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Major U.S. Sting Operation Arrests Iranian in Nuclear Smuggling Network

By David Albright and Andrea Stricker

This case highlights that Iran continues to need high-technology goods from Western countries and China to operate and improve its centrifuge plants. Improved export controls and sanctions implementation, particularly by China, remain key to thwarting and delaying Iran's efforts. This case also shows that cooperation between governments and industry is critical to countering nuclear smuggling efforts by countries such as Iran.

In one of the most significant cases to date in U.S. efforts to combat Iran's illicit nuclear trade, the Department of Justice on July 13, 2012 announced the arrest of an Iranian national for directing an illicit nuclear procurement ring. Parviz Khaki, an Iranian national, is alleged to have bought or attempted to buy from U.S. companies large quantities of dual-use equipment and raw materials for Iran's gas centrifuge program. A District of Columbia grand jury indicted him and an associate, Zongcheng Yi, based in China, on six counts of conspiracy, export control, fraud, and money laundering charges for procurements or attempted procurements made between 2008 and 2011.¹ Several of the attempted procurements may have been intended for the Fordow Fuel Enrichment Plant or another unknown enrichment plant. Some of the procurements in particular could have been endeavors to obtain sufficient raw materials to build several thousand components for advanced gas centrifuges that are currently under development in Iran.

Khaki and Yi along with another unindicted Philippines national and U.S. national and unnamed others located in China, Iran, and elsewhere cooperated to send or attempt to send U.S. and European-origin goods to Iran and Iranian companies or entities via transshipment through China, the Philippines, and Hong Kong. Khaki was arrested in the Philippines, where he is presently detained, based on a U.S. arrest warrant and earlier indictment.² His extradition is expected since the United States and the Philippines have a mutual extradition treaty. Yi has not been arrested or extradited from China; the United States and China lack an extradition treaty. It is unknown if the United States has requested extradition of Yi. In the past, China was not cooperative on arrest or extradition requests concerning Chinese citizens caught violating U.S. export laws.

¹ United States District Court for the District of Columbia, *Grand Jury Indictment: United States of America v. Parviz Khaki and Zongcheng Yi*, May 7, 2012, unsealed July 12, 2012. Available at: http://content.govdelivery.com/attachments/USDHSICE/2012/07/13/file_attachments/141298/Khaki%2B_Yi_Superseding_Indictment.pdf

² Philippines National Bureau of Investigation, *Press release*, May 28, 2012. Available at: <http://www.nbi.gov.ph/news/05282012.html>

China should be expected to cooperate this time in the case of an extradition request, faced with nuclear-related procurements by Iran in alleged violation of United Nations Security Council sanctions. In addition, China should launch its own prosecutions of those involved in this smuggling operation, since these individuals likely violated Chinese trade control laws and national legislation implementing Security Council sanctions.

Some of the goods were successfully obtained by Iran but many were sought from one or more undercover U.S. federal agents posing as procurement agents, or middlemen, claiming experience in illegally obtaining and exporting U.S. goods. According to the indictment, the goods sought by Iran through affiliates in China, “goods that can be used to construct, operate, and maintain gas centrifuges to enrich uranium,” included 20 tons of C-350 maraging steel (enough for several thousand centrifuges, or a plant the size of Fordow), 20 tons of 7075-T6 aluminum alloy 150 mm rods, mass spectrometers, magnetic tape, measuring instruments, pressure transducers, and vacuum pumps. Table 1 below lists all of the goods included in the indictment. The goods successfully acquired by the network included lathes and nickel alloy 120 wire, exported to Iran via Hong Kong. The other goods were not obtained because they were sought from U.S. undercover agents posing as willing middlemen. Khaki and Yi, if ever arrested, face the potential for decades in prison if found guilty of the violations.

This case shows in particular the power of counter-proliferation methods in slowing Iran’s centrifuge program, which continues to depend on foreign supply. It also indicates that even as Iran has tried to develop a more indigenous program of advanced centrifuges, it has sought a range of dual-use goods overseas. Iran, like other developing countries, appears unable to build gas centrifuge plants without outside assistance, making well-enforced sanctions and trade controls an important tool in detecting Iran’s secret centrifuge activities and slowing down its overall nuclear progress.

The Scheme

Beginning in October 2008 or earlier until at least January 2011, Khaki allegedly directed the efforts of a nuclear procurement scheme, working to transship goods to Iran’s gas centrifuge program with Yi of China, managing director of a company called Monalila Co. Ltd located in Guangzhou City, China. Two unindicted co-conspirators based in the Philippines and the United States in addition to unnamed “others” located in China, Iran, and elsewhere assisted their efforts. According to the indictment, Khaki allegedly directed Yi, the U.S. associate, and the Philippines associate to contact U.S. companies with requests for price quotes and to place orders for dual-use goods and raw materials needed by Iran’s gas centrifuge program. Khaki referred to “customers” in Iran which may have been companies or entities that are part of Iran’s centrifuge program or working under contract to procure for the program. The network deceived U.S. companies into selling some of the goods by indicating the end user of the goods was not Iran, thus not requiring a license for export. The network sought many goods from one or more undercover U.S. agents posing as middlemen. Goods the network successfully acquired were sent to purported end users in Hong Kong, the Philippines, and China and then surreptitiously re-exported to Iran.

Goods Sought as Part of U.S. Sting Operation:

Raw Materials

C-350 Maraging Steel In December 2008, Khaki allegedly asked an unnamed Chinese individual to seek 20 tons of C-350 maraging steel from the United States, which he said was on behalf of a company in Iran. He first requested samples and gave his address in Iran for the Chinese individual. The individual reported that samples are unavailable due to U.S. export restrictions. The individual also responded that a middleman, corresponding with the individual about the large maraging steel order, wanted end user information for the goods and confirmation that it would not be used for nuclear purposes. The middleman was actually an undercover U.S. agent working as part of a sting operation. He or she claimed past experience illegally obtaining and exporting U.S. goods.

The undercover U.S. agent provided the Chinese individual with a price quote for 20 tons of C-350 maraging steel, and Khaki allegedly began communicating directly with him or her. The official informed Khaki on several occasions that maraging steel was controlled by U.S. export laws for end use in nuclear applications but that he or she would help with the export for a fee. Khaki allegedly indicated a desire to also make money from the procurement. It is unclear what transpired with this procurement order, the indictment indicating that communications about payment and logistics continued between Khaki and the official until the end of 2009.

According to federal law enforcement officials, the specifications of the maraging steel sought by Iran fall under the Nuclear Suppliers Group dual use annex section 2.C.11 and it “was for none other than uranium enrichment and gas centrifuges.”³ This quantity of maraging steel is in theory enough for several thousand centrifuges, although officials declined to provide additional dimensional information at this time.

Because of maraging steel’s ability to withstand high speeds, it has special uses in Iran’s centrifuges. Without more information, particularly dimensional information, it is difficult to judge which centrifuge would use the C-350 maraging steel. However, the grade of C-350 would suggest a use in the advanced centrifuges, since the first generation IR-1 centrifuge can use a slightly lower grade of maraging steel. In any case, the maraging steel is used in the IR-1 centrifuge and advanced centrifuges, such as the IR-2m. In both the IR-1 and IR-2m centrifuges, the critical bellows use maraging steel. Advanced centrifuges, such as the IR-2m, also use maraging steel in their end caps. Figure 1 shows a generalized centrifuge, where the bellows and end caps are illustrated. Figure 2 shows a photo of a cutaway model of the IR-1 centrifuge, which has four high strength aluminum rotor tubes connected by three maraging steel bellows, and a picture of a P-1 centrifuge rotor assembly, where the bellows are visible. The P-1 is the Pakistani version of the IR-1 centrifuge. In these cases, the bellows points inward, unlike in figure 1. The IR-2m centrifuge uses two carbon fiber rotor tubes connected by a maraging steel bellows. Figure 3 shows the IR-2m centrifuges in an experimental cascade at the Natanz pilot enrichment plant.

³ According to section C.2.11, this is “maraging steel ‘capable of’ an ultimate tensile strength of 2050 MPa or more at 293 K (20°C)...[and of linear dimensions above 75 mm].” See Nuclear Suppliers Group, *Guidelines, Annex: List of Nuclear-Related Dual-Use Equipment, Materials, Software, and Related Technology*, INFCIRC/254/Rev.8/Part2a, June 30, 2010. Available at: <http://www.nuclearsuppliersgroup.org/Leng/PDF/infirc254r8p2.pdf>

High Strength Aluminum In November 2008, Khaki allegedly contacted the unnamed Chinese individual to seek a price quote for large quantities of high strength aluminum, specifically 20 tons of 7075-O aluminum alloy in bar with a diameter of 80 mm and 20 tons of 7075-T6 aluminum alloy 150 mm rods. Communications from Khaki allegedly indicated that he needed U.S. or European-origin products as Iran had had past problems with the quality of Chinese aluminum alloys. Iran has claimed that it can make 7075 aluminum, but the quality of this aluminum may also pose a problem. The Chinese individual sent price quotes of \$6,637 per ton for the 7075-O aluminum alloy and \$6,972 per ton for the 7075-T6 aluminum alloy.

The 7075-T6 aluminum rods, with a diameter of 150 mm, could be used for making end caps and the internal baffles of the IR-1 centrifuges. However, the diameter would be reduced to about 100 mm.

In addition, these 150 mm 7075-T6 rods could be used for manufacturing end caps of at least one advanced centrifuge under development in Iran that has a diameter of about 145 mm. Although these centrifuges would normally be expected to have maraging steel end caps that cap carbon fiber rotor tubes, Iranian officials have disclosed that the centrifuge program has been developing end caps made of high strength aluminum for one of its advanced centrifuges. This choice likely required a re-design of the centrifuge and may have reflected a shortage of maraging steel and a perception that high strength aluminum would be easier to smuggle into Iran. The impact on centrifuge performance of a switch to high strength aluminum end caps would be less severe as Iran has stated it intends to operate its advanced centrifuges at speeds less than possible for carbon fiber rotors, which can have an operational rotational speed over 700 meters per second. Instead, the top speed may be limited to a top wall speed of 550 meters per second, which may allow for the use of high strength aluminum end caps. Nonetheless, the switch from maraging steel to aluminum in an advanced centrifuge is not ideal, since aluminum has properties, namely creep, which can reduce component and overall centrifuge lifetime.

Strip Foil In February 2009, Khaki allegedly sought from a magnetics company in China metallic strip foil with specifications similar to Arnokrome III, which can be used for gas centrifuges. He allegedly requested a product made by a U.S. manufacturer. Khaki allegedly stated that the goods were to be used for a high speed motor capable of reaching 70,000 rotations per minute (rpm). Khaki then allegedly began communicating with the undercover U.S. agent posing as a middleman, requesting that the agent obtain Arnokrome III magnetic tape from a U.S. manufacturer located in Illinois. The Chinese magnetics company eventually responded that the U.S. manufacturer had ignored its requests.

Each of Iran's centrifuges use a high speed motor. They are commonly located at the bottom of each centrifuge. The information is not specific enough to assign a centrifuge but the motor rating could be sufficient for the motors of the IR-1 centrifuge or a low speed advanced centrifuge.

Mass Spectrometers

In May 2009, Khaki allegedly contacted the undercover U.S. agent posing as a middleman about obtaining two types of mass spectrometers, a thermal ionization spectrometer and a magnetic spectrometer. The indictment indicates that Khaki allegedly e-mailed that he wanted mass spectrometers for the purpose of "isotopic analysis of gaseous UF₆."

Each centrifuge plant needs mass spectrometers. This procurement could have been for the Fordow Fuel Enrichment Plant, a replacement for a broken one, or intended for an unknown centrifuge plant.

Measuring Instruments

In October 2008, Khaki allegedly contacted an unnamed individual in Sweden about procuring magnetic gauging equipment called a gauss meter, used for measuring magnetic fields, from a U.S. company located in Ohio. Khaki allegedly then contacted an individual in China who provided a price quote for a DSP gauss meter. The Chinese individual noted that the supplier needed certification that he or she was not a middleman but the end user; the supplier also needed to know that it would be used only in China and would not be used for weapons of mass destruction.

In August 2009, Khaki allegedly e-mailed the individual the indictment calls “Coconspirator 2,” a woman located in the Philippines, with a request for price quotes for a TCH600 nitrogen/hydrogen/oxygen analyzer, made by a Michigan company. The co-conspirator told Khaki that she falsely represented to the supplier that the analyzer would be used in the Philippines. She then informed Zongcheng Yi in China that she was looking for someone to serve as a phony end user. She apparently found one but told Khaki that the Philippines company or entity would have to buy the analyzer directly from the Michigan supplier. Khaki allegedly opted to ask the undercover U.S. agent for help obtaining the item.

These instruments are useful in measuring the magnetic field of ring magnets used in the top bearing of Iranian centrifuges.

Vacuum System Equipment

In February 2009, Khaki allegedly asked Yi to obtain price and delivery specifications for goods procured from a U.S. company in Massachusetts, including two models of MKS Baratron pressure transducers, which the indictment states “are ideal for measuring gas pressure within gas centrifuge piping systems.” Khaki allegedly told Yi not to indicate the end user was Iran. Yi sent a price quote for the items. Iran has attempted to procure hundreds, if not thousands, of pressure transducers in the last several years. It uses a considerable number of them in its IR-1 cascades to measure pressure (see figures 4, 5, and 6).

In June 2009, Khaki allegedly requested from the undercover U.S. agent to buy from a U.S. company a more extensive array of vacuum pumps and accessories, which the indictment says “could be used in the assembly of a large vacuum pump system.” The items included a Trivac vacuum pump and rotary pump, Dow Corning sealing greases and diffusion oil, ball valves, high vacuum and pirani gauges, and a Center Two displayer. In January 2010, Khaki allegedly e-mailed Yi to ask for a quote for an industrial-sized GNB G(630)P high vacuum gate valve from a California company.

Large amounts of vacuum equipment are critical to the operation of centrifuge plants, since the cascades run under vacuum. Iran has tried often and broadly to obtain vacuum equipment from abroad. Although it is trying to build its own vacuum pumps, it has been unsuccessful in matching the quality and reliability of Western vacuum equipment.

Radioactive Source Materials

In May 2009 and January 2011, Khaki allegedly contacted the undercover U.S. agent requesting radioactive sources and test materials from a Connecticut company. He sought barium-133 and europium-152 sources in 2009 and a cobalt-57 source in 2011.

These radionuclides are typically used in taking measurements in industrial applications. According to the U.S. Environmental Protection Agency, Barium-133 is used to measure the thickness of metal components and coatings and the moisture content in manufactured products. Cobalt-57 is used in mineral processing to measure mineral levels in process streams and in density gauges and spectroscopy.⁴ Europium-152, according to Argonne National Laboratory, is primarily used in “nuclear reactor control rods, because of its effectiveness in absorbing neutrons.”⁵ This suggests Iran may have sought the radioactive source for its reactor program.

Goods Acquired Successfully

Lathes

In February 2009, Khaki allegedly asked Yi to contact a U.S. company for a price quote for two Twister Speed lathes. Khaki allegedly asked Yi to find out how long it would take to export the lathes from the United States to Monalila Co. Ltd. in Guangzhou City, China. Khaki allegedly told Yi that the end user was Iran. The U.S. company sent an invoice for the lathes to Yi, who forwarded it to Khaki. Khaki allegedly e-mailed a person the indictment calls, “Coconspirator 1,” a citizen of the United States and apparently a middleman, asking him or her to find out whether the company was an actual entity. Khaki allegedly told the U.S. individual that the goods were destined for Iran.

The next month, Khaki allegedly cooperated with the U.S. company in arranging to undervalue the goods upon export in order to avoid customs duties. Khaki told the company to ship the lathes to a trading company located in Hong Kong. Yi confirmed to Khaki in April 2009 that once the lathes were received in Hong Kong, he would ship them to Khaki’s location in Iran. In May, Yi transferred payment for the lathes from a Chinese bank to the U.S. company. In June, Yi received the lathes and shipped them to Iran.

Twister Speed lathes are typically designed for quick operations on small parts, such as burr removal and polishing. They often work in conjunction with a computer numerically controlled (CNC) lathe that would make a high precision part. CNC lathes are used in making centrifuge parts.

Nickel Alloy Wire

In January 2009, Khaki allegedly asked the same U.S. co-conspirator, or middleman, to contact a U.S. company about purchasing nickel alloy 120 wire. The U.S. individual sent to the company a price request, and when the company responded with a quote, the co-conspirator sent it to Khaki. Khaki allegedly asked the U.S. individual to find out the cost of shipping the nickel alloy to China. Khaki

⁴ U.S. Environmental Protection Agency, “Common Industrial Devices and Other Uses of Radioactive Sources,” Radiation Protection web site. Available at: <http://www.epa.gov/rpdweb00/source-reduction-management/applications.html>

⁵ Argonne National Laboratory, “Europium,” Human Health Fact Sheet, August 2005. Available at: <http://www.ead.anl.gov/pub/doc/europium.pdf>

allegedly asked Yi to send the U.S. individual the Monalila Co. address as the end user and the U.S. individual sent a purchase order to the U.S. company stating Monalila Co. as the purchasing entity.

In April, Khaki allegedly e-mailed Yi that he needed the nickel alloy export quickly or would be required to pay a fine to a “customer in Iran.” Khaki allegedly informed the U.S. co-conspirator that the payment would be sent from China to give the impression that the end user was Monalila Co. About one week later, Khaki apparently decided to use Hong Kong as the phony end destination, and Yi asked the U.S. company to ship to the same Hong Kong trading company referenced above. In June, the U.S. company shipped the nickel alloy to Hong Kong with documents attached stating that diversion from Hong Kong was prohibited by U.S. export laws.

Successful Arrest

The United States sought the assistance of the Philippines’ National Bureau of Investigation for the arrest of Khaki, transmitting an arrest warrant and indictment from the District Court of the District of Columbia. Khaki was arrested at Ninoy Aquino International Airport while attempting to board a flight to Qatar. His extradition to stand trial is expected. Zongcheng remains at large. It is thus far unclear whether China has been cooperative with U.S. requests to investigate his company’s activities or arrest him, or for that matter, carry out its own prosecution of this smuggling network and its accomplices.

Lessons and Observations

This case study shows that China and other parts of East Asia continue to be problem zones for export control enforcement and serve as hubs for Iranian illicit procurement and transshipment schemes. Iran utilizes private Chinese companies to acquire a range of high-tech, dual-use goods and raw materials, including from U.S. or European companies, often through subsidiaries in China. These Chinese companies either violate unintentionally or deliberately Chinese export controls or United Nations Security Council sanctions by supplying these goods for export to Iran. Foreign companies in China have a difficult time spotting Iran’s smuggling efforts, and the Chinese government does a poor job exposing smuggling efforts or helping companies avoid them. The United States and European Union should continue cooperating with China to improve and enforce its trade control and sanctions. China should work more with domestic industries to detect illicit procurement schemes. China should also start routinely investigating and arresting smugglers operating from its territory or, on a case-by-case basis, grant extradition for citizens caught violating U.S. and other countries’ export laws.

This case shows that Iran still seeks high quality materials it needs for its centrifuge program from Western companies, showing the importance of governments cooperating with companies and mounting sting operations to learn about Iran’s nuclear efforts and delay and set back its progress. Government/private sector cooperation was instrumental to this sting operation and should be augmented both in the United States and internationally. Key suppliers targeted by this illicit procurement network cooperated productively with U.S. authorities.

This case demonstrates that Iran’s centrifuge program continues to depend critically on foreign supply. It also shows that as Iran has attempted to develop a more indigenous program of advanced centrifuges, it has still depended on foreign supply for many goods. One analyst recently speculated

that centrifuge technology cannot be controlled and therefore counter-proliferation methods do not work in detecting or thwarting attempts to build centrifuge programs, but this case shows that such claims are unfounded.⁶ A truly indigenous centrifuge program may not be possible for developing countries because of the technical and economic challenges in making the wide variety of high-tech goods and raw materials necessary to build and operate centrifuge plants able to make significant amounts of enriched uranium. Moreover, except in a few developed countries, centrifuge programs, even those based on more simple centrifuges than currently deployed in Iran, have faced significant technical obstacles in reaching production-scale operations. Thus, this analyst has also severely understated the difficulty of building and operating gas centrifuges on such a scale.

This case study also shows that a profit motivation remains central to the efforts of smugglers to obtain the goods Iran seeks. As sanctions and trade controls squeeze Iran's ability to procure goods it requires, the potential for profits and risk-taking will increase, necessitating more vigilance on the parts of governments and companies.

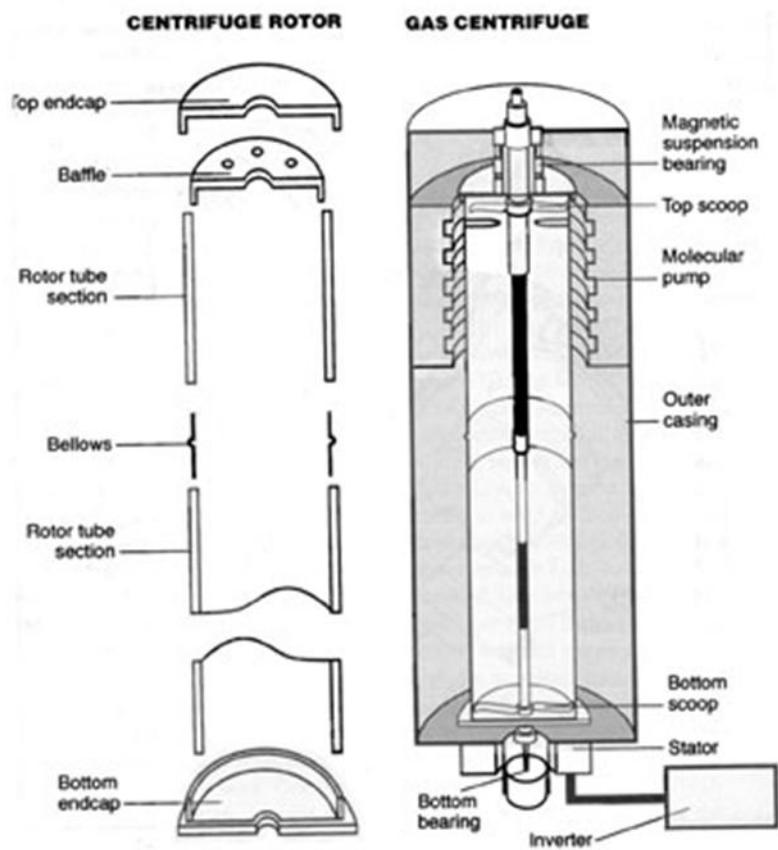
This groundbreaking U.S. sting operation led to the successful arrest of an Iranian who represents a member of the core of Iran's illicit procurement efforts, or Iranian nationals working for or with the companies and entities that fill orders for the nuclear program. These people are typically difficult to arrest because they reside inside Iran and can only be caught while traveling abroad. Increased use of transnational and national sting operations and cooperation among a wider range of countries would help deter would-be smugglers and shut down Iran's illicit procurement networks.

⁶ R. Scott Kemp, "Centrifuges- A New Era for Nuclear Proliferation" (Washington, D.C.: Nuclear Policy Education Center, June 5, 2012). Available at: http://npolicy.org/article.php?aid=1183&tid=30#_ftnref5. The article states: "Underlying these proposals, however, is an unspoken assumption that centrifuge technology can be controlled. The proposals do not acknowledge that the centrifuge is a fifty-year old device based on straightforward principles of mechanical engineering, that essentially all of the required design information needed is in the public domain, or that basic centrifuges require no exotic tools or materials to make. If centrifuges can be indigenously produced, they cannot be effectively restrained by technology controls."

Table 1: Attempted Procurements and Successful Procurements, as described in the indictment

Quantity:	Attempted Procurements:
20 tons	C-350 Maraging Steel
20 tons	7075-O Aluminum Alloy in rods with diameter of 80 mm
20 tons	7075-T6 Aluminum Alloy in rods with diameter of 150 mm
1	Arnokrome III Magnetic Tape
1	Thermal Ionization Mass Spectrometer
1	Magnetic Mass Spectrometer
1	DSP Gauss Meter
1	TCH600 Nitrogen/Hydrogen/Oxygen Analyzer
1 each	Radioactive Source Materials- Barium-133 source, European-152 source, Cobalt-57 source, Cadmium-109 source
	<i>Vacuum System Equipment and Accessories:</i>
1	MKS Baratron Pressure Transducer, model # 626A01TDD
1	MKS Baratron Pressure Transducer, model # 626A11TDD
1	Trivac 65B Vacuum Pump
1	Trivac D16 Rotary Pump
1	Dow Corning Sealing Greases
1	Dow Corning 704 Diffusion Oil
1	Ball Valve DN 40 ISO-KF, model # 174-97
1	Ball Valve DN 25 ISO-KF, model #174-96
1	High Vacuum Gauge, model # 230-070
1	Pirani Vacuum Gauge, model # 230-026
1	Center Two Displayer
1	Industrial-sized GNB G(630)P High Vacuum Gate Valve
Quantity:	Successful Procurements:
2	Twister Speed Lathe
1	Nickel Alloy 120 Wire

Figure 1: Generalized Centrifuge Schematic



Source: Albright, D. and Hibbs, M., 'Iraq's shop-till-you-drop nuclear program', *Bulletin of the Atomic Scientists*, vol. 48, no. 3 (Apr. 1992), pp. 32 and 33.

Figure 2: Cutaway Model of the IR-1 Centrifuge and a P-1 Rotor Assembly



**P1 Rotor
Assembly**



Figure 3: Cascade of advanced centrifuges, likely the IR-2m centrifuges, in an experimental cascade at the Natanz pilot enrichment plant.



Figure 4: Example of an MKS pressure transducer of a similar product line as in the attempted procurement by Iran.



Figures 5 and 6: Images of Iranian president Mahmoud Ahmadinejad touring the Natanz pilot enrichment plant with pressure transducers pictured. Figure 5 shows a pressure transducer on top of a single advanced centrifuge test stand. In Figure 6, the president's arm is brushing one in the foreground. Another is on the other end of the table. Many pressure transducers are visible in the piping of the cascade of IR-1 centrifuges in the background.



Figure 5



Figure 6