

Iran Installing More Advanced Centrifuges at Natanz Pilot Enrichment Plant: Factsheet on the P-2/IR-2 Centrifuge

By David Albright and Jacqueline Shire
The Institute for Science and International Security (ISIS)
February 7, 2008

Recent press reports by [Reuters](#), the [Associated Press](#) and the Austria Presse Agentur have highlighted Iran's decision to move ahead with installation of modified P-2 centrifuges at the Natanz pilot fuel enrichment plant. Iran's name for the machine is the IR-2.

This decision appears to reflect Iran's commitment to expanding and improving its enrichment capabilities beyond those of the P-1 centrifuge, of which 3,000 are currently operating at the larger Natanz fuel enrichment plant. According to press reports, the modified P-2/IR-2 centrifuges are still being tested and no nuclear material has been introduced yet. The following provides some basic background about this centrifuge and a brief history of Iran's research and development of them to date.

What is a P-2 centrifuge and how has Iran modified it?

The P-2 centrifuge, deployed in Pakistan's nuclear weapons program, is essentially the same design as one developed by Germany in the early 1970s and stolen by A.Q. Khan from Urenco, the uranium enrichment consortium of Britain, Germany, and the Netherlands. The P-2 uranium enrichment throughput is about 2.5 times greater than the P-1 centrifuge. Where the P-1 in Pakistan achieved an annual enrichment output of about two separate work units (swu) annually, the P-2 has a capacity of about five swu annually.

The P-2 as modified by Iran is about one half the length of the P-2 and has no bellows, a difficult to make component. If configured appropriately, it would take approximately 1,200 P-2/IR-2 centrifuges to produce more than enough weapon-grade uranium for a nuclear weapon in one year, where it would take 3,000 P-1 centrifuges to produce a similar quantity.

The original P-2 uses a rotor tube made out of maraging steel and one bellows at the center of the tube. According to Iran's declarations to the IAEA, Iranian experts decided that they could not make the P-2 bellows, which is thinner and more difficult to manufacture than the P-1 bellows. Iran therefore modified the design, using a single carbon fiber rotor and forgoing the maraging steel bellows.

A carbon fiber rotor can spin much faster than a maraging steel rotor (which in turn spins significantly faster than the aluminum rotor in the P-1). The extra speed of the carbon fiber rotor allows the shorter IR-2 centrifuge to have the same enrichment output as the P-2 centrifuge. Carbon fiber rotors are also less expensive to produce than tubes made of maraging steel.

Iran's history with the P-2:

According to the IAEA's November 2004 safeguards report, Iran received design drawings for a P-2 centrifuge in 1995 from the A.Q. Khan network, but did not begin working on the centrifuge until 2002 because of staffing shortages. Work in 2002-2003 was reportedly undertaken by a private workshop under contract to Iran's Atomic Energy Organization and was "limited to the manufacture and mechanical testing of a small number of modified P-2 composite rotors." Composite rotors are another name for carbon fiber rotors.

In 2004, Iran insisted that work on the P-2 was suspended while Iran was adhering to the Additional Protocol, though it foreshadowed its intention to resume R&D, informing the IAEA in its declarations under the Additional Protocol that it "foresees" such work in the future.

Iran has told the IAEA that it did not acquire any completed P-2 centrifuges from abroad, and that with the exception of some raw materials supplied from the P-1's R&D effort, its components have been domestically produced.

If Iran were to deploy large numbers of IR-2 centrifuges at Natanz, it will require foreign procurement for key parts, including magnets and carbon fiber. It may also need to procure additional maraging steel for rotating parts such as the endcaps of the rotors. The November 2004 IAEA report notes that Iran attempted to purchase from one supplier some 4,000 magnets for the P-2, with promises of larger orders to follow. While no magnets were delivered by this supplier, Iran did report obtaining an unspecified quantity from other foreign suppliers in 2002.

Iran resumed work on the IR-2 in early 2006 when it notified the IAEA that it was ending its voluntary adherence to the Additional Protocol. It remains unclear how many IR-2 centrifuges Iran will install at the pilot enrichment plant at Natanz or when Iran will start enriching uranium in those centrifuges. It is also unknown whether Iran plans to install large numbers of these centrifuges in the underground Fuel Enrichment Plant.