



EXPLAINERS

More exasperation than anything Nuclear expert Mariana Budjeryn assesses Ukraine's rumored capacity for a 'rudimentary bomb within months'

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“Ukraine could develop a rudimentary nuclear bomb within months,” the British newspaper The Times declared in the opening line of a controversial article published on November 14. In response, Ukrainian Foreign Ministry spokesperson Heorhii Tykhyi reiterated Kyiv’s commitment to the Non-Proliferation Treaty and denied any plans to develop or acquire nuclear weapons. The Times report was based on a recent briefing paper prepared for Ukraine’s Defense Ministry, but concerns — some might call it alarmism — about Kyiv’s capacity to assemble and deploy a nuke have resurfaced repeatedly since Russian troops first invaded.

Mariana Budjeryn is a senior research associate with the Project on Managing the Atom at the Harvard Kennedy School’s Belfer Center and the author of “Inheriting the Bomb: The Collapse of the USSR and the Nuclear Disarmament of Ukraine.” Just weeks after the start of Russia’s full-scale invasion, Dr. Budjeryn said the Kremlin’s claims about Ukraine developing nuclear weapons were “dangerous nonsense.” She recently argued that “President Zelensky’s ‘NATO or nukes’ as a ploy for immediate NATO membership lacks credibility and is unlikely to succeed as a strategy.” Meduza spoke to Dr. Budjeryn to assess The Times report about Ukraine’s supposed capacity for a “rudimentary bomb within months.”



Mariana Budjeryn

— We’ve heard repeatedly over the past few years that Ukraine has what it takes to build a nuclear bomb, maybe even quickly. This recent article by Maxim Tucker at The Times rehashes the highlights of the argument: Ukraine has lots of spent fuel, Ukraine has Soviet-era expertise in making nuclear weapons, and making a simple nuke would, therefore, be a cinch. What’s wrong with this picture?

— As with most super-simplified statements, it's both true and false at the same time. The truth is that, yes, Ukraine has tons of fuel spent. Yes, especially the RBMK spent fuel in Chornobyl contains potentially lots of weapons-grade plutonium.

— This is at the facility that had the meltdown?

— Yes, the Chornobyl Nuclear Power Plant had four RBMK reactors, derivatives of Soviet weapons plutonium reactors.

Their main configuration would produce a large portion of different isotopes of plutonium in the spent fuel, including Plutonium-239, which could be separated. And all of that is still sitting in the exclusion zone. It's been sitting in these spent fuel pools, even after all the reactors eventually were shut down. And it's been transferred into longer-term storage, which is still in the exclusion zone.

The Times article also claims that Ukraine could separate out enough plutonium for a simple nuclear explosive device. Now, it's hard for me to estimate whether a couple of months, three months, four months, or several months is the correct timeline. But it is possible that, within a year, Ukraine could potentially separate the nine kilograms of plutonium, which is what's called a significant quantity by the International Energy Agency's standards. In other words, you could construct a nuclear bomb with nine kilograms of plutonium for a yield like "Fat Man" [the codename for the type of nuclear weapon detonated over Nagasaki].

— **How much spent fuel would you need to get to that level?**

— I don't know. There are tons and tons of [spent] fuel [in Ukraine], but you'd need a process for separating it out.

Critics say you'd need to build a huge industrial-sized plutonium separation facility, but not necessarily. These things are being done for research purposes at the Institute for Nuclear Research in Kyiv. There is a hot-cell laboratory that can separate out tiny bits of plutonium. So you can do STEM fundamental research and physics and nuclear physics with it. Theoretically, if you put that facility on 24/7 and used these hot cells to separate out this plutonium, you could possibly get to nine kilograms.

Now, there are also unofficial U. S. Department of Energy estimates suggesting you can possibly construct a nuclear weapon with as little as four kilograms of plutonium. Jeffrey Lewis had a really good Twitter/X thread on this with links and materials.



Dr. Jeffrey Lewis 
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No, it probably can't. At least not anytime soon. A short .

 **The Times and The Sunday Times**  [@thetimes](#)
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Where this whole line of argumentation and reasoning breaks down is: All right, so, several months in, you've got your nine kilos of plutonium, and then what? Let's assume Ukraine has preserved the kinds of engineering and radio chemical expertise and the physicists that could be mobilized into this urgent program to construct this warhead.

The idea of the plutonium-implosion bomb is that you have these conventional explosives in this really intricate configuration, and they go off at exactly the same millisecond, and they compress that matter together, which starts the nuclear reaction and the release of energy.

If the precise electronics and ignition systems for conventional explosives are not super sophisticated, they will misfire. Something will explode here, but the energy will go out there.

Nuclear reactions, in general, are rather inefficient. The idea [with weaponization] is to make them as efficient as possible with the nuclear material that you have. And that takes really precise engineering to configure the reaction so that you get the most bang — no pun intended — for the nuclear material you have.

Presumably, you can get that done within several months to a year. But that's a big "if." It's an "if" that Ukraine could separate the plutonium — say, at the Kyiv Nuclear Research Institute — without that institute, which sits smack in the middle of the city, surrounded by civilian buildings, getting

bombed like the Kharkiv Institute. The Russians know exactly what this facility is and what its capabilities are.

Possibly, if Ukraine could somehow marshal the expertise and the engineering needed here, they could get to a “Fat Man” kind of bomb in several months. That's not an outlandish claim.

But what do you do in 2024 with a “Fat Man” kind of device? That's a gravity bomb. It's an enormous thing that was loaded onto an aircraft. The aircraft had to fly over Nagasaki, open the hatch, and drop the friggin' thing right over its target.

— A “Fat Man” style bomb is just too heavy to put on a missile?

— Yes, it's not anything you can hoist on a missile. It's this enormous kind of caricature-looking bomb.

— How close is what you're describing to what's depicted in the film *Oppenheimer*?

— There, it's mostly “Little Boy.” that's featured, and [Fat Man] was even bigger.

To have a credible deterrent, you need a way to deliver it to the target. The Times article mentions this alleged Ukrainian ballistic missile that is being developed. We've yet to see it, but it's not inconceivable. Ukraine did have technical

explorations — maybe even a prototype — of a Sapsan system, a short-range ballistic missile developed in 2000.

The Saudis expressed interest, and the idea was that Pivdenmash would develop this short-range ballistic missile system for them, use the money to finance the R&D and the development and testing, and once Saudis ordered a certain number, then Ukraine could finance its own serial production. But the Saudis basically took the technical information and withdrew. So, once a prototype or the R&D was completed, the Saudis basically bought it and decided to build it themselves.

That system was constrained still by ranges under the Intermediate-Range Nuclear Forces Treaty. You could scale it up, probably, maybe to the 600-kilometer [372-mile] range, but we don't know where that is in the process. While we haven't seen this ballistic missile, it's not inconceivable that the Ukrainians, over the past three years, have been developing, maybe testing, and maybe could finance its serial production.

Remember that these missiles don't explode on impact. They need electronics and programming to explode at a certain point of reentry to make their burst more efficient, for the lack of a better word. You do it some distance above the ground because it absorbs much of the energy released, whereas the shockwave inflicts a lot more damage when it's above the ground.

— But it's a dirtier explosion if it's closer to the ground, is that right?

— It's not necessarily dirtier, but the yield will be much smaller.

— So, militarily, there's no reason to detonate these bombs lower?

— You can do a ground explosion, for instance, if you're busting hardened silos. If your aim is to bust something underground, like hardened ICBM silos, then chances are you want a ground explosion.

These are really morbid discussions, but it's how militaries [think], and it's especially relevant if you have a lower-yield nuclear weapon. You want to get the most out of that yield.

‘You're talking about some really serious alchemy here’

— Where's the biggest bottleneck, in your view, when it comes to Ukraine's capacity to go nuclear and wield a nuclear deterrent?

— One is the industrial capacity to produce weapons-grade nuclear fuel. Reprocessing or enrichment would be even harder to hide.

Ukraine does have its own uranium in Zhovti Vody, where it mines the ore. Then milling is extracting the actual uranium ore, purifying it from all the other crap that comes with it: other rock and that sort of thing. Then you have this uranium ore called “yellowcake.” It’s this gooey substance.

The next step is conversion into uranium hexafluoride. You take that yellowcake, that kind of *kasha*, yellow-like mush, and you convert it into gas. Uranium hexafluoride is a gas.

— And you probably don't want to breathe it.

— It's one of the most toxic, awful substances out there. And you feed that into your centrifuge facility, these cascades of centrifuges.

When Ukraine looked into enrichment in the 1990s and did the feasibility study, they considered building at least a 100,000-centrifuge facility. You really need to spin them a lot to get these tiny little atoms of [Uranium-]235 that are lighter. They go up, and the heavier [Uranium-]238, which is 90 percent of all uranium isotopes in this hexafluoride, drop. And then you skim these little 235s that you need, and you put them in the next set of centrifuges, and they spin that and purify it even further.

It’s a very big industrial process.

— Is it possible to hide this sort of thing? If Kyiv were to pursue a nuclear weapons program, are there lessons it

could take from Iran's reprocessing and refinement efforts?

— I think Iran has put some of its centrifuges underground, but — again — it's a big-scale facility. You can't hide it. You're going to see it from satellites. You're going to see these great, big engineering works.

— How big are these facilities? How big is a single centrifuge?

— A facility would be a large building. A single centrifuge would be a human-size, maybe even taller, kind of cylinder. And it needs very precise electronics to spin really fast to separate these atoms and not shatter. It takes space.

So, you have to produce the centrifuges, which will take time. The enrichment process will possibly be more visible and labor-intensive just because you need this enormous facility.

— And, moving onto the next stage, is converting it into metal bomb components easier to hide?

— So, once you take that enriched uranium from the centrifuges, you still need a separate conversion facility basically to take what is gas and put it back into metal form. You're talking about some really serious alchemy here.

With uranium, you need 23 kilograms [50.7 pounds] for a single bomb — that's the “significant quantity.” But you need

only nine kilograms [19.8 pounds] of plutonium. And then you still need a system to ignite the nuclear chain reaction for the explosion, whether a gun-type device like “Little Boy” or something else.

That also means you need many more components besides nuclear material. But it’s not prohibitive. North Korea figured it out, Iran has a bomb design, Pakistan figured it out — and these are not countries that we think of as super technologically advanced. But it took them time and lots of trial and error, and these are not things Ukraine necessarily has.

‘You’re seeing the exasperation among very serious people’

— What can you tell Meduza’s readers about the Center for Army, Conversion, and Disarmament Studies, which published the paper at the center of The Times report?

— I don’t personally know [the center’s director, Valentyn] Badrak, but he’s rather well-regarded. He's not some loose cannon who says crazy things. I'm surprised they would put out a report like this, unless there's really something... I don't know. Maybe the Ukrainians developed some capabilities since 2014 or something they kept secret, but I was surprised.

And Oleksii Yizhak [the report's author and department head at Ukraine's National Institute for Strategic Studies], I know him personally. We haven't coauthored together, but we've thought of doing that. I know him well through the Odesa Center for Non-Proliferation; he's contributed to their book. He's based in Dnipro and has very close relations with Pivdenmash and the design bureau. He's more on the missile side. But I cite him in my book. He's legit.

— Could this report indicate shifting professional views among experts in Ukraine?

— I think what you see here, more than any practical move to a nuclear problem, is the exasperation among very serious people.

Oleksii was quoted as saying, “They treat nuclear weapons as some kind of God. So perhaps it is also time for us to pray to this God.” And, in this sense, I can understand the sentiment.

Certainly, if Ukraine today has some, even very distant, options for a nuclear program, it had double, triple that in the early 90s. And all of that was scrapped. Yes, Ukraine didn't have an operational deterrent, but it had a lot friggin' more than it has now. They scrapped all of it in the spirit of: “Oh, let's do non-proliferation and international security for everyone.” And “you're going to be protected by these assurances and brought into the fold of the international community.” You'll also be secure with these collective

structures, such as the Organization for Economic Co-operation and Development, the Non-Proliferation Treaty, and the United Nations.

Where's all that now? Not only did it prove not to deter anything, but now Putin is issuing nuclear threats. And it's working, at least partially, with the West. We've heard it up and down the line. [Outgoing NATO Military Committee Chair] Admiral Bauer just recently said that we would have been there [in Ukraine] with our troops if Russia were not a nuclear state.

Biden: "Armageddon. World War III. We should not escalate."
Schultz: "We should not escalate. Nobody wants a nuclear war." It's working.

If nuclear deterrence works for other folks, why couldn't it work for Ukraine? But then you're back at square one: If you're going to say these things, you'd better have something to back it up.

Honestly, I would be surprised if the Ukrainians had some kind of secret mini-nuclear program. I'd be surprised if they had something to lean on in these statements. And I'd be impressed if they could pull off something like this, given how penetrated they are otherwise by Russian spies and whatnot.

This interview has been condensed and edited for clarity.

Interview by **Kevin Rothrock**

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