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Status of ITER Project Progress

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I am very pleased to have the opportunity to address this gathering of the Fusion Energy Forum this year as I did in 2017. Unfortunately, I am not able again to be present with you in person. But I hope—with this virtual appearance on remote video conference systems with Tada San—that I will be able to provide you with some updates and new perspectives regarding the progress of the ITER Project. I will divide my remarks into four main topics:

1. Organizational progress;
2. Worksite progress; and
3. Manufacturing progress.

First, organizational progress. As you know, the ITER Project has gone through an extended period of reform since 2015, designed to get the project on a reliable path for construction, assembly and installation, and—ultimately—operation.

Fundamentally, this required large improvements to how we worked as an integrated team. By “team,” I mean to include the ITER Organization, all the ITER Domestic Agencies, the contractors, and the suppliers. The key points were as follows:

- To be effective, a large project as ITER required centralized decision-making, supported by a Reserve Fund that could be used, as needed, to implement these decisions when they involved unavoidable changes.
- Working as an integrated team, we developed a reliable, updated Overall Project Schedule which was approved by the ITER Council in November 2015 and confirmed a year later, with a corresponding Overall Project Cost.
- We established Project Teams in critical areas, composed of top experts from across ITER.
- Above all, we put a very strong focus on the creation of a new ITER culture. A Project culture. A nuclear safety culture. A culture of teamwork, with clear values and highly effective project management.

Finally, during this period, as the organizational reforms proceeded and we became stronger, we needed to receive external validation.

- First, we received in April 2016 an independent report after review by outside experts to verify that the updated schedule and cost projections were credible and reliable.
- This outcome led the ITER Council to put its stamp of approval on the Overall Project Schedule. This includes achieving First Plasma in 2025—and then, using a staged approach, reaching Deuterium-Tritium Operation with full fusion power in 2035.
- Second, we instituted a series of “In-Depth Reviews” of specific aspects of project management. So far this has included In-Depth Reviews on:
    - Risk Management;
    - Interface Freezing; and
    - Configuration management;

- And next year we anticipate an In-Depth Review on the ITER Assembly and Installation Strategy—as we prepare for the next phase of the project.

Another aspect of validation and credibility has been the establishment of a series of ITER Council approved Project Milestones, derived from the Master Schedule, beginning in 2016 and continuing through First Plasma 2025. The completion of these milestones, on time and on budget, means that the project overall is staying on track. I am pleased to report that so far we have completed 37 of these agreed project milestones. We are considering some one hundred more in the next seven years.

Finally, our Project Control Office has established a system of measurable ITER project metrics, which consider all aspects of design, construction, manufacturing, installation, assembly, and system commissioning.

- In November 2017, we passed the 50% mark—according to these project metrics—signalling that we were halfway through the "total construction through First Plasma."
- This was seen as a big event—the world took notice—and we witnessed more than 700 articles in the international media regarding this achievement.
- According to the latest measures, by the end of 2018 we will be at nearly 60%. On average, each month we complete approximately 0.6/0.7%. Considering the number, 85, of months remaining until December 2025, this demonstrates that we are on track for First Plasma 2025.

So as you can see, at the same time that all of these ITER Organizational Reforms were underway, we have also been proceeding—successfully—with

construction and manufacturing operations—both at ITER Headquarters and in laboratories and workshop production facilities worldwide.

Let's move to the worksite progress now. I would like to mention a few of these tangible aspects of the Project, starting with progress on the ITER worksite.

- Across the worksite, construction continues to proceed at a very fast pace. As we will show you on the video, many buildings are already in use, and the largest physical structures are well on the way to completion.
- At the centre of progress is construction of the Tokamak Complex. For the Tokamak Building itself, the bioshield is now essentially complete, and we have completed what we call the "concrete crown" civil works—which will bear all of the 23,000 tonnes of weight of the Tokamak.
- We expect the overall Tokamak Building to be turned over and ready to start Assembly on schedule in March 2020.
- In August, we inserted 6 large drain tanks and suppression tanks—procured by the United States and China—into their place in the Tokamak Building.
- In late November, just a few weeks ago, we successfully inserted the first real Tokamak machine component—the first Cryostat Feedthrough for Poloidal Field Coil #4—into its place at the bottom of the bioshield.
- On either side of the Tokamak Building, the Diagnostics Building and Tritium Plant are also well underway, with the first Tritium tanks installed.

- Just behind the Tokamak Complex is the 60 meter high Assembly Hall, where the largest components will be assembled before being installed into the Tokamak. Inside the Assembly Hall, the first SSAT, or Sub-Sector Assembly Tool, procured by Korea, has been nearly completed, and the second one is well underway to completion. These SSATs are giant, 800-tonne tools that will be capable of holding the toroidal field coils, vacuum vessel sectors, and thermal shield— components that weigh hundreds of tonnes— and will be able to bring them together with the required precision of only millimetres.
- Next to the Assembly Hall, construction is underway on the Radiofrequency Heating building. This will house the plasma heating systems – including both microwave and radiofrequency systems.
- On the other side of the Assembly Hall, the Cryogenics Plant structure is complete, the giant helium tanks are installed, and most of the refrigeration and cryogenics equipment has been installed. This will be the largest single platform Cryoplant in the world – delivering liquid nitrogen and liquid helium to keep the ITER magnets at minus 269 degrees.
- Next to the Cryogenics Plant, the Magnet Conversion Buildings are also complete, and installation of the convertors and associated electrical equipment is well underway.
- Toward the rear of the ITER worksite are two very important fabrication buildings. The first is the Poloidal Field Coil facility. The largest of the Poloidal Field Magnets are too massive to be shipped to ITER from a distance, so they must be fabricated onsite. Most of the double pancakes are complete for Poloidal Field Coil #5, and the cold testing facility is ready to go.

- Fabrication is also ongoing in the Cryostat Workshop, under the control of the Indian Domestic Agency. The Cryostat baseplate has been largely completed, and welding operations are nearly complete on the Cryostat Lower Cylinder. I was recently in India to witness that Larson & Toubro have largely completed forging the pieces of the Upper Cylinder, which will be shipped to ITER very soon to begin welding operations of that next section.

Let's move now to the manufacturing progress. As you know, ITER is a global enterprise. I should also briefly mention some of the manufacturing progress taking place in ITER Member countries worldwide. Of course, each Member is involved in almost every part of the ITER machine—so I will only give a few examples of recent progress.

- In Korea, manufacture of Vacuum Vessel Sector #6 is nearing 85%. Strong progress is also being made on the other sectors in Korea and Europe.
- Japan is contributing to very many aspects of the ITER Tokamak and supporting systems. In particular, I would mention the completion of all superconductor strands for the Central Solenoid, and the strong progress made on the Toroidal Field Coil winding packs. The first Japanese winding pack is now undergoing cold testing.
- In China, Poloidal Field Coil number 6 is being manufactured in Hefei. China also has delivered the large transformers to the ITER worksite that will deliver the Pulsed Power Electrical Network to the machine.
- In Europe, this year we inaugurated the SPIDER Neutral Beam Test Facility in Padua, Italy, where Japan is also a strong supporter of the project.

- In addition to progress on the Cryostat I already mentioned, India is also making good progress on its contributions to ITER's heating and current drive systems, in vessel shielding, and other components.
- Russia is making excellent progress on Poloidal Field Coil #1 at the shipyard in St Petersburg, as well as on the fabrication of port plug structures.
- In the US, the Central Solenoid – sometimes referred to as the "beating heart" of the ITER Tokamak – is well underway at General Atomics in San Diego—both the magnet itself and the support structures.

I could go on. But as you can see, it is impossible to cover all the aspects of the ITER Project in a briefing such as this.

Let me close by emphasizing that we cannot do it alone. This progress can only be achieved with strong support from all involved, including our important partners represented here at the Fusion Energy Forum. We are grateful for this support. I wish you a very successful conference.

Thank you.