

Molten-Salt Reactors (Thorium Optional)

- MSR automatically throttle via thermal expansion of salt...
 - As thermal load changes, **fission rate tracks salt density**.
 - **No runaway or 'meltdown'** -- salts are radiation stable, gravity removes melt from core.
- MSR have higher temp & power density so ~30% better thermal efficiency
 - ~1000°C **unpressurized** temp range from solid to vapor – water only has 100°C range.
 - **De-commissioned LWRs** can become ~3x more potent MSRs.
 - Gas (Brayton) or steam-turbine cycles possible – **no water needed for cooling**.
- MSR can consume existing LWR Actinide wastes...
 - **DMSR can use mixed fertile/fissile/transuranic salt** (fluorides/chlorides).
 - **Reduction of wastes onsite**, down to whatever low level is desired – **no 'spent' fuel**.
 - Typical **wastes** from a 1GWe ThMSR, over 30 years, is under 100lbs (<1 cubic foot)..
 - A 1GWe **ThMSR makes 1/1000 the Plutonium of an LWR** -- DMSR can consume that.
- MSR run unpressurized, -- no explosive potential, natural evolution of fission gasses...
 - MSR have no expensive control/containment or emergency systems.
 - **MSR cost <\$3/Watt** (far less than current ²³⁵U LWRs) – **less than coal**.
 - **Scalable** from 1MWe to multiple GWe – siting anywhere on Earth or in space.
 - Natural, gravity shutdown upon abnormal behavior – **'walk-away safe'**.
 - Initial working MSR was for the 1960s DoD Atomic Plane – had to be **small & safe**.
- Thorium salt (ThF₄) may be used to breed fissile MSR fuel (²³³U) internally...
 - Thorium is far **more common & cheaper than Uranium**.
 - **No 'enrichment'** \$ or energy wasted – ²³²Th is just a metal common in "rare-earth" ores.
 - **All Thorium is consumed** – no 'spent' fuel (>90% of BWR/PWR Uranium goes unused).
- Thorium-Fluoride MSR = LFTR...
 - Exceedingly stable inexpensive salt, of **no weapons value**.
 - **No refuelling shutdowns** needed, **no excess fuel** in core – **proliferation resistant**.
 - ²³²Th is neutron-bred in core to ²³³Uranium within the molten salt – **no external fissiles after startup**.
 - ²³³U fissions better than higher U isotopes & Pu, so **far less waste**.
 - ²³³U bred from Th is accompanied by **isotopes that discourage weaponization**.