

LETTER TO THE EDITOR

PERCEPTIONS OF THE DEMO FROM INTOR DAYS AND TODAY

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I commend *Fusion Science and Technology (FS&T)* on an interesting issue (Volume 67, Number 1, January 2015) on current perceptions of the DEMO to follow ITER. After spending the better part of a decade in the INTOR Workshop working with Russian, European, Japanese, and American fusion physicists and engineers on the definition and research and development (R&D) requirements for INTOR/ITER, during which we frequently considered the question of what type of DEMO would follow, I gave a paper¹ at a 1994 International Atomic Energy Agency meeting on a systems study of the DEMO. My perceptions were certainly conditioned by my INTOR experience of defining the INTOR design concept for the next step and the necessary R&D program and so could be taken as representative of the INTOR era (the 1980s).

Now 20 years have gone by, during which all that R&D as well as advanced plasma physics research has been carried out, and the next step—ITER—has been designed and is being built; i.e., fusion has advanced by 20 years. I thought it would be interesting to compare the present perceptions of the DEMO assembled by the ARIES team in the January 2015 issue of *FS&T* with the INTOR-era perceptions of 20 years ago. Both sets of perceptions were generated using similar types of systems codes, although the present systems codes are much more extensive and the input is supported by more recent studies.

As it turns out, both the ARIES team and I looked at two categories of DEMO: those based on Advanced Physics but conventional ITER-level Technology (AP/IT) and those based on Advanced Physics and Advanced Technology (AP/AT). As shown in Table I, the physics assumptions (confinement, beta, bootstrap current, plasma shape) have not changed too much in 20 years, nor has the magnetic field strength. The resulting sizes, plasma currents, and neutron wall loads are similar. The ARIES AP/AT, which takes advantage of advances in current drive and higher beta limit, is more attractive than anything envisioned 20 years ago.

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REFERENCE

1. W. M. STACEY, "Extrapolation to a Demonstration Reactor from the ITER and Advanced Physics and Materials Databases," *Proc. 15th Int. Conf. Plasma Physics and Controlled Nuclear Fusion Research*, IAEA-CN-60/F-P5, Vol. 2, p. 779, Seville, Spain, September 26–October 1, 1994, International Atomic Energy Agency (1995).

TABLE I

Perceptions of the DEMO from INTOR Days and Today

| Parameter | AP/AT ARIES 2015 (ACT1) | AP/AT INTOR 1994 (M) | AP/IT ARIES 2015 (ACT3) | AP/IT INTOR 1994 (I) | AP/IT INTOR 1994 (J) |
|------------------------------------|----------------------------|-------------------------|----------------------------|-------------------------|-------------------------|
| P_{fus} (MW) | 1800 | 1500 | 2600 | 3000 | 1500 |
| H_{ITER98} | 1.65 | 1.7 ^a | 1.65 | 1.7 ^a | 1.7 |
| β_N | 4.75 | 3.7 | 4.0 | 3.8 | 3.7 |
| f_{bs} | 0.91 | 0.74 | 0.86 | 0.80 | 0.73 |
| B_{TFC} (T) | 11.8 | 12.0 | 10.6 | 12.0 | 12.0 |
| κ/δ | 2.2/0.6 | 2.0/0.8 | 2.2/0.6 | 2.0/0.8 | 2.0/0.8 |
| R (m) | 6.25 | 6.36 | 8.50 | 7.56 | 6.24 |
| a (m) | 1.56 | 1.49 | 2.13 | 2.82 | 2.30 |
| I (MA) | 11.0 | 17.0 | 16.4 | 17.5 | 14.6 |
| P_{CD} (MW) | 40 | 75 | 78 | 0 | 75 |
| Γ_{FW} (MW/m ²) | 2.45 | 2.01 | 1.86 | 1.79 | 1.33 |

^a0.5 H_{ITER89} .