Episode Book

EPISODE #5649

Who Actually Controls Europe's B61 Bombs?

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SYNOPSIS

Daniel asked a simple question: if the US puts nuclear weapons in other countries, doesn't that take enormous trust? The answer is that the arrangement is deliberately built so it doesn't. This episode walks through the physics package — why the actual nuclear core is the size of a softball while the warhead around it is the size of a person — then the numbers, where SIPRI counts roughly 12,241 warheads across nine states and two respected organizations disagree by 1,500. From there it's the part almost nobody knows: 125 to 130 US B61 bombs sit in Belgium, Germany, Italy, the Netherlands, Turkey, and the UK under NATO nuclear sharing, guarded by US Munitions Support Squadrons, stored in vaults built into aircraft shelter floors, and secured by Permissive Action Links whose original threat model explicitly included the host allies themselves.

TRANSCRIPT



Corn

What if the most dangerous object in Europe is guarded by something that looks like a calculator you'd buy at RadioShack?



Herman

That's... a very specific question, Corn.



Corn

It's where Daniel's prompt ends up. Here's what he wrote in this week. A few episodes back he asked what a nuclear warhead actually looks like, thinking it was an obscure question, and it turns out there's a whole genre of YouTube material on it. Maintenance convoys, the physics package, all of it. And the thing that surprised him most is that the part that actually triggers the explosion is tiny. Then he says his second wrong assumption was the numbers. He'd guessed each nuclear state keeps a few of these in a highly secure facility. Turns out there are a lot more. And then the third thing he stumbled onto, which is the one he really wants us to dig into, is that the US distributes its arsenal across allied states. He says it makes abundant sense to push the envelope of deterrence out geographically, but it seems like it would require enormous trust. You're putting nuclear weapons in another country and hoping they use them responsibly.



Herman

Or at least adhere to your mutual understanding.



Corn

Right. So his actual questions are: how does this whole enterprise work exactly, and among the confirmed nuclear powers, how many of them choose this distributed architecture?



Herman

Three misconceptions, and the third one has the best answer.



Corn

Let's start with the warhead. Why is the physics package small, and why is the warhead not?



Herman

The physics package is the nuclear explosive package. That's the primary and the secondary, the actual assembly that produces the explosion. Everything else in a warhead is engineering built around it. The primary is a fission trigger, typically boosted fission, and the secondary is the fusion stage. Radiation from the primary's detonation is contained and used to compress and ignite the secondary. That's the Teller-Ulam staged radiation implosion design, and it's been the basic architecture since the early fifties.



Corn

So the primary is a bomb that exists to light a bigger bomb.



Herman

That's exactly what it is. And the package itself sits inside a uranium-238 reflector casing, with polystyrene foam around it. That's the structure. The nuclear part is small. The non-nuclear part is what makes it look like a warhead.



Corn

Give me the number that makes it land.



Herman

Fat Man's plutonium pit was nine point one centimeters in diameter. Three point six inches. The size of a softball. The bulk of Fat Man's girth was the implosion mechanism, concentric layers of uranium-238, aluminium, and high explosives. The nuclear core was the small thing in the middle.



Corn

Everyone pictures the bomb as the bomb. It's actually the packaging.



Herman

The W54 warhead, used in the Davy Crockett recoilless rifle, was twenty-eight centimeters across. Eleven inches. Put that next to Fat Man at a hundred and fifty centimeters and the shrink is the whole story of the second half of the twentieth century. The smallest nuclear weapon ever deployed was the W48 artillery shell.



Corn

An artillery shell.



Herman

The Swan device, which was the first two-point hollow-pit fusion-boosted implosion design and the prototype for basically everything that followed, was twenty-nine centimeters in diameter and fifty-eight centimeters long.



Corn

So the core is a softball, and the shell around it is the size of a person.



Herman

Modern pits contain three and a half to four and a half kilograms of plutonium and yield five to ten kilotons. That's fission of roughly half a kilogram of plutonium. Half a kilogram doing that much work.



Corn

That's the part that should be unsettling and somehow isn't, because we've all seen the diagrams.



Herman

The diagrams make it look like a machine. It is a machine. That's the point. The physics is small and the engineering is large.



Corn

But hold on. If the physics package is that small, why is a modern warhead still so heavy? Why can't you just put a softball in a suitcase?



Herman

You can, and people have worried about exactly that. But the casing isn't padding. It's the reflector, the radiation channel, the neutron initiator housing, the arming and fuzing electronics, the environmental control system, the reentry vehicle. A reentry vehicle has to survive atmospheric reentry at thousands of degrees. It has to arm at the right altitude. It has to not arm at the wrong altitude. Every one of those functions adds mass and volume, and none of them are the explosion.



Corn

So the bomb is the easy part and the delivery is the hard part.



Herman

The bomb was solved in the forties. The delivery problem is what kept engineers employed for seventy years.



Corn

Which is a nice segue, because the delivery problem is exactly where the numbers come in.



Herman

At the start of last year, nine states possessed approximately twelve thousand two hundred and forty-one nuclear weapons. Nine thousand six hundred and fourteen in military stockpiles. Three thousand nine hundred and twelve deployed with operational



Herman (continued)

forces. And about two thousand one hundred of those on high operational alert on ballistic missiles.



Corn

Say the first number again.



Herman

Twelve thousand two hundred and forty-one.



Corn

Daniel guessed a few.



Herman

The nine are the US, Russia, the UK, France, China, India, Pakistan, North Korea, and Israel. The US and Russia together hold almost ninety percent of all warheads.



Corn

Break it down.



Herman

Russia around five thousand four hundred and fifty-nine. US around five thousand one hundred and seventy-seven. China around six hundred. France two hundred and ninety. UK two hundred and twenty-five. India one hundred and eighty. Pakistan one hundred and seventy. Israel ninety. North Korea fifty.



Corn

And that's where it gets interesting, because those numbers are contested.



Herman

The Federation of American Scientists estimates the US stockpile at around three thousand seven hundred and Russia at around four thousand three hundred and nine. That's not a rounding difference. That's a disagreement about what counts and what's knowable.



Corn

How do two organizations with good access disagree by fifteen hundred warheads?



Herman

Different definitions of stockpile, different assumptions about dismantlement rates, different treatment of weapons awaiting disassembly. And Russia doesn't publish. Nobody really publishes. The numbers are estimates built from treaty data, satellite imagery, and history.



Corn

So the honest answer to how many warheads exist is a range.



Herman

With a decent center of mass. SIPRI's twelve thousand is the best public figure. It's just not a fact in the way people want it to be.



Corn

What about the trend?



Herman

The overall number is declining, because the US and Russia are dismantling retired warheads. But SIPRI warns the dismantlement rate is slowing and will soon be outpaced by the rate at which new warheads enter global stockpiles. Their line is that the era of reductions since the end of the Cold War is coming to an end.



Corn

So the curve is flattening and about to turn.



Herman

China is the one to watch. SIPRI's director said China could reach a thousand warheads in seven or eight years. They're at six hundred now.



Corn

That's a build, not a modernization.



Herman

It's both. They're replacing older systems and adding new ones, and the silo fields in the west suggest the ceiling is higher than the current number.



Corn

And the silo fields are visible from space, which is the weird part. You can watch a country build a nuclear arsenal on Google Earth.



Herman

You can watch the construction. You can't watch what goes in them. That gap between what's observable and what's knowable is the entire discipline of nuclear estimation.



Corn

Okay. Now the third misconception, which is the one Daniel actually cares about. Nuclear weapons stay home.



Herman

The US stations nuclear weapons in Belgium, Germany, Italy, the Netherlands, Turkey, and the United Kingdom. As of last year, a hundred and twenty-five to a hundred and thirty tactical B61 bombs are believed deployed in Europe under nuclear sharing.



Corn

Give me the base-by-base.



Herman

Belgium, Kleine Brogel, ten to fifteen. Germany, Büchel, ten to fifteen. Italy, Aviano twenty to thirty and Ghedi ten to fifteen. Netherlands, Volkel, ten to fifteen. Turkey, Incirlik, twenty to thirty. UK, Lakenheath, twenty-five to thirty.



Corn

Lakenheath is the new one.



Herman

In July of last year, experts concluded twenty-five to thirty US nuclear weapons had been redeployed to RAF Lakenheath for the first time since two thousand eight. The evidence was telemetry from a Boeing C-17 flight on the fifteenth of July from New Mexico to the UK.



Corn

Telemetry.



Herman

People track the flights. That's how open source works now. And then in October, the Federation of American Scientists put out a report arguing the weapons may not actually be present yet, because the base might need security upgrades until twenty thirty-one.



Corn

So the experts disagree about whether the bombs are there.



Herman

That's a live disagreement. One camp says the flight pattern is conclusive. The other says the infrastructure isn't ready.



Corn

Which tells you something about how much of this is inference.



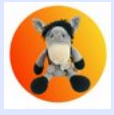
Herman

Almost all of it. Nobody announces this.



Corn

So walk me through the inference. How do you get from a C-17 flight to "there are nuclear weapons at Lakenheath"?



Herman

You look at the aircraft, the route, the timing, the historical pattern of similar flights, the base's known storage infrastructure, and the political context. No single piece is conclusive. The combination is persuasive to some analysts and not to others.



Corn

And that's the same method that produces the warhead counts.



Herman

It's the same method all the way down. You're always reasoning from traces.



Corn

Why does the US do it at all?



Herman

NATO's own framing is that nuclear sharing ensures the benefits, responsibilities, and risks of nuclear deterrence are shared across the alliance. That's the official line. A scholar at Leiden, Linde Desmaele, argues the weapons are primarily tools of alliance management, serving three purposes. Deflection, which is a low-cost way for allies to maintain alliance standing. Legitimation, which unifies allies against joining the Treaty on the Prohibition of Nuclear Weapons. And consultation, which gives non-nuclear allies insight and influence over US policy and anchors the US to Europe.



Corn

So the bombs are the excuse for the conversation.



Herman

The bombs are the price of admission to the conversation. That's the argument.



Corn

Now the mechanism, because this is where Daniel's trust question actually gets answered. The US doesn't hand over the weapons.



Herman

The weapons remain under US custody and control in peacetime. They're guarded by US Air Force personnel, Munitions Support Squadrons, stored in WS3 vaults inside hardened aircraft shelters.



Corn

WS3.



Herman

Weapons Storage and Security System. Vaults built into the floor of the shelter. The aircraft parks over them.



Corn

And the locks.



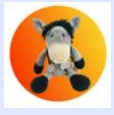
Herman

Permissive Action Links. PALs. Electronic locks and codes that prevent unauthorized arming or detonation. The US developed and installed them in Europe starting in the early sixties.



Corn

What was the threat model?



Herman

Steven Bellovin gave a talk on this at USENIX in two thousand six. The original motivation was preventing unauthorized use by enemy countries, terrorists, rogue or pressured US troops, and our allies.



Corn

Our allies is in the list. That's the answer to Daniel's question, isn't it. He says it seems like it would involve a huge amount of trust. It doesn't. It's engineered to not require trust.



Herman

That's the crux. This is called non-substantive nuclear sharing, because operational control is never transferred. The host nation can't detonate the weapon unilaterally. They can't arm it. They can't do anything with it without the codes.



Corn

And before PALs?



Herman

Before PALs, the US used what's called substantive sharing. The dual-key Thor IRBM in the UK under Project Emily. An RAF officer's key began the launch sequence and a USAF officer's key armed the warhead. And there was no real protection from British seizure of the American key.



Corn

Two keys, one of which could just be taken.



Herman

Eisenhower reportedly wanted to give allies de facto control while retaining titular possession only. Which is a sentence that should keep people up at night.



Corn

So the sixties were more dangerous than now.



Herman

In this specific respect, yes. The locks got better.



Corn

What happens in wartime?



Herman

Host-nation Dual-Capable Aircraft would deliver the bombs. F-16s, Tornados, transitioning to F-35As. Use is claimed to require authorization from the NATO Nuclear Planning Group and the US president. Reportedly the UK prime minister as well for Lakenheath.



Corn

Claimed.



Herman

Claimed. The procedures aren't public. And the NPT compatibility question is worth noting, because the US and USSR negotiated the wording of Articles One and Two in October nineteen sixty-six specifically to make nuclear sharing compatible with the treaty. The claim that these arrangements were secret has been thoroughly debunked.



Corn

So the whole thing is legal, public, and locked.



Herman

Legal, public, and locked.



Corn

Which brings us to Daniel's last question. Among the confirmed nuclear powers, how many choose the distributed architecture?



Herman

Two.



Corn

Two.



Herman

The United States and Russia. Of NATO's three nuclear powers, the US, the UK, and France, only the US provides weapons for sharing.



Corn

France has floated it.



Herman

In March of last year, Macron said France would consider extending its nuclear deterrent to other European states. But both Macron and his defence minister stressed France retains ultimate control, and explicitly denied this amounted to nuclear sharing. Germany's Friedrich Merz said European weapons could only supplement the US arrangement.



Corn

So France wants the conversation without the architecture.



Herman

They want the strategic effect without the custody problem. Which is a very French solution.



Corn

And the UK?



Herman

Historically deployed, stationed, and tested weapons on West German, Singaporean, and Cypriot territory. Does not currently share.



Corn

So Russia is the other one. Belarus.



Herman

After the February twenty twenty-two referendum removed Belarus's neutrality, Putin announced the first warhead delivery on the sixteenth of June twenty twenty-three. Russia supplied nuclear-capable Iskander-M missiles with warheads of variable yield, five to fifty kilotons, and modified Belarusian Su-25 aircraft for bombs of twenty kilotons or less.



Corn

And are the warheads actually there?



Herman

As of last year, there's no conclusive open-source evidence warheads are actually stored in Belarus. Lukashenko claimed in December twenty twenty-four that Belarus hosts dozens. Putin emphasized Russian control is maintained. A CIS official described it as a double nuclear button.



Corn

A double nuclear button.



Herman

That's the phrase.



Corn

Which is the same architecture as the US model, just with worse public relations.



Herman

Same logic. Different branding.



Corn

And the speculative one.



Herman

Pakistan and Saudi Arabia. A BBC Newsnight report in twenty thirteen, and Western officials, claimed Saudi Arabia could obtain Pakistani warheads at will. Gary Samore said the Saudis believe they have some understanding with Pakistan that, in extremis, they would have claim to acquire nuclear weapons. CSIS called the BBC report partially incorrect and unverified. And then on the seventeenth of September last year, Pakistan and Saudi Arabia signed a Strategic Mutual Defence Agreement. An attack on one is treated as an attack on both. A senior Saudi official said it encompasses all military means.



Corn

Which is not the same as a nuclear umbrella.



Herman

It's not the same. It's the kind of language that fuels the speculation without confirming it.



Corn

So the answer to Daniel is two, and possibly more soon.



Herman

The model is being copied. Russia's Belarus deployment, France's deterrent-extension debate, Poland's aspirations, the Pakistan-Saudi pact. The distributed architecture is spreading even as arms control erodes.



Corn

Which is the opposite of what most people assume. Everyone thinks the trend is toward fewer weapons in fewer places.



Herman

The warhead count is declining. The number of countries hosting someone else's warheads is not.



Corn

There's a detail I keep coming back to. The PAL.



Herman

The lock.



Corn

The most dangerous object in Europe is secured by an electronic lock and a wire seal, and the original threat model included the host nation. That's the whole trust paradox in one device. You don't trust your ally, so you build a lock. And then you station the weapon on their soil anyway, because the alliance needs it there.



Herman

And the lock is the trust.



Corn

The lock is the trust. Which is a strange sentence but I think it's true.



Hilbert

The vaults smell like hydraulic fluid and something metallic, and they keep them at eighteen degrees year-round.



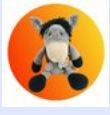
Corn

You've been in one.



Hilbert

I maintained the environmental control systems. Civilian contractor, US airbase in Europe. I was young, I was an electrical engineer, and my job was the air handling in the WS3 vaults. Nobody ever told me what was in them. Everybody knew.



Herman

What was the eighteen degrees for?



Hilbert

That's what the spec said. Temperature and humidity both held tight. The equipment didn't care what it was cooling. It cared that it stayed at eighteen.



Corn

Did you ever see the weapons?



Hilbert

Once, during a maintenance drill, I saw a PAL up close. Small black box, keypad, a wire seal on the side. It looked like something you'd buy at RadioShack. That's the thing I remember. Not the bomb. The lock that looked like a calculator.



Herman

Bellovin's point exactly. The device is mundane by design.



Hilbert

The guards had a motto. Munitions Support Squadron. We own it, you don't.



Corn

That's not a motto, that's a policy statement.



Hilbert

It was on a sign.



Corn

So the trust paradox, as we've been calling it, is a sign on a wall and a black box with a keypad.



Hilbert

And a smell. Hydraulic fluid and something metallic. I still notice it in garages sometimes.



Herman

The interesting part is that the mundane detail is the security. If the lock looked like a nuclear safety device, it would be a target. If it looks like a calculator, it's just equipment.



Hilbert

Nobody photographs equipment.



Corn

That's the whole doctrine in five words.



Herman

Which connects to something we said earlier about the numbers. The reason the estimates disagree is the same reason the lock looks like a calculator. The system is designed so that the interesting parts don't announce themselves.



Corn

And the eighteen degrees.



Herman

The eighteen degrees is the part that stays with me. Somebody wrote a spec, and somebody else maintains it, and that's the actual security posture. Not the doctrine. The spec.



Corn

So the cutting-room floor. The thing we didn't get to.



Herman

The Ivy Mike test, the first two-stage thermonuclear, was ten point four megatons on the first of November nineteen fifty-two. And Castle Bravo came in at two and a half times its predicted yield because of lithium-7, which nobody had accounted for. The physicists were wrong about their own bomb by a factor of two and a half.



Corn

That's the part that should worry people more than the locks.



Herman

It's the part that explains why the locks exist.



Corn

Here's the forward-looking thought, then. Daniel asked how many nuclear powers choose the distributed architecture, and the answer today is two. But the model is being copied, and the thing that makes it work isn't trust. It's a lock that looks like a calculator and a temperature spec that somebody maintains. If the technology fails, or the political situation changes, or the person whose job it is to hold eighteen degrees stops showing up, the architecture doesn't degrade gracefully. It just becomes what it always was. Nuclear weapons in someone else's country.



Herman

The lock is the trust. Until it isn't.



Corn

That's the episode. Thanks to Hilbert Flumingtop, our producer, who apparently has been in a vault.



Herman

He has been in a vault.



Corn

This has been My Weird Prompts. If you found this interesting, rate and review the show. It helps other listeners find us.



Herman

We'll be back soon.



Corn

See you tomorrow.