The alley of lost towns. Chornobyl, October 2025.

PHOTO: MARIANA BUDJERJYN

ATOMS FOR PEACE AND ATOMS FOR WAR IN UKRAINE'S NUCLEAR HISTORY

by **Mariana Budjeryn**

abstract

Forty years after the Chornobyl disaster, the essay reflects on the impact of peaceful and weaponized nuclear energy in Ukraine's history. One of the leading nuclear energy operators in the world, Ukraine suffered the worst nuclear accident in history, which had wide-ranging geopolitical consequences. One of them was to influence Ukraine's decision to surrender the nuclear weapons inherited from the USSR, a decision that ultimately exposed Ukraine to Russian predation. After its full-scale invasion of Ukraine in 2022, Moscow proceeded to create and manipulate unprecedented nuclear dangers for Ukraine's civilian nuclear infrastructure, blurring – as it once did in Chornobyl – the distinction between atoms for peace and atoms for war.

KEYWORDS: Chornobyl, nuclear, ZNPP, Ukraine, Russia.

Since the advent of nuclear energy, atoms for war and atoms for peace have been inexorably linked. The horrific debut of nuclear energy on the international stage in August 1945 was in the form of bombs dropped by the United States on Japanese cities of Hiroshima and Nagasaki, ostensibly to end a deadly war and usher in peace. The same technologies that forged fuel for the bombs, later produced nuclear material for peaceful uses in medicine, agriculture, and, most prominently, in generating electricity to power economic growth and development. Yet the fission reaction inside the reactor core must be kept under careful control, lest it should run away with disastrous consequences, as it did at the Chornobyl Nuclear Power Plant in Ukraine 40 years ago.

Since 1945, nine countries managed to develop and keep nuclear weapon arsenals, on which they rely for their national security. Some 32 countries currently operate nuclear power plants, with 440 nuclear reactors producing nearly 400 gigawatts of electricity annually, about a tenth of the world's total electricity.[1] But all nations live in a world shaped by the nuclear predicament, the power constellations underwritten by nuclear weapons, and the promise – and peril – of energy generated by nuclear reactors.

I.

Of all nations of the world, few have been marked by the atom to the same extent as Ukraine. Throughout the 1970s, Ukraine, then a constitutive republic of the Soviet Union, became the site of ambitious nuclear buildup. The first nuclear reactor came online in September 1977 at the Chornobyl Nuclear Power Plant just 130 km north of capital Kyiv. It would be followed by the construction of another 14 nuclear reactors across five plants, with many more planned. If Soviet plans came to full fruition, Ukraine would have become home to at least 13 nuclear power plants operating a total of 49 nuclear reactors to generate some 50 gigawatts of electricity.

Yet Soviet nuclear ambitions in Ukraine would never be fully realized. On Saturday, April 26, 1986, at 1:23am, during a planned safety system test, the core of an RBMK reactor of Unit 4 at Chornobyl experienced a critical power excursion. Within seconds, nominal energy output of the reactor core surged by a

factor of more than 100, followed by a steam and then hydrogen explosions that tore through the roof of the reactor building. The resulting fires raged for ten days, spewing radioactive plumes from the molten nuclear fuel and the burning graphite moderator rods, high into the atmosphere, spreading over much of the northern Europe.

The human and environmental toll of the Chornobyl accident was unprecedented. Some 100 radioactive isotopes were released into the environment as a result, most damaging of which were iodine-131, strontium-90, ceasium-137, and plutonium-239, -240, and -241. With precipitation, Chornobyl isotopes were deposited as far afield as Austria and Ireland. In Ukraine, Belarus, and parts of Russia, over 125 thousand square kilometers, a third of that – arable lands, were contaminated by radioactive fallout.[2] Some 400,000 people were eventually evacuated and resettled from the worst affected areas.[3] In Ukraine alone, nearly 200 towns and villages disappeared as a result of Chornobyl.

II.

The causes of the accident were attributed to a series of operator errors and a faulty reactor design that lacked a containment structure that would have prevented the release of radioactivity in the atmosphere. But fundamentally, the Chornobyl disaster was a product of a dysfunctional system of industrial management, built on fear and lies, in an ailing Soviet empire.[4] Too big to cover up, the accident exposed the Soviet population not only to ionized radiation but to damning truths about the rot inside the Soviet system that took no account of human life and wellbeing. Throughout the late 1980s, "anti-nuclear" sentiment became synonymous with "anti-Soviet" and was coopted by the pro-independence movements in Lithuania, Ukraine, and Belarus.[5] Soviet leader Mikhail Gorbachev recognized that the Chornobyl disaster significantly contributed to the Soviet collapse.[6]

The societal and political impact of Chornobyl was evident in Ukraine's decision to declare its intention to become a nuclear-free state in the Declaration of State Sovereignty adopted by the first freely elected Ukrainian parliament, the Verkhovna Rada, on July 16, 1990.[7] Shortly after, the Rada voted for a moratorium on all new nuclear build in Ukraine, essentially mothballing three nuclear reactors under construction one each at Rivne, Khmelnytsky, and Zaporizhzhia nuclear power plants.[8]

Ukraine's unilateral nuclear renunciation anchored nuclear debates when the Soviet Union disintegrated in the fall of 1991. The fate of the enormous nuclear arsenal, the world's third largest, left behind by the Soviet collapse became the dominant foreign policy preoccupation of the newly independent Ukraine. While Ukraine negotiated to obtain financial compensation and security guarantees in exchange for denuclearization, it never wavered from its declared commitment to rid itself of nuclear weapons.[9] In December 1994, Ukraine joined the Nuclear Nonproliferation Treaty (NPT) as a non-nuclear-weapon state after signing in Budapest, Hungary, a Memorandum on security assurances to Ukraine in connection with its decision to disarm with the United States, United Kingdom, and Russia, which alone inherited the USSR's nuclear status.[10]

Figure 1. **Nuclear reactors in Ukraine**

	Connected to the grid	Design lifespan, 30y/Life extension/ **Decommissioned**/ **Meltdown**	Reactor type
Chornobyl NPP			
ChNPP-1	1977	2007/**1996**	RBMK
ChNPP-2	1978	2008/**1991**	RBMK
ChNPP-3	1981	2011/**2000**	RBMK
ChNPP-4	1983	2013/**1986**	RBMK
Rivne NPP			
RNPP-1	1980	2010/*2030*	VVER-440
RNPP-2	1981	2011/*2031*	VVER-440
RNPP-3	1986	2016/*2036*	VVER-1000
RNPP-4	2004	2034	VVER-1000
Khmelnytsky NPP			
KhNPP-1	1987	2017/*2028*	VVER-1000
KhNPP-2	2004	2034	VVER-1000
South Ukrainian NPP			
SUNPP-1	1982	2012/*2033*	VVER-1000
SUNPP-2	1985	2015/*2035*	VVER-1000
SUNPP-3	1990	2020/*2030*	VVER-1000
Zaporizhzhia NPP			
ZNPP-1	1984	2014/*2024*	VVER-1000
ZNPP-2	1985	2015/*2025*	VVER-1000
ZNPP-3	1986	2016/*2026*	VVER-1000
ZNPP-4	1987	2017/*2027*	VVER-1000
ZNPP-5	1989	2018/*2028*	VVER-1000
ZNPP-6	1995	2025	VVER-1000

III.

Ukraine's nuclear renunciation was hailed as a contribution to international peace and security. The country moved on to focus on nation- and institution-building and economic development. By 1995, in fulfillment of its obligations under the NPT, Ukraine put all its civilian nuclear facilities under comprehensive safeguards of the International Atomic Energy Agency (IAEA).[11] The three remaining RBMK-type reactors at Chornobyl, deemed unsafe, were gradually decommissioned, the last one in 2000. In 2016, Chornobyl's damaged reactor 4 and its "sarcophagus," hastily constructed after the 1986 disaster, were covered by a New Safe Confinement, a marvelous feat of engineering and international collaboration, costing nearly $2 billion and built to serve for 100 years and allow the cleanup of some 170 tons of nuclear material still buried under the reactor rubble.

MEANWHILE, IN 1995, the moratorium on reactor construction was lifted, a function of realistic reassessment of Ukraine's energy

needs, and the three mothballed reactors were finished and brought online, one in 1995 and two in 2004. Ukraine came to operate a total 15 VVER-type reactors distributed among four nuclear power plants that generated nearly 14 gigawatts of electricity, half of Ukraine's energy mix, placing Ukraine among the leading nuclear energy producing nations of the world. Ukraine also endeavored to diversify its fuel supply away from Russia, on which TVEL fuel assemblies it hereto relied, and introduced fuel assemblies, developed for the VVER reactors by an American company Westinghouse, first in 2005 at unit 3 of the South Ukrainian nuclear power plant and later at other reactors.

IV.

But Ukraine's geostrategic position between an expanded NATO to the west and an increasingly revisionist Russia to the east, left the country in a security vacuum that invited predation. When Russia, one of the signatories of the Budapest Memorandum, violated its commitments to respect Ukraine's territorial integrity and international borders in 2014 and then again with renewed viciousness in February 2022, Ukraine's decision to disarm came under much public scrutiny. Observers called into question the prudence of the 1994 decision, doubted the competence of Ukraine's then-leaders, and drew attention to the considerable political and economic pressure exerted on Ukraine by its interlocutors, the United States and Russia.[12]

Yet while all these factors undoubtedly played a role in Ukraine's nuclear disarmament, the effect of Chornobyl on Ukraine's nuclear decision-making was as salient then as it is overlooked today. In a bitter historic irony, however, the decision to disarm, along with the feebleness of security commitments pledged in the Budapest Memorandum, left Ukraine vulnerable to aggression by Russia, a nuclear power that relied heavily on nuclear threats in perpetrating its war. While most Russian nuclear rhetoric has been aimed at compelling Ukraine's western partners to temper their support for Ukraine's defense effort, there is an ever-present possibility that Russia might resort to the use of nuclear weapons on the battlefield or to terminate the war on its terms.[13]

"THE NINE REACTORS THAT REMAIN ON UKRAINE-CONTROLLED TERRITORY ARE IN A CONSTANT PERIL OF LOSING OFF-SITE POWER OR BEING DIRECTLY DAMAGED BY THE STRIKES."

AMONG THE MANY nuclear risks created and manipulated by Russia to its advantage in the conduct of its war against Ukraine are the threats to the safety and security of Ukraine's civilian nuclear power plants. The Chornobyl Nuclear Power Plant and the 30-kilometer Exclusion Zone around it were among the first places to be occupied by the invading Russian army in the early hours of February 24, 2022.[14] The presence of foreign troops and the proximity to active fighting raised fears of the dispersal, intentional or accidental, of the thousands of tons of spent nuclear fuel and other radioactive materials in storage at the Chornobyl zone.

Budapest Memorandum is bull...it. A book of stamps by Ukrposhta, Ukraine's national postal service, 2025. PHOTO: MARIANA BUDJERJYN

These fears paled, however, to what soon followed at the Zaporizhzhia nuclear power plan (ZNPP), the largest nuclear power plant in Europe, contributing nearly a quarter of Ukraine's electricity. On the night of March 3–4, 2022, a column of Russian troops and heavy armor stormed the ZNPP, which at the time operated four of its six reactors. Three reactors went into emergency shutdown under the Russian fire, and one remained in operation to support Ukraine's embattled power system. This was the first such armed assault on an operating nuclear power plant in human history.

On September 11, 2022, all six nuclear reactors at the ZNPP were shutdown. But on October 5, 2022, Russian president Vladimir Putin issued a decree claiming Russian ownership of the plant, essentially perpetrating the biggest industrial theft in recorded history.[15] Under its occupation, Russia weaponized the plant, maintaining a permanent military presence of 500 soldiers and storing military equipment and live munition in its turbine halls, using it as a shield to stage artillery barrages on Ukrainian positions, and manipulating nuclear risks through disinformation and false flag operations to sow fear and put pressure on Ukraine and its partners.[16] In the four years and counting of its occupation by Russia, the ZNPP lost off-site power, essential for safe operation of its cooling systems that prevent core meltdown, 12 times. On June 6, 2023, the Russian military blew up the Kakhovka dam downstream on the Dnipro, draining the reservoir on which the ZNPP relied for cooling water supply. Importantly, the Ukrainian operating staff found itself hostage to the Russian occupying authorities, pressured to sign contracts with the Russian nuclear operator Rosatom and take Russian passports. Dozens of operators have been illegally detained and many mistreated and tortured, thousands fled to the Ukraine-controlled territory, enduring a dangerous journey through occupied territories and Russia.[17]

Ukraine's other nuclear power plants have been bearing

the brunt of electricity generation in a situation where other generating facilities, including thermal, hydro, and combined heat power plants, as well as the transmission grid are being systematically degraded by unrelenting Russian missile and drone strikes. The nine reactors that remain on Ukraine-controlled territory are in a constant peril of losing off-site power or being directly damaged by the strikes. Indeed, on February 14, 2025, a Russian drone struck the NSC over Chornobyl's reactor 4 and caused significant damage that undermined hermetic characteristics of the structure that were supposed to last for the next 100 years.

In 1986 Ukraine found itself the site of the world's worst nuclear accident at Chornobyl that resulted from systemic negligence and poor safety culture inherent in the Soviet political system. The accident affected millions of people well beyond Ukraine, shaped the development of nuclear energy globally, and, by contributing to the Soviet collapse and Ukraine's nuclear disarmament, had significant geopolitical repercussions. Today Ukraine once again finds itself at the fulcrum of unprecedented nuclear dangers, perpetrated by a nuclear power with explicit malign intent. Ukraine's story continues to raise the specter of nuclear catastrophe, blurring the distinction between atoms for peace and atoms for war.

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