Testimony (Written Statement) of Robert C. Iotti

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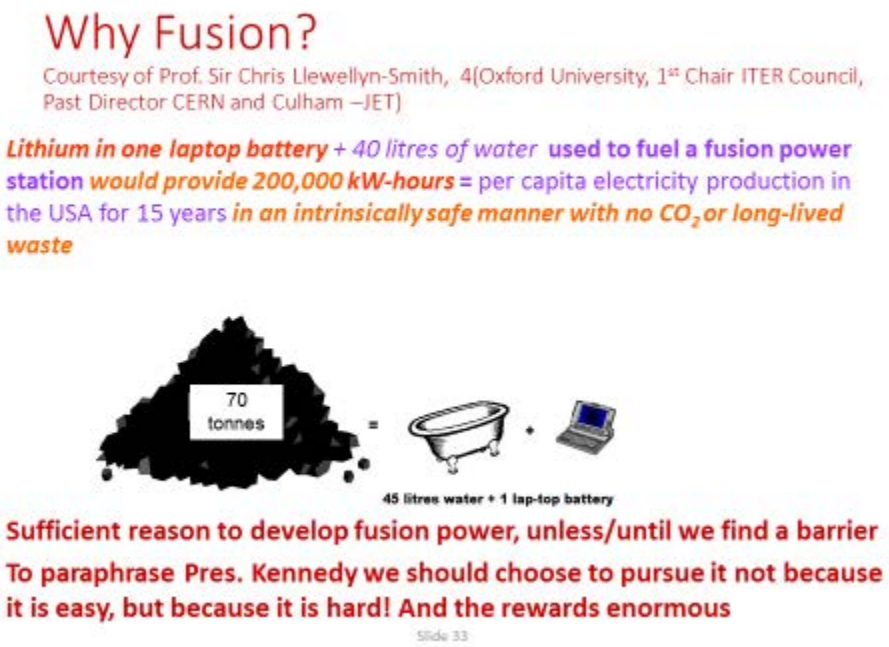
Madame Chair, Ranking Member Swalwell, and Members of the Committee: Thank you for this opportunity to appear before you today.

My name is Bob Iotti. I am the present Chair of the ITER Council. It is an honor to provide this testimony on progress of the ITER international fusion project and the challenges that we are facing. While being the Chair of the Council provides me with a unique perspective on the project, I am not representing the views of the Council, but simply providing information that is known to me in as its Chair, as well as offering some personal views.

Since one of the purposes of the Hearing is to assess the status of the International Thermonuclear Experimental Reactor (ITER) it is appropriate that I begin with my view of the worldwide importance of this project.

Nuclear Fusion is what powers the Sun and the stars, and, in principle, could provide an almost unlimited, environmentally benign power on Earth: unlimited because the fuel is essentially unlimited, and environmentally benign because it is inherently safe and produces no long lived radioactive isotopes. To put it in perspective, the lithium from one laptop battery plus 40 liters of water can provide the per capita consumption of electricity in the US for 15 years. Harnessing fusion, however, has proven to be a much greater scientific and technical challenge than originally hoped, and ITER is indispensable and pivotal to such achievement



We do know that the fusion process produces energy. Aside from powering the Sun and stars, a controlled magnetic confinement fusion experiment at the Join European Torus (JET in the UK) has produced 16 MW of fusion power, and the Tokamak Fusion Test Reactor (TFTR) at the Princeton Plasma Physics Laboratory produced 10MW; both experiments sustained the fusion power for about a second and required somewhat more heating power than the power produced. Based on these successful experiments and many other experiments worldwide, ITER has been designed to produce 500 MW of power for about 450 sec or more,

with a power gain, which is the ratio of fusion power to external heating power, of 10 which is 8 times larger than the current world record made by JT-60 in Japan (equivalent to 1.25 with D-T fuel). In ITER, unlike JET and TFTR, the plasma will be mainly self-heated by the fusion reactions, which is why it is called a burning plasma since it burns the fuel and fusion power dominates the dynamics of the plasma. This is the only planned magnetic fusion facility that will enable us to study both the physics and technological issues of a burning plasma. The achievement of high power gain, large fusion power and long pulse operation are key scientific and technological challenges that need to be addressed for the development of a fusion power plant.

While I was involved in the construction of TFTR nearly 40 years ago and worked on ITER for two years in the 90's, my career has been mainly in the design and construction of defense nuclear facilities and commercial nuclear power plants in the U.S and Internationally, in large infrastructure projects and in successful waste management projects at INL, Hanford and Savannah River. Thus, I have developed an appreciation for the complex nature of large projects and the additional complexity associated with international projects. I was nominated by the U.S. to become the Chair of the ITER Council beginning on January 1st of this year, and elected unanimously by the other Members. I had previously been the Chair of the Council's Management Advisory Committee (MAC) and had attended Council meetings from mid- 2007 through the end of 2009. I had remained as U.S member of the MAC for the next four years, and hence followed the deliberations and decision of the Council during that period.

ITER has recently been the subject of several articles in the press. Unfortunately most of the articles have chosen to highlight the challenges that ITER face. Not as well publicized is the progress that ITER has made. Construction of the facility is proceeding in Cadarache, France, after receiving regulatory approval. Nearly 90% of the Procurement Arrangements (PAs) have been signed (specifically 99 PAs out of a total 140. The 99 PAs account for 2600 kIUA of the possible 2901 kIUA credit. The kIUA is a unit of account establishing the credit that a party is given for a particular contribution in kind). The PAs are the contractual documents between central organization (called the ITER Organization or IO for short) and the Domestic Agencies (DAs) of the parties who are signatories to the Joint ITER Joint Implementation Agreement (JIA) These PAs enable design, fabrication, and installation of the various required buildings, structures, systems and components of the facility. Buildings are under construction and the components are being fabricated in the diverse Domestic Agencies. Progress has been and is being made.

Unquestionably ITER as a project has had management problems. At present, the schedule for achieving first plasma and DT operations is uncertain, as is its final cost. What is known is that the schedule is longer and its costs greater than originally anticipated. There are a number of reasons for the overrun in schedule and cost. Some are not within the control of the project, such as the explosion in commodity prices in the 2005-2010 period. Some are due to the first of a kind nature of the ITER project and are almost invariably present in first of a kind facilities worldwide. We have seen them in the U.S first of a kind projects, like NIF and MOX for example. Some are indeed failures of management and also of multiple stakeholders in their decision making process. The latter encompass lack of sufficiently completed design for some systems and components, and delays caused by advisable changes in the design.

One of the difficult, if not the most difficult, problems causing delays and overruns are those that stem from the (JIA) itself. The IO and the Director General (DG) of the project are held responsible for the overall design, licensing, construction, commissioning, and then operation of the facility. The various buildings, structures, components and systems are provided as contributions in–kind to the IO by the DAs. The Domestic Agencies have all of the funds, which in turn are subject to the budgets allocated to ITER by the various parties. The IO operations are funded by cash contributed from those funds by the various parties on a yearly basis. The DG and the IO have no direct control over the Domestic Agencies, so that when, as is often the case, there is misalignment of incentives between the IO and any particular DA, decisions cannot be readily made, leading to delay and cost increases. An example of divergence of incentives, which occurs very frequently, is proceeding with a change in design, which the IO considers essential, but for which the particular DA or DAs involved have insufficient funds. The JIA specifies that anything that involves cost or

schedule decisions requires unanimity or at least Members' best efforts to achieve consensus. All it takes is for the Member that has a problem with a particular decision, to not agree and that decision cannot be made. While the issue is difficult, it does not mean it is without a solution, and we are working on it, and are making reasonable progress.

Funding shortfalls can directly contribute to schedule delays and consequent cost increases. Given the schedule delays and cost increases experienced to date, it is normal for the parties to have budget problems. The U.S is not alone in experiencing these cost increases and delays. However, the US's strategy that yearly funding should be minimized until the schedule is known with a high degree of confidence and international ITER performance improves can further increase US costs and could well delay the ITER schedule. It creates a funding profile that is clearly insufficient for the US to deliver all of its in-kind contributions on the Council's presently approved schedule (1st plasma in Nov 2020, DT in 2027), necessitating delaying the delivery of some of the in-kind systems/components to much later dates. That presently approved schedule, however, is being updated. Whether the updated schedule, when completed in mid-2015, will show the US to be on the critical path remains to be seen. To avoid being the cause of international delay, the US may have to adjust the US budget accordingly. How much adjustment will be required will be determined by schedule dates. Similarly, failure of other Members to deliver on appropriate dates, whether because of budget shortfalls or other reasons, can cause cost increases for some or all Members, including the US.

A recent Management Assessment, conducted in 2013, pointed out issues in the IO management as well as the overall governance by the ITER Council. It also pointed out that action would be required on all, not just a few, of the recommendations in order to turn the project around.

So what steps has the Council taken to address the management challenges in ITER?

Prior to the 2013 Management Assessment, the Council had already been active in intervening in ways that would spur progress, such as would be expected from the equivalent of a Board of Directors. However, due in part because the people who prepared for the meeting did not bring forward the tough issues, and in part because the meeting agenda contained a large number of topics with no assigned priority or importance, the Council effectiveness was not optimal. In response to the MA recommendations, the Council has taken action to improve its effectiveness and efficiency. In the just completed Council meeting, the issues which used to consume a great part of the meeting, but were not controversial, were disposed instantly by approving a Consent Package containing the material on those issues, thereby enabling the Council to concentrate solely on the difficult and controversial issues. Of course, any member can raise issues regarding the Consent Package but this has streamlined the meeting making it more substantive.

Specifically in regard to the management of the project, the DG accepted all of the recommendations of the MA, and immediately after the IO started corrective action. The Council requested that the IO and the Council Preparatory Working Group prepare a detailed plan of action to respond to each and every recommendation that the Management Assessment had. The plan was then reviewed and some actions were approved and some sent back for further improvement. I was charged to provide the guidance to the DG to improve the response, which I did. For some recommendations many different actions are necessary, while for others a single action suffices. Every one of the actions is being implemented. Some are paying immediate dividends, and some will require more time to complete implementation and for us to see the results.

One example of tangible progress being already seen is the development of an updated realistic schedule. Because of the past experience of clearly being unable to do so, the approach to develop an updated schedule is to first develop an annual work plan for 2014, and use the experience in how well that plan can be met, to inform the subsequent development of the overall schedule. Until very recently, we were

developing schedules replete with milestones, but were only meeting about 50% of them, and when a milestone was not met, it would simply be rescheduled. That has changed! In the first five months of this year, virtually all milestones have been met, and a few more, not yet scheduled, have been achieved. Milestones that are in jeopardy are immediately acted upon to prevent or minimize slippage. Of course five months of progress do not necessarily make a trend, but compared to the past, this is very gratifying. Not only is this a good sign, but we are learning from the annual work plan effort how to develop a more realistic updated schedule, and this bodes well for the ability of meeting our target date to have an updated, high confidence schedule by the middle of 2015.

With regard to the recommendation to reduce the number of senior managers in the IO and move more authority to delegate to the lowest technically competent level, the IO has proposed and begun implementing a revised organization which already reduces the senior managers by about 25% and flows down the decisions to the appropriate competent technical levels. The Council is still reviewing the IO proposed organization with a view to reduce the senior managers further to about 50%

As part of the same organizational changes, the IO is adding a considerable number of systems engineers, which will strengthen the systems engineering and integration capability, not only of the IO, but that of the DAs, by facilitating the handling of the interfaces with the DAs. This has contributed to the schedule delays and is being addressed.

Steps have been taken to reduce the IO bureaucracy and in particular to increase the IO effectiveness and efficiency. This will remain work in progress for some time, but as an example, the Council has approved the centralization of CAD services and its performance by IO staff as opposed to the previously used outside contractors. This saves money and time.

The actions to establish a project and a safety culture will also be work in progress for some time. Although all of the numerous actions proposed to accomplish this are being implemented, changes in culture take time. However I am encouraged with the different attitude I see in both the IO and the DAs. There is a new “can-do” spirit and increased cooperation, not quite at the optimal level, and not universal to all persons, but clearly much improved over what used to be there.

For those recommendations that affect not only the IO, but the relation between the IO and the DAs, and hence depend on their cooperation, the Council established a working group, under the chairmanship of an IO senior representative, and including the most senior personnel from each of the domestic agencies, to study ways in which the interaction between the IO and the DAs could be significantly improved without requiring a change in the JIA. A change of the JIA is considered impractical and virtually impossible.

This working group is addressing what is perhaps the most difficult task of any of those resulting from the MA recommendations. It has made very good progress is establishing means whereby decision are made jointly by the IO and DAs without jeopardizing compliance with the JIA, which holds the DG as the leader and nuclear operator. In this approach issues will be studied, with different options for decision presented to an executive group, comprising the IO and all DAs, that works with the DG and jointly arrives at a decision, which is then announced by the DG, but has already been agreed by the DAs. This approach will not solve all problems, and some decision may still have to go to the Council. The Council itself, however, will have the same problem of being blocked by any Member, hence to aid the Council in arriving at a decision, the various options with pros and cons will be presented to them.

I need to add that in establishing the action plans, in helping implementing them, and in the various working groups, the US is a very active contributor to the solutions. I am not referring to myself, because I am not a member of the US team, but as Chair I represent all Parties in the Council. Here, I refer to US representatives

from the Domestic Agency and directly from the DOE. The US influence on ITER transcends its financial contribution, with many Members looking to the US to lead in solutions. This is true even despite the U.S present budget situation, although I must admit that it is sometime difficult to have the U.S opinion prevail, when the U.S is having budget difficulties, which are perceived as a lack of U.S commitment to the ITER Project.

Finally the Council, with the highest priority, has acted on the recommendation to accelerate the Director General transition, by forming a working group chaired by me. The assignment of this working group was to detail all of the steps necessary for an appropriate succession planning. This working group has completed its work, which has been accepted by the Council. The next step, already approved, is the formation of a Search Committee, who will meet in Paris on July 15th, elect its own chair, and start reviewing potential candidates and establish a ranked short list as soon as practical. While this effort is being conducted on a schedule which is as accelerated as possible, the priority is on identifying and successfully recruiting the next DG. Until that is done, it makes little sense to discuss if the present DG term of office should end before the end of his contract.

In summary, progress is being made. In the IO and some of the DAs, progress in fixing the management issues is not as rapid as one would like, but that is not surprising given the international nature of ITER, the difficulties of making decisions, due to the underlying structure of the project which to date has often resulted in stalemated IO and DAs. A new and better spirit of cooperation between the IO and the DAs is nascent, but not yet fully at the level it must be. Communication within the project is improving, but still has a way to go.

Nevertheless, despite the management problems, it is important that this Committee recognize that progress is being made in the licensing of the facility and the fabrication of the ITER various components and in the buildings. Attached to this testimony, I have provided a booklet of pictures that show the progress made in this regard in the various Domestic Agencies and at the site. The project has received approval for construction from the French regulator, and the first components will start arriving on site at the end of this year.

Obviously that progress is impeded every time any Member has difficulties with their budget, and given the past schedule slippages and cost increases, budget difficulties should be expected. At the very least, they should be expected to continue until such time that the project can develop reliable schedule and cost estimates so that they become known with high confidence, and the various Members can use that information to make concrete plans based on predictable data.

I believe that the project will produce a predictable schedule by mid-2015. Having a predictable schedule will also enable knowledge of the costs.

Let me close my testimony by answering two questions: will ITER be successful and what is in it for the U.S?

Success may be in the eye of the beholder, and given the history to date, some may consider ITER to be an unsuccessful project regardless of the ultimate outcome. I choose to judge its success based on whether it will deliver or exceed the performance that is expected. Like all “experimental” facilities, there is always a risk that the facility will fall short of the objective. That is why it is called “experimental”. Nevertheless the design of ITER has been based on, -and takes advantage of decades of-, progress made in all of the fusion facilities worldwide, and as such the risk of falling short in performance is low. There are no showstoppers, and what technological challenges exist can be met and overcome.

Why does it benefit the U.S?

- In the shorter term, 80 per cent of the US contribution to the ITER Project is in the form of components, systems and structures produced by the US – which has a direct, positive impact on U.S. jobs, and U.S. industry.
- As I have pointed out, the biggest challenge to the project is the JIA where systems, components, buildings etc. are provided as contributions-in-kind. However, it is this same in-kind contribution approach which provides the US (and other members) the opportunity to develop its industry and people in cutting-edge areas of technology. We are not just building a tokamak. The technological spin-offs from the US experience in fabricating the ITER tokamak components can be potentially immense.
- The US cannot afford to be left behind in this technology. By contributing just 9 per cent of the cost of the project, the US obtains full and equal access to the Intellectual Property to be generated during the course of constructing and operating this facility. This intellectual property is likely to go well beyond just component-specific fabrication technologies and methods.
- Once built, this immense facility is going to be available for a considerable period of time for researchers and scientists from the member countries as a matter of right. JET was commissioned in 1983-84 and is still continuing in operation.

In conclusion, I firmly believe that ITER will be a great success, not only as an experimental facility, but as a model of international cooperation, and the U.S must be part of this grand challenge.

Thank you, Madame Chair and Members of the Committee. I will be happy to answer any questions you may have.