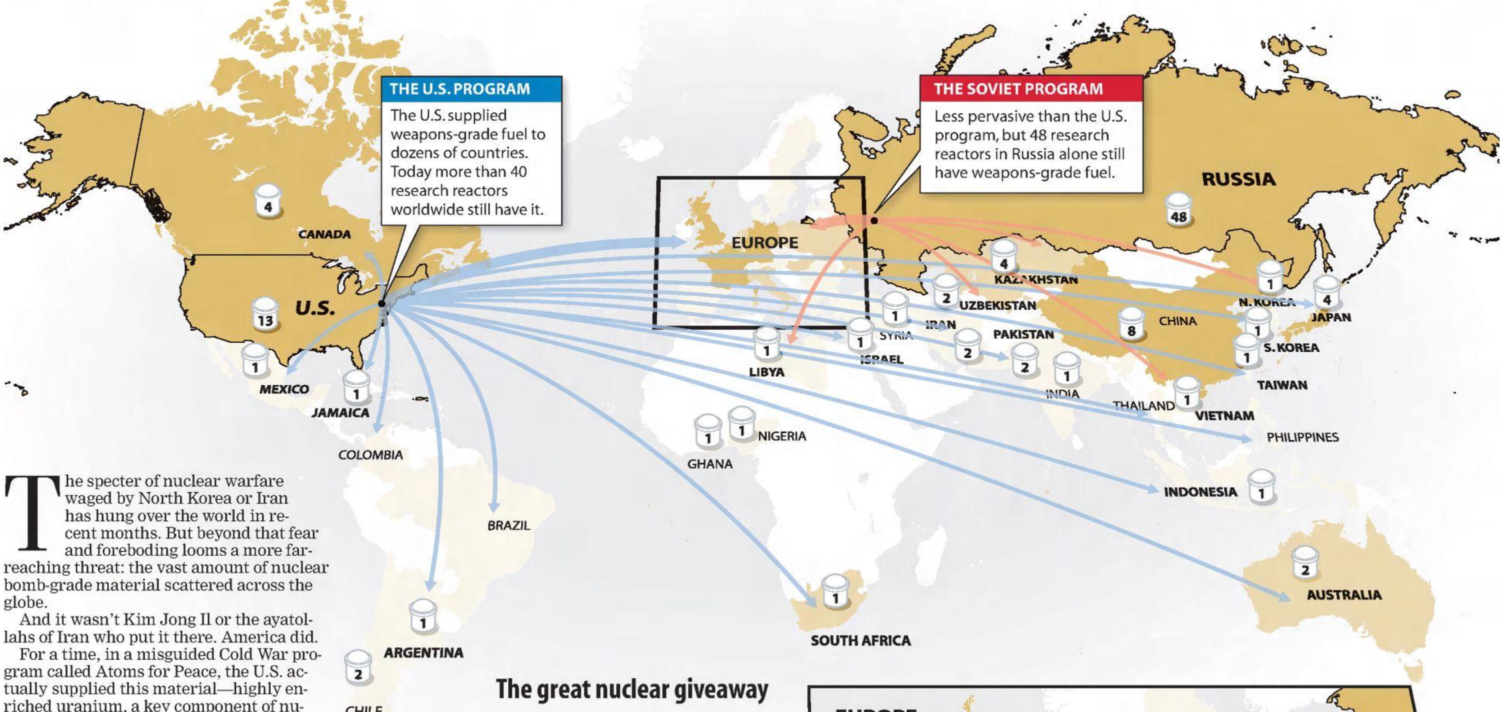
A TRIBUNE INVESTIGATION: How America gave away bomb-grade uranium and failed to get it back

Nuclear menace made in U.S.



The specter of nuclear warfare waged by North Korea or Iran has hung over the world in recent months. But beyond that fear and foreboding looms a more far-reaching threat: the vast amount of nuclear bomb-grade material scattered across the globe.

And it wasn't Kim Jong Il or the ayatollahs of Iran who put it there. America did.

For a time, in a misguided Cold War program called Atoms for Peace, the U.S. actually supplied this material—highly enriched uranium, a key component of nuclear weapons. The Soviets followed suit.

The threat still posed by these stockpiles, particularly in the wake of the Sept. 11 terrorist attacks, is so dire that the keepers of the Doomsday Clock cited the issue as among their chief concerns this month when they moved the iconic measure of global security closer to midnight.

Just last week, Georgian authorities disclosed they had caught a Russian man trying to sell uranium he had hidden in two plastic bags in his pocket—an unsettling reminder of how easy it is to smuggle this dangerous material.

Yet decades of fitful commitment by the U.S. government to retrieve bomb-grade uranium have left the world no safer, a Tribune investigation has found. Today, roughly 40 tons of the material remains out of U.S. control—enough to make more than 1,400 nuclear weapons.

For a quarter-century, as the U.S. struggled to persuade friends and enemies alike to return the uranium in exchange for safer material, a physicist at Argonne National Laboratory outside Chicago led the effort.

His undertaking, one that spanned six continents, mirrors America's troubled quest to reverse a mistaken policy that imperils the world to this day.

STORY BY TRIBUNE STAFF REPORTER SAM ROE
BEGINS ON PAGE 24

The great nuclear giveaway

CURRENT OR PAST SUPPLIER OF ***HIGHLY ENRICHED URANIUM (HEU)***

U.S. — U.S.S.R./Russia

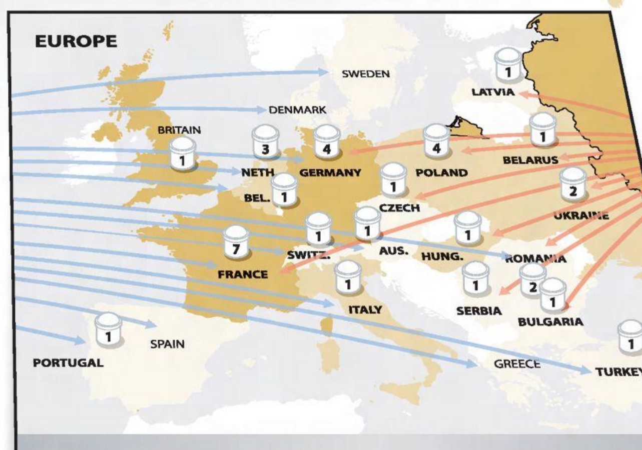
CURRENT AMOUNT OF NON-MILITARY ***HEU***

(Building a nuclear bomb would require at least 25 kilograms, or 55 pounds.)

- Less than 100 kg (1 kg=2.2 pounds)
- 100-1,000 kg
- More than 1,000 kg

NUMBER OF RESEARCH REACTORS WITH ***HEU:***

141 At least 141 civilian research reactors worldwide use highly enriched uranium or have it stored on site. Of the 45 countries with such reactors, 38 got HEU from the U.S. or Soviet Union. Britain, China and France also have supplied countries with reactors and HEU.



Sources: International Panel on Fissile Materials, U.S. Department of Energy, International Atomic Energy Agency, Tribune reporting

Chicago Tribune / Adam Zoll and Steve Layton

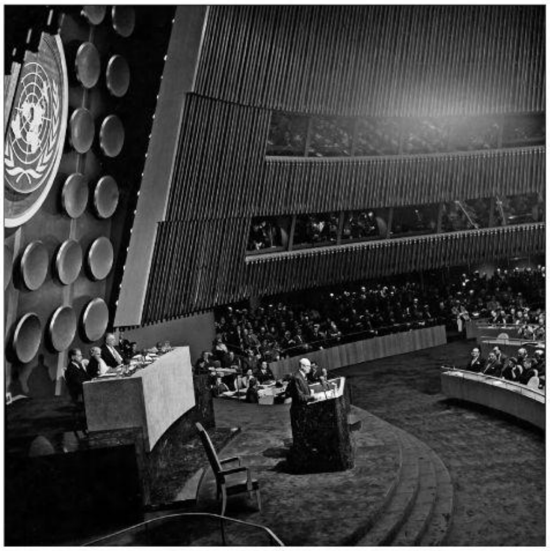
A TRIBUNE INVESTIGATION

Cold War's deadly legacy

Atoms for Peace left bomb-grade fuel in reactors across the globe

First of two parts

By Sam Roe
Tribune staff reporter



UN photo

President Dwight Eisenhower, addressing the UN General Assembly in 1953, unveils the Atoms for Peace program, in which the U.S. shared nuclear technology and material with other nations.

Photo courtesy of Armando Travelli

In the early 1950s, Armando Travelli joins his parents at the Fontana delle Naiadi in Rome. Young Travelli envisioned that someday even his local fountain would be powered by the atom.

The urgent call reached Armando Travelli in Vienna.

Get to Romania as soon as you can, the voice on the phone told Travelli, an Argonne scientist-turned-diplomat. Dictator Nicolae Ceausescu is considering returning the bomb-grade uranium America had given him.

Within days, Travelli stepped inside a sprawling nuclear research reactor in the southern Romanian city of Pitesti. There he saw firsthand the chilling consequences of using highly enriched uranium to cement alliances with backwater dictators.

He watched as one worker reached into a pipe and nonchalantly pulled out a spaghetti-like jumble of electrical wires. Later, he learned that other workers had wedged a hunk of wood between two uranium-filled rods to keep them from jostling in the reactor pool. The makeshift repair backfired when the wood swelled and couldn't be removed.

But Travelli, who shuttled back and forth to the facility from Chicago for several years in the 1980s, didn't know the worst of it. When his mission bogged down, Romania secretly used the reactor and the enriched uranium to help separate plutonium—the first step in building an atomic bomb.

Ceausescu has long since faced a firing squad, and his successors disclosed the secret effort. But a quarter-century after Travelli's first visit to the reactor, some of the dangerous material remains there.

Romania is but one example in a world that reverberates from the fallout of the United States' Cold War folly known as Atoms for Peace, a program that distributed highly enriched uranium around the world.

That uranium was intended solely to be used as fuel in civilian research reactors. But it is potent enough to make nuclear bombs and can be found everywhere from Romania, now a crossroads for nuclear smuggling, to an Iranian research reactor at the center of that nation's controversial nuclear program.

Three dozen other nations also obtained highly enriched uranium from the U.S. Then in 1974, India set off its first nuclear weapon, and America scrambled to get the bomb fuel back—an effort led by Travelli out of Argonne National Laboratory near southwest suburban Lemont.

The attacks of Sept. 11, 2001, gave the mission a new sense of urgency: For terrorists or rogue nations, highly enriched uranium is by far the easiest way to build a nuclear bomb. Only 55 pounds are required. Double that and terrorists would need only limited technical skill to slam two pieces together to start a chain reaction—the same technique used in the bomb dropped on Hiroshima.

Even since 9/11, though, the worldwide mission to retrieve this uranium repeatedly has fallen short. Now, through exclusive access to the government archive chronicling the effort, the complete story behind that failure can be pieced together for the first time.

When Travelli embarked on his quest in 1978, he thought it could be accomplished with relative ease, taking maybe five years. He was wrong.

Atomic age breeds hope

In the middle of Rome sits one of the city's most famous fountains: the marble and bronze Fontana delle Naiadi, depicting four nymphs riding a swan, snake, horse and dragon.

During the waning days of World War II, when Armando Travelli was just a boy, he and his mother would stop at the fountain on their way home from church or while walking in the neighborhood.

"I wish you could see it with the electricity on," he recalled her telling him. "It is so beautiful with lights and the water running."

"What's electricity?" he had asked. With the war on, he had known only candles.

When the conflict ended after the U.S. dropped two atom bombs on Japan, Travelli became part of the nuclear generation that grew to fear atomic energy but also marvel at its power. U.S. officials predicted nuclear bombs would blast holes for harbors, and electricity would be so cheap it wouldn't be metered. Travelli envisioned cars, boats—even his neighborhood fountain—powered by the atom.

Such dreams were energized by a bold new American experiment called Atoms for Peace. Unveiled by President Dwight Eisenhower in 1953, the program promised to share some U.S. nuclear technology with foreign nations that vowed to forgo atomic weapons.

"It was the grand bargain," said Ellie Busick, who helped oversee non-proliferation efforts at the State Department in the 1980s and '90s. "We were way ahead in building bombs, but we were not naive enough to think that nobody could ever do this but us."

The Soviets started sharing nuclear technology, too, and a Cold War chess match ensued, with the two superpowers and a few other nations supplying uranium and dozens of nuclear research reactors to their allies. U.S. reactors, for instance, went to Iran, Pakistan and Colombia; Soviet reactors to Libya, Bulgaria and North Korea.

Romania, a Soviet satellite courted by the Americans, got two reactors: one from the U.S., another from the Russians.

Reactors became the equivalent of international status symbols; church groups funded some to win overseas converts. U.S. firms vied for lucrative contracts, and Argonne became the heart of Atoms for Peace research, building foreign-bound reactors dubbed Argonauts.

By the mid-1970s, Travelli was a rising young star at the lab. He was designing a research reactor so powerful that it would need two tons of highly enriched uranium fuel—enough, in the wrong hands, to make 72 nuclear bombs.

Washington's bungled moves

America didn't give away its most potent fuel—not at first.

The Eisenhower administration decided to supply foreign nations with only low-enriched uranium, which would be far less useful to bombmakers. But in the early 1960s, when reactor operators complained about the fuel's effectiveness, the U.S. government started providing highly enriched uranium instead.

"That was dumb—to send the easiest material in the world from which to make nuclear bombs to civilian facilities all over the world," said Matthew Bunn, a nuclear fuel expert and science adviser to the Clinton White House.

America initially provided this dangerous uranium fuel with the provision that foreigners return the used material, which remained weapons-grade. But in 1964, the Johnson administration started selling the fuel with no such requirement.

After India detonated its first nuclear weapon, built with the help of a reactor from Canada and heavy water from America, everything changed.

Suddenly, the U.S. wanted its most valuable nuclear material back.

One of its first attempts played out 10 months later, in 1975, at the end of the Vietnam War. Two federal nuclear engineers volunteered for a daring raid in the Central Highlands of South Vietnam. The mission: rescue bombmaking plutonium from a research reactor supplied by the U.S.

With sniper fire crackling all around, the engineers sneaked inside the reactor, packaged the material and were airlifted to safety. Hours later, the Viet Cong overran the area.

Only later was it determined that the engineers had made an embarrassing mistake: In the chaos of the mission, they took the wrong container. They hadn't rescued plutonium, but rather polonium-210, a radioactive material not as useful in weaponry (though the substance recently captured headlines when it killed a former KGB agent).

Rather than relying on haphazard missions such as the one in Vietnam, the U.S. decided it needed a formal, concerted effort to retrieve bombmaking material, particularly highly enriched uranium fuel, that America had shipped overseas.

President Jimmy Carter knew something about reactors as he had done graduate work in nuclear technology. But he faced a diplomatic quandary: He couldn't just demand the fuel back, because other nations legally owned it.

Instead, the U.S. set out to do what it had failed to do in the 1960s: Invent a variety of replacement fuels that could adequately power the reactors but be useless for bombs. Then the U.S. could offer these replacement fuels to foreign nations in exchange for the highly enriched uranium.

To lead this effort, Energy Department officials wanted someone who knew reactors inside and out.

They turned to Travelli.

For scientist, a quest begins

Then 44, Travelli had built an impressive résumé that included teaching at MIT and designing and testing advanced reactors at Argonne.

Colleagues found him genial, meticulous and restrained. "You could yell at him and he wouldn't yell back," recalled Jim Snelgrove, an Argonne fuel specialist.

Travelli also had an international flair: He was dapper, well traveled and fluent in Italian, English, French and German.

When his bosses asked him if it were possible to develop fuels that could replace highly enriched uranium in research reactors, Travelli concluded it was.

But when they asked him whether he would lead the effort to invent these new fuels and persuade foreigners to make the switch, he was taken aback.

His life's work had been to spread nuclear technology, not rein it in. Now he was supposed to do a complete turnabout and remove enriched uranium from research reactors, facilities that didn't produce one watt of power?

"I didn't want this to be the accomplishment of my life," Travelli recalled. "My goal was to try to find a source of energy for the whole world."

But his bosses convinced him it was foolish to use weapons-grade fuel in reactors if something safer could be substituted, and so he decided to give it a shot.

Operating out of a small office in Building 362, a three-story brick structure on Argonne's 1,500-acre campus, Travelli started with just two staffers, a $645,000 annual budget and little idea of where to begin.

No one even had a list of all the research reactors the U.S. had exported. He assigned one of his workers to try to track down the reactors by scouring the scientific literature and government documents. Occasionally the staffer would burst into his office and exclaim: "I found another one!"

CIA agents eventually started coming to Travelli for information, not the other way around.

Travelli hung a 5-foot-long metallic map of the world in his office, putting green triangular magnets in spots with Atoms for Peace reactors.

But his first mission would be so secret—and so odd—that he promised at the time never to utter a word about it, let alone mark it on his office map.

The State Department was sending him to Taiwan, which U.S. officials suspected of secretly developing nuclear weapons.

There, in the countryside, sat a research reactor that looked fairly typical: a large, circular, windowless building with a domed roof.

But when Travelli stepped inside, he was astonished. The dark room the size of a theater was completely empty except for a massive, tomblike structure rising 30 feet. There were no signs of researchers or exper-

Unleashing the atom

When Albert Einstein unveiled his special theory of relativity in 1905, he set in motion the ability to understand and exploit the power of the atom. In the decades that followed, scientists developed impressive applications for this power, from the promise of nuclear energy to the terrifying devastation of nuclear weapons.

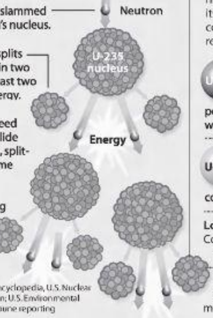
How nuclear fission works

The entire process happens almost instantaneously.

1 A neutron **is slammed** into an **atom's nucleus.**

2 The impact **splits** the nucleus **in two** and releases at **least two** neutrons and **energy.**

3 The newly **freed** neutrons **collide** with other **nuclei, split**ting them the **same** way. The **cycle** produces **a chain** reaction, **releasing** exponentially larger quantities of energy.



Sources: World Book Encyclopedia, U.S. Nuclear Regulatory Commission; U.S. Environmental Protection Agency; Tribune reporting

Why uranium?

Uranium, a silvery-white radioactive metal, is used in nuclear fission because one of its isotopes, known as U-235, is conducive to splitting and releasing energy.

U-235: This rare form of the element is the energy source behind nuclear **power reactors and** gives nuclear **weapons their explosive might.**

U-238: This more benign, and much more common, **form is** typically used in **combination with** U-235.

Low-enriched uranium: Contains less than 20 percent U-235, with the rest U-238.

Highly enriched uranium: Contains 20 percent U-235 or more, with the rest U-238.

Applications of nuclear fission

▶ **NUCLEAR POWER**

Fuel used: Low-enriched uranium

Up to 5% U-235

How it works: A controlled nuclear reaction creates heat that converts water into steam. The steam drives a generator, producing electricity.

▶ **NUCLEAR RESEARCH**

Fuel used: Some reactors use highly enriched uranium

More than 90% U-235

(Others use low-enriched uranium)

How it works: A controlled nuclear reaction produces neutrons used for research.

Sample uses:

- Production of isotopes for nuclear medicine
- Soil analysis
- Determining the chemical properties of various materials for manufacturing

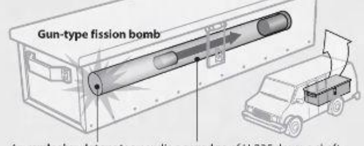
▶ **NUCLEAR WEAPONS**

Fuel used: Highly enriched uranium

More than 90% U-235

How it works: Modern nuclear weapons are complicated and use nuclear fission and fusion. Experts worry that terrorists able to procure enough highly enriched uranium could try to build a gun-type fission bomb, a simple, widely available design and the type of bomb dropped on Hiroshima.

Note: A gun-type nuclear bomb requires at least 110 pounds of highly enriched uranium. A more sophisticated design, called an implosion weapon, requires 55 pounds.



An **explosive detonates**, sending a **wedge** of U-235 down a shaft toward a **larger piece** of U-235. The impact causes a nuclear chain reaction and a large explosion.

Chicago Tribune / Adam Zoll and Steve Layton

A TRIBUNE INVESTIGATION

iments. Soft Chinese music flowed from hidden speakers.

Squinting through the dim, green-tinted light, Travelli and his team quietly moved forward, as if entering a temple. Their Taiwanese hosts led them to the structure in the middle, a concrete block that held the reactor core and its valuable nuclear material.

Later, out of earshot of his hosts, Travelli would tell his colleagues: "There is no research going on in there. That's just a machine for churning out plutonium for a nuclear weapon."

The State Department told Travelli's team that everything they saw in Taiwan must be held in strict confidence, more so than a standard classified mission. Nothing could be committed to writing. No trip reports, memos or notes.

It wasn't just because the U.S. believed the Taiwanese were trying to build the bomb. The secrecy was to protect Canada.

Canada not only supplied Taiwan's reactor, but the facility's core was identical to the one that the Canadians had provided to India, which had used the reactor to help build that nation's first bomb.

So the Americans took the responsibility for trying to neutralize Taiwan's reactor by altering its fuel. Unlike the other reactors Travelli would encounter, this one was fueled by natural uranium, not highly enriched uranium. But when natural uranium is burned, it produces plutonium, which also can be used to make nuclear bombs.

For two years, in 1979 and 1980, Travelli traveled back and forth to Taiwan, poring over schematics of the reactor and calculating how best to change its fuel. At one point, Travelli's team was invited to a reception held by the Taiwanese defense minister.

"I assure you that the reactor you are interested in has no military connection whatsoever," Travelli recalled the minister saying. "There is nothing sinister about it."

Travelli thought this statement peculiar, given that no one from his team had directly accused the Taiwanese of trying to build weapons.

Not long after, the Taiwanese, weary of the scrutiny, decided to shut the reactor.

Travelli went back to his Argonne office and looked at his wall map. The Taiwan case had taken two years to complete. How could he possibly address all of the other research reactors on the U.S. target list in the next three years, as he originally envisioned?

A path strewn with obstacles

The U.S. thought its plan would go smoothly: Argonne would develop new fuels, America would offer them to other nations, and the foreigners would quickly trade in their enriched uranium.

Though some nations agreed to the plan, most fiercely opposed it. They feared such a swap would slow their reactors, interrupt research and result in costly safety reviews.

Profit and prestige also played a part. Some reactor operators charged scientists tens of thousands of dollars to conduct experiments. If the facilities used a less powerful fuel, they might be seen as second-rate. A few reactors even displayed brass signs boasting: "Fueled with highly enriched uranium."

But the greatest obstacles to retrieving bomb fuel were of America's own making.

When Ronald Reagan defeated Carter in 1980, the retrieval effort fell out of favor. With memories of India's test fading and terrorism still viewed as a foreign problem, the Energy Department in 1981 proposed shutting down Travelli's mission, according to government records.

Though the program survived, the message was clear: Influential forces in the department didn't have much use for it. "They just wanted it to all go away," recalled Busick, the former State Department official.

As Travelli wrestled with his own government, he had an unsettling encounter that magnified his plight.

In 1981, during the height of the Cold War, he was attending a nuclear conference in what was then West Germany when a thin man in black glasses and a black suit approached him, stony-faced. The details of that conversation always have stuck with Travelli:

"Is my understanding of U.S. policy correct, that you are trying to retrieve highly enriched uranium from research reactors?" the man asked.

"That is correct," Travelli replied.

"And the reason is to reduce the chance that this material might fall into the wrong hands?"

"That's right."

"And the primary emphasis is on reactors that the United States supplied to its allies?"

"Correct."

"Not those the Soviet Union supplied to her allies?"

"Correct."

The man smiled slowly, shook Travelli's hand and walked away.

Travelli did not know whether this man was a scientist, bureaucrat, spy or some combination. But the meeting made him realize he had little idea what the Soviets and their satellites were up to.

He soon would find out: Travelli became deeply involved with the reactor in Romania, a facility beset by problems since America provided it in the 1970s to Ceausescu, the repressive and mercurial dictator.

Those working at the reactor were not immune to Ceausescu's bizarre policies. Every spring and fall, buses would pull in front of the facility, and its scientists were herded aboard and driven to nearby fields to plant corn or pick tomatoes.

"Why can't they get the peasants to do this?" one of the scientists, Corneliu Costescu, recalled complaining. "We're nuclear scientists."

But Romania's dictator believed it was much easier to round up scientists at nuclear facilities than peasants in villages.

Travelli invited Costescu and two other Romanian physicists to America to study whether the bomb fuel used in their facility could be replaced by something safer. After months of work, the Romanian scientists concluded that it could. But higher-ups in Romania weren't convinced, especially because the U.S. refused to pay for the new fuel.

Normally, America didn't cover the cost of replacement fuel when swapping it for bomb-grade material. Instead, the U.S. waited until countries used up all theirs, then asked them to pay for the replacement fuel.

But Romania was operating its reactor less and less in order to conserve its highly enriched uranium. A standoff ensued, and several years passed with no progress.

During this long delay, Romania, unbeknownst to the U.S., used the American-supplied reactor to help separate plutonium, a serious violation of international rules governing the development of nuclear weapons.

Travelli and U.S. officials would not learn of the Romanian action until after the Berlin Wall came down and Ceausescu was executed by his own people. In 1992, seven years after the nuclear infraction, the new Romanian government voluntarily reported the case to the International Atomic Energy Agency.

The agency, satisfied that corrective action had been taken, reported the infraction to the UN Security Council for informational purposes only—one of just a handful of cases ever reported to the council.

But even after Romania's admission, the American government did not invest more in its effort to retrieve bomb-grade fuel worldwide.

Instead, it took steps that ensured failure for several years to come.

Reaching out to former foes

Despondent over a lack of progress, Travelli began to neglect his wall map. When people brushed up against it, shifting the magnets around, he didn't bother to fix them.

It wasn't as though he had made no headway: By 1993, he had helped retrieve bomb fuel from 19 reactors—about a quarter of all U.S.-supplied facilities—and invented safer fuels that could be used in several dozen more.

But in further cost-cutting moves, the Energy Department had eliminated his research budget, preventing him from developing the new fuels needed for the remaining reactors still using highly enriched uranium.

Worse, the U.S. was refusing to stop using enriched uranium in more than a dozen reactors on American soil. In fact, in 1993 President Bill Clinton backed a plan in Tennessee to build a giant, $3 billion research reactor complex—a facility that would use bomb-grade fuel.

The plan eventually was canceled, but foreigners derided America's attitude as a colossal double standard: It was OK for the U.S. to use bomb grade fuel but not for other countries. The foreigners began holding on to their uranium more tightly than ever.

With few champions in Congress or the federal bureaucracy, Travelli's program became an orphan, bounced from agency to agency. When Travelli tried to apply pressure from behind the scenes—appealing to congressional staffers for more support, for example—he alienated those in Washington already skeptical of a national security program being run by scientists out of Chicago.

Allan Krass, a retired State Department official, supported Travelli's effort but realized others did not. These officials "really saw it as a bunch of guys who just wanted to get more money so that they could keep their program alive but who didn't have any good ideas and weren't making much progress," Krass said.

Just when it appeared Travelli's quest would die, the State Department in the mid-1990s became increasingly alarmed at reports of thieves stealing small amounts of highly enriched uranium in Russia and other former Soviet republics.

Travelli proposed an idea: What if he expanded his efforts to include the tons of highly enriched uranium the Soviets had distributed over the last three decades?

The State Department had a similar idea. It gave Travelli $1.5 million—money that could be spent only overseas—and in 1993 he flew to Moscow. It was his first trip there, and he did not know what to expect.

To his surprise, he discovered that the Russians had been monitoring his work for years. They had read all of his papers, knew all of his team members' names—even copied his effort by retrieving some of their own nuclear fuel.

"It was eerie, like meeting your long-lost twin brother," Travelli recalled.

He also was startled to see the same mysterious, stony-faced man who had approached him 12 years earlier in West Germany and pumped him for information. The man's name, it turned out, was Nikolay Arkhangelsky, an influential nuclear official. But Arkhangelsky remained elusive.

Travelli would go on to meet with him about 20 times and even travel with him to three countries to tour nuclear facilities. But he never learned basic information about the Russian. His business card simply read "scientific adviser," and some members of Travelli's team came to suspect that he was working for the Russian secret police—a charge Arkhangelsky later would laugh off.

Over the course of several more visits to Moscow, Travelli proposed to Arkhangelsky and the other Russians that the two countries work together to solve the fuel problem once and for all.

Retrieving it one nation at a time, he concluded, was failing desperately. There were just too many reactors requiring too many kinds of fuel.

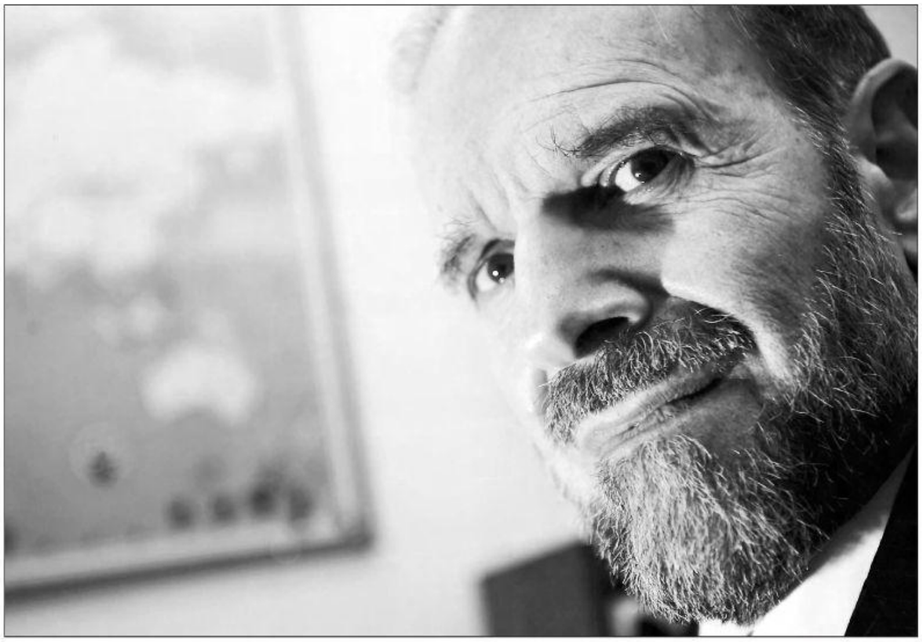
But what if the U.S. and Russia started from scratch, returned to the lab and tried to invent a single fuel that could replace bomb material in every reactor in the world?

No longer would they have to fear rogue states, friends becoming enemies, unchecked reactors or nuclear terrorists. All the world's bombmaking fuel could be removed from civilian use, and the Atoms for Peace debacle would be over.

After considering it, the Russians agreed to try. Even the reluctant U.S. Energy Department was willing to help pay for the effort.

Finally, Travelli felt success might be at hand.

COMING MONDAY: The search for a magic fuel.



Tribune photo by Zbigniew Bzdak

For a quarter-century, Argonne National Lab's Armando Travelli led U.S. efforts to recover bomb-grade uranium the nation had distributed to reactors worldwide.

Photo for the Tribune by Justin Jin

Nikolay Arkhangelsky, a top Russian nuclear official, was Armando Travelli's foil and eventually his partner in the effort to secure weapons-grade material around the world.

In the Web edition

- Learn why highly enriched uranium is the easiest pathway for terrorists to build the bomb.
- Take a tour of a dilapidated Russian research reactor.
- Retrace Armando Travelli's quest, testing your knowledge of his struggle to retrieve bomb-grade fuel.
- See what damage even a crude nuclear device would do if set off in the Loop.

Go to **chicagotribune.com/atoms**

How we reported this series

Sam Roe

To chronicle America's failed quest to retrieve uranium, Tribune staff reporter Sam Roe obtained exclusive access to the government archive of the effort through scientist Armando Travelli.

Roe examined thousands of records never before publicly reviewed, including scientific trip reports, internal memorandums and e-mails, and government correspondence.

He also reviewed congressional testimony, previously classified records, foreign and U.S. research papers, and reports by government agencies and the International Atomic Energy Agency.

Roe conducted extensive interviews with Travelli, who led the uranium retrieval effort for a quarter of a century. He also interviewed dozens of U.S. and foreign scientists, nuclear reactor operators, current and former government officials, and top energy officials here and in Russia.

He can be reached at sroe@tribune.com