04\22

I C I

CBRNE DIARY

Dedicated to Global First Responders

April 2022

STOP WAR

ВОЙНА

PART B

An International CBRNE Institute publication

ICI International CBRNE INSTITUTE

CBRNE-Terrorism Newsletter

W O M D

C2BRNE DIARY

DIRTY R-NEWS

Radiation Emergency Medical Challenges and a Global Pandemic

By Ron Cain

Source: https://www.domesticpreparedness.com/healthcare/radiation-emergency-medical-challenges-and-a-global-pandemic/

Mar 23 – It seems that every day over the past two years there are plenty of news stories covering the strain hospitals are facing in staffing shortages and the impacts from a global pandemic. Emergency medical services (EMS) are also dealing with their own similar issues across the nation. Many of these critical facilities and services are located in the proximity of nuclear power plants in which previous agreements were established to provide treatment, patient transportation, radiation monitoring, and decontamination in the event of a patient-generating event within a nuclear power plant's emergency planning zones.

Biennially, the Federal Emergency Management Agency (FEMA) grades Medical Services Drills (MSD) and requires training in the off year for designated hospitals and EMS systems. FEMA requires radiation response teams in both hospital and prehospital organizations with specialized training. It is possible due to the combination of staffing shortages and pandemic impacts that a gap in radiation emergency preparedness could lead to life-threatening problems that are much worse that a negative drill finding from FEMA.

A Solution for Meeting Training Requirements

A state level emergency management agency in the Southeast recently addressed these potential issues after it revised the MSD training it offers to hospitals and EMS systems. During a rehearsal of concept (ROC), the scenario included a county emergency management department in coordination with an affected hospital requesting state level training support for new emergency department staff with no previous radiation emergency experience or training.

The training content provided during the ROC included the following:

- Oak Ridge Institute for Science and Education's Radiation Assistance Center/Training Site (REAC/TS) standards are emphasized throughout the training. REAC/TS is considered the gold standard for radiation emergency medical treatment and patient decontamination.
- Training content focused on new and/or inexperienced EMS and hospital staff with didactic and practical learning outcomes.
- Reminder that the ongoing global pandemic has created some similarities in response and management of radiation emergencies for EMS and hospital responders and clinicians.
- Emphasis on the partnership between local EMS, hospitals, local, state, and federal level emergency management organizations.
- Comparisons and contrasts between a medical services drill and a real radiation emergency incident.

A didactic presentation was followed by practical training on dosimetry, patient monitoring, how to use detection instruments, patient packaging for EMS transport, and patient decontamination. This usually lasts two hours but can go longer depending on class size. No virtual option was available due to the critical need to teach the above listed skills in person for better learning outcomes.

The Medical Services Drill photos were taken in May 2021. The REAC/TS class photo was taken in February 2020 in one of the last classes held in person due to COVID. *Source:* Ron Cain (2022).

Like many other issues the global pandemic has exposed, radiation emergency preparedness could become a vulnerability itself – if it has not already. The ROC scenario included a mix of travel nurses, new employees, and staff members that transferred from other hospital departments – all with no combined experience in radiation emergency medicine or in patient decontamination. With a graded MSD in the future and a gap in their preparedness, outside help in the form of state level training support was requested by the local emergency management agency.

A state level emergency management agency in the Southeast recently addressed potential issues related to a radiation emergency using a rehearsal of concept (ROC).

REAC/TS offers excellent training at its site in Oakridge, Tennessee. The nuclear energy companies coordinate and support the attendance of hospital, EMS, and emergency management professionals that are involved in radiation emergency preparedness,

but the courses seem to fill fast. In addition, like many other teaching institutions in the past two years, they have canceled in-person classes due to the pandemic. Subsequently and realistically, the option was not in the ROC scenario to send hospital and EMS employees to REAC/TS.

Key Takeaways From the ROC

With all the aforementioned issues with EMS and hospitals, the ROC included a discussion about the realities of an MSD versus real events:

- FEMA requires the demonstration of one patient for treatment, transportation, monitoring, and decontamination during its graded MSDs. In reality, there may be many patients calling EMS or driving themselves to the hospital.
- Nuclear power plant emergencies tend to develop slowly, and the hospital and community may have activated their emergency plans days before the first potentially contaminated patient arrives. Incident management for extended times should be considered.
- EMS and hospitals should evolve their radiation emergency planning for multiple patient transports from within contaminated zones and establish robust personal protective equipment resupply lines. Radiation emergencies, unlike a viral pandemic, can be rapidly detected using dosimetry and radiation monitoring instruments that are stockpiled in nuclear power plant emergency planning zones.
- Actual nuclear power plant emergencies will require the partnerships between local, state, and federal agencies who should already be coordinating well before any exercise or actual incident.

Trained radiation response teams that exist today could be non-existent tomorrow due to the staff turnover and other factors related to the global pandemic. This will negatively impact two of FEMA's community lifelines – the Health and Medical and the Energy (Power & Fuel) – and potentially impact even more community lifelines as the incident grows. The ROC scenario was built with these critical issues in mind.

While it is still important for EMS systems and hospitals to pass FEMA-graded medical services drills, it is far more important to adapt to the constantly changing operational environment and to continue to be prepared for real radiation emergencies that threaten the life safety of communities, however unlikely they may be.

Ron Cain is a radiological emergency preparedness coordinator for a state emergency management agency. He has previous experience as a hospital and small county emergency manager. He has over 25 years of experience as a paramedic in county, military, and private EMS systems. He is a graduate of the National Fire Academy's EMS Special Operations and Advanced Life Support for Hazardous Materials Incidents Course and a graduate from the REAC/TS Radiation Emergency Medicine Course. He is a state certified emergency manager and has earned undergraduate and graduate degrees in disaster and emergency management.

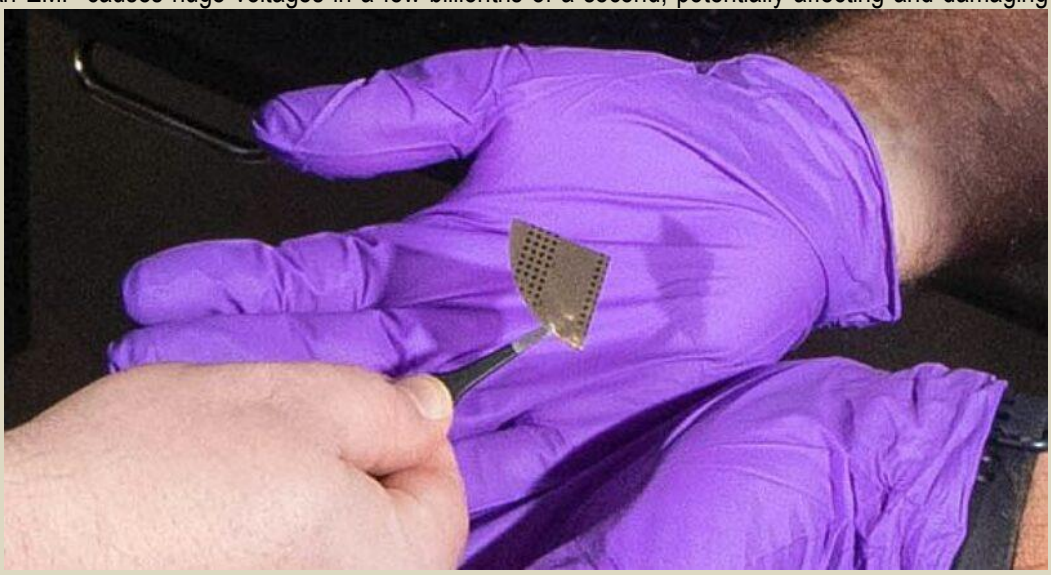
Ultrafast Devices to Protecting the Grid from EMPs

Source: https://www.homelandsecuritynewswire.com/dr20220323-ultrafast-devices-to-protecting-the-grid-from-emps

Mar 23 – Scientists from Sandia National Laboratories have announced a tiny, electronic device that can shunt excess electricity within a few billionths of a second while operating at a record-breaking 6,400 volts — a significant step towards protecting the nation's electric grid from an electromagnetic pulse.

The team published the fabrication and testing results of their device on March 10 in the scientific journal IEEE Transactions on Electron Devices. The team's ultimate goal is to provide protection from voltage surges, which could lead to months-long power interruptions, with a device that operates at up to 20,000 volts. For comparison, a household electric dryer uses 240 volts of electricity.

An electromagnetic pulse, or EMP, can be caused by natural phenomena, such as solar flares, or human activity, such as a nuclear detonation in the atmosphere. An EMP causes huge voltages in a few billionths of a second, potentially affecting and damaging electronic devices over large swaths of the country.



EMPs are unlikely, said Bob Kaplar, manager of a semiconductor device research group at Sandia, but if one were to occur and damage the huge transformers that form the backbone of our electric grid, it could take months to replace them and re-establish power to the affected portion of the nation.

"The reason why these devices are relevant to protecting the grid from an EMP is not just that they can get to high voltage — other devices can get to high voltage — but that they can respond in a couple billionths of a second," Kaplar said. "While the device is protecting the grid from an EMP, it's at a very high voltage and thousands of amps are going through it, which is a huge amount of power. A material can only handle so much power for a certain amount of time, but we think the material in our diode has some advantages over other materials."

A Regulator Valve for the Grid

The new Sandia device is a diode that can shunt a record-breaking 6,400 volts of electricity within a few billionths of a second — a significant advancement toward being able to protect the nation's electric grid from an EMP. The team, including Sandia electrical engineer Luke Yates, the first author on the paper, is working towards fabricating a diode able to operate at around 20,000 volts, since most grid distribution electronics operate at around 13,000 volts.

Diodes are electronic components found in nearly every electronic device and serve as one-way regulator valves, said Mary Crawford a Sandia Senior Scientist leading diode design and fabrication for the project. Diodes allow electricity to flow in one direction through the device, but not the other. They can be used to convert AC power into DC power, and in this project, divert damaging high voltage away from sensitive grid transformers.

Kaplar agreed that the diode operates somewhat like a regulator valve in plumbing. He said, "In a regulator valve, even if you open that valve all the way, you can't flow an infinite amount of water through the valve. Similarly, there's a limit to how much current you can flow through our diode. If the valve on the pipe is closed, if the pressure reaches a certain point, it'll burst. Analogously, the diode cannot block an infinite voltage. However, our EMP device uses the

point at which the diode can no longer block the high voltage, holds the voltage to that 'pressure,' shunting the excess current through itself, to the ground and away from the grid equipment in a controlled, non-destructive fashion." The voltage surges caused by EMPs are a hundred times faster than those caused by lightning, so experts don't know if the devices designed to protect the grid against lightning strikes would be effective against an EMP, said Jack Flicker, a Sandia electric grid resiliency expert on the team.
"The electric grid has a number of different protections," Flicker added. "They range in timeframe from very fast to very slow, and they're overlaid on the electric grid to ensure that an event cannot cause a catastrophic outage of the electric grid. The fastest protection that we typically have on the grid reacts against pulses at one millionth of a second, to protect against lightning. For EMPs, we're talking ten billionths of a second, a hundred times faster."
The new Sandia device can react that quickly.

Growing Perfect Layers

Part of what makes the diode special is that it is made from gallium nitride, the same basic material used in LEDs, Kaplar said. Gallium nitride is a semiconductor, like silicon. But because of its chemical properties, it can hold off much higher voltage before it breaks down than silicon, Crawford said. The material itself also responds very quickly and therefore is a good candidate to achieve the fast response needed to protect the grid from an EMP.
Crawford and materials scientists Brendan Gunning and Andrew Allerman made the devices by "growing" gallium nitride semiconductor layers using a process called chemical vapor deposition, she said. First, they heat a commercially available gallium nitride wafer to around 1,800 degrees Fahrenheit and then add vapors that include gallium and nitrogen atoms. These chemicals form layers of crystalline gallium nitride on the surface of the wafer.
By tweaking the ingredients and the "baking" process, the team could produce layers with different electrical properties. By building up these layers in a specific order, combined with processing steps, such as etching and adding electrical contacts, the team produced devices with the needed behavior.
"A major challenge of achieving these very high voltage diodes is the need to have very thick gallium nitride layers," Crawford said. "The drift regions of these devices have thicknesses of about 50 microns, or 1/6th of a sheet of notebook paper. This may not sound like a lot, but the growth process we use can have growth rates of only one or two microns per hour. A second major challenge is maintaining very low densities of crystalline defects, specifically impurities or missing atoms in the semiconductor material, throughout the growth time in order to generate devices that work at these very high voltages."
For the team to reach their ultimate goal of a device that operates at 20,000 volts, they will need to grow the thick layer even thicker with even fewer defects, Crawford said. There are several other technical challenges to constructing a device that can operate at such high voltages and currents, she added, including designs to manage the very high internal electric fields within the devices.

Testing Ultrafast Diodes

Once Crawford's team fabricated the devices, Flicker and his team tested how the devices responded to fast voltage spikes, similar to what would occur during an EMP. His challenge has been modifying a tool to measure the very fast response time of the devices. "Developing the tools that can accurately measure the very fast responses is very difficult," Flicker said. "If we're talking one or two billionths of a second, they need to be able to measure even faster than that, which is a challenge."
Flicker and his team used very specialized equipment to apply a high voltage pulse, and measure the electric pulse that is reflected back from the diode to tell when the device turns on, very accurately and in less than a billionth of a second.

Useful for Smart Transformers, Solar Panel Converters and More

Diode devices like the Sandia gallium nitride diode can be used for other purposes, beyond protecting the grid from EMPs, Kaplar said. These include smart transformers for the grid, electronic devices to convert electricity from roof-top solar panels into power that can be used by household appliances, and even electric car charging infrastructure.
Commonly, solar panel converters and electric car charging infrastructure can handle 1,200 or 1,700 volts, he added. But operating at higher voltage allows for higher efficiencies and lower electricity losses. Another portion of the project is to develop diodes for these types of devices that operate at high, but not record-breaking voltage but are easier to manufacture, Kaplar said. The Naval Research Laboratory is leading this part of the project.
Some smart transformers and electronic devices can now operate at up to 3,300 volts, Flicker said, but efficiencies would be even greater if they could operate at 10,000 or 15,000 volts with one semiconductor device.
"We have this primary goal of protection of the electrical grid, but these devices have other uses beyond that," Flicker said. "It's interesting to have our application area, but know that these devices can be used in power electronics, power converters, everything that's at very high voltages."

Could an attack on Ukrainian nuclear facilities cause a disaster greater than Chernobyl? Possibly, simulations show.

By Jungmin Kang and Eva Lisowski

Source: https://thebulletin.org/2022/03/could-an-attack-on-ukrainian-nuclear-facilities-cause-a-disaster-greater-than-chernobyl-possibly-simulations-show/

Mar 23 – As Russian military forces shelled the Zaporizhzhya Nuclear Power Plant (ZNPP) in southern Ukraine on March 4, 2022, a fire broke out on the site. Among the six reactor units at the complex, auxiliary buildings attached to the Zaporizhzhya Unit 1 reactor were damaged. Fortunately, the damage did not threaten the safety of the unit.[1] And a recent assessment by the International Atomic Energy Agency indicates that, although management of the plant by a Russian military commander is less than ideal, "regular staff have continued to operate the Zaporizhzhya [nuclear power plant]" and "at least 11 representatives of the Russian state [nuclear power] company Rosatom were also present there, without interfering with the operation of the nuclear facilities."

Even so, Russia's military attacks on the Zaporizhzhya plant raise great concerns about the possibility of nuclear accidents. Some experts have suggested the attack on Zaporizhzhya could have caused a huge catastrophe; others were much more conservative in their estimates of possible radiation releases from such an attack. To illustrate the potential damage from a military attack on a nuclear power plant, we simulated and analyzed hypothetical releases from a core meltdown and spent fuel pool fire at one unit, Zaporizhzhya 1, if an attack by missiles or artillery had disabled cooling systems there.

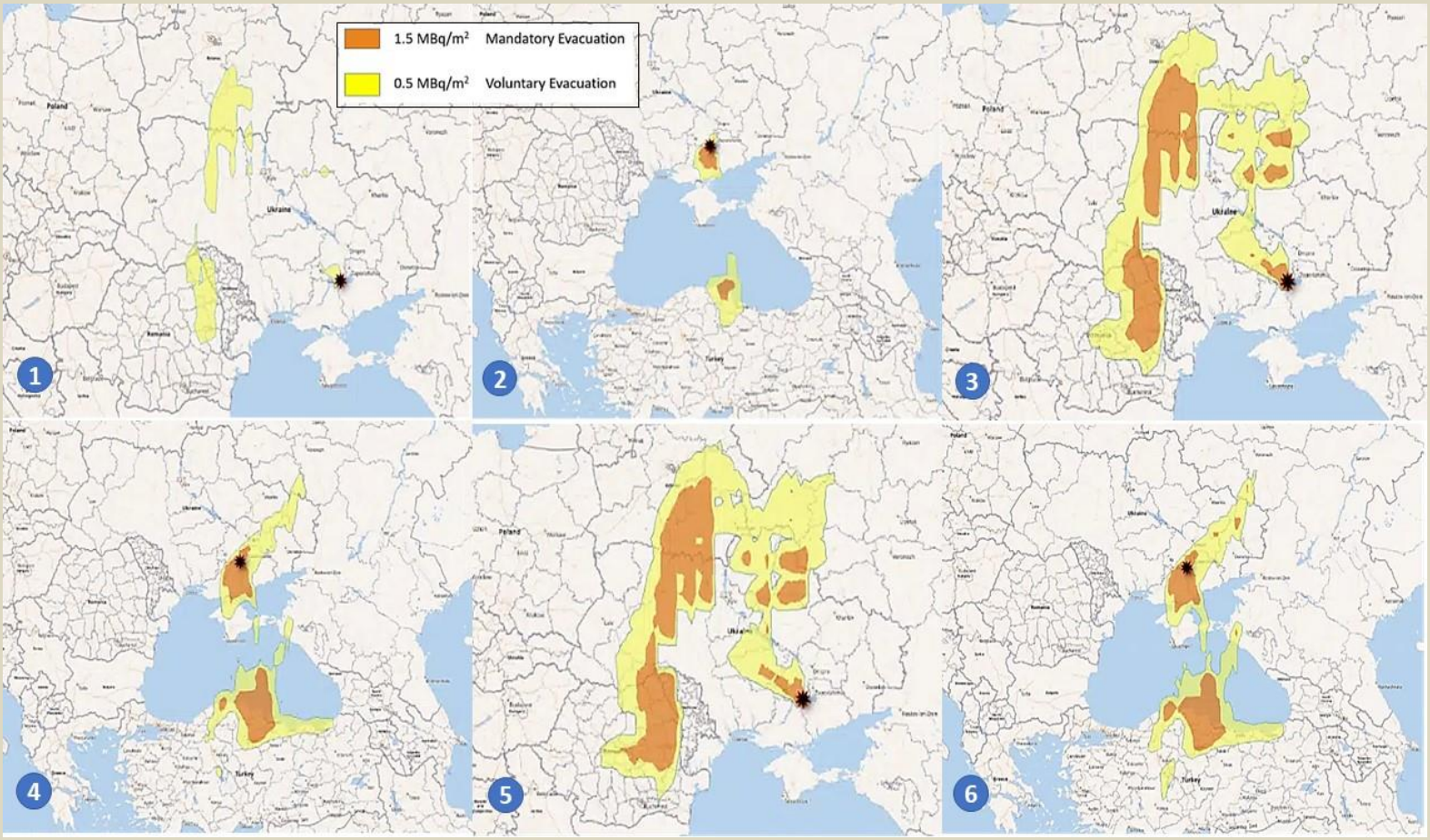
Military attacks that disable a nuclear power plant's safety systems, including reactor cooling and power systems, could lead to a core meltdown, as happened at the Fukushima Daiichi nuclear power plant in Japan in 2011, when an earthquake and ensuing tsunami disabled safety systems and caused three core meltdowns. Failure of cooling systems for a spent fuel storage pool can lead to an increase in the temperature of the fuel. If cooling is not reestablished, spent fuel that has been removed from the reactor for less than a few months can heat to temperatures on the order of 1,000 degrees Celsius and cause the zirconium cladding on fuel assemblies to catch fire and release radiation. The fire can spread to cooler spent fuel, too.

As shown in the maps and tables below, a meltdown and/or spent fuel pool fire could force large population relocations in up to five countries, depending on the the type of nuclear incident and weather patterns.

Zaporizhzhya 1 is a pressurized water reactor with an electric power capacity of 950 megawatts-electric; it has been operated since 1984.[2] For our simulation, we assumed a cesium 137 release of 157 petabecquerels of radioactivity due to a nuclear core meltdown of the reactor, which is 50 percent of the cesium 137 core inventory.[3] For a spent fuel pool fire occurring in the Zaporizhzhya Unit 1 spent fuel pool, we assumed a cesium 137 release of 590 petabecquerels, which is 75 percent of the pool inventory of cesium 137.[4]

To assess the impact of radiological fallout on the population and land area, the atmospheric dispersion following the releases was simulated using the Hysplit[5] model provided by the National Oceanographic and Atmospheric Administration (NOAA) and a population database provided by the National Aeronautics and Space Administration (NASA). The

simulations ingested meteorological data from the Global Data Assimilation System (GDAS) and were conducted as if the radiation release and spread happened in the third and fourth weeks of March 2021.[6]
On the maps in Figure 1 below, the contamination levels for compulsory evacuation are shown in orange and those for voluntary evacuation in yellow. The yellow area corresponds to contamination levels greater than 0.5 megabecquerels per square meter and less than 1.5 megabecquerels per square meter. The orange area corresponds to contamination levels greater than 1.5 megabecquerels per square meter. As shown in the maps, populations could have to be relocated in up to five countries, depending on the the type of nuclear incident and weather patterns.
After the Chernobyl accident, in addition to the 30-kilometer-radius evacuation zone around the reactor, relocation was made compulsory from areas with cesium 137 contamination levels higher than about 1.5 megabecquerels per square meter. Below this contamination level, strict radiation-dose-control measures were imposed in areas contaminated down to 0.5 megabecquerels per square meter. Nevertheless, large fractions of the populations in those "radiation-control" areas evacuated. In Ukraine, evacuation of these areas was made compulsory.[7] In addition to an initial 20-kilometer evacuation zone, a standard similar to 1.5 megabecquerels per square meter was used for Fukushima.[8]



(1) A simulation of contamination spread after a hypothetical core meltdown at Zaporizhzhya 1, using weather information from the third week of March 2021. (2) Simulated contamination levels after a hypothetical core meltdown at Zaporizhzhya 1, using weather information from the fourth week of March 2021. (3) Simulated contamination levels after a hypothetical spent fuel pool fire at Zaporizhzhya 1, using weather information from the third week of March 2021. (4) Simulated contamination levels after a hypothetical spent fuel pool fire at Zaporizhzhya 1, using weather information from the fourth week of March 2021. (5) Simulated contamination levels after hypothetical accidents due to a simultaneous core meltdown and spent fuel pool fire at Zaporizhzhya 1, using weather information from the third week of March 2021. (6) Simulated contamination levels after hypothetical accidents due to a simultaneous core meltdown and spent fuel pool fire at Zaporizhzhya 1, using weather information from the fourth week of March 2021.

Tables 1 and 2 below show the populations corresponding to the relocation areas in Ukraine and the neighboring countries for the hypothetical nuclear accidents calculated for two weather patterns in March.

Table 1: Relocated populations for hypothetical nuclear accident at Zaporozhye 1

Country	Relocated populations (Week 4)	
	Compulsory	Voluntary
Ukraine	362,000 – 1.6 million	280,000 – 2.4 million
Turkey	69,000 – 2.2 million	1.7–3.2 million
Russia	0 – 28,000	0 – 770,000

Table 2: Relocated populations for hypothetical nuclear accident at Zaporozhye 1

Country	Relocated populations (Week 3)	
	Compulsory	Voluntary
Ukraine	34,000 – 3.6 million	960,000 – 6.7 million
Russia	0 – 60,000	600 – 1.4 million
Romania	0 – 2.1 million	1.1–1.5 million
Moldova	0 – 420,000	260,000 – 450,000
Belarus	0 – 880,000	320,000 – 1.9 million

Notes

[1] "Updated information about Zaporizhzhia NPP," 04 March 2022 07:15, https://snriu.gov.ua/en/news/updated-information-about-zaporizhzhia-npp.

[2] "Nuclear Power in Ukraine," World Nuclear Association, Updated 4 March 2022, https://world-nuclear.org/information-library/country-profiles/countries-t-z/ukraine.aspx.

[3] A core inventory of cesium 137 is estimated from those of Fukushima Unit 1, 2 and 3. K. Nishihara, H. Iwamoto, and K. Suyama, "Estimation of Fuel Compositions in Fukushima-Daiichi Nuclear Power Plant," JAEA, JAEA-Data/Code 2012-018 (Japanese), https://jopss.jaea.go.jp/pdfdata/JAEA-Data-Code-2012-018.pdf; A 50% release rate is based on Table 4 of a report. M.L. Ang et al., "A Comparison of World-wide Uses of Severe Reactor Accident Source Terms," SAND94-2157, September 1994, https://inis.iaea.org/collection/NCLCollectionStore/_Public/26/032/26032994.pdf; The amount of 157 petabecquerels of radioactivity of cesium 137 is about twice of that from the Chernobyl accident which was about 85 petabecquerels. UN Scientific Committee on the Effects of Atomic Radiation, *UNSCEAR 2000: Summary of Low-Dose Radiation Effects on Health* (New York: United Nations, 2000), Annex J, https://www.unscear.org/docs/publications/2000/UNSCEAR_2000_Annex-J.pdf.

[4] A 75 percent release of cesium 137 that is originally contained in the spent fuel pool is US NRC's assumption for the densely packed spent fuel pool fire. "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel," NUREG-2157 Vol.1, USNRC, 2013, https://www.nrc.gov/docs/ML1419/ML14196A105.pdf; We estimate 186 tHM, as the current spent fuel inventory of re-racked pool of Zaporizhzhya 1. A. Afanasyev, "Spent Fuel Management in the Ukraine," 1998, https://inis.iaea.org/collection/NCLCollectionStore/_Public/29/026/29026647.pdf?r=1; An inventory of spent fuel of ZNPP 1 as of 1 July 2017 was 141 tHM. National Report of Ukraine for the 6th Review Meeting, 2017, p.118, https://www.iaea.org/sites/default/files/national_report_of_ukraine_for_the_6th_review_meeting_-_english.pdf; We assume the average burnup of the spent fuel, 40 MWd/kgHM. The amount of 590 PBq of radioactivity of Cs-137 is about seven times of that from the Chernobyl accident which was about 85 PBq.

[5] A.F. Stein, et al., "NOAA's HYSPLIT atmospheric transport and dispersion modeling system," Bull. Amer. Meteor. Soc., 96, 2059-2077, 2015, http://dx.doi.org/10.1175/BAMS-D-14-00110.1.

[6] The meteorological data used involved a three-hour time resolution and one-degree spatial resolution. The model was employed to simulate a 32-hour long release and the subsequent dispersion for one week, including dry and wet deposition.

[7] Frank von Hippel, Masafumi Takubo, Jungmin Kang, "Plutonium: How Nuclear Power's Dream Fuel Became a Nightmare," Springer 2019. After the Chernobyl accident, the threshold contamination levels for compulsory evacuation and for strict radiation control were set at 40 curies per square kilometer (1.48 megabecquerels per square meter), and 15 curies per square kilometer (0.56 megabecquerels per square meter), respectively. UN Scientific Committee on the Effects of Atomic Radiation, *UNSCEAR 2000 Report to the General Assembly, with Scientific Annexes:*

Sources and Effects of Ionizing Radiation, Vol. 2, Annex J, "Exposures and Effects of the Chernobyl Accident" (New York: United Nations, 2000), http://www.unscear.org/docs/publications/2000/UNSCEAR_2000_Annex-J.pdf.
[8] Frank von Hippel, Masafumi Takubo, Jungmin Kang, "Plutonium: How Nuclear Power's Dream Fuel Became a Nightmare," Springer 2019. At Fukushima, the Japanese government set the threshold for compulsory evacuation at an unshielded dose rate of 20 millisieverts in the first year, which, after taking into account weathering effects, corresponds to about 1.5 megabecquerels per square meter. Frank N. von Hippel and Michael Schoeppner, "Economic Losses from a Fire in a Dense-Packed U.S. Spent Fuel Pool," *Science & Global Security*, 25 (2017): 80-92, endnote 10, https://doi.org/10.1080/08929882.2017.1318561.

Jungmin Kang, an independent consultant and South Korea's member of the International Panel on Fissile Materials, chaired South Korea's Nuclear Safety and Security Commission in 2018.
Eva Lisowski is a member of the MIT Nuclear Weapons Education Project and an independent consultant in nuclear weapons effects modeling and nuclear accident simulations. She is currently a graduate student at the Tokyo Institute of Technology and earned her bachelor degree in nuclear science and engineering from MIT in 2020.

Tanner Pharma Increases Europe-Based Inventory of Leukine® to Expand Availability and Enhance Response to Potential Radiation Exposure Due to the Ongoing Conflict in Ukraine

Source: https://www.biospace.com/article/releases/tanner-pharma-increases-europe-based-inventory-of-leukine-to-expand-availability-and-enhance-response-to-potential-radiation-exposure-due-to-the-ongoing-conflict-in-ukraine/

Leukine is FDA Approved to Treat Acute Radiation Syndrome (ARS) and Recommended in EMEA/CPMP Guidance to Treat Systemic Sulfur Mustard (HD) Gas Exposure

Mar 24 – Tanner Pharma Group, an international distributor of essential medicines, announced that it has significantly increased its inventory of Leukine (sargramostim, yeast-derived rhuGM-CSF) to be held in Europe. This action is being taken in partnership with Leukine's owner, **Partner Therapeutics** (PTx), in response to the ongoing war in Ukraine and escalating potential for incidents that could require rapid deployment of medical interventions to treat radiation or chemical exposure.

"In response to the ongoing conflict in Ukraine, Tanner is supporting preparedness and response in Europe by increasing the local inventory of Leukine that can be rapidly deployed in response to an emergency," said Banks Bourne, CEO and Founder of Tanner Pharma. "The unique efficacy of Leukine, which has been shown to improve survival **when given within 96 hours after radiation exposure** and without whole blood transfusions, makes it a highly effective countermeasure with important logistical advantages in the event of a nuclear detonation. Positioning more supply in Europe ensures that more Leukine is available quickly, if needed."

Leukine is an immune system modulator that is FDA approved to treat the hematopoietic effects of acute radiation syndrome and has been held for use by the U.S. Government as a medical countermeasure since 2013. Leukine is also recommended to treat H-ARS in the International Atomic Energy Association (IAEA) 2020 Medical Management of Radiation Injuries(1) and was used to successfully treat some victims of the Chernobyl Nuclear Power Plant in 1986.(2) Beyond ARS, Leukine is recommended in EMEA/CPMP Guidance Document on the Use of Medicinal Products for the Treatment of Patients Exposed to Terrorist Attacks with Chemical Agents as a treatment for exposure to sulfur mustard (HD) gas.(3) It is currently under development, but not currently FDA-approved for use against sulfur mustard exposure.

High doses of radiation profoundly damage the body's immune system. Damaged cells include monocytes, macrophages, platelets, neutrophils, dendritic cells and red blood cells, in other words, pancytopenia. Leukine stimulates each of these cell types and is shown to accelerate recovery from pancytopenia. Its broad impact enables increased survival from ARS without the need for blood transfusions. This is a critical advantage given the

expectation that after a radiological or nuclear event, blood products will be limited or unavailable. It is also the only ARS countermeasure that has been shown to be effective when administered more than 24 hours after exposure. In fact, the studies have shown efficacy when administered up to 96 hours after exposure. [4,5] In the aftermath of radiological or nuclear event, a 48-96 hour treatment window is absolutely critical. [6,7] The logistical challenges of making supplies and health care professionals available for response and treatment suggest it will be 2 days before drugs can be administered at any scale. Leukine is also stable at room temperature for 12 months, eliminating the need for a refrigerated supply chain in a crisis.

Below is a summary of the use of Leukine for Acute Radiation Syndrome (ARS) and Sulfur Mustard (HD) Gas Exposure provided by Partner Therapeutics:

ABOUT LEUKINE IN ACUTE RADIATION SYNDROME (ARS)

Leukine is FDA approved to increase survival in patients exposed to myelosuppressive doses of radiation (Hematopoietic Subsyndrome of Acute Radiation Syndrome or H-ARS). Data from multiple GLP NHP studies funded by the U.S. Biomedical Advanced Research and Development Authority (BARDA) demonstrate that Leukine increases survival by stimulating thrombopoiesis and significantly increasing platelet count in addition to accelerating the recovery of leukocytes and reticulocytes, thereby addressing all three primary components of hematopoietic damage from radiation exposure, collectively pancytopenia. NHP studies show that Leukine improves survival and accelerates recovery from myelosuppression (including thrombocytopenia) when given up to 96 hours post radiation exposure. [4,5,8] Leukine is not EMA approved for H-ARS. Leukine is a yeast-derived recombinant form of Granulocyte-Macrophage Colony Stimulating Factor (GM-CSF), a pleiotropic small protein that promotes the generation of megakaryocytic and erythroid progenitors and induces progenitor cells to divide and differentiate within the granulocyte and macrophage pathways. Leukine induces production, maturation and differentiation of the myeloid lineages of hematopoietic precursor cells, including granulocyte, macrophage, platelet, dendritic cell and red cell lineages. It also activates mature granulocytes and monocytes, increasing their phagocytic and lytic properties. Leukine's impact on platelets, monocytes, macrophages, and dendritic cells, in addition to its known effects on neutrophils, has been shown across several disease states and supports its use in H-ARS.
Leukine's FDA label in ARS reads: "To increase survival in adult and pediatric patients from birth to 17 years of age acutely exposed to myelosuppressive doses of radiation (Hematopoietic Subsyndrome of Acute Radiation Syndrome [H-ARS])," Leukine® for Injection: see www.leukine.com/pi for Leukine prescribing information.

ABOUT LEUKINE IN SULFUR MUSTARD (HD) GAS EXPOSURE

Leukine is not FDA or EMA approved to treat HD gas exposure. Leukine is recommended in EMEA/CPMP Guidance Document on the Use of Medicinal Products for the Treatment of Patients Exposed to Terrorist Attacks with Chemical Agents as a treatment for exposure to HD gas. HD exposure suppresses bone marrow function, leading to myelosuppression and pancytopenia. Leukopenia was reported in patients requiring hospitalization after exposure during WWI, WWII and the Iran-Iraq War, and mortality was reported in all cases where leukocyte counts dropped below 200/µl[6]. While mortality is reported in less than 2.5% of all exposed to HD, hematological damage is the primary driver of hospitalization and severe hematological damage is the primary cause of mortality. [10]
Leukine accelerates recovery of bone marrow function and recovery from pancytopenia and decreases deaths from infections in persons with bone marrow failure under diverse circumstances including following intensive chemotherapy and after acute high-dose whole body radiation in the context of hematopoietic cell transplants.[4,5,8] Both clinical experience in persons receiving Leukine after chemotherapy and therapeutic radiation and data from GLP NHP ARS studies supporting Leukine's approval and use in those indications, demonstrate that Leukine accelerates recovery from bone marrow suppression and pancytopenia and reduces the rate of infection and septicemia, and is likely to provide the same benefit after HD exposure. [4-5,9-11]
Tanner provides a regulatory-compliant pathway to make Leukine available in international markets.

●▶ References are available at the source's URL.

What's the Threat of Nuclear War Right Now?

By Sarah Kuta

Source: https://www.homelandsecuritynewswire.com/dr20220324-what-s-the-threat-of-nuclear-war-right-now

Mar 24 – Brian Toon has gotten emails from all over the world in the last few weeks, many from people frantically asking what to do or where to go if nuclear war breaks out.
Toon, a professor of atmospheric and space physics and atmospheric and oceanic sciences at the University of Colorado, Boulder, is a leading nuclear war researcher, so the sudden

flood of panicked messages makes sense. As Russian President Vladimir Putin ordered Russian troops to invade Ukraine on 24 February, he threatened any intervening country with "consequences you have never faced in history."
And during an interview Tuesday with CNN's Christiane Amanpour, Putin's chief spokesperson refused to rule out the possibility that Russia would consider using nuclear weapons.
Is Putin serious? And if Russia did deploy nuclear weapons, what would that mean for the rest of the world? Toon shared his nearly 40 years of nuclear expertise with *CU Boulder Today*, to shed some light on the situation.

Sarah Kuta: How real is the threat of nuclear war right now?

***Brian Toon*:** I don't think we should be very worried. Putin is fully aware that if he actually started a nuclear war, he would end up with Russia being a burning pile of rubble. There are only 200 cities in Russia with more than 100,000 people. The U.S. could attack every Boulder-sized and bigger city in Russia with 10 nuclear weapons. Putin is certainly aware of that, and I don't think he would want that. What he's trying to do is bully the West into not helping Ukraine.

Kuta: What are the other nuclear implications of Russia's invasion and Putin's threat?

***Toon*:** The world is always on a hair-trigger for nuclear war. The American president and the Russian leader have military people who follow them around with nuclear launch codes, because there are all these ground-based missiles that need to be launched within tens of minutes before they are destroyed if we are attacked.
For example, there are about 50 nuclear-tipped missiles just north of us near Fort Collins always waiting to be launched at Russia. It's dangerous, and it's open to accidents and misunderstandings, but it's unlikely anything is going to happen.

Kuta: What's the status of nuclear weapons around the world?

***Toon*:** In 1986, there were 70,000 nuclear weapons on the planet—it was totally out of control. Right now, there are about 13,000 on the planet. That build-down started when former President Ronald Reagan and Mikhail Gorbachev, former president of the Soviet Union, agreed to eliminate a lot of short-range nuclear weapons in Europe because the scientific community told them that if they used all these weapons, they were going to destroy most of the population on the planet.
Now, the U.S. and Russia are limited by treaty to have about 2,000 nuclear weapons each that are ready to fire; they have another 2,000 weapons each that are in storage or reserve that can be brought out in an emergency. The U.S. and Russia have 90% of the weapons; but Britain and France have 200 each; China has about 200; India and Pakistan have 150 each; Israel has around 100 and North Korea has some unknown number.

Kuta: How powerful are today's nuclear weapons?

***Toon*:** If you take the smallest nuclear weapon on an American submarine, the zone of death around ground zero is about 3 miles in radius, so drop just one of those in the middle of Denver and it would eliminate a large fraction of the city. An American submarine carries about 96 nuclear warheads, and they're each about 10 times more powerful than the Hiroshima bomb that killed 100,000 people in 1945. That means an American submarine could potentially kill 100 million people if it launched all of its bombs toward cities. And the Russians could do the same.

Kuta: What would happen if a country decides to use nuclear weapons?

***Toon*:** If there was a war between India and Pakistan, which are not very big nuclear weapons countries, and they used half of their arsenals, it would kill somewhere between 50 and 150 million people from the direct explosions in cities. But we think about 1 to 3 billion people would die globally because the smoke from the burning cities would get into the stratosphere and block sunlight. Ground temperatures would fall to Ice Age conditions within weeks and destroy agriculture. People would starve to death because they couldn't grow food.
With a nuclear war between the U.S., Europe and Russia, it would get even colder because there would be even more smoke. In grain-growing areas like Ukraine and Iowa, temperatures would fall below freezing for two years. Not only can you not grow anything, but you don't have transportation—the refineries are going to be destroyed, and power lines are all going to go down.
There's only enough food in a city for about six days, and there is only enough grain in global storage to feed the world's population for about 60 days. So, this is a threat to the global population, even if you're nowhere near where the explosions occurred.

Kuta: What long-term concerns do you have?

***Toon*:** Unfortunately, Russia and the U.S. have been in an arms race. In future decades, we could have a big problem with how short the warning time of an attack could be. Right now, the president has this 30-minute window to defend against missiles, but Russia is building weapons to shorten the warning time.
If the warning time is just minutes—there won't be time to wake up the U.S. president to have him or her decide to launch our missiles, so what are you going to do? Will we have to have artificial intelligence (AI) decide if we're being attacked and whether we should respond? We will be forced into a situation in which, instead of having the president decide, we're going to have some machine decide?

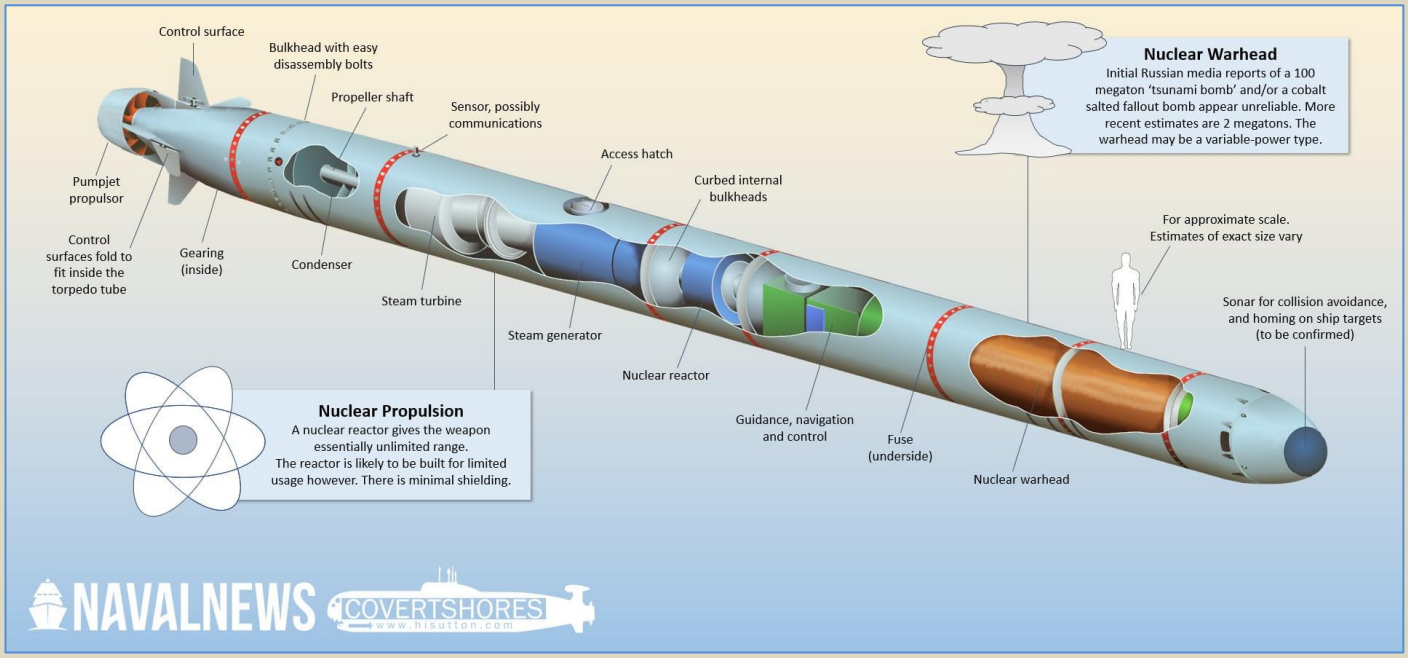
Kuta: What's your message to people who are worried about nuclear war right now?

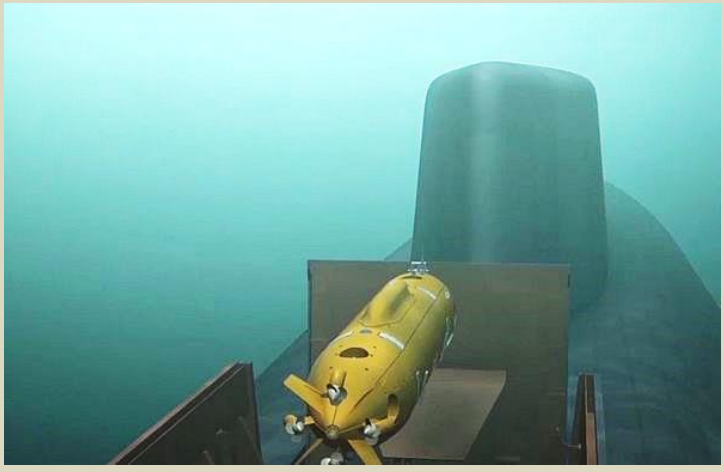
***Toon*:** People shouldn't dwell on this. We have enough problems with unending COVID and other social issues. But they should realize there are many nuclear weapons out there, and we need to do something so we don't have threats of nuclear war in the future. New treaties could prevent the use of AI from controlling nuclear weapons and stop the development of new types of nuclear weapons delivery systems that shorten the warning time. Removing land-based missiles in the U.S. could eliminate a target painted on America that we otherwise have to defend by attacking Russia with nuclear weapons if we think, with no time to be sure, that they are attacking us.

Sarah Kuta is a writer and editor.

Vladimir Putin unveils underwater Poseidon drone that carries nuclear warheads 'capable of causing 300ft tsunamis'

Source: https://www.mirror.co.uk/news/world-news/vladimir-putin-unveils-underwater-poseidon-12554382





May 18 – A nuclear-powered underwater drone capable of destroying enemy naval bases and causing huge tsunamis is under construction in Russia, according to a state news agency.

The Poseidon will be able to carry a nuclear warhead with a capacity of up to two megatonnes, a source told TASS.

The source said: "It will be possible to mount various nuclear charges on the 'torpedo' of the Poseidon multipurpose seaborne system, with the thermonuclear single warhead... to have the maximum capacity of up to 2 megatonnes in TNT equivalent."

With its nuclear munition, the underwater drone "is primarily designed to destroy reinforced naval bases of a potential enemy," the source said.

The drone will have a speed of 60-70 knots and will be operational at a depth of more than 1km.

TASS has not been able to confirm the information.

Rex Richardson, a physicist, told Business Insider: "A well-placed nuclear weapon of yield in the range 20 MT to 50 MT near a sea coast could certainly couple enough energy to equal the 2011 tsunami, and perhaps much more.

"Taking advantage of the rising-sea-floor amplification effect, tsunami waves reaching 100 meters [330 feet] in height are possible."
The project of developing the Poseidon drone was unveiled by Russian President Vladimir Putin in his State of the Nation address to the Federal Assembly on March 1.

The Russian leader said that these drones could be armed with both conventional and nuclear munitions and would be capable of destroying enemy infrastructure, carrier-led naval forces and other objectives.
Russia's president claimed the Poseidon will have "hardly any vulnerabilities" and said it would carry a "massive nuclear ordinance". He added: "There is simply nothing in the world capable of withstanding them."
Russian Navy Commander-in-Chief Sergei Korolyov later said that the new weapon would enable the fleet to accomplish a broad range of missions in waters adjacent to the enemy territory.
According to the chief naval commander, the trials of the drone's basic element, the small-sized nuclear powerplant, have already been carried out.
Poseidon drones together with their carriers make part of the so-called oceanic multipurpose system.
The drone got its name following the results of open voting on the website of Russia's Defense Ministry.

Meet the nuke the U.S. keeps in Europe, waiting to not be used

It's estimated there are 100 of these B61 nuclear bombs there, designed to unify NATO and deter Russia

By Dan Zak

Source: https://www.washingtonpost.com/lifestyle/2022/03/25/nuclear-weapon-b61-russia/

An empty B61 thermonuclear bomb at the National Atomic Testing Museum in Las Vegas in 2005. (Joe Cavaretta/AP)

Mar 25 – Near steep vineyards of riesling grapes, in an underground vault at an air force base in western Germany, sits an American nuclear bomb. More than one of them, actually. Each bomb is about the length of two refrigerators laid down end to end and as heavy as the average adult male musk ox. The bombs are slender and pointy and a little more than a foot wide. Experts estimate that there are about 100 such bombs stored among five NATO countries, ready to be loaded on jets and dropped by the United States and its allies — old-school style, parachute and all —

toward an enemy target. One version of this bomb can carry the explosive equivalent of 11 Hiroshimas.
The bomb's family name is B61. Over the past half-century, in various modifications, B61s have been sent to Europe to deter Russia and reassure the NATO alliance, and they remain there for those reasons. Scenarios for their detonation seem far-fetched — but perhaps not as far-fetched as they seemed a month ago. As Russia's invasion of Ukraine triggers another round of anxiety about World War III, the B61 remains the only U.S. nuclear weapons system based in Europe, a forward-deployed reassurance for NATO at a time when Russian President Vladimir Putin is rattling his own nuclear saber.
The B61 is loaded with meaning. It embodies the paradox, inertia, specter, bargain and cost of nuclear weapons, especially at a moment like this.
Is it ammunition for a hot war or an artifact of a cold one? Both? Neither?
"The political value of these weapons is immense," says Franklin C. Miller, who was President George W. Bush's senior director for defense policy and arms control, referring to the B61s. "NATO governments view them as a major political commitment — the visible, touchable, tangible side of our extended deterrent."
"I remember a chief of staff of the Air Force who asked me if we could get rid of our nuclear weapons in Europe," says Andy Weber, who was assistant defense secretary for nuclear, chemical and biological defense programs under President Barack Obama. "There's no military value to our nuclear weapons in Europe. Zero. They're there for purely political reasons."
The B61 is nevertheless a bomb. It serves a purpose sitting in a vault because it would serve a purpose if dropped from a plane.
"It provides the alliance with a nuclear response — that's its military value," says retired Gen. Philip Breedlove, supreme allied commander of NATO from 2013 to 2016 and now chair of the Frontier Europe Initiative for the Middle East Institute.
How might a B61 be used? During an escalating hypothetical conflict between NATO and Russia, a single nuclear warning shot from Russia into Poland could invite an allied nuclear response: a B61 dropped on a military site in Kaliningrad, for example. This in turn could prompt a Russian escalation, and then — if things continue down that path — all-out nuclear war with the United States, resulting in at least 91.5 million casualties worldwide, according to a 2019 simulation from Princeton University's Program on Science and Global Security. At that point, we could confront levels of horror that have been confined to theory and fiction for 77 years. If, for example, an 800-kiloton Russian intercontinental ballistic missile detonated 1.8 miles above the White House, there could be half a million fatalities and people might endure third-degree burns from Silver Spring, Md., to Alexandria, Va., according to Nukemap, a modeling website created by nuclear-weapons historian Alex Wellerstein.
U.N. Secretary General António Guterres said on March 14 that "the prospect of nuclear conflict, once unthinkable, is now back within the realm of possibility," referring to Putin's decision to put his nuclear forces on alert.
Appearing Tuesday on CNN, a spokesman for Putin refused to rule out the use of nuclear weapons, particularly if the Kremlin perceives an "existential threat" to Russia.
National security adviser Jake Sullivan noted Tuesday during a White House press conference that it was Putin who, early on, "raised the specter of the potential use of nuclear weapons."

An inert B61 casing at the Hill Aerospace Museum in Utah. (Jon G. Fuller/VWPics/AP)

"It is something we do have to be concerned about," Sullivan said. "Based on our current analysis, we have not changed our nuclear posture to date. But we are constantly monitoring for that potential contingency."
What could rouse the B61s from their underground slumber? The classic scenario, Miller says, involves NATO being unable to halt a Russian invasion using its nonnuclear defenses. But the United States has a variety of other, smarter options than the B61 in its nuclear and nonnuclear arsenals. Even in an escalation scenario, the 50-year-old deterrent we keep in the ground might stay there.
"I suppose you could fairly ask me, 'If we were starting fresh, would we need those weapons there?'" Miller says of the B61s. "The answer might be no. But we're not starting fresh, and these weapons have a long history."
The B61 was birthed in the years after the Cuban missile crisis because the Air Force was interested in the possibility of dropping nukes from low-flying aircraft at high speeds, according to the second volume of Chuck Hansen's "Swords of Armageddon." The B61 could

be used as a "tactical" or "nonstrategic" nuke on a battlefield, against a forward military target, as opposed to a "strategic" obliterating strike, behind enemy lines, on a seat of government or city.

In the late summer of 1969, scientists and military commanders gathered in Los Alamos, N.M., the birthplace of the atomic bomb, for a three-day symposium on tactical nuclear weapons. It had been almost a quarter-century since World War II ended with a pair of nuclear attacks on Japan and two decades since the founding of the North Atlantic Treaty Organization, or NATO, which by then had grown to 15 countries.

The tactical nuclear program in Europe "remains the single most unifying element in NATO," Gen. David A. Burchinal, then-deputy head of U.S. European Command, said in his remarks. "We must launch a determined program in weapons developments and weapons improvement to meet our present and future requirements," he said. "We cannot rest on the laurels of 20 years of relative calm in NATO Europe."

The new B61 family, in other words, was welcome but insufficient.

By 1975 the United States had in Europe 6,951 tactical nuclear warheads and 145 nuclear storage sites, according to a declassified memo sent to Secretary of State Henry Kissinger. The idea was deterrence: Any Soviet incursion into Europe would risk a limited nuclear strike, which could escalate to an all-out strategic war, which would outweigh any benefits of an incursion, according to James M. Acton, co-director of the nuclear policy program at the Carnegie Endowment for International Peace.

The B61 is left over from those days. It is a bomb that promotes unity by threatening the apocalypse.

"There was a time earlier in my career when I supported the withdrawal of these weapons from Europe," Acton says. "I've changed that because I think there's a number of allies that value them, and I think — especially given recent Russian actions — that they are important enough to a number of countries that I wouldn't want to undermine NATO unity by trying to withdraw them."

The leadership of NATO — of which Ukraine is not a member — has committed to remaining a nuclear alliance as long as nuclear weapons exist.

"At a time when discussions of lethal autonomous weapons, drone swarms and the weaponisation of outer space make modern warfare seem like a sci-fi thriller, nuclear weapons can seem as retro as a Sony Walkman or landline telephone," Jessica Cox, NATO's director of nuclear policy, wrote in 2020. "And yet, nuclear-armed nations such as Russia and China are once again investing heavily to create more sophisticated and diverse nuclear arsenals, North Korea is continuing its nuclear expansion apace, and Iran is once again making headlines for its nuclear developments."

And so the B61 persists, albeit at a fraction of the size of Russia's larger tactical nuclear force, which is undergoing updates and "possesses significant advantages" over the arsenals of the United States and its allies, according to the Trump administration's Nuclear Posture Review in 2018. The estimated 100 U.S. bombs beneath European landscapes are waiting not for detonation so much as refurbishment. (If bombs stick around, bombs get old.) In May, the United States is scheduled to begin full-scale production of a modernized version of the B61 that will have an adjustable yield — meaning that the military can dial up or down the force with which each bomb explodes — and a guided tail kit to improve accuracy (no parachute necessary).

This modernization, which started more than a decade ago, is predicted to cost between $9.1 billion and $10.1 billion — making it probably the most expensive nuclear-bomb program in U.S. history, according to Hans Kristensen, director of the Nuclear Information Project at the Federation of American Scientists.

"Ever since the end of the Cold War, there have been fewer and fewer" U.S. nuclear weapons in Europe, Kristensen says, and many U.S. officials "say we don't need that stuff there anymore." But for some, he says, the invasion of Ukraine "reaffirms the need for these weapons in Europe," and the modernization of the B61 "commits to the next era of forward deployment of nuclear weapons."

In this way, the life of the B61 evokes the U.S. nuclear arsenal in general: Aged, yet born anew. Mostly hidden but always at the ready. Sacrosanct to some, outmoded to others.

Jon Wolfsthal, senior director for arms control and nonproliferation on Obama's National Security Council, says U.S. officials might wish that the billions spent on B61 modernization were instead invested in nonnuclear capabilities, American troop presence and support for Ukraine.

"When I was in government, we argued the B61 and nuclear-sharing in NATO is essential for alliance unity, right? It turns out it's not," says Wolfsthal, a senior adviser to the anti-nuclear nonprofit Global Zero. "What's essential for NATO unity is the threat of Russia."

The mood in Germany — where for years the parliament has held debates on phasing out custody of those B61s by the vineyards — "has changed significantly since the Russian invasion of Ukraine," says Xanthe Hall, a nuclear-disarmament expert for the German chapter of International Physicians for the Prevention of Nuclear War. "People are actually scared and have woken up to the fact that nuclear weapons threaten them personally."

"The reaction to this is very strong but in both directions. Many people are calling for abolition of nuclear weapons," she says, while "others are saying that nuclear deterrence is our only protection." On March 14 Germany announced that it would replace its aging bomber jets

with American F-35s that can also carry B61s, signaling a recommitment to the allies' nuclear-sharing agreement.
Critics of the modernized B61 consider it not a relic of the Cold War or a sign of NATO unity but essentially a new and destabilizing type of bomb, with its "dial-a-yield" capability and increased precision potentially lowering the threshold for use in a conflict, Hall says.
Jill Hruby, the administrator of the U.S. National Nuclear Security Administration, said in a December statement that the B61's refurbishment "improves accuracy and reduces yield with no change in military characteristics, while also improving safety, security and reliability."
While the bombs are being altered, so is the rhetoric around them. In recent years both Russia and the United States have increasingly sent signals about using nuclear weapons in conflict rather than strictly as deterrents to conflict, according to Christine Parthemore, chief executive of the Council on Strategic Risks.
"Around 2015, 2016 I started hearing people in the Pentagon talk about it much more openly, in a way that sounded like they were normalizing it," says Parthemore, who attributes this partly to the belligerent rhetoric of Putin and North Korean leader Kim Jong Un. "If we think nuclear weapons are primarily or entirely for deterring nuclear weapons *use*, they should be sitting somewhere and maintained as an afterthought, as a political weapon, and seen as not having useful warfighting capability."
But the warfighting capability is what imbues a bomb with its deterrent value, according to experts, and a modernized B61 — with its higher accuracy paired with the low yield — might be a more conceivable option in a military conflict.
"The greatest danger of nuclear war are these so-called smaller, tactical weapons on ambiguous delivery vehicles," Weber says. "Somehow using vanilla terms like 'low yield' makes it seem like they're acceptable."
As Jim Mattis told the House Armed Services Committee in 2018 when he was defense secretary: "I don't think there is any such thing as a 'tactical nuclear weapon.' Any nuclear weapon used any time is a strategic game-changer."
Perhaps as soon as next year, in a world reshaped by however this Russian invasion plays out, NATO soil will be reseeded with modernized nuclear bombs from the United States. They will remain underground and out of sight — but never far from the surface.

Dan Zak is a reporter for The Washington Post. He writes a wide range of news stories, narratives and profiles from local, national and foreign assignments, from the Academy Awards to Fallujah, Iraq. He joined The Post in 2005.

Wildfires break out in Chernobyl amid a non-functioning radiation-monitoring system

By Susan D'Agostino
Source: https://thebulletin.org/2022/03/wildfires-break-out-in-chernobyl-amid-a-non-functioning-radiation-monitoring-system/

Mar 23 – Seven wildfires have broken out in the exclusion zone surrounding the Chernobyl Nuclear Power Plant, the site of the world's worst nuclear disaster, according to a statement by Ukraine's Parliament. The fires, which were observed via satellite, exceed Ukraine's emergency classification criteria tenfold. Ukrainian officials stated that the fires were caused by "the armed aggression of the Russian Federation, namely the shelling or arson," though this has not been independently verified. Wildfires risk mobilizing and dispersing radioactive contaminants left over from the 1986 nuclear accident at Chernobyl.
Ukrainian firefighters have been unable to access the area since Russia took control in the first days of the war. Energoatom, Ukraine's state nuclear company, also reported this week that Chernobyl's radiation monitoring system is no longer working. Without the data that system would provide, radiation levels in the region may rise unchecked. Though the Chernobyl nuclear power plant is no longer operational, it requires constant management.
Ukraine's State Agency on Exclusion Zone Management also reported this week that the Russian military destroyed a six-million-euro laboratory that, in part, worked to improve radioactive waste management, according to the *Associated Press*. The lab contained "highly active samples and samples of radionuclides" that could have been released, according to the agency.
Seasonal wildfires are common during spring and summer in the region surrounding Chernobyl. An April 2020 wildfire required more than 100 fire trucks with accompanying firefighters to extinguish; still, it burned more than 8,600 acres. Following that fire, the Chernobyl management team adopted early intervention efforts, such as moving firefighting equipment to the region in advance of fires, that helped mitigate risks. The team also offered fire-prevention education to workers in and residents living near the region. Those efforts kept the 2021 fire season under control, Kateryna Pavlova, Chernobyl's Head of the Department for International Cooperation and Public Relations, told the *Bulletin*. "Last year, we prepared the exclusion zone to [prevent] a big fire, but this year it's the opposite," Pavlova said. "We are not prepared." She added that the wildfires of concern started in March this year, whereas in years past, such fires, including the big one in 2020, started in April.

Fire in the Chernobyl Exclusion Zone from an earlier wildfire in April 2020. Credit: State Agency of Ukraine on Exclusion Zone Management. Accessed via Wikipedia. CC BY 4.0.

The current wildfire crisis follows a series of unfortunate events at the infamous Chernobyl site in the past month. After Russian forces took control of Chernobyl, they held hundreds of plant workers hostage in what the International Atomic Energy Agency call a "dire situation." The staff worked at gunpoint, without replacement and despite exhaustion, to maintain safety at the nuclear facility. This week, some of the staff were freed, with priority given to those who were sick, after more than three weeks of captivity. Many of those who have been released have been unable to return to their families as the Russian military has not provided safe corridors, Pavlova reported. Earlier this month, the plant also was cut off from the power grid, which raised concerns about monitoring the level and temperature of water in spent nuclear fuel cooling pools. The plant operated on emergency diesel generators during the power outage, and power has since been restored. Russian forces also shelled and took control of Ukraine's Zaporizhzhya Nuclear Power Plant—the largest in Europe—earlier this month. Though that incident resulted in no change in radiation levels, nuclear experts have expressed concern that an intentional or accidental wartime strike on a power plant's reactor or spent fuel cooling pools could exact a significant human and environmental toll.

Susan D'Agostino is an associate editor at the *Bulletin of the Atomic Scientists*. Her writing has been published in *The Atlantic, Quanta Magazine, Scientific American, The Washington Post, BBC Science Focus, Wired, Nature, Financial Times, Undark Magazine, Discover, Slate, The Chronicle of Higher Education*, and others. Susan is the author and illustrator of How To Free Your Inner Mathematician: Notes on Mathematics and Life (Oxford University Press, 2020). She is a member of the editorial board of the Mathematical Association of America's *Math Horizons* magazine. Susan earned a PhD in mathematics at Dartmouth College and an MA in science writing at Johns Hopkins University. She has received science writing fellowships from the National Association of Science Writers, the Council for the Advancement of Science Writing, and the Heidelberg Laureate Forum Foundation.

North Korea tests a banned missile—and glamorizes nuclear weapons

By Susan D'Agostino

Source: https://thebulletin.org/2022/03/north-korea-tests-a-banned-missile-raising-speculation-and-concern/

North Korea's state television released a propaganda video about its recent missile launch featuring Kim Jong Un. Screenshot accessed via Korea Now, the official YouTube Channel of the Yonhap News Agency. Yonhap is funded in whole or in part by the Korean government.

Mar 25 – North Korea launched what is presumed to be a banned intercontinental ballistic missile (ICBM) toward the East Sea on Thursday, according to South Korea's *Yonhap News Agency*, marking an "end to its self-imposed moratorium on nuclear and long-range missile testing." Though Pyongyang has conducted other missile tests this year, this test involved what appeared to be the most powerful missile North Korea has launched. The test comes during a time when the world's gaze has been fixed on Russia's war in Ukraine, which just entered its second month.

"This launch is a brazen violation of multiple UN Security Council resolutions and needlessly raises tensions and risks destabilizing the security situation in the region," White House Press Secretary Jen Psaki said in a statement.

North Korea claimed that the missile was a Hwasong-17—a "monster missile" according to analysts—first unveiled in a 2020 military parade. After Thursday's launch, North Korea's state television released a Hollywood-esque video featuring Kim Jong Un in dark sunglasses and a leather jacket, flanked by generals, in a slow-motion walk accompanied by heart-pounding music while the colossal weapon rolls out behind him. The men check their

watches (who wears a watch these days?). A red light flashes and beeps, the missile launches in a cloud of exhaust and fire, and men in a control room erupt with cheers while shaking their fists. The propaganda video does not hint at the humanity-ending potential of nuclear weapons.

The missile reportedly traveled 1,080 kilometers (670 miles), reached an altitude of 6,200 kilometers (3,850 miles), and flew for 71 minutes, according to the *Associated Press*. If confirmed as an intercontinental ballistic missile, the incident suggests that North Korea has made significant progress in developing a nuclear weapons delivery system that could reach the United States.

"My suspicion is that the payload for this particular test may have been a single, representative dummy warhead to demonstrate maximum range," Ankit Panda, author of *Kim Jong Un and the Bomb: Survival and Deterrence in North Korea*, wrote on Twitter.

Japanese Prime Minister Fumio Kishida, upon arriving in Belgium for the Group of Seven meetings focused on the war in Ukraine, called North Korea's launch "unforgivable recklessness."

South Korea, in a demonstration of its retaliatory capabilities, launched missiles from air, sea, and land off its east coast in response. South Korean President Moon Jae-in said that the launch represented a "breach of the suspension of intercontinental ballistic missile launches promised by Chairman Kim Jong Un to the international community." Moon is scheduled to leave office on May 10 after losing in a tight election to incoming President Yoon Suk-yeol. The new president has promised to be tougher on North Korea and to strengthen ties with the United States.

North Korea's nuclear arsenal has made "significant advances" in recent decades, according to Hans Kristensen and Matt Korda, both of the Nuclear Information Project at the Federation of American Scientists. Kristensen and Korda are the authors of the Nuclear Notebook, published bimonthly in the *Bulletin of the Atomic Scientists*. In their last column focused on North Korea, they estimated that the country "may have produced **enough fissile material to build between 40 and 50 nuclear weapons**; however, it may not have actually assembled that many."

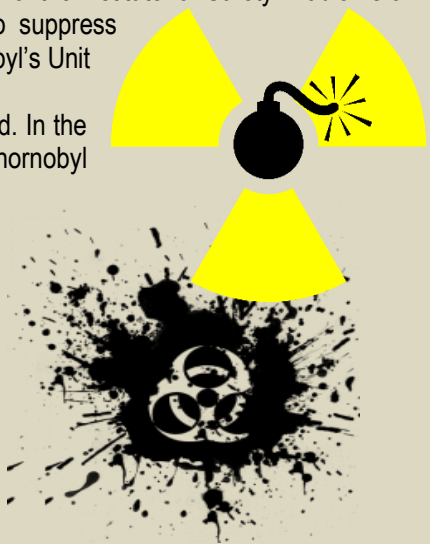
After North Korea's 2017 missile tests, the United Nations Security Council, on which the United States, Russia, and China are permanent members, imposed dramatic sanctions on North Korea. Given the lines that have since been drawn in the war in Ukraine, cooperation on additional sanctions seems unlikely.

In the weeks leading up to Thursday's provocation, the United States and South Korea had grown increasingly concerned about the prospect of North Korea testing an ICBM. "The door has not closed on diplomacy," Psaki said in the White House statement, "but Pyongyang must immediately cease its destabilizing actions."

Dirty bomb ingredients go missing from Chornobyl monitoring lab

Source: https://www.science.org/content/article/dirty-bomb-ingredients-go-missing-chornobyl-monitoring-lab

Mar 25 – When the lights went out at Chornobyl Nuclear Power Plant on 9 March, the Russian soldiers holding Ukrainian workers at gunpoint became the least of Anatolii Nosovskyi's worries. More urgent was the possibility of a radiation accident at the decommissioned plant. If the plant's emergency generators ran out of fuel, the ventilators that keep explosive hydrogen gas from building up inside a spent nuclear fuel repository would quit working, says Nosovskyi, director of the Institute for Safety Problems of Nuclear Power Plants (ISPNPP) in Kyiv. So would sensors and automated systems to suppress radioactive dust inside a concrete "sarcophagus" that holds the unsettled remains of Chornobyl's Unit Four reactor, which melted down in the infamous 1986 accident.



Although power was restored to Chornobyl on 14 March, Nosovskyi's worries have multiplied. In the chaos of the Russian advance, he told *Science*, looters raided a radiation monitoring lab in Chornobyl village—apparently making off with radioactive isotopes used to calibrate instruments and pieces of radioactive waste that could be mixed with conventional explosives to form a "dirty bomb" that would spread contamination over a wide area. ISPNPP has a separate lab in Chornobyl with even more dangerous materials: "powerful sources of gamma and neutron radiation" used to test devices, Nosovskyi says, as well as intensely radioactive samples of

material leftover from the Unit Four meltdown. Nosovskyi has lost contact with the lab, he says, so "the fate of these sources is unknown to us."

The drama at Chornobyl began on 24 February, the very first day of the invasion. At 5 a.m., as Russian troops poured across Ukraine's border with Belarus—just 15 kilometers from Chornobyl—ISPNPP managers were ordered to evacuate most staff, who monitor the safety of the plant, provide technical support for decommissioning, and develop protocols for managing radioactive waste in the off-limits "exclusion zone" surrounding Chornobyl. Within 2 hours, 67 had cleared out; two who live in Chornobyl village stayed behind to keep an eye on the institute's lab. "We've lost contact with these brave people," says ISPNPP senior scientist Maxim Saveliev. By 5 p.m., Russian troops had taken control of all Chornobyl facilities. A shift supervisor, Valentin Geiko, negotiated a deal under which the plant's Ukrainian guards would disarm and the Russian soldiers would not interfere with civilian workers, Nosovskyi says. But for nearly a month, the soldiers forbade a shift change—essentially holding the workers hostage—and confiscated their cellphones. In a gesture of defiance, the workers played the Ukrainian national anthem every morning, cranking up the volume, Nosovskyi says. Finally, earlier this week, the occupiers allowed fresh staff to rotate in. But some captive workers chose to remain, he adds, "so as not to put at risk people who should come in their place."

Chornobyl is not the only Ukrainian nuclear installation at risk in the war. On 4 March, Russian forces shelled the Zaporizhzhya nuclear power plant—fortunately missing its reactor halls. Two days later, a rocket attack damaged a research reactor used to generate neutrons for experiments at the Kharkiv Institute of Physics and Technology. Nosovskyi labels the assaults as nothing short of state-sponsored "nuclear terrorism."

But Chornobyl has a unique set of radioactive hazards. On 11 March, wildfires ignited in the nearby radioactive forests, which harbor radioisotopes that were disgorged in the accident and taken up by plants and fungi. Russian military activities have prevented firefighters from entering the exclusion zone, Nosovskyi says. The fires continue to burn and could grow more intense as the weather warms, he says, releasing radiation that could lead to "significant deterioration of the radiation situation in Ukraine and throughout Europe." So far, remote measurements suggest radioactive particle concentrations in the smoke do not pose a health hazard, he adds, but an automated radiation monitoring system that went down in the power outage has not yet been brought back online. That means "there is no information on the real situation in the exclusion zone," says Viktor Dolin, research director of the Institute for Environmental Geochemistry in Kyiv.

The restoration of electricity averted the nightmare of a hydrogen explosion in the spent fuel repository, where 8500 tons of uranium fuel rods continue to cool off in pools of water. The repository poses a major radioactive threat: Through radioactive decay, the assemblies have accumulated about 240 times more cesium-137 and 1500 times more strontium-90 than the destroyed reactor spewed in 1986, Dolin says. Staff intend to punch holes in the repository's walls to allow hydrogen gas to escape in the event of a future power outage, Nosovskyi says.

The other big menace at Chornobyl are the fuel-containing masses (FCMs)—fuel rods, zirconium cladding, and other materials that melted into radioactive conglomerations during the accident and continue to smolder under Unit Four's sarcophagus, hastily erected in the wake of the disaster. For years Ukrainian scientists, with Russian colleagues from the Kurchatov institute, have kept a tense vigil. (The institute severed ties with its Ukrainian partners in a statement earlier this month supporting the war and the "denazification" of Ukraine.) Occasional spikes in the number of neutrons streaming from certain FCMs—a sign of fission—prompt sprinkler systems to spray gadolinium nitrate solution, which absorbs neutrons. The odds of self-sustaining fission, or criticality, in an FCM are minuscule, and even if criticality triggered a small explosion, the burst would probably be contained within an arching steel structure, called the New Safe Confinement (NSC), that was erected over the sarcophagus in 2016 to shield it from the elements and create a safe space for cleanup work. But the NSC was not designed to withstand shelling, and a breach could disturb the FCMs. It could also release some of the hundreds of tons of highly radioactive dust that have accumulated in the sarcophagus over the years as the FCMs gradually disintegrate. Thousands of other sites in Ukraine have radiological materials. Most are under the watchful eye of Ukraine's nuclear regulator. "There's a lot of ongoing effort to secure material," says Peter Martin, a nuclear physicist at the University of Bristol who collaborates with scientists at Chornobyl. That means, where possible, moving sources into vaults and repositories. But Vitaly Fedchenko, a nuclear security expert at the Stockholm International Peace Research Institute, notes that Ukraine, like other parts of the former Soviet Union, has not kept track of all the Soviet nuclear legacy. "There are a lot of radioactive sources that are not on anyone's radar," he says. "Even Ukraine's radar."

Richard Stone is senior science editor at the Howard Hughes Medical Institute's Tangled Bank Studios in Chevy Chase, Maryland.

EDITOR'S COMMENT: A fact? Fake news? Propaganda news? To be used by Russians to blame Ukrainians? To be used by Ukrainians to blame Russians? To cover the smuggling of nuclear material? Only time will show reality; let's hope that all nuclear material will remain safe and in place – for now and the future!

Middlebury Institute of International Studies at Monterey
James Martin Center for Nonproliferation Studies

An Indian perspective on China's nuclear weapons

Source: https://capsindia.org/wp-content/uploads/2022/02/New-Delhi-Paper-9.pdf

Mar 25 – China's response to its security challenges from the US appears to entail a 'hedging' nuclear strategy involving asymmetric and competitive 'assured retaliation' capabilities. These include nuclear modernization marked by the deployment of Multiple Independently Targetable Reentry Vehicles (MIRVs) and Hypersonic Glide Vehicle (HGV) to counter the US missile defense systems. Further, while Beijing's nuclear strategy is primarily geared towards the US, it also has inconspicuous involvement in the nuclear dynamics in its immediate neighborhood. China is involved in protracted territorial disputes with its nuclear armed neighbor India. The territorial disputes led the two states to war in 1962, and in recent times, have caused frequent border skirmishes. Although both China and India have never issued a nuclear threat to each other, Beijing often views New Delhi as a peripheral threat. China has been involved in building Pakistan's nuclear weapons capabilities, which the latter uses to balance against India.

The existing global nuclear dynamics are marked by nuclear multipolarity—a situation much different from the bipolar Cold War context — which make nuclear deterrence increasingly complex and enmeshed. Changes in the nuclear capabilities of either the US or China inevitably disturb the strategic nuclear balance between Beijing and New Delhi. Further, any attempt by India to redraw the strategic balance vis-à-vis China is bound to pull Pakistan into an offense-defense spiral. This way, the overlapping dyads get morphed into a chain of security dilemmas and strategic rebalancing.

China's evolving nuclear posture in the context of nuclear multipolarity presents a unique and complex set of challenges for the world's security. This monograph attempts to analyze the gradual developments in China's nuclear capabilities and strategy and their implications on global and Southern Asian strategic stability. Conjoined to this endeavor is an attempt to highlight the Indian variable in Beijing's nuclear strategic calculus, and to bring out an Indian perspective on China's nuclear strategy.

Domestic Preparedness

Radiation Emergency Medical Challenges and A Global Pandemic

By Ron Cain

It seems that every day over the past two years there are plenty of news stories covering the strain hospitals are facing in staffing shortages and the impacts from a global pandemic. Emergency medical services (EMS) are also dealing with their own similar issues across the nation. Many of these critical facilities and services are located in the proximity of nuclear power plants in which previous agreements were established to provide treatment, patient transportation, radiation monitoring, and decontamination in the event of a patient-generating event within a nuclear power plant's emergency planning zones.

Ron Cain is a radiological emergency preparedness coordinator for a state emergency management agency. He has previous experience as a hospital and small county emergency manager. He has over 25 years of experience as a paramedic in the county, military, and private EMS systems. He is a graduate of the National Fire Academy's EMS Special Operations and Advanced Life Support for Hazardous Materials Incidents Course and a graduate of the REAC/TS Radiation Emergency Medicine Course. He is a state-certified emergency manager and has earned undergraduate and graduate degrees in disaster and emergency management.

Iran's Centrifuges: Models and Status

Source: https://www.iranwatch.org/our-publications/weapon-program-background-report/irans-centrifuges-models-status

Mar 30 – Iran possesses thousands of gas centrifuges that are the mainstay of its nuclear program. Gas centrifuges spin uranium hexafluoride gas (UF6) to separate uranium isotopes suitable for nuclear fuel, a process known as uranium enrichment.[1] The number and capacity of these machines determine Iran's "breakout" time: how long it would take Iran—if it decided to do so—to produce the fuel for a small nuclear arsenal. The machines are also key to Iran's ability to "sneakout" by producing nuclear weapon fuel at secret sites.

In recent years, Iran has developed and deployed centrifuge models that can enrich greater amounts of uranium with fewer machines relative to its original IR-1 design. Iran's increasing mastery of centrifuge design and manufacturing raises the risk of a "sneakout," and it reflects an acquisition of knowledge that cannot be reversed.

The table below sets out the capacity and primary materials of each of Iran's currently-deployed centrifuge models, as well as the number of each model known from publicly-available IAEA reports[2] to be installed and/or producing enriched uranium at Iran's three declared enrichment sites: the Fuel Enrichment Plant (FEP) and Pilot Fuel Enrichment Plant (PFEP) at Natanz and the Fordow Fuel Enrichment Plant (FFEP) at Fordow.

In addition to the models listed in the table, Iran has developed several other centrifuge designs that are not currently installed at any of its declared sites, either because they are still under development or have so far proven unsuccessful in operation. These include the IR-2, IR-3, IR-6m, IR-6sm, IR-6smo, IR-8s, and IR-9s.

This table is based on a November 2021 Iran Watch report, Beyond the IR-1: Iran's Advanced Centrifuges and their Lasting Implications, which contains detailed analysis of each centrifuge model. The table is updated periodically as the IAEA releases new information.

MODEL	CAPACITY (SWU/yr)[3]	ROTOR ASSEMBLY MATERIAL[4]	FIRST TESTED[5]	# INSTALLED	# IN PRODUCTION MODE[6]
IR-1	~0.8[7]	Aluminum + maraging steel	Late 1990s	**Total: 7147** *at FEP: 6084* *at PFEP: 18* *at FFEP: 1045*	**Total: 6301** *at FEP:[11] 5239* *at PFEP: 18* *at FFEP: 1044*
IR-2m	~4-5[8]	Maraging steel + carbon fiber	2009	**Total: 1080** *at FEP: 1044* *at PFEP: 36* *at FFEP: 0*	**Total: 1077** *at FEP: 1044* *at PFEP: 33* *at FFEP: 0*
IR-4	~4-5[8]	Carbon fiber	2009	**Total: 523** *at FEP: 348* *at PFEP: 175* *at FFEP: 0*	**Total: 521** *at FEP: 348* *at PFEP: 173* *at FFEP: 0*
IR-5	6-10[9]	Carbon fiber[10]	2013	**Total: 39** *at FEP: 0* *at PFEP: 39* *at FFEP: 0*	**Total: 36** *at FEP: 0* *at PFEP: 36* *at FFEP: 0*
IR-6	6-10[9]	Carbon fiber[10]	2013	**Total: 545** *at FEP: 0* *at PFEP: 213* *at FFEP: 332*	**Total: 374** *at FEP: 0* *at PFEP: 208* *at FFEP: 166*
IR-6s	3-6[9]	Carbon fiber[10]	2013	**Total: 40**	**Total: 39**

MODEL	CAPACITY (SWU/yr)[3]	ROTOR ASSEMBLY MATERIAL[4]	FIRST TESTED[5]	# INSTALLED	# IN PRODUCTION MODE[6]
				at FEP: 0 *at PFEP: 40* *at FFEP: 0*	*at FEP: 0* *at PFEP: 39* *at FFEP: 0*
IR-7	11-20[9]	Carbon fiber[10]	2019	**Total: 1** *at FEP: 0* *at PFEP: 1* *at FFEP: 0*	**Total: 0** *at FEP: 0* *at PFEP: 0* *at FFEP: 0*
IR-8	16-24[9]	Carbon fiber[10]	2017	**Total: 1** *at FEP: 0* *at PFEP: 1* *at FFEP: 0*	**Total: 0** *at FEP: 0* *at PFEP: 0* *at FFEP: 0*
IR-8B	10-15[9]	Carbon fiber[10]	2019	**Total: 1** *at FEP: 0* *at PFEP: 1* *at FFEP: 0*	**Total: 0** *at FEP: 0* *at PFEP: 0* *at FFEP: 0*
IR-s	8-12[9]	Carbon fiber[10]	2019	**Total: 10** *at FEP: 0* *at PFEP: 10* *at FFEP: 0*	**Total: 10** *at FEP: 0* *at PFEP: 10* *at FFEP: 0*
IR-9	34-50[9]	Carbon fiber[10]	2021	**Total: 1** *at FEP: 0* *at PFEP: 1* *at FFEP: 0*	**Total: 0** *at FEP: 0* *at PFEP: 0* *at FFEP: 0*

Footnotes:

[1] Nautral uranium contains about 0.7 percent of the fissionable isotope U-235. Uranium is considered enriched when the concentration of U-235 is increased. Uranium enriched to 3-5 percent concentration of U-235 is suitable for nuclear reactors. Weapons-grade uranium is usually defined as 90 percent U-235.

[2] As of March 3, 2022.

[3] The capacity of a centrifuge is measured in “separative work units” (SWU) per year. SWU reflect the effort needed to separate the two uranium isotopes (U-235 and U-238) in the enrichment process. A centrifuge with a higher SWU per year can enrich greater quantities of uranium to higher levels in shorter periods of time than a less efficient centrifuge.

[4] The rotor of a centrifuge is what spins the uranium hexafluoride (UF6) gas to separate uranium isotopes. Centrifuges use “bellows” between rotors to form a rotor assembly that allows for flexibility when spinning at higher speeds. The bellows and the rotors themselves must be made with strong, lightweight material. Carbon fiber is an ideal material for this purpose, but aluminum and specialty steels such as maraging steel can also be used.

[5] Fed with UF6; excludes mechanical testing.

[6] Accumulating enriched uranium

[7] Calculated from output data contained in IAEA reports.

[8] Based on the capacity of the Pakistani P2 centrifuge, the base model for the IR-2m and IR-4.

[9] The low end of the range is based on estimates contained in "A Comprehensive Survey of Iran's Advanced Centrifuges" by David Albright, Sarah Burkhard, and Spencer Faragasso, published by The Institute for Science and International Security on December 2, 2021 and available at https://isis-online.org/isis-reports/detail/a-comprehensive-survey-of-irans-advanced-centrifuges; the high end of the range consists of nominal claims made by Iranian officials or Iranian media (possibly referring to kg UF6 SWU/yr, which has a value 1.47 times higher than the more standard kg U SWU/yr).

[10] Due to technological progression, centrifuges developed after the IR-4 are assumed to have their rotor assembly made entirely from carbon fiber even when not explicitly confirmed as such.

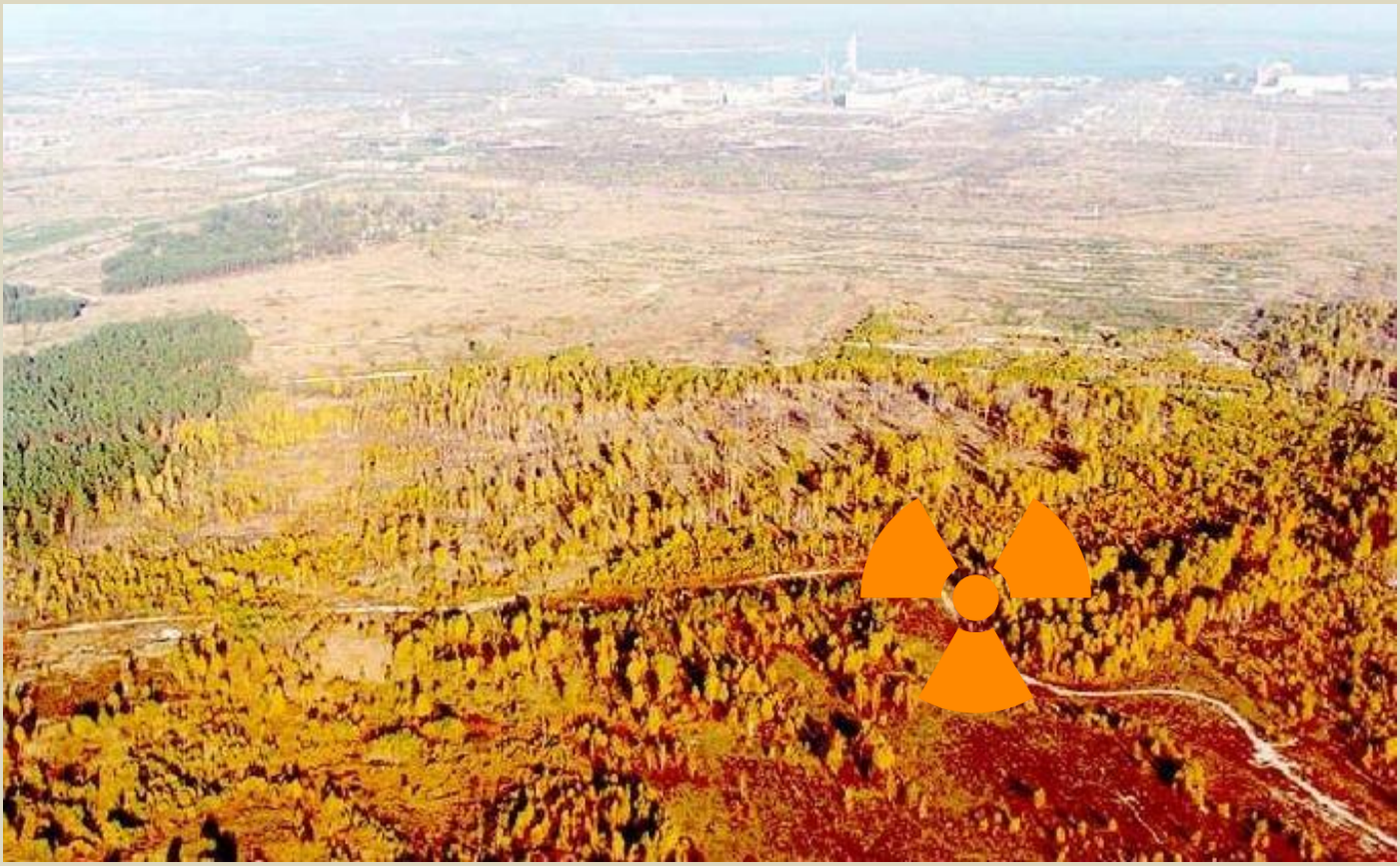
[11] The IR-1 production mode number for FEP is an estimate based on an average of 169 machines per cascade, obtained by dividing the total number of machines planned in the

April 9, 2021 Iranian DIQ reported in GOV/INF/2021/24 (6084), by the number of planned cascades (36). That average is multiplied by the number of cascades (31) reported in GOV/2022/4 to be in production mode.

Russian troops leaving Chernobyl nuclear site 'have acute radiation sickness'

Source: https://www.mirror.co.uk/news/world-news/retreating-russian-troops-leaving-chernobyl-26596437

Mar 30 – Russian troops leaving the Chernobyl nuclear site have 'acute radiation sickness', it has been claimed.
The Pentagon confirmed Russian troops were pulling out of the irradiated nuclear wasteland, but an employee at the Public Council at the State Agency of Ukraine for Exclusion Zone Management said they were running away "irradiated".
He said they were being transported by the bus load to a special radiation medical centre in Gomel, Belarus to help treat their radioactive poisoning.
In a post on Facebook, Yaroslav Yemelianenko, who worked to keep the site safe, said: "Another batch of radiation irradiation of Russian terrorists who captured the Chernobyl zone, was brought to the Belarusian center of radiation medicine in Gomel today.
"Digging the trenches in the Rudu forest[1], bitches? Now live the rest of your short life with this. There are rules of handling this



territory. They are mandatory to perform because radiation is physics - it works regardless of status or chases. If you have minimal intelligence in command or soldiers, these consequences could have been avoided."

[1] The Red Forest (*Rudyi lis*, literally "ginger-color forest") is the 10-square-kilometre (3.9 sq mi) area surrounding the Chernobyl Nuclear Power Plant within the Exclusion Zone located in Polesia. The name "Red Forest" comes from the ginger-brown color of the pine trees after they died following the absorption of high levels of radiation from the Chernobyl accident on 26 April 1986. In the post-disaster cleanup operations, the Red Forest was bulldozed and buried in "waste graveyards".The site of the Red Forest remains one of the most contaminated areas in the world today.

He went onto quote a Belarusian TV channel which said "about 7 medical PAZs arrived at the Republican Scientific and Practical Center for Radiation Medicine and Human Ecology.
"The photo shows that people are visible in cars. Let's note that Russian soldiers are brought to this centre on a regular basis"
This shocking revelation comes as US intelligence confirmed Russian soldiers have withdrawn from the site.
It also comes days after Russian claimed it would 'drastically reduce combat operations' around Kyiv.
Earlier this week, Moscow claimed it would take the significant step as a gesture to advance peace talks, but both Ukrainian and US officials expressed scepticism about Russian intentions.

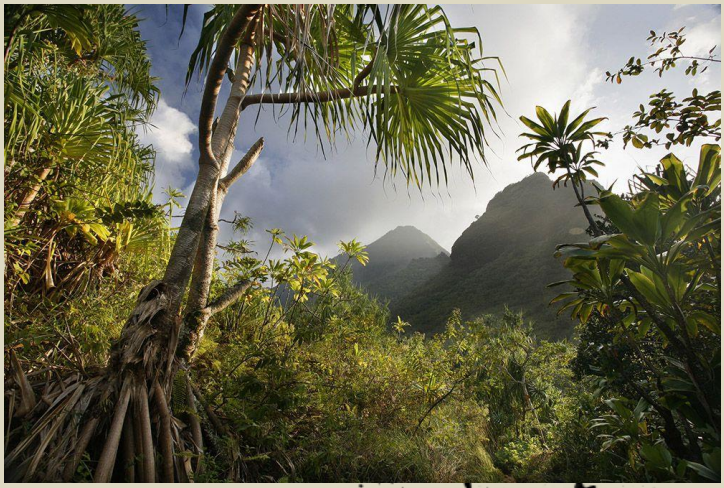
Food Security During a Nuclear Winter

Source: https://www.homelandsecuritynewswire.com/dr20220331-food-security-during-a-nuclear-winter

Mar 31 – The day after lead author Daniel Winstead approved the final proofs for a study to be published in *Ambio*, the journal of the Royal Swedish Academy of Sciences, Russia put its nuclear forces on high alert.
"In no way, shape or form had I thought that our work — "Food Resilience in a Dark Catastrophe: A new Way of Looking at Tropical Wild Edible Plants" — would be immediately relevant while we were working on it," said the research technologist in Penn State's College of Agricultural Sciences. "In the short term, I viewed it as an abstract concept."
Winstead and study co-author Michael Jacobson, professor of forest resources, had to look back at the Cold War era to get information for their review.
"So, it did not enter my mind that it would be something that could happen anytime soon," Winstead said. "This paper was published during this latest invasion by Russia into Ukraine, but our work on it began two years ago. The idea that nuclear war could break out now was unthinkable to me."
The research acknowledges what has been widely agreed upon for decades: In higher latitude countries — such as nuclear powers the U.S. and Russia — there would be no agricultural production and little food gathering possible in a nuclear winter after an all-out conflagration. If warring countries unleashed large portions of their nuclear arsenals, the resulting global, sun-blocking cloud would turn the ground to permafrost.
A nuclear war would cause global blockage of the sun for several years due to injections of black carbon soot into the upper atmosphere, covering most of the planet with black clouds, the researchers said. Computer models predict that a large nuclear war, primarily between Russia and the U.S., could inject upwards of 165 million tons of soot into the upper atmosphere from more than 4,000 nuclear bomb explosions and ensuing wildfires.

Such a nuclear war could result in less than 40 percent of normal light levels near the equator and less than 5 percent normal light levels near the poles, with freezing temperatures in most temperate regions and severe precipitation reductions — just half of the worldwide average — according to the study. Post-catastrophe conditions, which could last 15 years in some wet tropical forests such as those in the Congo and Amazon basins, could cause a 90 percent reduction in precipitation for several years after such an event.

But tropical forests would offer an opportunity for limited food production and gathering by local inhabitants because, despite the dense soot clouds, the region would be warmer. In the study, researchers classified wild, edible plants into seven main categories, augmented by forest insects: fruits, leafy vegetables, seeds/nuts, roots, spices, sweets and protein.



In a nuclear winter, the study shows, the following foods would be available in varying degrees in tropical forests: konjac, cassava, wild oyster mushroom, safou, wild spinaches, vegetable amaranths, palms, mopane worm, dilo, tamarind, baobab, enset, acacias, yam and palm weevil.
The researchers chose 33 wild, edible plants from a list of 247 and considered their potential for cultivation in tropical forests in post-nuclear war conditions. Their selections were complicated by the fact that in the tropics there are relatively few food-bearing plants that are both drought tolerant and shade or low-light tolerant.
Post-catastrophe conditions would be unlivable for humans in many areas around the world, and agriculture may not be possible, the researchers concluded. This study shows how just

a few of the many tropical wild, edible plants and insects could be used for short-term emergency food cultivation and foraging after an atmospheric soot injection from a catastrophic event such as a nuclear war.
The world's tropical forests hold many underutilized crops and resources, Jacobson pointed out. This study offers a new perspective on global food security and resilience using forest foods, along with policy and preparedness recommendations.
"But regardless of the risk of nuclear war, there are numerous other existential threats, not least being climate change," he said. "Meeting food security — and nutrition — in the face of any of these risks is clearly one of humanity's major challenges over the next decades. To that end, it is imperative that we better understand our food production, supply and value chains to make them less vulnerable and more adaptable in times of crises."
This study is part of a much larger project, "Research on Emergency Food Resilience," underway at Penn State. Open Philanthropy provided funding for this work. Much of the data for this review came from a previous research paper.

How Russia Might Deploy Nukes in Ukraine War

By Peter Brookes
Source: https://www.heritage.org/global-politics/commentary/how-russia-might-deploy-nukes-ukraine-war

Mar 31 – With Russian forces struggling mightily to subjugate Ukraine in the face of incredible resistance from both the Ukrainian army and ordinary citizens, observers are concerned about the Kremlin escalating the war with the use of nuclear weapons.
At this point, it's arguably "low risk," but it's not "no risk."
Moscow could certainly decide to move the war from conventional to nuclear at any time. As such, we must take the threat of the use of Russian nuclear weapons very seriously, surveil it intensely, and prepare for the possibility of a nuclear event.
But under what circumstances might Russia use a nuke against Ukraine—or as part of the Ukraine conflict?
Dmitry Medvedev, former Russian president and current deputy chairman of the Russian Security Council, outlined Moscow's policy on using nuclear weapons in an interview Saturday, according to The Guardian:
Number one *is the situation when Russia is struck by a nuclear missile. The* ***second case*** *is any use of other nuclear weapons against Russia or its allies. The* ***third*** *is an attack on a critical infrastructure that will have paralyzed our nuclear deterrent forces, and the fourth case is when an act of aggression is committed against Russia and its allies, which jeopardized the existence of the country itself, even without the use of nuclear weapons, that is, with the use of conventional weapons.*
That's relatively clear, but that's not all.
Russia also has a secretive "escalate to deescalate" doctrine for the use of nuclear weapons that Medvedev didn't mention—unsurprisingly—in that list of four conditions. This unspoken possibility is perhaps the most likely scenario of all.
Let's face it: The war isn't going well for Vladimir Putin & Co. What the Kremlin thought would be a three-day dash to Kyiv has turned into a monthlong slog, which has seen Russian forces losing general officers, troops, and equipment at an alarming rate.
The outcome—once thought to overwhelmingly favor Moscow—is up for grabs.
That state of affairs doesn't bode well for the Kremlin and its cronies. Even authoritarian leaders care about public opinion at home and the effect it might have on the regime's control over the country.
Losing the war in Ukraine would have repercussions on Russia internationally, too, including significant reputational costs, likely diplomatic pariah status, punishing economic costs, and a demoralized, depleted military.
In other words, losing in Ukraine will be plenty painful for Putin and his pals—and this is when, unfortunately, the use of nuclear weapons potentially comes into play for the Russians.
Indeed, Putin might use a nuke (or more) in an (as yet unproven) "escalate to deescalate" plan for advancing Russia's unjust goals in Ukraine.
Although there is debate about the effectiveness of using a nuke on the battlefield in Ukraine, alternatively Russia could pop off a low-yield, tactical (aka battlefield) nuke over an unpopulated area, or even the Arctic Ocean.
The point would be to send a clear signal to the U.S., NATO, and others who are supporting the Ukrainian political and military resistance that their backing must end—immediately.
If they choose otherwise, the risk would be that Moscow might escalate from a single, low-yield battlefield nuke over an unpopulated territory to high-yield theater or intercontinental-range nukes targeting populated areas in these countries.
The Kremlin might calculate that Ukraine's supporters (e.g., NATO) don't have the political will to risk a wider conflict or chance a move up the nuclear-escalation ladder.
Ukraine's backers—and Ukraine itself—would have to make some fateful choices.
Using the "escalate to deescalate" nuclear stratagem, Moscow potentially could force any number of advantageous political and military outcomes to the war in Ukraine, including a victory that avoids the unpleasantries of a loss.

Of course, the use of a nuclear weapon in war for the first time since World War II is a troubling idea to contemplate. But we must understand that the Russian political and military playbook includes pages on the use of nukes.
Consequently, we must consider Russia's use of nuclear weapons a real possibility, monitor the movement of Russian nuclear forces with vigor, and prepare for making the tough choices that the possibility of a nuclear event would bring.

Peter Brookes is a Senior Research Fellow, Weapons of Mass Destruction and Counter Proliferation @ the Davis Institute for National Security and Foreign Policy.

EDITOR'S COMMENT: Why after reading similar articles I have the impression that many people and "experts" would be satisfied with a nuclear war? All this threat literature simply adds to the problem without providing anything useful other than the usual 10 minutes of publicity.

Iran's Nuclear Timetable: The Weapon Potential

By Valerie Lincy and Gary Milhollin
Source: https://www.iranwatch.org/our-publications/articles-reports/irans-nuclear-timetable-weapon-potential

Mar 31 – This timetable estimates how soon Iran could enrich enough uranium to fuel a small nuclear arsenal. It assumes Iran would try to build an arsenal of five warheads of the implosion type – the goal Iran set for itself when it began to work on nuclear weapons decades ago. With its thousands of gas centrifuges, some operating and some in storage, Iran can enrich uranium to a grade suitable for nuclear reactor fuel or to a higher grade suitable for nuclear weapons. On January 5, 2020, Iran announced that it would no longer observe any limit (such as that set by the nuclear accord of 2015) on the use of its centrifuges, or on the possession of uranium they enrich. Since then, Iran has expanded its stockpile of enriched uranium, increased the enrichment level of that stockpile, and brought more advanced centrifuges into operation.
The potential is estimated as of mid-February 2022, the date of inspection contained in the latest public report by the International Atomic Energy Agency (IAEA). Because Iran has reduced its cooperation with the Agency, it is no longer able to verify Iran's stockpile of enriched uranium. The Agency's reports are only able to estimate its contents. The analysis below is based on those estimates.

Summary

Iran's nuclear program has reached the point at which, within a few months, Iran could enrich enough uranium for five fission weapons. For that uranium to pose a nuclear weapon threat, however, it would have to be processed further, and the other components of a successful weapon would have to be ready to receive the processed uranium. These additional steps, together with the several months for enrichment, mean that Iran cannot yet make a dash to a small nuclear arsenal within a practical length of time. Such a dash would probably be detected before it could succeed, and would invite retaliation Iran could not deter. A dash to a single weapon would take less time but would not be practical. Such a weapon would have to be tested,[1] which would consume all the nuclear material the dash produced.
Iran's ability to enrich uranium quickly has improved with its recent progress in the testing and deployment of more powerful centrifuge models. Centrifuge performance is measured in separative work units (SWU), which indicates the work required to increase the concentration of the fissionable U-235 isotope. Iran has installed several cascades of these new models in production lines where they have steadily increased both the size and enrichment level of Iran's uranium stockpile. This progress increases the risk of secret sites – permitting them to be smaller and easier to hide. Iran has used such sites to carry out illicit activity in the past and they continue to pose the greatest nuclear weapon risk. That risk has increased further recently because of Iran's decision to limit inspections by the IAEA, block IAEA access to recorded data from centrifuge production plants, and refuse to cooperate with the Agency's investigation of three suspicious sites.
These steps by Iran are parts of the long nuclear game Iran has been playing for decades.

Nuclear Weapon Potential of Iran's Centrifuges and Low-Enriched Uranium

As of February 2022, Iran was operating 31 cascades of IR-1 centrifuges as well as eight cascades of more powerful centrifuges (six IR-2m cascades and two IR-4 cascades) at the Natanz Fuel Enrichment Plant (FEP). In addition, Iran was operating 1,044 IR-1 centrifuges and 166 more powerful IR-6 centrifuges at the Fordow Fuel Enrichment Plant (FFEP) and several hundred more centrifuges at the Natanz pilot plant, notably the IR-4 and IR-6. Iran also had several thousand IR-1 centrifuges in storage at Natanz and continues to test other more powerful centrifuge models in smaller numbers at the Natanz pilot plant.

Some of these models are adding to Iran's enriched uranium stockpile. By deploying them in larger numbers, Iran would be able to produce nuclear weapon fuel more quickly.
Iran's centrifuges have not produced uranium usually defined as weapon-grade, which is uranium enriched to 90% in the isotope U-235. All of Iran's production has been at lower grades. Thus, the lower-grade uranium would have to be enriched further to reach at least 90%. The estimates below assume that, in a dash to make weapons, Iran would rely on its IR-1 and IR-2m centrifuges now operating, and would use its accumulated stockpile of enriched uranium[2] to produce nuclear weapon fuel. Iran's enriched uranium stockpile already contains sufficient uranium to fuel five nuclear warheads with further enrichment.[3] The estimates also assume that the IR-1 centrifuges currently operating will perform at the same rate they have in the past and that the IR-2m centrifuges would perform at 80% of their estimated nominal output.[4]

Estimated minimum time it would take Iran's IR-1 and IR-2m centrifuges presently installed in production mode to enrich enough uranium for		
	As of May 1, 2022	**As of July 15, 2022**
One weapon	1.2 weeks[5]	1.2 weeks[10]
Two weapons	2.1 weeks[6]	1.7 weeks[11]
Three weapons	3.7 weeks[7]	3.3 weeks[12]
Four weapons	7 weeks[8]	5.1 weeks[13]
Five weapons	11.6 weeks[9]	9 weeks[14]

These estimates are the minimum theoretical times it would take Iran's known installed centrifuges, operating continuously at their proved capacity, to accomplish the required amount of work. The time actually needed in practice would be greater. The estimates assume that only the IR-1 and IR-2m centrifuges, which have been successfully operating in production mode for some time, would be used. The time estimate for five bombs can be expected to fall in the coming months, as Iran brings more centrifuges into production mode and raises the enrichment level of its uranium stockpile.
It is important to consider that the enriched uranium produced would be in a gaseous compound, uranium hexafluoride (UF6). It would take additional time to convert the uranium in the gas to metallic form, and then to cast and machine the metal into weapon components. According to the IAEA, Iran began work on uranium metal production in early 2021. The uranium metal, however, would only be a threat if Iran had already perfected all the other parts needed for a working weapon, such as the high explosives and firing circuit, and had made sure the parts would work together to achieve a nuclear explosion. There is ample evidence in the public domain that Iran has tried to achieve that goal (see Weaponization below), but no conclusive evidence that it has succeeded.

The Risk of Secret Sites
Intelligence agencies have long been unanimous in one prediction: If Iran makes nuclear weapons, it would do so at secret sites. The reasons are clear. If, in a dash to make weapons, Iran were to divert known (and therefore inspected) sites, material, or equipment to weapon making, it would risk detection before success, would violate the Nuclear Nonproliferation Treaty (NPT) and would make itself an international pariah. It would also invite an attack on the very sites, material and equipment it diverted. No country has ever chosen to make an illicit diversion and dash to weapons, probably for the reasons just stated.
The data below reveal that as Iran develops more powerful centrifuges, it would need ever smaller sites to enrich weapon quantities of uranium. And the smaller the site, the more difficult it will be to detect. For example, operating at 80% of its nominal capacity, Iran's IR-2m centrifuge, of which Iran has at least 1,000, could enrich the same amount of uranium as the IR-1 centrifuge in approximately one-fifth the space. Iran's enrichment plant at Fordow, which was publicly exposed in 2009, was built clandestinely by Iran to house about 3,000 centrifuges. For this reason, the estimates below use 3,000 centrifuges as the possible size of a secret enrichment plant.

Estimated minimum time it would take 3,000 of Iran's IR-2m[15] centrifuges operating at an assumed 80% of nominal capacity and starting with natural uranium to enrich enough uranium for	
One weapon:	Four months[16]
Five weapons:	One year and eight months[17]

These centrifuges would require only about 32,000 square feet, equal to approximately twice the size of the ice surface of a professional hockey rink.[18] Alternatively, Iran could decide to split these 3,000 IR-2m centrifuges equally among three smaller sites of approximately 11,000 square feet each. That would decrease the size of each site and therefore the likelihood of detection. Each site would be about two-thirds the size of the ice surface of a professional hockey rink.[19] By February 2022, Iran was operating six cascades of IR-2m centrifuges (approximately 1,050 machines) in production mode at the Natanz Fuel Enrichment Plant, as well as two cascades of IR-4 centrifuges, which are estimated to have a capacity similar to the IR-2m.[20]
Also by February 2022, Iran was feeding a cascade of up to 164 IR-4 centrifuges and a cascade of up to 164 IR-6 centrifuges in production mode at the Pilot Fuel Enrichment Plant,[21] and a cascade of 166 IR-6 centrifuges in production mode at the Fordow Fuel Enrichment plant.[22] According to Iran, the IR-6 produces about 10 SWU per year, ten times as much as the IR-1. If so, it could enrich the same amount of uranium in a fraction of the space. Iran's claim to a capacity of 10 SWU has been strengthened recently by Iran's plan for Fordow, where two cascades of IR-6 machines are intended to produce the feed for the IR-1 centrifuges enriching up to 20% U-235.[23] To produce enough feed for this configuration, each IR-6 machine would have to produce at least 6.6 SWU.[24]

Estimated minimum time it would take 3,000 of Iran's model IR-6[25] centrifuges operating at an assumed 80% of nominal capacity and starting with natural uranium to enrich enough uranium for	
One weapon:	Two months[26]
Five weapons:	Ten months[27]

These IR-6 centrifuges would require approximately the same space as the model IR-2m centrifuges above, or approximately twice the size of the ice surface of a professional hockey rink. The space requirements above reveal that as Iran develops more efficient centrifuges, it could rely on ever smaller sites to enrich weapon quantities of uranium.

The Status of Weaponization Efforts
The analysis above assumes that Iran would use 16 kg of highly enriched uranium metal (about 90% U-235) in the finished core of each nuclear weapon. Sixteen kilograms are assumed to be sufficient for an implosion weapon. This was the amount called for in a design for such a device that has circulated on the nuclear black market, to which Iran has had access.
Some experts believe that Iran could use less material, assuming Iran would accept a lower yield for each weapon. According to these experts, Iran could use as few as seven kilograms of this material if Iran's weapon developers possessed a "medium" level of skill, and if Iran were satisfied with an explosive yield slightly less than that of the bomb dropped on Hiroshima, Japan.[28] If Iran chose to use an amount smaller than 16 kg, the time required to make the fuel for each weapon would be less than estimated here. Or, in the amount of time estimated here, Iran could make a greater number of weapons. Iran could decide not to use such a smaller amount of uranium if Iran wanted to have more confidence that its weapons would work, or if it wanted to reduce the size of its weapons by reducing the amount of high explosive.
According to an investigation by the IAEA into "possible military dimensions" of Iran's nuclear program, Iran had a coordinated nuclear weapon program between 1999 and 2003. Specifically, the IAEA found that Iran developed several components of a nuclear weapon and undertook related research and testing. The investigation revealed Iran's efforts in the following areas:

- computer modeling of implosion, compression, and nuclear yield;
- high explosive tests simulating a nuclear explosion using non-nuclear material in order to see whether an implosion device would work;
- the construction of at least one containment vessel at a military site, in which to conduct such high explosive tests;
- studies on detonation of high explosive charges, in order to ensure uniform compression in an implosion device, including at least one large scale experiment in 2003, and experimental research after 2003;
- support from a foreign expert in developing a detonation system suitable for nuclear weapons and a diagnostic system needed to monitor the detonation experiments;
- manufacture of a neutron initiator, which is placed in the core of an implosion device and, when compressed, generates neutrons to start a nuclear chain reaction, along with validation studies on the initiator design from 2006 onward;
- the development of exploding bridgewire detonators (EBWs) used in simultaneous detonation, which are needed to initiate an implosive shock wave in fission weapons;
- the development of high voltage firing equipment that would enable detonation in the air, above a target, in a fashion only making sense for a nuclear payload;
- testing of high voltage firing equipment to ensure that it could fire EBWs over the long distance needed for nuclear weapon testing, when a device might be located down a deep shaft; and

- a program to integrate a new spherical payload onto Iran's Shahab-3 missile, enabling the missile to accommodate the detonation package described above.

Information obtained by Israeli intelligence and revealed in April 2018 indicates that Iran sought to preserve this program after 2003 by dividing its nuclear program between covert and overt activities and retaining an expert team to continue work on weaponization. This "atomic archive" includes blueprints, spreadsheets, charts, photos, and videos – apparently official Iranian documents – that provide additional detail about Iran's efforts to develop a working nuclear weapon that could be delivered on a ballistic missile.

Need for Enriched Uranium?

Iran has no need to enrich large quantities of uranium for reactor fuel, which is the stated aim of its centrifuge enrichment program. Russia is fueling Iran's only power reactor (at Bushehr) and stands ready to do so indefinitely at a cost much lower than Iran would incur by enriching the uranium itself.[29]

If Iran did try to make the fuel itself, it is unlikely that Iran could field enough centrifuges to do so within the next ten years, or even longer. A standard sized power reactor (1,000 MWe) such as Iran's reactor at Bushehr requires about 21 metric tons of low-enriched uranium fuel per year, which would require generating nearly 100,000 SWU.[30] Iran's centrifuges now produce about 9,000 SWU. Thus, Iran would have to increase its capacity more than tenfold to have any plausibility as a civilian effort.

In an October 2015 letter to then-President Hassan Rouhani, Iran's Supreme Leader Ali Khamenei called upon the government to develop a plan for the country's nuclear industry to achieve an annual uranium enrichment capacity of 190,000 SWU within 15 years. In order to accomplish this, Iran would have to manufacture, install, and operate almost 240,000 additional IR-1 centrifuges, based on their historic output. Or, Iran would have to perfect, manufacture, and deploy in production mode a lesser number of more powerful centrifuges. It is uncertain how long it would take Iran to accomplish either of these steps, but either would take many years.

Iran's Violations of Nuclear Accord

Following the U.S. withdrawal from the 2015 nuclear accord in May 2018, Iranian leaders threatened to stop implementing some of Iran's commitments under the accord. Approximately one year later Iran began doing so. The table below summarizes the steps Iran has taken since July 2019.

Date	Iran's Violations of the 2015 Accord
July 2019	Begins enriching uranium above the 3.67% U-235 limit set by the accord, to a level of up to 4.5% U-235.
August 2019	Exceeds the cap of 300 kg of UF6 on its stockpile of low-enriched uranium set by the accord.
September 2019	Expands its centrifuge research and development beyond the limits set by the accord, both in the number and type of more powerful centrifuge it operates.
November 2019	Resumes uranium enrichment at locations beyond those mandated by the accord, including the Fordow plant and the Natanz pilot plant.
January 2020	States it will no longer limit the number of centrifuges in operation, which had been capped at 5,060 IR-1 centrifuges operating at the Natanz Fuel Enrichment Plant.
July 2020	Announces plans to transfer more powerful IR-2m, IR-4, and IR-6 centrifuges from the Natanz pilot plant to the Natanz Fuel Enrichment Plant. The accord limits Iran to the use of IR-1 centrifuges at the Fuel Enrichment Plant.
October 2020	Installs IR-2m centrifuges and begins installing IR-4 centrifuges at the Natanz Fuel Enrichment Plant.
November 2020	Begins uranium enrichment in a cascade of 174 IR-2m centrifuges at the Natanz Fuel Enrichment Plant.
January 2021	Begins enriching uranium to the level of 20% U-235 at the Fordow plant and begins uranium enrichment in a second cascade of 174 IR-2m centrifuges at the Natanz Fuel Enrichment Plant.
February 2021	Begins installing IR-6 centrifuges at the Fordow plant and uses a facility in Isfahan to produce uranium metal, which the accord prohibits for 15 years.
February 2021	Stops implementing transparency measures, including the Additional Protocol to Iran's Comprehensive Safeguards Agreement and additional transparency and access measures allowed under the accord.
April 2021	Begins enriching uranium up to 60% U-235.
May 2021	Installs equipment to produce uranium metal in quantity.

Footnotes:

[1] In a dash, Iran would be expected to use its uranium to fuel a weapon with an implosion design, such as the bomb dropped on Nagasaki, Japan; such a weapon would have to be tested to prove it worked, as was the Nagasaki bomb. A gun-type device such as the one dropped on Hiroshima without being tested, would require more than twice as much uranium.

[2] The IAEA estimated, but was unable to verify, that as of February 19, 2022, Iran's uranium stockpile contained 2883.2 kg of uranium in the form of uranium hexafluoride (UF6), 33.2 kg of which was enriched "up to" a level of 60% in the fissionable isotope U-235, 182.1 kg of which was enriched "up to" a level of 20% U-235, and 1,277.9 kg of which was enriched "up to" a level of 5% U-235. The U-235 isotope makes up about .7% of natural uranium; its concentration can be increased, or enriched, using centrifuges.

[3] Twenty kilograms of uranium in the form of UF6 enriched to 90% U-235 are assumed to be sufficient for one weapon. The uranium would need to be further processed into finished metal weapon components, which is assumed to cause about a 20% loss of material.

[4] According to pre-2016 production data from Natanz, Iran's IR-1 centrifuges have achieved an average annual output of about .8 separative work units, or SWUs, per machine. The IR-2m is based on Pakistan's P-2 centrifuge and is assumed in these estimates to have an operational output of 4 SWU (and a nominal output of 5 SWU). See Alexander Glaser, "Characteristics of the Gas Centrifuge for Uranium Enrichment and Their Relevance for Nuclear Weapon Proliferation (corrected)," Science and Global Security, Vol. 16, Nos. 1-2 (2008), p. 9. The SWU is the standard measure of the effort (work) required to increase the concentration of the fissionable U-235 isotope. See http://www.urenco.com/index.php/content/89/glossary.

[5] Iran's stockpile of enriched uranium is held at various enrichment levels and is sufficient in U-235 to fuel five nuclear warheads. Thus, these calculations assume that Iran would use this enriched stockpile in a dash to make weapons. The following table estimates Iran's stockpile as of May 1, 2022.

IRAN'S ESTIMATED LEU STOCKPILE (5/1/22)	IF ENRICHED TO WEAPON GRADE (90% PRODUCT)	SWU REQUIRED	NUMBER OF NUCLEAR WEAPONS
33.6 kg up to 60% U-235 (~54%)	20 kg	95 SWU	One weapon (95 SWU)
10.2 kg up to 60% U-235 (~54%)	6 kg	29 SWU	
72.5 kg up to 20% U-235 (~18%)	14 kg	218 SWU	Two weapons (342 SWU)
104.7 kg up to 20% U-235 (~18%)	20 kg	315 SWU	Three weapons (657 SWU)
51.6 kg up to 20% U-235 (~18%)	9.9 kg	155 SWU	
258.1 kg up to 5% U-235 (~4.5%)	10.2 kg	417 SWU	Four weapons (1,229 SWU)
508.6 kg up to 5% U-235 (~4.5%)	20 kg	821 SWU	Five weapons (2,050 SWU)

These theoretical calculations are generated using a SWU calculator published by URENCO, a European uranium enrichment consortium. The calculations assume that 100 kg of 90% U-235 in the form of UF6 would be needed for an arsenal of five nuclear weapons. The tails are assumed to be 1% and because the IAEA describes the enrichment level as "up to" a percentage, a lower feed enrichment percentage is used for these calculations (included parenthetically).

Iran's stockpile on May 1, 2022 is estimated by using the IAEA's latest reported production rate of uranium enriched up to 60% U-235 (0.149 kg per day) and up to 20% U-235 (0.657 kg per day) between November 2021 and February 2022.

With an output of .8 SWU annually, Iran's 31 cascades of IR-1 centrifuges at FEP (assumed to contain about 168 machines per cascade) would generate about 4,166 SWU per year, Iran's 1044 IR-1 centrifuges at FFEP would produce about 835 SWU per year, and Iran's six cascades of IR-2m centrifuges at FEP (assumed to contain about 174 machines per cascade) would generate about 4,176 SWU per year assuming an operational capacity of 4 SWU per machine. The IR-2m is based on Pakistan's P-2 centrifuge and is assumed in these estimates to have a nominal output of 5 SWU.

If Iran chose to produce enough enriched uranium for one weapon, it could do so by feeding uranium enriched up to 60% U-235 into either the cascades of IR-1 or IR-2m centrifuges at FEP. In either case, it would take the centrifuges at least 1.2 weeks to accomplish the necessary enrichment work (95 SWU). To reduce the time further would require feeding both the IR-1 and IR-2 cascades at the same time, an additional step Iran may not deem necessary in light of the short time frame.

[6] If Iran fed uranium enriched up to 60% U-235 and up to 20% U-235 into its IR-1 and IR-2m centrifuges being fed in production mode at FEP, at their estimated capacity of 8,342 SWU (see Note 5 above) they would take at least 2.1 weeks to accomplish the necessary enrichment work for two weapons (342 SWU).
[7] If Iran fed uranium enriched up to 20% U-235 into all of its IR-1 and IR-2m centrifuges being fed in production mode, at their estimated capacity of 9,177 SWU (see Note 5 above) they would take at least 3.7 weeks to accomplish the necessary enrichment work for three weapons (657 SWU).
[8] If Iran fed uranium enriched up to 20% U-235 and uranium enriched up to 5% U-235 into all of its IR-1 and IR-2m centrifuges being fed in production mode, at their estimated capacity of 9,177 SWU (see Note 5 above) they would take at least 7 weeks to accomplish the necessary enrichment work for four weapons (1,229 SWU).
[9] If Iran fed uranium enriched up to 5% U-235 into all of its IR-1 and IR-2m centrifuges being fed in production mode, at their estimated capacity of 9,177 SWU (see Note 5 above) they would take at least 11.6 weeks to accomplish the necessary enrichment work for five weapons (2,050 SWU).
[10] As in Note 5 above, Iran's stockpile on July 15, 2022 is estimated by using the IAEA's latest reported production rate of uranium enriched up to 60% U-235 (.149 kg per day) and up to 20% U-235 (.657 kg per day) as of February 2022.

IRAN'S ESTIMATED LEU STOCKPILE (3/15/22)	IF ENRICHED TO WEAPON GRADE (90% PRODUCT)	SWU REQUIRED	NUMBER OF NUCLEAR WEAPONS
33.6 kg up to 60% U-235 (~54%)	20 kg	95 SWU	One weapon (95 SWU)
21.5 kg up to 60% U-235 (~54%)	12.8 kg	61 SWU	
37.6 kg up to 20% U-235 (~18%)	7.2 kg	113 SWU	Two weapons (269 SWU)
104.7 kg up to 20% U-235 (~18%)	20 kg	315 SWU	Three weapons (584 SWU)
104.7 kg up to 20% U-235 (~18%)	20 kg	315 SWU	Four weapons (899 SWU)
31.6 kg up to 20% U-235 (~18%)	6 kg	95 SWU	
355.2 kg up to 5% U-235 (~4.5%)	14 kg	574 SWU	Five weapons (1,568 SWU)

If Iran fed uranium enriched up to 60% U-235 into its IR-2m centrifuges being fed in production mode at FEP, at their estimated capacity of 4,176 SWU (see Note 5 above) they would take at least 1.2 weeks to accomplish the necessary enrichment work to produce one weapon (95 SWU).
[11] If Iran fed uranium enriched up to 60% U-235 and up to 20% U-235 into its IR-1 and IR-2m centrifuges being fed in production mode at FEP, at their estimated capacity of 8,342 SWU (see Note 5 above) they would take at least 1.7 weeks to accomplish the necessary enrichment work for two weapons (269 SWU).
[12] If Iran fed uranium enriched up to 20% U-235 into all of its IR-1 and IR-2m centrifuges being fed in production mode, at their estimated capacity of 9,177 SWU (see Note 5 above) they would take at least 3.3 weeks to accomplish the necessary enrichment work for three weapons (584 SWU).
[13] If Iran fed uranium enriched up to 20% U-235 into all of its IR-1 and IR-2m centrifuges being fed in production mode, at their estimated capacity of 9,177 SWU (see Note 5 above) they would take at least 5.1 weeks to accomplish the necessary enrichment work for four weapons (899 SWU).
[14] If Iran fed uranium enriched up to 20% U-235 and uranium enriched up to 5% U-235 into all of its IR-1 and IR-2m centrifuges being fed in production mode, at their estimated capacity of 9,177 SWU (see Note 5 above) they would take at least nine weeks to accomplish the necessary enrichment work for five weapons (1,568 SWU).
[15] By November 2021, Iran was already operating six cascades of IR-2m centrifuges (approximately 1,050 machines) in production mode. The IR-2m is based on Pakistan's P-2 centrifuge and is assumed in these estimates to have an operational output of 4 SWU (and a nominal output of 5 SWU). See Alexander Glaser, "Characteristics of the Gas Centrifuge for Uranium Enrichment and Their Relevance for Nuclear Weapon Proliferation (corrected)," Science and Global Security, Vol. 16, Nos. 1-2 (2008), p. 9.
[16] 3,000 IR-2m centrifuges, each with an operational output of 4 SWU, would produce approximately 12,000 SWU in one year. If about 4,000 SWU are needed to produce the 20 kg of 90% U-235 to fuel one weapon (assuming tails of .3% and a feed assay of .7% U-235) then it would take at least 4 months to produce the 4,000 SWU.
[17] The same 3,000 IR-2m centrifuges, producing an assumed 12,000 SWU per year, would produce the 20,000 SWU needed to fuel 5 weapons in approximately one year and eight months.
[18] Each centrifuge is assumed to require about one square meter (10.7 square feet) of space, the amount used in Iran's enrichment plant at Natanz. The ice surface of a National Hockey League rink is 200 feet long and 85 feet wide.
[19] 1,000 centrifuges at 10.7 square feet each would require about 11,000 square feet.
[20] "Verification and Monitoring in the Islamic Republic of Iran in Light of United Nations Security Council Resolution 2231 (2015) (GOV/2022/4)," International Atomic Energy Agency, March 3, 2022, paragraph 15.
[21] "Verification and Monitoring in the Islamic Republic of Iran in Light of United Nations Security Council Resolution 2231 (2015) (GOV/2022/4)," International Atomic Energy Agency, March 3, 2022, paragraph 18.

[22] "Verification and Monitoring in the Islamic Republic of Iran in Light of United Nations Security Council Resolution 2231 (2015) (GOV/2022/4)," International Atomic Energy Agency, March 3, paragraph 20.
[23] "Verification and Monitoring in the Islamic Republic of Iran in Light of United Nations Security Council Resolution 2231 (2015) (GOV/2022/4)," International Atomic Energy Agency, March 3, 2022, paragraph 20.
[24] The 1,044 IR-1 centrifuges at Fordow generate about 835 SWU annually, if operated at their historic production rate of .8 SWU each. If this amount of work is used to enrich feed at about 4% enrichment to a level of about 20% enrichment, which Iran plans to do at Fordow, Iran would require 435 kg of about 4% feed to produce 82 kg of 20% product annually. To produce the 435 kg of about 4% feed from natural uranium, as Iran expects the IR-6 centrifuges to do, would require 2,295 SWU. Dividing the 2,295 SWU by the number of IR-6 machines in the two cascades yields about 6.6 SWU per machine for two cascades of 174 machines (the number used at Fordow for the IR-1 machines) or about 7 SWU for two cascades of 164 machines (the number used at Natanz for the IR-6 machines in production mode).
[25] Iran has claimed that the IR-6 centrifuge is ten times more powerful than the IR-1. The IR-6 is assumed in these estimates to have an operational output of 8 SWU (80% of the nominal output of 10 SWU). See Kiyoko Metzler, "UN Atomic Watchdog Raises Questions of Iran's Centrifuge Use," Associated Press, May 31, 2019.
[26] 3,000 IR-6 centrifuges each producing 8 SWU per year would produce in one year 24,000 SWU, or 2,000 SWU per month. Thus, it would take two months to produce the 4,000 SWU needed to fuel one weapon.
[27] 3,000 IR-6 centrifuges would produce the 20,000 SWU needed to fuel five weapons in about ten months.
[28] See Thomas B. Cochran and Christopher E. Paine, "The Amount of Plutonium and Highly Enriched Uranium Needed for Pure Fission Nuclear Weapons," (Washington, DC: Natural Resources Defense Council, revised April 13, 1995).
[29] Russia and Iran signed a nuclear fuel agreement in 1995. Under the agreement, Russia committed to supplying fuel for Bushehr for ten years and Iran committed to returning the spent fuel to Russia. Reportedly, the original 1992 nuclear cooperation agreement between Russia and Iran stipulated that Russia would supply fuel for the Bushehr reactor "for the entire lifespan of the nuclear power plant." See Mark Hibbs, "Iran's Russia Problem," Carnegie Endowment for International Peace, July 7, 2014.
[30] See the nuclear fuel cycle simulation system published by the IAEA (http://infcis.iaea.org/NFCSS/NFCSSMain.asp?RightP=Calculation&EPage=2&Re...).

Russia's Energy Clout Doesn't Just Come from Oil and Gas – It's Also a Key Nuclear Supplier

By Alex Gilbert and Morgan Bazilian
Source: https://www.homelandsecuritynewswire.com/dr20220402-russia-s-energy-clout-doesn-t-just-come-from-oil-and-gas-it-s-also-a-key-nuclear-supplier

Apr 02 – As Western nations look for ways to reduce their reliance on Russian oil and gas, another aspect of the Ukraine crisis has received less attention: Most of the 32 countries that use nuclear power rely on Russia for some part of their nuclear fuel supply chain. Nuclear power is a critical part of many national electricity grids. European countries especially rely on nuclear power, including France, where it produces 69% of the nation's electricity supply, Ukraine (51%), Hungary (46%), Finland (34%) and Sweden (31%). In the U.S., nuclear reactors generate 20% of the nation's power. Many of these countries originally embraced nuclear power to minimize dependence on imported fossil fuels and, more recently, to reduce carbon emissions and improve air quality.
Economic fallout from the war in Ukraine could disrupt access to fuel for the nuclear power industry. We believe that countering Russia's influence will require concerted efforts that balance energy security, climate mitigation and a commitment to international law.

A Global Industry
Around the world, 32 countries operate about 440 commercial nuclear power reactors that generate 10% of the world's electricity supply. The U.S. has the most operating reactors (93), followed by France (56) and China (53).
Many nations export nuclear fuel, materials and services. The leading international suppliers are the U.S., Russia, Europe and China. Several other countries play important roles, including Canada and South Korea.
Producing nuclear fuel involves five steps:

- Raw uranium ore, which usually contains less then 2% uranium, is mined from the ground.
- The ore is milled to separate the uranium from other materials, yielding a powder called yellowcake.
- Yellowcake is chemically converted to gaseous uranium hexafluoride.
- Uranium hexafluoride is processed to increase its concentration of uranium-235, which can be split in reactors to produce large quantities of energy. U-235 only makes up 0.7% of natural uranium; enrichment for commercial reactor fuel increases its concentration, usually up to 5%.

❖ Enriched uranium is fabricated into fuel rods for reactors.

Uranium conversion, enrichment and fabrication are sophisticated technical processes that are handled at a small number of facilities around the world.

Fuels for nuclear reactors are highly specialized and tied to specific reactor designs. Buying a power reactor from a supplier such as Rosatom, Russia's state nuclear company, or the French company Framatome, can lead to decades long supply dependencies

All of these factors make nuclear supply chains more complex, less competitive and harder to shift rapidly than other energy types, such as oil and gas. And since key materials and technologies for civilian nuclear power can also be used to produce weapon-usable nuclear materials, international nuclear sales are subject to strict export controls and trade restrictions.

Russia as a Nuclear Supplier

Compared to other mined commodities such as cobalt, world uranium resources are spread reasonably widely. Kazakhstan produces more than 40% of the global supply, followed by Canada (12.6%), Australia (12.1%) and Namibia (10%). Russia is a minor player, producing around 5%, while the U.S. and Europe produce less than 1%.

However, much of the milled uranium from Kazakhstan travels through Russia before it is exported to global markets. Other parts of the supply chain also route through Russia. Only a handful of facilities in the world convert milled uranium into uranium hexafluoride; Russia produced approximately one-third of the 2020 supply, much of it made with uranium from Kazakhstan.

Russia also has 43% of the global enrichment capacity, followed by Europe (about 33%), China (16%) and the U.S.(7%). There is some spare capacity in the U.S. and Europe, and China is expanding.

Before it invaded Ukraine, Russia had a national strategy to increase its nuclear energy exports. It is a leading supplier of nuclear reactors, building plants abroad and then providing their fuel. Its customers include former Soviet states and Warsaw Pact members like Ukraine and Hungary, along with new nuclear power users such as Egypt.

Some 16%-20% of the annual U.S. uranium supply is at least partially sourced from Russia, mainly for enrichment. Many European countries buy converted or enriched Russian uranium, and China is a growing market for Russian nuclear exports.

If U.S. nuclear trade with Russia is affected by the Ukraine conflict, the most serious impact would be on two planned advanced reactor demonstration projects: the Xe-100 in Washington state and Natrium in Wyoming. These reactors need fuel that is enriched to nearly 20% uranium-235, and Russia is currently the world's only supplier.

Market Impacts of the Ukraine Crisis

Global uranium prices were low for most of the past decade, hovering between $20 to $30 per pound after the Fukushima nuclear disaster in Japan. Then in 2021 and early 2022, market speculation and domestic protests in Kazakhstan pushed prices up. Now, the war in Ukraine has driven some trades to almost $60 per pound, and potentially higher. Uranium is not openly traded on markets, so not all prices are public.

The Biden administration reportedly is considering nuclear sanctions on Russia. U.S. utilities oppose this step for fear that it would make uranium fuel scarcer and more expensive. Many U.S. nuclear plants are already struggling economically.

If Russia retaliates against Western pressure by withholding converted or enriched uranium, we estimate that plants in the U.S. and Europe could be affected within 18 to 24 months, based on the amount of advanced notice required for fuel orders. Some U.S. utilities have said they do not expect shortages, but the opacity of the market and long time frames make this hard to predict. Utilities will face higher prices if they turn to Europe, Japan or China for uranium conversion or enrichment services.

What about uranium supplies? Western producers – notably, Canada and Australia – have large reserves that would be economic to mine at current price levels. And some U.S. politicians, mainly in western states, are calling for more domestic mining.

But this would be controversial. Over 500 abandoned mines remain from extensive uranium production across the Navajo Nation in Arizona, Utah and New Mexico during the Cold War. These areas are still experiencing harmful effects, including environmental contamination and claims of mysterious illnesses and cancers.

Opportunities for U.S. Leadership

Rather than focusing on domestic uranium mining, we see it as a higher priority for the U.S. to reconsider its enrichment capabilities and policies. Private companies have been reluctant to invest in new enrichment facilities while cheaper alternatives like importing from Russia were available. The Department of Energy is moving forward on a program to fund fuel production for advanced reactors, but it might have to also focus on making fuel for existing U.S. reactors if Russia's supply is interrupted.

In our view, the U.S. should also work to counter Russia's efforts to export fabricated fuel and reactors. Ukraine is already working with U.S.-based Westinghouse to develop fuel for its Russian-designed reactors that can replace Russian-manufactured fuel. Seven of Ukraine's 15 reactors already use this fuel, which is fabricated in Sweden. We believe U.S. policy should support similar efforts elsewhere as needed.

Finally, if the U.S. and other countries seek to remake world nuclear supply chains, we believe the nuclear industry should strive to transcend its toxic legacy. This would require engaging at the start with affected communities, securing benefits for them, making project plans more transparent and incorporating environmental justice into every project. Of course, the first step toward ethical uranium is ensuring that the nuclear power industry is not funding Russia's war against Ukraine.

Alex Gilbert is PhD Candidate in Space Resources @ the Colorado School of Mines.
Morgan Bazilian is Professor of Public Policy and Director, Payne Institute @ the Colorado School of Mines.

Britain could build seven nuclear power stations - minister

Source: https://www.reuters.com/article/britain-energy-nuclear/britain-could-build-seven-nuclear-power-stations-minister-idUKKCN2LU0KO

Apr 03 - Britain could build up to seven new nuclear power stations as part of a radical expansion of homegrown energy following Russia's invasion of Ukraine, Business Secretary Kwasi Kwarteng told The Sunday Telegraph.
"There is a world where we have six or seven sites in the UK" by 2050, Kwarteng told the newspaper.
The Sunday Telegraph said ministers have agreed to set up a new development vehicle, called Great British Nuclear, to identify sites, cut through red tape to speed up the planning process, and bring together private firms to run each site.
It said Britain's new energy security strategy, set to be unveiled on Thursday, is expected to commit the government to support the construction of at least two new large-scale nuclear plants by 2030 in addition to small modular reactors

Swiss Cold War bunkers back in vogue as Ukraine conflict rages

Source: https://www.france24.com/en/live-news/20220402-swiss-cold-war-bunkers-back-in-vogue-as-ukraine-conflict-rages

Switzerland's underground bunkers, long seen as a quirky curiosity mostly used for storage or as very well-protected wine cellars, are being viewed in a new light since Russia invaded Ukraine Fabrice COFFRINI AFP

Apr 02 – Meyrin (Switzerland) (AFP) – Russia's invasion of Ukraine has reawakened interest in Switzerland's concrete nuclear fallout shelters, built during the Cold War with enough space to shelter everyone in the country.
Since the 1960s, every Swiss municipality has had to build nuclear bunkers for their residents, while such shelters have also been mandatory in all homes and residential buildings over a certain size built since then.
The shelters have become an integral part of the Swiss identity, on a par with the country's famous chocolate, banks and watches.
But the underground spaces, long seen as a quirky curiosity mostly used for storage or as very well-protected wine cellars, are being viewed in a new light since Russia invaded Ukraine on February 24.
Just days into the attack, Russian President Vladimir Putin put the country's strategic nuclear forces on high alert, sparking global alarm.
Fierce fighting near Ukraine's nuclear power plants, including Chernobyl -- the sight of the world's worst nuclear accident in 1986 -- have also heightened fears that even traditionally neutral Switzerland could be affected by the war.

'Ukraine is very nearby'

"People are discovering that Ukraine is very nearby," Marie Claude Noth-Ecoeur, who heads civil and military security services in the mountainous southern Wallis region, told AFP.

The wealthy Alpine country has pledged that each and every resident will have a shelter space if needed.

In fact, the country of 8.6 million people counts nearly nine million spaces across 365,000 private and public shelters.

But while there are more than enough spots at a national level, there are vast regional differences.

Geneva is worst off, with only enough places for 75 percent of its population.

Nicola Squillaci, head of Geneva's civil protection and military affairs division, said the shelters were conceived to provide protection "especially in the case of a bombing and a nuclear attack".

They would help protect the population "against the shock waves, and against radioactivity in the air", he told AFP.

Ducking into a private shelter for around 150 people, underneath a brand new residential building in the Geneva suburb of Meyrin, Squillaci pointed out how, in peace time, it was equipped with basement storage units for the apartment dwellers above.

But unlike most storage facilities, this one comes with composting toilets, kits for quickly assembling beds, and a ventilation system that filters the air coming in from the outside.

'Capsule'

"It is like a capsule, with airlocks on emergency exits and main exits," Squillaci said. "If the building were to collapse, the shelter would remain intact." Switzerland's vast network of nuclear bunkers have a range of other day-to-day uses, including as military barracks or as temporary accommodation for asylum seekers.

But Swiss authorities require that they can be emptied and reverted back to nuclear shelters within five days.

So far, Switzerland's population has never been ordered down into the shelters, not even in the wake of the Chernobyl disaster.

Experts say the most likely scenario for needing to use them has always been a possible accident at one of Switzerland's own nuclear power plants.

But now the conflict raging in Ukraine has added a new, urgent layer to the national nuclear anxiety.

With public concern growing, Swiss authorities have published overviews of the available shelter spots, and have urged households to always maintain a stock of food to last at least a week.

With Ukraine, "the geopolitical situation has altered the paradigms a bit," Squillaci said, adding that authorities were receiving "enormous numbers of legitimate questions from citizens."

A number of property owners who previously sought to pay a fine rather than build bunkers were also backtracking, he said.

'Temporary protection'

To compensate for the lack of shelters under chalets and other traditional mountain homes, Alpine cantons like Wallis meanwhile rely heavily on large collective bunkers.

In Evionnaz, a municipality with around 1,000 inhabitants, the collective shelter can accommodate around 700 people, counting 15 dormitories filled with row after row of three-storey bunk beds. "The country asks us to be on the ready," Noth-Ecoeur said.

"Today we are in a preparatory phase, and we are ready to put the shelters to use." Experts caution though that the level of protection provided by the shelters in the case of actual nuclear weapons use would depend heavily on the intensity and proximity of the strikes.

"The shelters could offer the population a certain level of temporary protection against radioactive events," Swiss defence ministry spokesman Andreas Bucher told AFP.

"A large-scale nuclear war would however be catastrophic, and no state would be able to guard against the effects."

How the IAEA can help nuclear power plants in Ukraine's war zone

By Noah C. Mayhew

Source: https://thebulletin.org/2022/03/how-the-iaea-can-help-nuclear-power-plants-in-ukraines-war-zone/

IAEA Director-General Rafael Mariano Grossi met with senior Ukrainian government officials and staff at the South Ukraine Nuclear Power Plant on March 29. Credit: Fredrik Dahl / IAEA

Mar 31 – Since Russia's war against Ukraine began more than a month ago, Russian forces have occupied the Chernobyl Nuclear Power Plant and surrounding territory—the site of the infamous 1986 nuclear disaster—and taken control of the Zaporizhzhia Nuclear Power Plant in southeastern Ukraine. While Ukraine's state nuclear company reported today that the

majority of Russian troops occupying Chernobyl have left (apparently because of concerns about radiation), the Zaporizhzhia plant remains under Russian control.
Notably, the shelling of the Zaporizhzhia plant in early March led to calls from the international community for more to be done to ensure the safety and security of Ukraine's nuclear facilities. Many of these calls have been directed at the International Atomic Energy Agency (IAEA) and its Director General Rafael Mariano Grossi.
Thankfully, the shelling of the Zaporizhzhia plant did not damage the reactors themselves, though it did set a training facility at the plant on fire. It could have been much worse.
However, calls for the IAEA to impose a demilitarized zone around nuclear facilities, or mandate Russian forces not to shell nuclear facilities, are misplaced. The IAEA cannot compel a country to cease military hostilities. Moreover, the IAEA should not do anything to call into question its objectivity and neutrality—the IAEA's status as a neutral, international organization with a technical mandate is its greatest asset on the international stage, which, wartime or not, is inherently political.
This does not mean that the IAEA, often called the United Nations' "nuclear watchdog," is toothless.

The IAEA's mandate

At its core, the IAEA has two main functions: to "accelerate and enlarge the contribution of atomic energy to peace, health, and prosperity" and to implement safeguards to provide credible assurance that peaceful nuclear activities are not used to make nuclear weapons. The IAEA is not, however, a government that enforces laws. It is an international organization that works in service to its member states. Its authority rests in its statute, the agreements it has concluded with countries, and the additional authority granted to it by member states. There is no "don't shell a power plant" clause.
The IAEA is a technical organization, but its past directors-general have each made great contributions to the de-escalation of conflicts during international crises with nuclear dimensions. Hans Blix played a major role in bringing to light proof of North Korea's undeclared nuclear activities in the 1990s and sounded alarms that likely delayed North Korea's acquisition of nuclear weapons. Mohammed ElBaradei displayed extraordinary diplomacy and courage in negotiating the conflict between Iran and Western countries in the 2000s, likely preserving diplomatic pathways between the two.
Now Director-General Grossi is grappling with the first (and hopefully only) crisis of his tenure with a nuclear dimension. Since the first day of the invasion, the IAEA has published more than three dozen updates on the nuclear implications of the war. In a statement to the IAEA's Board of Governors on March 2, Grossi outlined "seven indispensable pillars" of nuclear safety and security, including the physical integrity of facilities.
Grossi has since traveled to Ukraine at the request of the Ukrainian government and yesterday made a statement at the South Ukraine Nuclear Power Plant as a show of support. He has previously dismissed Russia's ludicrous claim that Ukraine might be trying to build a nuclear weapon. Commenting on the urgency of getting a framework agreement on safety, security, and safeguards for Ukrainian nuclear facilities, Grossi said "we need to have this within days." Statements do not shield facilities from bombs, but they do matter, particularly coming from the IAEA Director-General.

What the IAEA can do

So what are Grossi's opportunities in Ukraine? Let us not forget that before he became the IAEA director-general, Grossi was a career Argentinian diplomat, and a skilled one at that. He entered Ukraine at the request of the Ukrainian government, but has also said that, to deliver the assistance Ukraine has requested, the IAEA would need "a commitment from every actor." This is apparently a reference to the framework for the safety and security of Ukrainian nuclear facilities, which he suggested earlier this month.
Grossi met with Ukrainian officials yesterday and is currently in Kaliningrad, pending talks with senior Russian officials tomorrow morning; it will take both sides to come to any sort of agreement regarding the nuclear facilities that Russia is occupying. Success in these meetings will not produce an end to the war, but it may lead to a reduced risk of an accident that could trigger a deadly event at a nuclear reactor or, perhaps as dangerous, such tension in the control room of a reactor that an operator makes a grave error.
Grossi cannot compel Russian forces to stay away from nuclear facilities, but he can serve as a buffer between Ukrainian and Russian officials, and as a moderator to focus discussion on the dangers that a nuclear disaster would pose to everyone. He cannot tell Russian forces to leave Ukrainian nuclear facilities, but he is in a better position to facilitate that discussion than perhaps any other actor.
The value of diplomacy in this situation cannot be overstated. A direct Ukrainian-Russian agreement on anything at this juncture is, in my view, profoundly unlikely, so decision makers must focus energy on the highest risks and how to reduce them. Grossi has an opportunity to be a neutral arbiter as concerns nuclear facilities in Ukraine. In a situation where diplomacy seems hopeless in almost every other arena, we can't turn up our noses at this opportunity to improve the safety and security of nuclear facilities located in an active war zone.

Noah C. Mayhew joined the Vienna Center for Disarmament and Non-Proliferation in July 2018 as a research associate focusing on focusing on IAEA safeguards and nuclear verification, nuclear nonproliferation, arms control, US-Russia relations, and the nexus between nuclear security and the peaceful uses of nuclear science and technology. Some of his previous contributions to nuclear discourse have been published by the *Bulletin,* Stiftung Entwicklung und Frieden, *Arms Control Today, The Nonproliferation Review*, and the Swedish Radiation Safety Authority. He is a commissioner on the trilateral Young Deep Cuts Commission.

The day after the Ukraine war

By Robert J. Goldston

Source: https://thebulletin.org/2022/04/the-day-after-the-ukraine-war/

Apr 06 – Sooner, or later, the war in Ukraine will end. We all hope that it will not conclude with a strategic nuclear exchange like the 1983 made-for-TV movie, *The Day After*. Assuming it does not, the United States will be confronted with the question of how it should proceed to construct a stable relationship with Russia. The alternative, greater instability, would bring unacceptable risk. Furthermore, quietly floated proposals for enhanced stability may help end the war sooner.

Strident voices are already floating the idea of doubling the US defense budget and increasing our reliance on nuclear weapons. Hopefully, instead we will respond as in the aftermath of the Cuban Missile Crisis and of the war scare of 1983, when a NATO military exercise may have provoked Soviet leadership to consider a pre-emptive nuclear strike on the United States. The well-founded fear of nuclear annihilation engendered by the Cuban Missile Crisis gave rise to the Limited Test Ban Treaty under John Kennedy, the Nuclear Non-Proliferation Treaty under Lyndon Johnson, and the Anti-Ballistic Missile Treaty under Richard Nixon. Similar fear engendered by the events of the early 1980s gave rise to the Intermediate-range Nuclear Forces treaty under Ronald Reagan, the Presidential Initiatives under George H.W. Bush and Boris Yeltsin that resulted in dramatic reductions in US and Russian nuclear arsenals, and ultimately the strategic arms reduction treaties that culminated in New START under Barack Obama. The US policy goal the day after the war in Ukraine ends should be to assure that the circumstances that gave rise to that devastating war should never recur. It is understandable that some will say that we should not negotiate with war criminals, but short of defeating Russia in a world war we will have no other choice. Here, I do not address the settlement between Ukraine and Russia. As President Biden has said, this is up to Ukraine. But five arms control and disarmament initiatives outlined below could contribute to stabilizing the relationship between the United States and Russia.

Conventional forces in Europe

The first of these initiatives, a new CFE agreement, seems obvious. The Russian build-up of conventional forces near the border of Ukraine was both an attempt to pressure Ukraine and a pre-requisite for invasion. In a parallel sense, the stationing of NATO forces close to the borders of Russia is perceived as a threat. Separating forces should be an element of European policy going forward. The original Conventional Forces in Europe treaty was suspended over disputes about its implementation. Leaders of the West and in Russia should be able to learn from their errors and structure a modern version of this agreement that gives assurance to both sides. It should include limitations on military exercises close to sensitive borders. There is no problem verifying such an agreement through satellite surveillance, but a return to a modernized Open Skies agreement would be a confidence-building measure for those states without access to satellite data.

Intermediate-range nuclear forces in Europe

A new INF agreement could be focused on what matters, nuclear-armed missiles, not all short and intermediate range missiles, as in the inaccurately named original treaty. Nuclear-armed missiles can carry roughly 100,000 times more explosive energy than conventional ones, putting them in a separate class. The new agreement could also be focused just on Europe, defined as ranging from Portugal and Ireland to the Urals, with the idea of reducing the risk of a rapid, decapitating strike on Moscow, Paris, or London. To mitigate the concern that either NATO or Russia intends to fight a nuclear war with theater nuclear weapons, all such non-strategic weapons could be withdrawn from these boundaries of Europe. Such an agreement would have balanced advantages. Intermediate range missiles in Europe are not a threat to US command and control, as they are to Russian systems, so the agreement advantages Russia. On the other hand, Russia has many more non-strategic nuclear weapons than NATO, so a pullback of Russia's theater nuclear weapons would advantage the United States.

Perhaps one lesson from the war in Ukraine is that an invasion takes time, so there is no need to forward position theater nuclear weapons, for example as recently proposed by Poland. Furthermore, forward positioning creates a use-them or lose-them pressure that makes it more likely that the nuclear threshold will be crossed early in a war. The proposed

agreement could be verified by national technical means, such as satellites, combined with local inspections verifying the absence of nuclear material in suspected storage bunkers.

Missile defenses

A new anti-ballistic missile, or ABM, agreement is a necessity to reduce the pressure on both Russia and China to diversify and grow their nuclear arsenals. Both states are concerned that the United States could one day develop a first-strike capability that would be able to destroy much of their strategic arsenals, and it would be backed up by missile-defense capabilities that could mop up a ragged second-strike response. This concern is reasonably underpinned by the fact that the United States has tested an interceptor launched by an Aegis destroyer against an ICBM-like target. The United States is planning to have 65 Aegis destroyers by 2025, and each can carry up to 96 missiles. This could constitute an apparently formidable ABM system, much more extensive that the Aegis Ashore systems installed in Romania and under construction in Poland. Thus, a new anti-ballistic missile agreement must verifiably limit the total number of ICBM interceptors.

Sadly, Russia and China are concerned that US missile defenses might someday work, while the reality is that they are not likely to work in the foreseeable future. Their main effects are to provide the United States with a false sense of security and, simultaneously and ironically, to provoke the diversification and growth of Russia's and China's nuclear arsenals. Resolving the paradox—that ABM capabilities reduce the national security of both parties—should be beneficial to Russia, China, and the United States.

New START+

The existing New START treaty will run out in February 2026. If no follow-on agreement is achieved, there will be no agreed limitation on US and Russian strategic weapons, allowing nuclear arsenals to grow again to the levels at the peak of the Cold War. A new agreement must be reached. Both the United States and Russia have about 400 warheads stationed on silo-based intercontinental ballistic missiles, and it is the policy of both sides that these missiles may be launched if they are perceived to be under attack, giving rise to another "use-them or lose-them" instability, which can lead to the disastrous, mistaken launch of nuclear-armed missiles in the fog of war or at a time of heightened tensions. It would be to the advantage of both sides if these missiles were eliminated.

The United States has argued that a New START follow-on treaty should include non-strategic nuclear weapons. However, counting weapons in each other's bunkers would be problematic compared with verifying the absence of such weapons, as is proposed here to be included in a new INF agreement. Russia could see a shift of the location of its theater nuclear weapons—rather than a reduction in their numbers—as advantageous, in that it would allow Russia to retain what it considers a key element of its defense strategy. The new ABM agreement would reduce the need for the new strategic weapons that Russia has announced to counteract US anti-ballistic missile capabilities. In any event such nuclear-armed and nuclear-powered submarine drones and very long-range cruise missiles should be counted and limited under a New START+ treaty, as Russia has already offered for its strategic hypersonic missiles.

Nuclear declaratory policy

President Putin's recent, barely veiled threats to use nuclear weapons in the Ukraine war bring to the fore concerns about nuclear declaratory policy. There are a range of options for making national policies on when nuclear weapons use might be considered more stabilizing. It would be most powerful if the leading nuclear weapons states, the P5 (China, France, Russia, the United Kingdom, and the United States), agreed on a common policy.

The P5 recently re-iterated the Reagan-Gorbachev statement that "nuclear war cannot be won and should never be fought." Unfortunately, however, this statement does not have direct implications for nuclear use policy. If the P5 could agree on a common policy that was explicit in its limitations, this could be of great benefit toward predictability and stability. It will be difficult to get to an agreement that bans the first use of nuclear weapons, as US allies have reportedly resisted such a policy and Russia clearly feels that it needs nuclear weapons to defend against conventional attack from NATO. A policy under which nuclear weapons would only be considered in the case of imminent existential risk[1] might be more achievable. The need for all parties to accede to the Treaty on the Prohibition of Nuclear Weapons is more obvious now, but such accession would be even harder to achieve given the heightened level of distrust. How far the P5 can get towards a common nuclear declaratory policy that provides stronger guardrails against the use of nuclear weapons will depend on many factors, but an effort in this direction is surely merited.

In sum

At the time of writing, a vastly destructive war is raging in Ukraine. President Putin has issued barely veiled threats of nuclear use, giving rise to concerns that this war could lead to a nuclear holocaust. The war in Ukraine has been much more destructive than either the Cuban Missile Crisis or the war scare of 1983, both of which turned the world away from nuclear confrontation. Whether or not the day after the war in Ukraine sees the use of wise

judgment, or growing danger, is up to both sides. The only alternative to establishing greater stability in the US-Russia relationship is greater risk.

Notes

[1] https://www.jstor.org/stable/20045532?seq=1,
https://thebulletin.org/2021/10/bilateral-strategic-stability-what-the-united-states-should-discuss-with-russia-and-china/
https://carnegieendowment.org/files/Perkovich_Vaddi_NPR_full2.pdf

Robert J. Goldston is a professor of Astrophysical Sciences at Princeton University. He was the director of the US Energy Department's Princeton Plasma Physics Laboratory from 1997 to 2009. He is an active researcher both on fusion energy, and on arms control and non-proliferation. In fusion research his recent focus has been on the physics of the plasma edge and means to mitigate high heat fluxes to material surfaces. In arms control he works on means to verify warheads for dismantlement, and in non-proliferation he works on means to safeguard gas-centrifuge enrichment plants.

Could China's "hot-swappable" missile system start an accidental nuclear war?

By Sky Lo

Source: https://thebulletin.org/2022/04/could-chinas-hot-swappable-missile-system-start-an-accidental-nuclear-war/

Apr 08 – In the U.S.-China Economic and Security Review Commission's most recent annual report to Congress, the commission suggested that the **DF-26 Chinese missile system** presents a unique escalatory threat in a potential conflict between China and

the United States. The DF-26, which has a range of approximately 4,000 kilometers, is a dual-capable, "hot-swappable" system: **The missile can carry either a conventional or a nuclear warhead, and warheads can be quickly swapped on launch-ready missiles.** Ever since its public debut in 2015, the DF-26's nuclear role has attracted significant attention from experts in the field. Some have suggested that using these missiles may lead to accidental nuclear escalation between China and the United States.

The worry is that the United States might see an incoming salvo of DF-26s and assume they are loaded with nuclear warheads. The American leadership might then decide to retaliate with nuclear weapons of its own, not knowing that the Chinese missiles are actually carrying

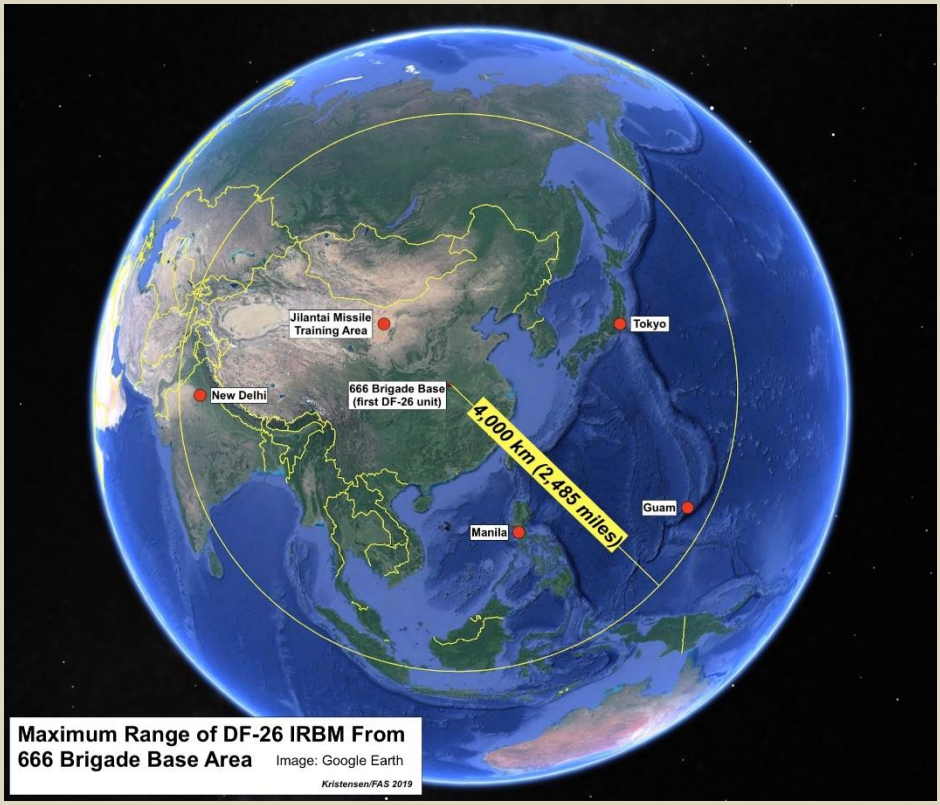
conventional warheads. Other analysts have argued that pre-launch ambiguity may contribute to unintended escalation. However, upon closer examination, nuclear escalation is not as likely as some believe.

The US response to incoming DF-26s

Modern early-warning systems are capable of calculating the trajectory and potential impact points for incoming warheads. In the case of a Chinese missile attack against US forces in the Indo-Pacific region, the United States would be able to identify incoming DF-26s as intermediate-range ballistic missiles heading toward US military bases located in the Pacific, rather than intercontinental ballistic missiles heading to the US homeland. Even if the Chinese missiles were loaded with nuclear warheads, these warheads would not hit major US population centers or reduce the effectiveness of US nuclear forces. US decision makers would not have much to lose by waiting until the missiles detonate before launching a counterattack. On the other hand, immediately launching a nuclear strike against China would likely result in a nuclear war that neither side wishes to fight.

The United States also has a very survivable sea-based deterrent and significantly more nuclear warheads than China. It would be nearly impossible for China to disarm the United States in a first strike. Even if American leaders were convinced that China was launching a nuclear strike against the United States, they would not have to immediately retaliate, as long as they were confident about US second-strike capabilities.

Also, assets that are especially vulnerable to a first strike could be evacuated and dispersed to avoid destruction. For example, the United States could immediately scramble strategic bombers carrying nuclear weapons, to avoid losing them on the ground. These measures can ensure that the United States does not have to launch an immediate retaliation even when under threat, reducing the possibility of an accidental nuclear war.



The Chinese response to a US attack

Some experts have suggested another type of scenario, in which the United States would fire conventional weapons at China's DF-26 launchers in an attempt to neutralize a conventional attack on Guam. China might see such an attack as a direct threat to its nuclear deterrent. This could drive Chinese leaders to launch a nuclear retaliation under the "use it or lose it" mentality. Yet, upon closer examination, such an idea is flawed.

First, China is not reliant on the DF-26 weapon system for its nuclear deterrence. The intermediate-range DF-26 is arguably less important than intercontinental ballistic missiles (ICBMs), such as the DF-41, in maintaining a credible deterrent against the United States. This is reflected in the number of warheads deployed with each type of missile. While the exact number of nuclear warheads allocated to DF-26 units remains unknown, it is estimated that China has only deployed 60 out of some 350 total warheads with its intermediate-range force. It is therefore unlikely for China to worry about the credibility of its nuclear deterrent against the United States, as long as its ICBMs remain survivable and effective.

Furthermore, China's nuclear warheads are deployed separately from its launch systems. The warheads are stored in underground bases and are only mated with their delivery systems in preparation for a strike. Warheads may also be dispersed and hidden within these large underground complexes to avoid destruction during a first strike.

A conventional strike against missile launch vehicles on the ground is unlikely to damage nuclear warheads stored underground. In the worst-case scenario, in which a small number of nuclear warheads are accidentally destroyed by the United States during a conventional strike, the Chinese nuclear deterrent would remain credible if it is able to inflict unacceptable losses on the United States in a nuclear exchange. Finally, it is unlikely that the United States would accidentally hit Chinese ICBM launchers when trying to hit DF-26s. DF-26 brigades are separate from other types of

Chinese missile brigades. ICBMs such as the DF-31 and DF-41 are also much larger than DF-26s. They do not share a common launch vehicle and can be identified more easily. Operationally, it is unlikely that China would intentionally disguise its ICBM launchers as intermediate-range missile launchers, knowing that the United States would likely target the latter in a conventional conflict.
In the worst-case scenario, in which the United States accidentally hits Chinese ICBM vehicles, it is unlikely that an accidental strike would be big enough to neutralize all Chinese second-strike assets immediately. China's silo-based missiles and nuclear submarines would also survive. There would be no need for China to immediately launch a nuclear retaliation.
In short, DF-26s do not generate additional instability in the current deterrence relationship between China and the United States. Launching conventional attacks with or against these missiles is unlikely to result in accidental nuclear escalation. The dual-use nature of DF-26s is unlikely to significantly change the US strategic calculus when considering a conventional strike against these launchers.

The benefits of dual capability
Even if the DF-26's ambiguity is unlikely to trigger a nuclear war, why would China develop a hot-swappable missile? What are the strategic benefits of using a dual-capable delivery system when China could just as easily develop two variants of the same missile? Some analysts have suggested that China is deliberately trying to create ambiguity for its own sake. However, as established above, the escalatory risk of striking DF-26 launchers is relatively low, so the United States is unlikely to be deterred from attacking these launchers based on the risk of accidental nuclear escalation alone. The benefit of strategic ambiguity seems questionable at best.
A better answer may be cost. Instead of building dedicated nuclear-strike platforms (which are arguably less likely to be used), dual-use platforms allow China to expand both its conventional and nuclear capabilities with one system. The operational costs might also be reduced, because fewer personnel are required than for separate missile brigades. Furthermore, maintenance facilities for both the launch vehicle and the missiles can be shared to improve efficiency and reduce cost. This enables China to expand both its conventional and nuclear forces with a limited budget. Apart from saving resources, dual-capable missiles are useful for maintaining secrecy and deceiving an adversary. China can hide the true number of its warheads with increased use of dual-use systems. As mentioned above, China's nuclear warheads are mainly stored underground and are difficult to identify using satellite imagery. On the other hand, launch systems (such as silos) can be more easily identified. Thus, it is easier for analysts to estimate the size of Chinese nuclear stockpile by tracking the number of launch systems. However, with the deployment of dual-use launch systems, it becomes more difficult for analysts to estimate the Chinese nuclear stockpile accurately, because the ratio of launch systems to warheads is unknown. The difficulty in estimating China's nuclear stockpile means that China can easily and diplomatically deflect any accusations about its nuclear build-up. It can also quietly expand its nuclear forces without drawing the attention of adversaries.
Finally, China may use these missiles as reserves for its main nuclear deterrent. As mentioned above, Chinese warheads are stored in underground tunnels away from the delivery systems. Thus, there is a chance for at least some of the warheads to survive a major nuclear exchange. On the other hand, in a hypothetical first strike against China, ICBMs are very likely to be targeted by enemy nuclear forces or launched in the subsequent retaliation. In a post-war environment, China could choose to install left-over warheads on unused DF-26s to quickly build a reconstituted deterrent. While these missiles do not have sufficient range to strike targets in the continental United States, they would be useful for regional deterrence against adversaries closer to China, such as India.
Regardless of the reasoning behind its development, the DF-26 represents a leap in Chinese precision strike capabilities. The increasingly robust Chinese nuclear force will be an important player in the deterrence relationships between nuclear powers for the foreseeable future.

Sky Lo is a recent graduate of The Australian National University's Master of Strategic Studies program. He received his B.Sc. in Molecular Biotechnology from the Chinese University of Hong Kong. He has great interest in nuclear issues, especially Chinese nuclear forces.

Russian military doctrine calls a limited nuclear strike "de-escalation." Here's why.

By Nikolai N. Sokov
Source: https://thebulletin.org/2022/03/russian-military-doctrine-calls-a-limited-nuclear-strike-de-escalation-heres-why/

Editor's note: *This article was originally published in 2014, as Russia was seizing Crimea. It is being published in updated form here because of its obvious relevance to the current Russian invasion of Ukraine, and to Russian President Vladimir Putin's recent threats regarding the use of nuclear weapons.*

Mar 08 – In 1999, at a time when renewed war in Chechnya seemed imminent, Moscow watched with great concern as NATO waged a high-precision military campaign in Yugoslavia. The conventional capabilities that the United States and its allies demonstrated seemed far beyond Russia's own capacities. And because the issues underlying the Kosovo conflict seemed almost identical to those underlying the Chechen conflict, Moscow became deeply worried that the United States would interfere within its borders.
By the next year, Russia had issued a new military doctrine whose main innovation was the concept of "de-escalation"—the idea that, if Russia were faced with a large-scale conventional attack that exceeded its capacity for defense, it might respond with a limited nuclear strike. To date, Russia has never publically invoked the possibility of de-escalation in relation to any specific conflict. But Russia's policy probably limited the West's options for responding to the 2008 war in Georgia. And it is probably in the back of Western leaders' minds today, dictating restraint as they formulate their responses to events in Ukraine.

Game-changer

Russia's de-escalation policy represented a reemergence of nuclear weapons' importance in defense strategy after a period when these weapons' salience had decreased. When the Cold War ended, Russia and the United States suddenly had less reason to fear that the other side would launch a surprise, large-scale nuclear attack. Nuclear weapons therefore began to play primarily a political role in the two countries' security relationship. They became status symbols, or insurance against unforeseen developments. They were an ultimate security guarantee, but were always in the background—something never needed.
Then a very different security challenge began to loom large in the thinking of Russia's political leaders, military officers, and security experts. That challenge was US conventional military power. This power was first displayed in its modern incarnation during the Gulf War of 1990 and 1991—but the game-changer was the Kosovo conflict. In Yugoslavia the United States utilized modern, high-precision conventional weapons to produce highly tangible results with only limited collateral damage. These conventional weapons systems, unlike their nuclear counterparts, were highly usable.

The Russian Tupolev Tu-22M3M can deliver nuclear weapons by missiles or by gravity bombs. Image originally posted to Flickr by Dmitry Terekhov at: https://flickr.com/photos/44400809@N07/19230388334. Licensed under cc-by-sa-2.0.

The Russian response, begun even before the conflict over Kosovo had ended, was to develop a new military doctrine. This effort was supervised by Vladimir Putin, then-secretary of Russia's Security Council, a body similar to the National Security Council in the United

States. By the time the doctrine was adopted in the spring of 2000, it was Putin who signed it in his new capacity as president.
The doctrine introduced the notion of de-escalation—a strategy envisioning the threat of a limited nuclear strike that would force an opponent to accept a return to the status quo ante. Such a threat is envisioned as deterring the United States and its allies from involvement in conflicts in which Russia has an important stake, and in this sense is essentially defensive. Yet, to be effective, such a threat also must be credible. To that end, all large-scale military exercises that Russia conducted beginning in 2000 featured simulations of limited nuclear strikes.
De-escalation rests on a revised notion of the scale of nuclear use. During the Cold War, deterrence involved the threat of inflicting unacceptable damage on an enemy. Russia's de-escalation strategy provides instead for infliction of "tailored damage," defined as "damage [that is] subjectively unacceptable to the opponent [and] exceeds the benefits the aggressor expects to gain as a result of the use of military force." The efficacy of threatening tailored damage assumes an asymmetry in a conflict's stakes. Moscow reasoned when it adopted the policy that, for the United States, intervening on behalf of Chechen rebels (for example) might seem a desirable course of action for a variety of reasons. But it would not be worth the risk of a nuclear exchange. Russia, however, would perceive the stakes as much higher and would find the risk of a nuclear exchange more acceptable. Indeed, in the early 2000s, Russian military experts wrote that US interference in the war in Chechnya could have resulted in a threat to use nuclear weapons.
The new strategy did not come out of the blue. Its conceptual underpinnings follow from Thomas Schelling's seminal books *The Strategy of Conflict* and *Arms and Influence*. At the operational level, the strategy borrows from 1960s-era US policy, which contemplated the limited use of nuclear weapons to oppose "creeping" Soviet aggression (as expressed, for example, in a 1963 document produced by the National Security Council, "The Management and Termination of War with the Soviet Union").

How and where?

Common sense might suggest that any limited use of nuclear weapons for de-escalation purposes would involve non-strategic (shorter-range) weapons. But this does not appear to be the thinking. In 2003, the Ministry of Defense issued a white paper that dotted the new doctrine's i's and crossed its t's. The white paper emphasized, among other things, that because the United States could use its precision-guided conventional assets over significant distances, Russia needed the ability to deter the use of those assets with its own long-range capabilities.
Accordingly, simulations of the limited use of nuclear weapons have featured long-range nuclear-capable systems (long-range air-launched cruise missiles above all, but medium-range bombers as well). To the extent that one can determine the targets that have featured in these exercises, they seem to be located over much of the world—Europe, the Pacific, Southeast Asia, the Indian Ocean, and even the continental United States. Targets appear to include command and control centers as well as airbases and aircraft carriers from which US aircraft could fly missions against Russia. In other words, for limited-use options, Russia appears to target military assets rather than the population or economic centers that were typical targets under Cold War strategies.
It is important to note amid all this that Russia's nuclear weapons are assigned only to conflicts in which Russia is opposed by another nuclear weapon state. When Russia was preparing the 2010 edition of its military doctrine, some proposed that the possibility of using nuclear weapons be expanded to more limited conflicts, such as the 2008 war with Georgia—but this proposal was rejected. Ultimately the 2010 doctrine tightened conditions under which nuclear weapons could be used. Whereas the 2000 document allowed for their use "in situations critical to the national security" of Russia, the 2010 edition limited them to situations in which "the very existence of the state is under threat." (Otherwise, the nuclear component of military doctrine remained fundamentally unchanged from 2000.)

Lessons acknowledged?

Nuclear weapons command attention and generate fear. But their utility is limited. Outside the most extreme circumstances, the damage they can inflict is simply too great and horrible for the threat of using them to be sufficiently credible. Furthermore, nuclear deterrence is fundamentally a defensive strategy—capable of deterring attack but incapable of supporting a proactive foreign policy. The United States, because of its conventional military power, is able to pursue a proactive foreign policy, and this has long been the envy of Russia's politicians and military leaders.
The 2000 version of Russia's military doctrine characterized the limited use of nuclear weapons as a stopgap measure to be relied on only until Russia could develop a more modern conventional strike capability, similar to that which the United States possessed. Russia's efforts to develop such a capability have been under way for more than a decade. Progress was slow at first due to chronic underfunding and the poor state of the Russian defense industry. The substandard performance of Russia's conventional forces during the 2008 war in Georgia led many to dismiss the idea that Russia would ever match the United States in conventional capabilities. But Moscow learned lessons from its Georgian experience, and modernization efforts have intensified in the last five years.
Today, Russia can boast of a new generation of long-range air- and sea-launched cruise missiles, as well as modern short-range ballistic and cruise missiles and precision-guided

gravity bombs. Theoretically, the cruise missiles could carry nuclear warheads, but their envisioned role is primarily conventional. Additionally, Russia's GLONASS satellite constellation now enables precision targeting and communications across the globe. Russia has also begun developing a global strike capability, analogous to the US Prompt Global Strike initiative, in the form of a new intercontinental ballistic missile that the military has said is primarily intended to carry conventional warheads.

Military maneuvers conducted last year, known as West 2013, were apparently the first large-scale Russian exercises since 2000 that did not feature the simulated use of nuclear weapons. This hints that Moscow has gained more confidence in its conventional capabilities. As these capabilities continue to improve, Russia is likely to rely less on its nuclear weapons. But this shift will significantly alter the Eurasian security landscape.

If Russia becomes able to project military force in the same way that the United States has projected force in Kosovo, Iraq, and Libya, Moscow will likely become more assertive in its foreign policy. This will affect NATO policy in turn. The alliance, owing in large measure to US dominance in conventional military power, has been able in recent years to reduce (though not eliminate) its reliance on nuclear weapons. But if Russia begins to close the conventional weapons gap with the United States, some NATO countries might argue that nuclear deterrence should regain some of its former prominence.

Thus, though Russia's reliance on nuclear weapons, including their "limited" use, is not good for international security, the likely alternative will hardly enhance security either. To avoid a new arms race—one centered around conventional weapons, which are less terrifying but more usable than nuclear weapons—it makes sense to begin work now on arms control options that would cover modern conventional strike and defense assets. Unfortunately, the majority of the US Congress refuses to consider arms control arrangements for classes of weapons in which the United States currently enjoys an advantage. But as history has demonstrated, no technological advantage lasts forever. One hopes that those capable of averting a new arms race acknowledge history's lessons before it's too late.

Nikolai N. Sokov, a senior fellow at the Vienna Center for Disarmament and Non-Proliferation, previously worked at the Soviet and Russian Ministry for Foreign Affairs and participated in the START I and START II negotiations. He is the author of *Russian Strategic Modernization: Past and Future*, and he co-wrote and co-edited the first Russian-language college-level textbook on nuclear nonproliferation, *Yadernoe Nerasprostranenie*.

Risks of a Dirty Bomb Attack Are Increasing

Source: https://www.homelandsecuritynewswire.com/dr20220411-risks-of-a-dirty-bomb-attack-are-increasing

Apr 11 – In a new factsheet, the GAO says that the risks of a dirty bomb attack are increasing and the consequences could be devastating.

GAO reported in 2019 that a dirty bomb using radioactive materials could trigger mass evacuations and have socioeconomic costs of billions of dollars.

For example, an accident at a hospital in 2019 involving a small quantity of radioactive materials resulted in clean-up and other costs of $150 million for that building alone.

Numerous incidents indicate weaknesses in controls over radioactive materials that could be used in a dirty bomb. Recent security threats have raised concerns that radioactive materials could be stolen and used in a domestic attack.

For example, in April 2019, a technician was arrested after stealing three radioactive devices from his workplace in Arizona. According to a court filing, the technician intended to release the radioactive materials at a shopping mall, but local police and the FBI arrested him before he could do so.

From 2010 through 2019, the Nuclear Regulatory Commission (NRC) reported over 2,000 nuclear materials events, which included instances of lost or stolen radioactive materials, radiation overexposures, leaks of radioactive materials, and other events. Furthermore, officials from the National Nuclear Security Administration (NNSA), which provides enhanced security to facilities with high-risk radioactive materials, told GAO that there is increasing interest among adversaries in using radioactive materials for making a dirty bomb.

GAO says that vulnerabilities arise because NRC's security requirements do not take into account the most devastating potential effects, including billions of dollars in cleanup costs, and deaths and injuries from chaotic evacuations. In addition, weaknesses in licensing make it relatively easy for bad actors to obtain small quantities of high-risk radioactive materials,
which could be dangerous in the wrong hands.

Among the risks the GAO highlighted:

- **Potential security weaknesses**. GAO has repeatedly found potential security weaknesses at medical and industrial locations storing such materials in the U.S. For

example, in 2014, GAO reported that **an individual had been given unescorted access to high-risk radioactive materials, even though he had two convictions for terroristic threat.** Furthermore, small quantities of radioactive materials located within the same facility are not subject to enhanced security requirements that the total amount would be required to meet. GAO-14-293, GAO-12-925

- **Weak licensing controls for radioactive materials**. NRC controls the flow of radioactive materials domestically through a licensing process. DHS, on the other hand, controls the flow internationally through a license verification process. In 2016, we reported that GAO created a fake company to obtain a license for radioactive materials. GAO altered the license and used it to obtain commitments to acquire a dangerous quantity of material. In 2018, GAO reported that agency officials at U.S. airports had not verified the legitimacy of all licenses for imported radioactive materials. GAO-16-330, GAO-18-214
- **Failure to consider key consequences of a dirty bomb**. Although NRC has implemented security requirements for large quantities of radioactive materials, it has not done so for small quantities of high-risk radioactive materials that can have significant socioeconomic consequences, even if they do not cause immediate deaths from radiation exposure. However, NRC considers only immediate deaths and health effects from radiation exposure as the criteria for determining what quantities of radioactive materials require enhanced security measures. Ultimately, greater use of technologies that do not rely on these materials could reduce the risk of a dirty bomb, where such alternative technologies are available and effective. GAO-19-468, GAO-22-104113

"Given the risks associated with these materials, which are in widespread use, it may be time to consider greater reliance on alternatives, when feasible," GAO writes. "Previously, GAO has recommended that Congress consider this matter."

Entering Dangerous, Uncharted Waters: Iran's 60% Highly Enriched Uranium

By David Albright and Sarah Burkhard

Source: https://www.homelandsecuritynewswire.com/dr20220412-entering-dangerous-uncharted-waters-iran-s-60-highly-enriched-uranium

Apr 12 – As soon as mid-to-late April, Iran is expected to reach a new dangerous, destabilizing threshold, having enough highly enriched uranium (HEU) to fashion a nuclear explosive, about 40-42 kilograms (kg) of 60 percent enriched uranium (uranium mass).[1] With this quantity, an enrichment level of 60 percent suffices to create a relatively compact nuclear explosive; further enrichment to 80 or 90 percent is not needed. According to the International Atomic Energy Agency (IAEA), 41.7 kg of 60 percent enriched uranium (uranium mass) is a significant quantity, which the IAEA defines as the "approximate amount of nuclear material for which the possibility of manufacturing a nuclear explosive cannot be excluded."[2]

A common fallacy is Iran would require 90 percent HEU, more commonly called weapon-grade uranium, to build nuclear explosives. Although Iran's nuclear weapons designs have focused on 90 percent HEU and likely prefer that enrichment, modifying them for 60 percent HEU would be straightforward and well within Iran's capabilities.[3] Historically, the term highly enriched uranium was developed in the nuclear weapon states to distinguish between enriched uranium able to fuel a practical nuclear weapon versus enriched uranium, labeled low enriched uranium, unable to do so. Their cutoff is at 20 percent enriched uranium. At the least, a device made from 60 percent HEU would be suitable for underground nuclear testing or delivery by a crude delivery system such as an aircraft, shipping container, or truck, sufficient to establish Iran as a nuclear power.

Moreover, Iran could further enrich its stock of 60 percent enriched uranium quickly to weapon-grade uranium, where this threshold quantity would be enough to produce about 25 kilograms, enough for a nuclear weapon and close to the IAEA-defined significant quantity. The delay caused by further enrichment would be measured in days if Iran used a significant part of its enrichment capacity and weeks if Iran operates just two production-scale cascades of advanced centrifuges.

Avoiding this uncharted threshold is a priority. To that end, Iran's recent move to chemically convert some of its HEU into an oxide form would suggest positive news, but it is not a remedy and does not prevent other dangerous situations. This new development does not reduce breakout timelines, may disguise preparation to make HEU metal, and creates other dangerous precedents. Moreover, Iran's actions stand in sharp conflict with today's international norms to avoid civilian HEU.

As this report was being finalized for publication, Iran's head of the Atomic Energy Organization of Iran (AEOI) announced that Iran would keep 2.5 kg of its 60 percent enriched uranium stock, referring to a draft nuclear deal that is yet to be finalized.[4] His comment implies the rest of the HEU stock would be eliminated in some manner. The 2.5 kg is likely a part of the HEU stock that has been converted into oxide form and partly used to make target plates for the Tehran Research Reactor (TRR). While such an agreement would reduce the 60 percent stock dramatically, it would legitimize Iran's use of civilian HEU and allow Iran to lock in a valuable precedent for HEU production, conversion, irradiation, and processing later. If true, this concession would represent a significant weakening of the conditions in the Joint Comprehensive Plan of

Action (JCPOA). This report will shed light on what this 2.5 kg quantity of 60 percent is, its usefulness in a breakout, and the risks posed by Iran's production and use of HEU.

Accumulation and Conversion of HEU

We estimated several months ago, first based on the quarterly IAEA Iran report from November 2021, and then again in March 2022, that Iran could accumulate a significant quantity of 60 percent HEU by spring 2022, based on its average daily production of 60 percent HEU up to the date of the IAEA reports.[5] More specifically, based on Iran's daily average production of 0.149 kg 60 percent HEU (uranium mass) from December 2021 through February 2022, and a stock of 33.2 kg as of February 19, it would have taken Iran 46 days, or until April 6, 2022, to accumulate 40 kg of 60 percent HEU (uranium mass).

In early March 2022, Iran converted a small quantity of its stock of 60 percent enriched uranium hexafluoride into an oxide form at an Esfahan facility, for subsequent use as targets in the Tehran Research Reactor to make molybdenum 99 (moly-99), a medical isotope.[6] Earlier, it had shipped 23.7 kg of 60 percent HEU hexafluoride to Esfahan from the Natanz enrichment plant. However, Iran's recent conversion of just 2.1 kg of HEU–equaling the amount Iran produces on average in two weeks–would only marginally delay the timeline to accumulate 40 kg to April 21.

Even if Iran converted a second batch of 2.1 kg HEUF6 to U3O8 in March 2022, this would roughly balance out the 4.5 kg of 60 percent enriched uranium (uranium mass) Iran is expected to have produced in March, based on its average monthly production earlier this year. If so, breakout timelines, which heavily depend on the 60 percent stock, would be roughly the same as at the end of February, absent a change in enrichment capacity.

Some may argue that chemical conversion into an oxide form does lengthen the breakout timeline. It is true it could take longer to convert the oxide compound back to hexafluoride form for enrichment in centrifuges than produce the first quantity of weapon-grade uranium, when breakout timelines are measured in terms of a few weeks. However, it could be reconverted to hexafluoride form for use in producing subsequent quantities of weapon-grade uranium and certainly used in producing the first weapon-grade quantity if the breakout timeline lengthens significantly.

It is also true that breakout timelines would lengthen if Iran converted additional 60 percent HEU from UF6 to U3O8 and made and irradiated HEU fuel plates faster than it produced new 60 percent enriched uranium. Irradiation in the TRR does make it harder to reuse the HEU. But it is unlikely if any but a tiny quantity of the HEU stock could be irradiated in the TRR. The TRR is a small reactor with a power of only 5 megawatts-thermal and less than optimal neutron fluxes to irradiate the HEU, leaving little space or capacity to use any but small amounts of HEU in targets.

Alternatively, the HEU oxide could be converted into HEU metal for direct use in a nuclear weapon if further enrichment was not desired. In that sense, Iran's transfer of 23.3 kg of 60 percent enriched uranium hexafluoride from the Natanz enrichment site to Esfahan could be interpreted as preparation for using the bulk of this material in a breakout to a nuclear explosive using 60 percent enriched uranium.

Because conversion from HEU oxide to HEU hexafluoride or HEU metal is so straightforward, converting HEU hexafluoride into an oxide form is usually not seen as proliferation resistant or a substitute to a ban on production of HEU combined with the blending down or export of all national stocks of HEU.

Target Production

The conversion of 60 percent enriched uranium to targets involves several steps with two critical stages, one, the production of U3O8 from highly enriched UF6, and two, the production of the target plate, which likely involves the pressing together of the U3O8 powder with aluminum powder.

Iran reached the first stage of converting 2.1 kg 60 percent UF6, or HEUF6, into 1.8 kg HEU3O8 between March 7 and March 9, 2022.[7] (Eslami is likely referring to this HEU, despite the numbers not matching exactly.) These amounts are given in uranium mass and indicate a loss and scrap rate of 300 grams of 60 percent uranium, or 14 percent.[8]

On March 11, Iran began stage two, making the target plates. Each plate contains about 5.8 grams of HEU mass. By March 15, Iran had produced a total of 88 targets, containing 515.7 grams of 60 percent uranium (5.86 grams per target and 3.52 grams of uranium 235 per target). If Iran continued producing targets at this rate, Iran may have used all or nearly all of the 1.8 kg uranium in the form of HEU3O8 by the end of March.

On March 15, Iran told the IAEA that it had inserted 32 HEU targets into the TRR for irradiation to make moly-99, containing 186.7 grams of HEU. The irradiation cycle for moly-99 production is relatively short, typically about one week, although the exact length is not known for the TRR, which has a lower thermal neutron flux than other reactors making moly-99. Nonetheless, assuming a seven day irradiation cycle, and a steady state of 32 targets per week for 21 weeks per year,[9] the total annual need for HEU would be about 4 kg. This value could be increased somewhat, but is just as likely to be lower, given the reactor's

age and relatively low power. But this calculation indicates that the maximum amount of HEU usable in targets to make moly-99 is very low, in particular compared to Iran's recent production levels of HEU.
Iran also announced in March that it intends to separate the moly-99 from the irradiated HEU and other fission products at the hot cells at the Molybdenum, Iodine, and Xenon Radioisotope Production (MIX) facility. Such processing would need to occur soon after the targets are irradiated since moly-99 has a half-life of only 66 hours, less than three days, meaning that delays result in rapid losses of moly-99 through radioactive decay. Moly-99 thus cannot be stockpiled in the irradiated target. Typically, moly-99 production and use in medicine is tightly scheduled and highly time dependent. Because the HEU target is only lightly irradiated, the recovered HEU remains near its original enrichment level. So, moly-99 production is not a method of eliminating HEU.
It is possible that Iran has converted additional 60 percent enriched uranium to U3O8, utilizing more of the 23.3 kg of HEU transferred earlier to Esfahan from Natanz. With the small amount usable in targets, significant conversion would be unlikely for moly-99 production. Moreover, the initial conversion suffered relatively high losses, 300 grams. While this amount may appear small, it is relatively large compared to Iran's production of 60 percent enriched uranium, where daily average production was at just below 150 grams in the early months of 2022.[10] Despite the losses, which could be reduced via practice, conversion could continue as a step in eventually going from HEU hexafluoride to HEU metal.

Violations of International Norms

Often lost in this discussion is that sixty percent enriched uranium is not needed to produce moly-99, since 20 percent enrichment is todays universally accepted upper bound enrichment level for moly targets. All of the major commercial producers of moly-99 have agreed to this norm.[11]
Iran's recent actions are thus seen as provocative, especially since the rest of the world has spent decades converting to the use of low enriched uranium targets to make moly-99, some even use natural uranium.[12] One of the last of the major holdouts on conversion, the 100 megawatt-thermal Belgium BR reactor, a reactor twenty times larger than the Tehran Research Reactor, started its conversion to the use of LEU targets in 2020 and is expected to finish it in 2022.[13] The entire purpose of this global, multi-decade effort is to reduce the amount of HEU in the civilian fuel cycle, thereby reducing the proliferation risks, including to terrorists, posed by HEU. Iran appears insensitive to this effort, even though it could use low enriched uranium, even natural uranium, to make moly-99, increasing doubts that its true purpose is purely civilian.
Given Iran's poor non-proliferation credentials, one must ask whether Iran will try to use moly-99 production as a justification to produce 90 percent HEU. Like in nuclear weapons, 60 percent enriched uranium is sufficient for moly-99 production, but 90 percent material is better. Afterall, moly-99 is a fission product of U-235, and the more available the uranium 235, the more moly-99 can accumulate in each target.
Not only is this a dangerous idea, its logic is contradicted by the accomplishments of the multi-decade, multi-lateral efforts to design and produce reliable LEU targets. These targets have an increased density of uranium, allowing for a greater density of uranium 235 as well, compensating for the lower enrichment level. After several decades of work, the world's reactor programs have lowered the enrichment level in targets to below 20 percent. Iran's actions stand in sharp contrast to that worldwide effort and should be fiercely resisted.

Conclusion

Absent IAEA assurance that Iran's nuclear program is peaceful, Iran's production and use of HEU should be seen as directly or via further enrichment building a stock of material intended for use in nuclear weapons, a way to be more prepared to build nuclear weapons in the event the leadership gives the order.
It is hard to fathom Iran's internal thinking behind its recent, provocative HEU conversion. Is it to give a misleading impression of limiting its stock of 60 percent enriched uranium hexafluoride below a key threshold? Or is it a sly attempt to create a precedent or excuse to produce it in the future in a post-nuclear limitation environment, or even keep a portion of its 60 percent stock in case of a nuclear deal? AEOI-head Eslami's proud declaration of keeping some of the HEU under a deal would suggest Iran has achieved the latter to the detriment of the West.
Although conversion followed by irradiation reduces Iran's usable HEU stock marginally in a breakout, this is not a viable pathway and creates an unnecessary and dangerous precedent for the use of HEU in its civil nuclear program. This precedent could justify Iran's further production of HEU in the absence of a deal, in the event of a new nuclear deal following the sunset on enrichment levels, or after a future deal's breakdown. A sounder position is to insist that Iran stop producing HEU permanently and ship out or blend down to low enriched uranium its whole HEU stock, whatever its form.

References/sources

1. Uranium mass is used in the report unless otherwise noted.

2. *IAEA Safeguards Glossary*, International Atomic Energy Agency, https://www.iaea.org/sites/default/files/iaea_safeguards_glossary.pdf.

3. David Albright with Sarah Burkhard and the Good ISIS Team, Iran's Perilous Pursuit of Nuclear Weapons (Washington, DC: Institute for Science and International Security Press, 2021).

4. IRNA, "Iran's Atomic Chief Vows 'Nuclear Renaissance," Islamic Republic News Agency, April 6, 2022, https://en.irna.ir/news/84707163/Iran-s-atomic-chief-vows-nuclear-renaissance. Eslami did not clarify whether he was referring to uranium mass.

5. David Albright, Sarah Burkhard, and Andrea Stricker, "Analysis of IAEA Iran Verification and Monitoring Report - November 2021," *Institute for Science and International Security,* November 19, 2021, https://isis-online.org/isis-reports/detail/analysis-of-iaea-iran-verification-and-monitoring-report-november-2021/8; and David Albright, Sarah Burkhard, and Andrea Stricker, "Analysis of IAEA Iran Verification and Monitoring Report - March 2022," Institute for Science and International Security, March 4, 2022, https://isis-online.org/isis-reports/detail/analysis-of-iaea-iran-verification-and-monitoring-report-march-2022. ↩

6. Director General, *Verification and monitoring in the Islamic Republic of Iran in light of United Nations Security Council resolution 2231 (2015),* GOV/INF/2022/8, March 16, 2022.

7. *Verification and monitoring in the Islamic Republic of Iran in light of United Nations Security Council resolution 2231 (2015),* GOV/INF/2022/8, March 16, 2022.

8. If the amounts given included the mass of the other elements in the chemical compounds, fluorine and oxygen, respectively, the amounts would translate to 1.416 kg uranium mass and 1.525 kg uranium mass. Since an increase in uranium mass is not plausible, the unit appears to be uranium mass only.

9. "Research Reactor Details – TRR", International Atomic Energy Agency, http://www-naweb.iaea.org/napc/physics/research_reactors/database/RR%20Data%20Base/datasets/report/Iran,%20Islamic%20Republic%20of%20%20Research%20Reactor%20Details%20-%20TRR.htm.

10. "Analysis of IAEA Iran Verification and Monitoring Report - March 2022."

11. "Report on Radioisotope Production by Working Group 3, Chaired by the Netherlands," The 3rd International Symposium on HEU Minimization, 5-7 June 2018, Oslo, Norway, https://www.stimson.org/wp-content/uploads/2021/01/WG3-OSLO2.pdf. For additional background on the amounts of HEU in civilian use historically, see Institute for Science and International Security, *Civilian HEU Watch* at https://isis-online.org/uploads/isis-reports/documents/Civil_Stocks_of_HEU_Worldwide_October_7_2015_Final.pdf.

12. "Report on Radioisotope Production by Working Group 3, Chaired by the Netherlands."

13. World Nuclear News, "Belgium starts producing Mo-99 using LEU," May 4, 2020, https://www.world-nuclear-news.org/Articles/Belgium-starts-producing-Mo-99-using-LEU.

David Albright is President and Founder of, and **Sarah Burkhard** is Research Associate at, the Institute for Science and International Security.

The World's Most Powerful Nuclear Missile Is a Russian ICBM Nicknamed 'Satan'

Source: https://www.military.com/history/worlds-most-powerful-nuclear-missile-russian-icbm-nicknamed-satan.html

In the late 1960s, the Soviet Union jumped ahead of the United States' first strike capability in a big way. The latest version of the R-36 intercontinental ballistic missile (called SS-18 by NATO) could hit anywhere in the U.S. with at least 10 18-25 megaton nuclear warheads.

The new missile could destroy the Americans' LGM-30 Minuteman III missiles before they ever left their silos. As time went on, more advanced designs only increased its nuclear payload. Eventually, it carried more power than anything in the U.S. arsenal. From the moment its existence was uncovered, NATO forces nicknamed the weapon the "Satan" missile.

The R-36 is a family of missiles. The original, designated SS-9 by NATO, was the USSR's second intercontinental ballistic missile. Its 1966 design allowed it to be shot into space and stay in orbit around the Earth for an indefinite period of time. This development led to Article

IV of the 1967 Outer Space Treaty, which prohibits nuclear missiles and other weapons of mass destruction from remaining in Earth's orbit.

Although the Outer Space Treaty's stipulations calmed some of the panic around the R-36 missile, the USSR's second version of the weapon wasn't going to make anyone feel better for long. The first model featured only one 20-megaton warhead. The second version, the R-36M, featured multiple reentry vehicles (the actual nuclear warheads), which could hit more than one target with one missile launch.

Like a giant revolver pointed at the entire planet. (The Kremlin)

By the mid-1970s, Multiple Independently-targetable Reentry Vehicles, or MIRV, became the standard for ICBMs. MIRV systems could not only hit multiple targets, but required the defender to fire three to 10 defensive missiles in response. On top of overwhelming missile defenses, it provided greater first strike firepower.

This was the age of mutually assured destruction, the military doctrine that both sides of a nuclear war would be destroyed in a nuclear exchange. If a nuclear war broke out, both sides would fire all their missiles. MIRV technology allowed for more targets and increased the odds of a first strike effectively wiping out the other side before it could retaliate.

The United States first developed MIRV-based missiles with the three-warhead Minuteman III in 1968, but the SS-18 "Satan" could carry eight to 10 more powerful warheads, with the explosive power to destroy American missiles inside protected silos. When the "Satan" system became fully operational in 1975, the U.S. worried it would no longer survive a Soviet first strike and began working on missiles with more and more warheads.

Inside the USSR, Soviet engineers and scientists kept making modifications for future iterations of the "Satan" ICBM. By the time the Soviet Union fell, it had gone through six different versions, each more powerful than the last. The sixth version of the SS-18 missile would be the most powerful nuclear weapon ever fielded by the Soviet Union.

By the time the USSR fell in 1991, Soviet-built SS-18 missiles could strike anywhere in the world.

It wasn't until the development of ballistic missile submarines that the United States could reasonably guarantee it would be able to retaliate in the event of a Soviet first strike. This third part of the nuclear triad -- the others are land-based ICBMs and nuclear-equipped bomber aircraft -- continues today. American ballistic missile submarines can carry up to 24 Trident II missiles, each with 14 reentry vehicles.

Land-based MIRV missiles like the Satan missile were banned by the 1993 United States-Russia START II agreement, but Russia withdrew from that accord in 2002 after President

George W. Bush's administration withdrew the U.S. from the 1972 Anti-Ballistic Missile Treaty, which limited the number of defensive missiles each country could maintain.
As of March 2022, Russia still fields 46 SS-18 missiles, each with 10 warheads, on top of its other deployed ICBMs, an estimated 320 in all, according to the Arms Control Association. While it plans to dismantle its Satan missile stockpile under the terms of the 2012 New START agreement, it is still building new ICBM technology.

A Satan missile silo, housing missiles allegedly capable of piercing any missile defense. (TASS)

Russia's newest weapon is the RS-28 Sarmat "Satan-2" missile, with 10 heavy reentry vehicles, each with enough payload to wipe out an area the size of Texas or France. It also features hypersonic glide vehicles to make it less detectable by U.S. or space-based sensor systems and could be immune to American missile defense systems.

Director-General of OECD Nuclear Energy Agency witnesses Barakah Nuclear Energy Plant's progress in rapidly decarbonizing the power sector

Source: http://wam.ae/en/details/1395303036132

Apr 01 – William D. Magwood, Director General of the Organization for Economic Co-operation and Development Nuclear Energy Agency (OECD/NEA) visited the Barakah Nuclear Energy Plant, where he witnessed the progress of the Plant. Barakah is now generating double the amount of zero-carbon electricity with the recent start of Unit 2 commercial operations as it powers the sustainable growth of the UAE.
Mr. Magwood was welcomed by Hamad Ali Al Kaabi, UAE Ambassador to Austria, and Permanent Representative of the United Arab Emirates to the International Atomic Energy Agency (IAEA), Mohamed Ibrahim Al Hammadi, Managing Director and Chief Executive Officer of the Emirates Nuclear Energy Corporation (ENEC), and senior leadership team members.
Magwood received an update on the project, toured a number of the Barakah Plant facilities, and met with some of the key members of the Emirati-led team operating and maintaining the Arab world's first multi-unit nuclear energy plant.
He witnessed the progress at Unit 1 and Unit 2, both of which are commercially operational and generating clean electricity 24/7. Units 3 and 4 are in the final stages of commissioning,

with Unit 3 already undergoing operational readiness preparations. The development of the Barakah Plant as a whole is now more than 96 percent complete. Once operational, the four Units of the Barakah Plant will produce up to 25% of the UAE's electricity needs and will prevent 22.4 million tons of carbon emissions every year.

Hamad Al Kaabi commented: "The Nuclear Energy Agency remains an important partner as we continue to deliver the UAE Peaceful Nuclear Energy Program, and we look forward to building on this cooperation in offering the UAE model as a successful case study for other nations looking to develop nuclear energy plants for the first time, or to expand their existing fleet, enhancing energy security and grid reliability with low carbon technology.."

Mohamed Al Hammadi said: "We were honored to welcome DG Magwood to Barakah to demonstrate our continued advancement in delivering a strategic low carbon electricity source for the Nation to power the development of a net-zero economy. The Barakah Plant is the largest clean electricity generator in the country, rapidly accelerating the decarbonization of the UAE's power sector."

DG Magwood said: "I was privileged to be able to visit Barakah Nuclear Energy Plant at such a key moment, with the recent start of Unit 2 commercial operations.

Mar 28 – Unit 2 at the United Arab Emirates' Barakah nuclear power plant has entered commercial operation, Emirates Nuclear Energy Corporation (ENEC) announced on March 24. Unit 2 adds an additional 1,400 MW of zero-carbon emission electricity to the UAE's national grid, bringing the total amount of electricity produced at Barakah to 2,800 MW.

This is an impressive achievement and puts the UAE well on course to deliver its targets for carbon free electricity and net zero by 2050. It's also a lesson to the world that new nuclear power plants can be built on schedule, within budget and by a country without a long history in nuclear energy."

The NEA is an intergovernmental agency that facilitates co-operation among countries with advanced nuclear technology infrastructures to seek excellence in nuclear safety, technology, science, environment, and law. It operates within the framework of the Organization for Economic Co-operation and Development (OECD).

NATO Intervention in Ukraine Could Spark Nuclear War. Here's How It Could Happen

By Harry Kazianis

Source: https://thefederalist.com/2022/03/04/nato-involvement-in-ukraine-could-spark-nuclear-genocide-heres-how-it-could-happen/

Mar 24 – **How did we just kill a billion people?"**

Over just three days, as I have done countless times over the last several years, a group of past and present senior U.S. government officials from both sides of the aisle gathered to wage a NATO-Russia war in a simulation at the end of 2019. In the course of what we called the NATO-Russia War of 2019, we estimated one billion people died. And if we aren't careful, what happened in a simulation could happen if a NATO-Russia war erupts over Ukraine.

In fact, in the simulation I mentioned above from 2019, in which Russia invades Ukraine in a similar way as it did over the last week or so, not only does NATO get sucked in

unintentionally, but Russia eventually releases nuclear weapons in its desperation. The result is an eventual escalation of bigger and more dangerous nuclear weapons whereby over one billion lives are lost.
But before we start staring into the abyss, allow me to explain the goal of such simulations. NATO clearly would have a massive conventional advantage in any war with Moscow, ensuring that in a straight-up fight Putin would lose. However, Russia has stated time and time again it will use nuclear weapons to defend its territory and its regime if it feels mortally threatened. Our simulation always seems to ask: Can we ever defeat Russian President Vladamir Putin in an armed conflict over Ukraine or the Baltics and not start a nuclear war in the process?
So far, over at least several years, and with at least 100 different participants that all held different ideas about war and political allegiances, the answer is a flat-out no.

Setting the Scene for War

The scenario the group decided to test back in late 2019 was similar to today: Russia decided to invade Ukraine under the excuse that it is must defend Russian-speaking peoples that are being "oppressed" by Ukraine's fascist government. In our scenario, we assumed Russia performs far more admirably than it does today but has more limited objectives, in that Moscow wants to connect Crimea to separatist regions in Eastern Ukraine that are under its effective control. We assumed that Russia does that quickly, achieving most of its military objectives in roughly four days.
But Ukraine does not give up so easily, just like in real life today. Ukrainian forces, after taking heavy losses, mount an impressive counterattack, whereby Russia loses over 100 tanks and over 2,500 soldiers. Images on social media show Russian armor ablaze, elite Su-35 fighter jets are shut down from the skies, and arms are now flowing in from the West in massive numbers.
Putin is outraged. He thought Ukraine would simply roll over, but he does not factor into his calculus the nearly decades-long training Kyiv received from the U.S. and NATO nor Ukraine's military build-up for the last several years that was focused on this scenario.
Russia then decides that its limited military objectives were a mistake, and that all of Ukraine must be "demilitarized." Moscow then launches a massive ballistic and cruise missile strike followed up by Russia's air force launching its own shock and awe campaign, destroying a vast majority of Ukraine's command and control structure, air force, air defense, and armored units in the process. At the same time, Russia starts surging troops to the borders of Ukraine in what looks like an imminent general invasion and occupation of the entire country.

The Spark

Here is where things take a turn for the worst. A Russian ballistic missile's guidance system fails and crash-lands into NATO member Poland, killing 34 civilians as it tragically lands into a populated village along the Polish-Ukraine border. While the missile was not directed at Poland intentionally, pictures on social media show children crying for their mothers and bodies left unrecognizable, and demands for justice and revenge mount.
To its credit, Poland, which has its own tortured history with the Soviet Union and Russia, does its best to show restraint. While not responding with its own military, it leads an effort to see that Moscow pays a steep price for its aggression in Ukraine and actions, even unintentional, in Poland. Warsaw leads a diplomatic and economic boycott of Moscow resulting in Russia being kicked out of SWIFT as well as direct sanctions on Russian banks, similar to what we are seeing today.
In our scenario, Russia's reaction is also swift. Moscow decides to launch a massive cyber attack on Poland, having based cyber warriors all throughout NATO territory, using their geography and proxy servers to mask the origin of the attack. Russia, in just two hours, takes off-line Poland's entire electrical grid, banking sector, energy plants, and more — essentially taking Poland back to the stone age.
And this is where the nightmare begins. Even though attribution is hard to achieve, Poland appeals to NATO and starts to privately share its desire to invoke Article 5 of the NATO Charter, declaring that an attack on one is an attack on the entire alliance. NATO is worried, as there is debate on how far to punish Russia while also feeling as if they do not have a clear military objective amongst the member states as some want to respond to what happened to Poland while others feel they must intervene militarily in Ukraine.

The Response

Here is where NATO surprises everyone. The alliance decides to set up a limited no-fly zone around the Ukrainian city of Lviv to protect innocent civilians and refugees that are trapped and have nowhere to go. Russia is warned: NATO is not intervening in the conflict, but will ensure that its planes and the airspace around Lviv are protected. NATO does make clear its jets will be in the skies above Ukraine, but will not operate from Ukrainian territory.
In Moscow, Putin now gets a sense that NATO is destined to intervene on Ukraine's side. Russia fears NATO will use this protected corridor as a base of operations to send ever more sophisticated weapons. And with its economy now in a tailspin due to sanctions, Putin feels

the walls closing in him. Before NATO can impose its no-fly zone, Putin orders strikes on any remaining airfields and military assets around Lviv.
But here is where Putin miscalculates and sets the stage for a NATO-Russia war. Putin orders another massive cyber-attack on the Baltic states' military infrastructure, thinking that NATO will use the Baltics to stage an invasion of Russia.
This ends up being the last straw for NATO, which then decides direct intervention in Ukraine is necessary to push back against Russian aggression. Before even an announcement is made, Russian intelligence sees missile and troop movements that indicate an impending NATO attack and decide to strike first — with tactical nuclear weapons. NATO decides to respond in kind.
Russia then targets European cities with nuclear weapons, with NATO and America also responding in kind. What is left is nothing short of an apocalypse, with what we estimate is billion people dead.

No War Goes As Planned
In every scenario I have been a part of there is one common theme to all of them: When Vladimir Putin feels boxed in and feels Russia is directly threatened, usually from a mistake he makes on the battlefield, he decides to use whatever escalatory step he desires to try and make up for it.
While we may well soon see Ukraine and Russia find a diplomatic path out of this brutal war, both sides seem dug in. That means the chances for escalation like the above are high. And if Russia and NATO do become involved in direct conflict, Putin knows that in a conventional fight his regime would be defeated. That means Russia will choose nuclear war.
The only question in a NATO-Russia war seems obvious: how many millions or billions of people would die?

Harry J. Kazianis is director of defense studies at the Center for the National Interest in Washington DC and executive editor of their publishing arm, The National Interest. The views expressed in this article are his own.

EDITOR'S COMMENT: Approximately 150 American B-61 nuclear gravity bombs are stationed in five countries in Europe: Belgium, Germany, the Netherlands, Italy (and Turkey). France and UK (Scotland) possess nuclear weapons. The population of these seven countries is approximately 391,480,000 people. Plus, US population: ~333,000,000 and Russia's population 146,000,000 people, all the above together are 870,480,000 people. Not exactly one billion claimed. Unless you kill a ¼ slice of nuclear China or India. Simulations should be based on actual numbers because politicians easily jump to wrong conclusions and stupid actions.

The nuclear missile next door

Source: https://www.stripes.com/theaters/us/2022-04-17/the-nuclear-missile-next-door-5716382.html

Apr 17 — Ed Butcher, 78, tied up his horse, kicked mud off his cowboy boots and walked into his house for dinner. He'd been working on the ranch for most of the day, miles away from cellphone range. "What did I miss?" he asked his wife, Pam, as he turned their TV to cable news. "What part of the world is falling apart today?"
"Russia's aggression has gone from scary to terrifying," the TV commentator said, as Pam took their dinner out of the oven.
"We're talking about a war that involves a very unstable nuclear power," the commentator said, as they bent their heads over the venison casserole to say a prayer.
"This could escalate," the commentator said. "It could explode beyond our wildest imaginations."
Ed turned the TV off and looked out the window at miles of open prairie, where the wind rattled against their barn and blew dust clouds across Butcher Road. Ed's family had been on this land since his grandparents homesteaded here in 1913 but rarely had life on the ranch felt so precarious. Their land was parched by record-breaking drought, neglected by a pandemic work shortage, scarred by recent wildfires and now also connected in its own unique way to a war across the world.
"I wonder sometimes what else could go wrong," Ed said, as he looked over a hill toward the west end of their ranch, where an active U.S. government nuclear missile was buried just beneath the cow pasture.
"Do you think they'll ever shoot it up into the sky?" Pam asked.
"I used to say, 'No way,' " Ed said. "Now it's more like, 'Please God, don't let us be here to see it.' "
The missile was called a Minuteman III, and the launch site had been on their property since the Cold War, when the Air Force paid $150 for 1 acre of their land as it installed an arsenal of nuclear weapons across the rural West. About 400 of those missiles remain active and ready to launch at a few seconds notice in Montana, Wyoming, North Dakota, Colorado and Nebraska. They are located on bison preserves and Indian reservations. They sit across from a national forest, behind a rodeo

grandstand, down the road from a one-room schoolhouse, and on dozens of private farms like the one belonging to the Butchers, who have lived for 60 years with a nuclear missile as their closest neighbor.

Gated Minuteman III launch facility E5 is located in the middle of Ed Butcher's Ranch in Fergus County, Mont. (Demetrius Freeman/The Washington Post)

It's buried behind a chain-link fence and beneath a 110-ton door of concrete and steel. It's 60 feet long. It weighs 79,432 pounds. It has an explosive power at least 20 times greater than the atomic bomb that killed 140,000 people in Hiroshima. An Air Force team is stationed in an underground bunker a few miles away, ready to fire the missile at any moment if the order comes. It would tear out of the silo in about 3.4 seconds and climb above the ranch at 10,000 feet per second.

It was designed to rise 70 miles above Earth, fly across the world in 25 minutes and detonate within a few hundred yards of its target. The ensuing fireball would vaporize every person and every structure within a half-mile. The blast would flatten buildings across a 5-mile radius. Secondary fires and fatal doses of radiation would spread over dozens more miles, resulting in what U.S. military experts have referred to as "total nuclear annihilation."

"I bet it would fly right over our living room," Ed said. "I wonder if we'd even see it."

"We'd hear it. We'd feel it," Pam said. "The whole house would be shaking."

"And if we're shooting off missiles, you can bet some are headed back toward us," Ed said.

Over the years, they'd reckoned with every conceivable threat to their land. Drought killed the nutrients in the soil. Hail destroyed the crops. Wolves and mountain lions attacked the cattle. Eagles dive-bombed the sheep. Animal skulls littered the same prairie where dozens of newborn calves arrived each spring. The Butchers' eldest son had died suddenly on the ranch of an asthma attack. Their great-grandson had just been delivered in the bunkhouse, the sixth generation to be born onto the property. One of the things Ed appreciated about ranch life was that it brought him closer to the natural cycles of life and death, which only made the idea of man-made, mass nuclear destruction more unimaginable.

"I guess we'd head for the storage room," Ed said.

"Make a few goodbye calls," Pam said. "Hold hands. Pray."

Ed got up to clear his plate. "Good thing it's all hypothetical. It's really only there for deterrence. It'll never actually explode."

"You're right," Pam said. "It won't happen. Almost definitely not."

Ed Butcher pets one of his horses in a field miles from the Minuteman III launch facility located on his ranch in Fergus County, Mont., on April 8, 2022. (Demetrius Freeman/The Washington Post)

Even though it was on their ranch, they had never been allowed down inside the missile silo. Sometimes they saw convoys of Humvees and a wide-load semi traveling on their dirt roads toward the launch site, and once Ed had glimpsed part of the Minuteman III as it was being lowered into the ground, with its black-and-white painted warhead and rocket engine. But the exact comings and goings of the missile on their land remained classified. The 80-foot bunker was mostly a place of their imagination.

It was known to the government as Launch Facility E05, one of 52 active nuclear missile sites on the old homestead farms of Fergus County. The government had chosen to turn the lonely center of Montana into a nuclear hot spot in the 1950s because of what was described then as its relative proximity to Russia, and also because the region could act as what experts called a "sacrificial nuclear sponge" in the event of nuclear war. The theory was that rather than unloading all of its missiles on major U.S. cities, an enemy would instead have to use some of those missiles to attack the silos surrounding Winifred, Mont., home to 35,000 cattle and 189 residents whose birthdays and anniversaries were all printed on the official city calendar.

Winifred was where the Butchers went for church on Sundays and for mail delivery each Wednesday, but they spent most of their time with their children and grandchildren on the ranch. They had 12,000 acres to manage and no paid employees, so two decades into retirement, Ed was still helping mend fences and check on the cows.

"Are you heading out today on the horse?" Pam asked him one morning, knowing he still occasionally liked to ride up to 20 miles a day.

"Nah, too cold," he said. "I'm a fair-weather cowboy anymore. I'll take the four-wheeler."

He put on his work gloves and drove onto the ranch, bumping over fields of sagebrush and dry creek beds as he turned away from the silo and neared the ponderosa pine forest on the south end of the property. He passed his grandfather's old bunkhouse, his father's first hunting cabin and a dozen hills and landmarks named after family friends and dead pets. Several horses spotted his four-wheeler and ran over to greet him.

"No treats today, fellas," he said, and he continued out to the cow pasture, where the first calf of the spring had been born overnight. He watched the calf struggle to stand and then fall back over. "Come on, girl. You've got it," he said, and he turned off the engine and watched until the calf got back on its feet.

He'd only lived away from the ranch once during his life, when he went to college in Billings and then started a career as a professor in North Dakota. He'd been on his way toward a doctorate in U.S. history until his father had a heart attack in 1971, and his mother called to say she was planning to sell the ranch unless he wanted to move back to Montana. He was their only child. The Butcher name was on the road, just like the Wickens and the Wallings and the Stulcs and all of the other original homestead families. Even though he loved teaching, he moved back with Pam to take over the ranch.

Their soil was usually too dry for grain, and there was almost no margin in raising cattle. It was no way to get rich, but over the years, Ed had taught himself and his three children to "get fat off the scenery," he said. Now, as he drove, he watched the snow melt off the nearby Judith Mountains and the cumulus clouds roll across the sky from Canada. A herd of antelope raced across the prairie and a porcupine waddled across the road in front of him.

"Not much has changed out here in a hundred years," he said, and then he drove over the hill toward the silo, which was a few miles from their house. The parched yellow grass on the government's one acre of land matched the rest of the Butcher ranch, but the Air Force had installed a chain-link fence and a portable bathroom. Behind the fence there were a few telephone poles, a small circle of concrete in the ground and a metal manhole cover that led down to the bunker. "No trespassing," a small sign read. "Use of deadly force authorized."

When the military built the launch site during Ed's teenage years, he'd seen it mostly as a potential intrusion, a symbol of federal government overreach and what he called the "insanity of the nuclear arms race." He'd been born into the dawn of nuclear warfare, and even if the historian in him believed the atomic bombs dropped on Hiroshima and Nagasaki were necessary to end World War II, he hoped never to see that kind of devastation again in his lifetime.

As a college professor, he'd driven a Volkswagen bus with a peace sign painted on the rear window, and Pam had attended a small protest against the Minuteman missiles at a federal building in rural North Dakota. They'd moved back to the ranch expecting that they might see some of the nuclear drama they'd heard about at other silos: toxic chemical leaks, accidental near-explosions, Russian spies or groups of nuns who chained themselves to the silo fence in acts of protest.

But, instead, each time Ed went to check on the silo, all he found was wind and sky and occasionally a cow entangled in the fence. The Air Force replaced the original Minuteman missile with a Minuteman II and then a Minuteman III. Military crews built better dirt roads on the Butcher ranch. They plowed those roads in winter. They provided jobs for electricians and contractors in Fergus County. They worked on the launch site mostly under the cover of night, and, as far as Ed could tell, nothing much ever happened. The missile was never launched. The nuclear apocalypse never came.

After a while, the silo started to feel to Ed less like a hazard than just another part of the landscape. It was a benign relic of the Cold War. It was one acre out of 12,000 — or at least that's what Ed had thought until late February, when Russia invaded Ukraine and Russian President Vladimir Putin put his nuclear weapons on higher alert.

"I bet Russian satellites are counting the hairs on my head right now," Ed said.

He looked up at the sky and then pulled his hat down toward his eyes. He turned away from the silo and headed back to check on the cows. "I liked it better when this place felt like a piece of history," he said.

Instead, at that moment:

Motion sensors were detecting any movement within 100 yards of the launch facility.

Military helicopters were patrolling for suspicious activity across all 450 active missile sites in Montana, North Dakota, Nebraska, Wyoming and Colorado.

Two members of the Air Force team were beginning another 24-hour shift in a bunker 7 miles from the Butcher ranch, where they took an elevator 60 feet below ground into a small room reinforced with 4-foot concrete walls. They had a tiny bathroom. They had a bed. They had an escape tunnel. They had a control panel where they could key in an eight-digit code to launch 10 nuclear missiles from Fergus County into the sky.

And a few miles further down the road, Ed's youngest son was at the county courthouse, helping to work on the next generation of America's nuclear arsenal. Ross Butcher, 53, was one of three elected commissioners in Fergus County, and lately part of his job was to coordinate with the military as it began replacing the Minuteman IIIs with a new and more efficient nuclear weapon, called the Sentinel. The Air Force had ordered 642 of them from Northrop Grumman at an estimated lifetime cost of about $260 billion, and now the military had sent Fergus County officials letters and power point presentations about what to expect during the next 10 years of "nuclear improvements to enhance our national defense."

"A complete renovation to all launch facilities," read one slide, and Ross flipped over to the next.

Thirty-one new communications towers. Eight more control centers. Twelve-hundred miles of high-speed underground wiring. Two workforce hubs with 2,500 to 3,000 employees.

"They're talking about adding almost 50 percent to our population," Ross said. "That kind of impact changes everything."

National polling had shown that most U.S. taxpayers don't want to spend hundreds of billions of dollars on a fleet of nuclear weapons that the government hopes will remain underground

until they eventually expire, but the military had found little of that resistance in Fergus County. Malmstrom Air Force Base in nearby Great Falls contributed more than $375 million to the local economy each year. Towns across rural Montana had named school teams after the Minuteman and built museum exhibits on nuclear history, and Fergus County had erected a 60-foot decommissioned missile as a monument next to the playground in a city park.

Ross had gone to meetings across central Montana about the impact of the new Sentinel missile, and he'd made the case that Fergus County's role was both economic and patriotic. "This is world peace through superior firepower," he'd said. He'd lived alongside a nuclear missile on his family's ranch for 53 years, and in all of that time, no country had fired a nuclear weapon.

"Nukes are a part of our global reality, so we better have good ones," he'd told county officials. "I'd love to go around promoting total world peace, but it's not realistic. We need to show that big stick or a bully can start pushing us around."

Which brought him to the last piece of information the Air Force had sent to Fergus County, about the projected lifetime of the Sentinel missiles in a continuing era of nuclear armament:

"Strong deterrence and protection into the 2070s and beyond," it read.

The hatch leading to the Minuteman III launch Facility silo E5 located in the middle of Ed Butcher's Ranch in Fergus County, Mont., on April 8, 2022. There are over 400 Minuteman Silos in the Great Plains Region. (Demetrius Freeman/The Washingtn Post)

Back at the ranch, Pam Butcher had begun to wonder if mankind would survive that long. "Everywhere I look, it's like humanity's moving toward its final hours," she said, because that's how she interpreted the recent wildfires, the droughts, the political instability in Europe, the erosion of American democracy, the inflation of the U.S. dollar, the coronavirus pandemic and also the series of tragedies that had devastated her family in the past few years.

Her brother and his wife had recently been killed in a collision with a semitruck. Her son-in-law had died of the coronavirus in 2021. And Trevis, her eldest son, had suffered a fatal asthma attack in his sleep after working 16-hour days on the ranch in dust and wildfire smoke. He'd always been in good health, and at the time of his death, he was managing the ranch and also becoming a leader within Montana's state Republican Party. The only way Pam could make sense of his death was by thinking that God needed Trevis to help get things in order for a monumental event. Maybe God was preparing for the rapture, Pam thought.

She'd started to get ready herself, storing several years of extra food supplies in the cellar and ordering dozens of books and DVDs from a Christian website. They sat in piles around

the living room: “Midnight Strikes,” “Final Age of Man,” “Realms of the Dead,” “Bad Moon Rising,” “Final Empire,” and “The Day the Earth Stood Still.”
“Oh, look,” Pam said, one afternoon, as she flipped through the stack and then held up her newest DVD to show Ed. On the cover was an image of a parched desert landscape, a nuclear firebomb, three men wearing hazmat suits, and a crumbling Statue of Liberty. “MEGADROUGHT,” the cover read. “The Annihilation of the Human Race Accelerates.”
“Will you sit and have a piece of cake and watch it with me?” Pam asked.
Ed shook his head and walked to his desk across the room. “You go ahead. I’m going to answer some emails.”
“Next time,” she said, and she sat in front of the TV and started the DVD. The screen flashed with disconnected images from around the world: an empty reservoir, a famished child, a group of rioters breaking the windows of a car, a screaming woman, a military helicopter, a cloud of smoke, a nuclear missile launching into flight.
“The four horsemen from the Book of Revelation are now riding,” the narrator said, as a fire spread across the TV screen. “We have transitioned into the prophetic end times.”
“Amen,” Pam said, as she turned up the volume. “Amen.”
“Are you prepared for the worst?” the narrator asked. “Who will survive?”
Pam’s plan was to go toward the cellar, where she thought she’d stockpiled enough supplies for them to be self-sufficient for at least a few years. They had a freezer full of meat and 3,000 rounds of military-grade ammunition to hunt the deer and elk on their land. They had a generator, 10,000 gallons of diesel fuel, and 20,000 gallons of propane. They could use their central fireplace to heat the whole house and their bushels of wheat to make fresh flour. Pam had gone online to buy water-filtration devices, purification tablets, and more than a dozen 5-pound “survival kits” that included evaporated soup and freeze-dried meals.
“The earth is under attack,” the narrator said.
“Everyone on the planet is in grave danger,” he said.
“North Korea, China, and Iran could all launch nuclear attacks. Russia is flexing its military muscle. America should expect an unimaginable threat at an unimaginable time.”
Pam had imagined it. She had seen the threat with her own eyes when she was 8 years old and her father woke her in the middle of the night to watch the United States launch one of its first tests of an unarmed nuclear missile in rural Nevada, not far from where her family lived in Utah. She watched the sky light up with a flash of orange light as the missile rose above earth and disappeared overhead, leaving behind a cloud of smoke that rolled outward across the desert.
Only years later did she begin to think about what would happen once a missile made its final descent. She’d taken a tour of a nearby launch control center, sat in the bunker with the Air Force team and heard about realities of nuclear war. The missile on the Butcher ranch could demolish an entire city. The detonation of all 150 nuclear missiles in Montana could blanket the world in fire and smoke, block out sunlight, lower Earth’s temperature, devastate agriculture and lead to mass starvation and extinction.
“War is now inevitable,” the narrator said, as the camera shook and people wearing gas masks ran from the sound of machine guns. Pam watched missiles and fireballs shoot across her TV screen until finally it went dark.
“Wow,” she said, after a moment, and Ed looked up from his computer.
“Wow,” he said.
“What did you think?” she asked him.
“I think whenever the good Lord calls, I’ll be ready to go with him,” he said.
“It’s getting so real,” she said. “It feels like it could happen at any moment.”
That night, the temperature dropped below freezing, a snowstorm rolled in from the mountains, and Ed awoke to the sound of an emergency call. His grandson, Josh, had gone to check on the cattle a little after 3 a.m., and he’d found the second calf of the season lying motionless at the bottom of a ravine. The calf was only a few hours old, and it had stumbled away from its mother and fallen into the frozen creek bed. Josh had picked up the calf, carried it to his truck, and turned up the heat. He’d driven back to the house and put the calf into an electric warming bed, but it was still cold and mostly unresponsive.
“I think we’re going to lose this one,” Josh told Ed, but when they checked on the calf a few hours later, it had opened its eyes. It was sluggish but not dead, so they decided to drive it back onto the ranch to see if it could somehow reunite and bond with its mother.
Ed’s daughter-in-law drove the pickup truck past the missile silo and out toward the cow pasture. His 4-year-old great-granddaughter held the calf in the passenger seat, trying to hug it back to warmth. Ed and Josh sat in the bed of the truck, and then they dropped the calf in the field and tried to call over to its mother.
“Mooo,” Josh yelled.
“Mooo. Come get your baby,” Ed called out, but the cow ignored them. This was her first calf, and she had no experience mothering. She chewed on the grass. She laid down. She glanced over at the shivering calf, stood up, and then walked farther away.
“She’s shunning her,” Josh said.
“It’s natural,” Ed said. “You have to expect some losses.”

"Yeah, but the second calf," Josh said.
Ed nodded "I know. It hurts."
They mended a nearby fence and started heading back toward the truck. "Mooo!" Ed called out, one more time, and the cow looked at him and then stood. She walked in the direction of her calf. She looked at it and eventually licked its head. She lay beside the calf and shielded it from the wind as the sun started to break through the clouds.
Ed stood next to his great-granddaughter and watched for another few moments, until finally the cow prodded the calf onto its feet and led it back toward the herd.
"How great is this?" Ed asked his great-granddaughter. There were no predators circling the cow pasture, no military helicopters patrolling above the ranch, no explosions coming from the silo over the hill. For the moment, it was just sky and wind and another new life awakening on the Butcher family ranch, where the missile was still buried below ground.

Study reveals: How many nuclear bombs would it take to destroy the world

Source: https://www.hitc.com/en-gb/2022/02/28/study-reveals-how-many-nuclear-bombs-would-it-take-to-destroy-the-world/

March 2022 – Since the historic Manhattan project (1942-1945), there have been multiple studies on how many nukes it would take to destroy the world or humanity. As the situation with Russia and Ukraine intensifies, discussions on nuke wars and possibilities of a Nuclear Winter have resurfaced. According to a declassified study, scientists started researching how many nuclear bombs it would take to destroy the world shortly after the end of the second world war, Business Insider had reported.
Later, another study revealed the maximum quantity of nuclear weapons a country should possess as the study discussed how many nukes it would take to destroy society as we know it.

How many nukes does it take to end the world?
The declassified study from the scientists at the Los Alamos laboratory, published in 1947 had first shed light on the question that how many nuclear bombs it would take to destroy the world. According to the study, it would take about ten to a hundred 'super nukes' to end humanity, a publication reported. Later, a study titled "A National Pragmatic Safety Limit for Nuclear Weapon Quantities" said that any nation that will unleash **more than 100 nuclear bombs** on another can destroy society. Joshua Pearce, professor at Michigan Technological University and other co-authors of the paper suggested, "With 100 nuclear weapons, you still get nuclear deterrence, but avoid the probable blowback from nuclear autumn that kills your own people." It further added, "The results found that 100 nuclear warheads are adequate for nuclear deterrence in the worst case scenario, while using more than 100 nuclear weapons by any aggressor nation (including the best positioned strategically to handle the unintended consequences) even with optimistic assumptions (including no retaliation) would cause unacceptable damage to their own society."

Generation IV, the future of nuclear power

By David Szondy
Source: https://newatlas.com/technology/generation-iv-future-nuclear-power/

Apr 15 – Although nuclear power remains controversial, new reactors are being built in surprising numbers and these will provide the second-largest share of the world's carbon-free energy. It's also an industry undergoing rapid change as new technology comes online. So, what will nuclear power look like in the decades to come?

On December 2, 1942, underneath the University of Chicago's Stagg Field football stadium, Chicago Pile 1 (CP-1) was activated, becoming the world's first nuclear reactor. Today, 78 years later, 440 reactors generate over 10 percent of the world's electricity, with another 50 now under construction.

Despite this, nuclear energy suffers from a very bad reputation. Like many things in life, this is due to a number of complicated factors. Nuclear energy is still a mysterious thing to many people. It's associated with nuclear weapons, and is still under the burden of decades of Cold War propaganda, as well as three extremely high-profile reactor accidents in the USA, USSR, and Japan.

In the West, reactor construction and development slowed to a crawl in the last decades of the 20th century, but the industry may be on the verge of a renaissance. Despite its reputation, nuclear energy has a number of advantages. It's not only carbon-free, it's emissions-free. It produces tremendous amounts of power with a very small area footprint. It can be sited in any region. And, surprisingly, it has the lowest per kilowatt death rate of any energy source.

The cost of nuclear power

However, nuclear energy has one big problem and that's cost. With plants costing up to US$15 billion, constructing a reactor is rarely profitable. Instead, most of the builder's revenue comes from refueling and servicing the reactors.

The main reason for the high cost of building nuclear power plants isn't because they are nuclear, but because they are large, often one-off, civil engineering projects that are few and far between, and can take up to 20 years to bring online. Instead of factory mass production, plants are built in the field. They also require a complicated licensing process, with the plant's design being tested, modified, and retested under a unique set of quality, safety, and security requirements, as well as the operator being required to meet all waste disposal costs.

Not only does all of this lead to cost overruns, the time taken means there's also plenty of opportunity to lose experience as engineers age and retire. This leads to oddities like Britain, which was one of the pioneers in nuclear energy, having to go abroad for help in building the country's latest reactors.

There are a number of ways of reducing costs, including using standardized designs, building enough plants to preserve skills and experience, employing various management streamlining measures, and, most importantly, by attacking the biggest building cost. The nuclear reactor and turbine islands do not dominate the costs of these advanced systems, rather, it is the civil works, structures, and buildings; electrical equipment installation; and other indirect costs for this work on site.

Because of this, the nuclear industry is looking to new reactor designs, some of which have been under development for decades, to not only reduce construction and operating costs, but also to improve safety and efficiency while decreasing the risk of nuclear weapons proliferation.

Future reactor designs

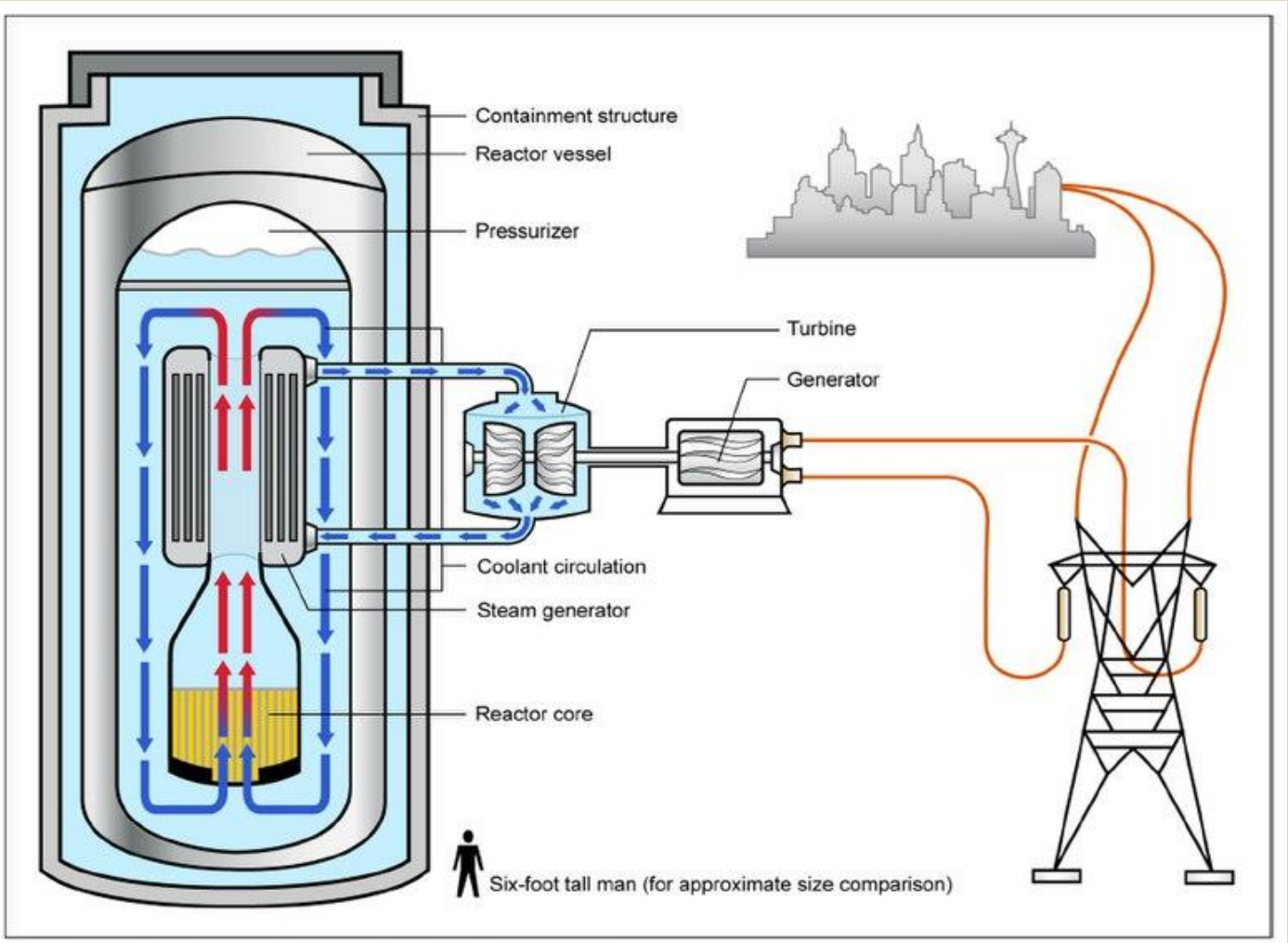
Today, the nuclear industry is in Generation III or III+. The first generation was marked by the prototype reactors of the late 1940s, '50s, and early '60s, and the second by the first commercial light water reactors from the mid-1960s to the mid-1990s. These were followed by Generation III, which are also light water reactors, but include new technology like more reliable fuels, passive cooling systems, and reactor cores that are less prone to failure. Generation III+, which will be built until the 2030s, are the latest reactors and are Generation III designs with additional improvements.

What comes next will be Generation IV, which is a family of much more advanced and diverse designs aimed at making nuclear plants not only less expensive, but also inherently much safer by incorporating new reactor technologies, as well as new materials and new manufacturing techniques.

Basically, these Gen IV reactors are characterized by their coolants, which can be water, helium, liquid metal, or molten salt. They are also differentiated by where in the neutron spectrum they operate. That is, in the thermal neutron spectrum or the fast neutron spectrum. In the latter, the neutrons that cause fission are generated by the nuclear reaction and are not slowed down, so the reactor operates at very high neutron energies, while in the former, the reactor uses a moderator to slow down the reaction, which occurs at lower neutron energies.

Let's look at some Gen IV reactors. This is by no means an exhaustive list, but it does include the main contenders likely to appear in the mid-21st century.

Small Modular Reactor (SMR)



Source: GAO, based on Department of Energy documentation. | GAO-15-652

Small Modular Reactors (SMR) are light water reactors that are basically advanced versions of the reactors in service today, except that they are smaller and can be mass-produced like motor cars. These aim at bringing down the costs of nuclear energy by introducing factory manufacturing techniques. Essentially, the idea is to create small, standardized reactors with a capacity of less than 300 MWe each.

Unlike conventional reactors, SMRs are not large civil engineering projects that can take 20 years to bring online and another 20 to turn a profit. Instead, as the name implies, SMRs are based on a smaller, simpler design made up of modules of not only the reactor, but also most of the support components as well.

This allows power plants to be built in factories or shipyards as robust modules, then shipped to the site for assembly. The goal is to not only bring down costs, but also to radically speed up plant construction and certification to begin operation.

Another advantage of SMRs is that plant configuration can be adapted to meet different customers' needs. Small, relatively isolated communities can order single-reactor plants that can serve, for example, a few thousand homes and businesses, while large cities can have plants with multiple reactors that can provide electricity to millions. Since they're small, SMRs can be used for specialized applications like oil exploration or serving military bases. In addition, modules can be designed to be shipped by the most appropriate means, including by barge, ship, truck, train, or even airship.

SMRs are also notable for incorporating passive safety systems that require little or no electrical power to operate and provide cooling if an accident occurs. They are also easier to shield without requiring massive concrete structures because they can be easily installed

underground or aboard ships or sea platforms where they sit below the water line, which shields them in the same way as the reactor on a submarine.

High Temperature Gas-Cooled Reactor (HTGR)

A High Temperature Gas-Cooled Reactor (TGR) is a graphite-moderated helium-cooled reactor that operates at temperatures two or three times those of conventional reactors, but with a lower power density. The concept has been under development since the 1940s, but it's only been in recent years that the technology has begun to mature.

The basis for the HTGR is that it runs on TRi-structural ISOtropic (TRISO) particle fuel. Instead of being formed into rods, TSRIO fuel is made of poppy-seed-sized particles consisting of uranium, carbon and oxygen sealed in three layers of carbon or ceramic materials to contain nuclear waste products.

These particles are formed into cylindrical pellets or billiard-ball-sized spheres called "pebbles." This makes the fuel very robust. It is more resistant to neutron irradiation, corrosion, oxidation, and high temperatures than conventional fuels. This means the pebbles won't melt in the reactor, which can run at higher temperatures. In addition, the pebbles can slowly circulate through the reactor, with spent pebbles being removed from the bottom of the reactor while fresh pebbles are introduced to replace them at the top.

Gas-Cooled Fast Reactor (GFR)

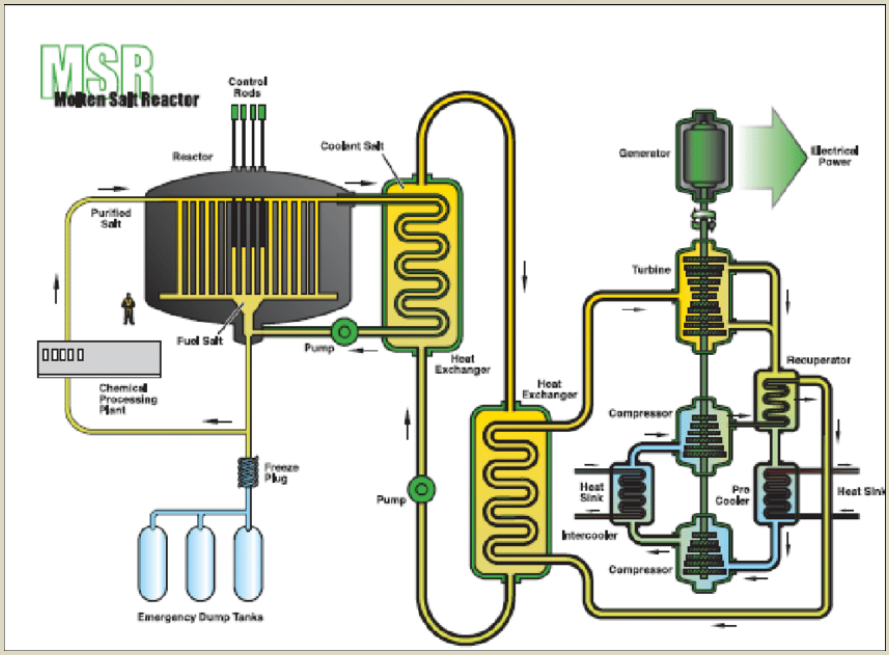
Gas-Cooled Fast Reactors (GFR) are also cooled by helium, but operate at a higher power density than an HTGR. They were originally developed as breeder reactors, which produce more fuel than they burn by converting thorium or non-fissile uranium isotopes into plutonium or fissile uranium isotopes, by using fast neutrons instead of the slow neutrons produced by conventional reactors.

The advanced versions of the GFR use a core made of ceramic uranium mono-carbide fuel to allow it to operate at high temperatures. The fuel is also configured so there's a high density of uranium atoms per volume of fuel.

S odium Fast Reactor (SFR)

Another fast reactor is the Sodium Fast Reactor (SFR), which is cooled by liquid sodium, which has very good heat removal capability. These are small reactors because this allows for inherent and passive safety features that don't work very well in larger sodium reactors. In the United States, the fuel used is a metallic alloy of uranium and zirconium clad in steel, while in Russia, France, and Japan the preference is for uranium oxide fuels. These fuels have low thermal density, so if the reactor core gets too hot, it expands, causing the nuclear reaction to naturally die down.

The core is also very compact because the SFR has a closed fuel cycle. That is, the uranium and plutonium are recycled inside the core as part of the nuclear reaction, allowing the reactor to run for decades between refueling.



Lead-Cooled Fast Reactor (LFR)

The Lead-Cooled Fast Reactor (LFR) is based on a reactor design developed for Russian nuclear submarines and, as the name suggested, uses lead as its cooling element. The latest versions run on uranium nitride instead of uranium dioxide. As with sodium, lead provides a similar passive safety system that automatically regulates the nuclear reaction if it starts to go out of control.

Fluoride-Cooled High-Temperature Reactor (FHR)

Fluoride-Cooled High-Temperature Reactors (FHR) are high-temperature reactors that are cooled by a molten mixture of lithium fluoride and beryllium fluoride salts instead of helium. These reactors have up to 10 times the power density of an HTGR using TRISO-particle fuel technology. The fluoride salts allow the reactor to run at lower temperatures compared to helium-cooled reactors and future designs will use pebble fuels.

Molten Salt-Fueled Reactor (MSR)
The Molten Salt-Fueled Reactor (MSR) is a bit of a twofer, where the molten salt is both the coolant and the fuel. Instead of being formed into rods, pellets, or pebbles, the fuel is mixed into the fluoride salt, which flows through graphite or a similar moderator that generates slow neutrons and controls the reaction.
MSRs can operate at higher temperatures, though this introduces corrosion problems, so the designs tend toward cooler versions. However, by combining the coolant and the fuel, removing wastes and introducing new fuel is much easier than in conventional reactors.

Beyond Gen IV
As the demand grows for carbon-free energy leads to more nuclear plants being built around the world, we'll be seeing these Generation IV reactors coming online. Since they're designed to be cheaper and faster to build, they'll very likely become very common very fast. But what will come after Generation IV? What will Generation V be like?
In many ways, they'll be more advanced versions of the Generation IV reactors, building on the lessons learned by the previous generation, but we are also likely to see new nuclear plants for new niche applications. There are already plans to build small reactors for use on the Moon, and work is being done on technologies like nuclear fuel that burns like a candle, with the reaction starting at one end and moving to the other as it gradually eats through the fuel.
We may also see a revisiting of other approaches to nuclear reactor design that are based on experiments conducted decades ago, but were abandoned in favor of more promising solutions. Some of these were so thoroughly abandoned that even experts in the field have only a hazy understanding of them. Now, they're being looked at again. Perhaps there will be a day when the term "nuclear fuel" will mean not only uranium and plutonium, but also lesser known ones like thorium.
Of course, if nuclear fusion is ever made practical, then all bets will be off as nuclear fission will likely go the way of the coal-fired locomotive.

David Szondy is a freelance journalist, playwright, and general scribbler based in Seattle, Washington. A retired field archaeologist and university lecturer, he has a background in the history of science, technology, and medicine with a particular emphasis on aerospace, military, and cybernetic subjects. In addition, he is the author of several websites, four award-winning plays, a novel that has thankfully vanished from history, reviews, and scholarly works ranging from industrial archaeology to law, and has worked as a feature writer for several international magazines.

Poll: Russia's nuclear saber-rattling is rattling neighbors' nerves

By Lauren Sukin and Alexander Lanoszka
Source: https://thebulletin.org/2022/04/poll-russias-nuclear-saber-rattling-is-rattling-neighbors-nerves/

Apr 15 – While Ukrainians fight or flee Russia's bombardment of their cities, many Europeans feel a palpable, renewed nuclear fear. Russian President Vladimir Putin ordered the country's nuclear forces on high alert. Russian troops forced Chernobyl Nuclear Power Plant employees to work a 600-hour shift at gun point. They also attacked the Zaporizhzhia Nuclear Power Plant, causing structural damage and starting a fire. Meanwhile, Romanians have spent millions for the emergency production of radiation-blocking iodine pills, Poland has signaled its willingness to host US tactical nuclear weapons, and officials from the Baltics have urged NATO to commit to intervene if Russia uses weapons of mass destruction.
How has the war reshaped Central and Eastern Europeans' perceptions of nuclear risk? In March, we polled citizens in Poland, Romania, Latvia, Lithuania, and Estonia with the goal of learning more about their thoughts on nuclear weapons.[1] Our findings paint a mixed picture. Citizens fear the nuclear implications of Russia's war in Ukraine, abhor nuclear weapons, and worry about Russian nuclear safeguards. At the same time, **they want their governments to acquire nuclear weapons.**

Russia waved the nuclear saber
On March 26, former Russian President Dmitry Medvedev laid out the country's conditions for a nuclear launch: a nuclear attack on Russia or its allies, an attack on critical infrastructure that "will have paralyzed [Russian] nuclear deterrent forces," or any "act of aggression committed against Russia and its allies, which jeopardized the existence of the country itself, even without the use of nuclear weapons."
Moscow emphasized its right to use nuclear weapons in response to non-nuclear "existential" threats. Kremlin spokesperson Dmitry Peskov recently warned that Moscow

"can use and we will actually use nuclear weapons to eliminate the threat for the existence of our country."
To some, an "existential threat" requirement may sound reassuring. But it should not. Russian disinformation narratives—such as when Russian media falsely accused Ukraine of building bioweapons and seeking a nuclear "dirty bomb"—could easily become flimsy excuses for existential threats. Moreover, a sufficiently humiliating defeat in Ukraine could arguably be interpreted as a threat to Russia's "existence," especially given the Kremlin's talk about Ukraine as rightful Russian territory.
And, of course, a direct challenge to Russian President Vladimir Putin's regime would likely be considered existential. This may be why White House officials quickly clarified that President Joe Biden's warning that Putin "cannot remain in power" was meant only as a lament about Putin's atrocities, not as a plan to oust him.

Do Europeans fear a Russian nuclear attack?
On March 15, 2022, we polled more than 1,000 Central and Eastern European citizens on their understandings of and attitudes towards regional nuclear threats. Our survey depicts a moment in time—just weeks after the full-fledged invasion, when the war was still new. As the war has evolved, perceptions about it may have changed. In addition, while we polled nationally representative samples in Poland and Romania, we could not do so in the Baltic states, making it more difficult to draw conclusions about public preferences in Latvia, Lithuania, and Estonia. Still, our polling represents a valuable snapshot of public views in the region during the first weeks of the war. The result suggest that Russia's neighbors do not trust the Kremlin to exercise caution in its nuclear affairs.
In Latvia, Lithuania, Estonia, Romania, and Poland, between 77 and 93 percent of respondents distrust Russian nuclear decision-making. In all of these countries except Latvia, a majority "strongly distrust" Russia's nuclear stewardship. These findings suggest that Eastern Europeans worry—or at least they did in mid-March—that Putin's nuclear threats could be more than just talk. Such dread goes hand-in-hand with broader anti-Russia views. Almost nine out of 10 people described their view of Russia as "unfavorable."
Yet Central and Eastern Europeans have a high level of confidence in NATO, even as the war in Ukraine has tested the alliance. In each of these countries, between 66 and 85 percent of survey respondents said they trusted NATO's nuclear decision-making—a stark contrast to their distrust of Russia. Their support for unilateral US decision-making around nuclear weapons fell in a similar range.
Central and Eastern Europeans also felt strong political alignment with NATO and the United States. Nearly 90 percent expressed pro-democracy and pro-NATO views. More than two-thirds characterized the US military as "morally good." These positive views help explain the region's increased coordination with and contributions to NATO. They also suggest these expanded commitments are not just symbolic. In fact, almost two-thirds said that they would want their country to contribute if NATO forces fought against a Russian invasion of a NATO state.
These public opinion measures, like most, omit nuance. Still, they suggest that Russia's nuclear threats raised alarm. Whether Putin's nuclear rhetoric is a "madman" strategy or just evidence of a madman, those living nearby are—with reason—scared.

Europeans are nervous about the emergent nuclear threat. Now what?
Nuclear weapons have shaped the ongoing war. When Putin warned that a NATO intervention would invite "consequences you have never seen," for example, many understood his words as a thinly veiled nuclear threat. Russia's nuclear forces have also kept US and NATO soldiers at bay. Meanwhile, Central and Eastern European leaders are likely aware of the asymmetry between Russia's massive nuclear arsenal and their own militaries.
Despite overwhelming support for Ukraine, NATO has stayed on its side of the border. Biden insists that American soldiers will not fight in Ukraine. Although Ukrainian President Volodymyr Zelenskyy has repeatedly called for a NATO-imposed "no fly zone," NATO has not agreed out of fear that doing so would escalate the conflict into a broad Russia-NATO fight.
Ukraine has mustered impressive force to resist and repel Russian operatives. Still, the war may have unfolded differently if nuclear history had been different. After securing independence from the Soviet Union in 1991, Ukraine was "born nuclear," which means that it was left with a robust stockpile from the collapsed Soviet Union. Yet Ukraine relinquished its weapons and signed the Nuclear Non-Proliferation Treaty. It did so in exchange for the 1994 Budapest Memorandum—a document in which Russia, the United States, and the United Kingdom declared their (non-binding) commitment to Ukrainian independence, sovereignty, and borders.
The memorandum was never intended to be a true security guarantee. It was not an international treaty nor was it ratified by national legislatures. With historical hindsight, other US partners teetering in dangerous nuclear environments may nevertheless have learned an inadvertent dangerous lesson about the "value" of membership in the nuclear club.
Indeed, across Eastern and Central Europe, formerly frosty attitudes about nuclear acquisition may be thawing. Half of all respondents in our poll wanted their countries to develop nuclear weapons.
Nuclear proliferation looked least desirable in Lithuania and Latvia—only 38 percent and 40 percent favored them, respectively. In Romania and Estonia, the public was split at 45

percent and 51 percent, respectively. In Poland, which boasts both by far the largest military and economy of the surveyed states, almost two-thirds of the public openly declared their support for a national nuclear weapons program.
These percentages are high enough that citizens are unlikely to act as a strong restraint on leaders seeking nuclear weapons, although this is unlikely, as well as largely impractical, at least in the Baltic states. In Poland, robust public support for building nuclear weapons could galvanize political conversations, as has been the case in South Korea. Although nuclear proliferation to date hasn't been a major topic in Polish politics, for years Poland has advocated for a "Eurodeterrent," or a nuclear sharing program between European states. Such a program would provide nuclear deterrence for Europe, independent of the US nuclear arsenal.
Crucially, citizens' expectations about the costs of proliferation are likely misinformed. Almost two-thirds think acquiring nuclear weapons would not prompt the US military to change its assistance to their country. Yet the United States has previously threatened to withdraw military support from allies who sought nuclear weapons. Similarly, only one-fourth of survey respondents anticipated that the United States would impose sanctions in response to nuclear weapon acquisition, even though such sanctions would be likely. If Europeans understood the costs of proliferation, they might not be as eager to support nuclear weapons acquisition.
Public support for nuclear proliferation is not driven by a perceived need for a stronger NATO nuclear presence; only about one-third of survey respondents approved of NATO stationing tactical nuclear weapons in their country. Instead, many citizens preferred that their country acquire nuclear capabilities and the accompanying control over when and why to use them.

A pro-nuclear European public should proceed with caution
Central and Eastern Europeans are not necessarily signaling nuclear hawkishness, despite these pro-proliferation views. Many oppose nuclear weapons for ethical reasons. Across our survey, 85 percent of respondents reported that there were no situations in which using nuclear weapons would be morally justified.
Respondents were not only repulsed by the prospect of nuclear use, but they also expressed their belief in other prominent, pacifistic norms. For example, more than three-quarters agreed that "the use of military force only makes problems worse," while almost all touted the importance of international law which, at least debatably, limits nuclear use.
Central and Eastern Europeans may be warming up to nuclear weapons not out of a desire for militancy but in response to renewed fears about Russian nuclear threats. They may believe that responsible nuclear stewardship could help avert nuclear disaster. But if the geopolitical situation continues to worsen, support for nuclear weapons acquisition, however ill-considered, may grow.

[1] We conducted an online public opinion survey using Lucid's Marketplace platform in Romania, Poland, Latvia, Lithuania, and Estonia. 1,385 people responded. The sample is nationally representative (using block quotas on age and gender) in Romania and Poland but not in the Baltic countries. The samples were balanced on key demographics and attitudes, such as political ideology. Our results control for these variables.

Lauren Sukin is a MacArthur Nuclear Security Postdoctoral Fellow at Stanford University's Center for International Security and Cooperation and an incoming Assistant Professor of International Relations at the London School of Economics and Political Science. Her research examines the role of nuclear weapons in alliances, crisis politics, and public opinion. She holds a PhD and MA in political science from Stanford University and ABs in political science and literary arts from Brown University.
Alexander Lanoszka is an assistant professor in the Department of Political Science and the Balsillie School of International Affairs at the University of Waterloo in Canada. His most recent book is *Military Alliances in the Twenty-First Century* (Polity, 2022). He received his Ph.D. from Princeton University.

Nuclear accidents and policy responses in Europe: Comparing the cases of France and Germany

By Kristian Krieger, Ortwin Renn, M Brooke Rogers, & Ragnar Löfstedt
Source: https://www.academia.edu/76940473/Nuclear_Accidents_and_Policy_Responses_in_Europe_Comparing_the_Cases_of_France_and_Germany

"This [Fukushima] accident is raising a certain number of questions throughout the world concerning the safety of nuclear facilities and energy choices. France chose nuclear energy, which continues to be an essential component of her energy independence and the fight against greenhouse gases. This choice went hand in hand with an unwavering commitment to ensure a very high level of safety for our nuclear facilities. [...]. I remain convinced that we made the right choices".

French President Nicolas Sarkozy 24/3/2011

"In Fukushima, we have had to recognise that even in technologically highly developed countries such as Japan the risks of nuclear energy cannot be controlled safely".

German Chancellor Angela Merkel 9/6/2011

"The phase-out of nuclear energy will be undertaken until 2022 and is irreversible"

Premier Minister Bavaria (Germany) Horst Seehofer 30/5/2011

This paper discusses the varying effects of major nuclear incidents on nuclear energy policies in different countries. The statements presented above offer a good illustration of the question this paper sets out to answer: What explains the different responses to major nuclear incidents in European countries? More specifically, why does Nicolas Sarkozy underline the French commitment to nuclear energy while Angela Merkel and Horst Seehofer undertake a complete U-turn in their nuclear energy policy for Germany in the aftermath of the Fukushima accident?

●▶ Read the full paper at the source's URL.

Dr. Brooke Rogers is a Reader in Risk and Terror in the Department of War Studies at King's College London where she co-directs the MA in Terrorism, Security and Society. Dr. Rogers is a social psychologist interested in risk and crisis communication, perceptions of risk, and health outcomes in response to extreme events.

New Treatment Removes Radioactive Barium from Nuclear Wastewater

Source: https://www.homelandsecuritynewswire.com/dr20220420-new-treatment-removes-radioactive-barium-from-nuclear-wastewater

Apr 20 – Exposure to ionizing radiation can be extremely dangerous for humans and animals. High acute doses lead to radiation burns and radiation sickness that can be lethal. Lower-level and longer-term exposure causes damage to the cells and organs that can lead to cancer.

These radioactive ions are a by-product of the process used to create nuclear energy and can be found in the wastewater produced by nuclear reactors. A research team from China's Taiyuan University of Science and Technology has developed a new process that offers a rapid and effective path to remove some of the most harmful of these – barium (Ba^{2+}) ions.

The first author of the study, which was published in the KeAi journal *Green Chemical Engineering*, is Dr. Xudong Zhao. He explains: "Over the past few decades, scientists have focused on treating radioactive ions using an adsorption process, which causes the dangerous ions to stick to the adsorbent's surface, which can then be safely scraped off. However, for this process to work safely and efficiently, achieving the right balance between adsorption capacity and adsorption speed is pivotal; something the various adsorbents that are currently used struggle to achieve."

To solve this problem, Dr. Zhao and his fellow authors have developed a new adsorbent that uses a sulfonic acid ($–SO_3H$) group. He says: "It exhibits excellent capture ability for barium due to its strong, hard acid-base and electrostatic interactions. We achieved an adsorption capacity of 152.0 mg g^{-1} and a fast equilibrium adsorption time, both of which are superior to most of other reported materials."

He adds: "Optimal pH was found to be almost neutral and changes in temperature had little impact on the effectiveness of the adsorbent. In addition, the process is irreversible, which means secondary pollution (by the ions leakage) is not an issue."

According to Dr. Zhao, the team's work not only provides an efficient adsorbent for capturing Ba^{2+} irreversibly, it also proposes a strategy for constructing adsorbents with simultaneous high adsorption capacity and fast kinetics. He explains: "These adsorbents could potentially be used in a variety of industries and industrial processes."

Nuclear expert cautions against unfamiliar new nuclear age

University of Leicester

Source: https://www.eurekalert.org/news-releases/950528

Apr 22 – High-tech advances in weapons technologies and a return of 'great power nuclear politics', risk the world 'sleepwalking' into a nuclear age vastly different from the established order of the Cold War, according to new research undertaken at the University of Leicester.

Andrew Futter, Professor of International Politics at the University of Leicester, makes the warning in a research paper for the Hiroshima Organization for Global Peace (HOPe), published today (Friday).

While stockpiles are much reduced from the peak of up to 70,000 nuclear weapons seen in the 1980s, progress in a number of new or 'disruptive' technologies threatens to fundamentally change the central pillars on which nuclear order, stability and risk reduction are based.

Modern nuclear weapons – acknowledged to be held by nine countries including the USA, Russia and UK – are more capable and more precise than their Cold War counterparts, and at the same time, are being augmented by a new suite of strategic non-nuclear weapons that might be used against or instead of nuclear weapons.

Advances in offensive capabilities have, however, been matched in increasingly sophisticated sensing, tracking and processing technologies designed to detect, prevent and in some cases respond to a nuclear strike – often using Artificial Intelligence (AI).

Professor Futter said: "While we've seen a substantial reduction in the number of nuclear weapons held across the world, it's important to remember that this reduction came about as much as a result of rationalization than a genuine drive to disarm. After all, you can't destroy a city twice, and it takes an enormous amount of money to build and maintain this technology.

"We've seen massive advances in the capabilities of these weapons and their support systems in the 30 years since the end of the Cold War, and there's a danger that this means the established rulebook of nuclear doctrine could be thrown out of the window."

However, there are potential political solutions as the world prepares to enter what Professor Futter terms a 'Third Nuclear Age'. He continued:

"Choosing the correct pathway for our nuclear future was hard enough in the past and there is no suggestion it will become any easier as we move into a new, potentially more complex and dynamic chapter in the nuclear story.

"Policy proposals to manage the challenges of the Third Nuclear Age are therefore inherently bound by whether one believes the best approach is to take our nuclear world as it is and seek to manage it through restraint, arms control, and norms; or whether it is possible to transition to a world where nuclear weapons no longer exist through sustained moral, ethical, legal and perhaps technological pressure."

'Deterrence, Disruptive Technology and Disarmament in the Third Nuclear Age' is published by the Hiroshima Organization for Global Peace.

'Disruptive Technologies and Nuclear Risks: What's New and What Matters', in which Professor Futter further explores the themes of new nuclear capabilities and their impact, is published in the journal *Survival*.

The Third Nuclear Age research project is funded by the European Research Council. Find out more at thirdnuclearage.com.

ICI International CBRNE INSTITUTE

CBRNE-Terrorism Newsletter

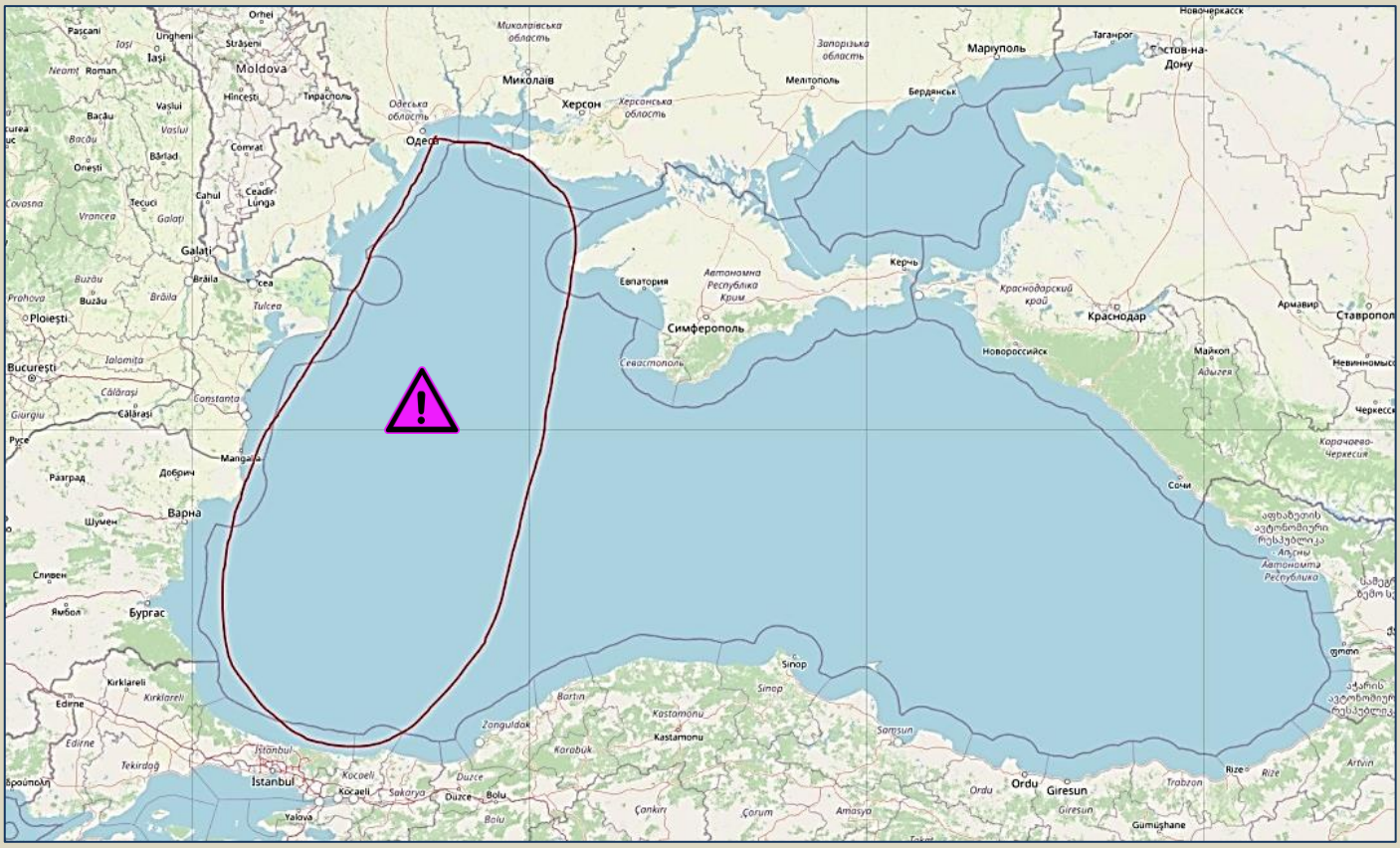
C2BRNE DIARY

EXPLOSIVE NEWS

Russia warns of Ukrainian mines in Black Sea

Source: https://www.dailysabah.com/world/europe/russia-warns-of-ukrainian-mines-in-black-sea

Mar 19 – Russia on Saturday warned that mines that the Ukrainian military had deployed in the Black Sea against its "military operation" could drift as far as the Bosporus and the Mediterranean Sea.



"After the start of the Russian special military operation, Ukrainian naval forces had deployed barriers of **mines around the ports of Odessa, Ochakov, Chernomorsk and Yuzhny**," the FSB security service said in a statement, adding that the mines were "dilapidated" and made in the first half of the 20th century.

Storms have cut cables to some of those mines that are now floating freely in the western Black Sea, pushed along by wind and the currents, it said.

Given the direction of the currents "the floating of the mines toward the Bosporus and then on to the Mediterranean is not excluded," it said.

Since launching its invasion on Feb. 24, Russia has effectively blocked Ukraine's access to the Black Sea.

UPDATE March 26 – Turkey's military (SAS teams) deactivated a mine on Saturday that had drifted in from the Black Sea, setting off a loud explosion north of Istanbul.


HEND

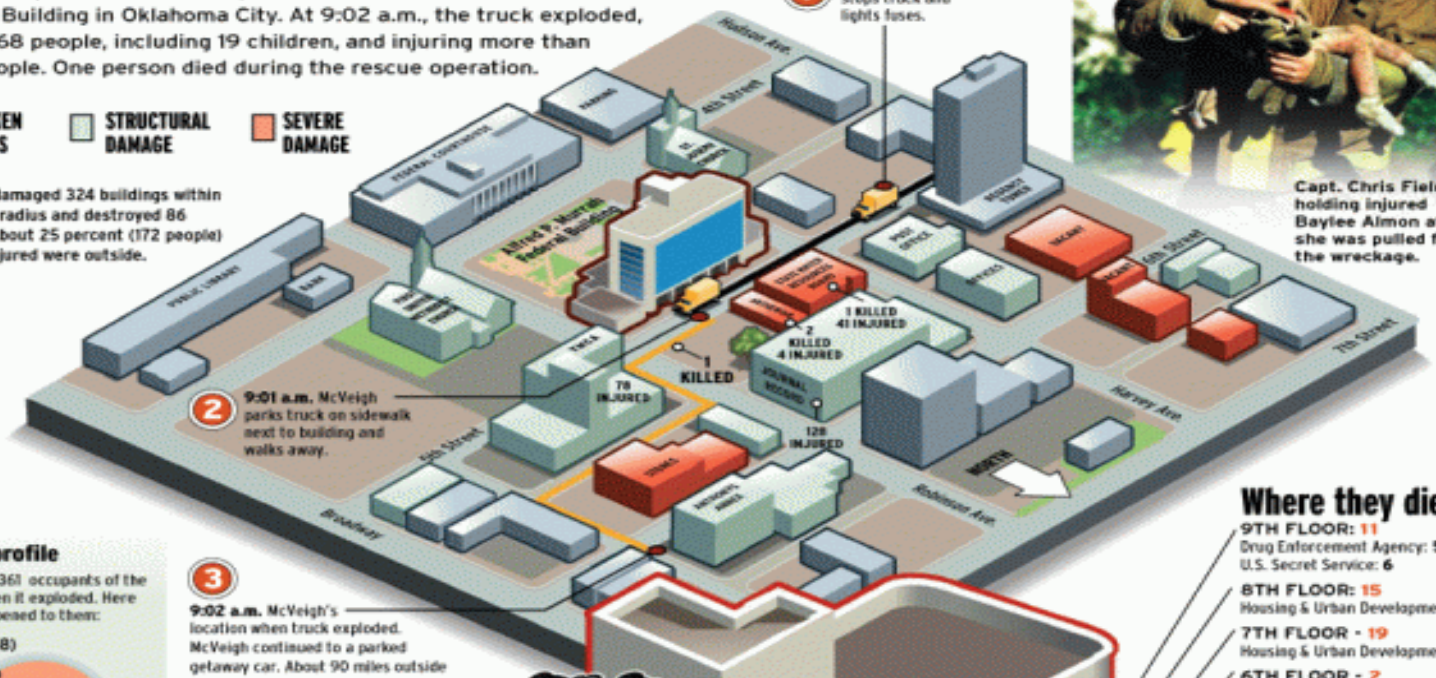
Oklahoma City bombing

On April 19, 1995, Timothy McVeigh drove a rental truck packed with a massive explosive device and parked it next to the Alfred P. Murrah Federal Building in Oklahoma City. At 9:02 a.m., the truck exploded, killing 168 people, including 19 children, and injuring more than 680 people. One person died during the rescue operation.

Capt. Chris Fields holding injured Baylee Almon after she was pulled from the wreckage.

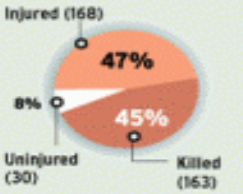
BROKEN GLASS | STRUCTURAL DAMAGE | SEVERE DAMAGE

The blast damaged 324 buildings within a 16-block radius and destroyed 86 vehicles. About 25 percent (172 people) of those injured were outside.



Victim profile

There were 361 occupants of the building when it exploded. Here is what happened to them:



Of the 163 who died:

Of the people in the second-floor day care center, 15 children and 4 adults were killed. Six people survived.

The terrorists

Timothy McVeigh: He built and detonated the bomb. He was convicted and executed by lethal injection in 2001.

Terry Nichols: He built the bomb with McVeigh. He was convicted of murder and is serving 160 life sentences in isolation at a supermax prison.

Michael and Lori Fortier: They were accomplices in the attack. Michael pleaded guilty and testified against McVeigh and Nichols in exchange for a 12-year sentence and immunity for his wife.

3 **9:02 a.m.** McVeigh's location when truck exploded. McVeigh continued to a parked getaway car. About 90 miles outside of the city, McVeigh was stopped for not having a license plate on his car. He had a concealed weapon in the car. He was arrested and jailed.

The blast

The explosion was estimated to have caused at least $652 million worth of damage.

The explosion was heard 55 miles away. Seismometers recorded the blast at about 6.0 magnitude.

Where they died

9TH FLOOR: 11
Drug Enforcement Agency: 5
U.S. Secret Service: 6

8TH FLOOR: 15
Housing & Urban Development: 15

7TH FLOOR - 19
Housing & Urban Development: 19

6TH FLOOR - 2
Marine Corps Recruiting: 2

5TH FLOOR - 10
Dept. of Agriculture - 7
Housing & Urban Development: 1
Customs Office - 2

4TH FLOOR - 19
Federal Highway Admin.: 11
Army Recruiting: 8

3RD FLOOR - 26
Defense Security Service: 5
Federal Credit Union: 21

2ND FLOOR - 19
Child Development Center: 19

1ST FLOOR - 42
Social Security Admin.: 40
General Services: 2

Explosion created a 30-foot-wide by 8-foot-deep crater.

The truck contained 13 barrels and more than 6,000 pounds of ammonium nitrate fertilizer, nitromethane, explosives and diesel fuel. The blast was the equivalent of more than 5,000 pounds of TNT.

Rescue effort

Hundreds of rescue personnel immediately searched the rubble for victims. Within the first hour, about 50 people were rescued from the collapsed building. More than 10 hours after the explosion, a 15-year-old girl was found alive near the bottom of the building. She was the last survivor rescued.

At 7:02 a.m. on May 23, 34 days after the bombing, the remaining building was demolished.

National Memorial

Dedicated on April 19, 2000.

Gates of Time: Matching bronze gates bracket the time of detonation — 9:02 a.m. The 9:01 gate represents the last moments of peace, while 9:03 is the first moment of recovery.

Field of Chairs: Sitting on the building's location, the 168 bronze, glass and stone chairs — one for each person killed — are arranged by the floor the victims were on.

Reflecting Pool: Shallow water on top of polished black granite creates reflections, allowing visitors to see how the memorial has changed them.

Rescuers' Orchard: Representing the responders who came to help the survivors.

The Survivor Tree: The 100-year-old tree barely survived the blast. Its bark was embedded with debris and its branches blown away. Many thought the tree would not survive. But after a year, the tree began to grow again. It is a prominent feature of the memorial and symbolizes the city's spirit of survival.

National Memorial Museum: It provides many exhibits and artifacts detailing the conspiracy to blow up the building. It also houses the National Memorial Institute for the Prevention of Terrorism.

Sources: Oklahoma State Department of Health, The Associated Press, The Oklahoman, Oklahoma City National Memorial, National Park Service Photo: Charles Porter/The Associated Press

Graphic by SCOTT BROWN
Contributing Artist

Ukrainian troops are 'using Taliban-style roadside bombs' to destroy Russian tanks

By Cahal Milmo

Source: https://inews.co.uk/news/ukrainian-troops-taliban-bombs-destroy-russian-tanks-1537690

A destroyed Russian Army all-terrain infantry mobility vehicle Tigr-M (Tiger) on a road in Kharkiv, Ukraine. Kyiv's forces are claimed to be making use of roadside bombs similar to those used by insurgents in the Middle East to target Russian armour. (Photo: REUTERS/Vitaliy Gnidyi)

Mar 24 – Ukrainian troops are claimed to be making devastating use of roadside bombs similar to those deployed by insurgents against British and American forces in Afghanistan and Iraq.

Kyiv's commando units have, evidence suggests, perfected the construction and use of improvised explosive devices (IEDs) capable of penetrating armour and destroying vehicles as part of Ukraine's increasingly successful counter-attacking strategy against the Kremlin's invasion force.

Taliban and Iraqi insurgents inflicted heavy losses on US and UK forces using jerry-rigged devices planted on roadsides.

The bombs were made all the more deadly with the adoption of so-called shaped charges which use a copper disc to form a projectile travelling with such force and speed that it can defeat advanced armour.

The apparent use of the technique against the Russians has given rise to suggestions that the Ukrainians are putting into operation knowledge passed on by Western military trainers who have been working with Kyiv's forces since shortly after Russia's annexation of Crimea in 2014.

Operation Orbital, the training mission for Ukrainian forces put in place by the British Ministry of Defence from 2015 until shortly before Vladimir Putin's invasion, specified "counter-IED" skills as one of the areas of knowledge passed on by UK soldiers.

Ukraine Weapons Tracker, an online research project set up by two British military analysts, this week posted an image on social media of a Ukrainian-built IED fashioned from two high-explosive artillery shells and a TNT charge.

A Ukrainian IED fashioned from two high-explosive artillery shells and a TNT charge. (Photo: @UAWeapons Twitter)

They said: "These are already being effectively used behind Russian lines, and are built to avoid inadvertent civilian casualties. Ukrainians are already taking advantage of experience gained by others in the Middle East."

A separate social media posting on Wednesday showed the remains of a Russian "Tigr" armoured vehicle close to Chernihiv in northern Ukraine which appeared to have been hit by an IED or an anti-tank mine. Several apparently pro-Russian social media sites have also posted footage purporting to show Kremlin troops defusing roadside bombs and mines, though the footage is unverified.

A Tigr Russian armoured infantry vehicle believed to have been destroyed an IED or anti-tank mine near Chernhiv, northern Ukraine. (Photo: via @Oscinttechnical)

Ukraine's armed forces have been particularly successful at staging fast-moving counter-attacks against Russian forces, using small teams to move behind enemy lines and strike columns of armour and vehicles made vulnerable by Moscow's long supply lines in Ukraine and the decision by commanders to bypass many towns as they focus on taking Kyiv and other major cities.

According to Oryx, another online project tracking weapons used in Ukraine, Russia has lost more than 1,700 military vehicles including tanks and armoured personnel carriers in the last four weeks, of which just over 900 were either destroyed or damaged. While many of these losses have been due to anti-tank weapons such as the NLAW system supplied by the UK, a significant number have been put down to other attacks including IEDs.

The Ministry of Defence in London confirmed that Operation Orbital had provided training on how to "detect, avoid and, if required, disarm" IEDs.

But it is understood the UK training did not involve any instruction on how to make the devices, which often rely on a so-called explosively formed projectile (EFP) – a curved metal disc turned into an armour-penetrating dart by the initial explosion.

There is nonetheless considerable evidence that the West has provided Kyiv's military, considered to have performed poorly during the

annexation of Crimea and subsequent battle against separatists in the Donbas region, with extensive training in special operations techniques.

The CIA is known to have run a longstanding programme both in Ukraine and in America training Ukrainian special forces in techniques including operating behind enemy lines and the use of unspecified weaponry. A senior member of the Ukrainian government acknowledged last year that the country's forces had received tutoring in "special reconnaissance direct action".

A former UK military officer familiar with IED design and deployment told **i**: "Any lesson in how to deal with an EFP device would require a significant understanding of how it works. I suppose it is then up to the Ukrainians to decide what to do with that knowledge. These are deadly but not particularly advanced weapons."

Cahal Milmo is the chief reporter of the i paper. Born in London, he has previously worked at the Independent and Press Association news agency, reporting on assignments from Rwanda to the Charlie Hebdo terror attacks.

DIY Innovations for Bomb Squads

Source: https://www.homelandsecuritynewswire.com/dr20220331-diy-innovations-for-bomb-squads

Mar 31 – It takes a special kind of person to be a bomb technician—someone who is brave, disciplined, determined, levelheaded, and creative. Operators must effectively employ critical thinking and problem-solving skills while working in stressful, potentially life-threatening situations. As a result, bomb technicians' ability to expect the unexpected and adjust accordingly has created a consistent pipeline of do-it-yourself (DIY) inventions to solve everyday issues they face, and the Science and Technology Directorate (S&T) works to validate and distribute these new capabilities.

Focusing on Smaller Solutions Can Have a Big Impact

Necessity is the mother of invention, and S&T has proudly helped bring many new scientific solutions into this world through its Response and Defeat Operations Support (REDOPS) program. REDOPS supports public safety bomb technicians across the nation by providing a collaborative structure for addressing improvised explosive device (IED) capability gaps. The REDOPS program consists of three focus areas: Bomb Squad Test Bed, Traditional Research and Development (R&D), and Micro R&D. Since it was stood up in 2016, the Micro R&D portfolio has worked with bomb squads across the country to identify useful DIY tools created by their team members to meet specific needs. All products are assessed for safety and effectiveness prior to being shared with the broader community via the Federal Bureau of Investigation (FBI)'s secure online Law Enforcement Enterprise Portal.

"We have direct communication with state and local bomb squads across the country through S&T's First Responder Resource Group (FRRG)," explained REDOPS Program Manager Byung Hee Kim. "We are also involved with the National Bomb Squad Commander's Advisory Board, as well as the FBI's Hazardous Devices School and Counter-IED Program. These partnerships are invaluable when it comes to searching for scientific solutions to operational challenges for our nation's bomb squads." REDOPS also participates in the U.S. Army-funded Raven's Challenge exercise series, U.S. Bomb Technicians Association events, National Tactical Officers Association events, and other state and local exercises to identify user innovations.

The following is a sampling of REDOPS Micro R&D tools making a difference on the frontline.

Father-Daughter Team Charged Up and Ready to Go

The job of a bomb technician is unquestionably dangerous, which is why their equipment must be unfailingly reliable. Unfortunately, the batteries that power bomb technicians' X-ray generators often lack battery power indicators to let the users know when charging is required. To avoid having an X-ray generator run out of power during a response, bomb technicians often measure the voltage with a multi-meter. This method is time consuming and introduces a complex process that requires ancillary expertise to successfully complete. Sergeant Arlin Vanderbilt of the San Francisco Police Department Bomb Squad recognized the problem and knew he could find a better solution. It turns out necessity isn't just the mother of invention—sometimes it's the father and the daughter, too. Vanderbilt sought out help from his 14-year-old daughter, Hanna. It seems for the Vanderbilts, family bonding time means inventing emergency response capabilities.

"I thought it would be a great project for her," said Vanderbilt. "We took some measurements, sat down, and drew it out and then she did all the CAD (computer-aided design) work. I think we printed three prototypes before hitting on the right shape."
Using Hanna's 3D design and printing expertise paired with Arlin's electronics knowledge, this dynamic duo created a quick, easy, and reliable voltage measuring tool that enables a bomb technician to determine the health of their X-ray generator batteries.
Now that it has been thoroughly assessed by other bomb squad technicians and evaluated by S&T, detailed instructions for how to build and use the voltage measuring tool are being securely shared with bomb squads across the country. Their invention will increase technicians' confidence in their equipment before going down range of an IED and will help countless colleagues avoid equipment failures.
In recognition of her special contribution, Hanna was bestowed the first-ever S&T "Young Innovator Award." She also received a special REDOPS t-shirt reserved for inventors with published ideas. To date, only bomb technicians have received the shirt. Hanna is the first-ever civilian—and high school student—to join the club. Her father was given a matching shirt as well.

Slicing Through Obstacles

The spirit of innovation can be found in all ages. While Hanna Vanderbilt may just be beginning her journey of ingenuity, James Jackson is an experienced expert. Now retired, Jackson dutifully served as Commander of the New York State Police Bomb Squad and is the most published bomb squad inventor in the country. His six published inventions have him sitting comfortably at the top of the leader board and the REDOPS team is still reviewing other inventions by Jackson for possible publication on the FBI's secure online portal.
His suite of bomb squad solutions includes the Whale Blade, which he developed to assist in IED render-safe operations. REDOPS team members saw the original Whale Blade during a Raven's Challenge exercise in Oriskany, New York, and redesigned the blade so that any bomb squad across the country could reliably build it. Since its publication in 2019, at least 15 squads have built the Whale Blade.
Deputy Thomas Groff, Bomb Squad Commander of the Rhode Island State Fire Marshal's Office, is just one colleague who was able to build his own Whale Blade based on REDOPS Micro-R&D instructions he securely accessed online. Groff has found the device incredibly useful on the job.
"We had a remote control car improvised incendiary device," explained Groff. "And we decided that mechanical disassembly was preferable to an energetics one. Since there was quite a bit of tape involved in the device, I decided to have them load the Whale Blade onto the bomb disposal robot. The blade sliced through the tape holding components together without a problem … so much so that the blade actually went right through the bottom of the remote control car at the end of the operation."
The original manufacturer of the main component of this device has stopped making it. The market is slowly running out of the part, and so the search for a new Whale Blade is underway. It is a risk bomb squads take when developing commercial-of-the-shelf tools, but it likely won't be long until a crafty technician finds an alternative.

A Shockingly Useful Invention

During a visit from S&T's FRRG and REDOPS, as well as FBI and others, the New Jersey State Police (NJSP) Bomb Squad demonstrated a DIY Shock Tube Dispenser, designed by Mike Klag, Jim Abbes, and Mike Agnes, that they had been using during explosive response operations. The visiting officials immediately knew this tool could provide value to the broader bomb squad community and recommended NJSP document their development and publish it. Recognizing the challenge for first responders to take time out of their schedule to develop such documentation, REDOPS offered their support. Team REDOPS wrote two FBI Special Technicians Bulletins: one described a manually deployed shock tube dispenser and the other a robotic deployed shock tube dispenser. Since publication, the manual version has been implemented in the FBI Tactical Bomb Technician program and squads across the country are currently making and using this tool with great success.
In fact, the Shelby County, Tennessee, Bomb Squad Commander recently reached out to say, "Just letting you know we have built the Shock Tube Dispenser from the instructions published in the Special Technicians Bulletin. We use these operationally quite often and issue them out to everyone on our team who is a certified explosive breacher. This bulletin has saved us time and money."

Never-ending Innovation

One never knows exactly what awaits in the field during an emergency response and the mental agility required by the job of a bomb squad technician goes hand-in-hand with innovation. So far, more than 200 bomb squads have built Micro R&D tools to fulfill all sorts of mission requirements. The REDOPS Micro R&D program is a demonstrated means of delivering quality capabilities to bomb squads across the country quickly and for minimal cost. As the former Kentucky State Police Bomb Squad Commander, Jim Adkins, recently put it, "We look forward to participating and appreciate all of the work you are doing with the REDOPS program. It really means a lot to those of us that operate on a shoestring budget."

S&T says it will continue to fund ingenious ideas from technicians in the field, and then publish new products that meet criteria for safety and effectiveness so bomb squads across the nation—and the communities they protect—can benefit.

Curbing Explosive Weapons in Populated Areas

By Lisa Schlein

Source: https://www.homelandsecuritynewswire.com/dr20220406-curbing-explosive-weapons-in-populated-areas

Apr 06 – An international agreement under negotiation at the United Nations this week seeks to reduce harm to civilians by curbing the use of heavy explosive weapons in cities, towns and villages.

The Ukrainian city of Mariupol is one of the latest examples of a populated area that has been turned to rubble by the relentless use of heavy explosive weapons. Ongoing bombing and shelling of cities and towns in Yemen, Ethiopia, and Syria, among others, are devastating whole communities and causing irreparable harm to civilians and civilian infrastructure.

Data collected over the past decade show 123 countries have experienced a similar fate. The International Network on Explosive Weapons, a coalition of non-governmental activists, says tens of thousands of civilians are killed and wounded every year using explosive weapons in populated areas. It says civilians comprise 90 percent of the victims.

The coordinator of the network, Laura Boillot, says restrictions must be placed on the use of explosive weapons such as aircraft bombs, multi-barrel rocket systems, rocket launchers, and mortars.

Boillot says direct attacks on civilians and civilian objects are prohibited under the rules of armed conflict and international humanitarian law. She notes, however, the use of explosive weapons is not illegal per se.

"But what we are seeing, and finding is that too often warring parties are killing and injuring civilians with outdated, inaccurate and heavy explosive weapons systems in towns and cities and this is because of their wide area affects, which makes them particularly risky when used in urban environments," she said.

The crisis and conflict researcher for Human Rights Watch, Richard Weir, is in the Ukrainian capital, Kyiv. Weir has seen for himself the havoc caused by explosive weapons on populated areas. He says they have a long-lasting, harmful impact on communities.

"They litter their impact areas with the remnants of their weapons and leave a deadly legacy in the form of unexploded ordnance… The effects of these weapons are devastating. They

are present and they are continuing. And that is why these negotiations are important. That is why states need to commit now to avoiding their use in populated areas," he said.
Activists are calling on negotiators to set **new standards to reduce harm to civilians**. They say the new international agreement also should contain commitments to assist the victims and families of those killed and injured, and to address the long-lasting humanitarian impact of explosive weapons.

Lisa Schlein reports for *VOA* from Geneva.

EDITOR'S COMMENT: Set new standards to reduce harm to civilians! What is this? Black humor? Civilians will always be the collateral damage of war. Ethics is an unknown word when comes to war.

Landmines: illegal weapons that litter the Middle East

Source: https://www.thenationalnews.com/opinion/editorial/2022/04/06/landmines-illegal-weapons-that-litter-the-middle-east/

A UN peacekeeper secures the site of a planned controlled-detonation of landmines. AFP

Apr 06 – The 1980-1988 Iran-Iraq War was so horrific that it has come to be known as the Middle East's First World War. The numbers speak for themselves. Some estimates put the number of casualties as high as 2 million people. But parallels with Europe between 1914 and 1918 do not stop at the number of deaths. It was also the modernised, indiscriminate nature of the killing, in which chemical weapons were used and deadly trench warfare dragged fighting and suffering on for eight years.
That war ended 34 years ago, but for the residents of Iraq's border regions it may feel unresolved. Dangers from the fighting still linger. None are more ubiquitous and terrifying than landmines. Today, Iraq is one of the most mined countries in the world. Whole areas of the country, both rural and urban, are cordoned-off because of the devices, which were prohibited under the Ottawa Treaty in 1997.

They are not just the result of conflicts that finished years before the ban. New minefields have also emerged after. The terrorist group ISIS planted them extensively in areas it occupied. One of the main reasons it has taken so long to begin reconstruction work in Mosul's historic Al Nouri mosque is the vast amount of explosive booby traps it planted in the vicinity.

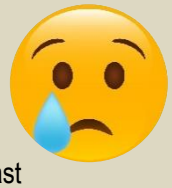
In Yemen, the Houthis, another terrorist group, deploy mines indiscriminately, making the country one of the most mined in the world, alongside Iraq and Afghanistan. The Saudi Project for Landmine Clearance estimates that up to 1 million mines will have to be cleared before Yemen is safe. It places another lethal burden on civilians, who are already dealing with a variety of humanitarian crises, from drought to famine.

Eman, a mother of seven living on Yemen's Red Sea Coast, is unlucky enough to live in the middle of a heavily contaminated area. She told the Danish Refugee Council: "Every day, I have to make the choice: to risk death by a landmine or to die of thirst." As a mother, her burden is all the worse. "We don't allow the children to go out anymore. We are scared for them. We live in fear", she says.

The UN estimates that in 2019, children made up a quarter of all deaths from anti-personnel mines. For the organisations that work in de-mining, a key part of the mission is raising awareness, particularly among young people, on lingering dangers. Civilians often have to stick to marked paths, as highly trained experts conduct the slow, expensive and incredibly dangerous work of detecting and defusing buried bombs. Their efforts should be lauded and supported financially, but that

they are needed at all is a sign of the failure of ongoing efforts to enforce international laws that govern appropriate use of force in conflicts. The issue is aggravated by the inability to destroy old stocks and a rise in unaccountable non-state actors.
Until these root causes are addressed, organisations such as the Halo Trust and the Saudi Project for Landmine Clearance will be in a near-endless, dangerous battle to make life safe for civilians, even long after conventional fighting is over. Monday was International Day for Mine Awareness day, which shone a light on their important work. For the sake of so many, they must remain supported permanently.
The First World War ended more than 100 years ago. Today, some experts predict that it could be another hundred years before all the unexploded munitions still left in its former battlefields are eliminated. For the sake of so many in the Middle East, particularly children, corresponding dangers, as well as their underlying causes, must be dealt with sooner. This situation is born out of lawless conflict, and it is preventable in part through greater awareness, accountability and support to those who are undertaking one of the most heroic and dangerous vocations around.

Mines kill, injure more than 500 children in Iraq: UN



Source: https://www.france24.com/en/live-news/20220405-mines-kill-injure-more-than-500-children-in-iraq-un

Apr 05 – At least 519 children have been killed or injured by landmines and unexploded ordnance in Iraq in the past five years, UN agencies have warned.
"More than 80 percent of children affected are boys," the rights groups UNICEF, the world body's children's agency, and the United Nations Mine Action Service (UNMAS) said in a joint statement on Monday night.
They added that boys were "disproportionately impacted due to incidents of child labour, such as grazing animals or collecting scrap metal to sell".
The statement said although Iraq has not "suffered from open conflicts" over past years, "the effects of explosive weapons will reverberate for years to come".
A report by the charity Humanity & Inclusion said: "Iraq is considered one of the countries most contaminated by explosive devices in the world," with more than 3,225 square km (1,245 square miles) of land contaminated with unexploded ordnance.
Advertising
The material is particularly present near the borders with Iran, Kuwait and Saudi Arabia, all areas where Iraq has been involved in armed conflicts over the past four decades.
Baghdad fought a war with Iran between 1980-1988, as well as the first Gulf War triggered by the invasion of Kuwait in 1990.
The Iraqi military between 2014 and 2017 backed by an international coalition fought a war against the Islamic State jihadist group.
In the joint statement, UNICEF and UNMAS urged "all parties to accelerate every effort to clear existing mines and unexploded ordnance" and called on "all parties to accelerate their efforts to remove mines and explosive remnants, to strengthen victim assistance and to support children's right to a safe, secure and protected environment".

Bombs dropped on Ukraine today pose danger to future generations

Source: https://publicintegrity.org/national-security/future-of-warfare/bombs-dropped-on-ukraine-today-pose-danger-to-future-generations/

Apr 04 – On March 22, a construction crew in Germany found an unexploded bomb in Essen, Germany, decades after it had been dropped during World War II. The area was evacuated, including part of a nearby hospital and a home for seniors. Late that night explosive ordnance disposal crews defused the bomb.
The old weapon is a reminder, as war continues a 1,000 miles east of Essen in Ukraine, that unexploded weapons are a multigenerational burden. When wars end, and even as they continue, the painstaking work of clearing lethal detritus must be done to prevent future deaths.
“A huge number of shells and mines have been fired at Ukraine, and a large part haven’t exploded. They remain under the rubble and pose a real threat,” Ukrainian Interior Minister Denys Monastyrsky told the Associated Press on March 19. “It will take years, not months, to defuse them.”
Before Russia invaded in February, Ukraine had already spent decades of work clearing up unexploded bombs and ammunition. In 2001, Ukraine authorized a program of clearing out unexploded ordnance left over from World War II. This included clearing the Inkerman Adits, horizontal mine shafts in Crimea where the USSR had stored over 10,000 tons of ammunition. A 1942 explosion rendered the stockpile unusable, detonating many of the weapons stored within, but left an estimated 1,000 to 3,000 tons of ammunition undetonated. The Adits were a particularly complex clearing problem, and just one of many areas where leftover war explosives had to be cleared in Ukraine.

Deputy team leader of Danish Demining Group mows the grass around the potentially mined areas marked by red sticks in Myrna Dolyna, Ukraine in July 2021. (Photo by Gaelle Girbes/Getty Images)

More recently, a May 6, 2004, fire at the Novobogdanovka ammunition base, just south of Mykolaiv, scattered bombs across an area of over 115 square miles. Accidents and human error at dozens of other ammunition facilities across the globe have resulted in fires, explosions and the scattering of unexploded ordnance.

But most of the unexploded weapons left in Ukraine are from deliberate attacks in war. The fighting in Donetsk, which started in 2014, has left unexploded artillery, landmines and cluster bomblets – weapons that persist and kill civilians. In the first nine months of 2021, landmines and unexploded ordnance killed 11 civilians in Ukraine and injured 38 more. The previous year, such weapons killed 11 civilians and injured 46.

Stepanivka, a village in Ukraine's occupied Luhansk province, was the site of fighting between Ukraine and Russian-backed separatists in 2014. Viktor Bykadorov, then acting mayor of the village, told the Wall Street Journal at the time that people won't go out to chop wood or let their children out to play, fearing mines and unexploded ordnance. Many of the explosives villagers observed in the woods were recent, but some of them date back to WWII.

Iron harvests

In 2015, the Organization for Security and Cooperation in Europe announced it was expanding its explosive ordnance disposal team training program in Ukraine, with the goal of helping Ukraine develop its own program.

"Children play a lot outdoors and tend to be drawn to the occasionally brightly coloured remnants, which almost always lead to death," explained Alexander Savelyev, OSCE Vienna-based associate project officer.

The OSCE's Special Monitoring Mission to Ukraine, which tracks the conflict, reported that in 2020, mines and other explosive objects killed and injured more civilians than artillery shelling or gunfire.

An unexploded World War I shell in a field near Auchonvilliers, France in November 2013. During the annual "iron harvest," unexploded ordnance, barbed wire, shrapnel, bullets and shells are collected by Belgian and French farmers plowing their fields along the Western Front battlefield sites. (Tom Stoddart/Reportage by Getty Images)

This total number of deaths includes those from landmines, which are explosive weapons used specifically because they persist in an environment. Militaries will place landmines to block off terrain from enemy advances, letting the buried explosives form a deadly barrier. International treaties ban the employment of landmines in part because of the harm they cause to civilians. Ukraine remains a party to the Mine Ban Treaty, though as recently as 2020, the country asked for an extension to fully comply with the treaty's obligation to destroy all anti-personnel mines within its borders.

By 2019, Ukraine already had destroyed over 70,000 landmines and explosive weapons remains, according to a Landmine and Cluster Munition Monitor report. This work was done by the military, police forces, national guard and nongovernmental organizations, among others. Ukraine has relied in part on donations for its demining equipment, with nations like Canada providing specialized landmine detection and monitoring tools. One such tool is a ground penetrating radar, which can help demining teams distinguish between metallic debris in soil and larger anti-vehicle mines.

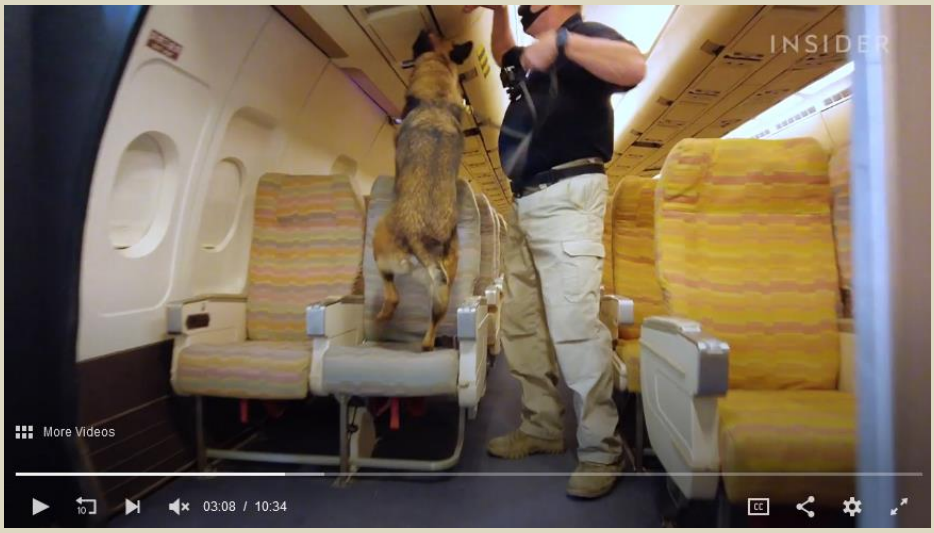
This work predates the present war, and will continue long after the fighting stops. For example, northeastern France still bears the scars of the first World War. Its 65-square mile "zone rouge" is cordoned off as unsafe until it has been fully cleared, which will take an estimated 300 years. Beyond the zone rouge, French and Belgian farmers experience an annual "iron harvest," when they unearth more military material when plowing fields.

Beyond Europe, a 2021 Congressional Research Service report estimated that at a minimum Cambodia had 739 square miles of land contaminated by landmines and unexploded American bombs, largely dating back to the Vietnam war. In Syria in 2021, landmines and other leftover explosives were the leading cause of death of children. This is what living with the slow work of explosive ordnance disposal means.

While some bombs unearthed are truly duds, others can persist with deadly potential for years, even centuries. In 2008, U.S. Civil War enthusiast Sam White died while restoring a recovered cannonball, still explosive 140 years after it had been made.
"Explosive weapons are prone to creating effects … that the users of these weapons cannot accurately foresee or control," wrote Richard Moyes, Director of Policy and Research for Landmine Action.
Some of the bombs dropped on Ukraine today, like all explosives used in war, will threaten lives in the future long after the war is over.

How TSA bomb-sniffing dogs are trained

Source [+video]: https://www.insider.com/how-tsa-bomb-sniffing-airport-dogs-trained-detect-explosives-2022-3



Mar 29 – The Transportation Security Administration (TSA) trains more than 300 explosive detection canines every year. It costs roughly $46,000 to train a passenger-screening canine and handler. The dogs are taught to detect dozens of different threat-based odors.
TSA employs more than 1,000 explosives detection canine teams at any given time. But before they're deployed to one of the many mass-transit sites across the United States, they must graduate from the TSA National Explosives Detection Canine Program. Insider spent a day with the program at the TSA Canine Training Center, located at Lackland Air Force Base in San Antonio, Texas, to see how the TSA trains both dogs and handlers. The dogs receive 24 to 32 weeks of training and work in a variety of environments, including mock aircraft and airport terminals. Trainers use classical conditioning to teach the dogs to search for odors from explosive materials. After six to eight weeks of training, the dogs are paired with a handler, whom they'll finish the course and graduate with. Roughly 90% of all canine teams graduate from the course.

War over physics!

Modern missile explosives that preserve windows!

Akar suspects mines in Black Sea released 'intentionally'

Source: https://www.hurriyetdailynews.com/defense-minister-suspicious-of-intentionally-leaving-mines-in-black-sea-172888

Apr 10 – Turkish Defense Minister Hulusi Akar has expressed suspicion over the possibility of intentionally leaving mines in the Black Sea in a bid to pave the way for NATO minesweepers to enter these waters.

Addressing the members of the ruling Justice and Development Party's (AKP) Central Decision and Executive Board (MKYK) at a meeting last week, Defense Minister Hulusi Akar said, "We have doubts as to whether the mines were left intentionally. Maybe these mines were left within **a plan for NATO minesweepers to enter the Black Sea**."

Akar's presentation at the party meeting included important information on the developments in the defense industry and the Ukraine war, the daily Hürriyet reported on April 10. The minister said that the possible plan might be aimed to put pressure on Turkey, but Ankara is determined to comply with the requirements of the Montreux Convention, the daily reported referring to anonymous sources. "We do not know who left the mines in the Black Sea. They are Russian-made, but the issue of which country left it is under investigation. There are reports that there are around 400 mines. We talked to the Bulgarian and Romanian authorities. They also carry out monitoring," Akar stated. Some say that maybe the mines were left in the Black Sea within a plan for NATO minesweepers to enter the Black Sea to put pressure on Turkey, Akar said.

The New York Times

To Push Back Russians, Ukrainians Hit a Village With Cluster Munitions

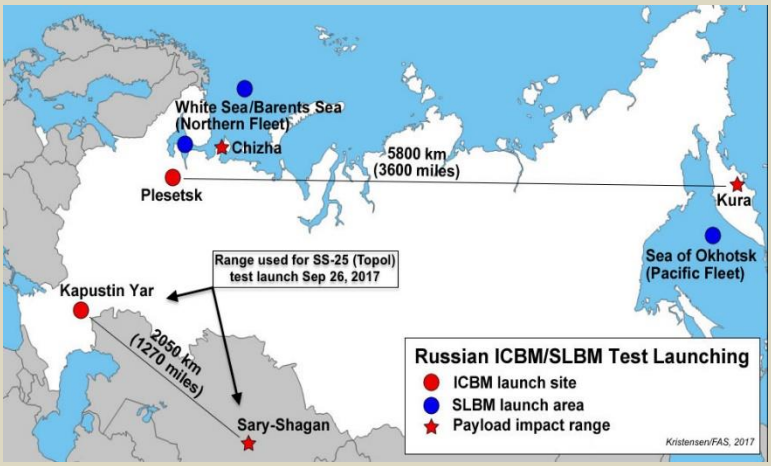
April 18, 2022, 8:17 a.m. ET
Thomas Gibbons-Neff and John Ismay

Amid NATO Tensions, Russia Successfully Launches Its 'Most-Powerful' Sarmat ICBM From Plesetsk Cosmodrome

Source: https://eurasiantimes.com/russia-launches-its-most-powerful-samrat-icbm-from-plesetsk/

Apr 20 – Amid tensions with NATO over Ukraine, Russia successfully conducted the launch of its intercontinental ballistic missile "Sarmat" from the Plesetsk cosmodrome in the Arkhangelsk region. This was reported on Wednesday by the Russian Defense Ministry.

"Today at 15:12 Moscow time at the Plesetsk state test cosmodrome in the Arkhangelsk region, a Sarmat fixed-based intercontinental ballistic missile was successfully launched from a silo launcher," the Russian Defense Ministry said. "The launch tasks have been completed in full. Design characteristics have been confirmed at all stages of its flight. Training warheads have arrived in a given area at the Kura training ground on the Kamchatka Peninsula," the report added.



In the Uzhur missile formation in the Krasnoyarsk Territory, work is underway to prepare the head missile regiment for re-equipment with a new missile system. The Sarmat missile system will replace the Voevoda," the Defense Ministry also said.

Earlier, EurAsian Times had reported that Russia was inching close to replacing its aging R-36 Intercontinental Ballistic Missile (ICBM) fleet with super-heavy missiles that can carry hypersonic glide vehicles.

The new ICBMs which are to be deployed would act as a major deterrence against NATO countries as tensions have dramatically increased over Ukraine.

The RS-28 Sarmat was first developed in the early 2000s. On July 21, 2011, Russia completed research and development of the Sarmat ICBM after giving production contracts to Makeyev Design Bureau and NPO Mash in early 2011.
The missile's initial prototype was constructed in late 2015, and two years later Russia conducted its first silo ejection test of the Sarmat in December 2017, which reportedly identified technical flaws in the launch system.
Two more silo ejection tests were supposedly successful in March and May 2018. With 50 missiles on order, the RS-28 was supposed to go into service in 2018.
The first Sarmat intercontinental ballistic missile (ICBM) regiment could enter service in late 2022 in Uzhur, Russia where the infrastructure at the Uzhur Rocket Division is already complete.

How Hypersonic Missiles Work and the Unique Threats They Pose

By Iain Boyd

Source: https://www.homelandsecuritynewswire.com/dr20220420-how-hypersonic-missiles-work-and-the-unique-threats-they-pose

Apr 20 – Russia used a hypersonic missile against a Ukrainian arms depot in the western part of the country on March 18, 2022. That might sound scary, but the technology the Russians used is not particularly advanced. However, next-generation hypersonic missiles that Russia, China and the U.S. are developing do pose a significant threat to national and global security.
I am an aerospace engineer who studies space and defense systems, including hypersonic systems. These new systems pose an important challenge due to their maneuverability all along their trajectory. Because their flight paths can change as they travel, these missiles must be tracked throughout their flight.
A second important challenge stems from the fact that they operate in a different region of the atmosphere from other existing threats. The new hypersonic weapons fly much higher than slower subsonic missiles but much lower than intercontinental ballistic missiles. The U.S. and its allies do not have good tracking coverage for this in-between region, nor does Russia or China.

Destabilizing Effect

Russia has claimed that some of its hypersonic weapons can carry a nuclear warhead. This statement alone is a cause for concern whether or not it is true. If Russia ever operates this system against an enemy, that country would have to decide the probability of the weapon being conventional or nuclear.
In the case of the U.S., if the determination were made that the weapon was nuclear, then there is a very high likelihood that the U.S. would consider this a first strike attack and respond by unloading its nuclear weapons on Russia. The hypersonic speed of these weapons increases the precariousness of the situation because the time for any last-minute diplomatic resolution would be severely reduced.
It is the destabilizing influence that modern hypersonic missiles represent that is perhaps the greatest risk they pose. I believe the U.S. and its allies should rapidly field their own hypersonic weapons to bring other nations such as Russia and China to the negotiating table to develop a diplomatic approach to managing these weapons.

What Is Hypersonic?

Describing a vehicle as hypersonic means that it flies much faster than the speed of sound, which is 761 miles per hour (1,225 kilometers per hour) at sea level and 663 mph (1,067 kph) at 35,000 feet (10,668 meters) where passenger jets fly. Passenger jets travel at just under 600 mph (966 kph), whereas hypersonic systems operate at speeds of 3,500 mph (5,633 kph) – about 1 mile (1.6 kilometers) per second – and higher.

Hypersonic systems have been in use for decades. When John Glenn came back to Earth in 1962 from the first U.S. crewed flight around the Earth, his capsule entered the atmosphere at hypersonic speed. All of the intercontinental ballistic missiles in the world's nuclear arsenals are hypersonic, reaching about 15,000 mph (24,140 kph), or about 4 miles (6.4 km) per second at their maximum velocity.

ICBMs are launched on large rockets and then fly on a predictable trajectory that takes them out of the atmosphere into space and then back into the atmosphere again. The new generation of hypersonic missiles fly very fast, but not as fast as ICBMs. They are launched on smaller rockets that keep them within the upper reaches of the atmosphere.

Three Types of Hypersonic Missiles

There are three different types of non-ICBM hypersonic weapons: aero-ballistic, glide vehicles and cruise missiles. A hypersonic aero-ballistic system is dropped from an aircraft, accelerated to hypersonic speed using a rocket and then follows a ballistic, meaning unpowered, trajectory. The system Russian forces used to attack Ukraine, the Kinzhal, is an aero-ballistic missile. The technology has been around since about 1980.

A hypersonic glide vehicle is boosted on a rocket to high altitude and then glides to its target, maneuvering along the way. Examples of hypersonic glide vehicles include China's Dongfeng-17, Russia's Avangard and the U.S. Navy's Conventional Prompt Strike system. U.S. officials have expressed concern that China's hypersonic glide vehicle technology is further advanced than the U.S. system.

A hypersonic cruise missile is boosted by a rocket to hypersonic speed and then uses an air-breathing engine called a scramjet to sustain that speed. Because they ingest air into their engines, hypersonic cruise missiles require smaller launch rockets than hypersonic glide vehicles, which means they can cost less and be launched from more places. Hypersonic cruise missiles are under development by China and the U.S. The U.S. reportedly conducted a test flight of a scramjet hypersonic missile in March 2020.

Difficult to Defend Against

The primary reason nations are developing these next-generation hypersonic weapons is how difficult they are to defend against due to their speed, maneuverability and flight path. The U.S. is starting to develop a layered approach to defending against hypersonic weapons that includes a constellation of sensors in space and close cooperation with key allies. This approach is likely to be very expensive and take many years to implement.

With all of this activity on hypersonic weapons and defending against them, it is important to assess the threat they pose to national security. Hypersonic missiles with conventional, non-nuclear warheads are primarily useful against high-value targets, such as an aircraft carrier. Being able to take out such a target could have a significant impact on the outcome of a major conflict.

However, hypersonic missiles are expensive and therefore not likely to be produced in large quantities. As seen in the recent use by Russia, hypersonic weapons are not necessarily a silver bullet that ends a conflict.

Iain Boyd is a Professor of Aerospace Engineering Sciences @ University of Colorado Boulder.

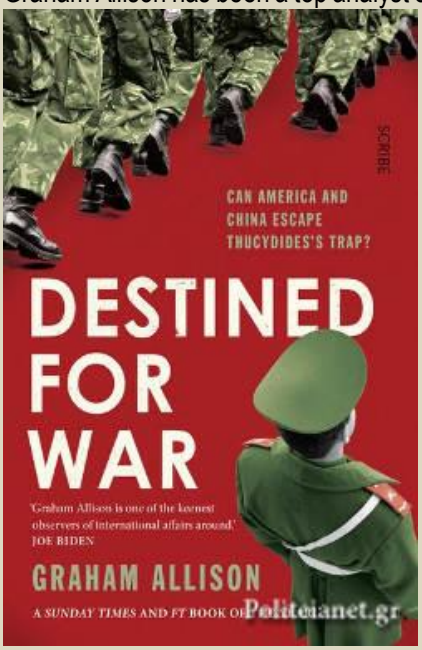
Interview with Graham Allison: Are the United States and China charging into Thucydides's trap?

By John Mecklin

Source: https://thebulletin.org/premium/2022-03/interview-with-graham-allison-are-the-united-states-and-china-charging-into-thucydidess-trap/

Mar 10 – In his classic *History of the Peloponnesian War*, the Greek historian Thucydides wrote: "It was the rise of Athens and the fear that this instilled in Sparta that made war inevitable." In his critically acclaimed and best-selling 2017 book, ***Destined for War: Can America and China Escape Thucydides's Trap?***, eminent international security analyst Graham Allison explores this phenomenon in modern eras when, as in ancient Greece, a rising power has threatened to displace a ruling one. The recent record is not particularly heartening: In the last 500 years, 12 of 16 such historical confrontations have ended in war.

Graham Allison has been a top analyst of national and international security policy for decades, advising or serving in the US Defense Department, State Department, and CIA and taking on a variety of leadership roles at Harvard's John F. Kennedy School of Government, where he has taught for more than 40 years. His Thucydides trap book has become a starting point for many—and perhaps most—serious discussions of recent US-China relations around the world. In this interview with *Bulletin* editor-in-chief John Mecklin, Allison explains why the United States and China appear to be falling into Thucydides's trap and how the relationship between the world's two greatest powers might be managed to avert war. (*Editor's note: This interview took place before Russia invaded Ukraine. It has been edited for clarity.*)



John Mecklin: Your Thucydides's trap article ran in *The Atlantic* back in 2015, followed by the book. And it's almost seven years later. Are the United States and China falling into the trap?

Graham Allison: In short, yes. The book-length version—*Destined for War*, which was published just as Trump became president—forecasts that things will get worse, before they get worse. I'm often asked by folks in Washington, "Well, you know, that was five years ago. What would Thucydides say now?" And I answer that if Thucydides were watching, he would say: Both antagonists are right on script, almost as if they were competing to see which could better exemplify the characteristics of the rising power on the one hand, and the ruling power on the other. And that he's sitting on the edge of his seat as they accelerate toward what could be the grandest collision of all times.

Mecklin: Given that happy view, what should the United States do to change its approach? I would understand if somebody had that sort of dark view with Donald Trump in the White House, saying all sorts of horrible things about China. What should Joe Biden be doing differently?

Allison: I am generally supportive of the president, whom I've known since the 1980s, and the team that he's got wrestling with this, including [National Security Adviser] Jake Sullivan and [National Security Council coordinator for Indo-Pacific Affairs] Kurt Campbell, and [Secretary of State] Tony [Blinken], etc. But I think the objective conditions that Thucydides trap captures, and Thucydides described in his brilliant analysis of the rivalry between Athens and Sparta, create a dynamic that is extremely difficult to manage successfully. Indeed, as I've written elsewhere, I believe President Biden faces the most complex and extreme challenge any American president has had to try to cope with. In China, one confronts not only a meteoric rising power on all dimensions that has in a single generation become a full-scale peer competitor. We also confront a nation that has become the second backbone with the United States of the global economy—an indispensable economic partner of Germany, Japan, the UK, and most other major economies in the world.

Unlike the Cold War rivalry with the Soviet Union, where the Soviet Union essentially isolated itself from the global economy and traded only with the countries in its sphere, China has developed an economy that's now as large as ours—indeed, by the yardstick CIA believes is the best metric for comparing national economies, an economy larger than ours. Hard to believe, yes; but go to the CIA website and look at their Factbook. China is the manufacturing workshop of the world. China is the most essential link in most critical global supply chains.

So let me step back, if I can. In trying to address this issue, one initially has to work on the diagnosis of the problem, to make sure that you have all the dimensions. In strategy, diagnosis precedes prescription [of a solution]. So the proper diagnosis, I believe, is to recognize this as a classic Thucydidean rivalry, in which a genuine, rapidly rising power is in fact, threatening a colossal ruling power. **As Thucydides explains, the Thucydidean dynamic is driven by three factors: material reality, psychology, and politics.** At the material level, China really is rising and encroaching on positions and prerogatives Americans have come to believe are naturally ours. In the book I suggest we visualize this as a seesaw of power—with the United States on one end and China on the other. As China has bulked up, it is lifting our feet off the ground. Many Americans see this as an assault on who we are—since for us, USA means number one. Others are still "China deniers"—refusing to acknowledge that China could be number one in any race that matters.

Psychology combines perceptions and misperceptions with emotions and identity—often producing what Thucydides called "fear" in the ruling power and "arrogance" in the rising power. The rising power thinks, "Well, wait a minute; I'm just asking for my due. The current arrangements of the so-called order were put in place before I arrived. I now have grown, and I deserve more say—and more sway. That's only reasonable." And the ruling power's perceptions and psychology begin with, "What the hell is going on here? Who does he think he is? What does he think he's doing? Why is he not appreciative of the international order that we provided within which he was allowed to grow up?"

And then there's a third layer of politics. Within the struggle for leadership within each government, a fundamental axiom declares: Never allow a significant political competitor to get to your right on a matter of national security. If he were looking for a poster child to illustrate this point, Thucydides could not find a better example than Washington today.

I have no doubt that some members of the Biden team get it. Certainly, Biden, Sullivan, and Kurt do. They appreciate that this is the best diagnosis of the challenge we face.

But if that's the challenge, what about the response? I'll confess that in *Destined for War*, I punt. The concluding chapters draw a dozen lessons from the earlier rivalries for escaping Thucydides's trap. And the final chapter outlines four potential strategies that cover the spectrum from accommodation, on the one hand, to seeking to undermine the Chinese regime, on the other. But end with a rousing call for a surge of strategic imagination, as impressive as what occurred in the period between 1946 with the 'Long Telegram" [on containment of the Soviet Union, written by George Kennan][1] and 1950 and NSC 68 and ultimately the framework for a Cold War strategy[2].

I've been working on this problem, and I still am short of an appropriate answer. But I'll offer my current best idea: Because China is so much more complex a challenge than the Soviet Union, the fundamental problem is that we have to pass what F. Scott Fitzgerald of *The Great Gatsby* called the test of a first-class mind. Namely, we have to be able to hold two contradictory ideas in our head at the same time, and still function.

That's a high bar. The two contradictory ideas and contradictory imperatives the Biden administration must respond to as it tries to find a way to manage this relationship are these: On the one hand, China is the most formidable rival any ruling power ever saw. So as [Singaporean statesman] Lee Kuan Yew said, China is becoming the biggest player in the history of the world. A nation with 1.4 billion people who are extremely talented and extremely ambitious believe their time has come. And China is displaying almost all the characteristics of a normal, rising power. In fact, and contrary to much of the Washington commentary, I believe the Xi government has not been excessively assertive, relative to rising powers at that stage in their own trajectory. I have a chapter in the book entitled "What if Xi's China were just like us?" But not us as we imagined we are today, but as we were were when Teddy Roosevelt, at the beginning of the 20th century, was leading us into what he was supremely confident would be an American Century. And if you look at what we did, in what we call our hemisphere, relative to what Xi's been doing at the same stage, he seems remarkably restrained.

In any case, one set of imperatives come from the fact that this rival—who has different values, and different views about how life should be organized, and how central to civil life individual liberties are—is a formidable competitor. On the other hand, both the United States and China live on a small planet in which technology and nature have condemned us to coexist—since the alternative is to co-destruct. China now has a nuclear arsenal that can absorb any American first strike and retaliate with a counterattack that destroys the United States as a functioning society. Thus, we have a condition that Cold War strategists identified as MAD: mutual assured destruction.

That's a deep, deep, complicated, painful truth that those of us who lived through the Cold War came to internalize. Ronald Reagan captured the central truth in his favorite one liner: "A nuclear war cannot be won and must therefore never be fought." This is a foundational insight. If I find myself in a nuclear war with you at the end of which my country has been erased from the map, who could call that victory? And if that's true, I then have somehow to constrain my behavior and to persuade you to constrain your behavior that would lead us to confrontations, like the Cuban Missile Crisis, that could ultimately end in a war, a nuclear war.

So proposition one, we have a shared common interest in our own survival, and in avoiding the nuclear war, of which we would each be the first two victims.

We now have a second version of this that I've called climate MAD. We now understand in ways we didn't earlier, that both the United States and China live in a small, contained biosphere in which greenhouse gas emissions from either of us goes into the same biosphere, and has the same impact on both of us. On our current trajectories, either of us, by itself, can so disrupt the climate, that neither of us can live appropriately within it. Unless the two of us can figure out a way to mutually constrain greenhouse gas emissions, we could make an unlivable biosphere. So that's, again, a common shared interest that we are powerfully compelled to address for the sake of our own survival.

And I now think there's a third dimension of this, which I'm still struggling to get my head around. If one considers the benefits of advancing global integration from creation of a bigger economic pie to advances in science, and technology, and medicine, and indeed, life as we know it, is it possible for a state to decouple itself from these benefits without impoverishing itself in a way that would be unsustainable for its political leadership? If the answer is no, then we have three dimensions of thick, inescapable interdependence that together condemn us to coexist.

The drive to survive is perhaps the most powerful motive for human beings. Thus, if my survival depends on finding some way to co-exist with you, however fierce our rivalry, I have to find a way. As Scott Fitzgerald pointed out, even for an individual, holding two genuinely contradictory ideas in your head at the same time and still functioning is really a stretch. To do that as a government and as a society, including our society today is even more so. So that's the challenge that the Biden administration is wrestling with. So far, they've made some progress on the rivalry front, less

on the necessities for cooperation. And beyond that, there's the further issue of finding a way to articulate cooperation with China that would be politically palatable.

Mecklin: You've explained the setup to the situation very well. The United States seems to be in the process of constructing some kind of containment of China, something, with this pivot to Asia idea, involving new alliances and the moving of forces. I'm not sure that that exactly matches up to what you just described. Is a military surrounding, a containment strategy, workable, given the complex situation you just described?

Allison: That's a good question and one that I've struggled with, too, so let me step back just one step, and then I'll answer directly—since I think the answer is no.

Given the complexity of the competing imperatives that we just discussed, it's not surprising that in trying to develop a playbook, people go back to historical analogs. The Cold War is becoming increasingly the preferred analog, even though most of the people talking about it don't know what the Cold War was. They vaguely remember that somehow we won, so let's do that again. It's like the challenge you and the magazine have in trying to remind people that nuclear weapons didn't disappear, either. In short, we live in the United States of Amnesia.

When people think about historical analogies, the Applied History Project here at Harvard recommends they follow the advice of Ernest May, one of the most distinguished international historians of the 20th century. According to what we call the "May Method," when you think of an analogy, like the Cold War, put it at the top of the page. Draw a vertical line down the middle of the page and put "similar" at the top of one column and "different" at the top of the other column. If after reflection you can't list three bullet points under each, take an aspirin and call a historian.

When I analyze the differences between the current situation and the Cold War with the Soviet Union, the differences outweigh the similarities. The first big difference is that China has an economy as big as ours, while the Soviet Union's GDP never reached half that of ours. Secondly, China has established itself as the indispensable partner of most major economies including Germany, Japan, the UK, and 130 other nations. If we tried to build some new economic Iron Curtain, which side will we find them on? Germany's major industry is automobiles and China is their No. 1 market. So as they and others keep telling American officials: Don't try to get us to choose between our security relationship with you and our economic relationship with China, which is essential for our prosperity.

Now, what could people rightly have in mind? I think those in the administration who've though about this more strategically would say, "Well, what we're doing with AUKUS[3] or with the Quad [4]or attempts to build positions of strength in Asia is to establish, at least in the military security area, a balance of power, or seesaw, where the correlation of forces advantages free societies like ours and our allies' and partners' over authoritarian competitors."

Actually, I like that conceptualization since it recognizes that the China challenge is not a problem to be solved but rather a condition that will have to be managed. And if we are able to manage on a level playing field a long-term competition between democracy and autocracy, I'd sign up. I'm still enough of a traditional small "l" liberal committed to a society based on citizens' liberties to believe that over the long run, that system will outperform a party-led autocracy. But we would see. Looking at the recent record, I understand why many Americans are disheartened. Looking at the recent record, the Chinese have some considerable grounds for their belief that their system—not just their society and economy, but their system—is in the ascendancy. But my bet is still on Team USA.

Mecklin: You've been talking about a rising power and a formerly dominant power, that relationship. But there's a third power in here, Russia, that may not be playing economically, but certainly has the nuclear weapons and the guile to play some sort of role here, as it's playing with Ukraine right now. How do you manage this really complicated, difficult US-China relationship when there's a spoiler like Russia jumping up and down and saying, "No, look at me."

Allison: Again, a great question. And in thinking about it, one's reminded why it's so much easier to offer advice from the sidelines than to be in the arena.

First, start with the historical canvas: We've seen many instances previously, in which there were not just the primary antagonists in a rivalry between a rising and a ruling country, but a third party as well. In the run up to World War I, it was not just Germany rising, threatening Britain's predominance. Germany was also looking over its shoulder at Russia, which appeared to be getting its act together, building up its army and completing railroad lines for bringing troops to the German border to present a serious threat.

Second, as a result of the failures of American policy in dealing with post-Cold War Russia, on the one hand, and the brilliance of Xi's diplomacy, on the other, we have essentially created what [Carter administration national security adviser] Zbig Brzezinski[5] called the "alliance of the aggrieved." Two countries that should objectively find themselves at odds because of territorial disputes and history have quickly become thickly aligned.

Third, while most of the Washington policy community is trying to hold onto the mantra from the decade after the Cold War that declares "Russia doesn't matter anymore," the brute fact is that Putin's Russia today is no longer the failing state many unilateralists remember. Putin's Russia has a military that can fight and win to achieve political objectives. The Russians demonstrated this in brutally destroying Chechnya—which is now pacified under

Russian rule. They demonstrated this in their attack on Georgia, which spiked its efforts to join NATO, and again in 2014 in seizing Crimea from Ukraine. In Syria, while Obama was declaring: "Assad must go," Putin said "nyet." And Russians smile when they remind American interlocutors that Obama is now gone, and Assad still rules Syria. If what one reads in the press and journals is an actual expression of what people really think, I'd say most of the Washington foreign policy establishment is not yet in this new reality zone.
In analyzing the current confrontation with Russia over Ukraine, consider five poker tables in which the hands have been dealt: the military cards, economic, diplomatic, hybrid warfare, and court of public opinion. I think Putin has the high cards in the first four of those games. The only arena in which we can seriously compete is the public sphere—and there I'd give the Biden team's effort good marks.
On the global chessboard, the fact that in Xi and Putin—not just two countries but two leaders who each are planning on leading their country for a decade or even two decades ahead—have such a tight relationship makes the US challenge all that more complicated. But if we recognize the fact, it offers clues about the timing of any Russian invasion of Ukraine. To make the point, I'm prepared to offer you 4-1 odds that Russia does not invade Ukraine before February 20. That means I'll bet $4 against your $1 on no invasion before that date. Why? Because the Beijing Olympics that begin on Feb 4 run to Feb 20th; Xi has designed what he's promised will be a "spectacular" show that shines the spotlight on a China that now stands tall; the most honored foreign guest at this event will be Vladimir Putin; and there is no way that he will rain on Xi's parade.
Mecklin: Interesting that something like the Olympics could have that power.
Allison: Yes. And a good reminder that these leaders of countries are fellow human beings. Relationships among them really matter. Watch the body language. Remember: Putin calls Xi his "best buddy." While China has only recently been active in most of the winter sports and thus is not going to win many medals, I have no doubt that the opening and closing ceremonies are going to be off the charts.
Mecklin: It's going to be interesting to see them try to do that, in the middle of a pandemic, when exactly nobody goes there. We'll see; maybe they'll pipe the applause in. I wanted to ask about two other things. One is this: You've been talking about a very complicated and difficult management situation for the United States versus a rising China. Within that difficult situation, how does the United States continue to push for human rights and democracy? I mean, what's happening to the Uyghurs is horrible.
Allison: Great question. Jake [Sullivan] has given the best answer to it that I've heard recently. First and foremost, this is about who we are. Start with the old Cold War mantra. Our overriding objective is to ensure the survival of the United States as a free nation, with our fundamental values and institutions intact. So the purpose of the United States in the world is first to provide space for a society to realize what free people can do. The centerpiece of our values is liberty for individuals. And that's the core of America's commitment to human rights: first survival, and then the Bill of Rights, and then what ultimately becomes the UN Declaration of Human Rights.
The thought that it's possible to create a government and a society in which individuals can be free to the maximum extent to realize their potential—is a radical idea. But it is the core of the American experiment. We don't always succeed but that's what we aspire to be—and what we encourage in other countries. As we re-learned in Afghanistan, attempting to promote democracy through the barrel of a gun is misguided. But affirming our values, standing up for them, calling out abuses of fellow human beings wherever they live, reflects our identity. And in the long-term competition with China, we are confident that a freedom-based democracy will prove superior to a Party-led autocracy in delivering what people want.
Of course, foreign policy pursues multiple objectives and hard cases require tradeoffs. So it's complicated. But in contrast to realists who dismiss or denigrate human rights, or some activists who imagine that the promotion of human rights should be the only objective, my view is that the centerpiece of American engagement in the world is to build a world safe for free human beings to be all they can be—beginning here in the USA.
Mecklin: Last thing I wanted to ask you about is something that may or may not be fun for you. I'm going to throw an old proposal of yours back at you—for a White House Council of Historical Advisers.
Allison: Yes, I'm still an enthusiast.
Mecklin: Why? Tell people why that would be a good idea.
Allison: Why do we have a Council of Economic Advisers? The answer is because we believe that by analyzing some of the choices that the president and the government have to make, professional economists can clarify the choices and their likely consequences. How well do they do? Well, excuse me, look at the inflation we have today. Did they forecast that? Nope. They don't have a crystal ball. The real world is highly uncertain. Nonetheless, relative to people who know no economics, they do a little bit better most of the time. Not as well as they claim—but a little bit better.
My colleague Niall Ferguson and I proposed an analog that could be called the Council of Historical Advisers. They would not have a crystal ball that would allow them to predict what's going to happen in the confrontation with China or Russia. But by analyzing the historical record, and by being systematic about historical analogies that policy makers grab in trying to make sense of a confusing world, like Cold War or containment, they can help illuminate

the challenges that we face and the choices. I'm happy to report that the Applied History movement now includes not just Harvard and Stanford, but vibrant work at the Kissinger Center at Johns Hopkins, the Clements Center at the University of Texas at Austin, at Duke, Ohio State, Berkeley and a dozen other universities that actively have people doing this.

If the question were, "What the hell is going on in the current confrontation with Putin, and why might he be doing this now?", that would be a good question to give to the Council. And you can see the pontification about it in a many, many publications, who knows maybe even your own.

Mecklin: A little bit, yeah.

Allison: To be suggestive, let me mention one of the tools in the Applied History toolbox. It begins with the recognition that for many policy makers and most of the foreign policy community, in what's been called the United States of Amnesia, every day is a new day where we begin with a clean whiteboard. Thus, the current confrontation with Putin is like a frame or snapshot from the course of a movie. But the applied historians remind us that what we see today is just the most recent frame in a process that has evolved over the past year or even decade. So the applied historian asks: "Show me the main scenes in the movie that led to the current picture. Or how about give me the main events in the movie that led to the current picture?" That sequence goes back at least to 2014 when Putin seized Crimea. Analyzing that event, what were the underlying factors, what were the proximate causes? The historian would note that this came after the color revolutions that overthrew governments in Georgia and Ukraine; that the EU was in a bidding war with Russia over Ukraine; that the Yanukovych government which the US certified had been legitimately elected was overthrown by the Maidan demonstrations; that the new government had Ukraine on a fast slide towards the EU. All this presented Putin the specter of the Russian navy's major warm water port in Sebastopol, which had been built by Catherine the Great, falling under the control of NATO—an outcome no Russian would accept if there were any alternative. And to understand that, the historian would go back to scenes from 2008 when at the NATO Summit in Bucharest the Bush administration, and [Secretary of State] Condi [Rice] pushed for an entry into NATO of Georgia and Ukraine.

In trying to answer the question of why Putin is acting now, in 2022, an applied history analysis would review key scenes over the past two years: actions by Ukraine, Europeans, and the US as well as those by Russia or others. Answering that question would require overcoming the myopia that dominates most thinking in Washington—what HR McMaster called "strategic narcissism." The alternative is to develop a capacity for "strategic empathy" in which one tries to get inside the adversaries' skin, to see the world through his eyes, and to think about his interests and threats to him as he does. The goal is not to legitimize or sympathize with his values and views, which can frequently be deplorable. Rather, it is to do a better job of forecasting what his next step might be, and to be in a better position to try to influence his behavior.

So I think, bottom line for the Council of Applied Historians: If the benchmark is the assistance that the Council of Economic Advisers provides in helping to clarify the economic dimensions of economic issues, historians could help clarify the geopolitical history and the factors that lead to the challenges and choices that the president faces today.

ENDNOTES

[1] George Kennan's February 22, 1946 'Long Telegram' can be found at the Wilson Center archives at https://digitalarchive.wilsoncenter.org/document/116178.pdf

[2] NSC 68, also known as "A Report to the National Security Council – NSC 68," April 12, 1950, can be found at the Harry S. Truman Library archives at https://www.trumanlibrary.gov/library/research-files/report-national-security-council-nsc-68?documentid=NA&pagenumber=1

[3]The Joint Leaders Statement on AUKUS, September 15, 2021, can be found at the White House Briefing Room site at https://www.whitehouse.gov/briefing-room/statements-releases/2021/09/15/joint-leaders-statement-on-aukus/

[4] For more information, see Sheila Smith's May 27, 2021 article for the Council on Foreign Relations titled "The Quad in the Indo-Pacific:What to Know" at https://www.cfr.org/in-brief/quad-indo-pacific-what-know

[5] For more, see the May 26, 2017 *New York Times* article "Zbigniew Brzezinski, National Security Adviser to Jimmy Carter, Dies at 89" at https://www.nytimes.com/2017/05/26/us/zbigniew-brzezinski-dead-national-security-adviser-to-carter.html

John Mecklin is the editor-in-chief of the *Bulletin of the Atomic Scientists*. Previously, he was editor-in-chief of *Miller-McCune* (subsequently renamed *Pacific Standard*), an award-winning national magazine that focused on research-based solutions to major policy problems. Over the preceding 15 years, he was also: the editor of *High Country News*, a nationally acclaimed magazine that reports on the American West; the consulting executive editor for the launch of *Key West*, a regional magazine start-up directed by renowned magazine guru Roger Black; and the top editor for award-winning newsweeklies in San Francisco and Phoenix. In an earlier incarnation, he was an investigative reporter at the *Houston Post* and covered the Persian Gulf War from Saudi Arabia and Iraq. Beyond the publications he has edited and opined in, his writing has appeared in *Foreign Policy*, the *Columbia Journalism Review*, and the Reuters news service. Writers working at his direction have won many major journalism contests, including the George Polk Award, the Investigative Reporters and Editors certificate, and the Sidney Hillman Award for

reporting on social justice issues. Mecklin holds a master in public administration degree from Harvard's Kennedy School of Government.

Four unanswered questions about the intersection of war and nuclear power

By Julien de Troullioud de Lanversin and Maxime Polleri

Source: https://thebulletin.org/2022/04/four-unanswered-questions-about-the-intersection-of-war-and-nuclear-power/

Zaporizhzhia nuclear power plant in southern Ukraine. The two tall smokestacks are at a coal-fired generating station about 3km beyond the nuclear plant. Photo credit: Ralf1969 via Wikimedia Commons.

Apr 19 – For a night on March 3, Russian military forces seized the Zaporizhzhia nuclear power plant in Ukraine, damaged its infrastructure, and spread fear of a nuclear catastrophe. Fortunately, the attack did not threaten sensitive areas of the nuclear power plant, and radiation levels around the plant did not raise concern. Still, the crisis underscored the danger posed by a war that crosses paths with a nuclear power plant. Since this may be a case of when, not if, the next wartime attack on a nuclear power plant happens, scholars and policymakers would be wise to revisit concepts for assessing and protocols for responding to nuclear power plant crises in war zones. Here are some unanswered questions that warrant immediate consideration:

How should experts redefine the boundaries between nuclear security and nuclear safety?

Nuclear safety professionals seek to understand and manage nuclear-power-plant risks produced by man-made errors (e.g., Chernobyl), system failures (e.g., Three Mile Island), or natural events (e.g., Fukushima). Nuclear security professionals, on the other hand, are concerned with preventing states from engaging in nuclear-armed conflicts and terrorists from hijacking nuclear power plants or nuclear materials. However, when war intersects with a nuclear power plant as it did in Zaporizhzhia, the distinction between nuclear safety and nuclear security crumbles.

Any form of military damages on infrastructures critical for the safe operation of a nuclear power plant has the potential to blur the line between nuclear safety and nuclear security. Even if the belligerent provoking these damages is clearly identified, it can remain difficult to ascertain whether such actions were intentional or accidental. For instance, armed forces might endanger the safety of a nuclear power plant by disrupting electricity supply in the pursuit of other objectives.

The lines between nuclear safety and nuclear security also fade away when military personnel occupy a nuclear power plant and interfere with its safe operation. If an accident occurs while military personnel occupy a nuclear power plant, doubts around the responsibilities or intentions of military occupants will not be resolved. For example, ill-

advised directives from military occupants to plant operators could lead to mismanaging a nuclear accident, which could endanger operators and local populations.

How can experts better understand and assess the dangers of wartime attacks on nuclear power plants?

Nuclear power plants are designed to withstand hazards that originate from operator errors, system failures, or natural disruptions. They are also managed to thwart terrorists' intent on provoking nuclear accidents or diverting nuclear materials. Nuclear experts understand these risks and have established protocols for these dangers.

Like a natural disaster, a warzone attack may come from the outside. However, the similarities stop there. Nuclear power plants are not designed to withstand military projectiles, and nuclear safety analysts have no experience incorporating the uncertainties that characterize military conflicts. The truth is that nuclear experts have little knowledge on how protective structures such as the containment building or the reactor vessel can withstand the destructive forces of a fired projectile. This is especially true for military projectiles as typically very little information around their penetrative and destructive power is available.

How does war impact nuclear safety management?

Plant operators are trained to ensure plant safety not only during normal operation but during power outages, natural disasters, and accidents. They are not trained, however, in fulfilling their duties against the backdrop of a war that threatens both the facility and their lives.

During Russia's takeover of the Zaporizhzhia power plant, for example, staff were forced to fulfill their duties at gunpoint. Such a scenario leaves operators susceptible to making errors. If military occupying forces lack knowledge of nuclear safety, they might impede the operators in their necessary tasks to safely operate the reactor. Moreover, soldiers on site might not even prioritize the safe operation of the plant at all if other military objectives prevail.

Last but not least, police forces, fire fighters, hospitals, public transportation, and communication networks that typically play a role in responding to nuclear accidents may also be unavailable during an armed conflict.

How can a wartime nuclear accident lower the nuclear threshold?

When an armed conflict involves countries with nuclear weapons, a conventional conflict could escalate to a nuclear conflict. Countries develop nuclear doctrines that make clear the conditions under which they would use nuclear weapons. This affords a level of control over possible nuclear escalations. The nuclear taboo—the idea that using nuclear weapons is immoral—also restrains nuclear weapon use. However, no one knows how a wartime attack on a nuclear power plant may affect perceptions of nuclear escalation or the nuclear taboo.

In the recent crisis, the Ukrainian government blamed Russia for shelling the Zaporizhzhia nuclear power plant while the Russian state media accused Ukrainian armed forces of sabotaging their own nuclear infrastructure. If the cause of the accident is unclear, opposing sides are likely to blame each other, which will contribute to escalating political tensions between adversaries.

When a nuclear power plant is caught in a war's crossfire, one side may assume that the other wants to turn a conventional conflict into a nuclear one. A country's reaction to such an attack further depends on its nuclear doctrine. For example, some experts believe that China would consider retaliating with nuclear weapons if its civilian nuclear facilities were attacked with conventional strikes—regardless of whether the attack was intentional or accidental.

Finally, should a nuclear accident occur during a war, the pervasiveness and invisibility of radioactive dangers will lead to confusion and suspicions among military actors. Opponents might accuse each other of using radioactive substances for military purposes, such as dirty bombs. Moreover, radiation might cross borders and affect countries initially not involved in the conflict. If these countries happen to possess nuclear capabilities, the likelihood of nuclear escalation may increase. For instance, if Poland—a NATO member—were impacted by a nuclear accident in Ukraine caused by Russian airstrikes, would NATO join the war?

A previously hypothetical scenario—an armed conflict that endangers the safety of a nuclear power plant—has now materialized. Policymakers and scholars can no longer remain naïve. Military conflicts threaten the safety of nuclear power plants in ways that are not well understood, and a nuclear accident in a warzone blurs the line between a conventional and nuclear war. As many countries around the world might adopt nuclear power, as nuclear power plants remain active for decades, and as global peace does not reign, the crisis at Ukraine's Zaporizhzhia's facility sounds an urgent alarm for nuclear experts and policymakers to revisit their understanding of nuclear dangers.

Julien de Troullioud de Lanversin is a research fellow at the Project on Managing the Atom at Harvard University's Belfer Center for Science and International Affairs. He has a doctorate in applied physics from Princeton University and a masters in nuclear engineering from Tsinghua University, Beijing. Julien's work is aimed at developing scientific models and

software to better characterize the impacts of nuclear technologies on society and to develop verification methods for nuclear arms control efforts.

Maxime Polleri is an assistant professor in the Department of Anthropology at Université Laval, in Quebec City, Canada. As an anthropologist, he studies the governance of nuclear catastrophes, with a focus on the 2011 Fukushima nuclear disaster. Polleri is also a Network Affiliate at the Center for International Security and Cooperation at Stanford University, where he was previously a MacArthur Nuclear Security fellow. He is also a member of MITATE Lab, an international research program on Fukushima issues.

ICI International CBRNE INSTITUTE

CBRNE-Terrorism Newsletter

CYBER NEWS

C2BRNE DIARY

Deep Learning: What Is Its Purpose?

Source: https://i-hls.com/archives/113950

Mar 31 – A field of machine learning, deep learning is based on the assumption that computers can learn and teach themselves, aiming to mimic the brain's activity in a computerized form. It enables machines to solve complex tasks even given a large and diverse set of unstructured data. A deep learning system can be found today in almost every technical field, from computer vision to bioinformatics and medical analysis.

As a part of deep learning, Deep Neural Networks (DNNs) are used, which are inspired by biological systems' information processing and distributed communication. Training these networks isn't cheap, and it's quite complicated, too.

A deeper understanding of deep learning can help find new methods for reducing training costs, thus enhancing the effectiveness of machine learning. Weightwatcher is a new open-source Python tool that may be able to help. Participants can utilize the tool to evaluate the performance of their machine learning – information that is analyzed in depth, and which offers insights and data about the training process of the model, as well as warnings if anything goes wrong.

The new tool applies concepts from theoretical physics and Random Matrix Theory (RMT) models to measure correlation between data. Additionally, it can be used to estimate the model's test accuracy without any test data. As a result, it can make it easier to fine tune pretrained models when applying

AI: Unnecessary Panic or Uncontrollable Technology?

Source: https://i-hls.com/archives/113984

Apr 02 – A group of researchers and over 500 experts, including Elon Musk, Stephen Hawking, Steve Wozniak, and Noam Chomsky, wrote an open letter in support of a UN ban on the development of lethal autonomous weapons systems as early as 2015. The authors argued that autonomous weapons will play a dangerous role in the creation of the third revolution in warfare, after the invention of gunpowder and nuclear weapons.

Artificial intelligence is significantly cheaper to operate and maintain than other weapons systems, including nuclear weapons. It is therefore expected to be incorporated into a wide variety of military and mass-produced targets, and to penetrate terrorist organizations and the black market. Since artificial intelligence is still a relatively new field, leading scientists demanded agreements and regulations regarding its use.

Almost seven years later, we are witnessing a huge integration of artificial intelligence technologies in the autonomous weapons industry. Recent reports revealed that a neural network system took just six hours to develop 40,000 distinct types of chemical weapons. Scientists used artificial intelligence to demonstrate how easily the system can be exploited for malicious purposes by a "bad actor", according to thetimeshub.in.

Scientists who instructed the algorithm to look for toxic components achieved impressive results: the algorithm was able to create tens of thousands of new substances, including those that are similar to the most powerful nerve agent ever created, VX. As a result, they hoped to raise awareness for their field, as well as the harm caused by improper use of technology, in a field that lacks coherent guidelines.

Cyberattacks Have Yet to Play a Significant Role in Russia's Battlefield Operations in Ukraine – Cyberwarfare Experts Explain the Likely Reasons

By Nadiya Kostyuk and Erik Gartzke

Source: https://www.homelandsecuritynewswire.com/dr20220404-cyberattacks-have-yet-to-play-a-significant-role-in-russia-s-battlefield-operations-in-ukraine-cyberwarfare-experts-e

Apr 04 – Throughout the latter half of 2021, as it became clear that Russia was massing a large portion of its conventional combat power on the eastern borders of Ukraine, analysts offered contrasting predictions about the role cyberspace would play in an armed conflict. These predictions capture an ongoing debate about whether conflict in cyberspace is destined to supplant conventional conflict or exacerbate it.

As the war has evolved, it's clear that analysts on both sides of the debate got it wrong. Cyber operations did not replace the military invasion, and as far as we can tell, the Russian government has not yet used cyber operations as an integral part of its military campaign.

We are political scientists who study the role of cybersecurity and information in international conflict. Our research shows that the reason pundits on both sides of the argument got it wrong is because they failed to consider that cyber and military operations serve different political objectives.

Cyber operations are most effective in pursuing informational goals, such as gathering intelligence, stealing technology or winning public opinion or diplomatic debates. In contrast, nations use military operations to occupy territory, capture resources, diminish an opponent's military capability and terrorize a population.

A Tactical Role for Cyberattacks?

It's common in modern warfare for new technologies to substitute for traditional military tactics. For example, the U.S. has made extensive use of drones, including in conflicts in Yemen and Pakistan where crewed aircraft and ground forces would be difficult or impossible to use. Because drones allow the U.S. to fight on the cheap with much less risk, they substitute for other forms of warfare.

In theory, cyber operations could have played a similar tactical role in Russia's invasion of Ukraine. But the Russian government has yet to use cyber operations in a manner that is clearly coordinated with military units and designed to smooth the advance of ground or air forces. When Russia invaded Ukraine, hackers disrupted access to satellite communications for thousands of people, and it was apparently a concern for Ukrainian defense officials. But overall, Ukraine has managed to maintain internet access and cellphone service for most of the country.

Russia has sophisticated cyber capabilities, and its hackers have worked their way into Ukrainian networks for many years. This raises the question of why Russia has not, for the most part, used cyber operations to provide tactical support for its military campaigns in Ukraine, at least until this point.

Separate Roles

In recent studies, we examined whether cyber operations mostly serve as complements to, or substitutes for, conventional conflict. In one analysis, we examined conventional military campaigns around the world over a 10-year period using the Militarized Interstate Disputes dataset of all armed conflicts. We also focused on the conflicts in Syria and eastern Ukraine. Our results suggest that cyber operations are generally not being used as either.

Instead, nations tend to use these two types of operations independently from each other because each mode of conflict serves different objectives, and cyberwarfare is most effective for gathering intelligence, stealing technology or winning public opinion or diplomatic debates.

In contrast, nations use traditional forms of conflict to control tangible assets, such as capturing resources or occupying territory. The various goals offered by Russian President Vladimir Putin for invading Ukraine, such as preventing Ukraine from joining NATO, replacing the government or countering fictitious Ukrainian weapons of mass destruction, require occupying territory.

There may be other reasons for the lack of overlap between cyber and conventional fronts in Ukraine. The Russian military could consider cyber operations ineffective for its purposes. The newness of cyber operations as a tool of war makes it difficult to coordinate with conventional military operations. Also, military targets might not be accessible to hackers because they might lack internet connectivity.

In any event, evidence that the Russian government intends to use cyber operations to complement military operations is thin. Our findings suggest hacking groups in previous conflicts faced considerable difficulties in responding to battlefield events, much less shaping them.

How Russia Is Using Cyber Operations

The main target of Russia's digital campaign in Ukraine is ordinary Ukrainians. To date, Russian cyber operations have sought to sow panic and fear, destabilizing the country from within, by demonstrating the country's inability to defend its infrastructure, for example, by defacing or disabling websites.

In addition, Russia has been using information campaigns to attempt to win the "hearts and minds" of Ukrainians. Prior to the start of the conflict, White House press secretary Jen Psaki warned of a 2,000% increase from the daily average in November in Russian-language social media content. This suggests that the purpose of these information operations was to make the case for Russia's intervention on humanitarian grounds and to build support for intervention among the Ukrainian public. The Russian government's domestic actions emphasize the value its leadership places on information operations.

A Supporting Role

Hackers' actions tend to occur out of the public eye, rather than in the flamboyantly violent manner favored by Hollywood cyber villains, which means it's difficult to know for sure what's happening. Nevertheless, the lack of overlap between cyber and conventional military operations makes sense operationally and strategically. This is not to say that the informational focus of cyber operations has no effect on military operations. Good intelligence is essential for success in any military conflict.

We believe Russia is likely to continue conducting information campaigns to influence Ukrainians, its domestic public and international audiences. Russia is also likely to seek to further penetrate Ukrainian networks to access information that potentially assists its military operations. But because cyber operations have not been thoroughly integrated into its military campaigns so far, cyber operations are likely to continue playing a secondary role in the conflict.

Nadiya Kostyuk is Assistant Professor of Public Policy @ Georgia Institute of Technology.
Erik Gartzke is Professor of Political Science @ University of California San Diego.

Russia's Cyber War: What's Next and What the European Union Should Do

By Arthur de Liedekerke and Arthur Laudrain

Source: https://www.homelandsecuritynewswire.com/dr20220404-russia-s-cyber-war-what-s-next-and-what-the-european-union-should-do

Apr 04 – Contrary to widespread expectations, the use of cyberweaponry in the Russian war with Ukraine has so far been limited. To date, the only significant, sophisticated operations with suspected Russian involvement are the attacks on communications giant Viasat's satellite networks, attempts to install data-wiping malware on Ukrainian government systems, and attacks against two major Ukrainian telecommunications firms. There are several reasons that can plausibly explain why cyber operations have remained marginal in the conflict. First, the Ukrainians have done a good job at bolstering their digital defenses, helped in part by their American allies. There are also the inherent limitations of cyberattacks: in an all-out kinetic war, missiles offer a faster and more effective means of achieving strategic objectives than lines of code.

Last, but certainly not least, it is worth remembering that we are in the early stages of a war that will drag on, potentially for months, leaving plenty of time for new Russian cyber operations. Apparent reluctance to use cyber capabilities beyond limited operational-level hits or disinformation campaigns may well abate as fears of spillover or retaliatory Western cyber responses diminish. The European Union (EU) must act now, while the intensity of cyber conflict outside Ukraine is still relatively low, to bolster its defenses and prepare for the specter of wide-ranging, damaging cyber operations later in the conflict.

Cyber and Information Warfare: The Cornerstone of Russia's Next Move?

Even if the Russians agree to a truce, cyber and disinformation efforts would be one of the few avenues available to them to inflict damage on Ukraine in the gray zone below the threshold of direct confrontation. As the Russian military shifts its objectives, resources and bandwidth will be freed up to fight from the rear. A cornered Moscow–with few other options left on the table–is likely to resort to the cyber domain, as other pariah states have done, as the ideal vector to circumvent isolation, spy on and disrupt Western defense plans, steal technology and intellectual property it will be cut off from, and heighten its global nuisance with disinformation operations. Recent attacks on a major Ukrainian telecommunications firm, Ukrtelecom, have heightened fears that Russia's stalling military campaign could cause it to turn to cyber operations as another means of achieving its aims.

What Should the European Union Do in the Immediate Term?

The EU has adopted new frameworks, including its much vaunted Strategic Compass, which, in the long term, will improve cybersecurity in the bloc, and potentially reduce the risk

of catastrophic Russian cyberattacks. However, the EU needs to take more steps in the short term to shore up cyber defenses and mitigate the threat of Russian cyber operations.
First, the EU should get its own house in order. The revised Network and Information Security (NIS) Directive–better known in Brussels circles as NIS 2–should be finalized in the coming months and will aim to further strengthen the security of supply chains, streamline incident reporting obligations, and introduce more stringent supervisory measures for a large number of operators of essential services and enterprises across the EU. While NIS 2 represents a step in the right direction, the EU still has some way to go in implementing harmonized cybersecurity rules across the bloc's own institutions.
Second, the EU and its Member States have a role to play in discouraging and deterring cyberattacks by demonstrating a willingness to act and impose costs on perpetrators. The first-ever operational deployment of the EU's Cyber Rapid Response Team to Ukraine, alongside similar teams from the United States, was a welcome signal in this respect. One way to impose further costs would be by pushing for coordinated attribution of cyberattacks at the EU-level. On the offensive and deterrent side, the EU should adopt a pooling of capabilities on a voluntary basis. Similar programs already exist among other groups, such as NATO's Sovereign Cyber Effects Provided Voluntarily by Allies (SCEPVA) program, which the EU could use as a model for its own programs.
Third, the EU should ensure it is better prepared by leveraging the tools it already has at its disposal. Intelligence sharing and situational awareness have proven vital before and during the war in Ukraine, but the future effectiveness of these strategies in deterring and mitigating cyberattacks will be reliant on Member States willingness to contribute with timely and actionable intelligence. In the short term, the Cyber Crisis Liaison Organisation Network (CyCLONe), a recently created group bringing together the executives of the EU's twenty seven national cybersecurity authorities, should be used to its full capability and integrated with the rest of the EU cyber ecosystem. CyCLONe, with their wealth of operational-level expertise, should be able to brief political decision-makers in the Council more frequently. On the military side, the EU still lacks a fully fleshed-out cooperation mechanism for military cybersecurity alerts, despite this being an objective since the 2014 EU Cyber Defence Policy Framework. Ensuring cooperation among both civilian and military groups is vital given the specter of Russian cyberattacks.
Supporting Ukraine is every democracy's duty. Russia will attempt to undermine this support through cyberattacks and other means. The EU needs to shore up its cyber defenses at home to ensure all Members can continue to aid Ukraine in the future.

Arthur de Liedekerke is a Project Manager at political advisory Rasmussen Global and a non-resident fellow at the Institute for Security Policy at Kiel University (*ISPK*), Germany.
Arthur Laudrain is a DPhil candidate in Cybersecurity at the University of Oxford (Wolfson College), Rotary Scholar for Global Peace, and Fellow at the European Cyber Conflict Research Initiative.

Five Fact-Checking Tips from Disinformation Experts

By Kevin Casey
Source: https://www.homelandsecuritynewswire.com/dr20220404-five-factchecking-tips-from-disinformation-experts

Apr 04 – The modern era of disinformation can be said to have begun in the 1980s. Operatives from the then Soviet Union concocted the lie that the AIDS epidemic sweeping the world at that time was created in a government laboratory in the US.
In a vast, worldwide operation involving field offices, agents and huge investments in newspapers, radio and even publishing a book, for years the KGB pushed the fake narrative to undermine the US and its allies. Known as Operation Infektion, the disinformation campaign was used to sow doubt and create social and political tensions all around the world.
Eventually, the story was repeated in 80 countries and translated into 30 languages until the Soviets admitted to making the whole thing up in 1987. Despite detailed admissions by senior Soviets, the rumor persists to this day, nearly 40 years later.

Spreads Like Wildfire
Nowadays, modern social networks provide immediate access to information from anywhere, wherever you are in the world.
While disinformation is nothing new, it spreads much faster now. Often it rides on a wave of emotion through personal social networks.
Disinformation comes from a variety of sources, foreign and domestic. It is a complex phenomenon with impacts in the real world.
'It's only by understanding disinformation that you can tackle it,' says Paula Gori, Secretary-General and Coordinator of the European Digital Media Observatory (EDMO).
EDMO is an independent EU-funded project whose aim is to bring together a wide range of factcheckers, researchers and stakeholders to combat disinformation.
EDMO is focused on the resilience of societies and looks at disinformation regardless of where it originates. It brings together a wide range of researchers and stakeholders in a consortium to understand disinformation and counter it.

'We bring together people, weaving together facts and evidence,' she said. 'EDMO acts as a community builder that brings together the stakeholders ensuring a multidisciplinary approach.'
Not all disinformation narratives are fabricated and promoted by malicious actors. Sometimes, they start as a normal reaction to try to grasp complex situations. We know from research that emotions play a key role in the spread of disinformation, and this was confirmed again during the Covid-19 pandemic.
Gori recalls the early stages of the Covid-19 pandemic, people were scrolling through social network feeds with a sense of foreboding. 'They were scared and were looking for information. The fact that the virus was new to the scientific community made it even easier to spread disinformation,' she said.
'Whatever you were seeing on screen, you were sharing it, because you actually were fearing for your life and you were not taking time to think before sharing.'
It is when online misinformation and false information is created and disseminated with the intent to intentionally deceive the public or to cause public harm that it becomes dangerous disinformation. That is the moment that we must react at all levels of society, together, to tackle the issue.
There are elements of sociology, anthropology, psychology, neuroscience, media literacy and more in that one impulse to share information with your friends and family, which is why 'the multidisciplinary approach is fundamental,' she said.
EDMO is set up to support the creation of a cross-border and multidisciplinary community of independent fact-checkers and academic researchers on disinformation in the EU.
EDMO has been enlarged to include national and regional research hubs, which are in a position to use their specific knowledge of local information environments. This will improve detection and analysis of disinformation threats and trends across Europe.

Freedom of Expression
Even though EDMO is building resilience against disinformation, an individual's opinions about any particular topic is never in question. 'You have to guarantee freedom of expression,' says Lauri Tierala, Program Director, EDMO.
'You cannot regulate disinformation away,' he said. 'You cannot have a Ministry of Truth.'
'There are, obviously, legitimate reasons in every society for political differences,' he said. 'But creating artificial dividing lines via disinformation leading to polarization only weakens the whole society.' In the Information Age, bad information can be highly damaging.
The war in Ukraine has made things even more complicated. In a recent post on the EDMO website, they investigated how social media channels that were usually centers of COVID-19 skepticism have suddenly pivoted to pushing disinformation about the Russian invasion of Ukraine.
There are many incentives to publish fake news and disinformation. It could be a power play by a nation state actor or an advertising play by a monetizing/financial interest. Some people then just share with their networks, believing they're doing some good when they're not, but without malicious intent. Disinformation has different origins and dynamics in how it spreads.
Unfortunately, disinformation is here to stay. At times, it sinks to the level of being an existential threat by having a negative impact on public health and global issues like responding to Covid-19 or climate-change. In some contexts, it has been used to motivate violence and it has a negative influence in the public debate, especially when it's part of a complex web of interactions.
Fact-checking is an essential skill to bring to the table, but EDMO has a broader mission to tackle disinformation and a comprehensive, multi-disciplinary way.

Informed Decisions
There is an onus on each of us to make informed decisions. We choose to go our own way with the information that's available to us - red, green or blue, but we should have good quality information, argues Gori.
EDMO is there to assist that process, she explains. It helps to increase awareness of disinformation for better informed decisions.
'I would be happy to know that there is someone who actually makes sure I can do this,' said Gori.

Follow the Fact Checking Rules
Tommaso Canetta is deputy director of Pagella Politica, an Italian fact-checking outlet and coordinator of the fact-checking activities inside EDMO. To highlight the mission of the International Fact Checking Day, he shares his five top tips anyone can use for fact checking a piece of content they receive.

1. Breathe. Slow down before you reshare and take a moment to engage your critical thinking skills. Allow your fast-acting emotional response to pass.
2. Cross reference. Take the time to find a reference to the piece of news you are seeing from another source before passing it on. Use at least one trusted news provider and

see if that piece of information is confirmed by other independent sources. If it's coming from an obscure social media source, it may not be trustworthy.

3. Advanced searches are available. Many search engines have an image search facility where you can search a photograph or screenshot. Sometimes a piece of content purports to be one thing with immediate consequences, but with a quick search, you can find it's from a totally different event in the past.
4. Go to a fact-checking site to see if it's come to their attention. Some media organizations invest considerable effort into verification and provide all their sources so that you can validate their research for yourself. Fact checking services to consider include DW Fact Check, FRANCE24 Les Obervateurs, AFP Factcheck and EUvsDisinfo amongst others.
5. Remember, as a rule of thumb, if something is too good or too bad to be true, it probably is not true.

Kevin Casey is Editor in Chief, Horizon Magazine *EU*.

How Ukraine Has Defended Itself Against Cyberattacks – Lessons for the U.S.

By Robert Peacock

Source: https://www.homelandsecuritynewswire.com/dr20220406-how-ukraine-has-defended-itself-against-cyberattacks-lessons-for-the-u-s

Apr 06 – In 2014, as Russia launched a proxy war in Eastern Ukraine and annexed Crimea, and in the years that followed, Russian hackers hammered Ukraine. The cyberattacks went so far as to knock out the power grid in parts of the country in 2015. Russian hackers stepped up their efforts against Ukraine in the run-up to the 2022 invasion, but with notably different results. Those differences hold lessons for U.S. national cyber defense.

I'm a cybersecurity researcher with a background as a political officer in the U.S. Embassy in Kyiv and working as an analyst in countries of the former Soviet Union. Over the last year, I led a USAID-funded program in which Florida International University and Purdue University instructors trained more than 125 Ukrainian university cybersecurity faculty and more than 700 cybersecurity students. Many of the faculty are leading advisors to the government or consult with critical infrastructure organizations on cybersecurity. The program emphasized practical skills in using leading cybersecurity tools to defend simulated enterprise networks against real malware and other cybersecurity threats.

The invasion took place just weeks before the national cybersecurity competition was to be held for students from the program's 14 participating universities. I believe that the training that the faculty and students received in protecting critical infrastructure helped reduce the impact of Russian cyberattacks. The most obvious sign of this resilience is the success Ukraine has had in keeping its internet on despite Russian bombs, sabotage and cyberattacks.

What This Means for the U.S.

On March 21, 2022, U.S. President Joe Biden warned the American public that Russia's capability to launch cyberattacks is "fairly consequential and it's coming." As Deputy National Security Adviser Anne Neuberger explained, Biden's warning was a call to prepare U.S. cyber defenses.

The concern in the White House over cyberattacks is shared by cybersecurity practitioners. The Ukrainian experience with Russian cyberattacks provides lessons for how institutions ranging from electric power plants to public schools can contribute to strengthening a nation's cyber defenses.

National cyber defense starts with governments and organizations evaluating risks and increasing their capacity to meet the latest cybersecurity threats. After President Biden's warning, Neuberger recommended that organizations take five steps: adopt multifactor password authentication, keep software patches up-to-date, back up data, run drills and cooperate with government cybersecurity agencies.

Access Control

Cyber defense begins with the entryways into a nation's information networks. In Ukraine in recent years, hackers entered poorly protected networks by techniques as simple as guessing passwords or intercepting their use on unsecure computers.

More sophisticated cyberattacks in Ukraine used social engineering techniques, including phishing emails that tricked network users into revealing IDs and passwords. Clicking an unknown link can also open the door to tracking malware that can learn password information.

Neuberger's recommendation for adopting multifactor password authentication recognizes that users will never be perfect. Even cybersecurity experts have made mistakes in their decisions to provide passwords or personal information on insecure or deceptive sites. The

simple step of authenticating a login on an approved device limits the access a hacker can obtain from just gaining personal information.

Software Vulnerabilities

The programmers who develop apps and networks are rewarded by improving performance and functionality. The problem is that even the best developers often overlook vulnerabilities as they add new code. For this reason, users should permit software updates because these are how developers patch uncovered weaknesses once identified.

Prior to the invasion of Ukraine, Russian hackers identified a vulnerability in Microsoft's leading data management software. This was similar to a weakness in network software that allowed Russian hackers to unleash the NotPetya malware on Ukrainian networks in 2017. The attack caused an estimated $10 billion in damage worldwide.

Just days before Russian tanks began crossing into Ukraine in February 2022, Russian hackers used a vulnerability in the market-leading data management software SQL to place on Ukrainian servers "wiper" malware that erases stored data. However, over the last five years Ukrainian institutions have significantly strengthened their cybersecurity. Most notably, Ukrainian organizations have shifted away from pirated enterprise software, and they integrated their information systems into the global cybersecurity community of technology firms and data protection agencies.

As a result, the Microsoft Threat Intelligence Center identified the new malware as it began appearing on Ukrainian networks. The early warning allowed Microsoft to distribute a patch around the world to prevent the servers from being erased by this malware.

Backing Up Data

Ransomware attacks already frequently target public and private organizations in the U.S. The hackers lock out users from an institution's data networks and demand payment to return access to them.

Wiper malware used in the Russian cyberattacks on Ukraine operates in a similar manner to ransomware. However, pseudo ransomware attacks permanently destroy an institution's access to its data.

Backing up critical data is an important step in reducing the impact of wiper or ransomware attacks. Some private organizations have even taken to storing data on two separate cloud-based systems. This reduces the chances that attacks could deprive an organization of the data it needs to continue operating.

Drills and Cooperation

The last set of Neuberger's recommendations is to continually conduct cybersecurity drills while maintaining cooperative relationships with federal cyber defense agencies. In the months leading up to Russia's invasion, Ukrainian organizations benefited from working closely with U.S. agencies to bolster the cybersecurity of critical infrastructure. The agencies helped scan Ukrainian networks for malware and supported penetration tests that use hacker tools to look for vulnerabilities that can give hackers access to their systems.

Small and large organizations in the U.S. concerned about cyberattacks should seek a strong relationship with a wide-range of federal agencies responsible for cybersecurity. Recent regulations require firms to disclose information on cyberattacks to their networks. But organizations should turn to cybersecurity authorities before experiencing a cyberrattack.

U.S. government agencies offer best practices for training staff, including the use of tabletop and simulated attack exercises. As Ukrainians have learned, tomorrow's cyberattacks can only be countered by preparing today.

Robert Peacock is an Assistant Professor of Criminology and Criminal Justice @ Florida International University.

55+ emerging IoT technologies you should have on your radar (2022 update)

By Satyajit Sinha

Source: https://iot-analytics.com/iot-technologies/

In short

- IoT Analytics identified 58 technologies that people working on IoT projects should have on their radar: 21 in IoT software, 21 in IoT hardware, and 16 in IoT connectivity.
- Of the 58 technologies on the radar, only a few are classified as nearing maturity, fairly mature, or mainstream—many of them are still further out and will need time to reach mass market maturity.

Why it matters

- The radar helps anyone working in IoT environments and projects understand which technologies they should be watching, evaluating, and perhaps deploying.

Selected highlights

The analyst team at IoT Analytics handpicked 58 of the most promising technologies relevant to IoT projects globally and ranked them according to their perceived maturity. The resulting **Emerging IoT Technologies Radar** will help anyone working in IoT-type environments and projects understand which technologies they should be watching, evaluating, and perhaps deploying.

The full report is available to IoT Analytics corporate subscription clients here: **Emerging IoT Technologies Report 2022.** The report contains additional details, such as market statistics, major vendors, and recent trends, for each of the highlighted IoT technologies, which are anywhere between "coming up" and "mainstream." The report is an update to the 2019 analysis on emerging IoT technologies.

IoT Software. Eight IoT technologies are nearing maturity, including edge AI, IoT-based streaming analytics, and supervised and unsupervised machine learning.

IoT Hardware. Six IoT technologies are now classified as fairly mature or mainstream: CPUs, MCUs, GPUs, security chips, FPGA, and edge gateways.

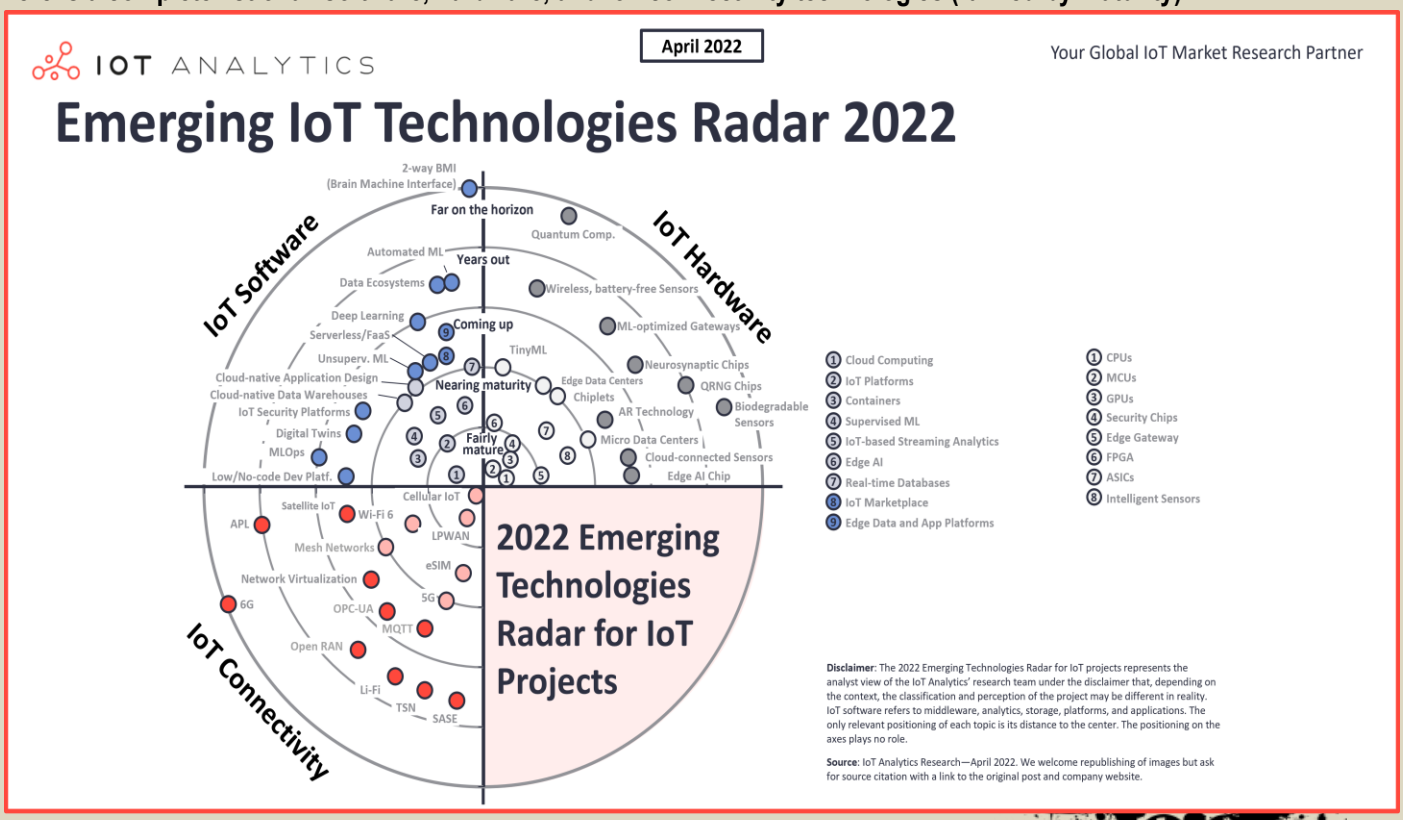
IoT Connectivity. Four IoT technologies are close to maturity: eSIM, mesh networks, 5G, and Wi-Fi 6.

The IoT technologies maturing the fastest

Of the 40 technologies that were highlighted in the 2019 radar, three technologies stand out as the fastest movers that advanced the most in three years: **Wi-Fi 6, GPUs, and intelligent sensors.**

- **Wi-Fi 6**. The deployment of Wi-Fi 6 chipsets at an early stage and the significant specification upgrade from earlier Wi-Fi versions led to a fast adoption by device players, especially in devices such as routers. Thanks to this adoption, Wi-Fi 6 has been extremely quick to move from "coming up" to "fairly mature." Wi-Fi 6 significantly increases the speed and the network's capacity to provide optimal throughput to access points. The upgrade from older Wi-Fi versions to Wi-Fi 6 opens the door for new applications, with almost four times higher throughput capacity than Wi-Fi 5. Routers, gateways, and customer-premises equipment (CPEs) were key devices for the quick adoption of Wi-Fi 6 in the last three years.
- **GPUs.** The optimization of GPUs to train AI deep learning models to process multiple computations simultaneously for IoT applications and the adoption of GPUs into data centers due to their parallel processing capabilities have led to faster maturity.
- **Intelligent sensors.** The last three years have seen an upsurge in technology developments around sensors that aim to solve problems related to latency, data throughput, and security for various edge applications. In contrast to older generation sensors, these new sensors are embedded with data processing capabilities that enable data to be processed closer to the sensor and respond to the user interface or actuators. Some of the applications driving the adoption of intelligent sensors were wearable medical devices, such as blood glucose monitors, and AI-based quality control in manufacturing.

Here is a complete list of all software, hardware, and IoT connectivity technologies (ranked by maturity):



A. IoT Software Technologies

Technology	Description	Classification	Adoption Rate
Cloud Computing	Cloud computing is the delivery of different services through the internet. These resources include tools and applications related to data storage, servers, databases, networking, and software.	Mainstream	
IoT Platforms	IoT platforms are software tools for building and managing IoT solutions. They also simplify coding and deploying applications for IoT solutions and enable efficient edge-to-cloud communications.	Fairly mature	
Edge AI/Analytics	Edge AI is a combination of edge computing and AI. AI algorithms are processed locally, either directly on the device or on a server near the device.	Nearing maturity	
Containers	A container is a standard unit of software that packages up code and all its dependencies, so the application runs quickly and reliably from one computing environment to another.	Nearing maturity	
IoT-based Streaming Analytics	Streaming analytics is the processing and analysis of fast-moving live data from various sources, including IoT devices, to raise automated, real-time actions or alerts.	Nearing maturity	
Supervised ML	Supervised ML is a subcategory of ML and AI. It is defined by its use of labeled datasets to train algorithms to classify data or predict outcomes accurately.	Nearing maturity	
Cloud-native Application Design	A cloud-native application is a program designed for a cloud computing architecture. These applications are run and hosted in the cloud.	Nearing Maturity	
Cloud-native Data Warehouses	A cloud-native data warehouse is a database delivered in a public cloud as a managed service that is optimized for analytics, scale, and ease of use.	Nearing Maturity	

Technology	Description	Classification	Adoption Rate
Real-time Database	A real-time database is a database system that uses real-time processing to handle workloads whose state is constantly changing.	Nearing Maturity	
Low-code/No-code Development Platforms	A low-code/no-code development platform provides a development environment to create application software through a graphical user interface.	Nearing Maturity	
Unsupervised ML	Unsupervised ML is a type of ML in which the algorithm is not provided with any pre-assigned labels or scores for the training data.	Coming up	
Serverless/FaaS	Function-as-a-Service, or FaaS, is a cloud computing service that allows developers to build, run, and manage application packages as functions without having to maintain their infrastructure.	Coming up	
Deep Learning	Deep learning is part of a broader family of ML methods based on data representations, as opposed to task-specific algorithms.	Coming up	
IoT Marketplaces	An IoT marketplace is a type of application marketplace where customers can go to an online storefront to find, purchase, and manage applications for their IoT devices.	Coming up	
Digital Twins	A digital twin is a digital representation of a physical object, process, or service.	Coming up	
IoT Security Platforms	An IoT security platform includes software security solutions for many layers of the IoT tech stack.	Coming up	

Technology	Description	Classification	Adoption Rate
IoT Edge Data & Application Platforms	Edge application platforms enable analytics application management at the edge. Edge data platforms are software tools to manage applications running on multiple edge compute resources.	Coming up	
ML Ops	ML Ops (also called DevOps for ML) is an engineering discipline that aims to combine ML systems development and deployment.	Coming up	
Automated ML	Automated machine learning is the process of automating the tasks of applying machine learning to real-world problems.	Years out	
Data ecosystems	A data ecosystem is the secure connection between different stakeholders of a process (e.g., vendors, suppliers, etc.) that share data in a way that has clearly defined rules for data access and privacy for everyone involved.	Years out	
2-way BMI (Brain Machine Interface)	Bidirectional brain-machine interfaces (BMIs) establish a two-way direct communication link between the brain and the external world	Far on the horizon	New entry

B. IoT Hardware Technologies

Technology	Description	Classification	Adoption Rate
CPU	CPUs are electronic circuitry that execute instructions that make up a computer program.	Mainstream	
MCU	Microcontrollers are integrated circuits that contain a processor, memory, and other peripherals.	Mainstream	
GPUs	Graphic processing unit	Mainstream	

Technology	Description	Classification	Adoption Rate
Security Chips	Security-enhancing, low-powered modules, include various security-sensitive functions	Fairly mature	
Edge Gateways	Physical devices that serve as the connection point between the cloud and controllers, sensors, and intelligent devices.	Fairly mature	
FPGA	Field programmable gate array	Fairly mature	
Intelligent Sensors	Sensors that take some predefined action when they sense the appropriate input.	Nearing maturity	
ASIC	Application-specific integrated circuit	Nearing maturity	
Chiplets	Chiplets are a new design philosophy that allows multiple chips with different process node sizes to be used in a single package or on a single substrate.	Nearing maturity	
TinyML	TinyML is a field of study in ML and embedded systems that explores models you can run on small, low-powered devices, like microcontrollers.	Nearing maturity	
Edge + Micro Data Centers (MDCs)	Edge data centers are located close to the edge of a network (where the network meets the endpoint layer). An MDC is for computer workloads not requiring traditional facilities.	Nearing maturity	

Technology	Description	Classification	Adoption Rate
Cloud-connected Sensors	Cloud-connected sensors use physical sensors to accumulate data and transmit them into a cloud computing infrastructure.	Coming up	
AR Technology	AR technology is a technology that combines virtual information with the real world.	Coming up	
Edge AI Chip	Edge AI chipsets refer to computational chipsets focusing on AI workloads that are typically deployed in edge environments.	Coming up	
Neurosynaptic Chips	Brain-inspired computer chip, in which transistors simulate neurons and synapses.	Years out	
QRNG Chips	QRNG refers to quantum driven secure chip design which can be integrated into current silicon design and manufacturing processes.	Years out	
Wireless, Battery-free Sensors	Sensors that can generate the energy that they need to function by themselves, i.e., they do not need to be powered by an external source.	Years out	
ML-optimized Gateways	Controllers that are optimized for ML algorithms.	Years out	
Quantum Computing	Computation using quantum-mechanical phenomena, for example superposition entanglement.	Far on the horizon	

Technology	Description	Classification	Adoption Rate
Biodegradable Sensors	Biodegradable sensors are designed and developed to detect various body signals, which can help track post-treatment prognosis.	Far on the horizon	New entry

C. IoT Connectivity Technologies

Technology	Description	Classification	Adoption Rate
Cellular IoT (2G/3G/4G)	Provides connectivity to IoT applications via traditional cellular networks	Mainstream	
LPWAN	Low-power, wide-area connectivity for IoT applications (e.g., Sigfox, LoRa, NB-IoT, and LTE-M)	Mainstream	
eSIM	A SIM-card embedded into mobile devices enables remote SIM provisioning, which allows storing multiple operator profiles simultaneously and switching between them remotely.	Nearing maturity	
Mesh Networks	A mesh network is a group of devices that act as a single Wi-Fi network, so there are multiple sources of Wi-Fi around your house instead of just a single router.	Nearing maturity	
5G	The fifth generation of cellular networks, commercially launched in 2019	Nearing maturity	
Wi-Fi 6	The newest version of the Wi-Fi protocol, also known as IEE 802.11ax	Nearing maturity	
Network Virtualization	Abstracts network elements and resources into a logical virtual network that runs independently on top of a physical network	Coming up	

Technology	Description	Classification	Adoption Rate
MQTT	MQTT is a lightweight, publish-subscribe network protocol that transports messages between devices.	Coming up	
OPC Unified Architecture (UA)	OPC UA is a machine-to-machine communication protocol for industrial automation from the OPC Foundation.	Coming up	
Satellite IoT	Provides connectivity to IoT applications via satellite networks	Coming up	
TSN	Time-Sensitive Networking is a set of standards defined by the IEEE for the time-sensitive transmission of data over deterministic Ethernet networks.	Years out	
Li-Fi	Wireless communication technology that uses light to transmit data	Years out	
Open RAN	Open RAN (Open Radio Access Networks or O-RAN) is the disaggregation of RAN functionalities through network virtualization and software-defined network technologies.	Years out	
Advanced Physical Layer (APL)	Developing industrial Ethernet standard that seeks to leverage the work of the IEEE 802.3cg (10BASE-T1L) task force to achieve a single twisted-pair industrial Ethernet standard for hazardous areas	Years out	
Secure Access Service Edge (SASE)	SASE is a new security model specifically to address the security challenges of the new reality organizations are facing.	Years out	

Technology	Description	Classification	Adoption Rate
6G	The sixth generation of cellular networks	Far on the horizon	→

↑ = Very fast movers ↗ = Fast movers → = Slow movers

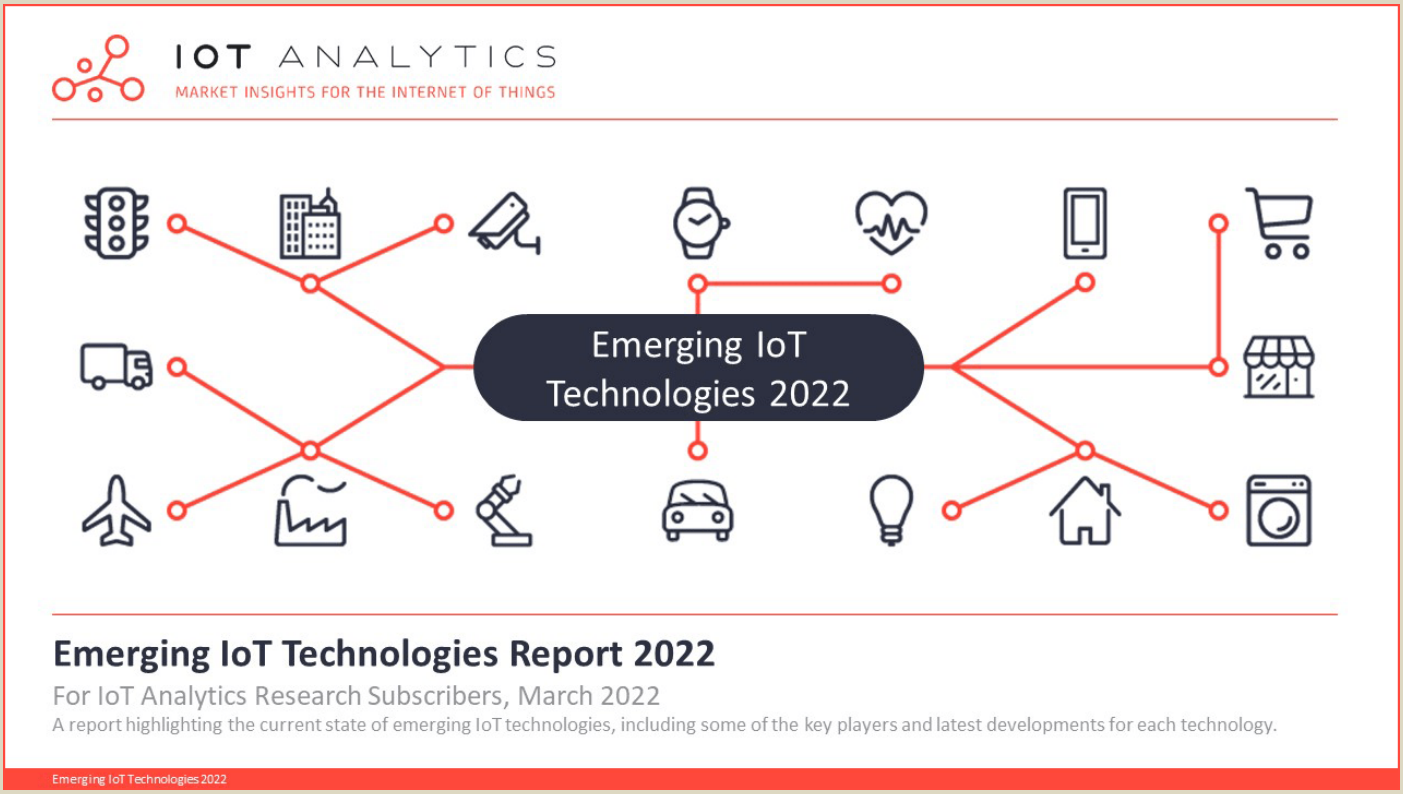
What the radar does and does not measure

Technology maturity. The radar shows a subjective measure of maturity as put together by the analyst team at IoT Analytics. The maturity scores are developed based on expert interviews, vendor briefings, secondary research, and conference attendances. The radar targets IoT practitioners that deploy IoT.

The IoT. IoT Analytics defines the IoT as a network of internet-enabled physical objects. Objects that become internet-enabled (IoT devices) typically interact via embedded systems, some form of network communications, and a combination of edge and cloud computing. The data from IoT-connected devices is often (but not exclusively) used to create novel end-user applications. Connected personal computers, tablets, and smartphones are not considered IoT, although these may be part of the solution setup. Devices connected via simple connectivity methods, such as RFID or QR codes, are not considered IoT devices.

Relevance of individual technologies. Not every technology is relevant for a given IoT context. Some technologies may only be used in specific IoT settings (e.g., low-power WAN [LPWAN] for remote, low-power applications), while others are used in settings where IoT only plays a minor role (e.g., cloud computing, which is also used in many non-IoT scenarios). IoT Analytics is aware that many other technologies exist that could be highlighted on such a radar.

More Information and further reading



Are you interested in learning more about IoT technologies?

The Emerging Technologies Report 2022 is a 76-page report highlighting the current state of emerging IoT technologies, including some of the key players and the latest developments for each technology.

The report consists of four parts:

1. **Emerging Technologies Radar** (Framework and criteria to classify selected technologies and overall view on classifications—6 pages)
2. **Software Technologies** (Deep dive into selected software technologies and one-pagers on the most interesting technologies—21 pages)
3. **Hardware Technologies** (Deep dive into selected hardware technologies and one-pagers on the most interesting technologies—29 pages)
4. **Connectivity Technologies** (Deep dive into selected connectivity technologies and one-pagers on the most interesting technologies—15 pages)

Sample

The sample of the report gives you a holistic overview of the available analysis (outline, key slides). The sample also provides additional context on the topic and describes the methodology of the analysis. You can download the sample here: Download now

Satyajit Sinha is a senior analyst focusing on IoT components, modules, and other hardware, along with IoT connectivity and security. He has a background in market research analysis and equity research.

ISIS Calls for 'Social Media Warfare' to Counter 'Enchanting' Influencers and Incite

By Bridget Johnson

Source: https://www.hstoday.us/featured/isis-calls-for-social-media-warfare-to-counter-enchanting-influencers-and-incite/

Apr 11 – A concerted focus on "social media warfare" is critical to advance on the ideological battlefield but also in order to counter the pull of "enchanting" social media influencers, ISIS Khorasan declared in a new issue of the group's English-language magazine. "War comes in many form and targets different aspects of humans. A war can be fought militarily targeting physical self or it can be fought ideologically targeting intellect," said an article in the third issue of *Voice of Khurasan* magazine released online. "As much importance the physical clashes hold ideological confrontations also matter if not more. The physical battle can be lost even before it starts if people, in our case Muslims, are defeated or at the least trapped in the battle for the hearts and minds."

"The Crusaders of the West understood the importance of battle for the hearts and minds, and hasten to prepare to advance for confrontation in this front by opening their research centres, colleges and other forms of institutions. They funded thousands of people in the name of research for this along and bought people who wear cloaks of Muslim," the article continued. "Think-tanks such as 'RAND Corporation' has wrote about these in more than a decade ago by outlining a framework that Crusader America should follow, which groups they should target to work hand in hand towards this intellectual Crusade."

ISIS said that the goal of the West's "ideological battle is to try and counter the true Islamic ideology which Crusaders claim as 'radical and dogmatic interpretations of Islam', and make sons of Islam follow the wishy-washy version of Islam that is against jihad, full implementation of Shari'ah and its religious punishments."

"Jihad against the crusaders and their allies is the best way to deter them. Jihad is not limited to fighting physically, and fighting with tongues are as important as fighting physically," ISIS-K said. "In this age, social media warfare holds the utmost importance as the medias and social media personalities are enchanting the eyes of the people. Fighting in this field needs to be done in order to incite the believers and save other Muslims from the negative impact of the enchanting battle for hearts and minds."

Voice of Khurasan has so far been on a monthly schedule, with the 37-page inaugural issue released in February, a 35-page issue released in March and the current April issue coming in at 20 pages long.

In the first issue, the group declared that theirs is the "most important province" of ISIS after Iraq and Syria. The magazine furthered the long-running ISIS narrative that the loss of the

group's claimed caliphate in Iraq and Syria is "temporary," adding that "although we lost the Khilafah territory and thousands of Mujahideen were martyred in a period of 5 years, there is no problem." ISIS told the Taliban in the article that they will "become our brother" if they "desist from your deeds, declare yourself free from infidel democratic system, free your necks from slavery of infidels and ISI, repent from infidel beliefs, innovations and other superstitions," release prisoners and "acknowledge the sovereignty of one God alone." The magazine declared that "even though our territories have been taken away from us" ISIS is still "engaged" in jihad as "we are East Africa, West Africa, Central Africa, Libya, Sinai and other countries including the Philippines are moving very fast and our numbers and strength are increasing day by day." The second issue similarly dedicated ample space to criticizing the Taliban and argued that "to this day no entity, no person has ever … brought forth a legit argument against the beliefs of the Khalifah" while slamming the "sheer stupidity" of al-Qaeda leadership. The magazine also brought up the Hay'at Tahrir al-Sham merger in Syria and a frequent target of ISIS ire, HTS leader Abu Mohammad al-Jolani, saying that he has "cut off his group from al-Qaeda, rebranded his group like he changes underpants in an attempt to escape from terrorism label."

Bridget Johnson is the Managing Editor for Homeland Security Today. A veteran journalist whose news articles and analyses have run in dozens of news outlets across the globe, Bridget first came to Washington to be online editor and a foreign policy writer at The Hill. She is a Senior Risk Analyst for Gate 15 and a private investigator.

Cyberpandemic – A cyber-attack with COVID-like characteristics?

Word Economic Forum | Jan 2021
Video: https://www.weforum.org/videos/a-cyber-attack-with-covid-like-characteristics

"What if an attack that is even more wide-ranging and costly than NotPetya—with the ability to self-propagate and even mutate to avoid preventative controls—created cascading lockups of systemically important businesses, bankrupting organizations, disrupting services and unwinding the digital transformation efforts made over the past years?" — WEF Global Risks Report, 2022

Petya is a family of encrypting ransomware that was first discovered in 2016 - a piece of criminal code that surfaced in early 2016 and extorted victims to pay for a key to unlock their files. This ransomware targets Microsoft Windows-based systems, infecting the master boot record to execute a payload that encrypts a hard drive's file system table and prevents Windows from booting. It subsequently demands that the user make a payment in Bitcoin in order to regain access to the system.'

Petya and **NotPetya** are two kinds of malware that affected thousands of computers worldwide in 2016 and 2017. Both Petya and NotPetya aim to encrypt the hard drive of infected computers, and there are enough common features between the two. Unlike the fact that the latter is a form originating from the former, NotPetya has many more potential tools to help it spread and infect computers. Moreover, while Petya is a standard piece of ransomware that aims to make few quick Bitcoin from victims, NotPetya is widely viewed as a state-sponsored Russian cyberattack masquerading as ransomware.

Although NotPetya was targetting war-ridden Ukraine, the aftermath was felt by the world. The malware had immense potential to destruct computers, data and wired machines across the world. In the excerpt from Sandworm published by WIRED, the author recounts how the spread of the malware affected not just its intended victim, i.e., Ukraine, but went out to numerous machines around the world, from hospitals in Pennsylvania to a chocolate factory in Tasmania. It ate into multinational companies including Maersk, pharmaceutical giant Merck, FedEx's European subsidiary TNT Express, French construction company Saint-Gobain, fmcg giants Mondelez, and Reckitt Benckiser. And, as not even expected by its inventors NotPetya spread back to Russia, striking the state oil company Rosneft. According to confirmation received by WIRED from former Homeland Security adviser Tom Bossert, the result of this attack was more than $10 billion total loss in damages. – Source

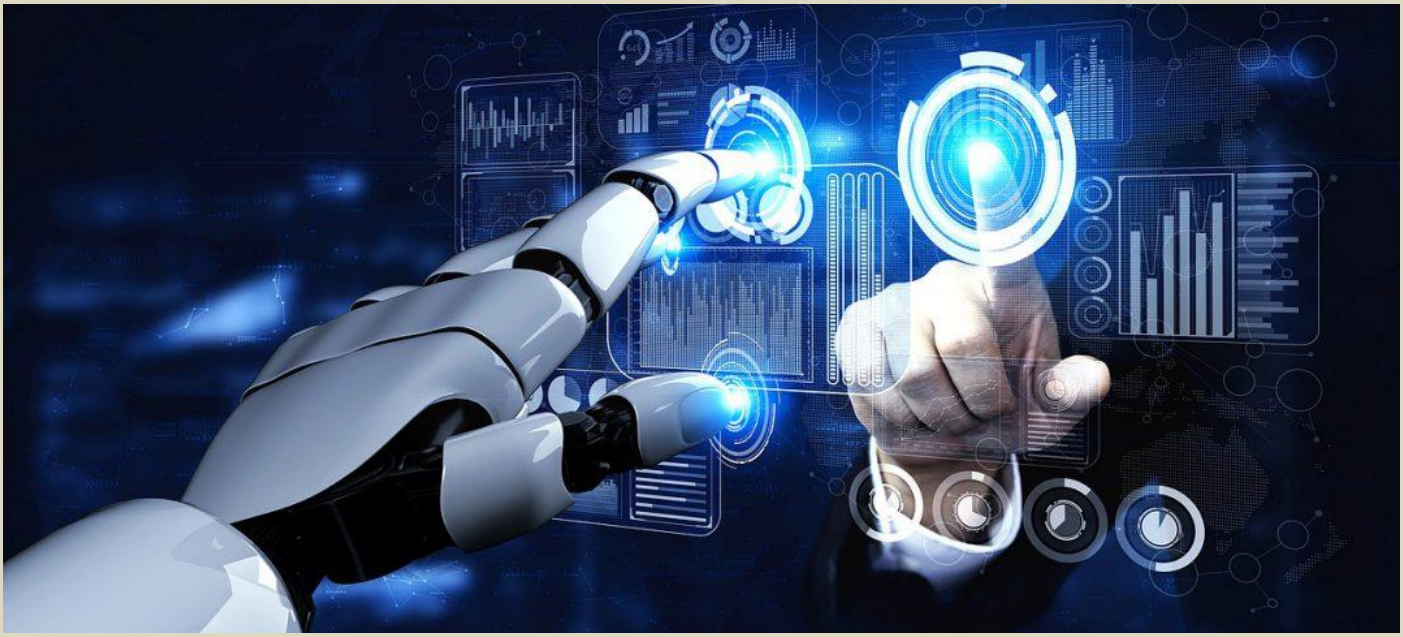
Internet of Robotic Things is Changing the World

Source: https://i-hls.com/archives/114244

Apr 19 – After demonstrating to the world the Internet of Things capabilities over the past few years, the Internet of Robotic Things (IoRT) is ready to change everything, making our lives more efficient and productive.

Using the new concept, automated devices will be able to communicate efficiently and data will be transferred over the Internet. Internet of Robotic Things is the result of combining the

Internet of Things (IoT) and robotics. In this concept, autonomous machines can communicate with one another through data collection from different sensors, enabling them to perform complex tasks.



In general, the concept can be applied in a range of industrial environments, combining three layers: a device or robot that collects and monitors data; analysis of the data using local and distributed intelligence; and combining the sensor data with intelligence to determine a plan of action.

Among the applications of these technologies are warehouses, where robots can safely navigate and handle various tasks, smart homes, in which the various devices can efficiently map each apartment and coordinate tasks between them, construction, where robots can replace humans for dangerous tasks like loading and unloading heavy equipment, and even in healthcare, where dedicated medical robots can monitor patients, according to analyticsinsight.net.

Autonomous robots used in hundreds of hospitals at risk of remote hijacks

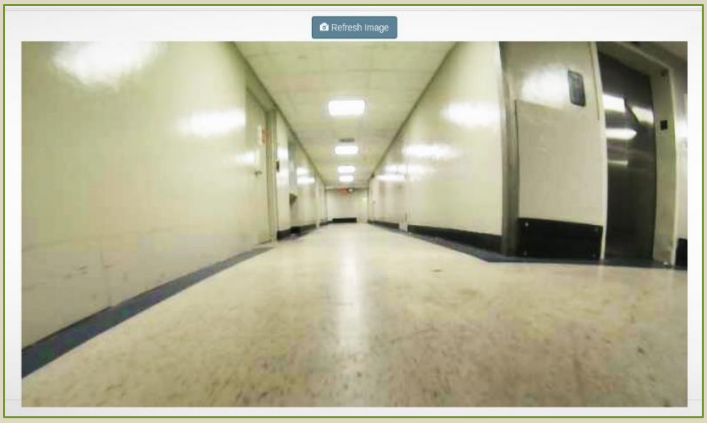
Source: https://techcrunch.com/2022/04/12/aethon-robots-hospitals-hijacks/

Apr 12 – A decade ago security researcher Barnaby Jack famously wirelessly hacked a hospital insulin pump live on stage in front of hundreds of people to demonstrate how easily it could be compromised to deliver a lethal dose of medication. In the years that have passed, medical device security has gotten better, albeit with an occasional high-profile hiccup. But researchers are now finding vulnerabilities in newer hospital technologies that weren't as ubiquitous a decade ago.

Enter autonomous hospital robots, the supposed-to-be-friendly self-controlled digital workhorses that can transport medications, bed linens, food, medications and laboratory specimens across a hospital campus. These robots, such as the ones built by robot maker Aethon, are equipped with the space to transport critical goods and security access to enter restricted parts of the hospital and ride elevators, all while cutting labor costs.

But researchers at Cynerio, a cybersecurity startup focused on securing hospital and healthcare systems, discovered a set of five never-before-seen vulnerabilities in Aethon robots, which they say allowed malicious hackers to remotely hijack and control these autonomous robots — and in some cases over the internet.

The five vulnerabilities, which Cynerio collectively call JekyllBot:5, aren't with the robots themselves but with the base servers that are used to communicate with and control the robots that traverse the hallways of the hospitals and hotels. The bugs range from allowing hackers to create new users with high-level access in order to then log in and remotely control the robots and access restricted areas, snoop on patients or guests using the robot's in-built cameras or otherwise cause mayhem.



Asher Brass, the lead researcher on the Aethon vulnerabilities, warned that the flaws required a "very low skill set for exploitation."

A screenshot from one of the cameras on an Aethon TUG robot. Image Credits: Cynerio

Cynerio said the base servers have a web interface that could be accessed from inside the hospital's network, allowing "guest" users to view real-time robot camera feeds and their upcoming schedules and tasks for the day without needing a password. But although the robots' functionality were protected by an "admin" account, the researchers said the vulnerabilities in the web interface could have allowed a hacker to interact with the robots without needing an admin password to log in.

One of the five bugs, the researchers said, exposed robots to remote control using a joystick-style controller in the web interface, while exploiting another one of the bugs to interact with door locks, call and ride elevators, and open and close medication drawers.

For the most part, the potential risk is limited if access to the robots' base servers are confined to the local network, limiting access only to logged-in employees. The researchers said the risk was far greater for the hospitals, hotels or any other place that use these robots that have a base server connected to the internet, since the vulnerabilities can be triggered from anywhere on the internet.

Cynerio said they found evidence of internet-exposed robots in hospitals as well as facilities providing care to veterans. Aethon touts its robots in hundreds of hospitals around the world, many in the United States, accounting for thousands of robots.

The bugs were fixed in a batch of software and firmware updates released by Aethon, after Cynerio alerted the company to the issues. Aethon is said to have restricted internet-exposed servers to isolate the robots from potential remote attacks, and fixed other web-related vulnerabilities that affected the base station.

In a statement given to TechCrunch, CEO of ST Engineering Aethon, Peter Seiff, confirmed the vulnerabilities but declined to answer our questions, such as what percentage of its customers' autonomous robots had been patched following the software update.

Ukraine is scanning faces of dead Russians, then contacting the mothers

Source: https://www.washingtonpost.com/technology/2022/04/15/ukraine-facial-recognition-warfare/

A Ukrainian serviceman takes a photo of a dead Russian soldier after Ukrainian forces overran a Russian position outside Kyiv on March 31. (Vadim Ghirda/AP)

Apr 15 – Ukrainian officials have run more than 8,600 facial recognition searches on dead or captured Russian soldiers in the 50 days since Moscow's invasion began, using the scans to identify bodies and contact hundreds of their families in what may be one of the most gruesome applications of the technology to date.

The country's IT Army, a volunteer force of hackers and activists that takes its direction from the Ukrainian government, says it has used those identifications to inform the families of the deaths of 582 Russians, including by sending them photos of the abandoned corpses.

The Ukrainians champion the use of face-scanning software from the U.S. tech firm Clearview AI as a brutal but effective way to stir up dissent inside Russia, discourage other fighters and hasten an end to a devastating war.

But some military and technology analysts worry that the strategy could backfire, inflaming anger over a shock campaign directed at mothers who may be thousands of miles from the drivers of the Kremlin's war machine.

The West's solidarity with Ukraine makes it tempting to support such a radical act designed to capitalize on family grief, said Stephanie Hare, a surveillance researcher in London. But contacting soldiers' parents, she said, is "classic psychological warfare" and could set a dangerous new standard for future conflicts.

"If it were Russian soldiers doing this with Ukrainian mothers, we might say, 'Oh, my God, that's barbaric,' " she said. "And is it actually working? Or is it making them say: 'Look at these lawless, cruel Ukrainians, doing this to our boys?' "

Clearview AI's chief executive, Hoan Ton-That, told The Washington Post that more than 340 officials across five Ukrainian government agencies now can use its tool to run facial recognition searches whenever they want, free of charge.

Clearview employees now hold weekly, sometimes daily, training calls over Zoom with new police and military officials looking to gain access. Ton-That recounted several "'oh, wow' moments" as the Ukrainians witnessed how much data — including family photos, social media posts and relationship details — they could gather from a single cadaver scan.

Some of them are using Clearview's mobile app to scan faces while on the battlefield, he said. Others have logged in for training while stationed at a checkpoint or out on patrol, the night sky visible behind their faces.

"They're so enthusiastic," Ton-That said. "Their energy is really high. They say they're going to win, every call."

The company, Ton-That said, first offered its services last month to Ukraine's Ministry of Defense after he saw Russian propaganda claiming that soldiers captured there were actors or frauds.

The system had primarily been used by police officers and federal investigators in the United States to see whether a photo of a suspect or witness matched any others in their database of 20 billion images taken from social media and the public Internet.

But about 10 percent of the database has come from Russia's biggest social network, VKontakte, known as VK, making it a potentially useful tool for battlefield scans, Ton-That said.

Clearview shared with The Post emails from three Ukrainian agencies — the National Police, the Defense Ministry and a third agency that asked the company to remain confidential — confirming the software was in use. Officials at those agencies and the IT Army declined to comment further or did not respond to requests for comment. Clearview declined to identify two other Ukrainian agencies it said were currently using its software.

In emails that Clearview shared with The Post, a representative of the Defense Ministry said it had tested Clearview by scanning photos of dead soldiers' faces and were "pleasantly surprised" when the tool returned links to the Russians' VK and Instagram accounts.

With the military's encouragement, other agencies tested the technology, too, Ton-That said. A National Police official said in emails shared with The Post that the agency scanned the face of an unidentified body found in Kharkiv with its head caved in and was pointed to the VK profile of a 32-year-old man who had been photographed with supporters of the Kharkiv People's Republic, a separatist group.

Ukrainian agencies, Ton-That said, have used the app to confirm the identities of people at military checkpoints and to check whether a Ukrainian is a possible Russian infiltrator or saboteur. He argued that the system could deter Russian soldiers from committing war crimes, for fear of being identified, and said the Ukrainians are considering using the tool to verify the identities of Ukrainian refugees and their hosts as they flee for safety.

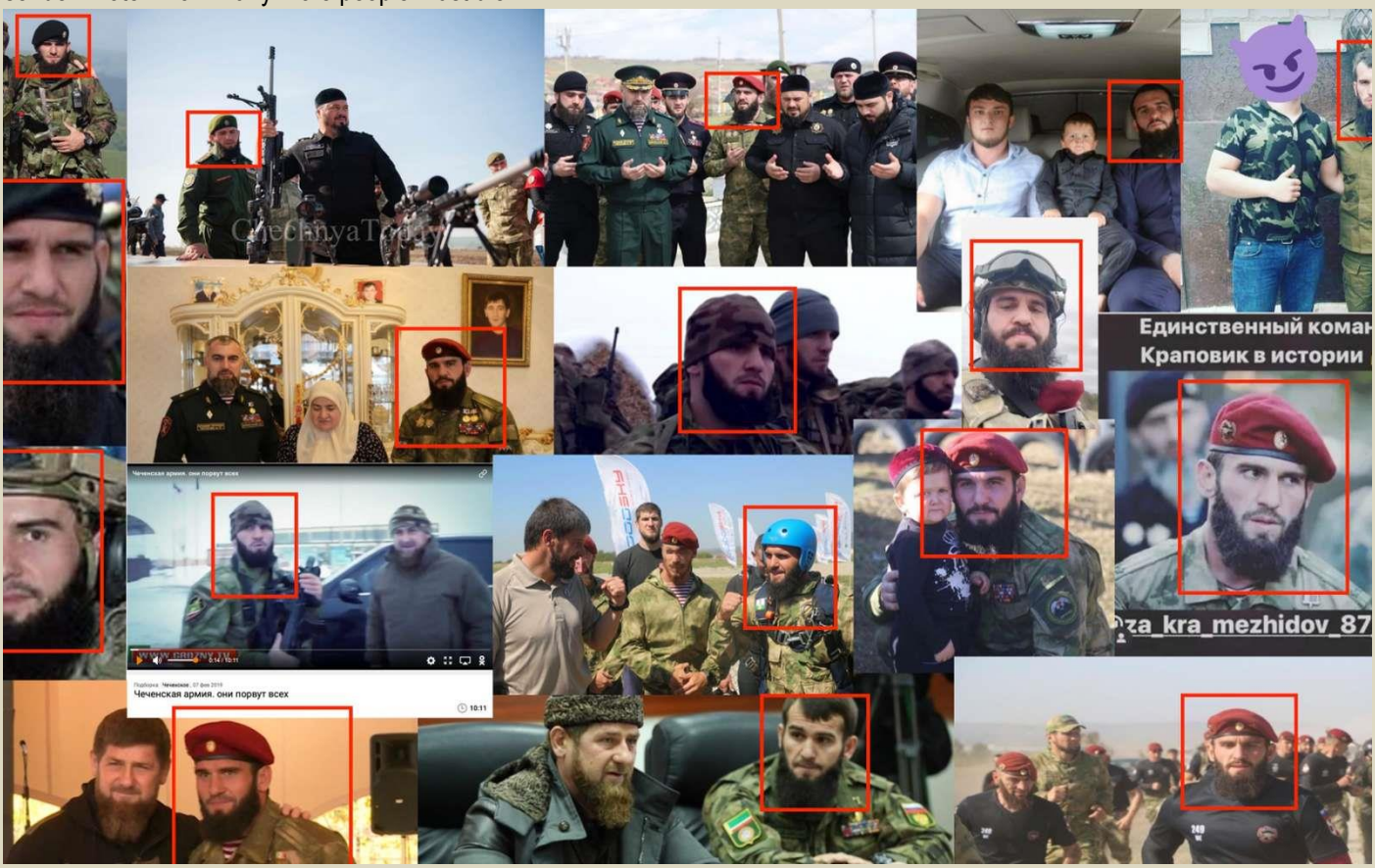
But officials' strategy of informing families of their loved ones' demise has raised concerns that it could anger the same Russians they had hoped to persuade. One national security expert said other Ukrainian actions — holding news conferences with captured Russian soldiers and posting to social media photos and videos showing prisoners of war — have been seen inside Russia not as a welcomed exposure to the truth but as a humiliation by the enemy.

A video that the IT Army posted to Telegram this month showed snippets of what the group characterized as conversations with Russian soldiers' relatives. In one chat, someone who was sent photos of a Russian soldier's bloodied face responded, "It's photoshop!!! THIS CAN'T BE." The sender wrote back, according to the footage: "This is what happens when you send people to war."

In another conversation, a stranger sent a message to a Russian mother saying her son was dead, alongside a photo showing a man's body in the dirt — face grimacing and mouth agape. The recipient responded with disbelief, saying it wasn't him, before the sender passed along another photo showing a gloved hand holding the man's military documents.

"Why are you doing this?" the recipient wrote back. "Do you want me to die? I already don't live. You must be enjoying this."

The stranger responded that young men were already dying, by the thousands. This is "the only way to stop all this madness," the sender wrote. "How many more people must die?"



The Post could not independently verify the conversations, and attempts to reach the mother were unsuccessful. But other elements of the same video show Clearview's facial recognition search interface alongside names of Russian soldiers. In one clip, the search of one corpse's face reveals the VK profile of a man photographed standing on a beach. The man's profile, which remains online, shows he followed online groups devoted to the Russian army as well as fitness, fishing and barbecue.

Beyond scanning corpses, Ukraine also is using facial recognition to identify Russian soldiers caught on camera looting Ukrainian homes and storefronts, an official with Ukraine's Digital Transformation Ministry told The Post.

Mykhailo Fedorov, the head of that ministry, this month shared on Twitter and Instagram the name, hometown and personal photo of a man he said was recorded shipping hundreds of pounds of looted clothes from a Belarus post office to his home in eastern Russia. "Our technology will find all of them," he wrote.

An official at the agency who spoke on the condition of anonymity told Clearview that it has used the system to identify people who had been detained in the country and check their social media for anything suspicious, including their "range of contacts." More than 1,000 such searches were run within the first few weeks, the official said in an email that Clearview shared with The Post.

Some analysts said Ukraine could use the advanced technology to draw a contrast with Russia's more rudimentary military equipment or to pursue humanitarian uses in a conflict marred by horrific Russian attacks.

But facial recognition search results are imperfect, and some experts worry that a misidentification could lead to the wrong person being told their child had died — or in the frenzy of war, could mean the difference between life or death. Privacy International, a digital-rights group, has called on Clearview to end its work in Ukraine, saying "the potential consequences would be too atrocious to be tolerated — such as mistaking civilians for soldiers." (Ton-That has said Clearview's search tool is accurate, including in cases of severe "facial damage.")

The U.S. military used biometric scanners to collect the fingerprints, eye scans and face photos of people during the Afghanistan war, believing it could help confirm allies and identify threats. But during the troops' rapid withdrawal last year, some of the devices were abandoned, raising fears that the sensitive data could be misused. (Clearview's online system, Ton-That said, allows the company to quickly sever access if an account falls into the wrong hands.)

Clearview has stirred international controversy for years because of the way it gathered photos for its database, harvesting massive amounts from social media companies and other Internet sites without owners' consent. The company has faced government investigations, ongoing lawsuits and demands from countries to delete their citizens' data. Members of Congress have proposed blocking federal money from going to Clearview on the basis that its images have been illegitimately obtained.

In an investor presentation first revealed in February by The Post, the company said it wanted to raise $50 million to expand its offerings to private-industry clients and boost its data-collection powers so that "almost everyone in the world will be identifiable."

Ukraine's aggressive use of Clearview searches have pushed the private company onto the front lines of a diplomatically fraught conflict — one that even the U.S. government has engaged cautiously in, for fear of triggering a global war. Hare, the researcher, said the company appeared eager to use its Ukraine work as a way to advertise itself to government clients around the world and "cash in on tragedy."

Ton-That said the company's sole ambition is to help defend a besieged country. But he also acknowledged the war has helped provide a "good example for other parts of the U.S. government to see how these use cases work."

"This is a new war," he said. And the Ukrainians are "very creative with what they've been able to do."

"We appear to have been hacked by Santa Claus."

ICI International CBRNE INSTITUTE

CBRNE-Terrorism Newsletter

C²BRNE DIARY

& Robotic

DRONE NEWS

Teledyne LVSS anti-drone system tracks up to 500 targets at once

Source [+video]: https://newatlas.com/military/teledyne-lvss-anti-drone-system-tracks-500-targets-once/

The Teledyne LVSS mounts on a Ford pickup (Teledyne)

Mar 30 – Teledyne FLIR Defense has unveiled its Lightweight Vehicle Surveillance System (LVSS) with advanced counter-unmanned aerial system capabilities. Mounted on a Ford F-250 standard truck chassis, it deploys in under a minute to counter-drone swarms.

Many people think of small drones as little quadcopters that take cool aerial videos and can really annoy people in parks, but these increasingly sophisticated machines have evolved to the point where the US Department of Defense regards them as posing new risks to military forces, no matter where they operate.

In recent years, nuisance incidents at civilian airports by irresponsible hobbyists have stepped up to deadly drone attacks in the United Arab Emirates and Saudi Arabia, and there have been reports of suicide drones being deployed against Russian forces in Ukraine.

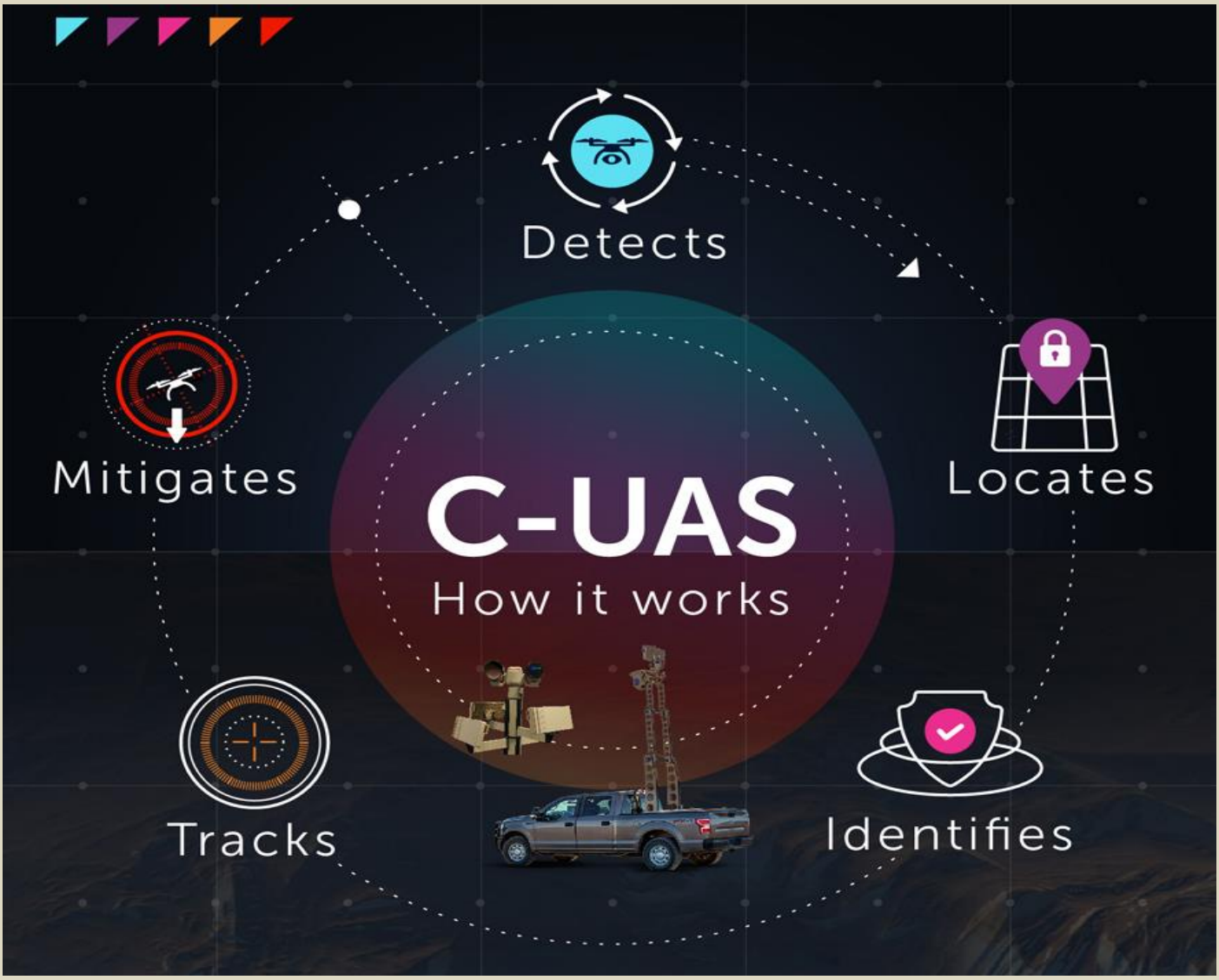
There are a number of ways of countering small drones that vary greatly in size and efficacy. Using a shotgun is one approach, but there are more practical solutions out there such as quadcopters carrying nets, net-shooting guns, aimable radio jammers that look like sci-fi ray guns, suicide drones to ram invaders, high-energy lasers, and even eagles.

The LVSS is at the high end of the spectrum, like the lasers mounted on trucks or warships. Its function isn't to deal with one or two rogue drones, but swarms that can number in the hundreds over large areas where they might be used not only as weapons, but as reconnaissance craft or smuggling platforms.

The stand-alone LVSS is designed for quick deployment and to relocate at a moment's notice. In less than a minute, it can raise its mast to a height of 16 ft (5 m) and be fully operational. On the move, it can stow its mast in 30 seconds.

Once on the job, the LVSS can cover a single section of a landscape, alternate sections, or sweep the entire hemisphere to a **range of 3 km** (1.86 miles) and a **height of 457 m** (1,500 ft). Its long-range radar and laser illuminators can track up to **500 targets in 3D** simultaneously, while its TacFLIR-380HD camera can scan in the infrared and identify not

only hostile drones, but potentially vulnerable aircraft using a combination of software, person-in-the-loop autonomy and artificial intelligence/machine learning.



Teledyne says that standing still or on the move, the LVSS can **neutralize hostile drones to a range of 1.5 km** using radiofrequency countermeasures with an output of 30 Watts. No details have been released about these countermeasures, but they are likely to involve jamming of control wavelengths, sending false control signals, spoofing navigation systems, blinding sensors, or overwhelming electronics to disable them. "Protecting vast borders, shorelines, and forward-operating bases is a job that's been made even more difficult with the challenges posed by drones," said Dr. JihFen Lei, executive vice president and general manager of Teledyne FLIR Defense. "The LVSS C-UAS combines sophisticated counter-drone technologies and counter-measures to make it the most effective mobile surveillance system available to combat these dangers.

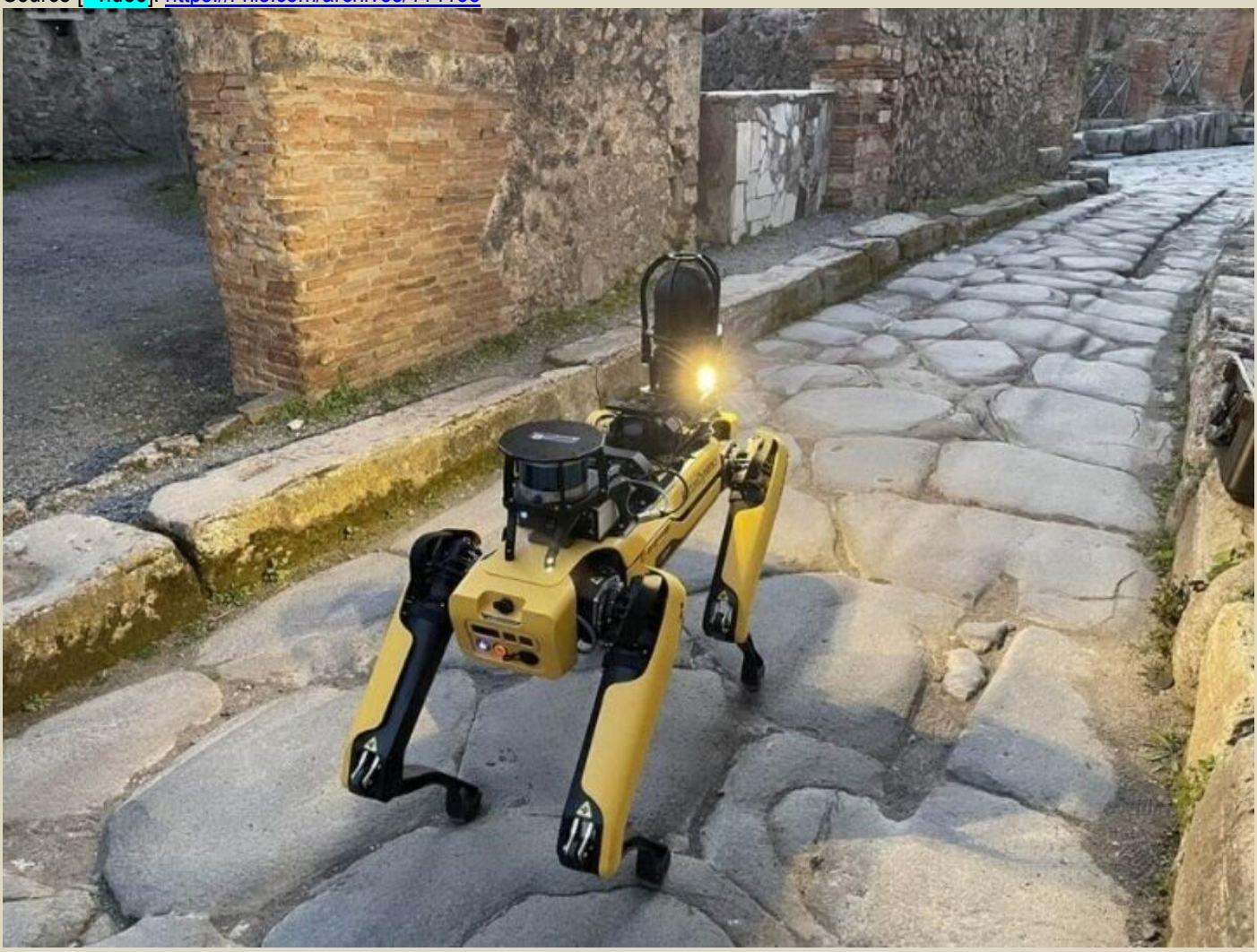
Ukrainian defenders show off improvised attack drones

Video: https://www.forces.net/ukraine/ukrainian-defenders-show-improvised-attack-drones

Apr 01 – Ukraine's success against Russia can be accredited in some part to its ability to improvise equipment. While much of Ukraine's success against Russian forces has been down to agile tactics and advanced hardware, the ability to improvise equipment is proving to be equally important. This agricultural drone has been converted to carry explosives – and is typical of the ingenuity Ukrainian defenders have been showing. Former Royal Marine and documentary-maker Emile Ghessen has been to see an **improvised drone factory near Kyiv**.

Watch Spot Travel to Pompeii

Source [+video]: https://i-hls.com/archives/114138



Apr 13 – In 79 CE ash from a volcanic eruption covered Pompeii, making it a city of ruins. Now, a robot dog named Spot coming to Pompeii's archeological site to gather information about the ancient Roman city as part of the Smart @ PPMPEI project of Pompeii's Archeological Park.

Spot, who has been at Pompeii for the first time, adapts quickly – the robot dog is specially designed to move in different types of terrain with agility and autonomy, and it is capable of reaching into tight spaces and collecting data that will help researchers in Pompeii's physical and historical preservation, according to pompeiisites.org. Researchers can enhance their knowledge of different areas on the site using this innovative technology without compromising their personal safety while improving monitoring on existing areas.

A state of emergency was declared in Pompeii in 2008 following criticisms of the site's maintenance. Several ancient structures in the area collapsed shortly thereafter. Several resources have been invested in revamping this site over the past several years for research, conservation, and maintenance purposes to turn it into a "smart archaeological site".

Pompeii's archeological site combines collaboration with the American robotics giant with an advanced system of Leica Geosystems (part of the hexagon) for 3D space scanning.

Leica's autonomous hovering laser scanner, the BLK2FLY, enabled researchers to perform many autonomous tasks and collect information in a safe environment from the air. With the help of the Robot Spot Dog and smart data analytics platforms, a wide range of vital data is being collected that will add new knowledge to the understanding of Pompeii. Although robots, artificial intelligence, and autonomous capabilities are often associated with the world of manufacturing, recent events in Pompeii have demonstrated that these new technologies can also be effective in archeological research and preservation.

US Navy shoots down drone using all-electric laser for the first time

Source: https://newatlas.com/military/us-navy-shoots-down-drone-using-all-electric-laser/

Apr 17 – The US Navy has shot down its first drone representing a subsonic cruise missile using an all-electric high-energy laser. At the US Army's High Energy Laser Systems Test Facility at the White Sands Missile Range, New Mexico, the Lockheed Martin Layered Laser Defense (LLD) weapon disabled the engine on a drone, which then parachuted to earth.

Sponsored by the US Office of Naval Research (ONR) and conducted in partnership with the Office of the Under Secretary of Defense (Research and Engineering) and Lockheed Martin, the February 2022 test was intended not only to demonstrate the ability of laser weapons to track and take out large targets like the drone in question, but also a variety of threats, such as robotic fixed-wing aerial vehicles, quadcopters, and subsonic cruise missiles.

According to the Navy, laser weapons have a number of advantages. Using a high-resolution telescope, the system can track and help identify incoming targets and determine how much damage the laser inflicts on a target. In addition, laser weapons can be scaled back to disable sensors or dazzle hostile forces without permanently blinding them.

Unlike earlier laser weapons, which were powered by chemicals, the LLD is solid-state, composed of coils of glass optical fibers doped with various elements. These coils can be bundled and the lasers they generate can be combined into a single, powerful beam and projected through optics that aim it, focus it, and compensate for atmospheric distortion.

In addition, laser weapons require no explosives or propellants, which makes them inherently safer to keep aboard ships, and it has a theoretically unlimited supply of ammunition so long as power is available, allowing for costs of about a dollar per shot.

The Navy has previously deployed laser weapons in 2014 aboard the USS Ponce in the Persian Gulf and the USS Portland in 2021 that disabled drones without shooting them down. Both were demonstrators and the Navy has no plans to field the LLD as a standard weapons system. But the latest test shows the increasing capabilities of the technology, including the use of artificial intelligence to track and target threats.

"The Navy performed similar tests during the 1980s but with chemical-based laser technologies that presented significant logistics barriers for fielding in an operational environment," said Dr. Frank Peterkin, ONR's directed energy portfolio manager. "And, ultimately, those types of lasers did not transition to the fleet or any other service."

"Iron Beam" laser weapon counters multiple targets in live fire tests

Source: https://newatlas.com/military/israel-iron-beam-laser-weapon-counters-multiple-targets-live-fire-tests/

Iron Beam firing (Rafael)

Apr 18 – Rafael has successfully tested its Iron Beam laser weapon in various scenarios against steep-track threats, including UAVs, mortars, rockets, and anti-tank missiles. The weapon is set to complement Israel's famous Iron Dome aerial defense system

With its ability to intercept incoming missiles using anti-missiles guided by a sophisticated radar tracking system, Iron Dome has chalked up a remarkable success rate in recent Middle Eastern conflicts. But it has a number of drawbacks. The missiles that are the heart of the system cost over US$100,000 per shot and it has trouble with incoming threats at close ranges under 4 km (2.5 miles). In contrast, Iron Beam is an optical fiber laser that can lock onto targets at the speed of light and destroy them within five seconds at a range of up to 7 km (4.3 miles). How powerful the laser is hasn't been released, but it's projected to soon be in the range of hundreds of kilowatts. In addition, each laser round costs about a dollar a shot, not counting hardware costs, and the ammunition is unlimited as long as electricity is available.

The Iron Beam laser weapon (Rafael)

The recent tests are part of the first phase of a program extending over several years by Rafael, other private companies and the Israeli Ministry of Defense's Directorate of Defense Research and Development (DDR&D) to produce high-energy lasers that can be ground- or air-based and are capable of handling multiple threats in conjunction with Iron Dome. "The completion of these innovative tests using a high-power laser is just the beginning of our vision," said Head of R&D at (DDR&D) Brigadier General Yaniv Rotem. "This is the first time we've succeeded in intercepting mortars, rockets, and UAVs from such challenging ranges and time intervals. The laser is a game-changer thanks to its easily operated system and significant economic advantages. The next step is to continue the development and initial system deployment within Israel. Our plan is to station multiple laser transmitters along Israel's borders throughout the next decade. We will continue to simultaneously develop advanced capabilities, including the aerial laser."

Israel's Laser Defense Programs

Source: https://blogs.timesofisrael.com/iron-beam-iron-dome-and-laser-defense/

Nautilus

The Nautilus Tactical High Energy Laser (THEL) , a US-IL collaboration, was started in 1995

and cancelled by 2006. The system shot down 28 Katyusha rockets and several artillery shells in tests, but was a chemical laser suffering from high costs, sensitivity to atmospheric conditions, and questionable portability.

Keren Barzel

Iron Beam (בַּרְזֶל קֶרֶן, keren barzel) was unveiled at an airshow in 2014 and deployed in August 2020. It is based on a fiber laser packing 'tens of kilowatts' of power, and is designed to destroy short-range rockets, artillery, drones, and mortars, with a range of up to 7 km (which is too close for the Iron Dome system to intercept).

The system is developed by Rafael, funded by the MoD, and extensively underwritten by the United States. An Iron Beam battery is mobile and composed of an air defense radar, a command and control (C2) unit, and two HEL (High Energy Laser) systems.

Light Saber

The "Lahav Or" (Light Saber) is a laser system designed to intercept airborne incendiary threats (e.g. balloons and drones) launched from the Gaza Strip, and is deployed operationally by the Border Police.

According to available details, the system has an effective range of 2 kilometers (1.2 miles), day or night. The system uses a relatively low-power 'eye-safe' laser capable of incinerating a balloon or a kite.

International Approval Shapes Public Perceptions of Drone Warfare

By Jim Hanchett

Source: https://www.homelandsecuritynewswire.com/dr20220419-international-approval-shapes-public-perceptions-of-drone-warfare

Apr 19 – Armed drone strikes earn more public support and legitimacy when they have international approval from organizations such as the United Nations, according to a survey conducted by a team of Cornell researchers.

Drones that carry weapons are increasingly employed as counterterrorism tools, but nations use and constrain strikes differently. **France, for example, submits its strikes to the U.N. for approval; the U.S. typically does not.**

This difference matters when it comes to public support and perceptions of legitimacy, according to doctoral students Paul Lushenko and Shyam Raman, and Sarah Kreps, the John L. Wetherill Professor of Government in the College of Arts and Sciences and a professor in the Cornell Jeb E. Brooks School of Public Policy.

The researchers cite as examples two drone strikes in 2021. France used a drone to kill Adnan al-Sahrawi, the Islamic State's leader in western Africa. Soon after, the U.S. used drones to kill two al-Qaida leaders in Syria.

While the weapons were similar, the approaches were not. France went to the U.N. in advance to secure backing; the U.S. acted unilaterally.

To find out which approach has greater public support and legitimacy, the researchers conducted a survey of a representative sample of 1,800 respondents in France and the U.S. The results were statistically significant and showed greater cross-national support and legitimacy when drone strikes had international approval and were perceived to comply with international law.

Respondents' homeland did play a factor, however. French respondents found any unilateral strike by their country or another to be less legitimate. Americans perceived unilateral strikes by their own country as more legitimate and more worthy of support. Together, these results suggest Americans and French citizens endorse unique patterns of drone warfare.

The researchers show that the "French model" of drone warfare is based partly on international authorization, which is the case for French counterterrorism strikes in western Africa.

"Despite the proliferation of armed drones globally, we lack an understanding of public attitudes for strikes, especially in a cross-national context," Lushenko said. "Our research shows that the public's perceptions for legitimate strikes are not merely a function of the target. The perceived legitimacy of strikes can be shaped by who uses drones and how they are constrained, suggesting that international authorization through the U.N. has important implications in the battle for public opinion."

Lushenko is a Ph.D. candidate in the field of international relations, and a General Andrew Jackson Goodpaster Scholar. Raman is a PhD student in the field of policy analysis and management. An article about their research, "Multilateralism and Public Support for Drone Strikes," was published in the April edition of Research and Politics.

Jim Hanchett is assistant dean of communications in the Cornell Jeb E. Brooks School of Public Policy.

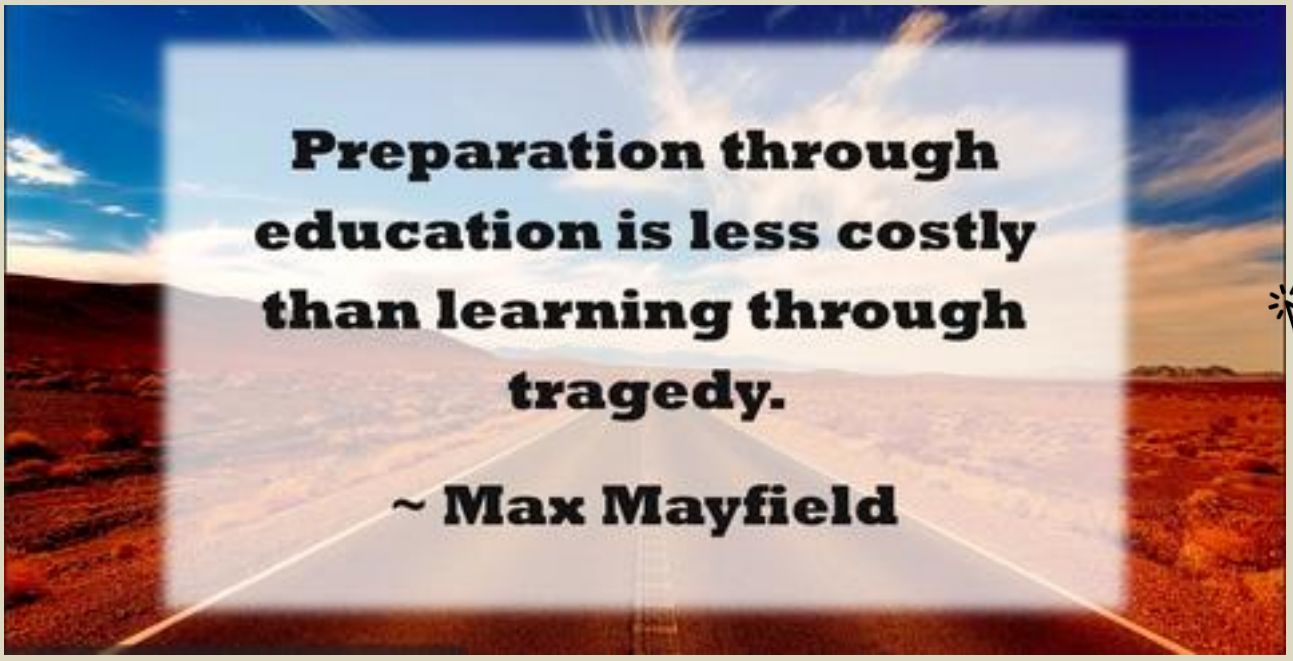
EDITOR'S COMMENT: Strange tactic! What if the UN says "no"? Should the requesting nation say "please"?


International
CBRNE
INSTITUTE
C2BRNE
DIARY
CBRNE-Terrorism
Newsletter
W
M
O
D
EMERGENCY
RESPONSE

Domestic Preparedness in a Post-COVID-19 World

By Nathan DiPillo

Traditional definitions of domestic preparedness have been influenced by the Cold War and international terrorism. As the 20-year milestone of the 9/11 attack on the United States passed, domestic terrorism also has made its mark on the interpretation of domestic preparedness. It is time for a fresh look, considering pandemics, local human-caused and natural catastrophes, reoccurring threats (like wildfires, earthquakes, and cyberattacks), and crumbling domestic infrastructure. The landscape of emergency response actions and readiness of public and private agencies in a globally interconnected world has left a deep scar on domestic preparedness and how risk is evaluated both nationally and internationally.



Because international CBRNE First Responders need a common roof!

https://www.ici-belgium.be/