Magnetized Target Fusion:
Input to the 35-yr Fusion Long-Range Electric Plan

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- Imagine a fusion concept where:
  - The plasma beta ranges from 0.5 to 1
  - The heart of the device fits on a modest table-top
  - The plasma density is high $>10^{19}$ cm^{-3}
  - The magnetic field confining the plasma is 500 Tesla !
  - The auxiliary heating power level is ~ 1000 Gigawatts !
  - The heating is “slow” adiabatic compression
  - Most of the initial physics research can be conducted with existing facilities and technology
  - In a reactor, on each pulse the liquid first wall would be completely fresh
  - The repetition rate is ~0.1 Hertz, so that there is time to clear the chamber from the previous event, and time to insert a new “target”

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- MTF offers a uniquely different pathway to achieving controlled thermonuclear fusion in the laboratory
  - Intermediate between MFE and IFE

- Presently only funded at the “Concept Exploration” level, it could operate at the “Proof of Principle” level in the very near term on Shiva Star in Albuquerque

- With existing pulsed power facilities, (ie, Atlas, which is now at the Nevada Test Site)… it offers the possibility of Performance Extension levels of fusion output (ie, Q~1) within a 5-8 year timeframe, at very modest costs.

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Starting next year, we would envision:

- **A 4-year integrated plasma/liner "physics" experiment to demonstrate implosions of interesting FRC target plasmas on Shiva Star (1-3 MJ driver level). (still CE)**

- **A 4-year multi-experiment CE level-of-effort to study the technology of possible "stand-off" drivers for rep-rating MTF. This could include studies of other candidate target plasmas.**

- **In parallel, a 4-year "Proof of Principle" program resulting in combined modeling and experimental understanding of high performance DD plasmas on Atlas (5-10 MJ driver level).**

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- **Use of DT in experiments to demonstrate batch burn fusion gain of 5-10, if warranted by results from 3). An interesting possibility is that these kinds of experiments could be conducted outdoors at LANL or NTS**
- **Technology development of a "scaled" flowing liquid-wall chamber. Goal of handling 1 Gigajoule yields in a ~ 10 meter diameter vessel (ie, NIF size).**
- **Demonstration of fusion gains in the range of 20-100, using more exotic burn/refueling/compression scenarios.**
- **Development of suitable pulsed power/energy handling technologies with fatigue lifetimes relevant for a reactor (this is really difficult).**
- **Finally, doing it all economically, given the present and future value of a Megajoule of electricity, needs reactor study efforts.**

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In summary:

MTF provides an exciting "new" approach to controlled fusion in the laboratory. (The basic idea is only 40 years old, but the integration is new!).

The application of a magnetic field to inhibit heat flow in an inertially compressed (high pressure) target plasma is a very general idea, with many possible implementations, both for targets, and drivers.

Pulsed fusion power generators are not necessarily a bad thing! No materials dpa issues, no first wall surface problem (destroy it on each pulse!), no erosion/redeposition, no divertor…….

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- **Our web pages are at: http://fusionenergy.lanl.gov and http://wsx.lanl.gov**

- **"Amplification of magnetic fields and heating of plasma by a collapsing metallic shell", by Linhart, Knoepfel, and Gourlain**, *Nuclear Fusion, CN-10/11, supl. Pt. 2, 733 (1962).*

- **"Why Magnetized Target Fusion Offers a Low-Cost Development Path for Fusion Energy", by Siemon, Lindemuth, and Schoenberg,** *Comments Plasma Phys. Controlled Fusion, Vol 18, No. 6, pg 363-386 (1999).*

- **"Scaling Relations for High-Gain Magnetized Target Fusion Systems", by D. Barnes,** *Comments Plasma Phys. Controlled Fusion, Vol 18, No. 2, pg 71-84 (1997).*