The Fastest Path to Commercial Fusion Power

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FNSF+ Could be the Pilot Plant for Commercial Fusion

Pilot Plant

Shippingport, 60 MWe, 1957

Oyster Creek, 620 MWe, 1969

Commercial Plant

- **The smallest facility to *pilot* the route to commercial fusion – by doing fusion nuclear science, demonstrating practical operation, and making net electricity, based on**
  - ITER + magnetic fusion R&D,
  - or NIF + inertial fusion R&D.
- **Results from NIF + ITER *well underway* could trigger a common preparatory R&D program – if (and only if) we have a compelling roadmap to commercial fusion power.**

A FNSF / Pilot Plant with P_{fus} = 30% of a Power Plant would Make Net Electricity

- Reduce linear dimensions to 2/3 power plant
- For fixed β, B, and T, P_{fus} down by $(2/3)^3$ = 30%
- *Assume same absolute recirculating power. (!)*
- For P_{fus} = 30%, $Q_{eng} \equiv P_{gross}/P_{recirc} > 1 \Leftrightarrow Q_{eng}$ of power plant > 3.33
- Pilot plant can do FNSF mission: Neutron flux ~ 2/3 power plant, surface area = 4/9, can adjust ^{6}Li enrichment.

Obviously there are other factors (*e.g.,* neutron m.f.p.).

On the other hand P_{recirc} = constant is conservative.

Initial looks at Tokamak, Stellarator, ST support 2/3 reduction

Much More Analysis is Required

- **What would such an FNSF / Pilot Plant look like?**
  - Advanced Tokamak (S/C for Q_{eng} > 1 & realistic maintenance)
  - Stellarator (Lowest recirculating power, no disruptions)
  - Spherical Torus (Cheapest, most readily maintained configuration)
  - Are there ICC game changers?

  Any design must "pilot" the power plant maintenance approach.

- **What near-term program of modeling, test stands, toroidal facilities is necessary to support such an FNSF / Pilot Plant?**
  - Plasma performance
  - Integrated plasma material interface
  - Neutron interactive materials

- **There is much synergy between needed MFE & IFE R&D**
  - An IFE pilot plant should be studied as well