Highlights of ARIES-AT Study

Farrokh Najmabadi
For the ARIES Team

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ARIES Web Site: http://aries.ucsd.edu/ARIES

The ARIES-RS Study Set the Goals and Direction of Research for ARIES-AT

	ARIES-RS Performance	ARIES-AT Goals
Economics		
Power Density	Reversed-shear Plasma Radiative divertor Li-V blanket with insulating coatings	Higher performance RS Plasma, High T_c superconductors
Efficiency	610^{o}C outlet (including divertor) Low recirculating power	> 1000 ^{o}C coolant outlet > 90% bootstrap fraction
Availability	Full-sector maintenance Simple, low-pressure design	Same or better
Manufacturing		Advanced manufacturing techniques
Safety and Environmental attractiveness	Low afterheat V-alloy No Be, no water, Inert atmosphere Radial segmentation of fusion core to minimize waste quantity	SiC Composites Further attempts to minimize waste quantity

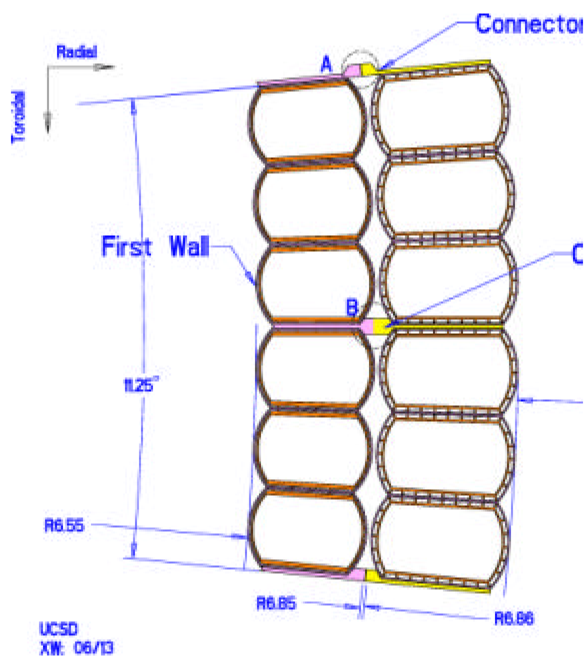
ARIES-AT^2: Physics Highlights

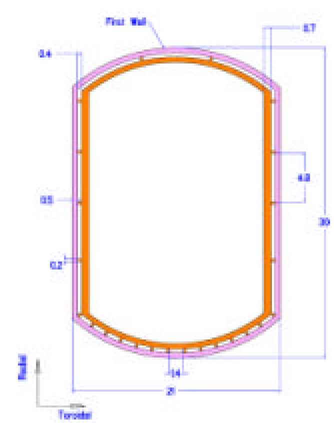
- Use the lessons learned in the ARIES-ST optimization to reach a higher performance plasma;
  - Using > 99% flux surface from free-boundary plasma equilibria rather than 95% flux surface used in ARIES-RS leads to larger elongation and triangularity and higher stable β.
- Eliminate HHFW current drive and use only lower hybrid for off-axis current drive.
- Perform detailed, self-consistent analysis of plasma MHD, current drive and divertor (using finite edge density, finite p', impurity radiation, etc.)
- ARIES-AT blanket allows vertical stabilizing shell closer to the plasma, leading to higher elongation and higher β.

ARIES-AT^2: SiC Composite Blankets

- Simple, low pressure design with SiC structure and LiPb coolant and breeder.
- Innovative design leads to high LiPb outlet temperature (~1100^{o}C) while keeping SiC structure temperature below 1000^{o}C leading to a high thermal efficiency of ~ 60%.
- Simple manufacturing technique.
- Very low afterheat.
- Class C waste by a wide margin.
- LiPb-cooled SiC composite divertor is capable of 5 MW/m^2 of heat load.

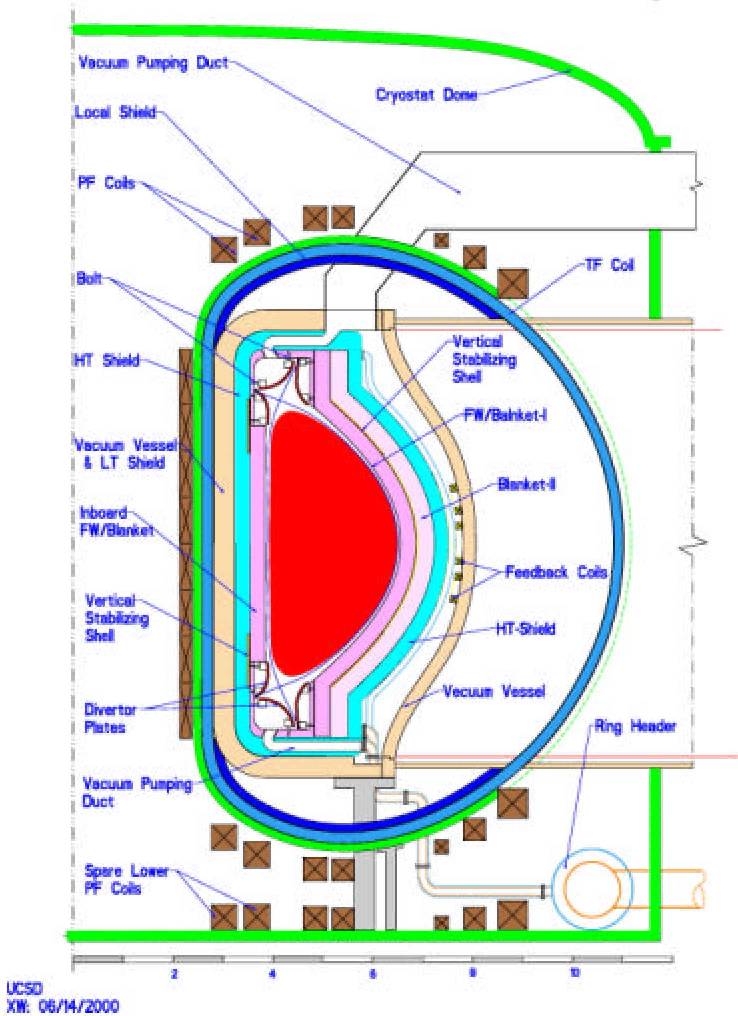
Outboard blanket & first wall



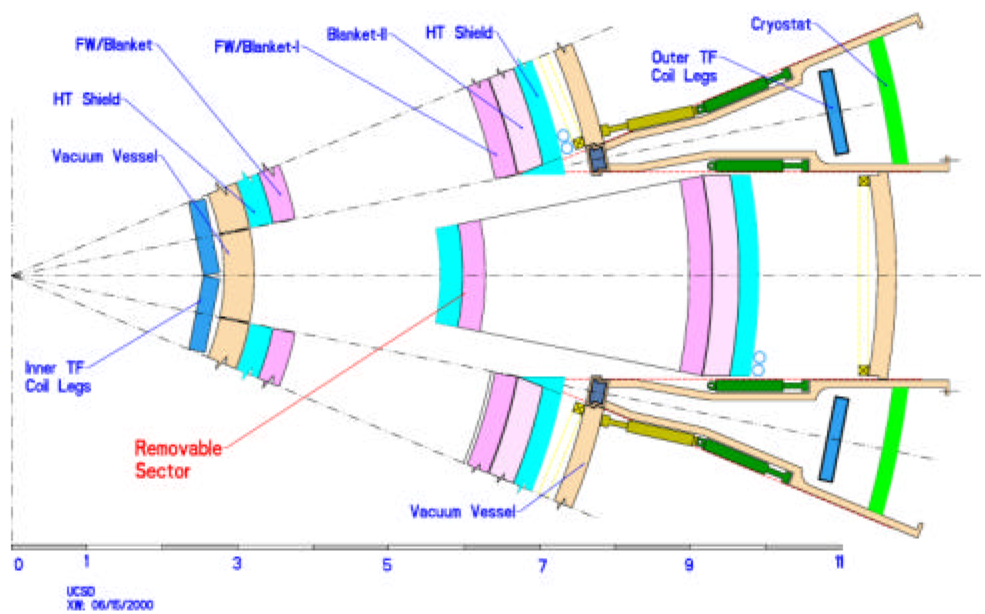


ARIES-AT Also Uses A Full-Sector Maintenance Scheme

Cross Section of ARIES-AT Power Core Configuration



Plan View of Showing the Removable Sector Being Withdrawn



Major Parameters of ARIES-RS and ARIES-AT

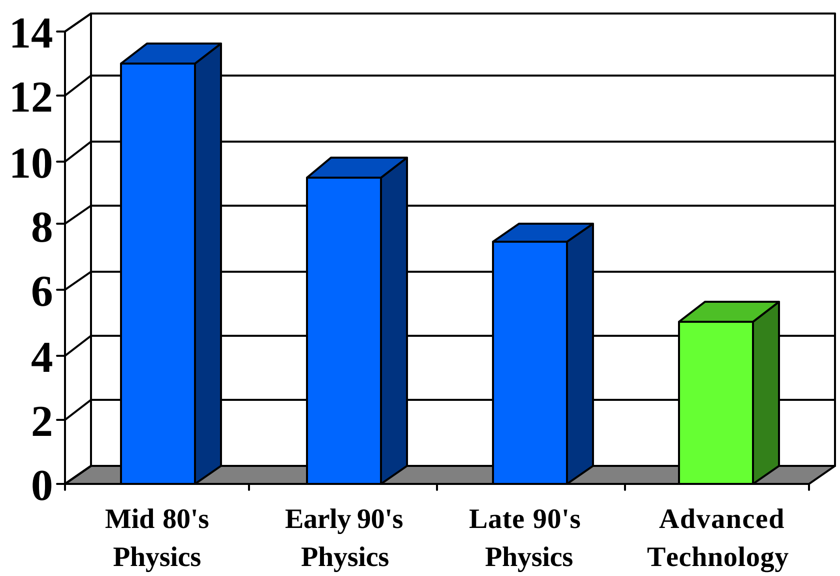
	ARIES-RS	ARIES-AT
Aspect ratio	4.0	4.0
Major toroidal radius (m)	5.5	5.2
Plasma minor radius (m)	1.4	1.3
Plasma elongation (κ_x)	1.9	2.2
Plasma triangularity (δ_x)	0.77	0.84
Toroidal β	5%	9.2%
Electron density (10^{20} m^{-3})	2.1	2.3
ITER-89P scaling multiplier	2.3	2.6
Plasma current	11	13

Major Parameters of ARIES-RS and ARIES-AT

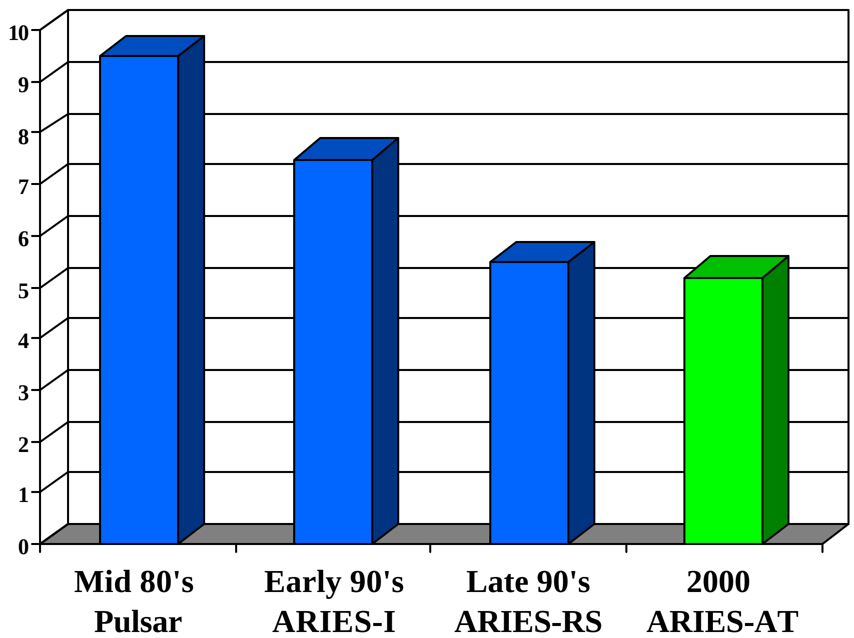
	ARIES-RS	ARIES-AT
On-axis toroidal field (T)	8	6
Peak field at TF coil (T)	16	11.4
Current-drive power to plasma (MW)	81	36
Peak/Avg. neutron wall load (MW/m^2)	5.4/ 4	4.9/3.3
Fusion power (MW)	2,170	1,755
Thermal efficiency	0.46	0.59
Gross electric power (MW)	1,200	1,136
Recirculating power fraction	0.17	0.14
Cost of electricity (mill/kWh)	76	55

Our Vision of Magnetic Fusion Power Systems Has Improved Dramatically in the Last Decade, and Is Directly Tied to Advances in Fusion Science & Technology

Estimated Cost of Electricity (c/kWh)



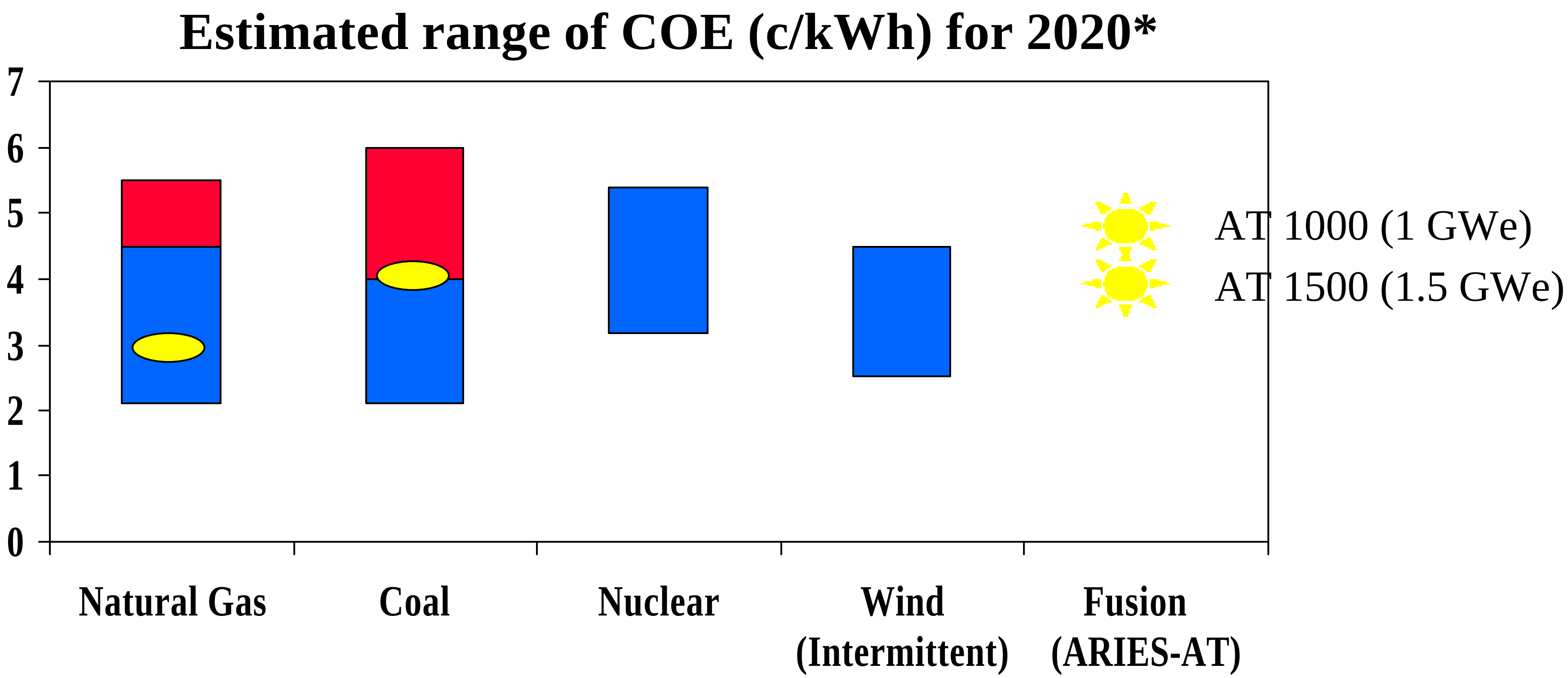
Major radius (m)



Present ARIES-AT parameters:

Major radius:	5.2 m	Fusion Power	1,755 MW
Toroidal β:	9.2%	Net Electric	1,000 MW
Wall Loading:	3.3 MW/m^2	COE	5.5 c/kWh

ARIES-AT is Competitive with Other Future Energy Sources



EPRI Electric Supply Roadmap (1/99):

Business as usual

Impact of $100/ton Carbon Tax.

Estimates from Energy Information Agency Annual Energy Outlook 1999 (No Carbon tax).

* Data from Snowmass Energy Working Group Summary.