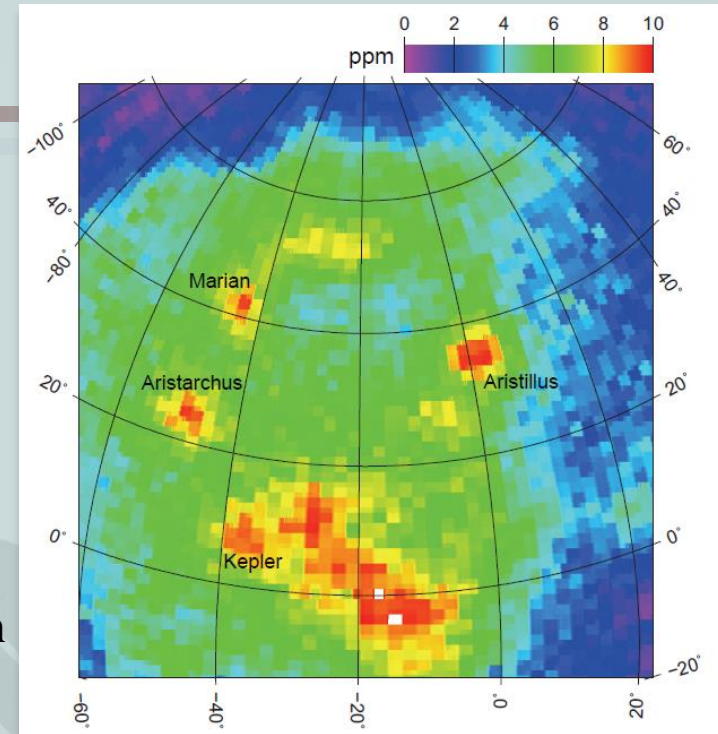


Lunar Power




- [Thorium has been detected on Moon by Chang e 2 also.](#)
- One kilogram of Thorium taken from Earth to begin with can provide 2.6 thermal MW plant for a year.
- Imagine ten such plants in ten different locations with ten kg of Thorium taken from Earth and the associated salt, which will eventually become self-sustaining with Lunar Thorium.
- Only the first such plant will require neutron producing radioactive material to commence the chain reaction.
- The U233 thus produced can provide any further neutrons for additional reactors, thus becoming self-sustaining.
- For power on Lunar surface however, this is only ONE of the promising options. Different location may find different solutions, such as beamed power from SBSP, or a combination there of, as whatever would be ideal for that locale.


Space Propulsion

cea

Nuclear Thermal Propulsion: a ~Twice Higher Isp than Chemical Propulsion



Chemical (LH₂ / LO₂) : M~13.8 g/mol, T~3420 K ⇒ I_{sp} ~480 s
 Thrust ~ 2 000 kN; burn time ~500 s; thrust/weight ~150
 "Energy-limited" performances (energy stored in chemical bounds)

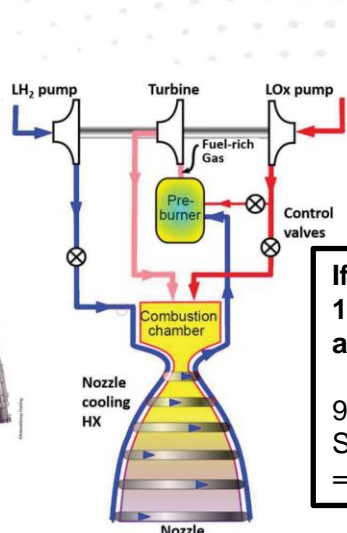


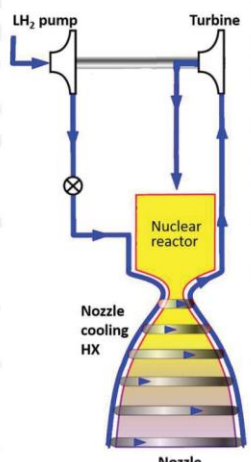
Nuclear Thermal (LH₂ propellant): M~2 g/mol, T~2700 K ⇒ I_{sp} ~900 s
 Thrust ~50 - 1 000 kN; burn time ~1 000 s; thrust/weight ~10 - 30
 Performances limited by fuel resistance to high temperature H₂

$$I_{sp} \propto \sqrt{\frac{2\kappa}{\kappa - 1} \frac{RT}{M}}$$

If MSR limited to 1200 C, then ISP approx.:

900 *
 SQRT(1473/2700)
 = 665 sec





Lecture Series on SPACE NUCLEAR POWER & PROPULSION SYSTEMS -2- Nuclear Thermal Propulsion Systems (last updated in January 2021)
Eric PROUST
9

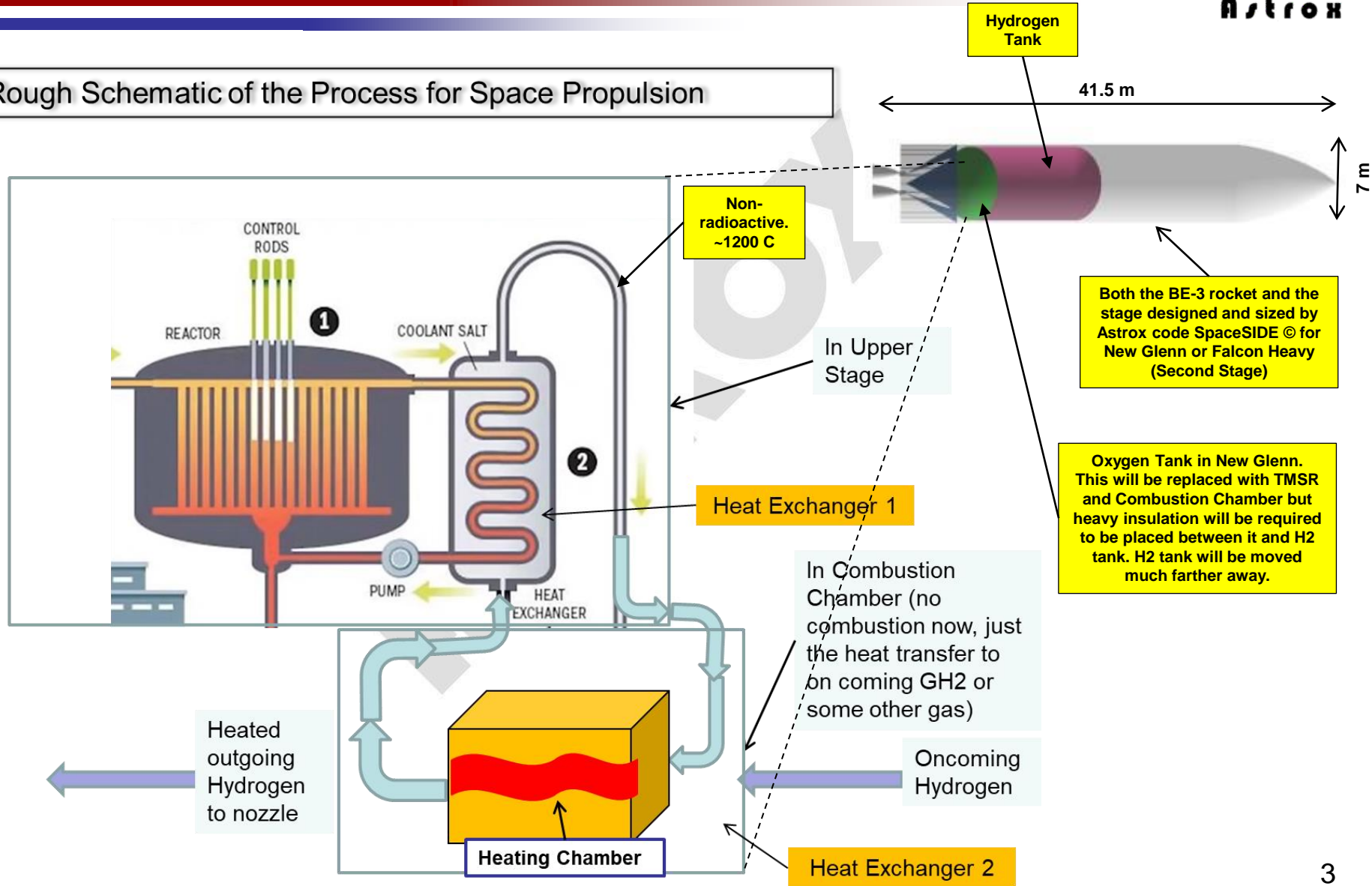
Courtesy: John Livingston

With considerable reduction in size and weight compared to NERVA type solutions, MSR maybe more attractive at system level.

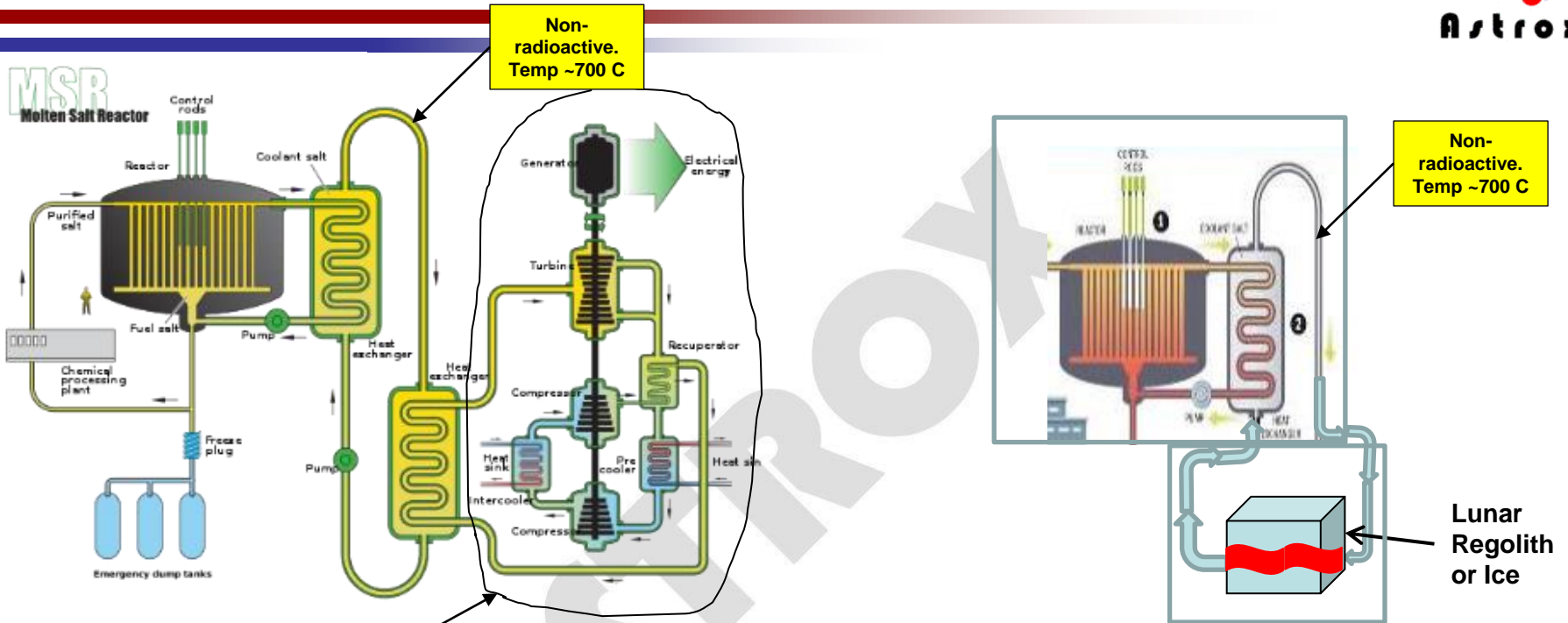
Space Propulsion – for journeys within CiSLunar space and to Moon/Mars



Rough Schematic of the Process for Space Propulsion



Repurposing TMSR on Moon/Mars



Closed loop CO2 turbine cycle for electricity production for habitats. Taken separately or in the same payload bay.

- Repurposing allows for reuse of the reactor
- Temperature of the molten salt is reduced to ~700 C whereby the corrosion of containment/pipes would be nil to limited (as ORNL 2 MW reactor showed)

SUMMARY



For US and the World terrestrially:

- Thorium offers immense supply of energy that can last several thousand years
- No CO2 emissions or pollutants
- No high-pressure explosion possibility
- Twice the efficiency of conversion to electricity as PWR
- Natural and fail-safe (freeze valve) mechanisms
- <1% radioactive waste products compared to ~95% for PWRs of today
- No Plutonium that can be used for nuclear explosives
- Does not need to be near water supply (river/lake/ocean), so can be built even in desert (ideal for Moon/Mars)
- Can be refueled continuously with chemical processing in the loop – without having to shut down as in PWRs
- **WHAT MORE DO WE WANT???**
- I respectfully urge this Administration to take this idea seriously and provide funding for this RD&E



First Woman on Mars – Must Go Gingerly



Ajay PK