§19. Assessment for Fusion Reactor Development

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Assessment for fusion reactor development has started to make clear critical issues, which should be resolved for the commercial fusion reactor as a major energy source in the next century.

Discussing items are as follows.

(1) The motive force of fusion power development from viewpoints of future energy demand, energy resources and earth environment for " Sustainable Development".

(2) Comparison of characteristics with other alternative energy sources, i.e. fission power and solar cell power.

(3) Critical issues of fusion DT reactor development such as Li extraction from the sea water, structural material and safety.

(4)Future planning of fusion research and advanced fuel fusion.

This year, discussions were mainly focused on above (1) and (2).

We may have oil resource of $4\sim5\times10^{12}$ barrel at least, which can support energy demand of the whole word for over 100 years. Therefore, there is no reason to urgently promote the research of alternative energy sources from viewpoint of energy resources.

MIT group has suggested that "Sustainable Development" requires the new energy source, which should not be so harmful to earth environment and should be in hand within following 20 years. Otherwise, we could not avoid the crisis of the civilized human life at the middle of the next century .

Therefore, the major reason to develop the alternative energy sources such as solar cell power, fission power, and fusion power is to keep future earth environment. Unfortunately, these new energy sources have crucial drawbacks, which should be overcome as fast as we can, however, a little of effort has been paid.

Major drawbacks of the solar cell power come from its small energy density. It needs wide area for power plant, and consequently becomes extremely heavy weight which causes low energy ratio. Therefore, the high conversion efficiency of solar cell over 40% should be developed. Otherwise, solar cell power could not be a major energy source in future.

The fast breeder is essentially necessary to have large amount of energy resource by nuclear mutation of U238 to Pu. Short doubling time of the fuel within 20 years is required to supply Pu to start the operation of new fast breeders which are successively being constructed to be a major energy source. However, today's fast breeders and their designs show that the doubling time is over several tens of year. Therefore, an improved fast breeder of which doubling time is under 20 years should be developed, however, non of country starts such research.

On the other hand, extraction of U from the sea water has succeeded. It increases the cost of electric power but only by about 10%. Combination of the light water reactor, of which technology is established, and a large amount of U in the sea water is more attractive than the fast breeder.

The bottleneck of the DT fusion reactor is its technological difficulties. Low activated structural material, which can bear large neutron dose up to 500 dpa, is required for the commercial reactor. However, non of the plan to research such material is accepted.

Even in the experimental power reactor which aims to long and high Q burn such as ITER, a diverter should bear large heat unload up to 30 MW/m^2 and large erosion rate over cm/year. An innovative scenario of the diverter is urgently required.