the key facts only when I asked him directly. The ***total system input power*** used for JET's heralded world-record fusion experiment was about 700 MW. (PDF Archive)

Holloway explained that the vast majority of power that goes into the JET reactor goes not to heating the reactor core but to feeding the copper magnetic coils and into other subsystems that are required to operate the reactor. When I interviewed Stephen O. Dean, the director of Fusion Power Associates, a nonprofit research and educational foundation, he concurred.

"The applied fusion power," Dean wrote, "is not a relevant measure of progress since these have all been experiments not designed for net [power]. The input referred to is just the input to the plasma and does not include the power to operate the equipment." (PDF Archive)

Thus, a more accurate summary of the most successful thermonuclear fusion experiment is this: With a total input power of ~700 MW, JET produced 16 MW of fusion power, resulting in a net ***consumption*** of ~684 MW of power, for a duration of 100 milliseconds.

In other words, the JET tokamak consumed ~98 percent of the total power given to it . ***The "fusion power" it produced, in heat, was ~2 percent of the total power input.***

In his book, *A Piece of the Sun*, Daniel Clery, a reporter for *Science* magazine who has a degree in theoretical physics, repeated this fundamental omission and contributed to the public misunderstanding of the meaning of break-even.

"The first great milestone of fusion [is] break-even," Clery wrote. "This is the situation when the power given off by the fusion reactions is equal to the power used to heat up the plasma." He mentioned nothing about the vastly greater amount of power needed to operate all of the reactor's required systems.

Clery, and people in the fusion business, rather than concede that they have pulled the wool over the eyes of less-knowledgeable science journalists, the general public, and elected representatives for years, likely will argue that the difference between ***system power input*** and ***fusion power input*** was well-known. As the examples I've provided here show, this crucial, omitted distinction was not well-known by non-specialists.

Now that we understand the distinction between system break-even and fusion (or plasma) break-even, the facts about the ITER power claims become clear.

1) Produce 500 MW of fusion power for pulses of 400 s

The world record for fusion power is held by the European tokamak JET. In 1997, JET produced 16 MW of fusion power from a total input power of 24 MW (Q=0.67). ITER is designed to produce a ten-fold return on energy (**Q=10**), or 500 MW of fusion power from 50 MW of input power, for long pulses (400-600 s). ITER will not capture the energy it produces as electricity, but as the first of all fusion experiments in history to produce net energy ... it will prepare the way for the machine that can.

Answer #1 to the question “What will ITER do?” from the official ITER Web site. The value of 24 MW for the total input power is wrong. The correct value is about 700 MW. Source: https://www.iter.org/sci/Goals (Retrieved Dec. 13, 2016)

The values given by fusion proponents to reporters, as shown in the news clippings below, have been widely circulated.

ITER (formerly the International Thermonuclear Experimental Reactor) will attempt to reproduce the sun’s power here on earth. It will generate around 500 megawatts of power, 10 times the energy needed to run it, using little more than hydrogen, the most abundant element in the universe. The project

Geoff Brumfiel, “Fusion’s Missing Pieces,” *Scientific American,* June 2012

Latin for “the way,” ITER will be the largest and most powerful fusion generator in the world, and is expected to to cross the break-even point. ITER is projected to produce 500 MW of power with an input of 50 MW, and be able to hold plasma for half an hour or more. That’s enough energy to power roughly 50,000 households.

Nathaniel Scharping, “Why Nuclear Fusion Is Always 30 Years Away,” Discover Magazine, March 23, 2016

The ITER project began in 2007, with the treaty signed by its international members came into force. Its approach to fusion is to trap heavy isotopes of hydrogen in a doughnut-shaped vacuum vessel known as a tokamak and heat them up to 150 million °C. This should force their nuclei to fuse into helium, releasing vast amounts of energy. Tokamaks have existed around the world for decades, but ITER would be the first to release substantially more energy than was put into the hydrogen plasma. It is predicted to produce about 500 megawatts of electricity.

Davide Castelvecchi and Jeff Tollefson, “U.S. Advised to Stick With Troubled Fusion Reactor ITER,” Nature, May 27, 2016. ITER will not produce any electricity. The ITER reactor will require much more power to operate than just to heat the plasma.

> Ultimately, the Tokamak reactor is projected to produce 500MW of fusion energy while consuming 50MW to heat the hydrogen. Because the primary purposes of the reactor are to learn more about the properties of plasma, the means of controlling plasma, and the production of tritium by lithium breeder blankets, the excess energy will not be harnessed to produce electricity.

Dave Loschiavo, "A Field Trip to ITER, a Work in Progress That Will Test Fusion's Feasibility," Ars Technica, July 3, 2016. The ITER reactor will require much more power to operate than just to heat the hydrogen.

ITER is not likely to produce any excess power, let alone excess energy. It will not generate any electricity. As with the power values for JET, the stated power values for ITER are based only on the ratio of fusion power out to plasma heating power in; the 500 MW value has nothing to do with net system power.

The Japan Atomic Energy Agency Web site is one of the few, if only, fusion organizations to provide honest information: "ITER is about equivalent to a zero (net) power reactor, when the plasma is burning." (PDF Archive)

> # ITER
>
> From Wikipedia, the free encyclopedia
>
> *For the type of medieval circuit court, see Eyre (legal term).*
>
> **ITER** (**International Thermonuclear Experimental Reactor**, and is also Latin for "the way") is an international nuclear fusion research and engineering megaproject, which will be the world's largest magnetic confinement plasma physics experiment. It is an experimental tokamak nuclear fusion reactor that is being built next to the Cadarache facility in Saint-Paul-lès-Durance, south of France.[1]
>
> The ITER project aims to make the long-awaited transition from experimental studies of plasma physics to full-scale electricity-producing fusion power stations. The ITER fusion reactor has been designed to produce 500 megawatts of output power for several seconds while needing 50 megawatts to operate.[2] Thereby the

Common misunderstanding of required operating power, as shown in Wikipedia image from Dec. 14, 2016

To perform the largest fusion experiments, ITER must draw electrical input power from a dozen hydroelectric and nuclear fission power plants in the nearby Rhône Valley. The Japanese Web site says that other ITER requirements during the fusion pulses lead to a total steady power consumption of 200 MW during the pulses. The Japanese Web site does not specify any additional power required to prepare for the pulses. But more power requirements are likely.

According to the ITER Web site, the power supply for ITER is planned to have a capacity of up to 620 MW. The total installed power for ITER, according to a technical document, "Power Converters for ITER," written by Ivone Benfatto, working with the European Fusion Development Agreement in Garching, Germany, will be about 1.8 GVA. All facts indicate that the idea that ITER will consume only a total of 50 MW of electricity to produce 500 MW of heat is erroneous.

ITER will not generate 450 MW of net power output because the reactor will require much more than the 50 MW of electrical input power needed just to heat the plasma. The 50 MW value is the only number for power input that has been disclosed publicly. The actual total input power required to operate the entire ITER reactor system has not been clearly disclosed. However, external power supplied to the reactor from the local grid is planned to have a capacity of 620 MW. Thus, the ITER reactor will not generate 10 times the total power needed to run it. As it is designed, the ITER reactor, if it exceeds system break-even, is not likely generate more than 1.14 times the total power to run it.

More details and references are in Chapter 3 of my book *Fusion Fiasco.*

Dec. 15, 2016 Addendum: As *Fusion Fiasco* (pages 35-37) shows, testimony from fusion representatives to Congress gave the erroneous impression that JET had produced net power in the millions of Watts. Congress approved funding for ITER based on this misunderstanding. Members of the European Union research commission may have been told a similar erroneous concept. An archived webpage from the official European Union energy research section said that JET had accomplished its mission and that "the scientific and technical basis has now been laid for demonstrating net fusion energy production."

Dec. 16, 2016, Update: Text has been added to several of the captions.

Dec. 19, 2016, Update: The last sentence has been changed to reflect the power balance as given in the Benfatto slides.

Share this article: http://tinyurl.com/zug8k92

Steven B. Krivit began his science journalism career focusing on low-energy nuclear reactions (LENR) in 2000. He initially reported on the work of credentialed scientists who claimed that they had experimental evidence of "cold fusion." He took those scientists at their word. However, by 2008, Krivit had identified eight experimental facts that disproved their erroneous "cold fusion" hypothesis. Krivit's latest article on LENR was published by *Scientific American* on Dec. 7, 2016.

Questions? Comments? Submit a Letter to the Editor.
Dec. 14, 2016
To the Editor:

I told you previously that magnetic fusion reactor researchers make detailed computer models of conceptual fusion power plants that account for all their power sources and sinks, and the interactions among them, to guide future research toward the desired goal of safe and economical commercial energy. The details of all the power flows, dissipation, and generation are given in published papers and in reports to national and international energy agencies. There is no cover-up, but one must read thoroughly and not report just one number.

My summary of the ITER tokamak's main purpose is: to study plasma behavior and validate plasma theory at anticipated thermonuclear conditions under various proposed fusion reactor operating scenarios. A second purpose is to study interactions of a strongly fusioning plasma with the nearby vacuum vessel wall and the tritium-producing "blanket".

ITER will be stopped frequently to reconfigure it to accommodate different planned and serendipitous experiments. Hence, it made no sense to design ITER as a power plant to send power to the electric grid.

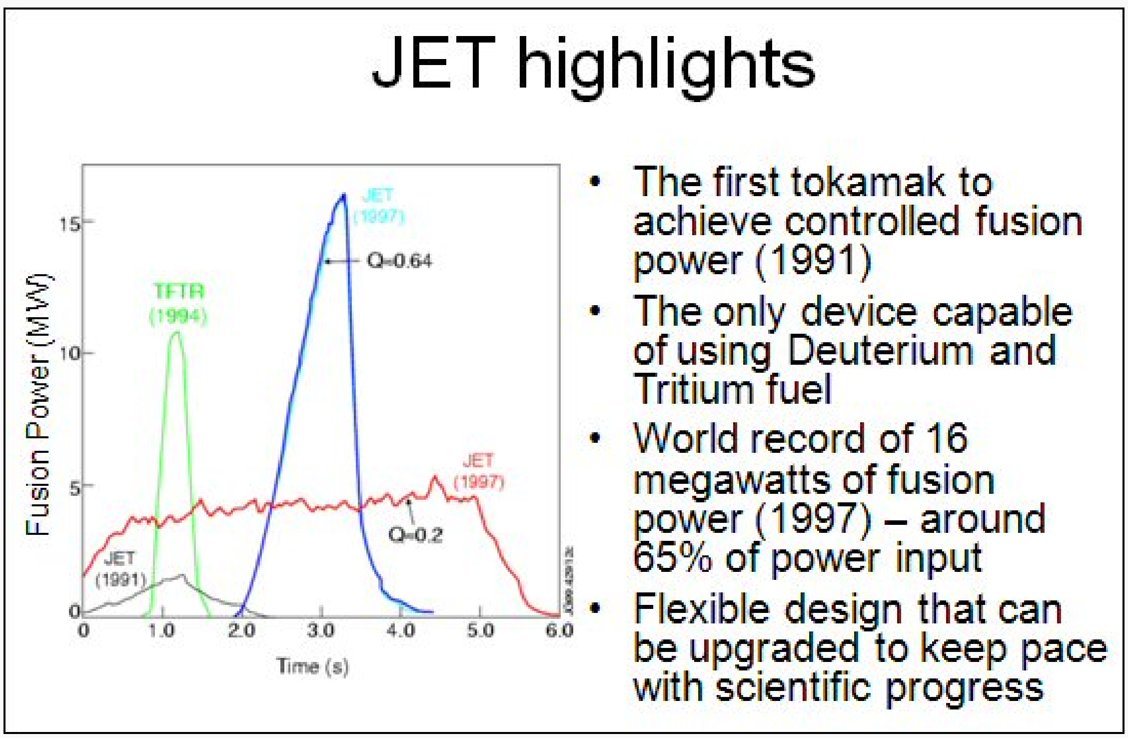
Michael J. Schaffer
San Diego, CA
Retired General Atomics fusion energy researcher

Dec. 14, 2016
Hi Michael,

Yes, I contacted and you gave me lots of technical details but you did not clearly answer my simple question about real net power. The reason, as I soon came to understand, was because you never think about real net power and you and your colleagues never measure real net power. This became clear to me only after my communications with Stephen Dean and Nick Holloway.

My journalism colleagues have been wondering whether I had my technical facts correct in this story. You, Dean, and Holloway were helpful, and unless you forgot to tell me something now, then the technical facts I've reported here are correct, and I thank you for your help.

The idea of blaming journalists for not asking questions which they had no idea they needed to ask doesn't fly. When I contacted you in 2014, I had 14 years as a journalist specializing in LENR, with some reporting on fusion and fission. Even then, I had no idea that the people in your industry had been promoting fusion results using two very different sets of numbers. It would be inconceivable to all but insiders that Holloway's slide No. 6, shown below, doesn't actually mean real input power.



Nick Holloway's 2011 slide #6. Fusion power output was actually about 2% of total power input. "World record" fusion pulse was not total net power of 16 MW, but a loss of about 684 MW.

You suggested that reporters should not report just one number. But Holloway didn't provide any other power gain/loss number in his 2011 slide presentation. This is the same situation for the values displayed on the ITER Web site today. Nobody but insiders would imagine that "total input power" wasn't really total input power. It would be inconceivable to all but insiders that the total input power for the JET 1997 pulse was around 700 MW rather than 24 MW. There's no cover-up here. Not yet. Just a lie of omission.

Best regards,

Steven B. Krivit

Dec. 15, 2016
To the Editor:

I am PhD student in MCF and your article is fair and correct – what scientist are talking about is 'scientific break-even', while you are pushing for 'engineering break-even' to be visible/emphasized to the public and I completely agree here with you (I was also shocked when I found out about this).

However saying only that 'ITER is the most expensive science experiment on Earth' could make taxpayers and politicians angry in such an article, without mentioning real benefits of ITER or what is the cost of the alternative.

I will give an example on NIF (National Ignition Facility) in Livermore (as I assume you are from USA, which pays around 2 billion $ for ITER). It costed around 4-5 billion $, so USA payed this 2 times more money than for ITER. NIF scientists claimed that they achieved ignition when ~15 kJ of power was ABSORBED and ~22kJ was an output. But then you can also find that for this 15kJ to be absorbed, one needs to spend 20 MJ into lasers. So they are very far even from the 'scientific break-even'… I could not find how much energy/power is needed to actually run those lasers, but I guess it would be in order of hundreds of MWs.

Moreover, EU gives around 9.5 billion $ for ITER in total, but solely German government gives 25 billion $ PER YEAR for the research in renewable energy production, which is well known to be not reliable/stable energy source and without positive perspectives/future at the current state of knowledge. But media in EU are also not mentioning those numbers or facts when they talk about renewables.

For the end, I would like only to pay your attention to the above topics that you can investigate better then me and maybe clarify it to the public as you did with ITER.

Best regards,
Milos
Vojvodina, Serbia

Dec. 15, 2016
Hi Milos,

Thank you for your letter. I know that you, and many other scientists and students, are sincerely doing your best to research better energy alternatives. The data on NIF, (see page 43-44 in my book) is this: Fusion power out divided by laser power in = 1%. That doesn't even account for total system power input. The total system power balance, whatever that is, would be much lower than 1%. I don't think the NIF people want the public to know the real system Q. They might not even know it themselves.

Best regards,
Steven B. Krivit

Dec. 15, 2016
To the Editor:

If discussing the power needed to heat a plasma then one should also quote the time for which that power was used or else talk about energy. The article is very difficult to interpret as the key information about duration of power usage is often missing. The author makes an important point but it would be better if energy or duration of power use were described in more detail.

Peter Osman
Lindfield West, Australia

Dec. 15, 2016
Hi Peter,

Thank you for your letter. I have changed one sentence in my article to read as follows: "ITER is not likely to produce any excess power, let alone excess energy." An additional clarification would, I think, also be helpful: Because there has never been any excess power in fusion experiments, there has never been any excess energy, nor a need (in this article) to report duration of power.

Best regards,
Steven B. Krivit

Dec. 15, 2016
To the Editor:

How can you write a follow up story to the Scientific American story on cold fusion and not make mention of the Hydrino process which by exhaustive experimental work and over 100 published papers proves Hydrino accounts for the anomalous energy. Brilliant Light Power has engineered the SunCell, a new primary power source, coming Q1'17. They should be included in your blog.

Eric Hermanson
Sterling Heights, MI

Dec. 15, 2016
Hi Eric,

So by April 1, 2017, according to you, members of the public will be able to go out and buy one of Randy Mills' energy products and power their devices and homes. Please get back to me then with information about where members of the public can purchase the system.

Warm regards,
Steven B. Krivit

Dec. 16, 2016
To the Editor:

Regarding the ITER power supply. The low end is 110 MW. They don't specifically state it, but this must be the steady state value. Of this, 80 MW is for the cooling and cryogenics, i.e. parts of ITER: obviously once the superconduction coils are cooled down, they want to keep it that way. That leaves 30 MW for other purposes. This seems way too high for offices and IT, but let's assume it is correct and the 30 MW is all non-reactor uses. Then during actual experiments, it goes up to 620 MW, that means a total of 620-30= 590 MW for ITER power requirements. This would be their worst case, maximum ITER power input. Then 590 in, 500 out, that's 85% . It cannot be that only 110 is required for the actual run, because they state that a large amount of power is needed for that. So your calculation of 450% is reasonable.

M. Ackermann
Strasbourg, France

Dec. 19, 2016
To the Editor:

Please allow me to submit a follow up to my previous letter from 2016-12-16. I have found a presentation about ITER power requirements. In this, at page 19, it shows the ITER power requirements during running to be 320+120 MW (excluding peaks). Therefore, with 440 MW in and 500 out, there would – if all goes as planned – be a net gain, output being 114% of input. Far from the claimed 10 times, but still a net gain.

M. Ackermann
Strasbourg, France

Dec. 19, 2016
New Energy Times has received two very long and convoluted letters from Peter Duncan-Davies in Croydon, U.K. This will serve to summarize and respond to his key points:

Duncan-Davies says that the *New Energy Times* use of the phrase “copper magnets” (for JET) is misleading because “given the age of the JET design, it probably does not use superconducting magnets.” “Copper magnets” is the term given to *New Energy Times* by Holloway, the JET spokesperson, as the original e-mails (provided with the hyperlink in the article) show. Additionally, the JET result discussed in the article was from 1997 and was consistent with the age of the design.

Duncan-Davies says that the *New Energy Times* article unfairly depicts the JET efficiency: “because JET was not fitted with efficient superconducting magnets it provides a very poor steady-state power balance during fusion pulses.” The JET result was the JET result. No further response is necessary to Duncan-Davies’ post-hoc excuse for the result.

Dec. 21, 2016
To the Editor:

In your discussion of the ITER yield, you’ve assessed it in terms of power, but as it’s not a continuous process, it should rather be assessed in terms of energy. Instant power doesn’t tell anything about the energy required to preheat the system, for example. The runtime of the experiments is another aspect that should also be investigated. How many cycles can be run in a day ? What is the minimum restoration time between cycles?

Eric Lombard
Paris, France

Dec. 21, 2016
Dear Eric,

Thank you for your letter. We discussed the proposed ITER yield in terms of power because ITER representatives discuss power gain, not energy gain.

Kind regards,
Steven B. Krivit