Review of Project Goals

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Some Observations…

- **Goal:** Minimize the time for fielding fusion energy in large scale
  - Objective driven as opposed to Device driven approach.
  - Trying to do the Next Step (EDemo, …) faster and therefore, with a lower extrapolation from today, makes the extrapolation between the Next Step and commercial larger and may delay large-scale deployment of fusion back.
- "Bigger" is the enemy of "Faster"
  - Compare the time for fielding ITER with that of the previous generation of tokamaks!

- **Questions:** Can we divide what needs to be done among several smaller (i.e., cheaper) devices/facilities?
- **Premise:** Cheaper devices can be fielded faster and can operate in parallel. They reduce the overall risk. More options can be examined.
- **Issues:** 1) Integration Risk, 2) Feasibility/cost of smaller devices?

Integration Risk Can Be Minimized

- Integration risk can be minimized if the device is divided along "Physical" boundaries as opposed to scientific/technical disciplines.
- MFE devices naturally divide along the in-vessel components:
  - **Plasma** only sees the first < 1mm of the in-vessel components and the EM field. (ITER results are applicable to power plant although no power producing blanket exists!)
  - **Power technologies** (all components between plasma and coils) see only neutron, heat, and EM loads (and the first <1mm also sees particle loads). It does not matter if the plasma is ignited or not!

- **Questions: Can we get "prototypical" neutron, heat particle, and EM loads in a smaller (i.e., "cheaper") device?**
  - Developing power technologies is a "wider" mission than blanket or component testing.

We need to evaluate carefully if smaller/cheaper devices can deliver "prototypical" fusion conditions?

- Define what needs to be done in order to certify fusion power technologies and what are the prototypical neutron heat, particle, and EM loads!
  - Probably only "tokamak-based" machine would be able to deliver prototypical conditions.
- Several proposal are on the table for small, low-power, driven devices:
  - ST-based
  - Conventional aspect ratio tokamaks with normal-conducting coils.
- These proposals (and others) should be evaluated and compared with the same "physics/technology" rules to asses if this option is feasible.

Mid-term ARIES Pathway Project Goals

- Define top-level Requirements (qualitative and quantitative) of the next step facility (fusion power technology demonstration and certification facility).
- System Code: Understand trade-offs to provide a range of embodiments for fusion power plants (and thus Demos)
  - Trade-offs (visualization)
  - Develop costing model/object functions for the next-step facility.
  - Operate in optimizer mode.
- Interim report
  - Top-level requirements
  - Systems code trade-off studies (of power plants)
  - What is new in our approach!

Example: EU Issue list

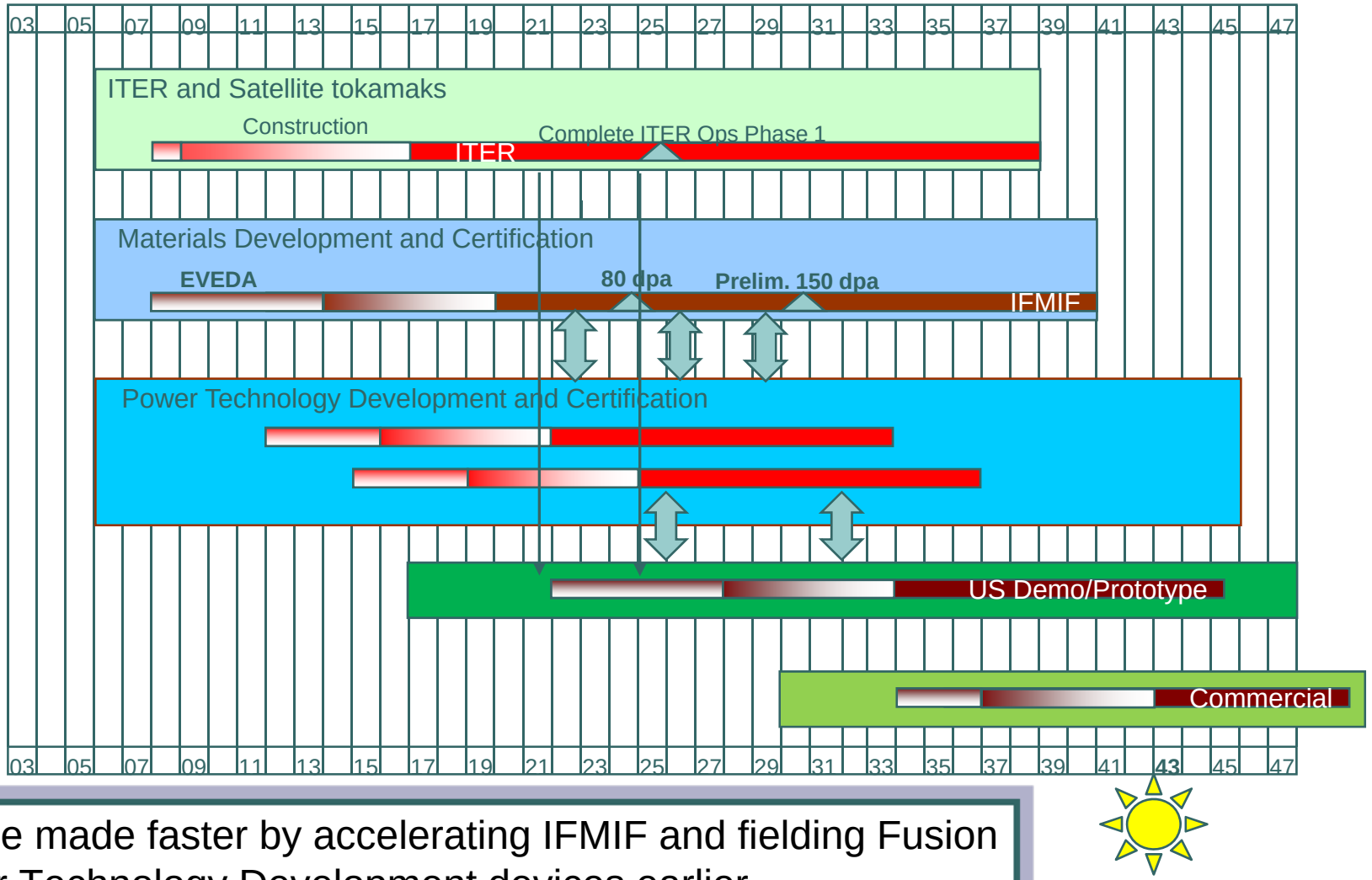
	Issue	Approved devices	ITER	IFMIF	DEMO Phase 1	DEMO Phase 2	Power Plant
Plasma performance	Disruption avoidance	2	3		R	R	R
	Steady-state operation	2	3		r	r	r
	Divertor performance	1	3		R	R	R
	Burning plasma (Q>10)		3		R	R	R
	Start up	1	3		R	R	R
	Power plant plasma performance	1	3		r	R	R
Enabling technologies	Superconducting machine	2	3		R	R	R
	Heating, current drive and fuelling	1	2		3	R	R
	Power plant diagnostics & control	1	2		r	R	R
	Tritium inventory control & processing	1	3		R	R	R
	Remote handling	1	2		R	R	R
Materials, Component performance & lifetime	Materials characterisation			3	R	R	R
	Plasma-facing surface	1	2		3	4	R
	FW/blanket/divertor materials		1	1	3	4	R
	FW/blanket/divertor components		1	1	2	3	R
	T self sufficiency		1		3	R	R
Final Goal	Licensing for power plant	1	2	1	3	4	R
	Electricity generation at high availability				1	3	R

Output:		
	1	Will help to resolve the issue
	2	May resolve the issue
	3	Should resolve the issue
	4	Must resolve the issue

Input:		
	r	Solution is desirable
	R	Solution is a requirement

UKAEA September 2007 (revised/improved version of original table in UKAEA FUS 521, 2005).

A "Faster Track" Approach to Large Scale Fusion Deployment



- Can be made faster by accelerating IFMIF and fielding Fusion Power Technology Development devices earlier.