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Talk on

EU R&D energy policy and the role of fusion research

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India

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Opening address

Distinguished Guests, Ladies and Gentlemen, I am delighted to be invited here at the opening session of this prestigious fusion conference. I would like to thank the IAEA, the FEC conference Organizing Committees and the local authorities for providing such an exquisite venue.

I would like to speak firstly about the role of nuclear fusion in the energy research and innovation landscape in Europe; secondly, how we intend to support fusion in the next Euratom programme for the period 2021-2027, and finally a few words on the importance of international co-operation in this field.

Energy

Energy is fundamental for our society. As world population grows and technologies evolve, energy remains at the top of our political agenda. The European Union owes its existence to treaties on the Coal and Steel community and EURATOM. Achieving Europe's Energy Union is one of the key objectives of President Juncker, as he again made clear during his State of the Union speech last month. This is directly linked to our economic competitiveness and the fight against climate change.

Over the last two decades there have been fundamental developments in our energy system both in Europe and internationally. We are witnessing a rapid introduction of decentralised renewable energy technologies in our drive for a clean environment, security of supply and a competitive economy. At the same time, public confidence in nuclear energy is being eroded in Europe and in other continents.

With the emergence of new technologies and systems for energy storage, the transition to renewable energy will continue to accelerate. This is essential if we are to meet the European emission reduction objectives under the Paris Agreement, as highlighted by the recent IPCC report.

Fusion energy

What place does fusion energy have in this landscape? What is the commitment of Europe to fusion R&D? And how does the fusion R&D programme need to evolve for fusion energy to be realised in this century? These are the three questions that I will now address.

Firstly, population and GDP growth are both projected to increase this century. As a result, the demand for electricity will continue to grow significantly beyond 2050. We cannot be sure that this increase can be met only through expansion of renewable energy sources.

Because the cost of electricity from renewables is falling faster than expected, estimates of their potential deployment are frequently being revised upwards. On the other hand, concerns about the intermittent nature of renewable energy sources are becoming more critical with the increase in installed production capacity. Given these uncertainties we must continue to develop alternative low emission technologies.

One of the few new energy sources on the horizon that fits into this picture is fusion energy. Fusion energy, similarly to nuclear fission, will be characterized by a large unit size, a high level of plant complexity and strict nuclear regulations. Fusion power entails long construction timelines and high capital investment, which will result in a relatively high cost of fusion

electricity. If it cannot offer cheap electricity, fusion must offer other qualities that consumers will be willing to pay for. Three such qualities come to mind: (1) Autonomy and security of supply: Fusion offers a country the option to make at least part of its energy system independent of imports; (2) Availability: Fusion power does not suffer from intermittency or seasonal fluctuation; (3) Low land use: Fusion power is compact and safe, so that units can be placed close to cities, energy-intensive industrial complexes or data centres.

For fusion energy to become a part of the energy landscape during the second half of this century, considerable additional efforts will be required. This is not just a technical challenge. Fusion will also need to find its place in a world of relatively cheap renewable energy sources.

Secondly, in line with the European Commission's 2050 vision on energy, the European fusion community prepared a roadmap for the demonstration of electricity from fusion power by the middle of this century. The successful and timely realisation of ITER is a critical element in the roadmap. I was very impressed by the recent progresses made in the construction of ITER, which was presented by Dr Bernard Bigot at the SOFT conference a few weeks ago. The technology and engineering achievements, where advanced materials are used to manufacture components more than 10 m tall, weighting hundreds of tons with millimetric accuracy were particularly impressive. I am certain that many of you are looking forward to hearing from Dr Bigot later this morning.

ITER is a prime example of pooling international expertise in an effort to demonstrate the viability of fusion as a new energy source which, if successful, may change the world. Tackling these challenges together gives access to the world's best talents, expertise and resources and also enhances

the supply and demand of innovative solutions. We will continue to support ITER in the future.

ITER has the highest priority in fusion research and the Commission is fully committed to the project. The Council of the European Union issued in April 2018 its conclusions "reaffirming" continued commitment of Euratom for a successful completion of the ITER project and allowing the European Commission to approve the new ITER baseline. This is reflected by the funding for ITER and its related activities under the next Multiannual Financial Framework, 2021 to 2027.

Thirdly, while keeping a focus on ITER, the Commission expects the fusion programme to be even further oriented toward technology developments, including greater industrial participation, culminating in the conceptual design of DEMO, the demonstration fusion power plant, by 2027. For DEMO we will need to develop many new technologies requiring a comprehensive research and development programme in parallel to ITER. The main objective of DEMO will be to demonstrate the technological and economic viability of nuclear fusion as an energy source. DEMO will therefore have to operate continuously and reliably for long periods of time - weeks if not months - with reactor-relevant components and systems. While machines like ITER are judged on the number of good pulses per day, their corresponding load factor is extremely low. Under optimistic hypothesis ITER's maximum load factor will be between 1% and 2.4% during its first years of operation. In DEMO, the target availability found in the literature varies between 30 and 60%. To achieve such target we will need vastly improved engineering practices, including the systematic use of engineering codes and standards whenever applicable, and radical design optimisation. For this, industry will need to be involved from the very start of the DEMO design process. And, for several

components, there may need to be a trade-off between performance and reliability. While advances in physics research will certainly still be required, a greater emphasis on technology, engineering and industrial infrastructure will be necessary.

How we are supporting fusion today?

The European Union has supported fusion research for over 60 years. With the current Euratom programme we have sought to re-invigorate the fusion programme and to ensure more focus on key activities. The Consortium "EUROfusion", which includes all European fusion research institutions, was formed and empowered to manage the European fusion research effort. The European Joint Programme, which is implemented by EUROfusion, is an example to the world of working together to deliver on common goals.

The European Commission is committed to ensuring that nuclear fusion remains an important and successful part of our research and innovation agenda. A significant proportion of the proposed Euratom budget for 2021-2027, a total of 2.4 billion Euros, will therefore be devoted to fusion research. I would now like to spend a moment on how this fits into the wider picture of EU research under the Euratom.

The new Euratom programme will continue to improve safety, security and radiation protection and to contribute to the decarbonisation of the energy system in the long term. The new elements that the European Commission has proposed include non-power applications such as the uses of ionising radiation, not only for medical applications, but also for industry, agriculture and space research. We propose to create stronger synergies between nuclear research and other research areas through joint activities within the new research and innovation framework for 2021-2027, Horizon

Europe. We will support research to ensure sufficient and secure supply of radio-isotopes, an extremely important aspect of medical applications. We will also offer to all projects the possibility for access to our Joint Research Centre facilities and expertise.

One overarching element of research is the human capital. It is imperative that we maintain and further enhance the number, the competences and the excellence of our research community, especially in the nuclear sector. For this reason, a continuation and even enhancement of the present education and training action is foreseen in the next Euratom programme. In this respect, especially concerning excellence, the Marie Skłodowska-Curie Actions will be opened up to Euratom researchers.

International Collaboration in fusion research

Global societal challenges require global collaboration. I see from this audience that fusion is truly a global venture. I would like to conclude my remarks today on the importance we attach in Europe to our international partnerships in this field.

The European fusion research programme has a long-standing and vigorous international dimension. There are more than one thousand collaborative actions between European fusion laboratories and research institutions outside the EU. These take place under several frameworks: the Commission has signed more than 10 bilateral cooperation agreements for collaboration in fusion research, we have the Broader Approach Agreement with Japan, and the eight multilateral fusion Technology Cooperation Programmes (TCPs) set up by the International Energy Agency (IEA). There are, furthermore, several bilateral collaboration agreements between individual European and non-European research institutions. In addition,

high level discussions take place under the auspices of the International Atomic Energy Agency, the agency organising this conference and several specialised fusion Technical Meetings every year.

This broad international collaboration is a specific feature of fusion research worldwide and the signature of the ITER Agreement would probably not have been possible without this background. The European Commission greatly values this international collaboration and is prepared to widen its scope in all cases when a fair and sound proposal will be presented.

Conclusion

It has been my pleasure to be here and inform you on the future prospects and opportunities that will exist in Euratom 2021-2027. The European Commission remains committed to fusion research and making ITER a success. However, given the rapidly evolving and dynamic situation in the current energy sector, within the EU and internationally, we need more than ever to take up the challenge and work together to put fusion firmly within the future energy landscape.

On that note, I would like to wish you a successful conference.