Comments on Metrics, etc

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for the National FIRE Study Team

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http://fire.pppl.gov

The Diversified International Portfolio for Fusion Based on FIRE

Is this the

Lowest-Cost Most-Efficient Path to an Attractive DEMO for MFE?

Dale Meade

FESAC Development Path Panel

Orlando, FL

November 15, 2002

Updated version of APS DPP Poster and
Presentation to FESAC Dev Path Panel

Topics

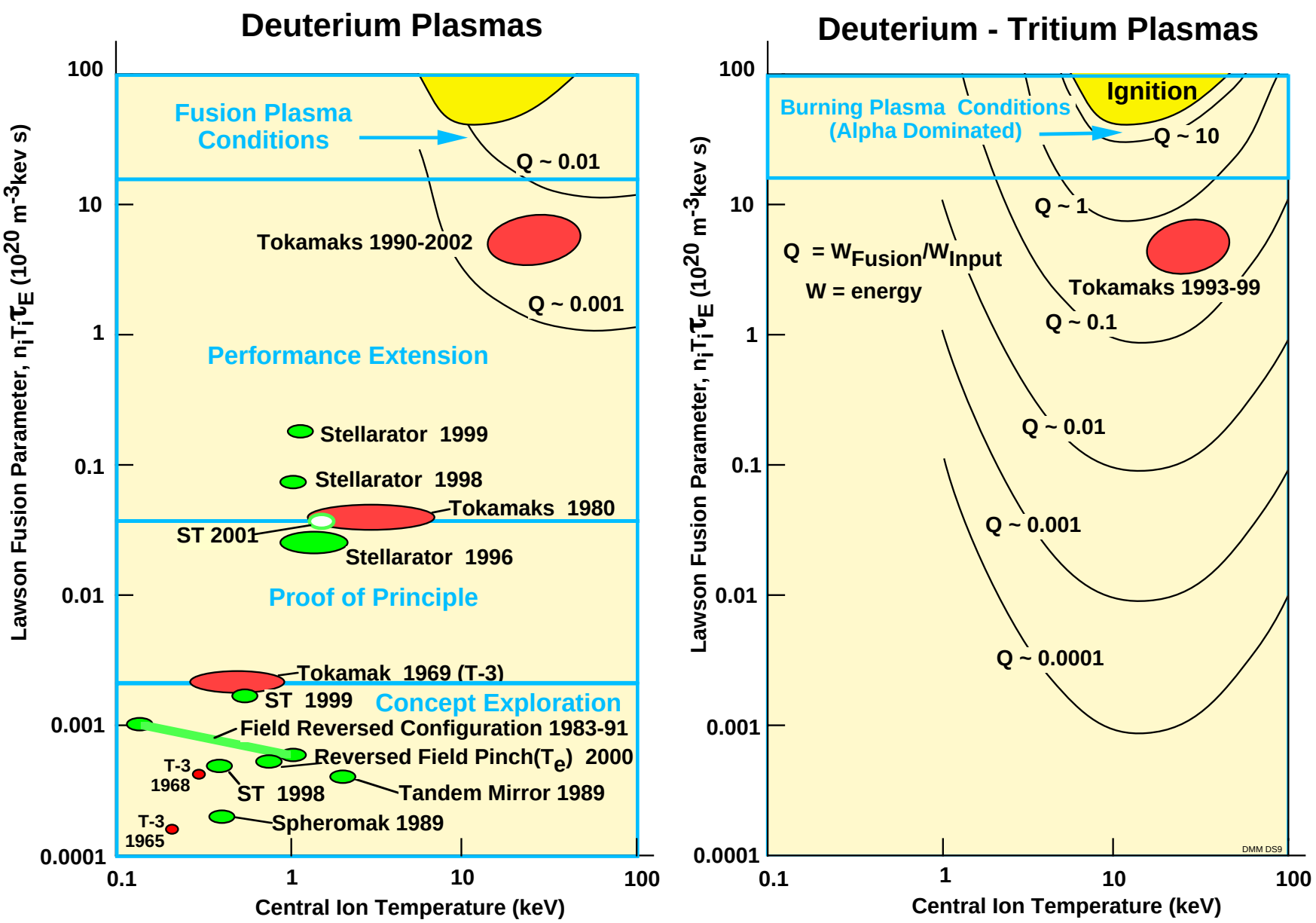
- FIRE Based Development Path Discussed at Orlando, any questions
  - Cost profiles were developed for FIRE-Based and ITER-Based Paths
  - Details are on the web, along with most of the talks from this Workshop

- Metrics
  - Some metrics are sprinkled throughout report, need more
  - need both dimensionless and dimensional – H & $n\tau_E T$, β & p, P/R & MWm^{-2}

    (Lawson Diagram)

    (Special Subcommittee on ITER Report - Kikuchi)

The Lawson Diagram is the 1st Metric for MFE BP Confinement



Needs to be updated for more recent results,
tokamaks split into short pulse H-Modes, longer pulse AT modes

Dimensional and Normalized Parameters could be Used to Track Progress

Issues		Metrics		Extrapolation* to DEMO
Configuration Optimization				
- confinement	H	$n\tau_E T$	τ_E	~20 @$10\tau_E$
- power density	β_N	nT	τ_{CR}	~3?
- Steady state	f_{bs}		τ_{CR}	~3?
- Exhaust Power	P/R	MW/m^2	τ_{div}, τ_{FW}	>10
Burning Plasma Physics				
- Fusion gain (self heating)	f_α	Q	$10\tau_E$	~100@$10\tau_E$
- Energetic Particles	β_α		τ_{MHD}	
Materials Development and Testing				
- Plasma Facing Components	MW/m^2	MJ/m^2/pulse		large
- Neutron Resistance		dpa		
- Enviromental Acceptance		Ci/MJ@50 yrs		
Fusion Tech. Develop't and Testing				
- magnets	Bmax	MJ		~60
- chamber technology	MW/m^2	MJ/m^2		
- tritium	kG-T	kG-T/yr		30 - 1000
- remote handling		$\tau_{replace}$		
- operational availability	MTBF	%		~100

* Extrapolation of Dimensional Parameter

Plasma Metrics for the Development of Fusion

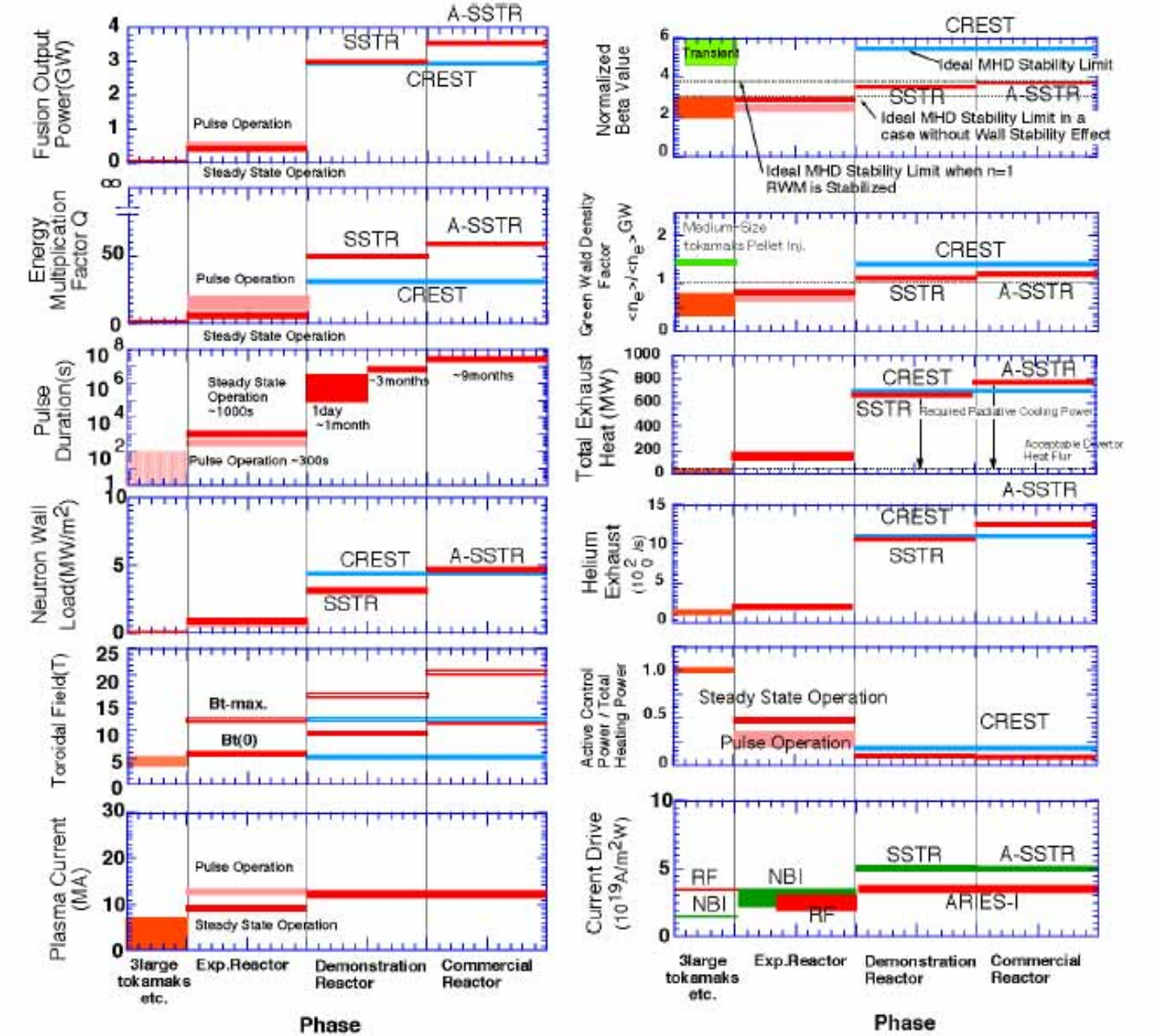


Fig. 3.1.3-1 Advancement in main parameters in each phase

Kikuchi et al

Fusion Needs a Significant Deliverable on the Decade Timescale

- 35 Years to the Moon (Fusion) – Doesn't Generate Interest and support.
- The creation and control of a burning plasma is the critical issue for fusion.
  Marburger to NRC Panel
  - 16 years to BP in ITER (ITER Site Study VG), a little long - vulnerable
  - < 10 years to Ignition in NIF or LMJ
- What could be done in by MFE in a decade? Unlimited by Cash Flow

  TFTR Const approval July 1975, Const + 3 yrs = Dec 85 = 10.5 yrs

  FIRE has 3 yrs design, 6 yrs construction time, 3 yrs DD, = 12 years

"I want fusion in a decade"