LIFE Power Plant

Fusion Power Associates

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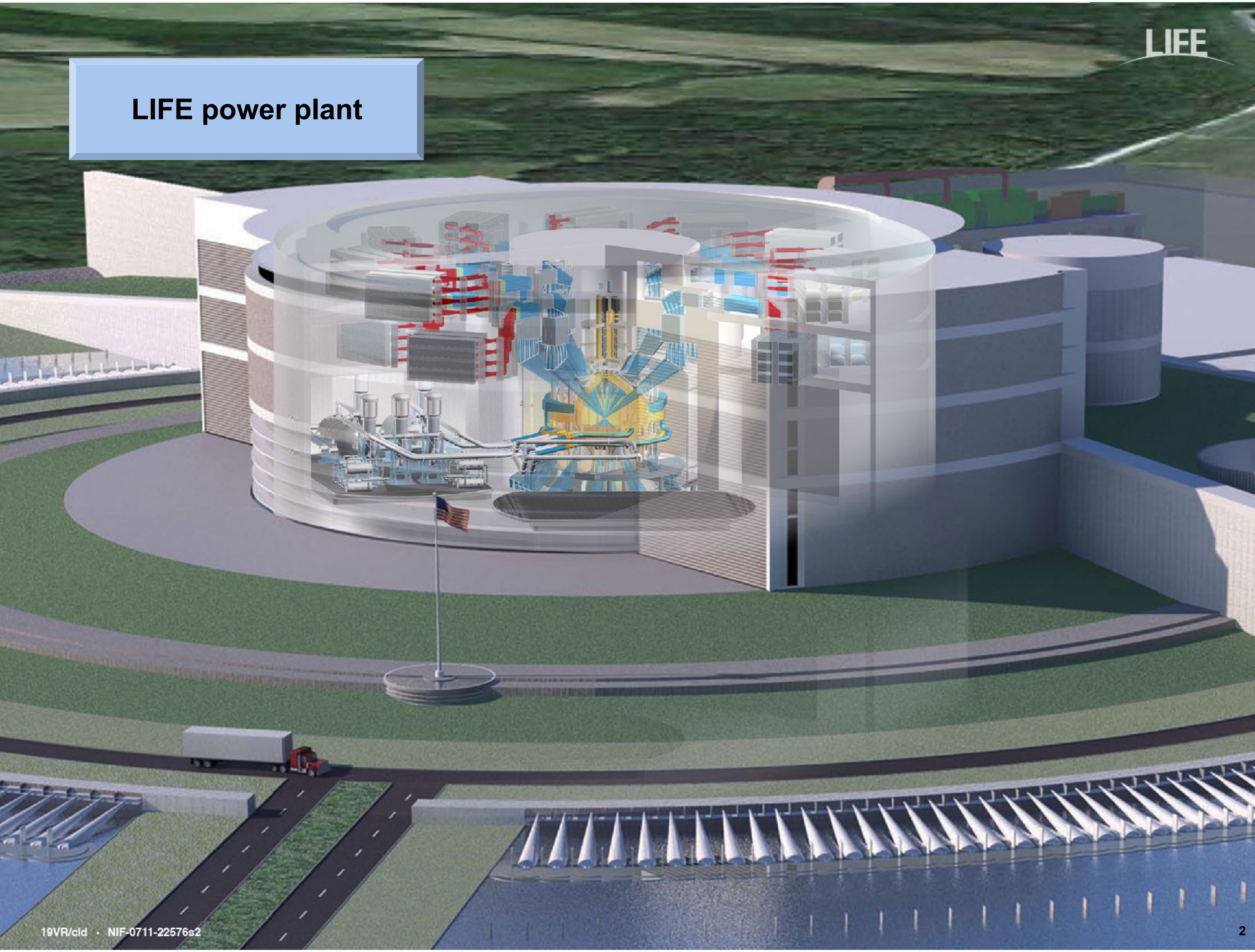
LIFE power plant



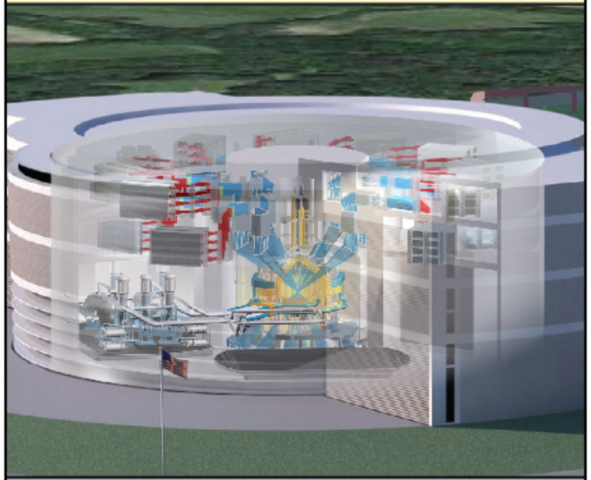
LIFE delivery timescale

National Ignition Facility

2009 - Facility complete
2012 - Ignition

Performance

Market Entry Plants

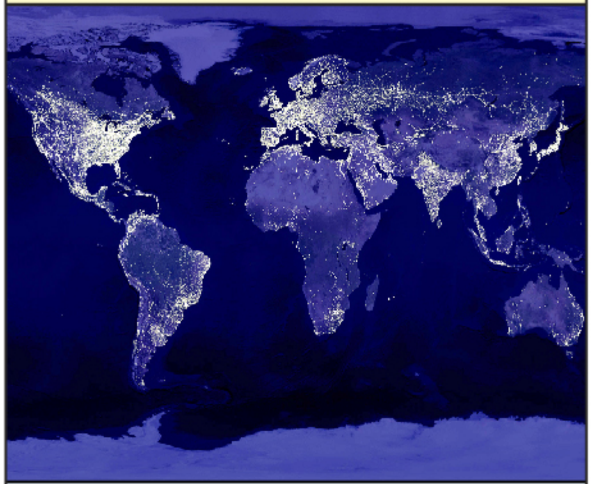


1,000 MW_{th}

2020's

Integration

Mature LIFE Technology



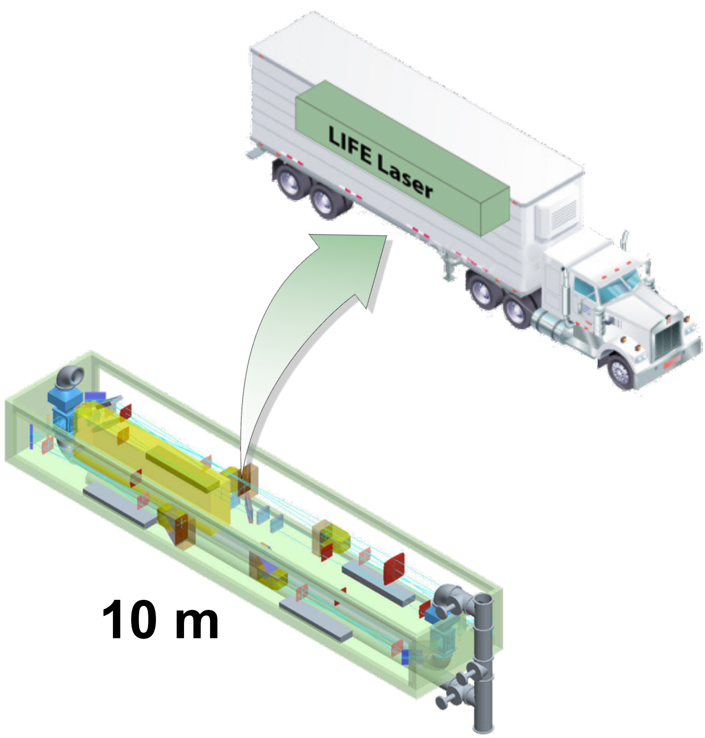
400 MW to 1,600 MW_e

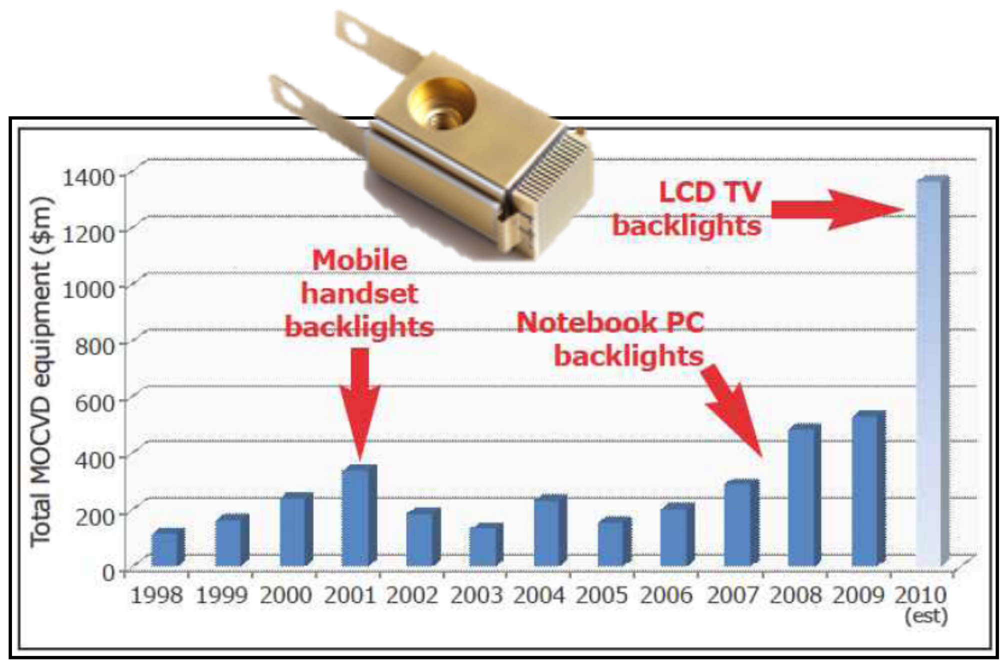
2030's

Timely delivery is enabled by a range of unique design choices …

1) Use of diode-pumped laser technology

- High efficiency allows near-term, NIF based, NIC-derivative fusion performance
- 3ω allows small, thin Fresnel lenses – enables use of existing data, and mitigates two major offline R&D programs (survival, maintenance)
- Solid state architecture enables tracking and engagement with no moving parts
- Builds on long-standing development of high repetition, robust laser performance
- Leverages substantial market (flat-panel displays, etc)





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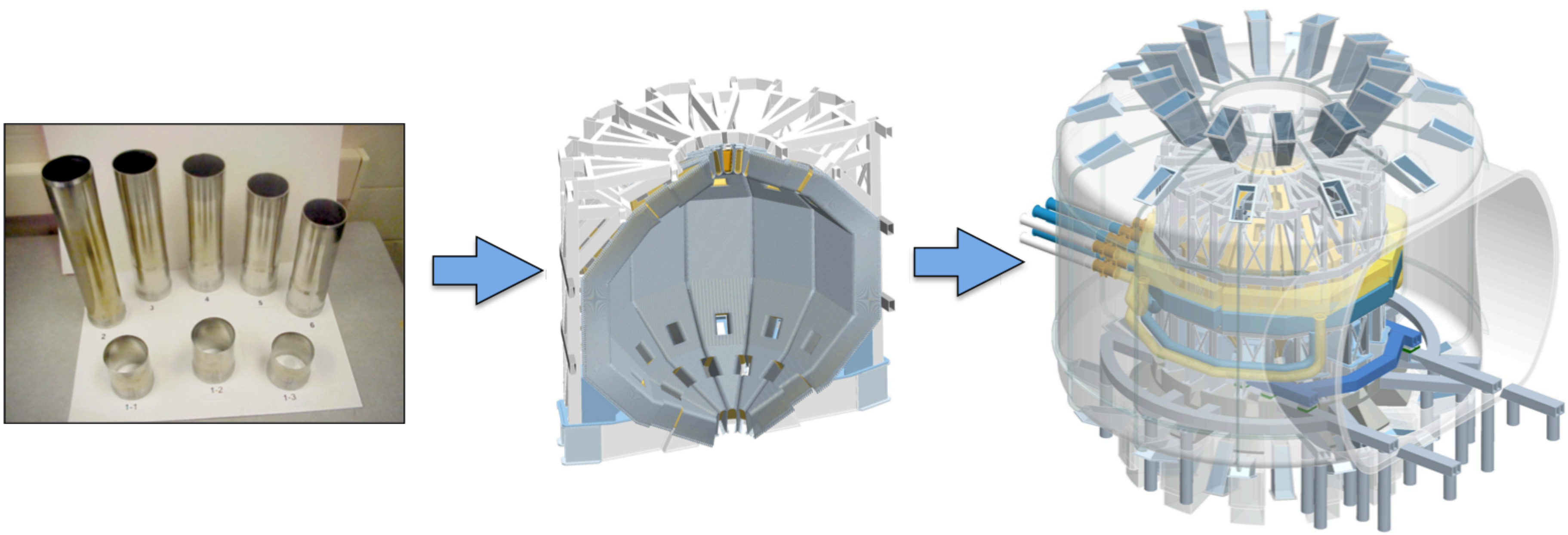
2) Indirect drive – allows gas filled, dry wall chamber using known materials

- Modular, replaceable engine units, decoupled from optical & pumping systems – allows structural material solution consistent with existing data (10 dpa)
- Removes ion threat and mitigates x-ray threat – allows simple steel piping
- No need for chamber clearing – removes major offline research program
- Unsealed FW/B – decouples material response from safety basis (and no need to determine a new regulatory solution for calculations of a disrupted liquid wall)



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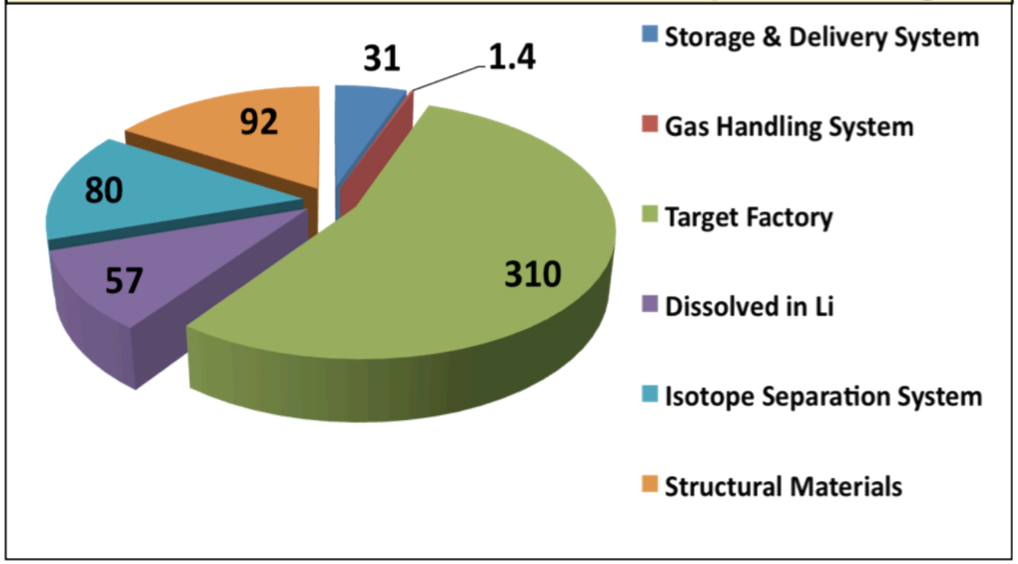
3) Laser IFE – decouples driver, fusion performance and wall response

- Allows high tritium breeding ratio – providing high design margin
- Design freedom for choice of heat transfer fluid. Solubility of tritium in Lithium enables benign operational regime, and removes need for safety-critical SSCs
- Design freedom to manage in-chamber chemistry – control tritium holdup
- Design freedom for wall material provides pathway to class-A low level waste

On-site tritium inventory of ~500g: a factor 10-100 lower than most prior designs



- **Major impact on the safety case and licensing timescales**
- **Plant rollout will no longer be limited by tritium availability**

Timely delivery is enabled by a range of unique design choices …

4) Architecture and approach that mirror NIF and AVLIS

- Application of directly relevant experience in facility design, construction, operation and maintenance
- Use of well established, and proven, vendor base

Timely delivery is enabled by a range of unique design choices …

5) Line-Replaceable Unit (LRU) architecture for major sub-systems

- Allows parallel development of key technology, fallback options and future upgrades via conventional project interface control methods

Timely delivery is enabled by a range of unique design choices …

6) Progression directly to economically viable, utility-scale plants – allows private-sector driven approach

- Donald Brandt—President and CEO, Pinnacle West Capital Corporation
- Joseph Callan—Former Executive Director, U.S. Nuclear Regulatory Commission
- David Christian—CEO, Dominion Generation; President, Virginia Power
- Peter Darbee—CEO and President, Pacific Gas & Electric Company (Ret.)
- Brian Debs (Member in residence)—former SVP, Ontario Power Generation Corp.
- William Fehrman—President and CEO, MidAmerica Energy Company
- Richard Kuester—CFO, Wisconsin Energy Corporation
- Charles "Chip" Pardee, SVP and COO, Exelon Generation
- Michael Sellman (Chairman)—CEO, Nuclear Management Company (Ret.)
- Michael Wallace—COO, Constellation Energy Group (Ret.)

In principle, many fusion options exist. NIF/LIFE allows timely integrated demonstration.

- Fusion performance based on an existing facility
- Tritium inventory that allows a regulatory solution adaptable from existing approaches
- Driver technology drawn from existing markets
- Engine solution using known materials
- Private-sector led funding and delivery
- Offline testing requirements consistent with facility build schedule

> - 42 Work Packages
> - 470 Functional Requirements
> - 970 Work Statements
> - 185 Milestones
> - 250 Line Integrated Project Schedule
> - 35 vendors consulted

Issues		Consequence	Current Status	Modeling/Concept Level Development	Testing/Laboratory Environment	Testing/Initial Pilot Operations
Fusion Fuel Design and Performance						
	Gain >60	M				
	On-the-fly ignition	H				
	> ~99% probability of ignition	M				
	Fuel materials compatibilities	H				
Fusion Fuel Manufacturing						
	DT layer in production environment	H				
	Fuel survival: injection, flight	H				
	Mass manuf: 400M/yr, <$1	H				
	Tritium Inventory-Fuel Filling	M				
Tritium Fuel Cycle						
	Tritium Breeding Ratio	H				
	Recovery from Li	H				
	Recovery from Xe	H				
Fuel Pellet Injection and Tracking						
	Accurate and repeatable in fusion env	H				
	Injector reliability in fusion env	M				
	Fuel survival in injector (fusion env)	H				
	Injector availability	M				
	Pellet tracking in fusion env	H				
Laser Fusion Driver						
	Rep-rate operation	H				
	Final optic survival	H				
	Electrical efficiency	L				
	Pellet engagement	H				
	Focal spot consistent with LEH	H				
	Laser system availability	M				
Fusion Engine						
	First wall radiation damage survival (FMS) 10 dpa	H				
	Chamber clearing	H				
	Debris management-from chamber outlet	H				
	Heat Transport - from chamber outlet	M				
	Thermal and mechanical insults	H				
	Corrosion	M				
	Chamber Design consistent with Fabrication	M				
	Availability	M				
	Concept of chamber replacement	M				
	Production capability for Chamber Materials (FMS)	M				
Power Conversion Systems						
	Tritium release through Rankine cycle	M				
Licensing and Regulatory						
	Licensing strategy	H				
	Auth for initial ops	H				
	NRC license for ComOps	H				
	Regulator approval of waste streams	H				

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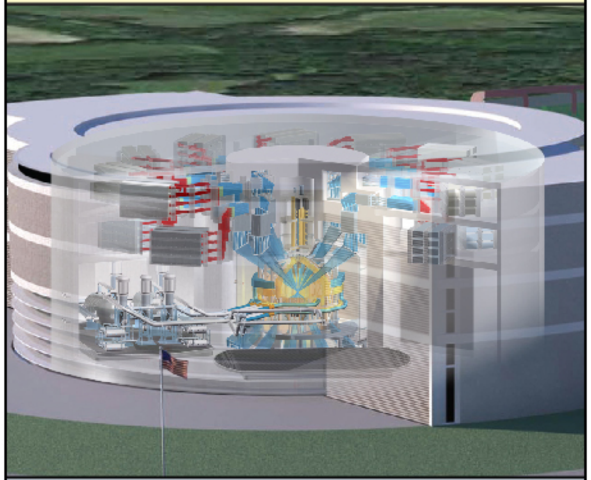

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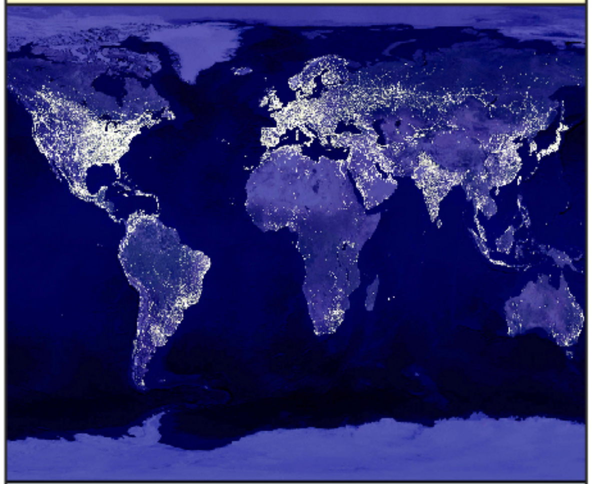

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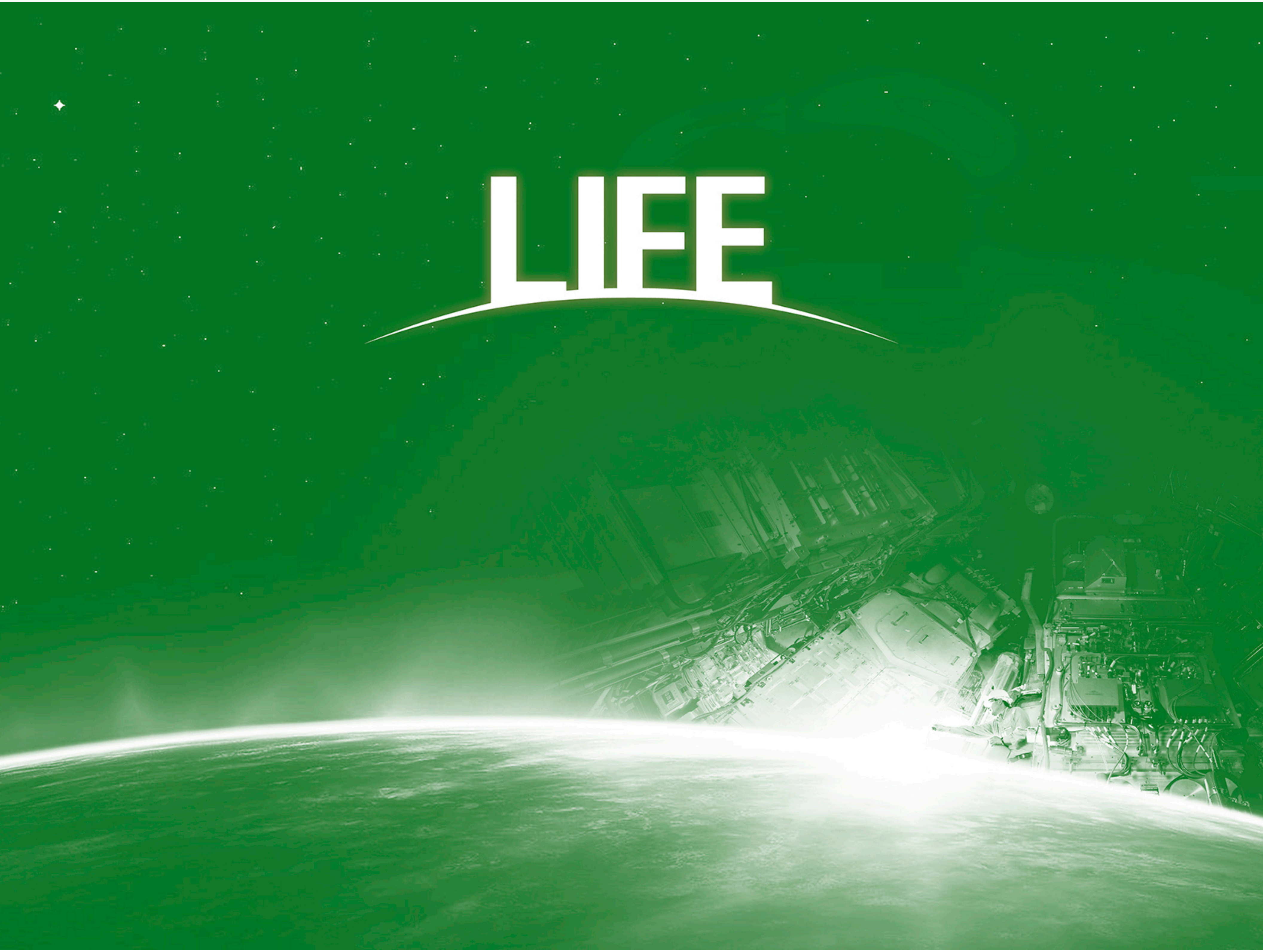
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