

Russia's War on Ukraine: The Nuclear Battlefield

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Waterville, Maine USA

- Ukraine as a center of physics research and development
- Ukraine as a major peaceful nuclear power – with WMD
- Russia's war on Ukraine, including its nuclear facilities

Ukraine: A birthplace of nuclear physics



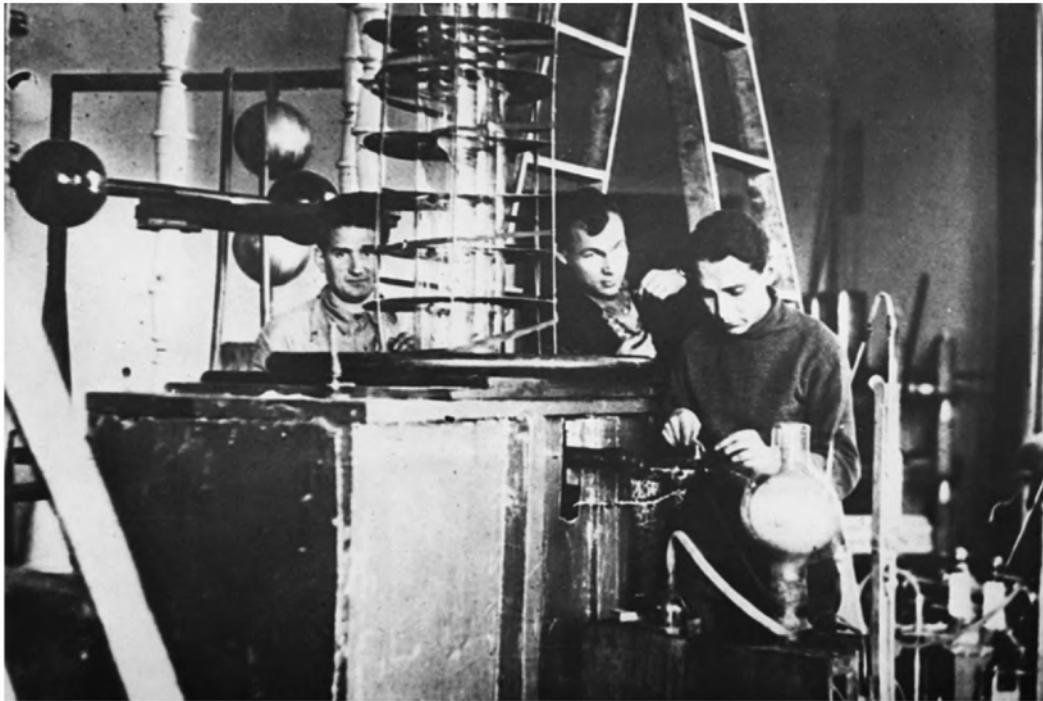
- Along with a number of European and American centers
- Ukrainian Physical Technical Institute (UFTI or KhFTI)
- Opens in Kharkiv in 1928-29
- Brilliance in theoretical physics, low temperature physics and nuclear physics
- Kirill Sinelnikov, Aleksander Leipunsky, Lev Shubnikov, and Lev Landau

Holodomir, Great Terror and WW II: The Institute Decimated

- The murderous famine: outside the institute on the streets
- The Purges: Shubnikov, Landau and Others
 - Xenophobia and Autarky (like today in ministry rules)
- Nazi Invasion: Destruction of Institute and Kharkiv
 - “De-Nazification” today??
 - Destruction of Kharkiv by Russia



UFTI as Laboratory no. 1 of the Soviet Atomic Bomb Project



СССР. Украинская ССР. Харьков. 1 января 1932 г. И. В. Курчатов, С. Н. Водолажский, Г. Я. Щепкин в лаборатории ускорителей Харьковского физико-технического института.

Фотохроника ТАСС



From Kharkiv to Obninsk: Breeder Reactors



(published only in 1990)

- From November 1949, the state launches fast-reactor development program. Leipunsky was designated as the program's scientific leader at the Institute of Physics and Power Engineering (IPPE) in Obninsk. It was the lead research institute.
- (Obninsk 1954: First civilian power reactor at 5,000 kw)

АЛЕКСАНДР ИЛЬИЧ ЛЕЙПУНСКИЙ

- В августе 1949 года Лейпунский перешёл в Физико-энергетический институт. В 1959 году Александр Ильич был назначен научным руководителем ФЭИ. Он пользовался исключительно высоким авторитетом.



К
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Ukrainian nuclear industry

- From moratorium on construction after Chernobyl...
...to rebirth in the 1990s.
- Yet Ukraine continues to rely on Russia for technology and fuel
- Ukraine is now seeking fuel elements from the EU and USA (e. g. Westinghouse)
- Chernobyl NPP has closed, but the zone will serve as a waste facility



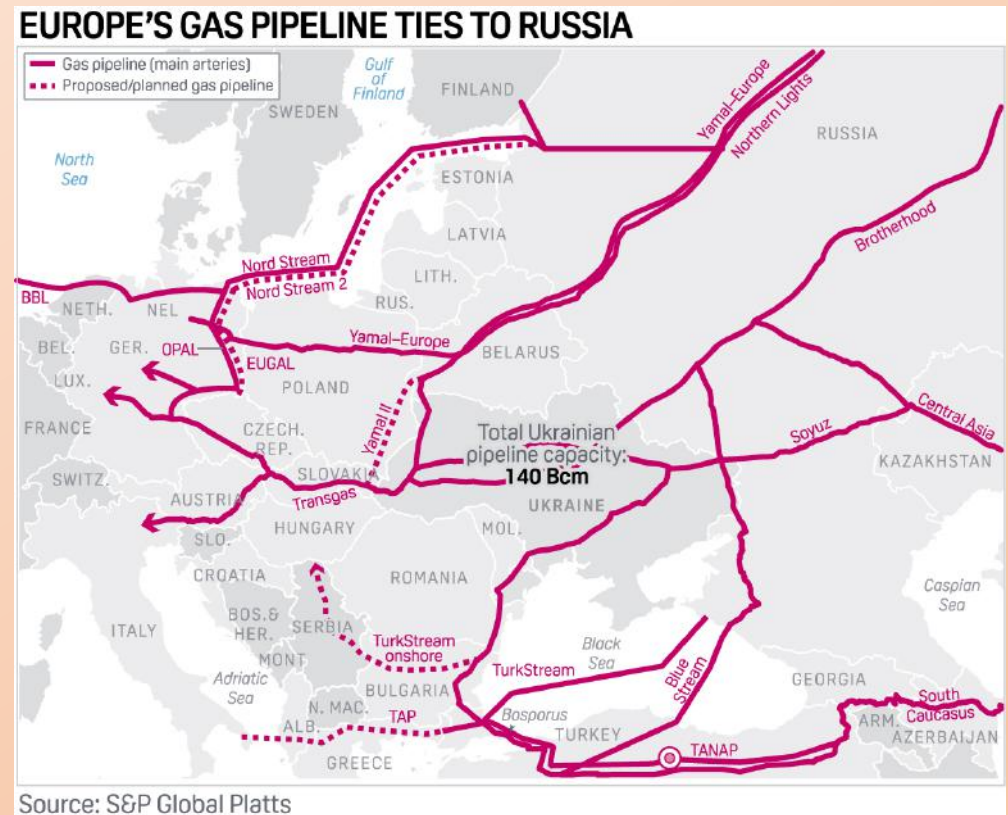
In Ukraine, 15 reactors at 5 stations

Ukraine has turned more to nuclear power; it produces fully half of its electrical energy from the atom, in third place in the world in total share behind France and Slovenia. Its fifteen reactors, all of them Soviet-designed PWRs (pressurized water reactors, VVERs in the Russian designation) produce almost 14 GW of electricity.



Nuclear power = Ukrainian energy independence?

- For Ukraine, atomic energy was the path to create energy independence from Russian gas.
- Much of the natural gas imported from Europe, however, originates in Russia and travels into Ukraine through reverse flows from central and eastern European countries.



Great pride in Ukraine's nuclear company towns: Neteshin: Khmelnytska NPP



Ukrainian nuclear imagery: pastoral visions, Orthodoxy and nation, children playing

Zaporizhia Nuclear Station

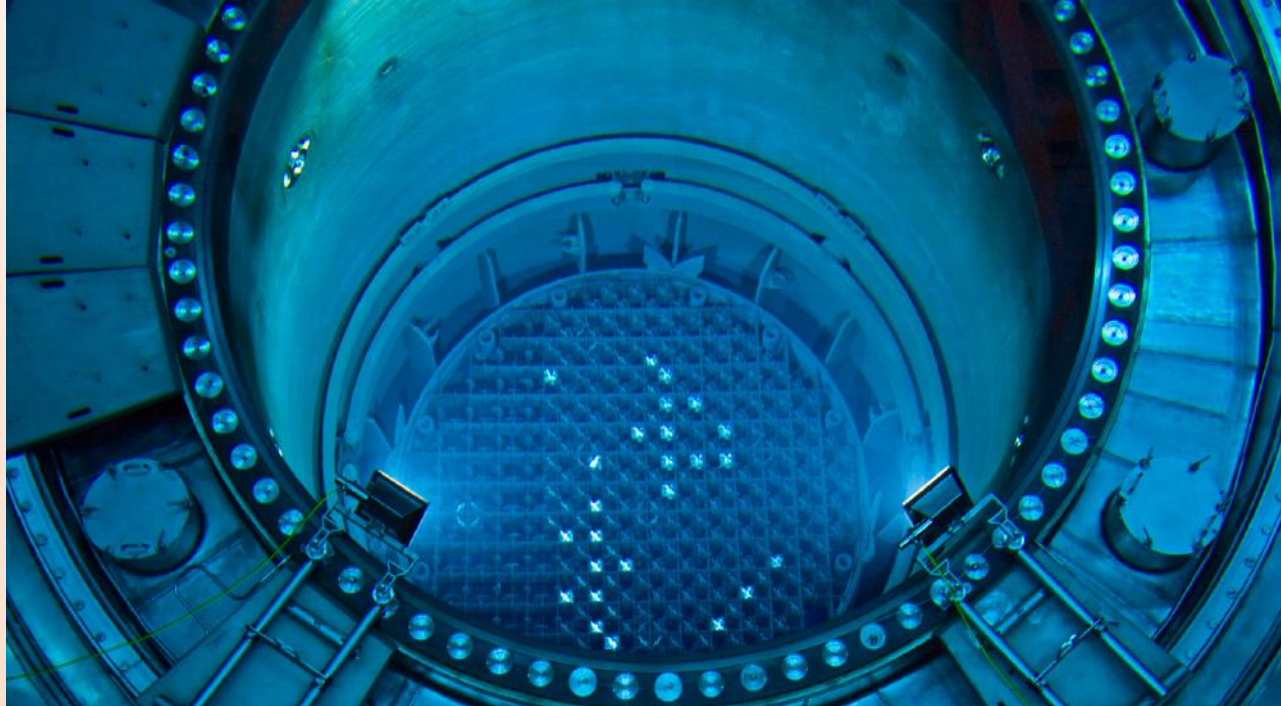


Source: T. Kasperski, "Children, Nation and Reactors: Imagining and Promoting Nuclear Power in Contemporary Ukraine," *Centaurus*, vol. 61, n°1, 2019, pp. 51–69,

Children's Art Contests



Independence in Fuel Supply?



- Ukraine has worked to modernize the industry, extend the life of existing stations, and achieve fuel cycle independence.
- Unfortunately, Ukraine's energy dependence on Russia extends to the nuclear sector on whom it relies for nuclear fuel and spent fuel storage.
- Hence Ukraine has turned to the EU and western corporations to supply fuel and technology, angering Putin and the Russian nuclear industry powerhouse, Rosatom

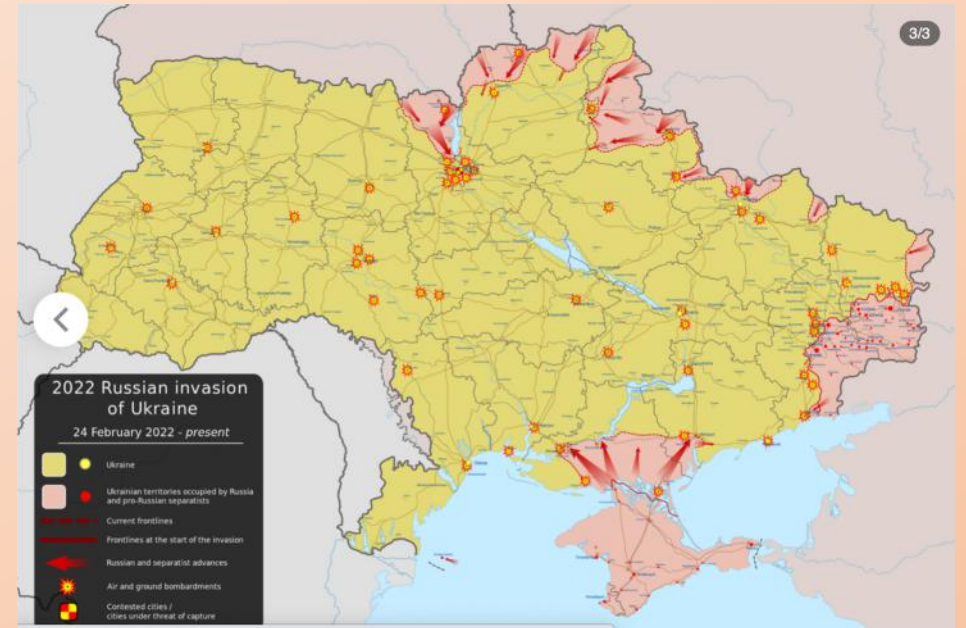
Nuclear Danger: The War with Russia (slide dates to November 2020)

- Ukraine gets technologies, fuel, and waste handling from Russia
- Yet remember only 230 km from Zaporozhe to Lugansk and the Russian supported separatists



February 24th, Russia Attacks Ukraine

- Targeting cities, women and children
- Targeting sanctuaries
- Targeting hospitals
- Remember: With help of Russian-supplied BUK surface-to-air missiles, pro-Russian separatists shot down Malaysia Airlines Flight MH17 from Amsterdam to Kuala Lumpur, on July 17, 2014, over Ukraine.



Attack on Kharkiv and UFTI

- **Russian launched air strikes on the country's second city, Kharkiv, March 2 (?).**
- At least 10 people were killed and 35 hurt when an opera house, a concert hall and government offices were struck in Kharkiv's Freedom Square on Tuesday.
- Ukraine's military said Russian troops had parachuted into Kharkiv in an effort to capture the besieged city.



Attack on Kharkiv and UFTI: Is this WW II?



NB: in the last 24 hours Russia bombed Kharkiv, a city of 1.5 million people, with over 200 missiles (March 27-28, 2022).

The Nazis destroyed the city in 1943.

The Russian “de-Nazifiers” kill men, women and children again in 2022.

At least 500 buildings – including hospitals and schools – have been demolished.

UFTI the leading center of nuclear research in Ukraine



The Russian destruction of the UFTI, including already a neutron generator, is an obvious effort to handicap future Ukrainian research – and could lead to the release radiation in a city of 1.5 million inhabitants.

Attack of the Chernobyl Exclusion Zone



- Russian troops entered the Chernobyl exclusion zone on February 24th, their vehicles raising dust and causing spikes in radioactivity.
- Chernobyl is the site of the entombed unit 4 that was destroyed in an explosion, three other reactors in the stage of decommissioning, spent nuclear fuel and other low- and high-level waste.

- As Timothy Mousseau noted in a recent [Conversation](#) the Russians likely chose to attack Chernobyl as a “large, unpopulated area connected by a paved highway straight to the Ukrainian capital...The Chernobyl zone abuts Belarus and is thus immune from attack from Ukrainian forces from the north.” It is unlikely that Ukraine would try to retake the site because of its massive amounts of nuclear material that might be released in battle.

Russia Attacks Chornobyl



Россияне «разбудили» Чернобыль: кто сейчас ответственен за безопасность ЧАЭС

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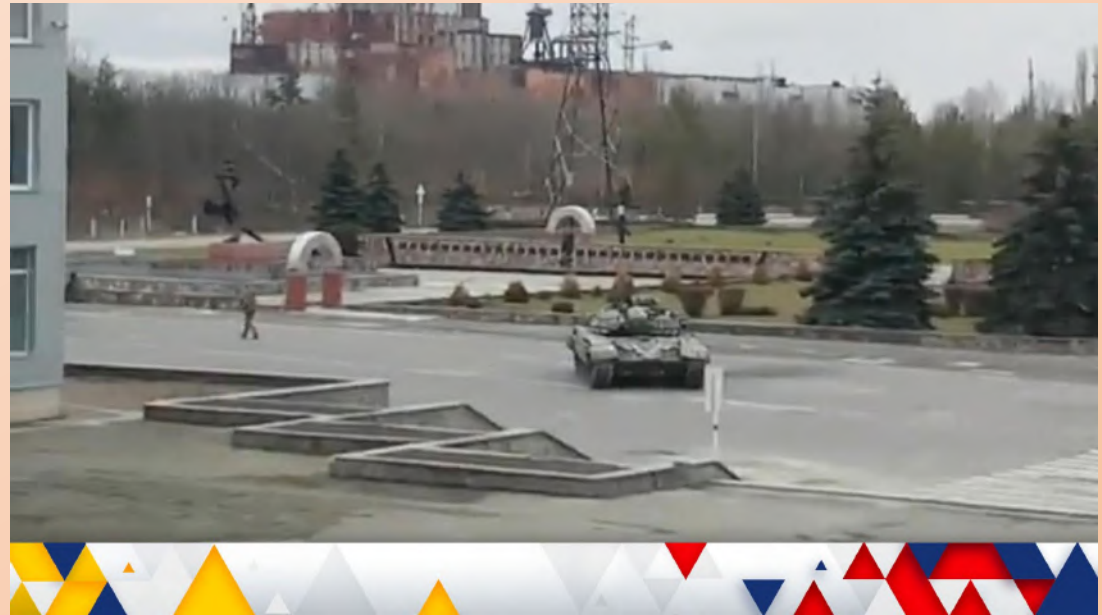
24 февраля российские войска захватили Чернобыльскую АЭС. После этого в зоне отчуждения был зафиксирован рост мощности дозы гамма-излучения. Так, некоторые датчики на площадке станции показали рост более чем в 30 раз. Высокие показатели держались и на вечер 25-го.

↑ Nuclear specialist Andrei Ozharovsky

Since the attack, the Russians have not permitted any workers to change their shifts. [Observers worry](#) whether the Russian military conquerors knew the radiation legacy of the Chornobyl site, if any nuclear and radiation safety specialists are among their personnel, and what the Russian government and its state nuclear monopoly, Rosatom, have to say on the matter, considering Russia is now responsible for its safety.

Chornobyl Under Assault

- Ukrainian soldiers have trained for some kind of military attack; the attack came unexpectedly from Russians

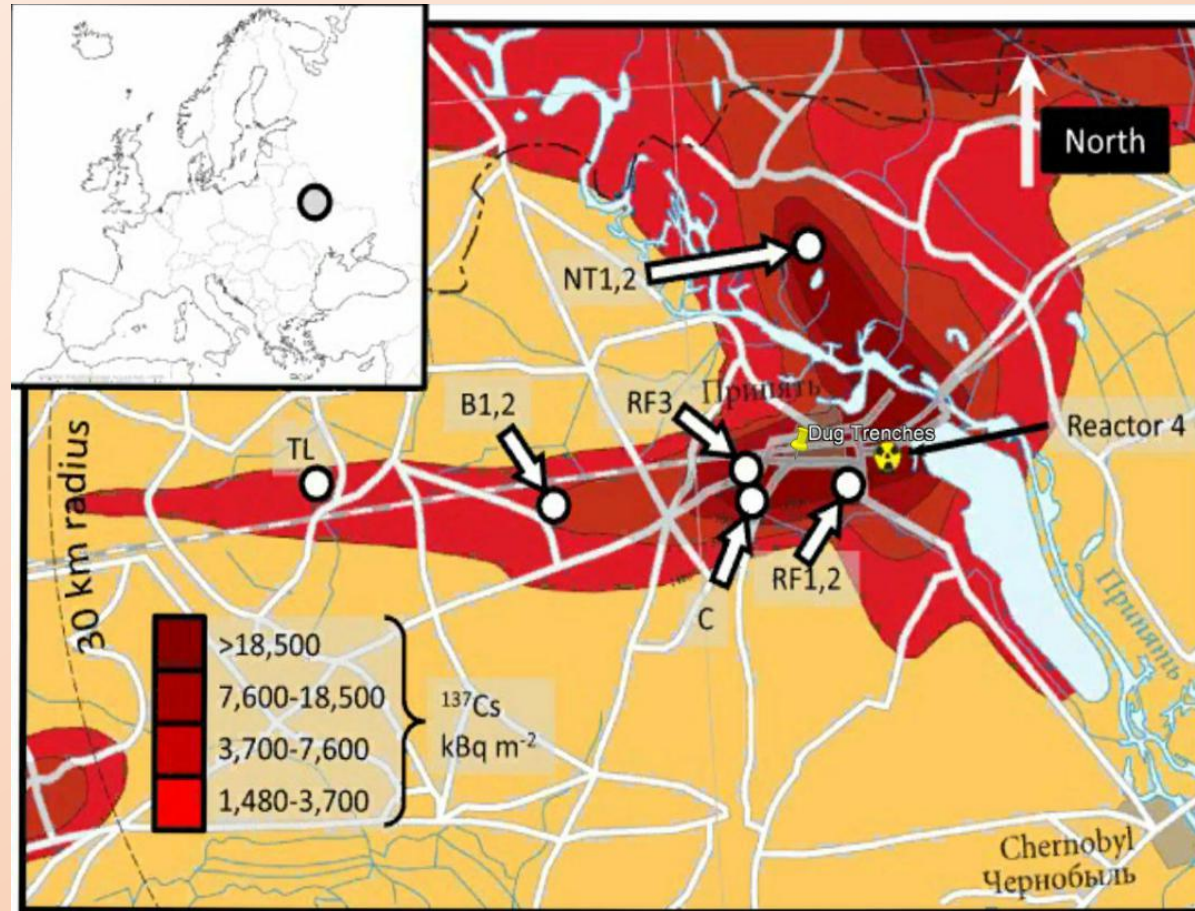


Dust, debris and fires → radionuclides on the march

Some 24,700 acres of the Chernobyl Exclusion Zone were on fire on Sunday. Commissioner for Human Rights of the Verkhovna Rada of Ukraine Lyudmyla Denisova said that these fires could potentially spread radionuclides to Belarus and the rest of Europe, spreading the radiation.



The movement of Russian troops in the Exclusion Zone: Digging foxholes in radiation



Other nuclear facilities targeted



- Russian military planners have targeted other nuclear facilities including waste dumps and power stations. [They hit a radioactive-waste burial facility](#) in Kyiv with a missile.

Russia Took Military Possession of the Zaporizhzhya NPP

- After several days of battle in which unarmed residents and Ukraine's national guard fought off superior forces, Russian columns moved into the Zaporizhzhya NPP in Enerhodar, with six 1,000 MW reactors the largest station in Europe, and with a spent nuclear fuel storage.



Can Nuclear Power Facilities Be Made Safe From Attack?

Why would Russia target them?

- Interfering with safe operation and damaging buildings and power lines on site, Russia risks a nuclear disaster greater than Chernobyl. Military activities have also been observed near the Southern Ukraine NPP.



Playing with nuclear fire.

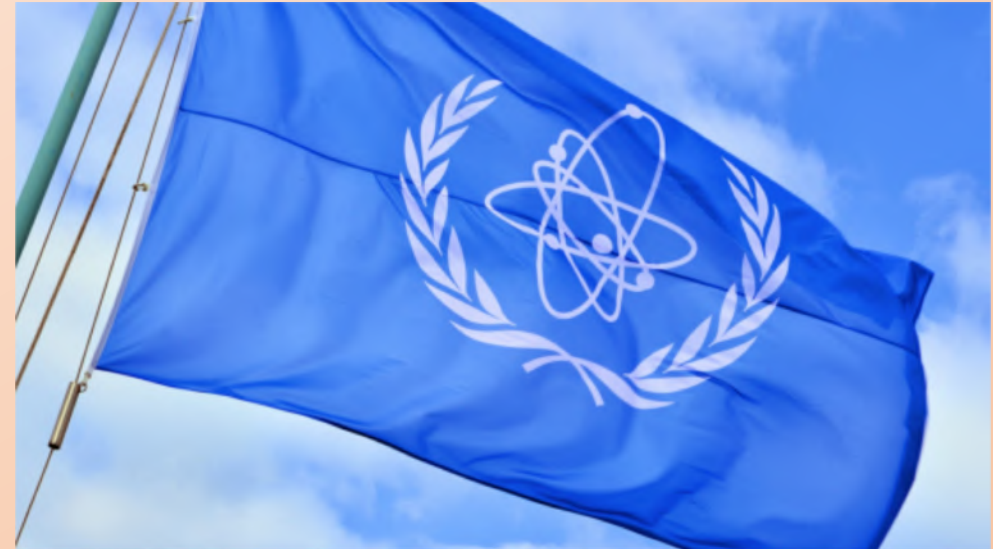


Shooting innocent civilians (physicists, too)



- The attacks on nuclear facilities notwithstanding, the International Atomic Energy Agency (IAEA) has been hesitant to call out one of its own members, Russia. [The IAEA director](#), has repeatedly urged that any military or other action that threatens the safety or security of NPPs stop immediately. He has called on Russia to permit stations workers to do their jobs. Yet Russia acts with impunity from Chornobyl to Kharkiv, and from Kyiv to Zaporzhzhya. At least the [European Nuclear Safety Regulators Group](#) directly condemned Russia's "unprovoked and unjustified" military aggression. [The Ukrainian government](#) did not hesitate to call Russian attacks "nuclear terrorism."

Rosatom participates in nuclear terrorism



The Russian Nuclear Enterprise as a Tool of Foreign Policy

- Reliance on pressurized water reactors (PWRs), but still 11 RBMKs operating
- Plans to increase share of electricity from 18% to 50% by 2050
- Importance of big technology to the Russian state
- limits on public opposition



Russia's nuclear imperialism

- Roopur, Bangladesh 2 @ VVER 1,200
- Belarus 2 @ VVER 1,200
- Egypt 4 @ 1,200
- India, up to 6 @ 1,200 at Kundankulam
- Turkey (Akkuyu) 4 @ VVER 1,200
- Hungary 2 @ 1,200 to supplement 4 @ 440 VVER
- China, Construction of Tianwan NPP → 4 units operating, 4 under construction

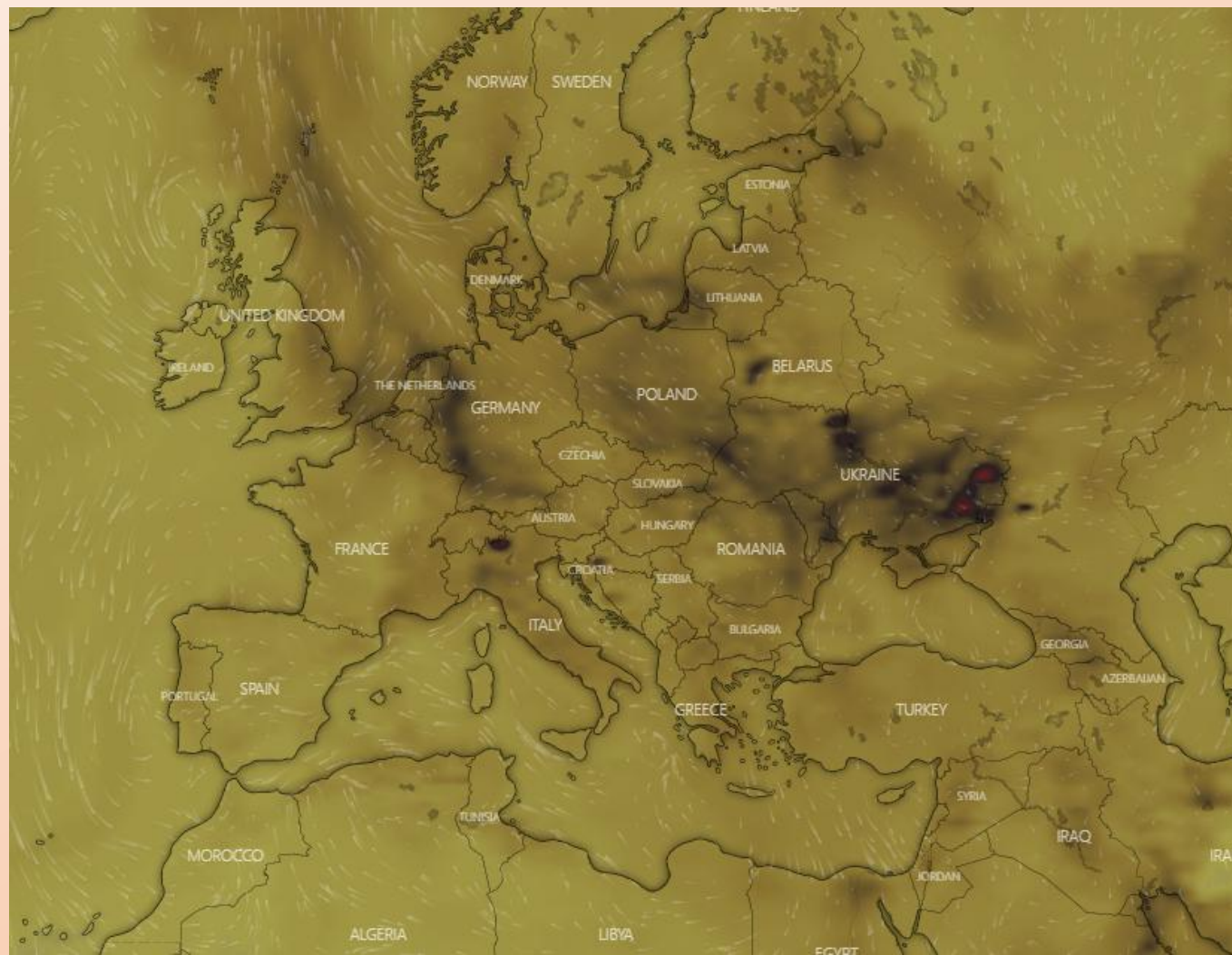


Finland: Hanhikivi NPP



- Construction from 2021, operation in 2028? Halted.
- Finland last week decided to halt the Fennovoima nuclear plant at Hanhikivi in northern Finland (with Russian PWRs).
- Europe's first nuclear power plant to open in 15 years, the much-delayed Olkiluoto 3 nuclear reactor (of French make), just started test production.

Satellites Record the Conflagration of Ukraine By the Russian Aggressors



Putin and Russia Threaten Nuclear Retaliation



How Should the U.S. Respond to Putin's Nuclear Provocation?

Putin's order to raise Russia's nuclear-alert status is aimed as much at a domestic audience as it is at the West.

By Tom Nichols

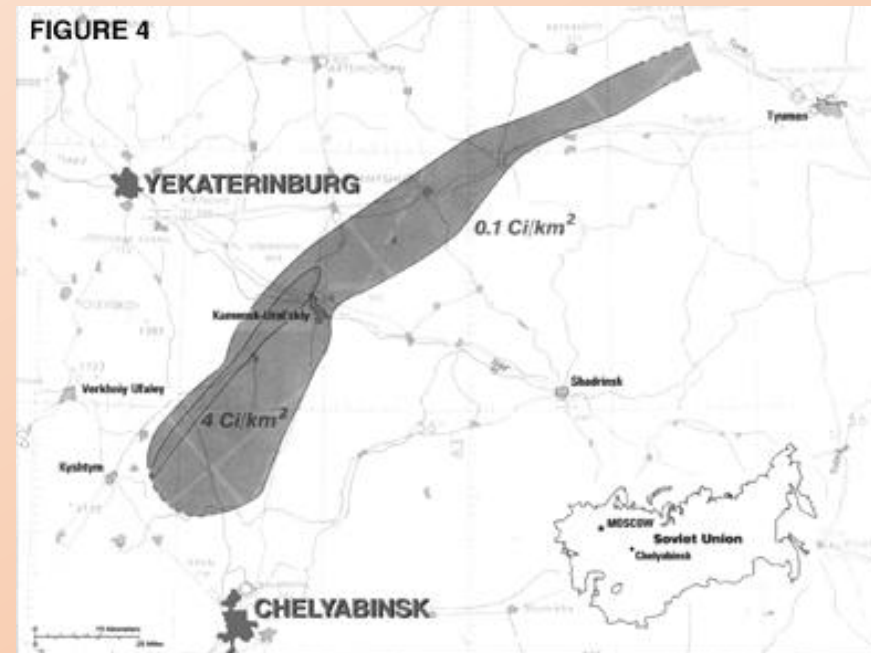
Putin pushed changes in nuclear doctrine that reaffirm Russia could use nuclear weapons in response to aggression involving conventional weapons that “threatens the very existence of the state.” As Russia attacked Ukraine [Putin put Russia's nuclear forces on high alert.](#)



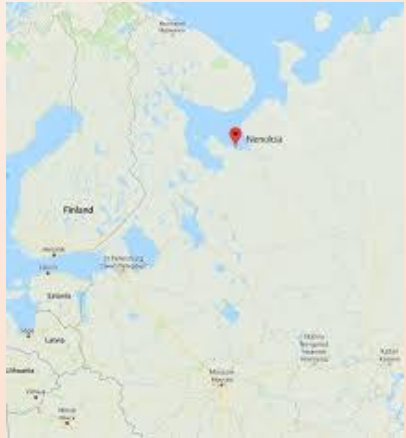
Past Soviet disasters: Russia knows precisely not to attack nuclear facilities

- Kyshtym (September 1957)
 - Explosion of plutonium waste dump
 - Waste initially dumped into lakes and rivers without treatment
 - Tank explosion pollutes 52,000 km² (20,000 mi²) affecting 270,000 people
 - 10,000 people evacuated, years later others evacuated.
 - Suffering to this day
- Chornobyl (April 1986)
- Kursk Submarine
- Many others

Kyshtym



White Sea Nuclear Weapons Accident (August 2019)



A Chernobyl-like accident occurred on August 8, 2019, at the State Central Navy Testing Range in Nenoksa on the White Sea shoreline but 45 kilometers from Severodvinsk (pop. 200,000) and 70 km from Arkhangelsk (pop. 350,000) when the “isotope power source” for a liquid-fueled rocket engine exploded, although there is disagreement over the exact event and its cause.



Leadership: Volodymyr Zelenskyy versus Ted Cruz



"Росатом" установит в Москве две фигуры Берию с вандалостойкими туловищами



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NEWS

Vladimir Putin's Black Belt Revoked by International Taekwondo Organization

BY **NICK MORDOWANEC** ON 2/28/22 AT 12:50 PM EST

Russian Soldiers Leave Chernobyl ... Glowing

Russian Blunders in Chernobyl: ‘They Came and Did Whatever They Wanted’

Tank treads ripped up the toxic soil, bulldozers carved trenches and bunkers, and soldiers spent a month camped in — and dug into — a radioactive forest.

← Tweet

Back

Lesia Vasylenko 
@lesiavasylenko

 troops stationed in [#Chernobyl](#) will likely die by the end of the year. They dug trenches in contaminated woods and ate out of plates left in contaminated houses. Russian command should be tried for crimes against their own soldiers.

4:09 PM · Apr 13, 2022 · Twitter for iPhone

1,497 Retweets 56 Quote Tweets 8,710 Likes



A crushed car and other debris littered a main intersection in the town of Chernobyl, where Russian forces established a staging ground for the assault on Kyiv.

Macron, “This is not how I imagined the grand return of nuclear power.”



“Dr. Strangelove” is here...



- Putin has abandoned interest in following existing international non-proliferation and nuclear safety regimes and ignores any call for circumspection, instead risking world-wide disaster with attacks on NPPs in the center of Europe.
- I agree with the call to boycott Rosatom worldwide.

