Introduction to Flibe Energy

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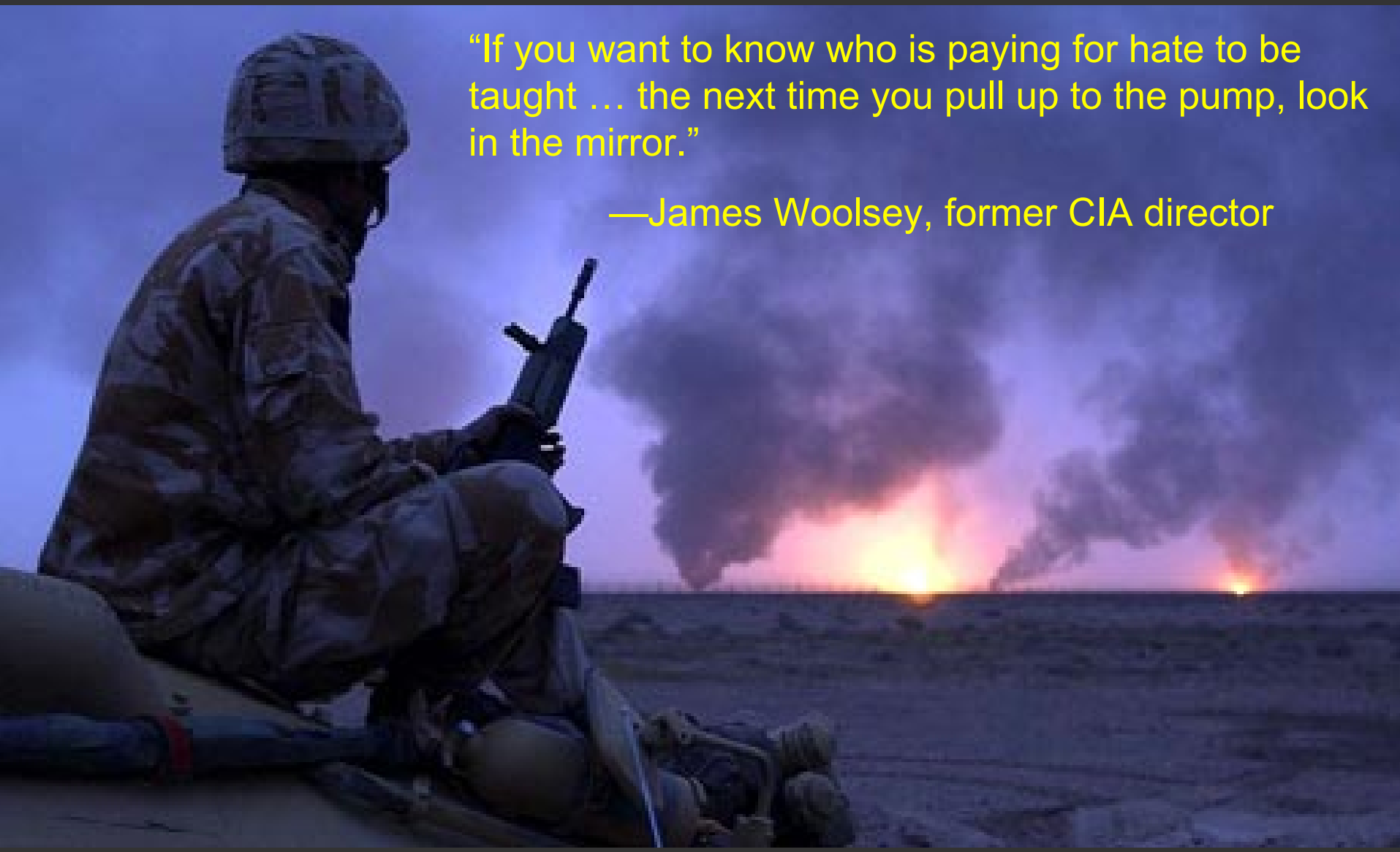
"We Americans want it all: endless and secure energy supplies; low prices; no pollution; less global warming; no new power plants (or oil and gas drilling, either) near people or pristine places. This is a wonderful wish list, whose only shortcoming is the minor inconvenience of massive inconsistency."

—Robert Samuelson


“If you want to know who is paying for hate to be taught … the next time you pull up to the pump, look in the mirror.”
—James Woolsey, former CIA director

"We do not have the resource base to be energy independent. The fact that the United States and the rest of the world will have to depend increasingly for its oil and also for its natural gas from the Middle East is not a matter of ideology and politics. It is simply inevitable."

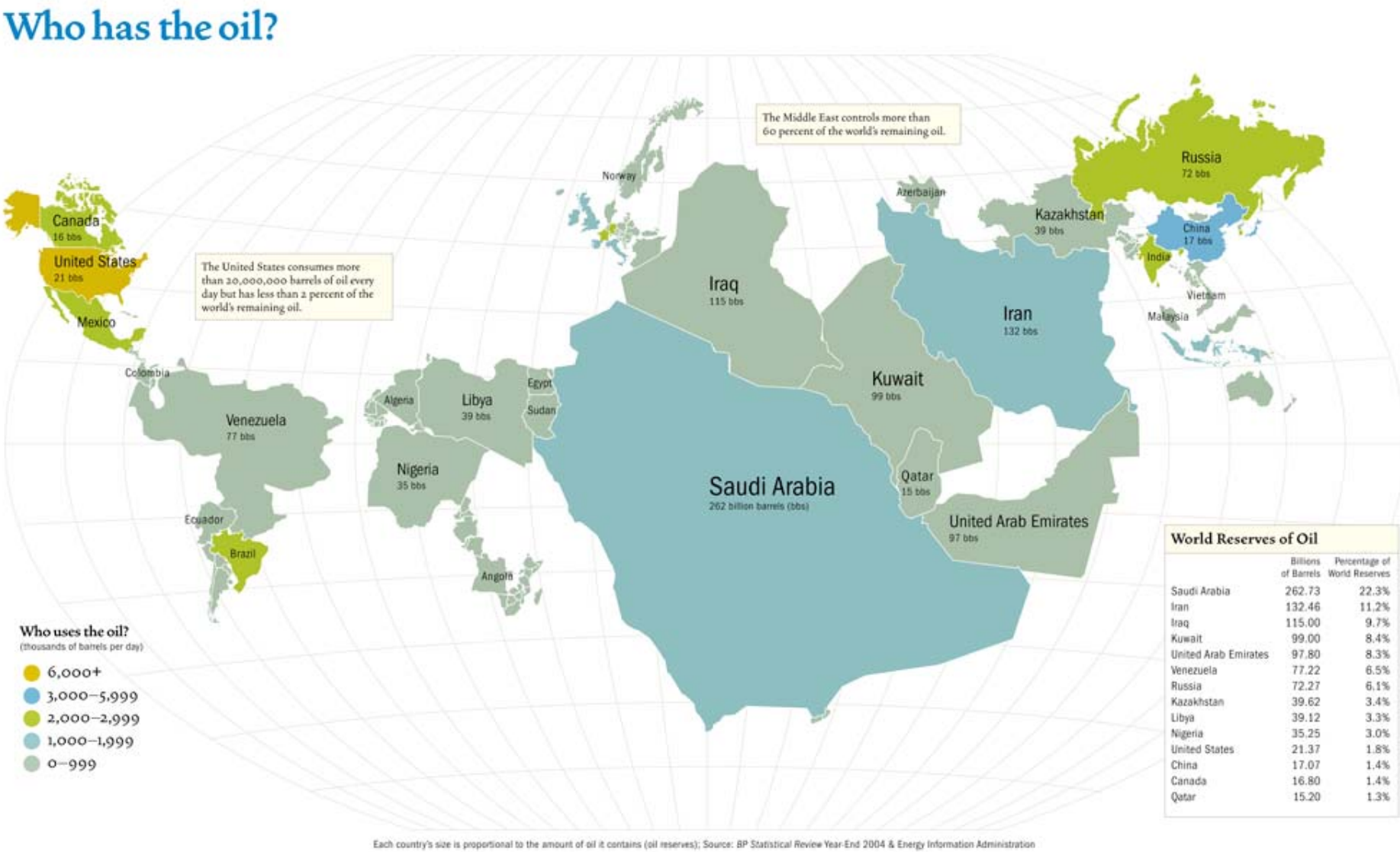
—Lee Raymond, CEO, Exxon Mobil


“Technology entrepreneurs and investors would do well to return to hard and important problems.”
—Peter Thiel, Clarium Capital

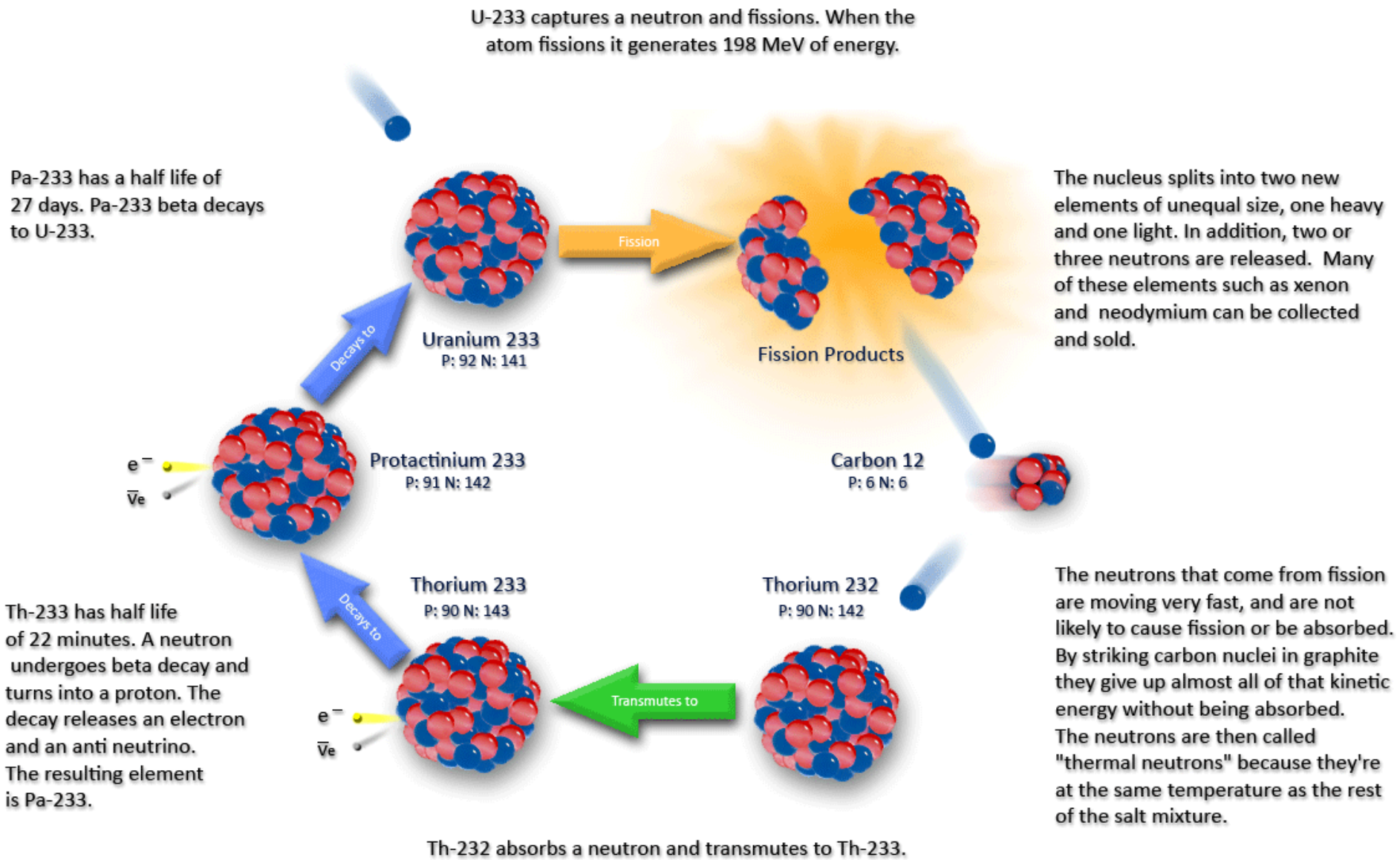
Flibe Energy's Value Proposition

- **Energy independence IS possible and affordable.**
- **The fuel is thorium, an abundant natural resource.**
- **The machine is the liquid-fluoride thorium reactor (LFTR), a demonstrated technology that has been forgotten.**
- **It is safe, mechanically simple, compact, and can be deployed virtually anywhere.**
- **In preparing to build LFTRs we will recover valuable medical radioisotopes that could provide early financial return.**
- **Operating LFTRs will generate electricity, desalinated water, and valuable radioisotopes for NASA and the medical sector.**

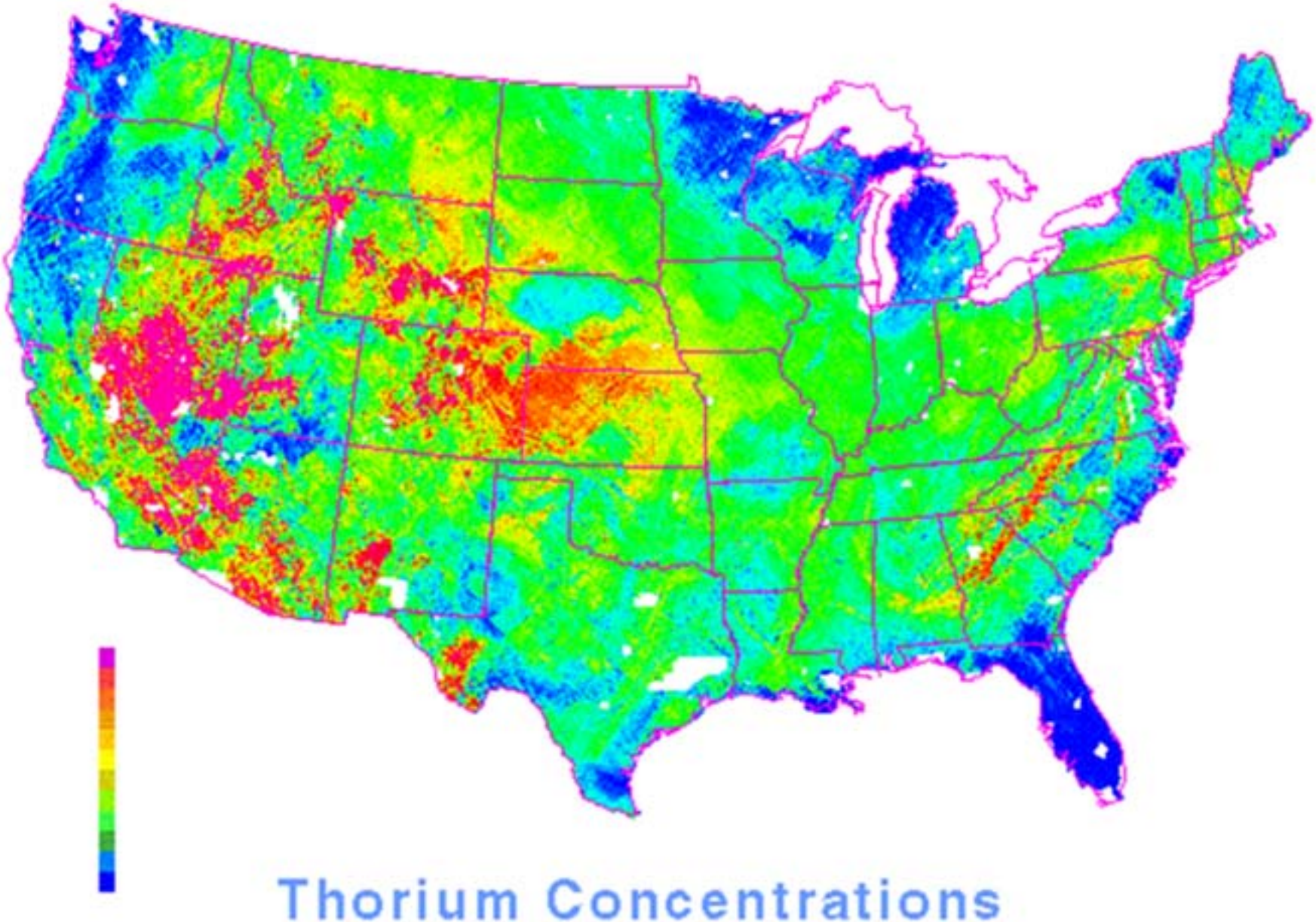
We Need a New Source of Energy



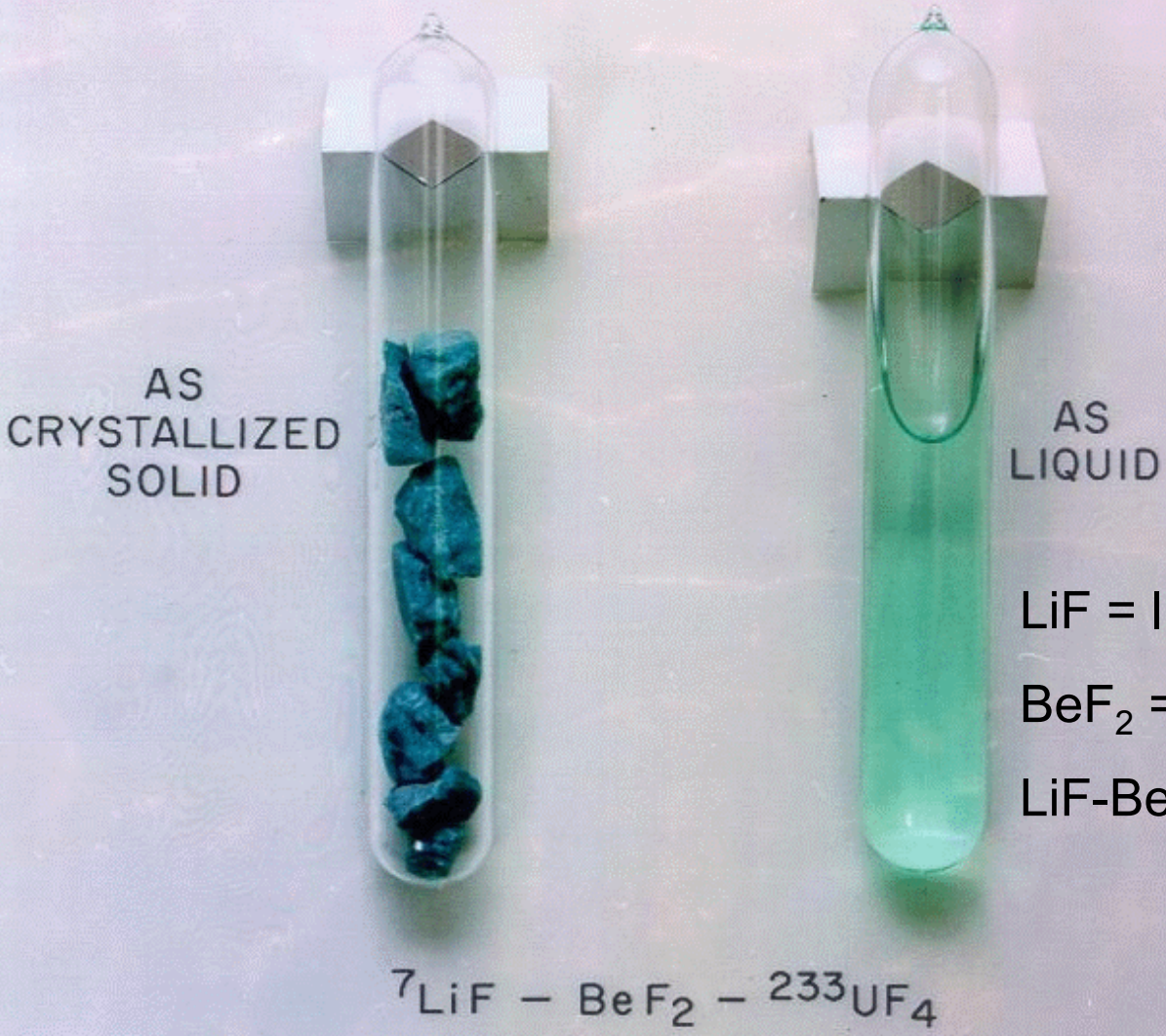
An Introduction to the Thorium Fuel Cycle



Thorium is a common mineral in the US and world



“F-Li-Be” is the secret to unlocking thorium’s potential



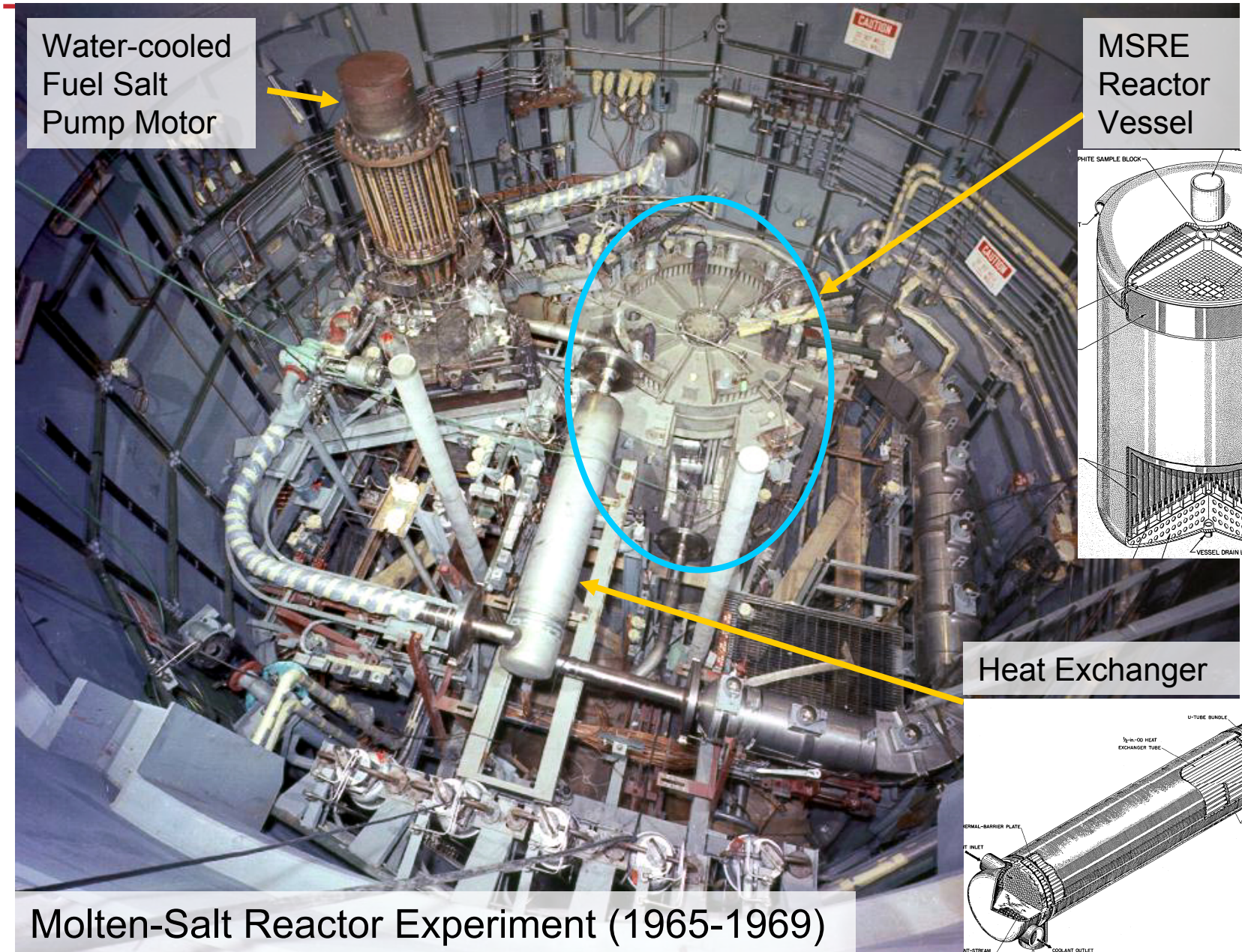
LiF = lithium fluoride

BeF_2 = beryllium fluoride

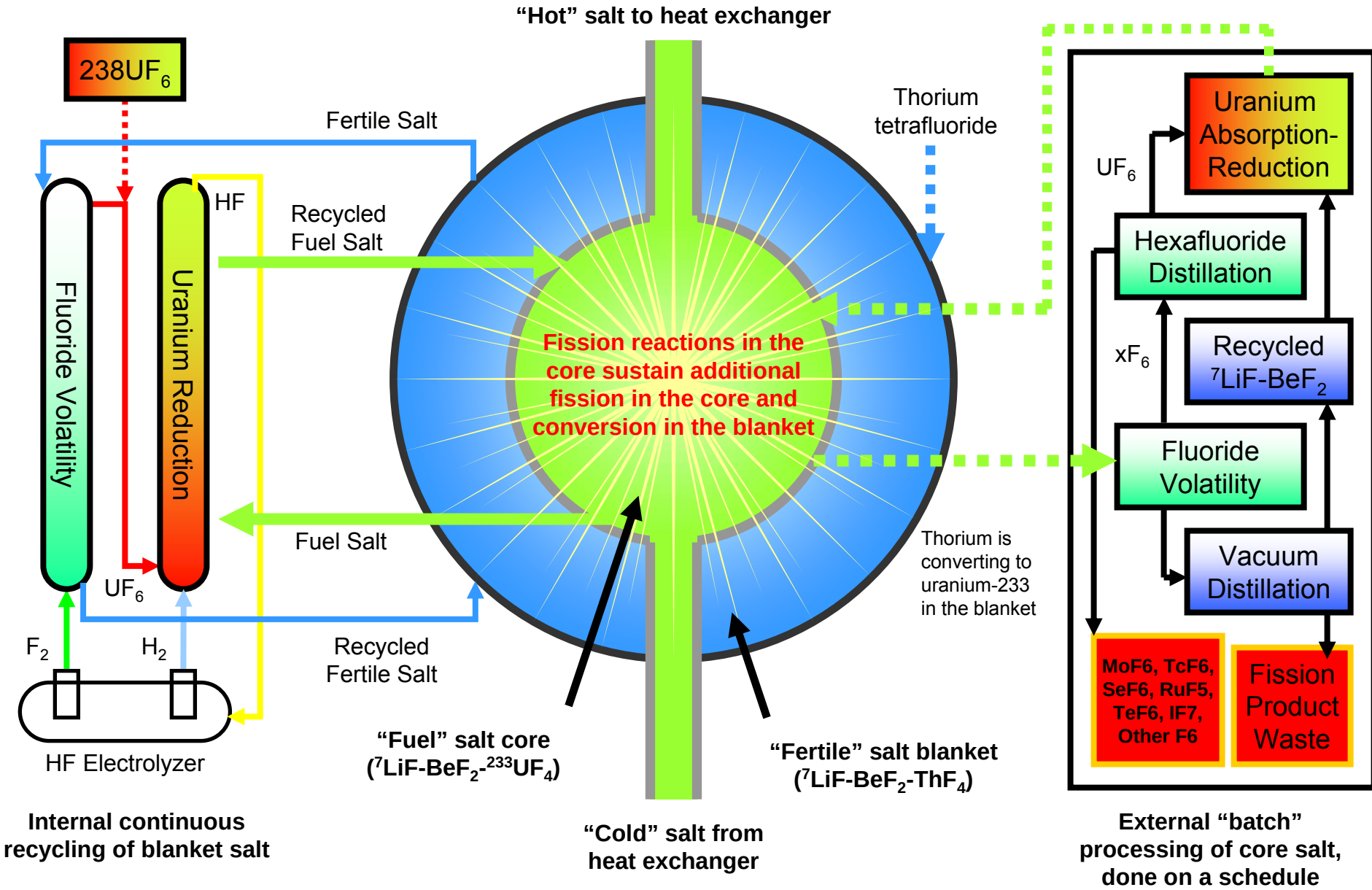
LiF-BeF_2 → “FLiBe”

FLUORIDE FUEL FOR A MOLTEN SALT REACTOR

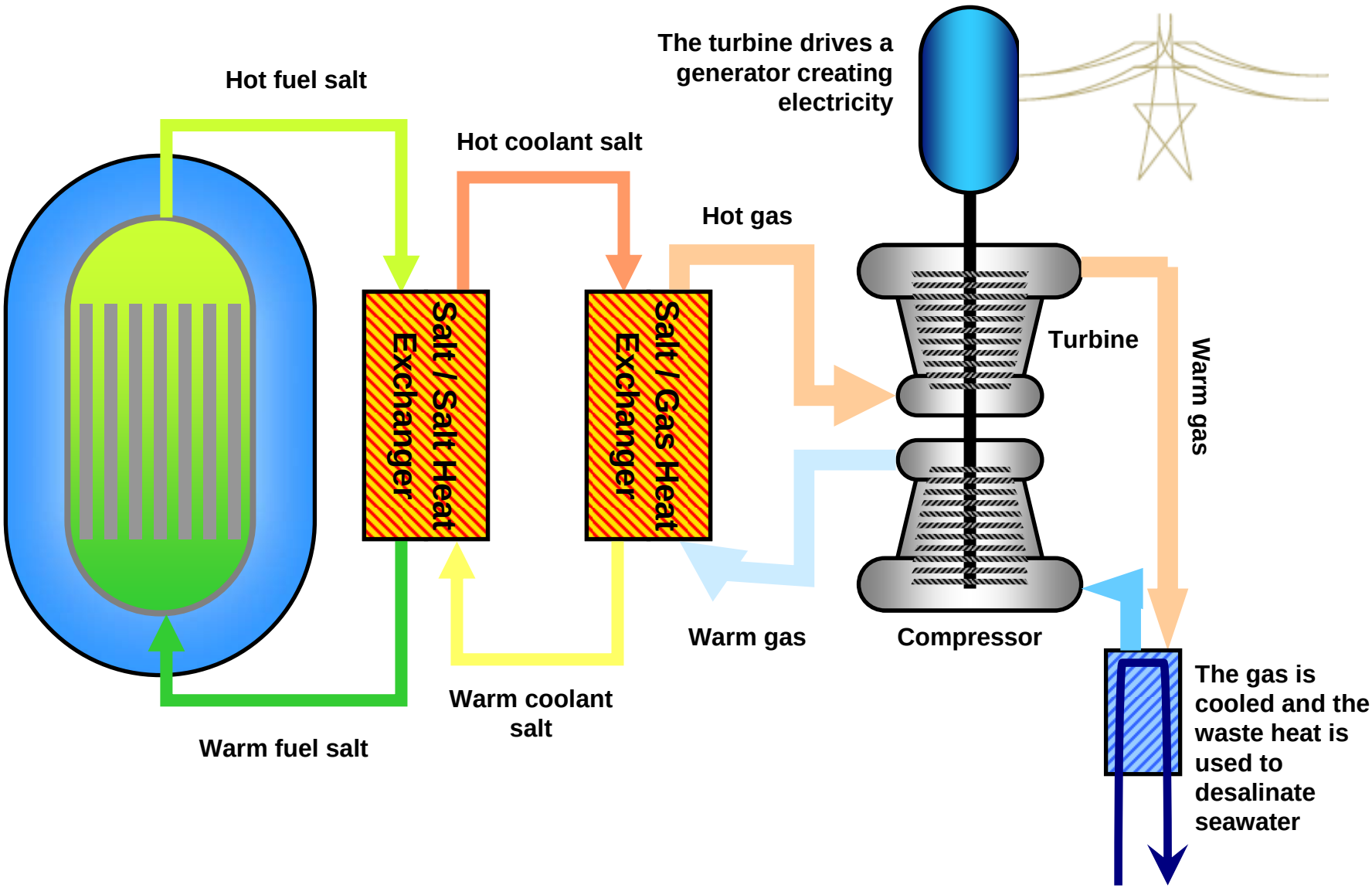
Nuclear Reactors using “FLiBe” were successfully built and operated



How does a fluoride reactor use thorium?

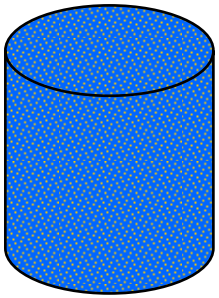


How does a fluoride reactor make electricity?

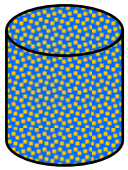


Uranium (PWR/BWR) vs. Thorium (LFTR)

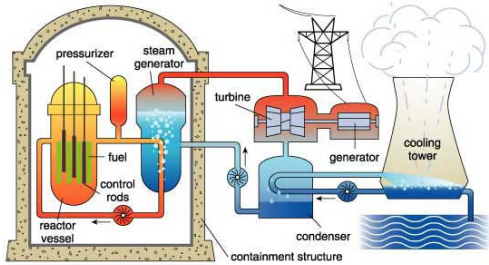
mission: make 1000 MW of electricity for one year



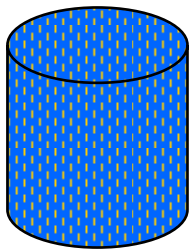
250 t of natural uranium containing 1.75 t U-235



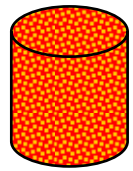
35 t of enriched uranium (1.15 t U-235)



Uranium-235 content is "burned" out of the fuel; some plutonium is formed and burned



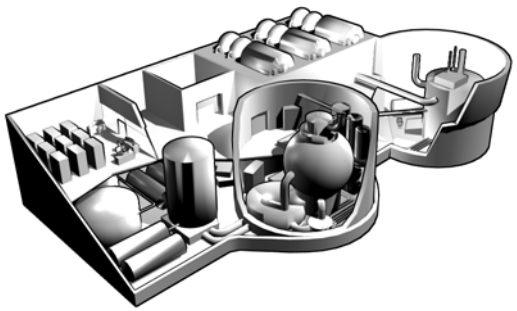
215 t of depleted uranium containing 0.6 t U-235—disposal plans uncertain.



35 t of spent fuel stored on-site until disposal at Yucca Mountain. It contains:

- 33.4 t uranium-238
- 0.3 t uranium-235
- 0.3 t plutonium
- 1.0 t fission products.

One tonne of natural thorium



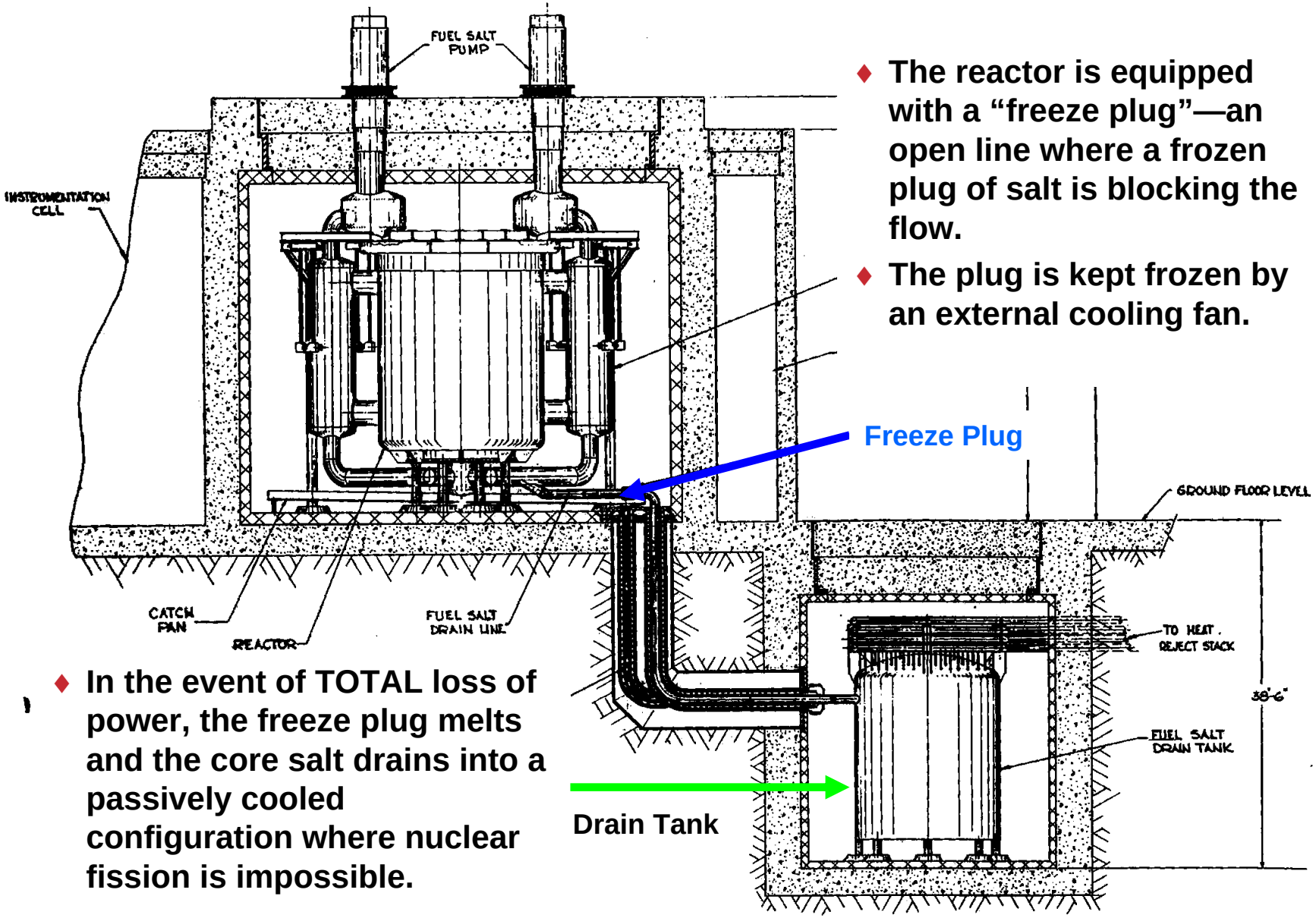
Thorium introduced into blanket of fluoride reactor; completely converted to uranium-233 and "burned".

One tonne of fission products; no uranium, plutonium, or other actinides.

Within 10 years, 83% of fission products are stable and can be partitioned and sold.

The remaining 17% fission products go to geologic isolation for ~300 years.

LFTR is passively safe in case of accident or sabotage



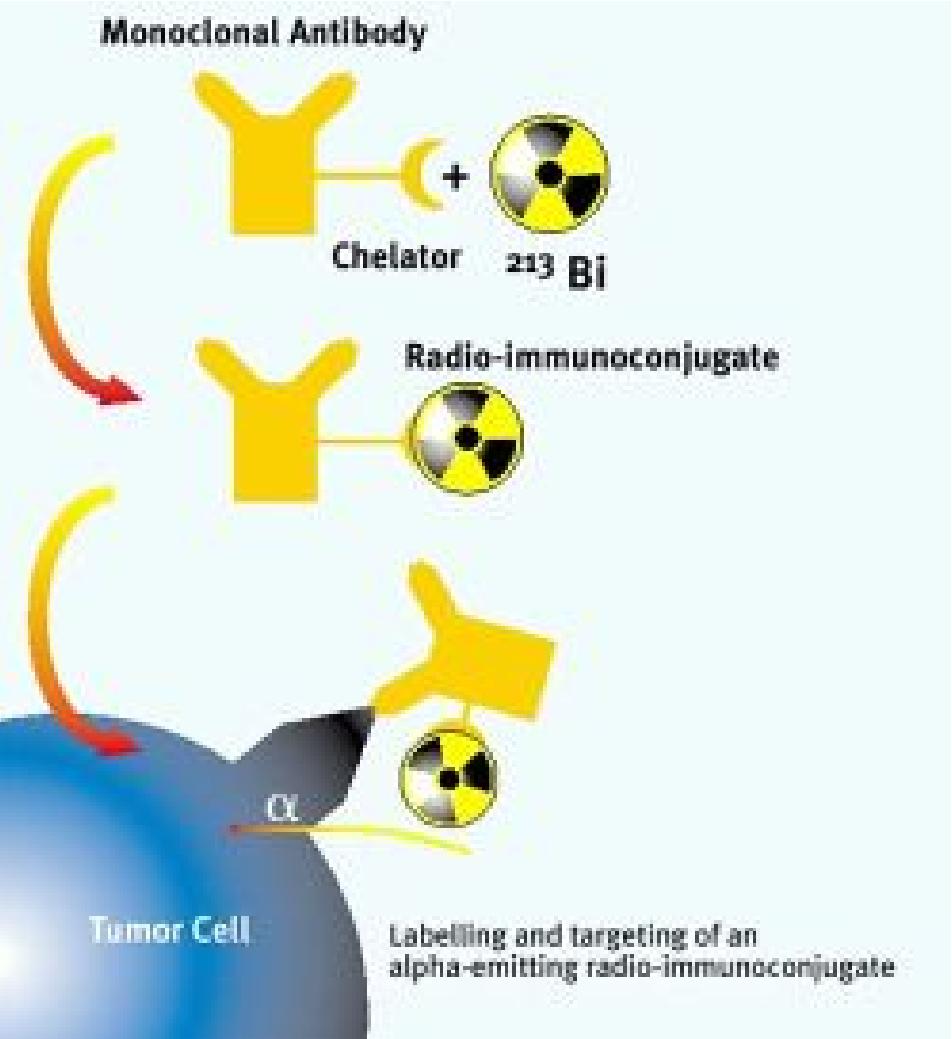
- The reactor is equipped with a “freeze plug”—an open line where a frozen plug of salt is blocking the flow.
- The plug is kept frozen by an external cooling fan.

- In the event of TOTAL loss of power, the freeze plug melts and the core salt drains into a passively cooled configuration where nuclear fission is impossible.

Medical Radioisotopes from LFTR

Bismuth-213

(derived from U-233 decay)



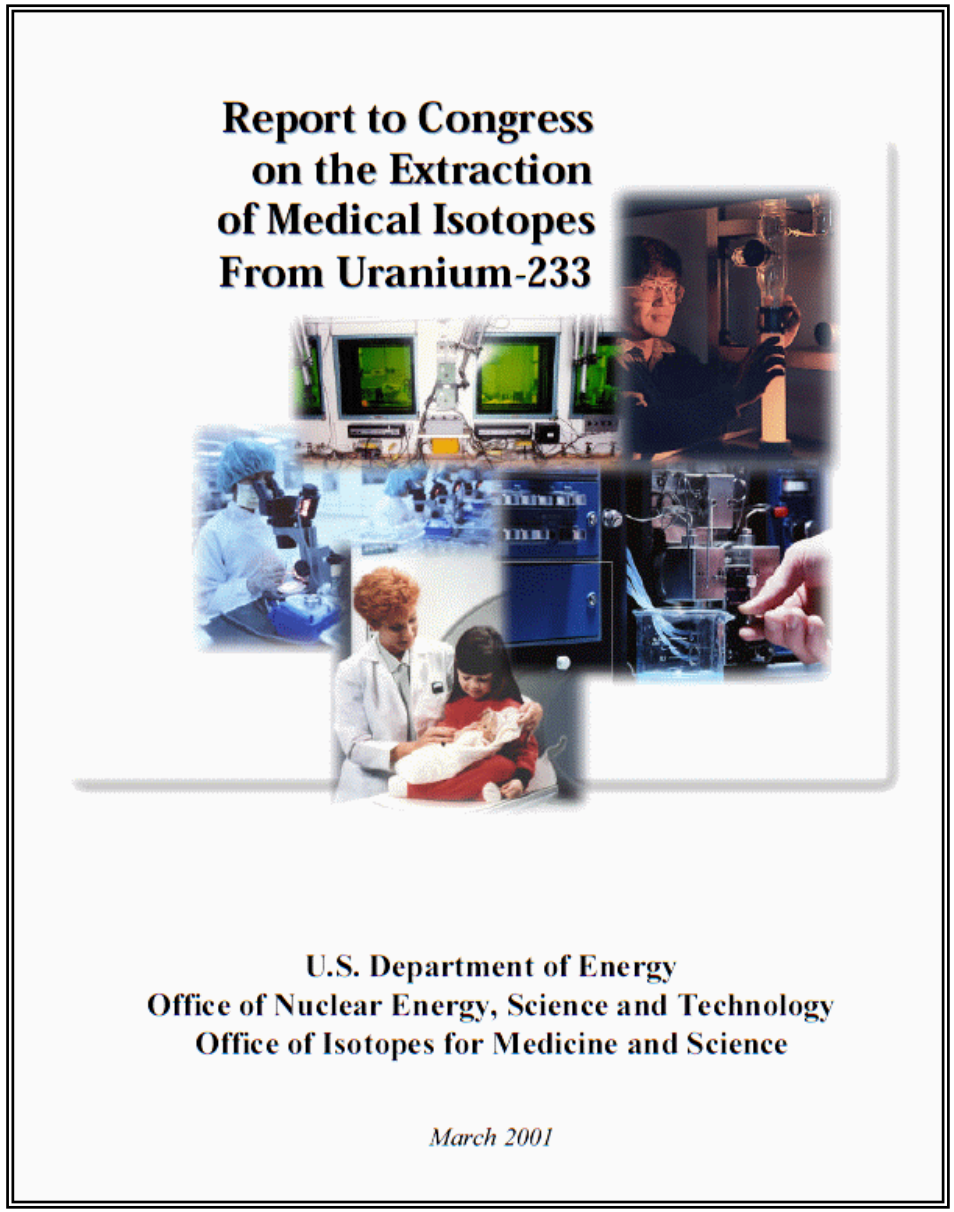
Molybdenum-99

(derived from U-233 fission)

Congressional Report Emphasizes Need for Th-229

"Ac-225 and Bi-213 are currently derived from purified Th-229 extracted from U-233 at ORNL. **The only practical way at present is to derive these isotopes from the natural decay of Th-229. Th-229 is produced by the natural decay of U-233.** Ac-225 is the product being shipped to medical facilities. Bi-213 is separated from the Ac-225 at the hospital and combined with the targeting agent.

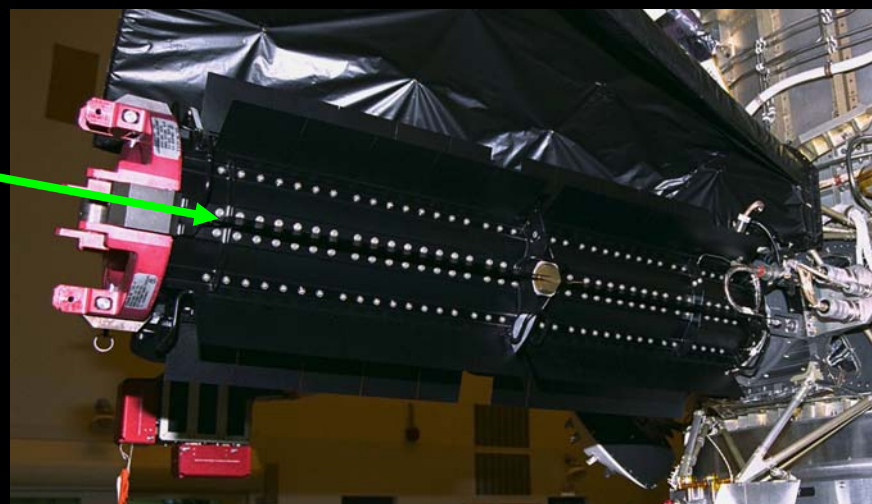
"**Bi-213 appears to be very potent**, so only a very minute quantity may be needed to treat a patient…**on the order of a billionth of a gram**."

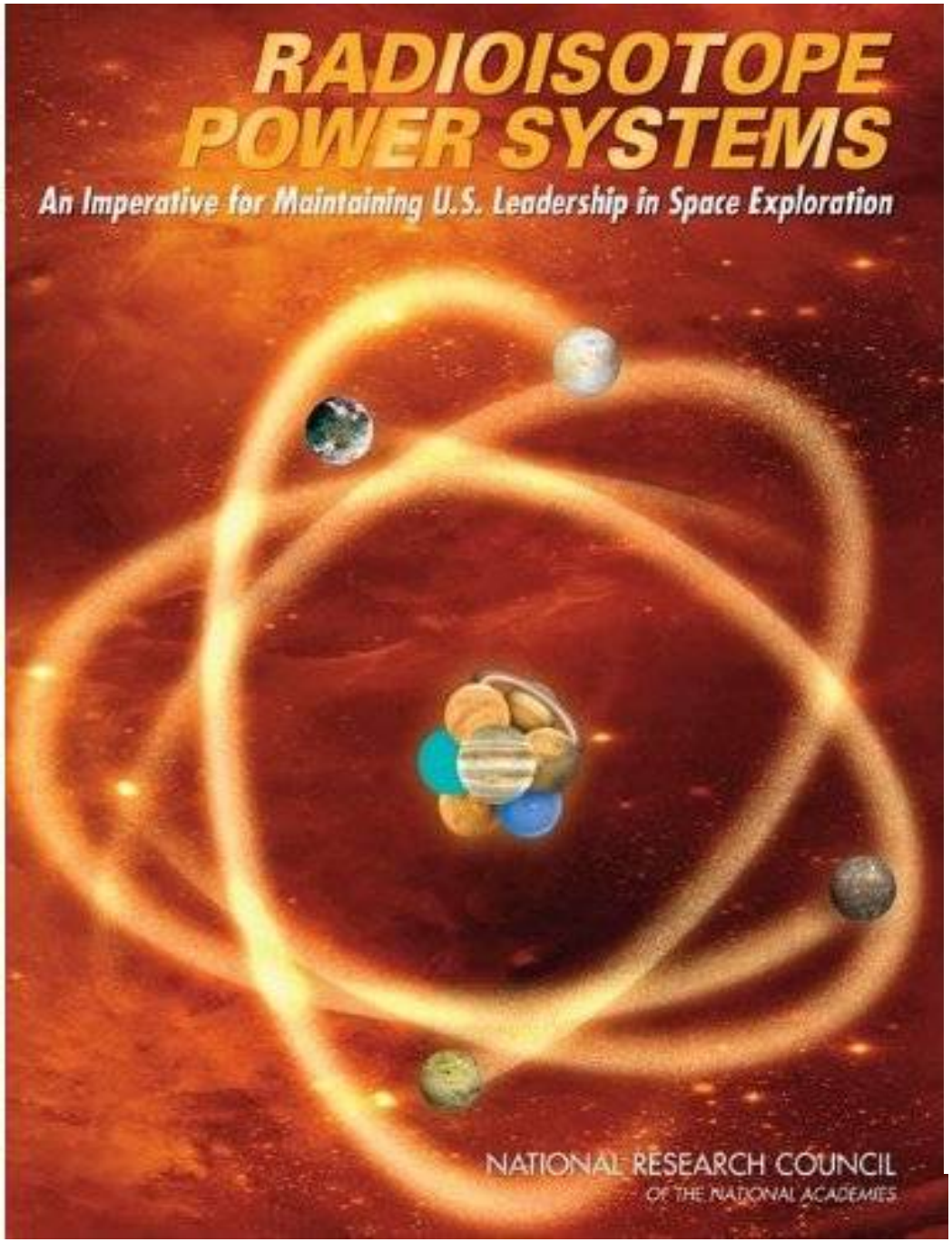


All of NASA's deep-space exploration missions have relied on one substance for their power…

RTGs

Radioisotope Thermoelectric Generator (RTG) with 20 kg of Pu-238 fuel



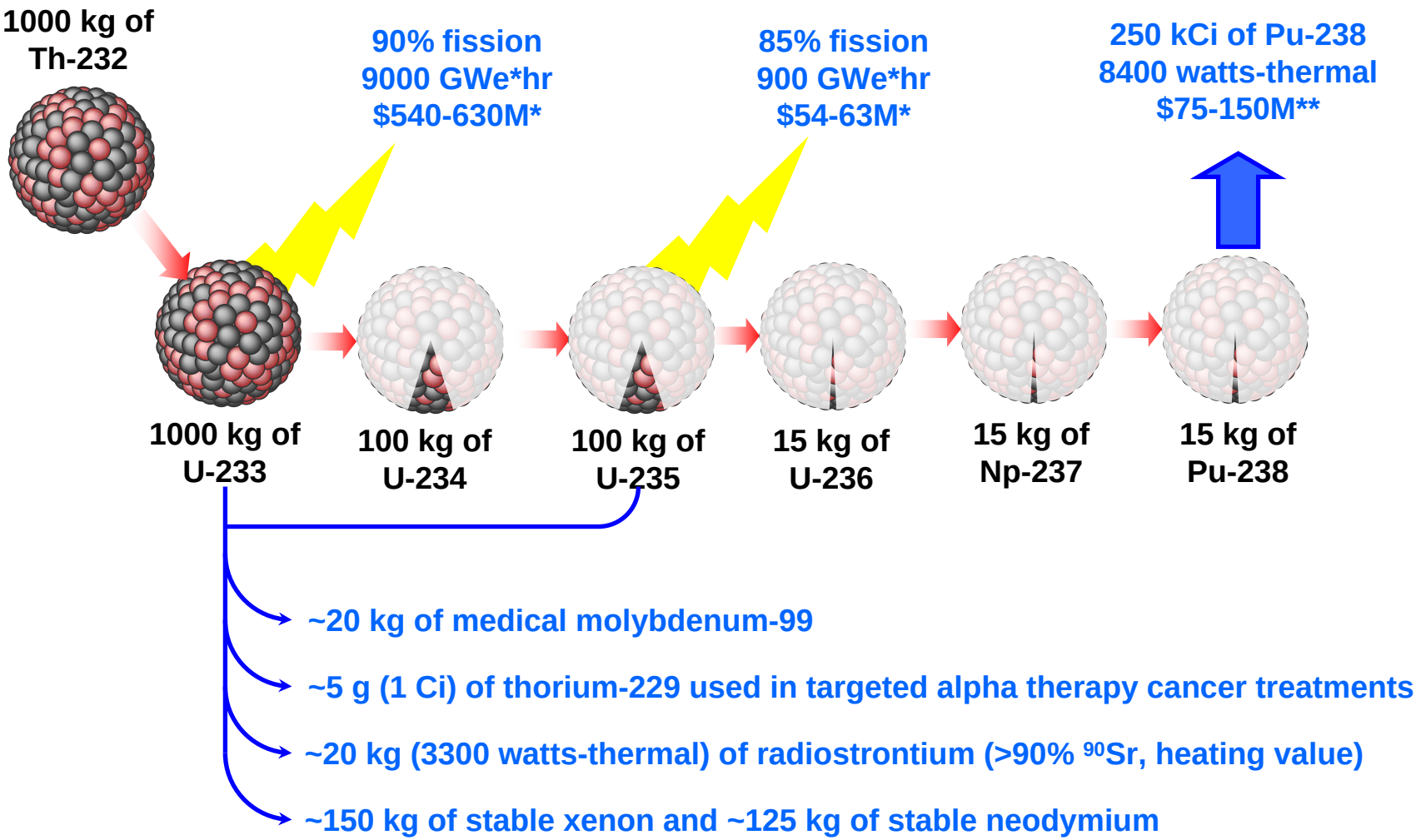


"It has long been recognized that the **United States would need to restart domestic production of plutonium-238** in order to continue producing radioisotope power sources and to maintain U.S. leadership in the exploration of the solar system.

"The problem is that the United States has delayed taking action to the point that the situation has become critical.

"Continued inaction will exacerbate the magnitude and the impact of future Pu-238 shortfalls, and it will force NASA to make additional, difficult decisions that will reduce the science return of some missions and postpone or **eliminate** other missions until a source of Pu-238 is available."

Electricity and Isotope Production from LFTR



Flibe Energy's Co-founders

- **Kirk Sorensen**
  - Chief nuclear technologist, Teledyne Brown Engineering, 2010-2011
  - US Army Space and Missile Defense Command, 2008-2010
  - NASA Marshall Space Flight Center, 2000-2010
  - MS, nuclear engineering, University of Tennessee, 2011
  - MS, aerospace engineering, Georgia Institute of Technology, 1999

- **Kirk Dorius**
  - Intellectual Property Counsel, Zagorin O'Brien Graham, Austin, TX
  - JD, University of New Hampshire School of Law, Franklin Pierce Center for Intellectual Property 2004
  - Mechanical Engineer, The Boeing Co., ICBM Ground Systems 2000-2001
  - BS, mechanical engineering, Utah State University, 2000

Early Stage Plans

- **We are committed to developing and building LFTR**
- **We are actively:**
  - Pursuing strategic industry and research partnerships
  - Educating decision makers
  - Exploring potential nuclear energy markets
  - Exploring markets for byproduct and secondary product streams
- **Flibe Energy's ambitious development program aims for**
  - First demonstration criticality in June 2015

Plenty to do!

We are working on it!

(please help!)