IEEE NPSS School on Nuclear Power for Sustainable Development

THE OHIO STATE UNIVERSITY

Evolution of Nuclear Fission Technology: From Gen II to Gen III+ and Gen IV and SMR

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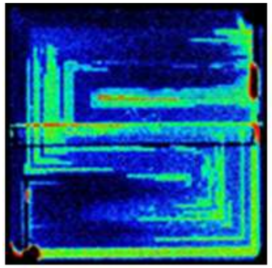
What's going on?

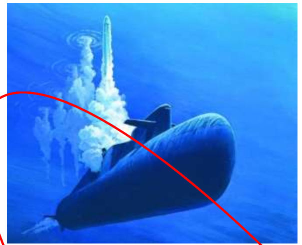
- Fission & Neutron Economy
- Viewing the Present through the Lens of History
- Advanced Reactor Concepts

Basics of Fission

- Nuclear power is a low carbon emission, 7/24, dispatchable energy source that support **grid stability**, **energy security**, and **climate goals.**
  - Accounts for total electricity generation 18% in USA and 10% in the world.

Hydrogen Fuel cell imaging





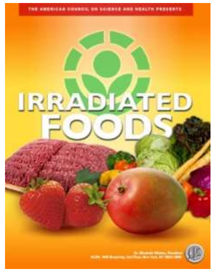
Propulsion

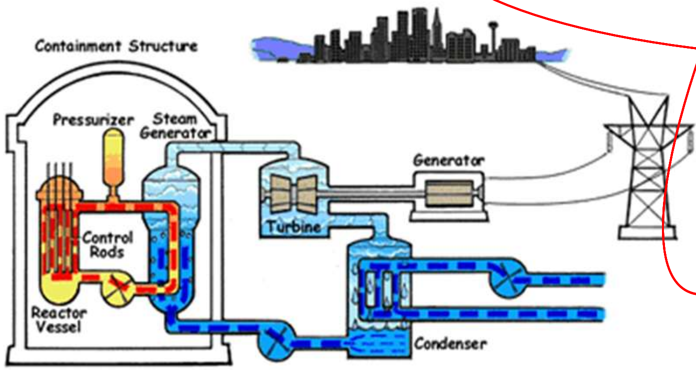
Healthy

40% of all procedures

Scientific R & D

Food irradiation





Electricity

Industry

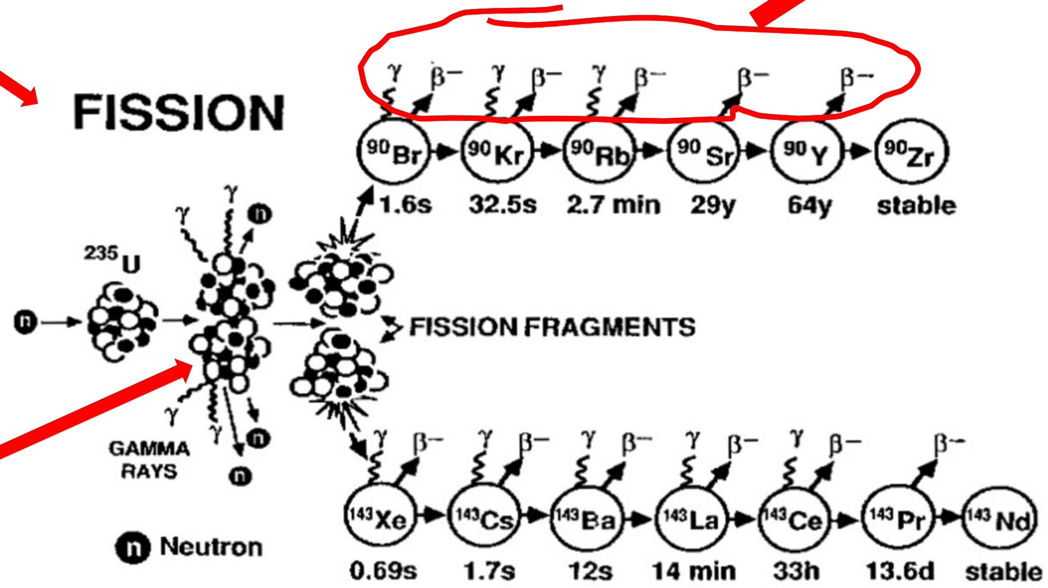
Well-logging

Smoke-detector

Basics of Fission

~ 200 MeV energy released

These decay energy is 7% of all the energy released – but the big problem!



~ 168 MeV as fission fragments

Fuel pellet, cladding, reactor vessel, and confinement building are 4 barriers holding these fission products

Knief, R. A. (1992). Nuclear engineering: theory and technology of commercial nuclear power. ANS

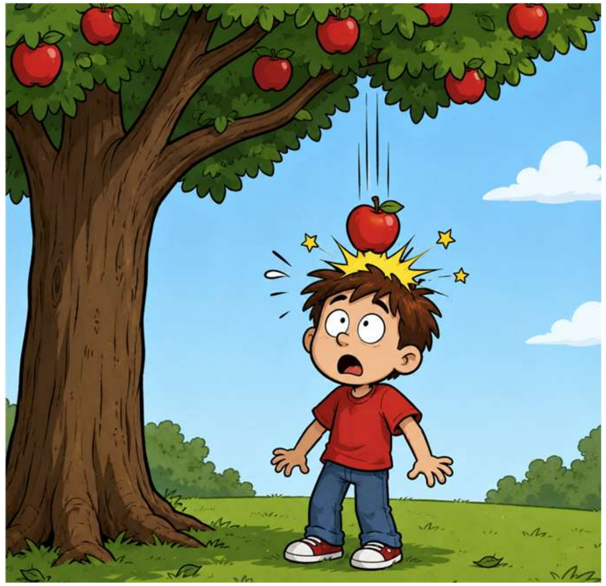
Energy Source	Fission Energy (MeV)	Heat Produced	
		MeV	% of Total
Fission Fragments	168	168	84
Neutrons	5	5	2.5
Prompt Gamma Rays	7	7	3.5
Delayed Radiations			
Beta particles & antineutrinos	20	8	4
Gamma Rays	7	7	3.5
Radiative Capture Gammas		5	2.5
Total	**207**	**200**	**100**

The electronvolt (eV) is built for particles because joules are too large there.

1 eV = 1.602 x 10^-19 J

0.0000000000000000001602 J

How much energy is 1 Joule?



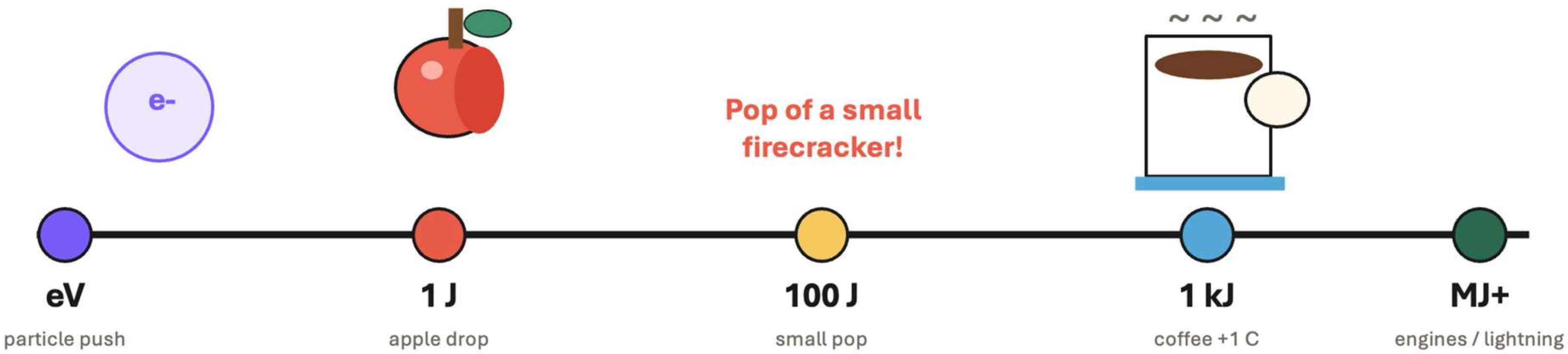
1 g TNT

4,184 J

1 J

0.239 mg TNT

E = mgh
0.10 kg x 9.8 m/s^2 x 1 m
≈ 0.98 J ≈ 1 J



Electron volt (eV) and Joule - Energy units:

eV is an extremely small unit

1 fission releases about 200 MeV but only 3.2×10^{-11} J

How is that possible that a typical nuclear power plant produce 1000 MW (10000 MJ/s)?

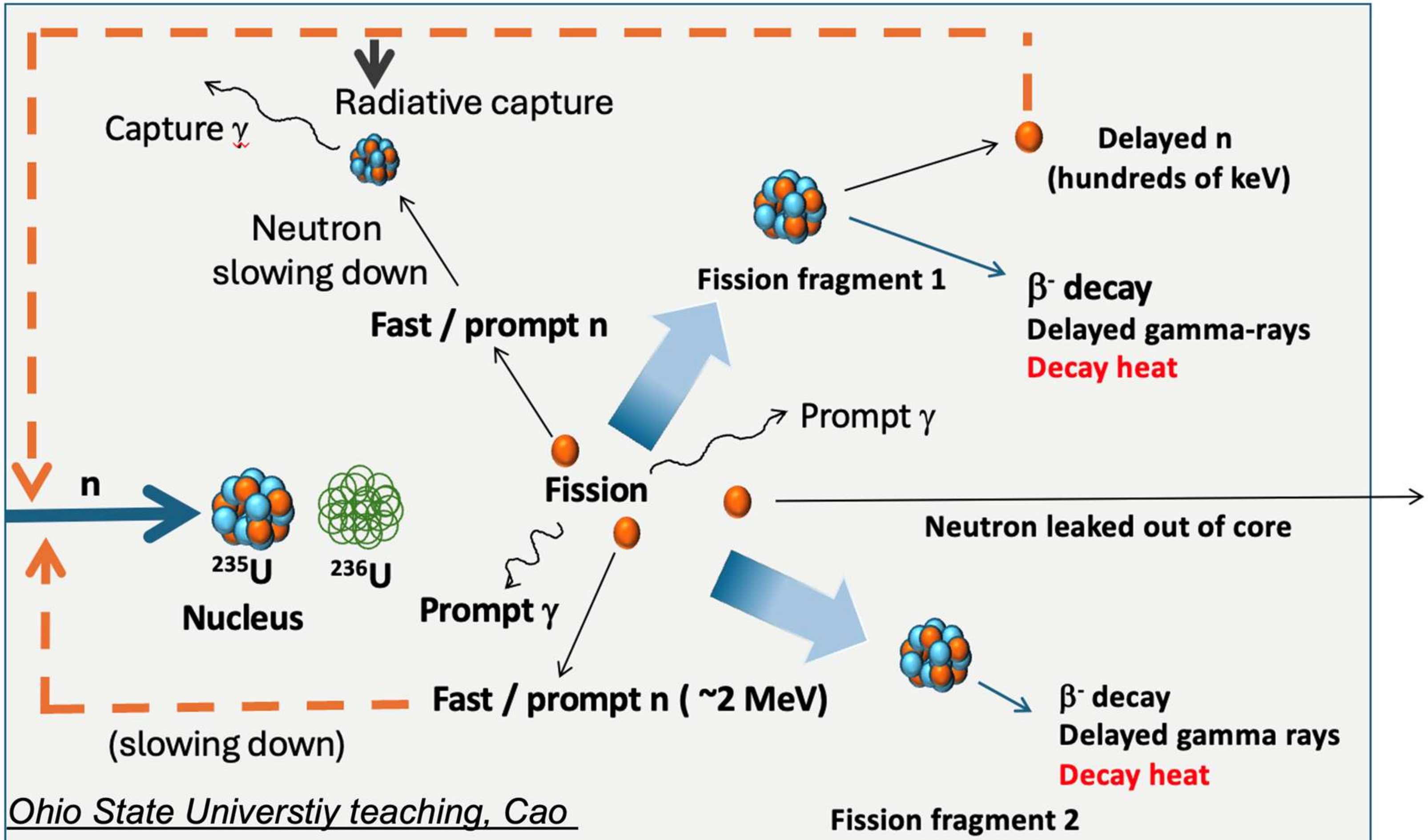
The 200 MeV released from a single fission event is a very small amount of energy, but it can drive this giangatic turbine?

For a plant to produce 500 MW,

$$\frac{5.00 \times 10^{8}\ \mathrm{J}}{3.20 \times 10^{-11}\ \mathrm{J/fission}} = 1.5625 \times 10^{19} \approx 1.56 \times 10^{19}$$ fission events per second

- **Sand:** about as many as all the grains of sand on Earth's beaches and deserts

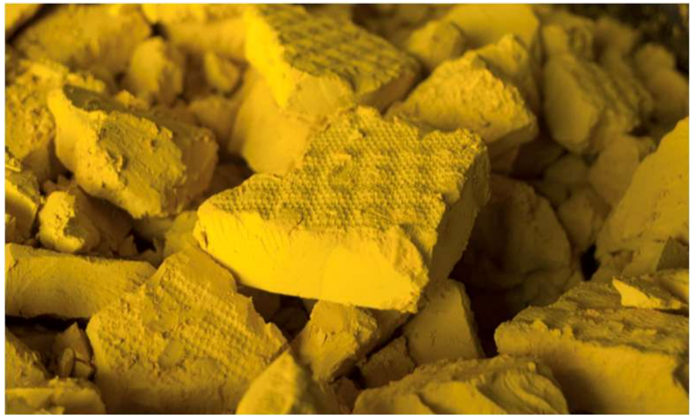
Reactor design is the art of optimizing a neutron economy



Ohio State Universtiy teaching, Cao

Boron in control rods and in water to regulate power by absorbing neutrons

1. **Fuel:** Uranium
- Oxide
- Metal
- TRISO*
- Carbide
- Nitride
- Liquid salt



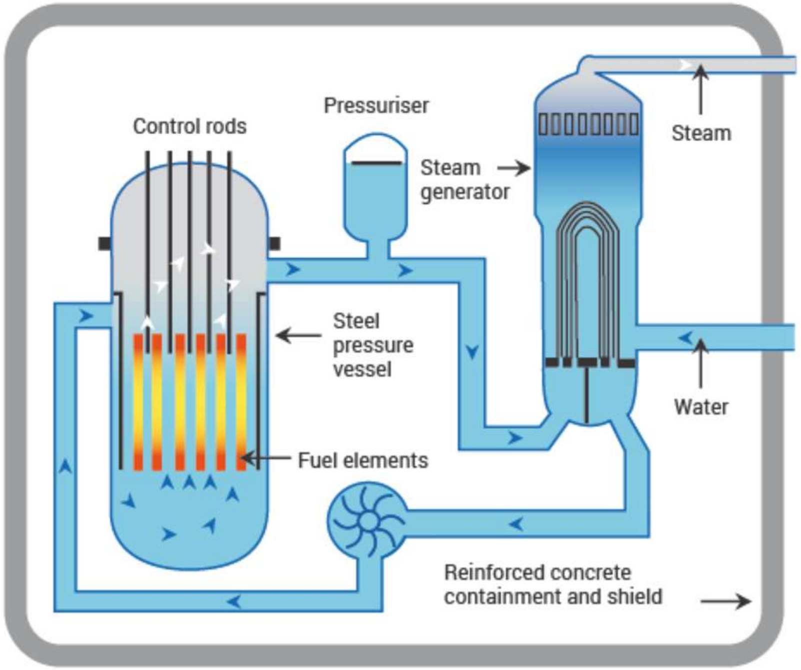
Yellowcake uranium is used in the preparation of uranium fuel that is used in nuclear reactors. (Photo: DOE)

2. Moderator:
- Light water
- Heavy water
- Graphite

3. Coolant:
- Water
- Liquid Sodium
- Helium Gas
- Liquid Lead
- Lead-Bismuth Eutectic
- Molten Salt

Light Water Reactors

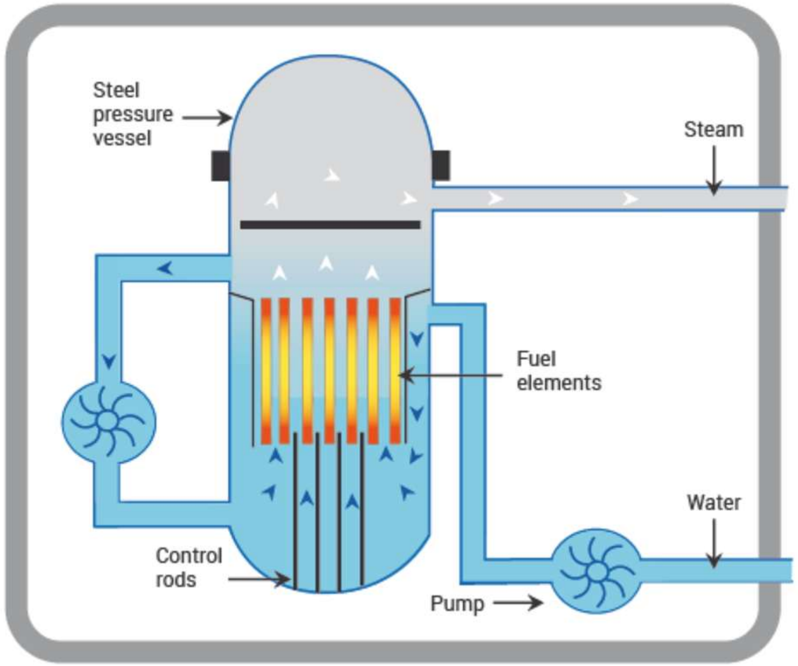
A pressurized water reactor (PWR)



307/440 (73%)

A PWR fuel assembly (typically 14×14 to 17×17) holds ~176–264 rods. A large reactor has ~150–250 assemblies containing 80–100 tons of uranium.

A boiling water reactor (BWR)



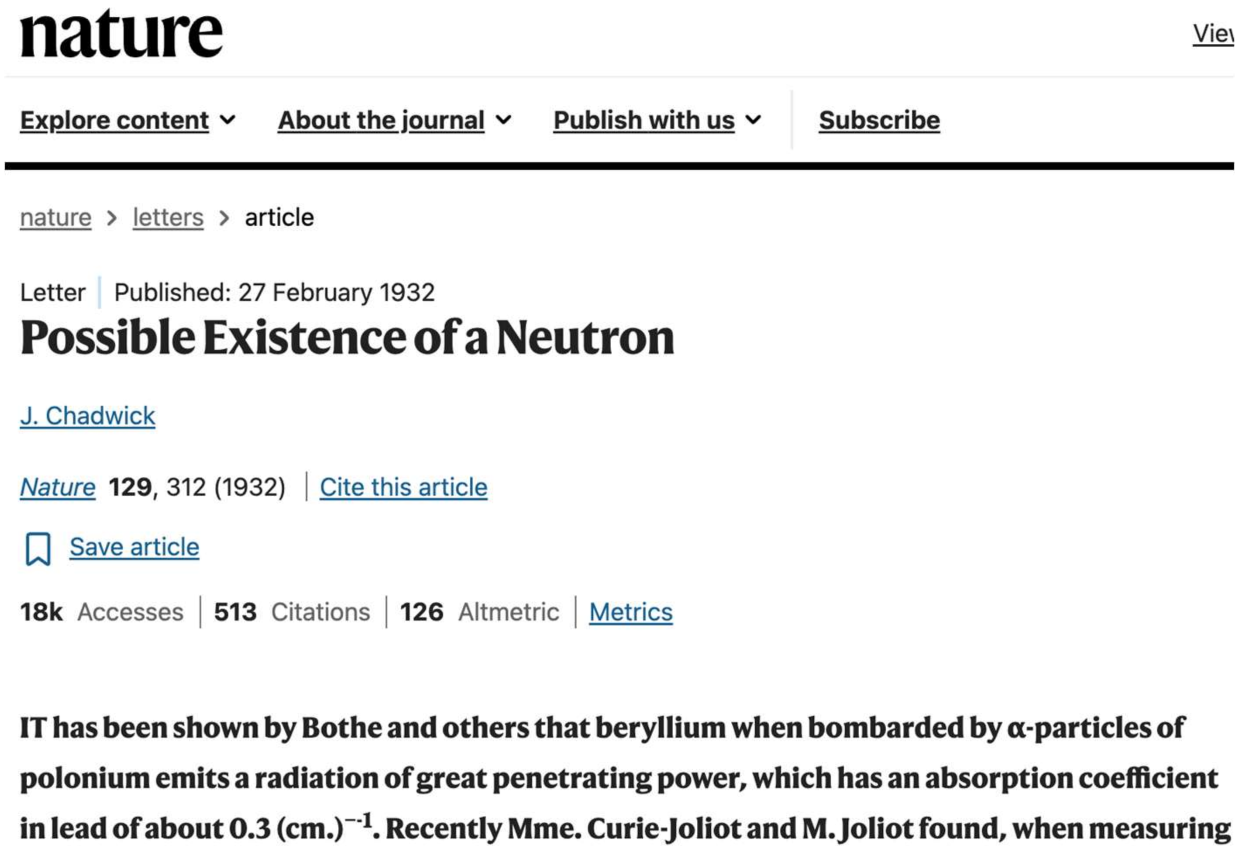
94/440 (21%)

~ 764 fuel assemblies, each containing 62 fuel rods, a total ~ 47,368 fuel rods, and 70-100 tons of uranium.

Source: World Nuclear Association

The **neutron** was discovered by **James Chadwick** in **1932**.

He published a short letter in *Nature* in February 1932 (“Possible Existence of a Neutron”)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nature > letters > article

Letter | Published: 27 February 1932

Possible Existence of a Neutron

J. Chadwick

Nature **129**, 312 (1932) | Cite this article

Save article

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IT has been shown by Bothe and others that beryllium when bombarded by α-particles of polonium emits a radiation of great penetrating power, which has an absorption coefficient in lead of about 0.3 (cm.)$^{-1}$. Recently Mme. Curie-Joliot and M. Joliot found, when measuring

The French patents in May 1939

RÉPUBLIQUE FRANÇAISE

MINISTÈRE DE L'INDUSTRIE ET DU COMMERCE

SERVICE de la PROPRIÉTÉ INDUSTRIELLE

BREVET D'INVENTION

Gr. 5. — Cl. 2. N° 976.541

Dispositif de production d'énergie.

CAISSE NATIONALE DE LA RECHERCHE SCIENTIFIQUE résidant en France (Seine).

Demandé le 1er mai 1939, à 16h 55m, à Paris.
Délivré le 1er novembre 1950. — Publié le 19 mars 1951.

(Brevet d'invention dont la délivrance a été ajournée en exécution de l'article 11, § 7, de la loi du 5 juillet 1844 modifiée par la loi du 7 avril 1902.)

On sait que l'absorption d'un neutron par un noyau d'uranium peut provoquer la rupture de ce dernier avec dégagement d'énergie et émission de nouveaux neutrons en nombre en moyenne supérieur à l'unité. Parmi les neutrons ainsi émis, un certain nombre peuvent à leur tour provoquer — sur des noyaux d'uranium — de nouvelles ruptures, et les ruptures de noyaux d'uranium pourront ainsi aller en croissant suivant une progression géométrique, avec dégagement de quantités extrêmement considérables d'énergie.

On s'est rendu compte, conformément à la présente invention, que si l'on parvenait à provoquer une telle réaction au sein d'une masse limitée d'uranium (ou de composé d'uranium ou d'un mélange contenant de l'uranium), on pourrait extraire de cette masse et utiliser à des fins industrielles l'énergie ainsi développée par les chaînes de ruptures successives.

Mais on se heurte immédiatement à une difficulté primordiale : ces chaînes pouvant se ramifier d'une manière illimitée, la réaction peut devenir explosive, ce qui restreindrait considérablement les possibilités d'utilisation de la masse d'uranium en question comme source maniable d'énergie industrielle.

On a donc cherché à maîtriser le dégagement d'énergie en l'empêchant de devenir explosif, et l'on a eu l'idée à cet effet :

1° Tout d'abord de réduire la vitesse de tout ou partie des neutrons libérés, de telle sorte qu'ils deviennent des neutrons lents, approximativement en équilibre thermique avec le milieu, ... répartitions des constituants du dispositif, arrêtant ainsi le développement des chaînes;

2° Ensuite, d'introduire dans le dispositif un ou plusieurs éléments — à l'état de corps simples ou de combinaisons chimiques — susceptibles d'absorber les neutrons ralentis en proportion d'autant plus forte par rapport à l'absorption par l'uranium que la température est plus élevée.

Par le premier de ces moyens ou l'emploi conjugué de ces deux moyens, les chaînes peuvent se développer jusqu'à ce qu'une énergie suffisamment importante soit libérée, et être alors automatiquement interrompues ou limitées, évitant ainsi le développement explosif de la réaction.

On arrive ainsi à libérer de la masse d'uranium considérée, en vue de son utilisation industrielle, et au fur et à mesure des besoins, l'énergie qu'elle est susceptible de fournir par transmutations.

Pour réduire la vitesse de tout ou partie des neutrons émis, on introduit au sein de la masse d'uranium — et suivant une répartition qui n'est pas nécessairement uniforme — des éléments très légers tels que l'hydrogène, le deutérium par exemple, libres ou combinés, ou des éléments légers tels que le glucinium, le carbone, l'oxygène par exemple, libres ou combinés.

Un avantage spécial des ralentisseurs très légers est de diminuer la proportion des neutrons qui sont absorbés par résonance dans l'uranium et qui peuvent être ainsi perdus pour le processus en chaînes.

Ces éléments pourront être introduits sous forme liquide, gazeuse ou solide (poudre par exemple).

Patent I (May 1st 1939) :
"device for energy production"

"We know that the absorption of a neutron by a nucleus of uranium can provoke the break of the latter with release of energy and emission of new neutrons in average number upper to one. Among these neutrons, some can provoke new breaks of nucleus of uranium , thus making these breaks increasing according to a geometric progression .... We have realized, in accordance with the present invention, that if one manage to cause such a reaction within a limited mass of uranium, one could extract from this mass the energy then developed by the chains of successive breaks"

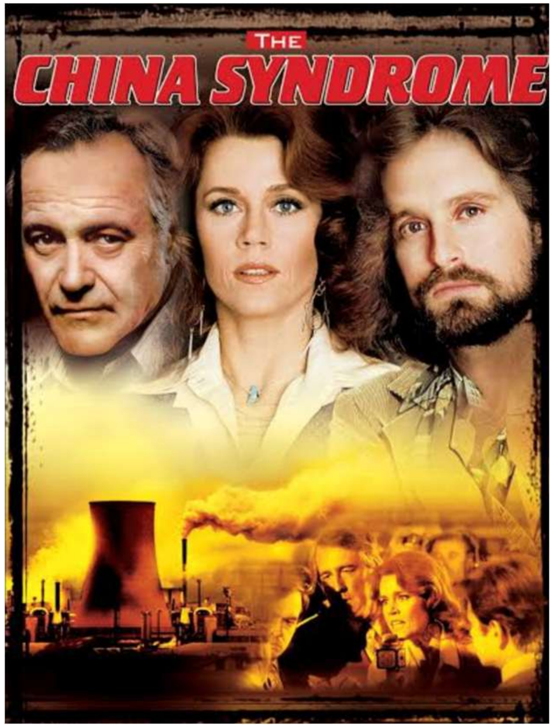
August 2, 1939: Albert Einstein signed the letter to President Roosevelt in USA that recent discoveries involving **uranium nuclear chain reactions** might make extremely powerful bombs possible and, importantly, that **Nazi Germany might pursue such a weapon**..

1. Birth (1938–1945)

- •Discovery of nuclear fission (1938)
- •Manhattan Project (1942)
- •First reactor (December 2, 1942)

2. Golden Age (1945–1973)

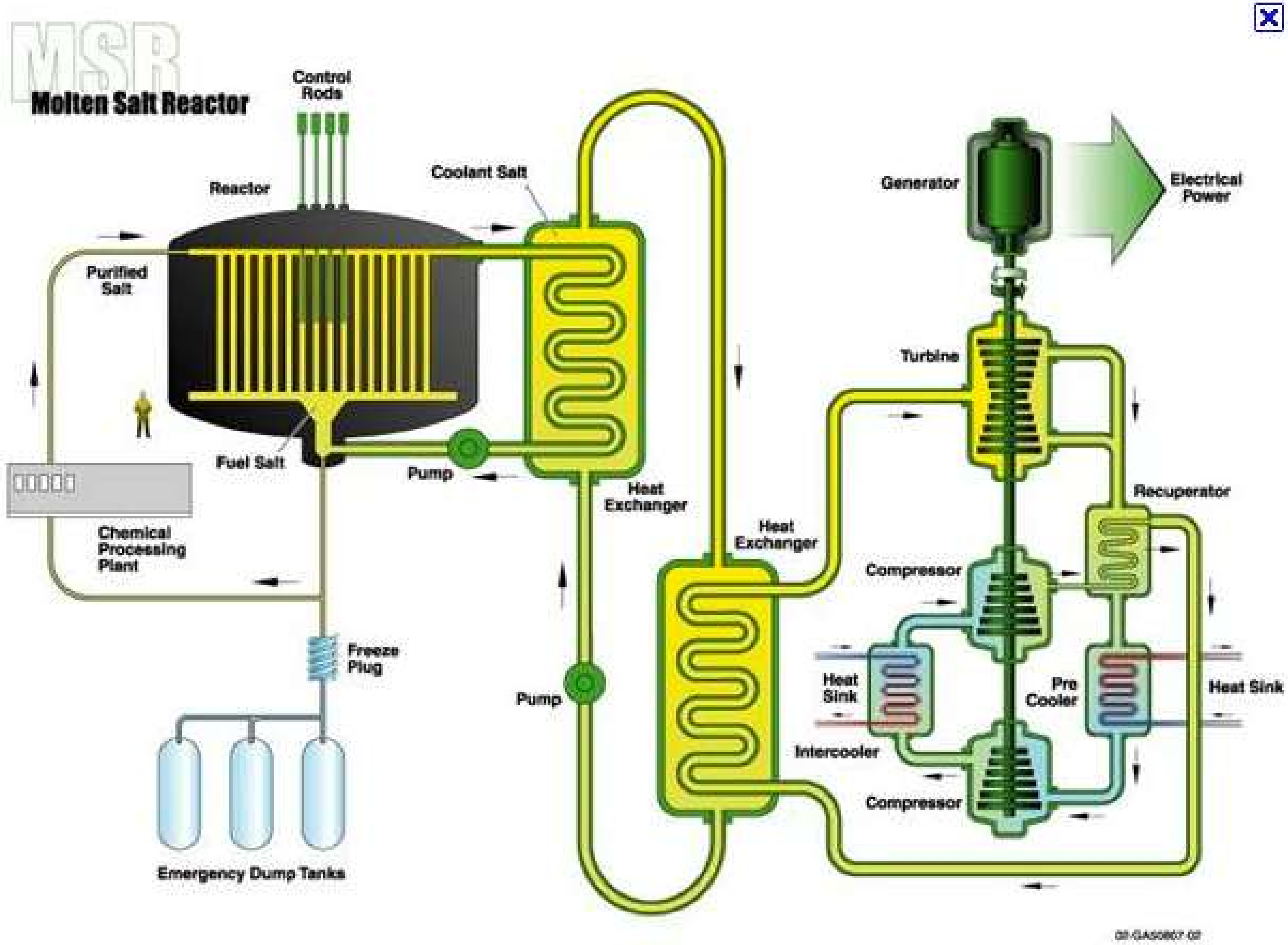
- •Rapid reactor innovation
- •Research reactors (OSU research reactor 1961)
- •Naval propulsion
- •Commercial nuclear power (1954, Obninsk, 1957, Shippingport)
- •Atoms for Peace
- •Worldwide optimism
- •ORNL becomes the world's premier reactor research center



3. The End of the First Nuclear Era (1973–1994)

- •Safety becomes dominant; regulatory expansion
- •Public opposition, advanced reactor programs cancelled
- •Three Mile Island (March 28, 1979) - The Movie: China Syndrome was released in the United States on March 16, 1979
- •Chernobyl (1986)
- •Industry stagnation

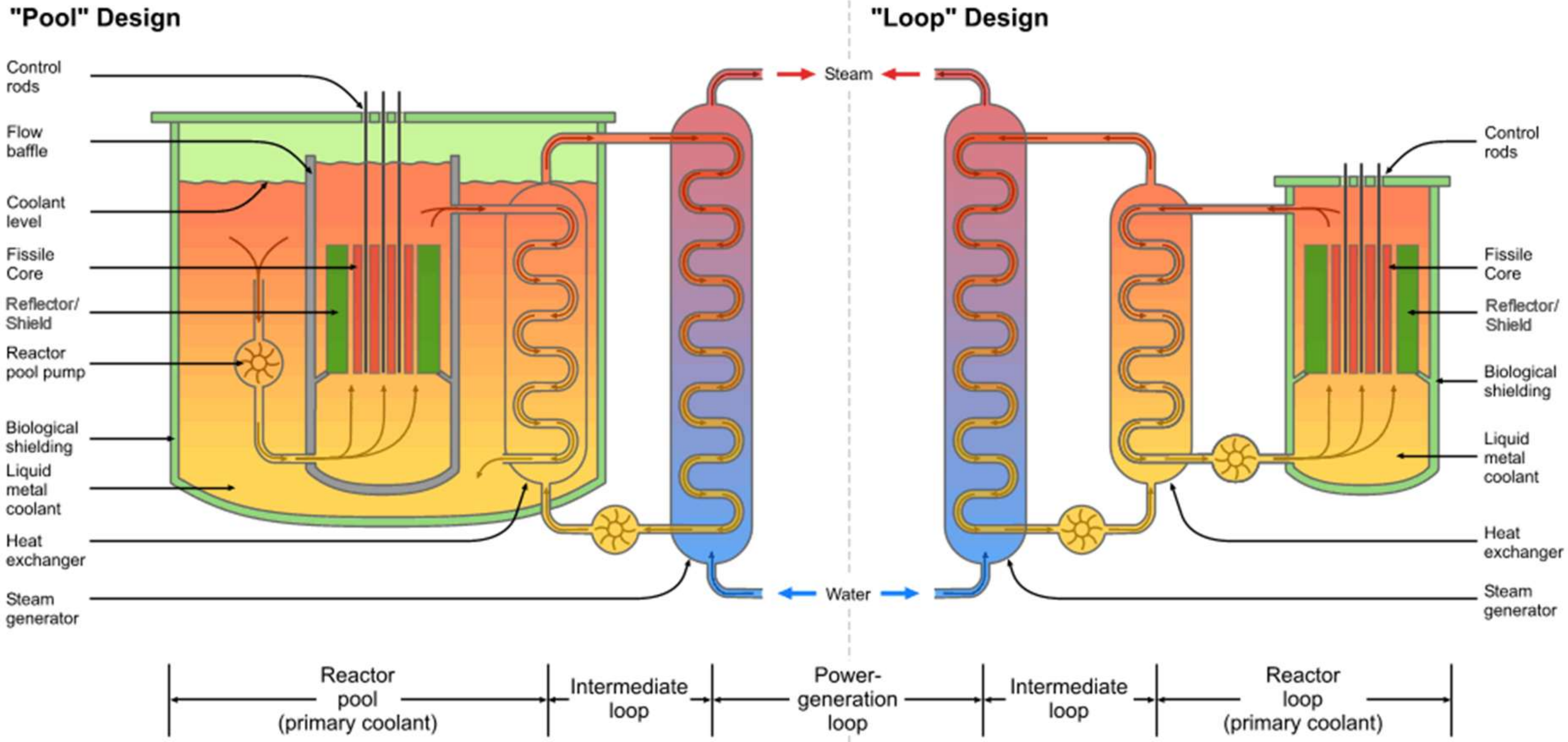
Molten Salt Reactor



Source: U.S. Department of Energy, Nuclear Energy Research Advisory Committee (NERAC).

Sodium-cooled fast reactor

- Because of coolant activation, the potential for sodium/water interactions between high-pressure steam and a low-pressure sodium loop, an intermediate coolant loop is used.
- This leads to two fundamental design choices: Pool vs. Loop

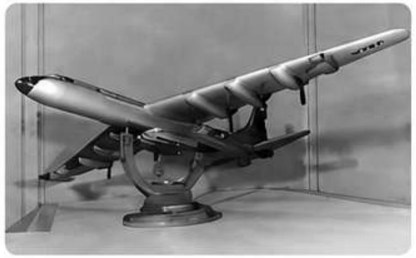


- Low pressure
- Recycle plutonium repeatedly
- Burn minor actinides (Np, Am, Cm)
- Reduce long-lived nuclear waste

Viewing the present through the lens of history

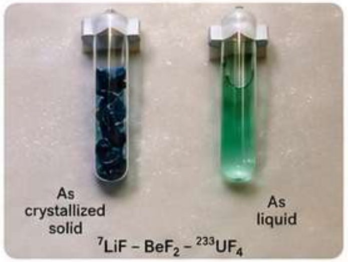
ORNL Aircraft Nuclear Reactor Progress (1949–1960)

1 1949
Nuclear Aircraft Concept Formulated



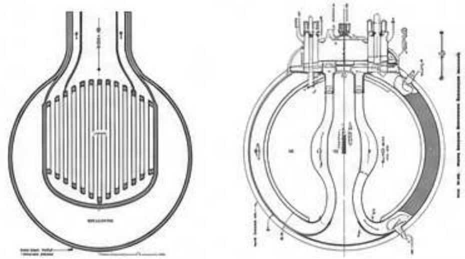
ORNL begins exploring the concept of a nuclear-powered aircraft.

2 1951
R.C. Briant Proposed Liquid-Fluoride Reactor



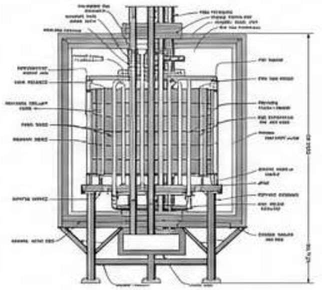
R.C. Briant proposes a liquid-fluoride reactor using FLiBe ($^{7}LiF–BeF_2$) with uranium fluoride.

3 1952–1953
Early Designs for Aircraft Fluoride Reactor



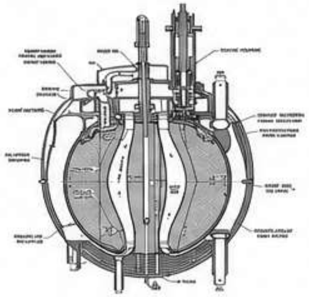
Preliminary reactor concepts and layouts developed for aircraft application.

4 1954
Aircraft Reactor Experiment (ARE) Built and Operated



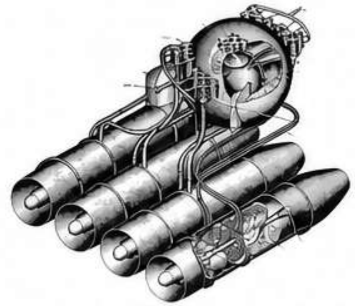
World's first successful aircraft reactor test. Produced 2.5 MW_{th} at ~860°C for ~100 hours.

5 1955
60 MW_{th} Aircraft Reactor Test (ART) "Fireball" Proposed



High-power (60 MW_{th}) reactor concept for aircraft propulsion.

6 1960
Nuclear Aircraft Program Cancelled in Favor of ICBMs



Focus shifts to intercontinental ballistic missiles ($ICBM_S$) and nuclear submarines.

Outcome: Pioneering research at ORNL advanced molten-salt reactor technology and informed future nuclear energy and propulsion programs.

Generated by AI

Historical Perspective

- **1940s**: The idea of sodium-cooled reactors was explored during the Manhattan Project, **1951**: The first experimental sodium-cooled reactor, the **Experimental Breeder Reactor I (EBR-I)**, was constructed and operated at the (now) U.S. Idaho National Laboratory.

- **1946 - 1950s**: The molten salt reactor (MSR) concept was proposed and developed at the U.S. Oak Ridge National Laboratory (ORNL).

- **Atoms for Peace** was initiated by President Eisenhower on **December 8, 1953**

- The first nuclear-powered submarine, **USS Nautilus (SSN-571), construction: 1952, launch: 1954**

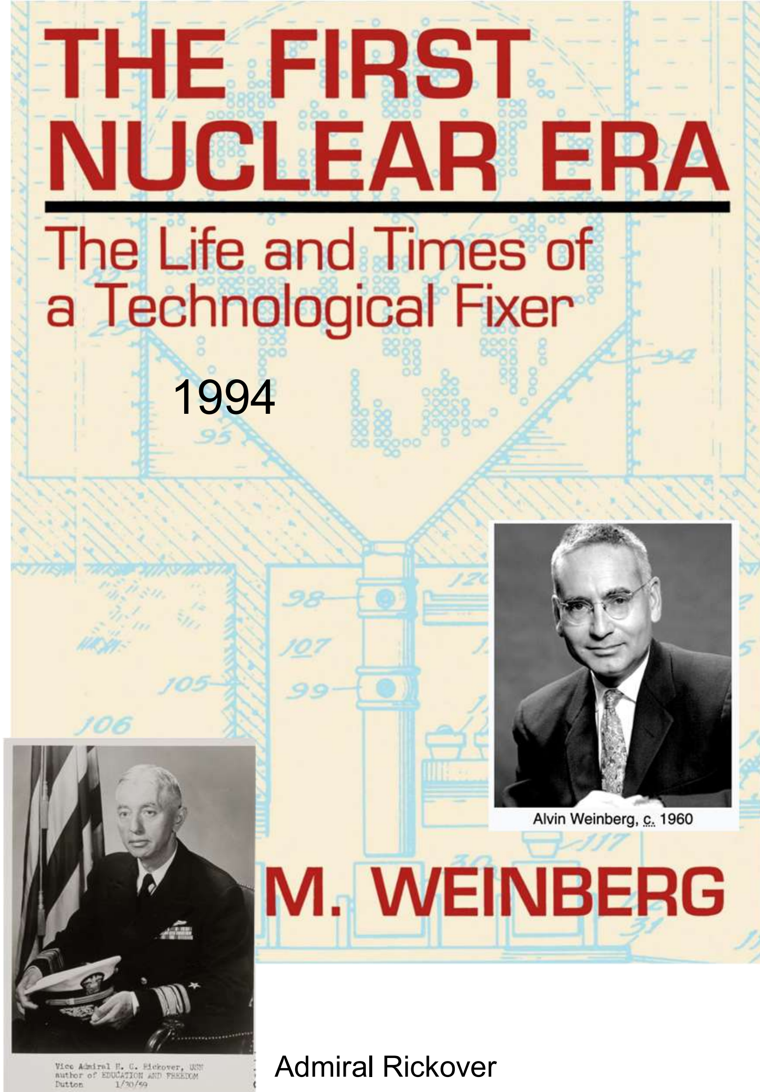
- The first civilian nuclear power plant in the United States was the **Shippingport, Pennsylvania, 1957, use water as moderator and water as coolant - Light Water Reactor (LWR)**

Historic Perspective

*"**That light water would be the main line for commercial development was a surprise to me** even though I had proposed this system for submarine propulsion. In the early days, other systems had their proponents. But the LWR had one overwhelming advantage: it has already proven itself as a reliable power plant for Nautilus."* ***—pg 133***

*"Why didn't the molten-salt system, so elegant and so well thought-out, prevail? .....It was a successful technology that was dropped because it was too different from the main lines of reactor development...**I hope that in a second nuclear era, the technology will be resurrected."*** ***—pg 130-131***

*"I knew this was untrue: pressurized water had been chosen to power submarines because such reactors are compact and simple. Their advent on land was entirely due to **Rickover**'s dominance in reactor development the 1950s, and once established, the light-water reactor could not be displaced by a competing reactor. **To claim that light-water reactors were chosen because of their superior safety belied an ignorance of how the technology had actually evolved**."* ***—pg 231***



1994

Alvin Weinberg, c. 1960

Admiral Rickover

From Many Paths to One Standard

Key Milestones in Reactor Development and the Rise of the Light Water Reactor

YEAR	MILESTONE	SIGNIFICANCE
1942	**Chicago Pile-1**	• Demonstrated the first controlled nuclear chain reaction, launching the reactor age.
1943–1945	**Hanford Production Reactors**	• Established large-scale reactor engineering for plutonium production.
1947–1953	**ORNL & Argonne develop multiple reactor concepts**	• Parallel development of PWR, BWR, sodium fast, molten salt, gas-cooled, and homogeneous reactors.
1949–1954	**Rickover develops the Naval PWR**	• Massive U.S. Navy investment matures PWR technology years ahead of competitors.
1951	**EBR-I (Fast Reactor)**	• First reactor to generate electricity, proving breeder reactor feasibility.
1954	**USS *Nautilus***	• First nuclear-powered submarine demonstrates PWR reliability.
1957	**Shippingport PWR**	• First U.S. commercial nuclear power plant; naval technology enters civilian service.
1958–1968	**Utilities adopt PWRs and BWRs**	• Standardization, supply chains, and licensing begin favoring LWRs.
1965–1969	**Molten Salt Reactor Experiment (MSRE)**	• Successfully validates molten salt reactor technology but is not commercialized.
1972–1977	**Advanced reactor programs lose support**	• Weinberg leaves ORNL; MSR funding ends while LWR deployment continues.
1983	**Clinch River Breeder Reactor canceled**	• U.S. commercial fast reactor program effectively ends.
1990s	**LWR becomes the global standard**	• Nearly all Western commercial reactors are PWRs or BWRs.

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Key takeaway from Weinberg's book:

The Light Water Reactor won the commercialization race before alternative reactor concepts had the opportunity to fully mature.

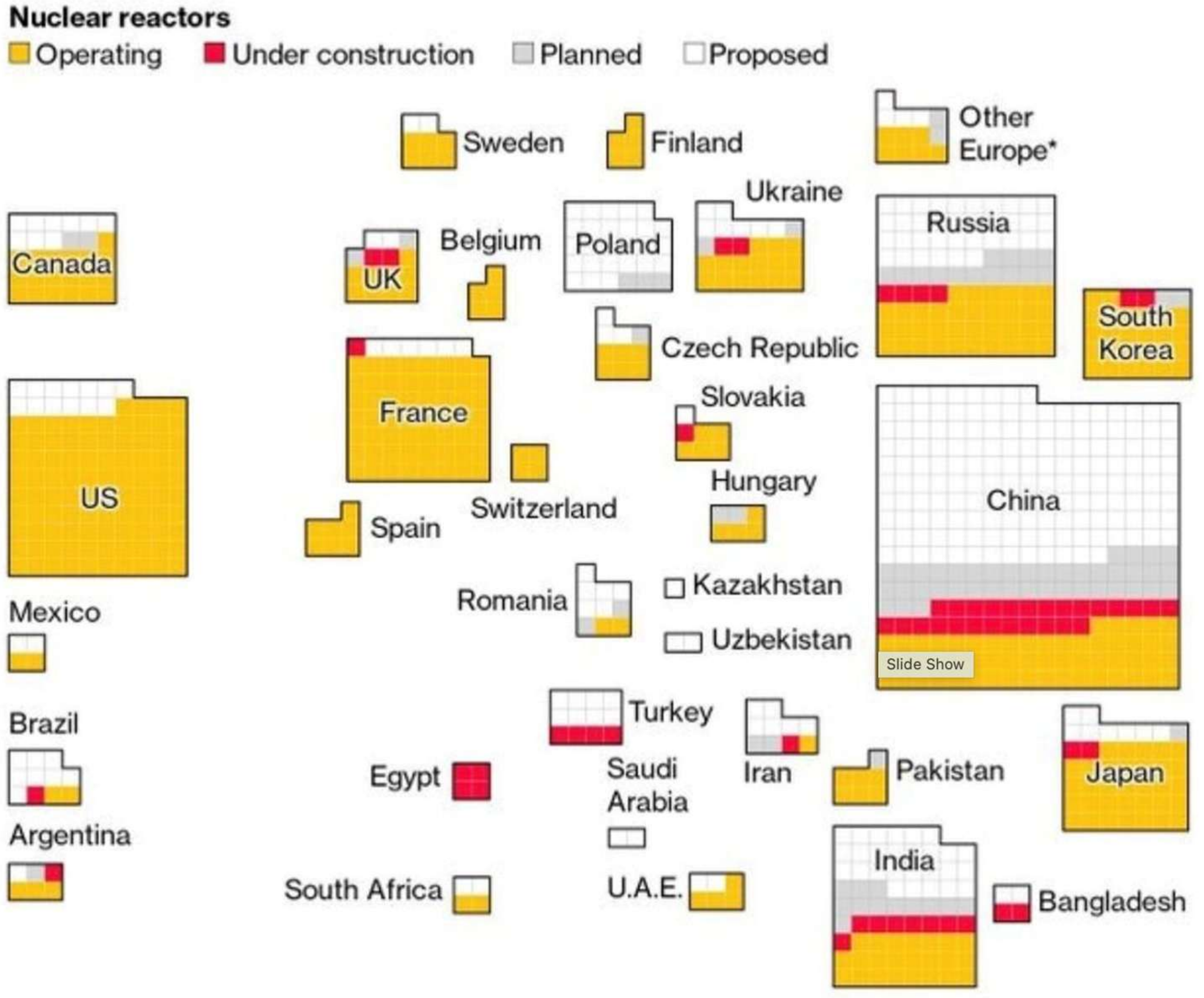
The commercialization of reactor technologies was shaped less by a direct technical competition than by a sequence of reinforcing decisions:

1. **Naval propulsion** gave the PWR a 10-year engineering head start.
2. **Shippingport** demonstrated that a naval reactor could be adapted for civilian electricity generation.
3. **Utilities and vendors** standardized on LWRs, creating economies of scale.
4. **Regulatory frameworks** evolved around LWR technology.
5. **Advanced reactors (MSR, SFR, HTGR)** remained successful demonstrations but never received comparable commercial investment.

Opinions: the lack of opportunities for non-LWR to grow as much as LWR technologies doesn't mean by default that they will be superior than LWR.

The Present - Nuclear Energy in the World

- China and India are leading with massive investments in nuclear reactors constructions.
- The US, France, Russia, and South Korea are also expanding their nuclear infrastructure.
- US has a surging interests in bringing nuclear energy to power AI/data centers



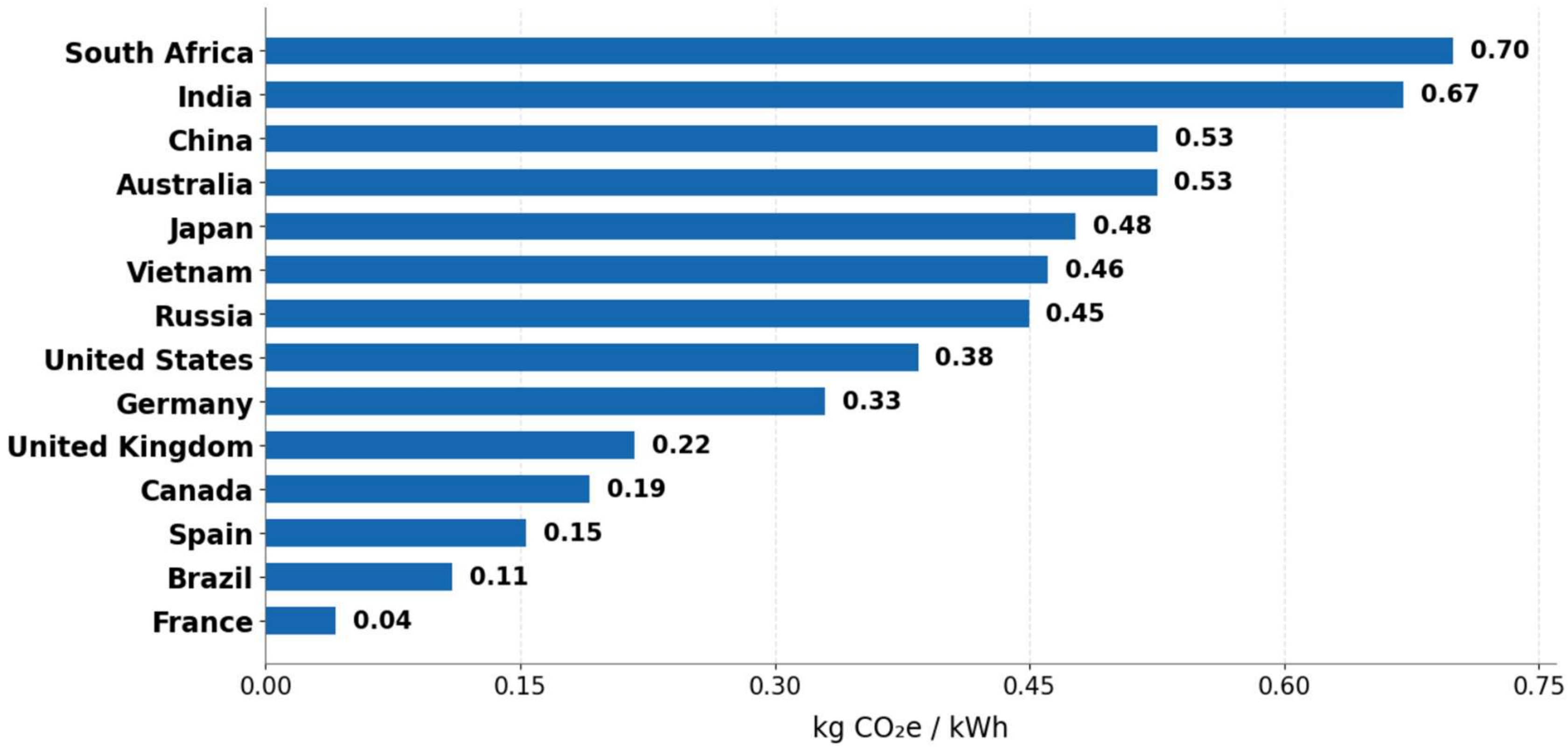
Source: World Nuclear Association
*Other Europe includes Armenia, Belarus, Bulgaria, Netherlands and Slovenia
Note: Reactor construction in Brazil, Ukraine and Japan is currently suspended

Current Operable Nuclear Power Plants

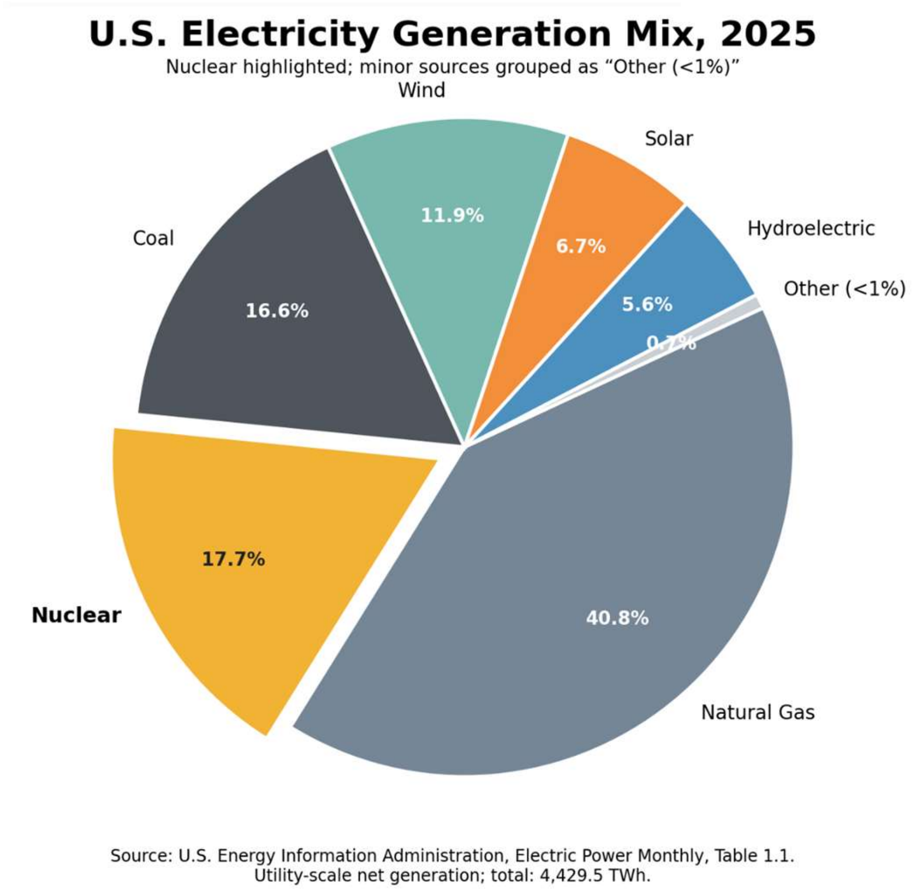
Operable nuclear power plants

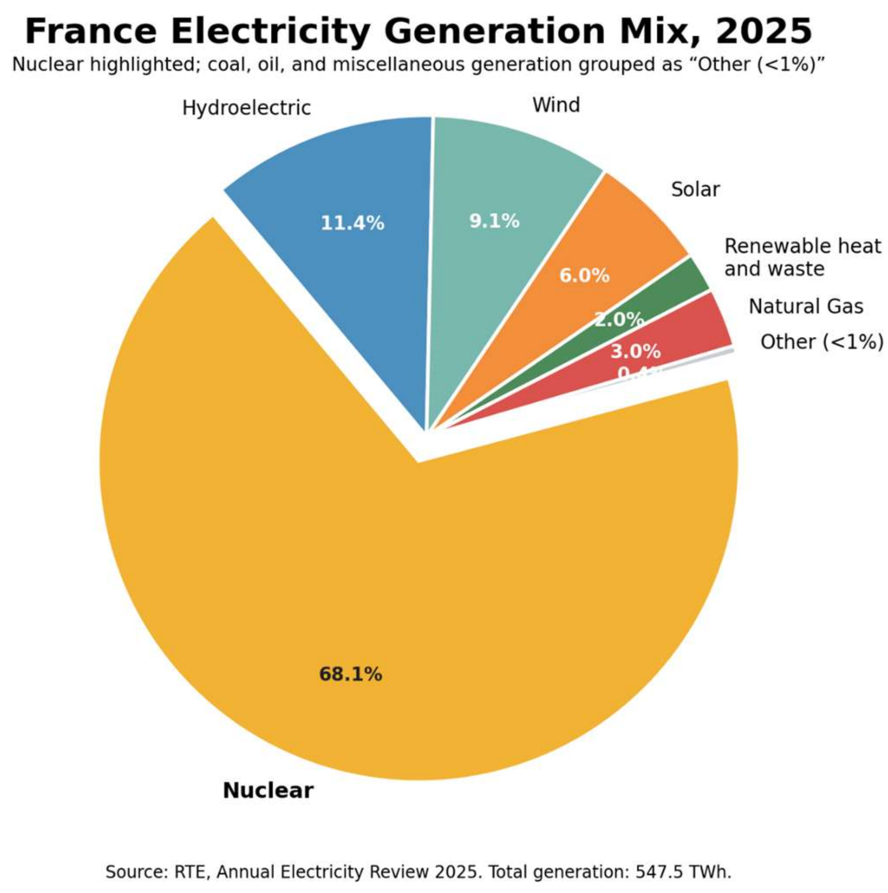
Reactor type	Main countries	Number	GWe	Fuel	Coolant	Moderator
Pressurized water reactor (PWR)	USA, France, Japan, Russia, China, South Korea	310	296.7	enriched UO_2	water	water
Boiling water reactor (BWR)	USA, Japan, Sweden	60	60.9	enriched UO_2	water	water
Pressurized heavy water reactor (PHWR)	Canada, India	48	25.0	natural UO_2	heavy water	heavy water
Light water graphite reactor (LWGR)	Russia	10	6.5	enriched UO_2	water	graphite
Advanced gas-cooled reactor (AGR)	UK	8	4.7	natural U (metal), enriched UO_2	CO_2	graphite
Fast neutron reactor (FNR)	Russia	2	1.4	PuO_2 and UO_2	liquid sodium	none
High temperature gas-cooled reactor (HTGR)	China	1	0.2	enriched UO_2	helium	graphite
TOTAL		**439**	**395.4**			

Electricity production and CO_2 emissions (kg CO_2e/kWh): a world comparison — 2025



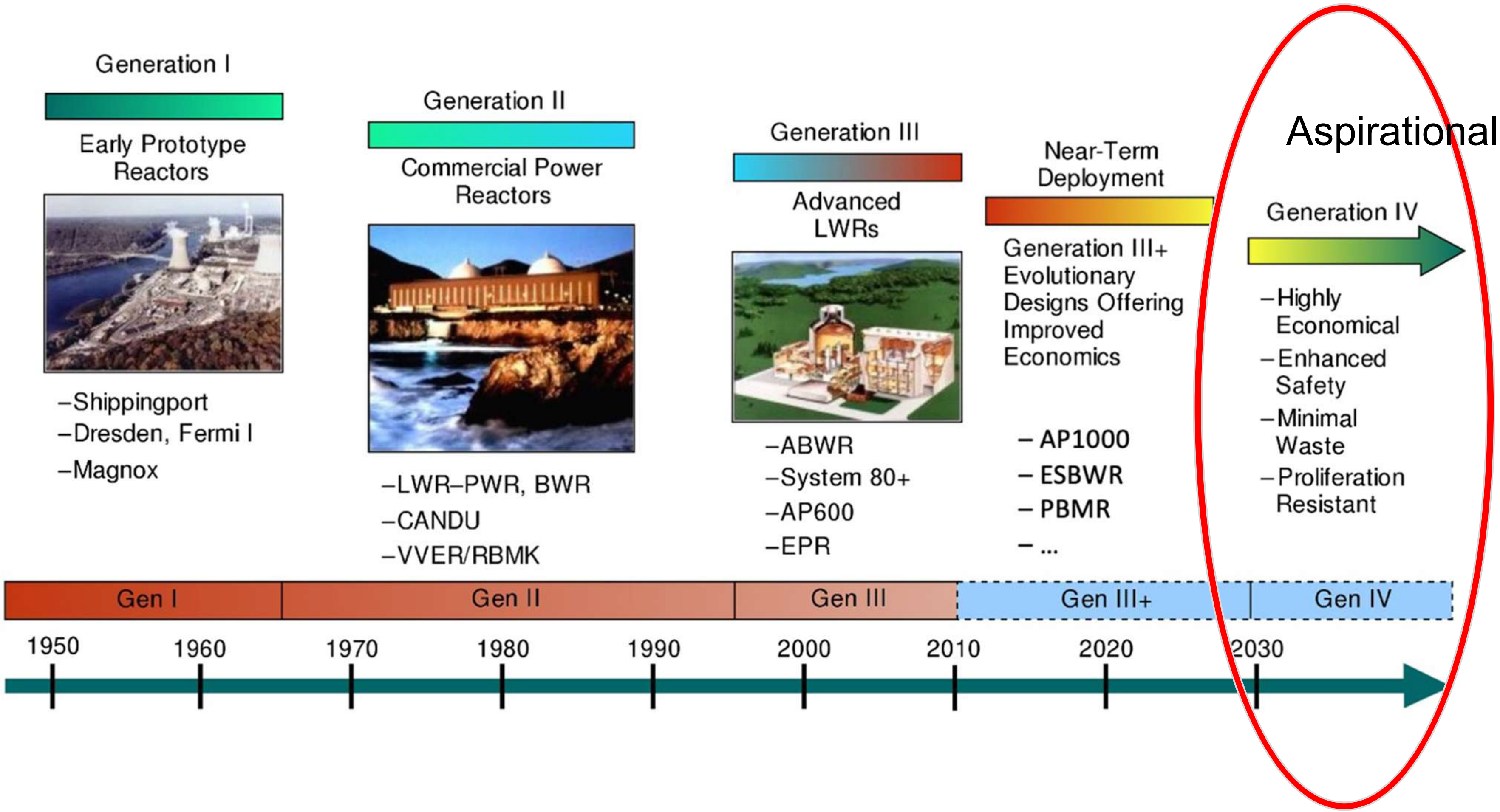
Note: Operational carbon intensity of electricity generation. Values are shown in kg CO_2e per kWh.
Source: Our World in Data energy dataset, based primarily on Ember Yearly Electricity Data.


U.S. Electricity Generation Mix, 2025
Nuclear highlighted; minor sources grouped as "Other (<1%)"
Wind
Solar
Coal
Hydroelectric
Other (<1%)
11.9%
6.7%
16.6%
5.6%
17.7%
Nuclear
40.8%
Natural Gas
Source: U.S. Energy Information Administration, Electric Power Monthly, Table 1.1.
Utility-scale net generation; total: 4,429.5 TWh.


France Electricity Generation Mix, 2025
Nuclear highlighted; coal, oil, and miscellaneous generation grouped as "Other (<1%)"
Hydroelectric
Wind
Solar
Renewable heat
and waste
Natural Gas
Other (<1%)
11.4%
9.1%
6.0%
3.0%
68.1%
Nuclear
Source: RTE, Annual Electricity Review 2025. Total generation: 547.5 TWh.

Generations of Nuclear Energy Systems chart

- This Nuclear Generation Chart is a bit outdated, but still relevant, proposed in 2000s
- Microreactors, SMRs, and advanced reactor concepts were not introduced back then



"Generation IV Nuclear Energy Systems: Program Overview" (Department of Energy, n.d.)

➢ **US nuclear capacity has the potential to triple from ~100 GW in 2024 to ~300 GW by 2050**

Advanced nuclear includes reactor types of all sizes across two generations

	Gen III+	Gen IV		
Coolant	Light water	Gas	Liquid metal	Molten salt
Examples	• Pressurized water reactor • Boiling water reactor	• High temperature gas reactor • Gas fast reactor	• Sodium fast reactor • Lead fast reactor	• Fluoride high temperature reactor • Molten chloride fast reactor
Typical fuel	LEU, LEU+	HALEU	HALEU	HALEU
Outlet temperature	~300°C	~750°C	~550°C	~750°C
Power output	Large, small	Small, micro	Small, micro	Small
Example reactor designers	• GE Hitachi • Holtec • NuScale • Westinghouse	• BWXT • General Atomics • Radiant • X-energy	• ARC • TerraPower • Oklo	• Kairos • Terrestrial

https://liftoff.energy.gov/advanced-nuclear/

U.S. DEPARTMENT OF ENERGY

SMR and Microreactor

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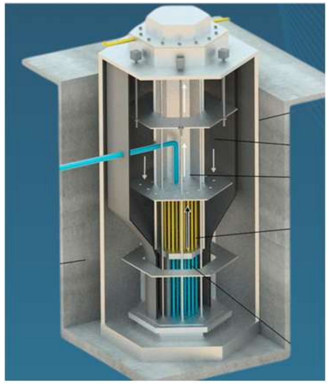
Advanced Reactor Types

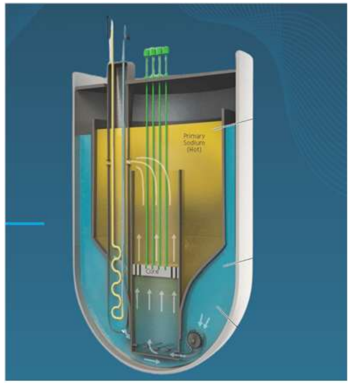
1.) Advanced Light Water Reactors

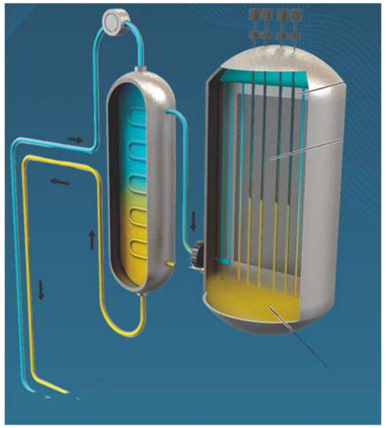
- Existing light-water reactor systems
- Use enhanced safety systems

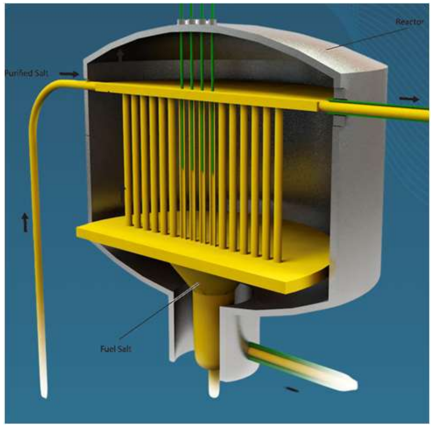


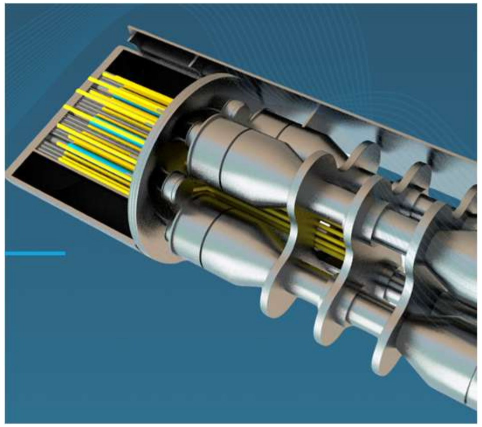
2.) Liquid Metal Fast Reactor

- Na or Pb
- High temperature
- Low pressure









3.) High-Temperature Gas Reactor

- (750 - 900 Celsius)
- TRISO fuel

4.) Molten-salt Reactor

- Atmospheric pressure
- On-line refueling

5.) Heat-pipe Reactor

- No pumps or moving parts

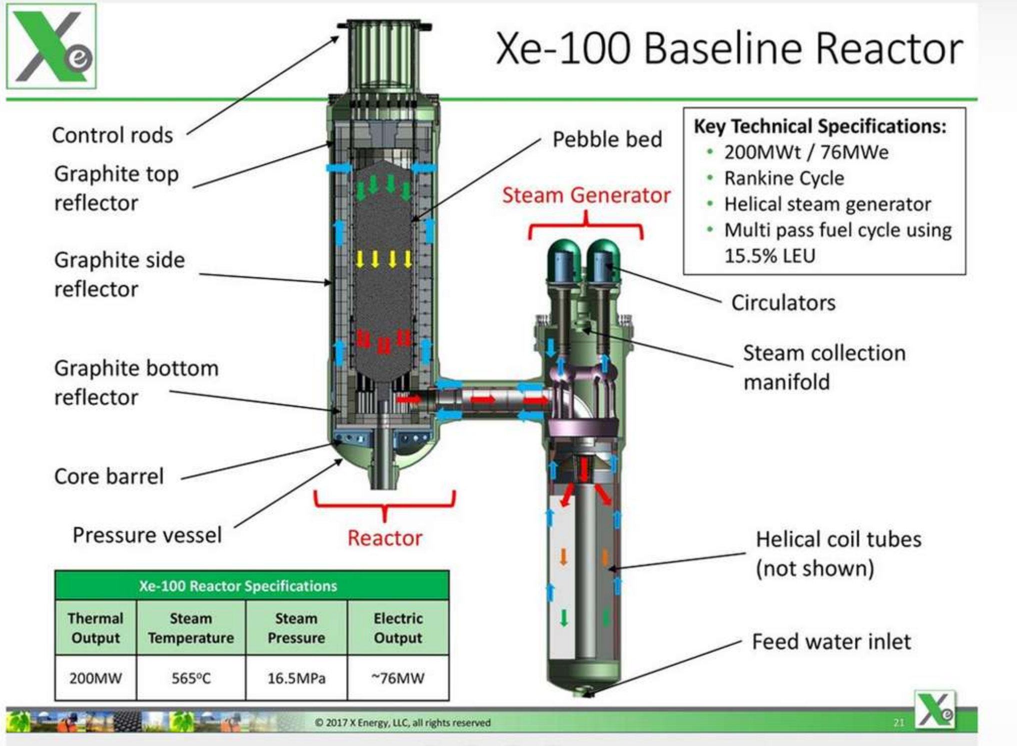
U.S. Department of Energy, Office of Nuclear Energy, educational use

X-energy's X-100

- In the U.S., X-energy is working on pebble-fueled Xe-100 design (80-MWe high-temperature, gas-cooled reactor) that can be scaled into a four-pack to make a 320-MWe power plant.
- Kairos Power also has a version of molten salt coolant (Flibe, contains fluorine, lithium, and beryllium), TRISO fuel-based reactor.

In the prismatic reactor, no flowing balls

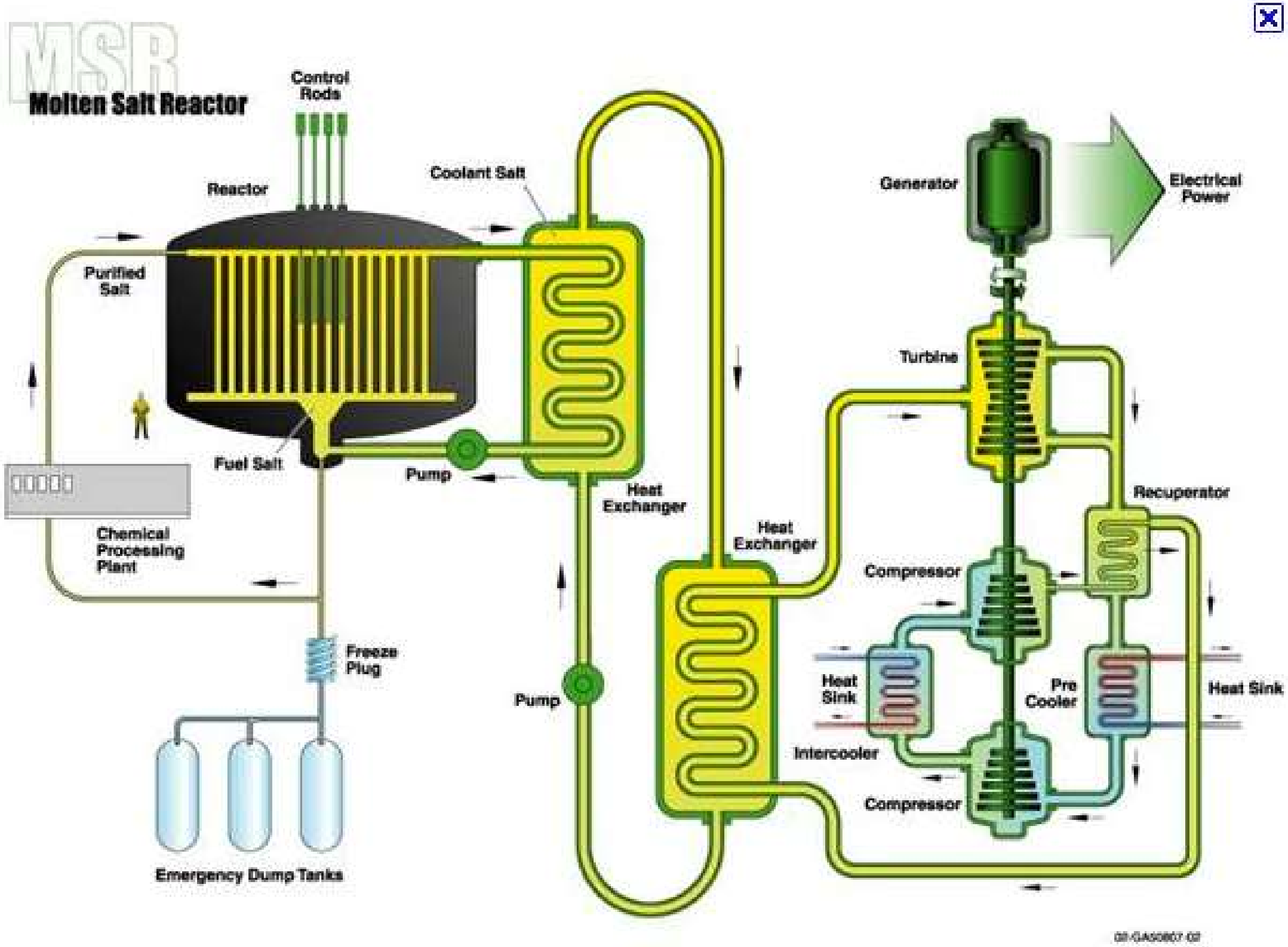
Thousands of hexagonal blocks are stacked and their TRISO fuel sticks replaced periodically.



Xe-100 Reactor Specifications			
Thermal Output	Steam Temperature	Steam Pressure	Electric Output
200MW	565°C	16.5MPa	~76MW

https://x-energy.com/

Molten Salt Reactor



Advantageous physical and chemical properties offered by molten salts:

- good heat transfer capacity
- radiation insensitivity
- high boiling point
- wide range solubility for actinides.

Such appealing properties make molten salts unique and attractive in several applications.

- ➢ It is a better core coolant for solid fuels than gas.
- ➢ It is a good solvent for fuel and actinide that enables the 'on-line' reprocessing of circulating liquid (molten salt) to remove typical reactor poisons like xenon, krypton, lanthanides etc.
- ➢ The high working temperature of salts is promising to offer a primary energy source for hydrogen production

- Abilene Christian University (ACU) is constructing a Molten Salt Research Reactor (MSRR) on its campus in Abilene, Texas
- 1 MWth
- Liquid fuel

Natura Resources

ARTICLE SEP. 17, 2024

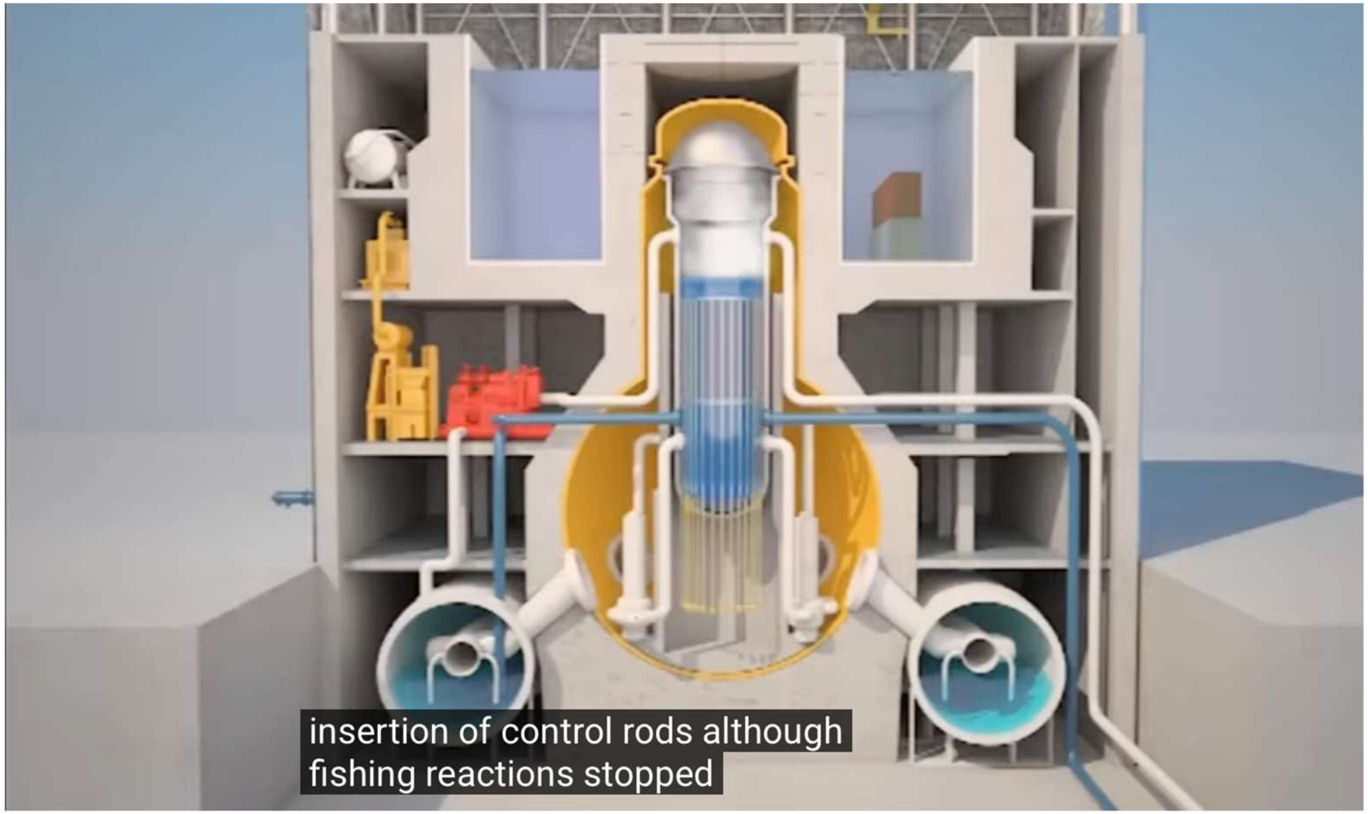
Natura Resources' Molten Salt Reactor at ACU Receives Historic NRC Construction Permit

https://www.naturaresources.com/natura-resources-molten-salt-reactor-at-acu-receives-historic-nrc-construction-permit

Molten Salt Reactor

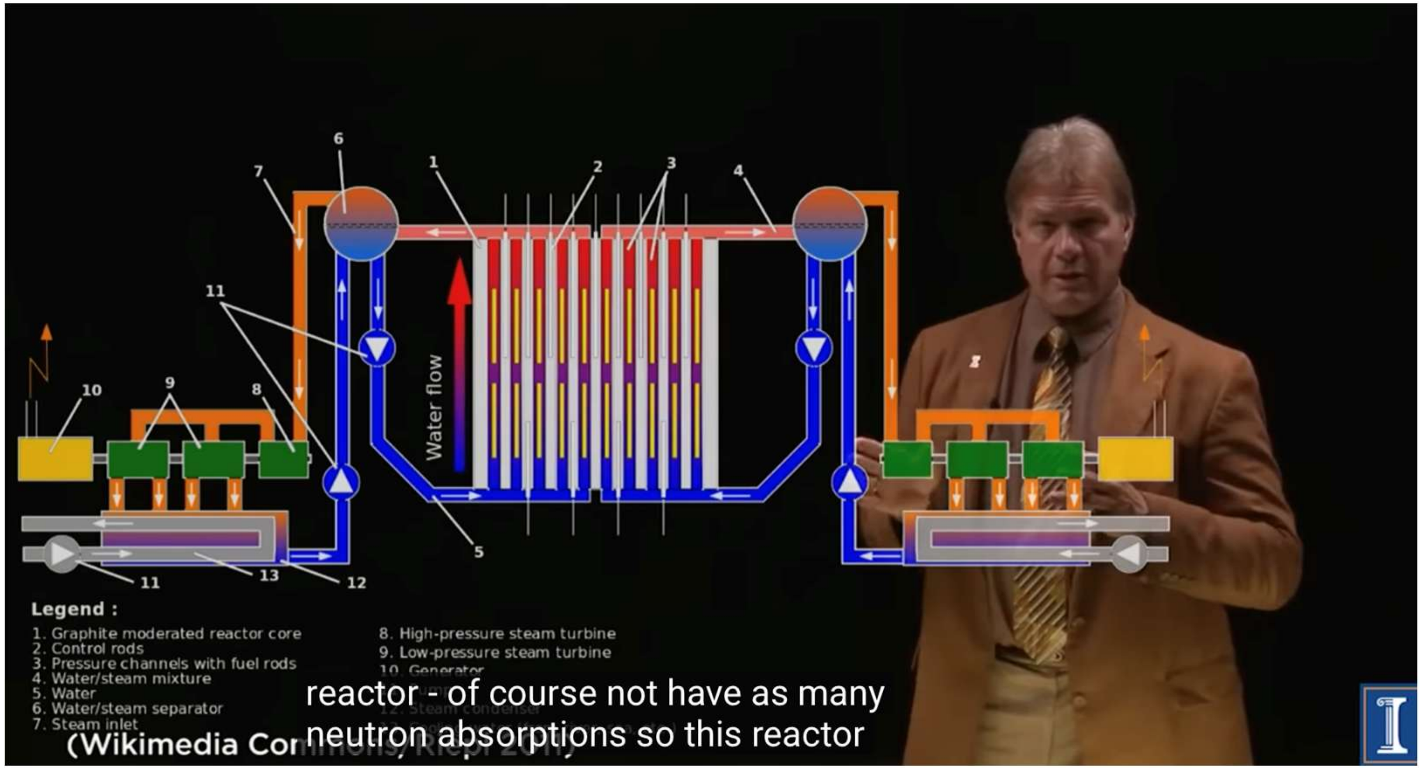
The MSR is not a new untested concept. As early as in the end of 1940s, it was proposed at Oak Ridge National Laboratory (ONRL), USA to use liquid fuel based on molten fluoride salts. The first small molten salt reactor was running by Aircraft Reactor Experiment (ARE) for approximately 100 h around 1955 at a thermal power of 2.5 MWth. Its primary fuel circuit was cooled by helium gas and the circulating fuel was comprised by NaF–ZrF_4–UF_4 mixture with molar composition of 53–41–6. The maximal operating temperature of circulating fuel was 882 °C. Ten years later the molten salt reactor experiment (MSRE) started [4] an 8 MWth reactor fuelled with new fuel salt composed only ^{7}LiF–BeF_2–UF_4. The moderator of the reactor was graphite. The structural material was nickel alloy INOR-8 (later called Hastelloy-N). The coolant of secondary circuit was LiF–BeF_2 eutectic. The power of MSRE was nearly 8 MWt and the working temperatures in the region of 600 °C. This reactor runs for four years without problems[5, 6].

An overview of nuclear accident in Fukushima Japan



https://www.youtube.com/watch?v=YBNFvZ6Vr2U

Chernobyl Visually Explained



https://www.youtube.com/watch?v=bCbms6umE_o

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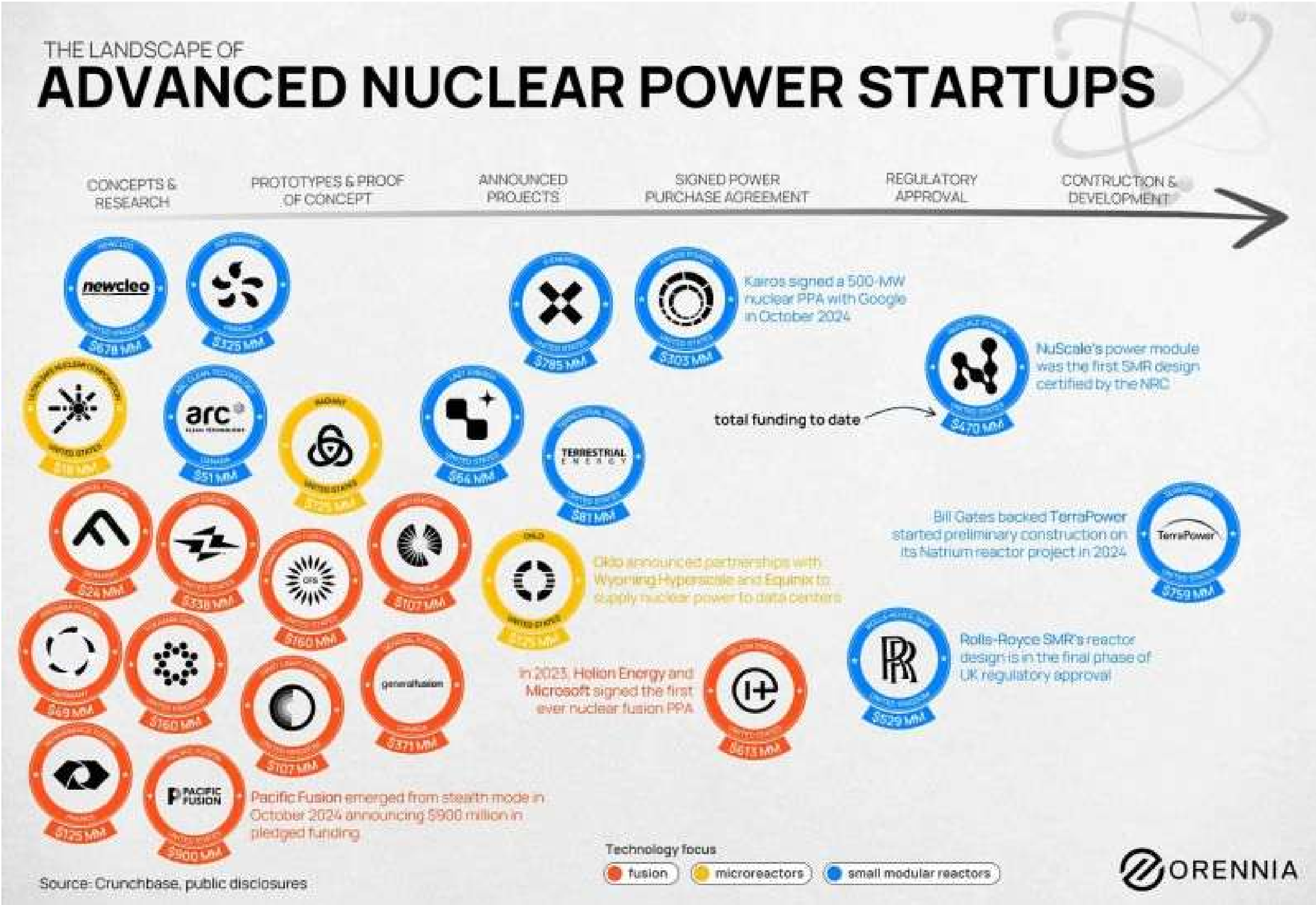
Summary

The Three Nuclear Eras

ERA	APPROXIMATE YEARS	CHARACTERISTICS
FIRST NUCLEAR ERA	1942–1990s	• Manhattan Project kicks off the nuclear age • Rapid reactor innovation and technology breakthroughs • Commercial nuclear build-out and industry optimism • Challenges emerge: Three Mile Island (1979), Chernobyl (1986) • Era ends with industry stagnation
INTERREGNUM ("NUCLEAR WINTER")	1990–2015	• Very few new reactor orders in the U.S. and Europe • Aging nuclear fleets • Low natural gas prices • Post-Chernobyl and post-Fukushima skepticism • Cancellation of many advanced reactor programs
SECOND NUCLEAR ERA	~2015–PRESENT	• Climate change drives clean energy solutions • Advanced reactors re-emerge • SMRs and microreactors are developed • Private investment and innovation accelerate due to AI and data center boom • Nuclear is increasingly viewed as part of clean energy and energy security

Take Away Message

- Industry, investor, government, academia are all on the same page, recognizing the rapid demands for electricity could not be met without a rapid deployment of nuclear energy.
- Advanced light water reactors (Gen III, Gen III+) need to be built NOW to meet the short-term rising electricity demands.
- AI infrastructure become the major driver for reactor deployment
- Opinions: the lack of opportunities for non-LWR to grow as much as LWR technologies doesn’t mean by default that they will be superior than LWR.
- Practical waste management technologies, fuel cycle, proliferation concerns



https://www.linkedin.com/posts/terrestrial-energy-inc_smr-advancednuclear-activity-7259953426606735360-LygD/?utm_source=share&utm_medium=member_ios