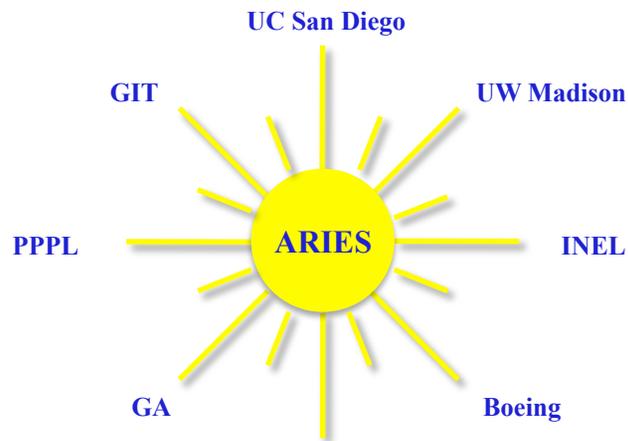


# Update of ARIES ACT-1 systems analysis



M. S. Tillack,  
with a lot of help from C. Kessel

---

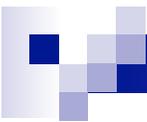
ARIES Project Meeting  
*22 - 23 Sept. 2013*

## Changes were made to ASC since September

- Adjustments to calculation of  $x_\lambda$ 
  - Removed factor of 0.8 on  $P_{\text{div}}$
  - Corrected and updated (line average vs. separatrix) density formula

$$x_\lambda = \frac{2.5(2.9 \times 10^{-2}) Q_{\text{MHD}}^{0.75} n^{0.15}}{P_{\text{div}}^{0.4} B_T} \quad n = 0.35 f_{\text{GW}} (I/\pi)(R/A)^2 \quad \Rightarrow \quad n = f_{\text{GW}} (I/\pi)(R/A)^2$$

- New radial builds (Oct 27 version)
- Edge radiation fractions (input) revised
  - Edge radiation to FW set to zero (was 10%)
  - Core radiation to divertor set to zero (was 10%)
- Economics fixes (per Waganer presentation in Sept 2012)
  - Updated price deflator base year (to 2009) and data (2009–2012)
  - Updated unit cost data
  - Unfortunately, bugs still remain in the COE algorithms



## Implementation stayed the same

- Overnight runs on PPPL cluster, 21 parallel jobs
- Post-filtering:
  1. Start with 412,690 physics solutions
  2. 58,080 of these are viable (finite COE)
  3. 80 survive filtering, as follows:
    - $990 \leq P_{\text{net}} < 1010$  MW
    - $R \leq 7$  m
    - $\beta_N \leq 0.05$  (for a total  $\beta$  of 6)
    - $f_{\text{GW}} \leq 1$
    - $H_{98} \leq 1.7$
    - $f_{\text{BS}} \leq 0.925$
- Keep only points having COE within 5% of the minimum. 43 remain. Worst of 80 survivors is 11% higher.

## Scan Results for ARIES-ACT1e

	182786 old pt	324144 FN pt	358136 low $\beta_N$ + COE	259637 low COE	253772 low qdiv	146585 low $B_T$ max	356451 low $f_{BS}$		min	max
<b>R (m)</b>	6.25	6.25	6.0	6.0	6.75	6.5	6.75		6.0	7.0
<b><math>\beta_{Nt} + \beta_{Nf}</math></b>	5.64	4.75	4.73	5.33	5.02	6.00	4.74		4.72	6.00
<b><math>f_{BS}</math></b>	0.91	0.89	0.89	0.91	0.90	0.90	0.805		0.805	0.905
<b><math>I_p</math> (MA)</b>	10.93	10.93	10.86	10.77	11.51	11.53	13.51		10.77	13.51
<b><math>B_T</math> on axis (T)</b>	6	7	7.25	6.5	6.5	5.75	7.25		5.75	7.5
<b><math>B_T</math> on coil (T)</b>	11.83	13.80	14.6	13.1	12.35	11.13	13.8		11.13	15.12
<b><math>P_{recirc}</math> (MW)</b>	160	176	177	155	161	229	320		149	320
<b>Fusion gain</b>	42.5	37.5	37.5	45.0	40	27.5	20.0		20	45
<b><math>\langle P_n \rangle_n</math> @FW</b>	2.45	2.46	2.68	2.65	2.1	2.35	2.42		2.01	2.83
<b>Peak <math>q_{FW}</math></b>	0.27	0.28	0.34	0.30	0.29	0.27	0.45		0.25	0.45
<b>Peak <math>q_{div}</math></b>	13.3	13.8	14.1	13.8	11.0	14.7	14.5		11.0	15.0
<b>COE (mill/kWh)</b>	64.32	66.06	65.17	63.83	67.19	66.46	71.09		63.8	71.4