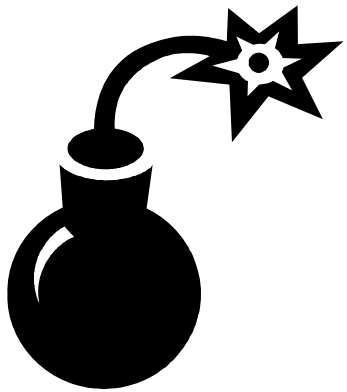
Fission-Fusion Hybrid Reactors

Lawrence Erickson

Why should we care about hybrids?

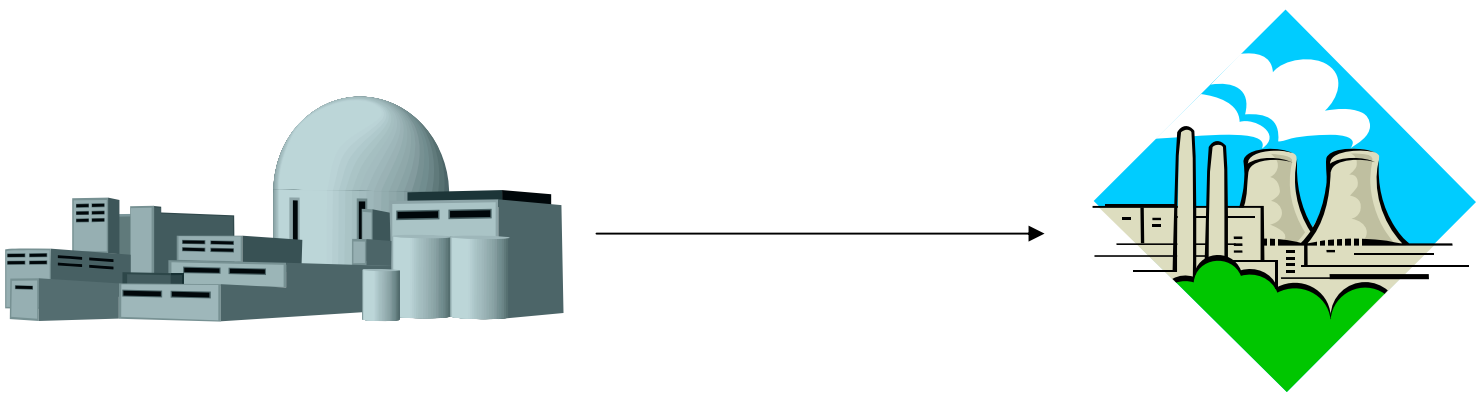
- Proliferation!



- Economics!

Use as a breeder reactor

- Breeder reactors can make fissile material (U-233 or Pu-239) out of non-fissile material (Th-232 or U-238).
- With current breeder technology, one breeder can serve one other reactor.



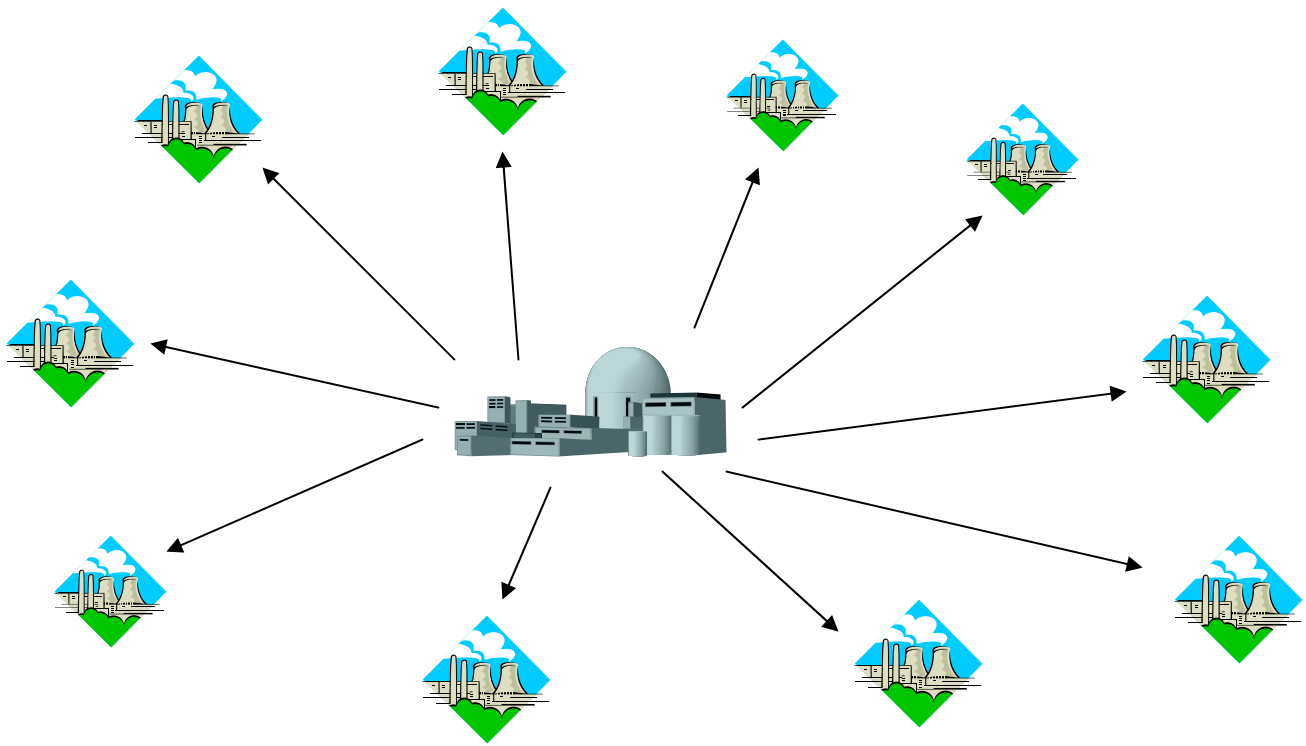
Proliferation

- Because they produce fissile materials that can be chemically separated from the reactor, every breeder reactor is a potential proliferation risk.

- So, how do we breed fuel while minimizing proliferation?

Fusion Breeder

- A DT fusion reactor produces a large amount of neutrons, which can be used to breed enough fuel for 10 satellite reactors.



Proliferation/Economics

- Fewer breeders means lower proliferation risk. Also, fusion breeders can make U-233 instead of Pu-239. U-233 is harder to separate from nuclear fuel.
- Fusion is not currently economically viable. Creating a fusion/fission hybrid could spur more research, which could eventually lead to an economical pure fusion reactor.

Who is doing research?

- Not very many people. Most of the literature on the subject dates from the mid 1970s to the early 1980s.

- A depressing paper from 1984 (Taczanowski) declared that fusion breeders could never be an economically viable alternative to fission breeders.

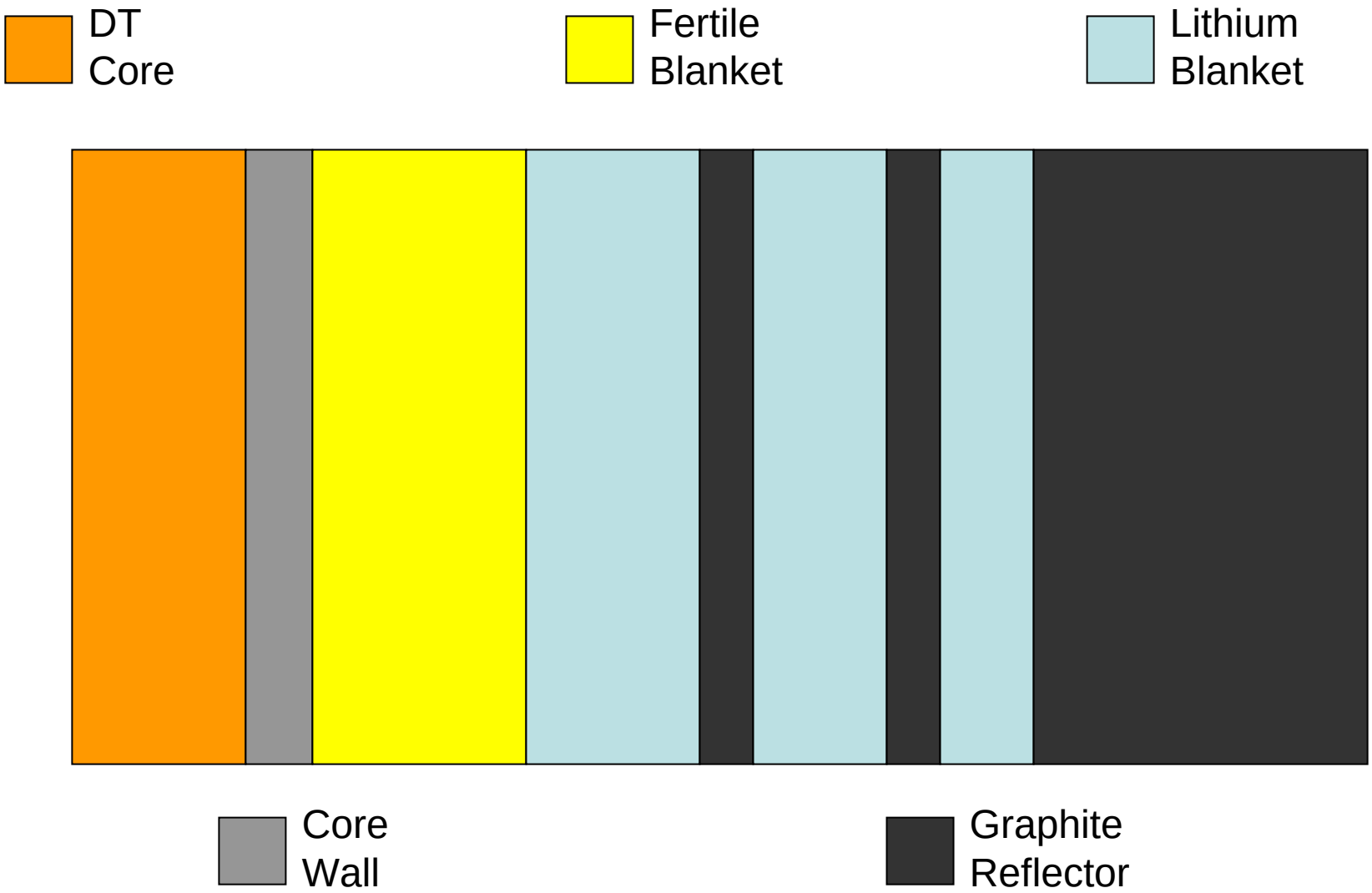
Wallace Manheimer

- Retired from Naval Research Laboratory.
- Is interested in fusion/fission hybrid not only for proliferation and economic reasons, but also for military propulsion reasons.
- Claims effective Q of hybrid would be around 10 given current technology.

Potential Problems with Manheimer

- Has been criticized for not fully developing his plan.
- Appears to be calling for other scientists to do research.
- Has been criticized for lacking the qualifications to do proper research.

Hybrid Reactor Blanket



Research into blanket material

- Pure lithium is unsuitable to use in the reactor blanket, but there are several lithium salts that could be used instead.

- Mustafa Ubeyli is currently investigating various salts at Gazi Universitesi in Ankara.

Further research by Ubeyli

- Investigation into the geometry of the reactor blankets.
- Investigation into high level fission waste transmutation in hybrid systems.
- Appears to be the only researcher still publishing about hybrid reactors.

Summary

- Potential security and economic benefits.
- Much of the work that has been performed on the subject is either theoretical or economical.
- There is no large-scale effort to make hybrid reactors a reality.
- Small amounts of work are being done on subproblems.