LIFE Overview

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The National Ignition Facility is complete - and on track to demonstrate power-plant scale fusion energy
Ignition: Next steps: Work on velocity and shape!
Principle of LIFE plant operation

There are science and technology challenges, but we do not see any show stoppers.

900 cycles/minute provides ~ GWe output
Target Chamber
June 1999

LIFE Fusion Chamber is About the Same Scale as the NIF Target Chamber.
Ignition target
LIFE Fusion Physics will be Demonstrated on the NIF
LIFE will use a modular laser architecture
LIFE’s modular architecture is what enables commercialization in a relevant timeframe.

- Modular fusion chamber reduces lifetime requirement from tens of years to 1 to 5 years.
- Modular laser, optics and processing equipment enables maintenance without plant shutdown.
- Pilot plant fusion chamber can use conventional steel rather than wait for new radiation-resistant alloys to be developed.
Each beamline folds into a transportable box, enabling an efficient & cost-effective supply chain

- Offsite beamline factory
- Truck-shippable 1w beamline
- Low-overhead installation
  - Kinematic placement
  - Few interfaces
High availability using hot-swappable components was demonstrated on AVLIS.

AVLIS maintained long-term (10 year) 24/7 operation at 99% availability with 1500 hr MTBF line replaceable units (LRUs)
Modular fusion “chamber” provides boiler-like heat extraction as well as tritium breeding

- Conventional steel manufacturing
- Flow connectors from the oil industry
- Radiation-tested optics solution
- No need for chamber clearing
Fuel production at the required scale and cost is achievable using known manufacturing techniques. Fusion fuel is designed to enable mass manufacturing.
LIFE Fuel cycle expected to allow for limited (< 1 kg) site tritium inventory

High burnup results in low TBR requirement for reasonable storage times (Abdou 1986)

More than 50% of plant’s T inventory resides in the target fill area

LIFE targets each contain only ~ 0.7 mg of tritium

T recovery from Li (demonstrated in 1974) is compact; limits inventory to 60 g
Goal of LIFE is to commercialize in time to play a role in coming recapitalization electric power sector.

LIFE strategy is to pursue design and physics solutions that can be implemented and demonstrated within about a decade of ignition.
LIFE is designed to use commercially available technology and material.

- Semiconductor diode lasers
- Conventional steel boiler
- Steam turbine cycle
- Mass manufacture of fuel
- Optics production
- Coolant systems
LIFE design is being guided by U.S. utilities

- Held first meeting of the LIFE Industry Stakeholders Advisory Board involving CEOs from electric utility companies, environmental leaders, etc.
- Contractual discussions with major vendors is well underway
LIFE is economically viable over a range of plant sizes

**Economic Performance as a Function of Plant Size**

- **Direct Capital Cost ($M)**
- **Cost of Electricity ($/MWh)**

**Axes:**
- **Plant Electrical Capacity (MW)**
- **Capital Cost**
- **Cost of Electricity**

The graph shows that as the plant electrical capacity increases, the capital cost decreases, while the cost of electricity decreases as well.
Rapid market entry strategy for LIFE

NIF/NIC

Performance

Market Entry Plants

Integration

2012

400 MW to 1,000 MW_{th}

2020’s

400 MW to 1,600 MW_{th}

2030’s