

NFLA Policy Briefing No. 227



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Subject: The potential impact of the conflict in Ukraine on nuclear power plants and potential nuclear escalation

Introduction

In light of today's military action in Ukraine, I reproduce with kind permission two articles by Linda Pentz Gunter and Ira Helkind from a briefing by International Physicians for the Prevention of Nuclear War.

Damage to Nuclear Power Reactors - Linda Pentz Gunter

The 15 nuclear power reactors at four sites in Ukraine both face and create a series of risks should a war or escalated conflict break out there. Even if the reactors sites —which deliver 50% of Ukraine's electricity needs — are not embroiled in the conflict zone, they are still vulnerable to catastrophic outcomes. The Chernobyl nuclear site and the Exclusion Zone are also potentially at risk.

The presence of 15 reactors in Ukraine, or any nuclear reactors anywhere, automatically adds to the medical risks for the surrounding populations should something else major happen. And that something else need not be a war.

We are already seeing the ravages of the climate crisis and how this can knock out essential power supplies. Nuclear power plants are already vulnerable. They are more so if caught up in a war that could cause the grid to go down.

There are 15 reactors in Ukraine grouped at 4 sites and providing 50% of the country's electricity needs. They are Russian VVER reactors of 1,000 megawatts each, similar in design to our traditional light water reactors.

And there is the closed Chernobyl nuclear plant in the north, which were RBMK graphite moderated reactors.

If a war takes out the electric grid, whether by accident or deliberate sabotage—including even through a cyber attack, the nuclear plant operators will try to shut the reactors down. But if they lose onsite power as well, should that backup power fail, as it did at Fukushima, things can get far more dire with similar outcomes to an actual attack.

Are any of Ukraine's reactors likely to be within the battle zone? Rivne and Khmelnytsky in the far west, are probably out of harm's way. South Ukraine is also less likely to come under direct attack. Of most concern, given its size and location is Zaporizhzhia. It's the largest nuclear power station in Europe, with a net capacity of 5700 MW. The Zaporizhzhia reactors were already vulnerable during the Crimea invasion in 2014 when a far-right Ukrainian group tried to gain entry. They are about 200 kilometers from the Donbas conflict zone.

If any of these reactors are embroiled in the war zone but not attacked or hit, the nuclear plant workers, may fear for their lives and the lives of their families. They would want to — and should — evacuate with their loved ones.

But what happens if they do? The answer is they can't. Or not all of them. Nuclear power plants, even under normal circumstances are never walkaway safe. Some workers would have to stay behind. If the nuclear workforce evacuates, you set in motion a cascade of meltdowns at that site, whether or not it is directly attacked.

If one or more of these reactors takes an *accidental* hit from a bomb or missile or even just artillery fire, we could be talking about another Chernobyl or, actually, multiple Chernobyls. The worst of all possible outcomes is that a direct hit destroys the reactor immediately. But even if the reactor is severely damaged or disabled, then you start to lose coolant and the reactor heats up, the fuel rods are exposed, and explosive gases are created. One spark and you could see an explosion as we did at three of the Fukushima reactors.

Some of the workforce may be injured or killed, or struggling to shut down the remaining reactors. Added to that, if the spent fuel pools boil and evaporate, exposing the rods, these could catch fire. A fuel pool fire is even worse than the reactor exploding because spent fuel pools contain a far hotter radioactive inventory than the reactor itself.

Those radioactive releases would be dispersed across thousands of miles. We have already had a glimpse of what that would look like for human health after Chernobyl. The plume pathway for just radioactive cesium-137 resulting from the 1986 Chernobyl explosion hit Belarus, Russia and Ukraine the worst. But it went all across Europe. Not all the hot spots were concentrated closest to Chernobyl.

If any of Ukraine's 15 reactors were hit, it would be much worse than Chernobyl. All of them are older than Chernobyl Unit 4 was in 1986. They have bigger radioactive inventories. And they are all multiple reactor sites. People all across Europe would be affected.

But what if there was a deliberate attack on the reactors, an act of sabotage to disable them, or even a cyber attack? We know nuclear sites are vulnerable to cyber attack. We've seen it before with the 2010 Stuxnet cyber attack on 15 of Iran's nuclear facilities including the Natanz uranium enrichment plant.

Would Russia — or any country or even rogue group — really use reactors as weapons of war, allowing them to deliberately melt down and potentially contaminate wide portions of Europe?

This would seem like a scaled down exercise in mutually assured destruction, given prevailing winds would likely blow much of the radiation across Russia and Belarus. A deliberate attack on a nuclear plant would have much the same outcome as an accidental one. It would release a massive plume of radioactivity and would be a medical and humanitarian disaster of monumental and likely completely unmanageable proportions.

What would that mean for human health?

We should have a guide from the example of Chernobyl. But there was a scandalous and even heartless international effort, by agencies like the IAEA, with vested interests in minimizing the disaster, to do just that. We must look to independent sources to get a truer sense of the numbers. And here we must remind ourselves that, with Chernobyl, we are talking about just one, relatively new reactor not the multiple ones now in Ukraine containing far more radioactivity.

Three of the best sources on the real health impacts are [IPPNW Germany's 20-years after Chernobyl report](#); Ian Fairlie's [TORCH Report](#); and Kate Brown's book — [Manual for Survival: A Chernobyl Guide to the Future](#). And then you just take their numbers and imagine an orders of magnitude worse situation if, let's say, one or more of the Zaporizhzhia reactors are hit, whether accidentally or deliberately, and melt down.

And that's not where it ends.

Looking at a specific sample of Chernobyl victims, [Dr. Wladimir Wertelecki](#), a physician and geneticist, who conducted post-Chernobyl research in Polissia, Ukraine, found birth defects and other health disturbances among not only those who were adults at the time of the Chernobyl disaster, but their children who were in utero at the time and, most disturbingly, their later offspring.

So if reactors are breached during a war in Ukraine, that war, in a medical sense, will never be over.

But what about the Chernobyl Exclusion Zone? Could it, and the nuclear site itself, get caught up in a war?

Russian troops could choose to cross into Ukraine from Belarus, the shortest route to Kyiv, taking them through the Chernobyl Zone. But it is marshy and difficult terrain, in addition to being radioactive, so certainly not the ideal entry point.

The destroyed Chernobyl Unit 4, along with 200 metric tonnes of uranium, plutonium, liquid fuel and irradiated dust, are encased in a sarcophagus completed in 2019. But that sarcophagus, which is only supposed to last 100 years, could collapse under the vibrations of explosions in a war zone. That would loft radioactive dust into the atmosphere causing yet another major health crisis.

And there is one more huge threat to this area, as well as to *any* war zone involving nuclear plants, and that is fire. We've already seen literally hundreds of fires in the Chernobyl Zone, sadly many started deliberately. Under ever more extreme climate conditions, wildfires will get larger and more frequent. In 2020, a forest fire that broke out within the Chernobyl Zone threatened to reach the plant site.

Forest fires re-emit and redistribute radiation trapped in the soil. The 2020 fire increased radiation levels to 16 times higher than they had been previously. War clearly raises the risk of fires. And the Chernobyl Zone is a tinder box.

Dr. Tim Mousseau and his team [discovered](#) that dead wood and leaf litter on the forest floors is not decaying properly, likely because the microbes and other organisms that drive the process of decay are reduced or gone due to their own prolonged exposure to radiation.

Equally, wildfires triggered by war close to any of Ukraine's operating reactors could have dire consequences. Even under just normal reactor operating circumstances, fire is considered the bulk of the risk for a core melt.

Wars in regions where there are nuclear reactors raise the dangers to almost unimaginable heights. All of this, in my view, strengthens the argument to permanently close and dismantle the world's nuclear power plants as soon as possible.

Even as this briefing is issued there are reports in the British media of fighting near the Chernobyl complex

<https://www.independent.co.uk/news/world/europe/chernobyl-nuclear-russia-attack-ukraine-b2022444.html>

President Volodymyr Zelensky has said that Russian soldiers have entered the area surrounding Chernobyl and are trying to seize the former nuclear power plant from defending Ukrainian forces.

Escalation to Nuclear Weapons - Ira Helfand, M.D.

A large-scale conventional conflict in Ukraine will create a catastrophic humanitarian crisis. But the parties to this dispute, NATO and Russia, are armed with enormous nuclear arsenals, and so it is important to consider also the consequences if the conflict escalates to the use of nuclear weapons since both NATO and Russian military doctrines allow for the use of tactical nuclear weapons to fend off defeat in a major conventional war.

Despite reductions in nuclear forces over the last several decades, Russia still has 1900 tactical nuclear weapons and 1600 deployed strategic nuclear weapons. On the NATO side, France has 280 deployed nuclear weapons and the UK, 120. In addition the United States has 100 B 61 tactical bombs deployed at NATO bases in Belgium, Germany, Italy, the Netherlands and Turkey and an additional 1650 deployed strategic warheads. (Ref)

If even a single 100 Kt (kiloton) nuclear weapon exploded over the Kremlin, it could kill a quarter of a million people and injure a million more, completely overwhelming the disaster response capability of the Russian capital. A single 100 kiloton bomb detonated over the US Capital would kill over 170,000 people and injure nearly 400,000.

But it is unlikely that an escalating nuclear conflict between the US and Russia would involve single warheads over their respective capitals. Rather it is more likely that there would be many weapons directed against many cities and many of these weapons would be substantially larger than 100 Kt. For example, Russia's 460 SS-18 M6 Satan warheads have a yield of 500 to 800 Kt. The W88 warhead deployed on US Trident submarines has a yield of 455 Kt.

Major cities like New York or Moscow are probably targeted with at least 10 to 20 nuclear weapons each 30 to 50 times more powerful than the Hiroshima bomb. To describe the destruction they would cause we can use the model of a single 20 MT (megaton) bomb. The total megatonage in an actual attack would be less, but, because the explosive force would be spread out more efficiently across the metropolitan area, the actual destruction would be even greater.

Within 1/1000th of a second, a fireball would form reaching out for two miles in every direction, four miles across. Temperatures would rise to 20 million degrees Fahrenheit, and everything--buildings, trees, cars, and people--would be vaporized.

To a distance of 4 miles in every direction, the blast would produce pressures of 25 pounds per square inch and winds in excess of 650 miles per hour. Forces of this magnitude can destroy essentially anything that we build including reinforced concrete and steel structures. Even deep underground bomb shelters would be crushed.

To a distance of six miles in every direction, the heat would still be intense enough to melt sheet metal. And to a distance of 10 miles in every direction, the blast wave would create pressures of 7 to 10 pounds per square inch and winds of 200 miles per hour.

To a distance of at least 16 miles in every direction, the heat would ignite all easily flammable materials--paper, cloth, wood, leaves, gasoline, heating oil--starting hundreds of thousands of fires. Fanned by blast winds still in excess of 100 miles per hour, these fires would merge into a giant firestorm 32 miles across and covering 800 square miles. Everything within this entire area would be consumed by flames. Temperatures would rise to 1400 degrees Fahrenheit. And everyone would die.

If just 300 warheads in the Russian arsenal got through to urban targets in the US, 75 to 100 million people would die in the first half hour and tens of millions would be fatally injured. Huge swaths of the country would be blanketed by radioactive fallout and the industrial, transportation and communication infrastructure which we all depend on would be destroyed. The internet, the electric grid, the food distribution system, the public health and banking systems would all be gone. In the following months the vast majority of those who survived the initial attack would also die, from radiation sickness, epidemic disease, exposure and starvation. A US attack on Russia would cause similar devastation.

But these are just the direct effects. In addition, the large scale use of nuclear weapons would also cause catastrophic climate disruption. When a nuclear attack causes a city to burn, enormous amounts of soot are lofted into the upper atmosphere. If all of the deployed weapons in the US and Russian arsenals were used against urban targets some 150 Tg (terragrams or million tons) of soot would be generated, blocking out the sun and dropping temperatures across the planet an average of 10⁰ C. In the interior regions of North America and Eurasia temperatures would drop 25 to 30⁰ C. The Earth has not seen temperatures this cold since the last Ice Age. In the temperate zones of the Northern Hemisphere there would be 3 years without a day free of frost—the temperature would drop below freezing every single day. Under those conditions the ecosystems which have evolved since the last Ice Age would collapse, food production would plummet and the vast majority of the human race would starve

Even a much more limited nuclear war would cause catastrophic global climate disruption. As few as 250 100 kiloton bombs could generate 37 Tg. of soot dropping temperatures 5.5⁰ C and triggering massive crop failures and catastrophic worldwide famine that would put hundreds of millions, possibly billions of people at risk. This would not mean the extinction of our species; it would mean the end of modern civilization. No civilization in history has survived a shock of this magnitude and there is no reason to assume that the delicate, complex economic system on which we all depend would do any better.

Richard Outram,
NFLA Secretary
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