A Tantalizing Look at Iranâ€™s Nuclear Program

Contributed by WILLIAM J. BROAD, NYTimes
Thursday, 01 May 2008
Last Updated Thursday, 01 May 2008

Barbed wire and antiaircraft guns ring a maze of buildings in the Iranian desert that lie at the heart of the West’s five-year standoff with Tehran over its program to enrich uranium. Click here to see an annotated version of this photograph. More Photos >

It is a place of secrets that Iran loves to boast about, clouding the effort’s real status and making Western analysts all the more eager for solid details and clues. Tehran insists that its plans are peaceful. But Washington and its allies see a looming threat.

The sprawling site, known as Natanz, made headlines recently because Iran is testing a new generation of centrifuges there that spin faster and, in theory, can more rapidly turn natural uranium into fuel for reactors or nuclear arms. The new machines are also meant to be more reliable than their forerunners, which often failed catastrophically.

On April 8, President Mahmoud Ahmadinejad visited the desert site, and Iran released 48 photographs of the tour, providing the first significant look inside the atomic riddle.

“They’re remarkable,” Jeffrey G. Lewis, an arms control specialist at the New America Foundation, a nonprofit research group in Washington, said of the photographs. “We’re learning things.”

Most important, the pictures give the first public glimpse of the new centrifuge, known as the IR-2, for Iranian second generation. There were no captions with the photographs, so nuclear analysts around the globe are scrutinizing the visual evidence to size up the new machine, its probable efficiency and its readiness for the tough job of uranium enrichment. They see the photos as an intelligence boon.

“This is intel to die for,” Andreas Persbo, an analyst in London at the Verification Research, Training and Information Center, a private group that promotes arms control, said in a comment on the blog site Arms Control Wonk.

One surprise of the tour was the presence of Iran’s defense minister, Mostafa Mohammad Najjar. His attendance struck some analysts as odd given Iran’s claim that the desert labors are entirely peaceful in nature. In one picture, Mr. Najjar, smiling widely, appears to lead the presidential retinue.

CBS News on Iranian Nuclear response by US Navy
{wmv}CBS-Iran-Nukes-Strike{/wmv}

Nuclear analysts say the tour opened a window into a hidden world previously known only to the Iranians and a few international inspectors.

“I don’t see anything to suggest this is propaganda,” Houston G. Wood III, a centrifuge expert at the University of Virginia, said in an interview. “They seem to be working on an advanced machine.”

Such judgments rest not only on the photographic clues, but also on the Iranian record of successful, if limited, enrichment, as well as the reports of international inspectors, who have tracked Iran’s effort to develop the new centrifuges.

Engineers use centrifuges for many applications other than enriching uranium. In general, the devices spin fast to separate all kinds of objects of differing mass and density — for instance, milk from cream and impurities from wine. To that end, centrifuges exploit simple laws of physics, doing so in ways that echo common experience.

A car that veers around a corner throws its passengers to one side. So, too, a centrifuge throws its contents off what would normally be a forward course. But it does so relentlessly.

Why do the contents separate? As Newton explained in his second law of motion, the more massive the object, the greater the tug. In the lurching car, an adult feels the force more than a child. In the centrifuge, heavy objects feel it more than light ones and, if possible, they move more vigorously toward the outer wall.

Nuclear centrifuges apply the same principle to uranium mined from the earth’s inner recesses, spinning it into

constituent parts.

Iran is separating U-235 from U-238. Rare in nature, U-235 easily splits in two to produce bursts of atomic energy. It also has three fewer neutrons than its cousin, making it slightly lighter and thus a candidate for centrifuge separation.

First, engineers turn the natural mix of uranium (0.7 and 99.3 percent, respectively) into a gas. Then, the centrifuge throws the heavier U-238 atoms toward the wall, letting the rare U-235 ones accumulate near the center. The results get scooped up continually. Rows of centrifuges repeat the process to slowly raise the rare isotope’s concentration.

It seems easy. But the centrifuges spin at about the speed of sound, must work day and night for months or years on end and can easily lose their balance, tearing themselves apart.

“Our machines broke down frequently” in the program’s early days, Gholamreza Aghazadeh, the chief of the Iranian Atomic Energy Organization, recalled in a 2006 interview on state television. He said a study had traced the failures to centrifuge assembly when technicians with bare hands inadvertently left behind clusters of microbes.

“This little amount of germs,” Mr. Aghazadeh said, was enough to throw the whirling devices off balance, leaving them in ruins. “When we say a machine is destroyed,” he added, “we mean that it turns into powder.”

In great secrecy, Iran began its centrifuge program in 1985, according to inspectors of the International Atomic Energy Agency. It copied a Pakistani design, known as the P-1. Today, the Iranian version stands more than six feet tall. Inside, a hollow rotor of aluminum spins the uranium gas to blinding speeds. Iran has installed 3,000 of the temperamental machines at Natanz, and recently began expanding that setup to 9,000.

In recent years, Iran has tried to move ahead in sophistication with a newer centrifuge design based on Pakistan’s second-generation model, known as the P-2. Its rotor is made of superhard steel that can spin faster, speeding the pace of enrichment while lowering the risk of breakdown.

But Iran had great difficulty building the machines and obtaining the special steel. Mostly in secret, it instead developed its own version, the IR-2. It is partly indigenous, signaling that the Iranians have achieved new levels of technical skill. If perfected, the IR-2 could accelerate Iran’s production of fuel for reactors or bombs.

Western experts say demonstration models of the IR-2 stand about three feet high — half the height of the P-1. But they spin twice as fast.

“That’s a lot,” said David Albright, president of the Institute for Science and International Security, a private group in Washington that tracks nuclear proliferation. “It would produce about four times the enrichment.”

The secret is carbon fibers, say international inspectors. The IR-2’s rotor is made not of steel or aluminum but black carbon that forms an incredibly strong tube for its weight. Experts say it is also cheaper to make than steel tubes.

Of the 48 photographs Iran released, Western analysts gave special scrutiny to one showing Mr. Ahmadinejad and his entourage viewing a disassembled IR-2, its guts arrayed on a table. Clearly visible are its casing, inner rotor, motor and several other critical parts.

Arms Control Wonk, which Dr. Lewis of the New America Foundation runs, led a discussion of the photo. Most comments focused on parts. But Geoffrey E. Forden, an arms expert at M.I.T., noted that the table also held an Iranian flag.

“Indigenous manufacturing of sophisticated components is something to be very proud of,” he wrote. “And showing them with an Iranian flag is a very good way of graphically proclaiming it.”

Several photos gave glimpses of what Western analysts consider the part of a nuclear centrifuge usually kept most secret — its bottom bearing. That sounds prosaic. But the bearing is critical to battling the bane of relentless spinning: friction, which can slow, cripple or destroy machines meant to work flawlessly for years.

Iran’s centrifuges, as is standard practice, have no physical support at the top. In an effort to eliminate friction, they have a magnetic bearing that holds the upper end of the rotor steady with invisible fields.

The rotor’s entire weight rests on the bottom bearing, which consists of a single, thin, needlelike projection, its rounded head etched with spiral grooves to promote the quick flow of lubricating fluid.

One picture showed a young woman with a black Islamic shawl showing a bottom bearing to Mr. Ahmadinejad, who wore

a lab coat and what seemed like a pleased expression. Another bearing sat on the table between them.

Dr. Lewis said the presence of the tiny part appeared noteworthy, since Iran once abandoned trying to build advanced centrifuges because of problems in making the bottom bearing.

Other photos showed rows of P-1 centrifuges as well as the new IR-2 model, apparently ready for testing.

A European centrifuge expert who closely follows the Iranian program, including the evaluations of international inspectors, said difficult work remained on the IR-2. “They obviously have months, if not a year, of test work to do before they can consider proceeding with mass production,” the expert said, who spoke on the condition of anonymity because of the issue’s sensitivity.

More generally, analysts say, Iran is slowly but steadily gaining the industrial experience needed to make reactor fuel, or, with the same equipment and a little more effort, bomb fuel — the hardest part of the weapons equation.

Uranium enriched to about 4 percent uranium 235 can fuel most reactors; to 90 percent, atom bombs.

Mr. Albright of the Institute for Science and International Security said that in one year 3,000 flawlessly running P-1 centrifuges could produce enough weapon-grade uranium for one nuclear weapon. Or, he added, the same could be achieved with 1,200 IR-2 machines.

American intelligence agencies say the earliest Iran could make a nuclear weapon is 2009, but consider 2010 to 2015 a more likely time frame. Iran insists it wants to make only reactor fuel for producing electricity.

Given the high stakes and international jitters, why did Iran release the photos? Analysts cite everything from a spirit of cooperation to blasts of disdain.

“Maybe it’s an invitation for engagement, or maybe it’s just to show off their achievement,” said R. Scott Kemp, a centrifuge expert at Princeton.

Dr. Wood of the University of Virginia said the episode smelled of hubris. “It was amazing to me that they put the pictures out there,” he said. “It’s sort of a cocky thing. I would think they had more to gain by keeping their cards close to their chests.”

By this analysis, the move trumpets Iran’s defiance of the West and the United Nations Security Council, which has imposed three rounds of sanctions on Tehran for its refusal to halt the uranium enrichment.

Some analysts see the centrifuges, despite the disclosures of the presidential tour, as a continuing enigma.

Ultimately, Tehran could use them for good or ill, for lighting cities or destroying them. Only time, they say, is likely to reveal Iran’s true intentions.

http://www.nytimes.com/2008/04/29/science/29nuke.html?_r=2&oref=slogin&ref=todayspaper&pagewanted=print

http://www.nytimes.com/2008/04/29/science/29nuke.html?_r=2&ref=todayspaper&oref=slogin&oref=slogin