Final ARIES-AT Systems Code Results

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ARIES Project Meeting

UCSD

December 5–7, 2000

UCSD

US Fission Plant Metrics*

- Fission fleet performance has improved.

(a) T. Moore, “License Renewal Revitalizes the Nuclear Industry,” EPRI Journal, 25, 3 (Fall 2000) 8.

COE Competition[a]

- NEA COE reduction measures[b]
  - Increased plant size
  - Improved construction methods
  - Reduced construction schedule
  - Design improvement
  - Improved procurement, organization and contractual aspects
  - Standardization and construction in series
  - Multiple unit construction
  - Regulatory and policy reform

[a] G. A. Davies, "Towards 3 cents per kWh," *Nuclear Engineering International*, 45, 549 (April 2000) 32.

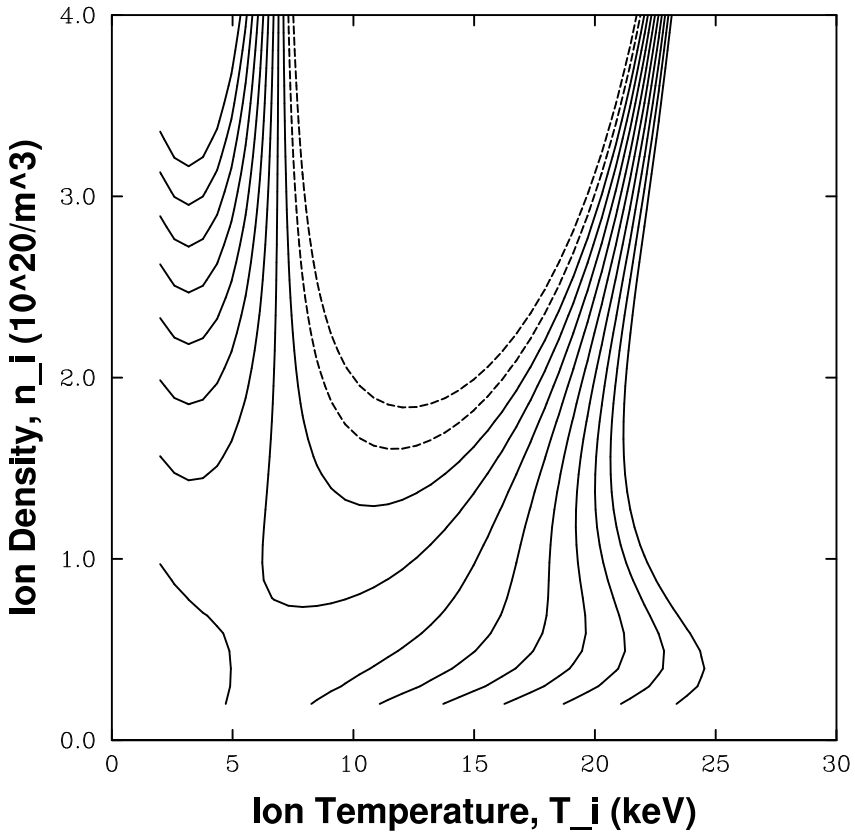
[b] anon., "Cutting the cost of nuclear," *Nuclear Engineering International*, 45, 549 (April 2000) 33.

ARIES-AT Systems Activities*

- ARIES-AT ($A = 4, \beta_N = 5.6, 6.0, 6.8$)
  - Baseline Strawman at $R_T = 5.2\,m$
  - No mantle radiation contribution
  - Final updates:
    - - higher plant factor, $p_f = 0.85$
    - - C. Kessel eqdisk at $\beta_N = 5.4$
    - - CD scaling per T. K. Mau, $f_{BC} \simeq 0.91$
    - - reconcile FPC volumes/masses (L. Waganer)
- Final Strawman (12/11) posted (12/19) to Website
- Finalization of ANS TOFE, Park City paper
  - respond to (relatively easy) reviewer comments
  - more comprehensive figures
  - COE for N-unit plant
- Final documentation (Dec. 31)
  - POPCON section for Physics Article (S. Jardin)
  - Systems Article (R. Miller)

* since last Project Meeting (Sep.).

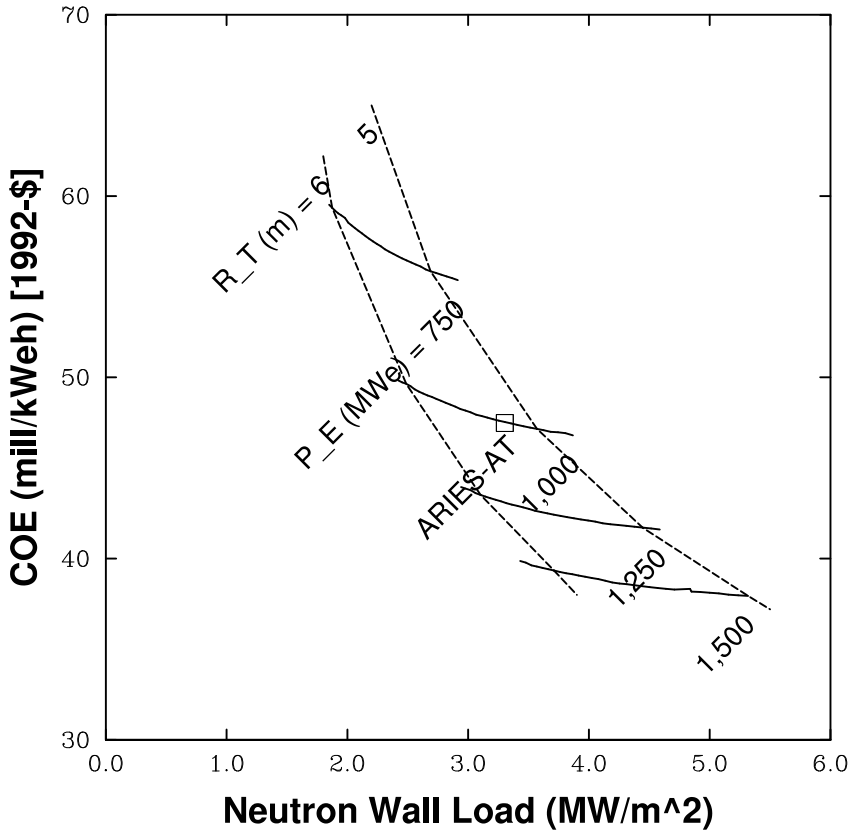
ARIES-AT Start-up/Burn POPCON†



- ITER-89P scaling
  - $T_i \simeq 18$ keV
    - - thermally stable
    - - near-optimal COE
  - contour interval is 10 MW
  - ignition (last solid contour)

† McPOP code courtesy of K. Werley (LANL).

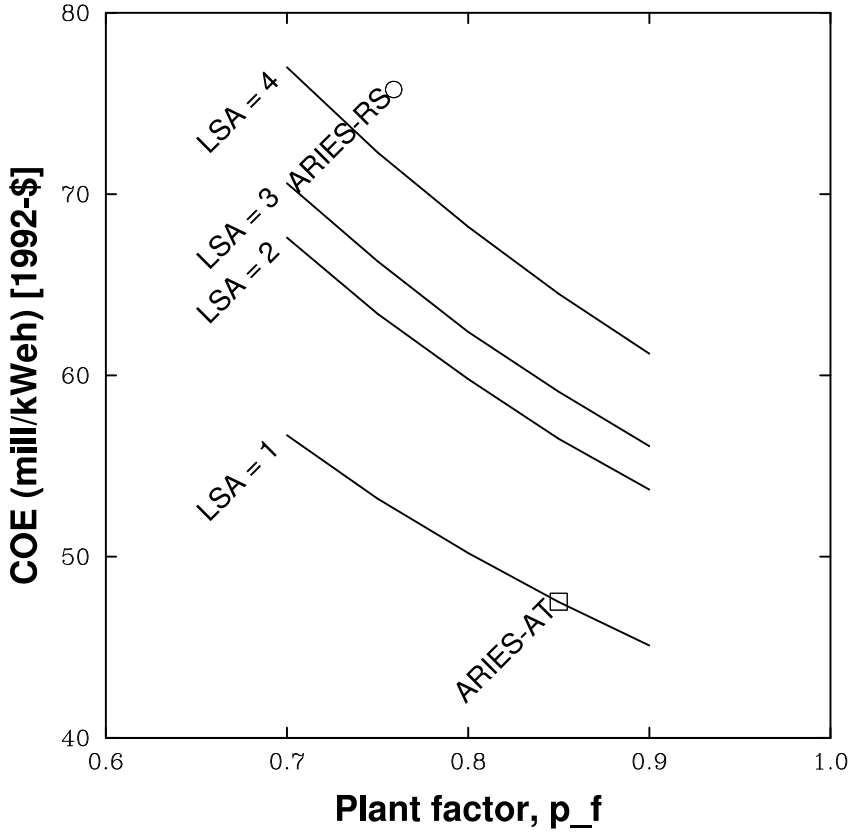
ARIES-AT Design Window†



- ARIES-AT Final Strawman
  - $p_f = 0.85$
  - $LSA = 1$

† R. L. Miller, ANS 14th TOFE, Park City, UT.

ARIES-AT Soft Parameters†



- ARIES-AT* Final Strawman (11 Dec. 2000)
  - $p_f = 0.85$
  - $LSA = 1$
- ARIES-RS* (1997)
  - $p_f = 0.76$
  - $LSA = 2$

† R. L. Miller, ANS 14th TOFE, Park City, UT.

* 6-yr construction lead time.

ARIES-AT Systems Conclusions

- ARIES-AT ($A = 4.0$)
  - Physics:
    - - Three E/S cases at $\beta_N = 5.6, 6.0, 6.8$
    - - Corresponding rf CD scaling, $f(T_e, Z_{eff})$
    - - Interim emphasis on $\beta_N = 6.0(5.4)$,
    - - P(rotation) thought to be small
  - Engineering:
    - - HTS slightly beneficial for TFC
    - - up-to-date radial/vertical builds
    - - high efficiency power cycle [added cost?]
    - - explored plant capacity factor, $p_f \geq 0.76$, pending RAM analysis (forced and scheduled outages)
- Defense of LSA = 1 cost credits
- Low-cost fabrication cost credits (?)
- Trade-offs and sensitivity parametrics