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Peaceful Uses Bona Fides: Criteria for Evaluation and Case Studies

Final Report

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Peaceful Uses Bona Fides: Criteria for Evaluation

1.0 Introduction

Anticipated growth of global nuclear energy in a difficult international security environment heightens concerns that states may exploit the civilian nuclear fuel cycle as means of acquiring nuclear weapons. Article IV of the Nuclear Nonproliferation Treaty (NPT) confers the "*inalienable right*" of Parties to the treaty to "*develop research, production and use of nuclear energy for peaceful purposes…,*" and states that all Parties "*facilitate… the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy…,*" and "*cooperate in contributing…to the further development of the applications of nuclear energy for peaceful purposes….*"

This right is balanced by the nonproliferation obligations set forth in Articles II and III of the NPT. To gauge the extent to which a state may be exercising its Article IV rights inconsistently with its Article II and III obligations, a series of indicators was developed to apply to an evaluation of the bona fides of a state's claims to a peaceful use nuclear program. Evaluation of a country's nuclear program relative to these indicators can help the international community identify when to take appropriate actions to ensure that the growth of the global nuclear energy industry proceeds peacefully with minimal nuclear proliferation risks.

2.0 Peaceful Use Defined

The NPT language – specifically the manner in which the right to peaceful use and the prohibition of nuclear weapons are juxtaposed against one another – underscores the mutual exclusivity of the two concepts, and leads to the following definition of peaceful use of nuclear energy:

> "Absence of possession, development or transfer of nuclear weapons or their inputs, and acceptance of rigorous nuclear safeguards and export controls, full transparency of all nuclear programs and facilities, proactive cooperation with the IAEA, and halting assistance to and cooperation with any violators of the NPT, parties withdrawing from the NPT, or any state or non-state actor seeking nuclear weapons or their inputs."

3.0 Peaceful Use vs. Peaceful Purpose

Article IV of the NPT refers to both peaceful *purposes* and peaceful *use*. Whereas peaceful <u>use</u> is a reasonably straightforward term – is the state misusing its nuclear program to build a weapons capability or not? – peaceful <u>purpose</u> suggests an additional consideration of intent, i.e., does the state intend to continue to use the supplied or indigenously developed nuclear material, technology or equipment throughout its lifetime

for peaceful purposes, or not? For example, an enrichment facility can be part of a civilian nuclear power program, but is also a critical component of a basic nuclear weapons program. If a state has reactors for power generation and enriched uranium from its enrichment plant is being used to fuel those reactors, it can be argued that the enrichment plant does meet the peaceful use criterion. However, determining why a country with one or two reactors and negligible uranium deposits seeks to invest in a uranium enrichment facility may lead to a different overall conclusion regarding the value of the enrichment plant and whether it is in the international interest for the state to exercise its Article IV rights. If the economic justification for the enrichment facility is weak, and there is no other compelling rationale for it, one might conclude that the intended use may not peaceful. This judgment would require careful evaluation of some other factors to see if they also point in the non-peaceful direction. In short, the NPT's references to peaceful purposes contributes to the definition of peaceful use provided above by adding a requirement of continued commitment to peaceful use for the lifetime of the nuclear facility, material or equipment.

Non-Nuclear Weapons States (NNWS) are obligated to limit their pursuit of nuclear energy exclusively to peaceful endeavors, leaving no room for a state to start pursuing nuclear energy for peaceful use with a later intent to move to pursue a weaponization track. The NPT empowers the international community to examine the purpose of a state's nuclear program, and if in doubt as to its peaceful intent, provides justification for curbing a state's right to develop research, production and use of nuclear energy, even indigenously.

4.0 Evolution of International Acceptance of Constraints on Nuclear Trade

The history of the NPT has been marked by tension between the NNWS on one hand and the Nuclear Weapons States (NWS) because the NWS constrain peaceful nuclear supply. For example, members of the Non-Aligned Movement, which are all NNWS, have asserted that the NWS provide too little nuclear assistance. Citing Article IV of the NPT, they insist that the NWS and other supplier countries are obligated to undertake and participate in the fullest possible exchange of materials, equipment and information for the peaceful use of nuclear energy. Over time, however, the broader international community has come to accept that unfettered transfer of nuclear material, equipment and information undermines nonproliferation. Even as early as 1948, Ernst David Bergmann, the father of the Israeli Nuclear Program, declared, "by developing atomic energy for peaceful uses, you reach the nuclear option. There are no two atomic energies."[1]

International acceptance of trade limits on nuclear technology was significantly advanced in 1991, when it became apparent that Iraq had violated its Article II and III obligations, and used its nuclear knowledge to build a weapons program. Thus, nearly the whole international community supported the position that unconditional nuclear supply under Article IV was no longer acceptable. As a result, the IAEA member states supported developing the Additional Protocol to IAEA safeguards agreements (AP). The AP established new inspection and reporting requirements that increase the IAEA's authority

[1] Cohen, Avner, *Israel and the Bomb,* (New York: Columbia University Press, 1988), 16.

and ability to evaluate a state's declaration of nuclear materials and activities by allowing the IAEA to check the correctness and the *completeness* of the declaration. The completeness requirements enable the IAEA inspectors to search for undeclared nuclear materials and/or undeclared activities in a state.

Of course, some dissenting voices among NNWS still persist. But the evolution in thinking is strong. At the 2005 NPT Review Conference, Malaysia submitted a working paper on behalf of the Non-Aligned States that focused on the right to peaceful use, but also recognized that the Parties' "inalienable right to develop research, production and use of nuclear energy for peaceful purposes" should be "*in conformity with articles I, II, and III of the Treaty….*"[2]

This statement is significant because it acknowledged the link between Articles I, II and III with Article IV: exercise of the right to peaceful nuclear technology is contingent upon meeting the Article I (NWS) or II (NNWS) commitment to not aid in or manufacture or otherwise acquire nuclear weapons, and the Article III obligation to accept IAEA safeguards. Thus, the exercise of the right to the technology is contingent on the state desiring to access the technology to reassure the international community of its solely peaceful intent by its full implementation of the obligations of the NPT.

5.0 Indicators of Peaceful Use

Given this evolution, it is of interest to find a method for the international community to evaluate a state's intent in acquiring nuclear material, equipment or technology. Table 1 presents four categories of indicators that can help in determining whether or not a state is or will be pursuing nuclear energy for solely peaceful purposes. They are: (1) a state's nonproliferation credentials; (2) a state's track record in fulfilling its NPT Article III safeguards obligations and its commitment to transparency; (3) the coherence of a state's nuclear program; and (4) the geopolitical context in which a state chooses to operate. The first column of the table provides the specific indicator, the second column provides a metric which might point to a state's possible non-peaceful use of its nuclear material, equipment, or technology; the third column provides a metric for states that demonstrate good peaceful use bona fides, and the fourth column provides a metric for states that meet a higher standard of peaceful use bona fides. This fourth category could used as a matter of policy to confer benefits on a state such as less onerous safeguards inspection by the IAEA or better access to nuclear technology from supplier countries.

The first category, **Nonproliferation Credentials**, focuses on the state's adherence to and participation and leadership in nonproliferation regimes. The minimum standard for a state to demonstrate the peaceful purposes of its nuclear program is ratification and full adherence to the NPT. States may demonstrate a greater level of commitment by ratifying a regional Nuclear Weapons Free zone Treaty and/or working with other countries to facilitate their compliance with the NPT, or by participation in any applicable regional nonproliferation regimes such as the Brazil-Argentine Agency for Accounting

[2] 2005 Review Conference Working Paper by the Group of Non-Aligned States Parties to the NPT, NPT/CONF.2005/WP.20, para. 1.

and Control of Nuclear Materials. Conversely, states that have not signed the NPT or ratified it, that express reservations about NPT adherence, or threaten to withdraw from the NPT regime are providing indications that undermine their assertions regarding their peaceful use intentions.

Table 1 – *Peaceful Use Indicators (Nonproliferation Credentials)*

		Non-peaceful Use Indicator	**Peaceful Use Minimum Indicator**	**Elevated Peaceful Use Indicator**
Nonproliferation Credentials	Metric	Threatened or actual withdrawal from NPT	Ratification and full adherence to NPT	Declared policies supporting NPT regime; enables NPT compliance by other countries
	Metric	No signature to any nonproliferation treaty	Participation in regional nonproliferation regimes if applicable	Member NWFZ; ratified CTBT

The second category is **Transparency and Fulfillment of Article III Obligations**. States demonstrate a peaceful intent commitment by concluding comprehensive safeguards agreements and subsidiary arrangements with the IAEA, declaring all nuclear materials and activities, fully complying with their safeguards agreements, developing complete State Systems of Accounting for and Control of Nuclear Material (SSAC), fully cooperating with the IAEA inspectors, and conducting trigger list exports and imports in compliance with Article III.2 of the NPT. If a state does not, for example, cooperate with the IAEA by refusing to provide nuclear material for inspection or by refusing access as agreed in its safeguards agreement to IAEA inspectors, this is a strong indicator of non-peaceful intent.

The higher standard for demonstrating good peaceful use bona fides includes a state's acceptance and implementation of an Additional Protocol (AP). Concluding an AP and implementing it and its subsidiary arrangements (where appropriate) by providing a correct and complete declaration of nuclear sites, materials, and equipment and providing trigger list export information to the IAEA, as appropriate, will meet these requirements. Maintaining a highly effective SSAC and opening up a nuclear program to international scrutiny by volunteering for visits by an IAEA peer review team such as an Operational Safety Review Team, or other international organizations such as the World Association of Nuclear Cooperators (WANO) can provide additional assurances of peaceful intent.

There are some examples of states which have overcome significant international concerns by providing for transparency in their nuclear programs to increase international confidence in their peaceful intent. One such example is South Africa. When South

Africa decided in 1994 to dismantle its nuclear weapons program and join the NPT as a non-nuclear weapons state (NNWS), it was highly cooperative and provided the IAEA with open access to its nuclear sites to establish the completeness and correctness of its initial inventory.

Table 2 – *Peaceful Use Indicators (Fulfillment of Article III Obligations)*

		Non-peaceful Use Indicator	**Peaceful Use Minimum Indicator**	**Elevated Peaceful Use Indicator**
Fulfillment of Article III Obligations	Metric	Safeguards agreement not in force; subsidiary arrangements not in place	Safeguards agreement and subsidiary arrangements in force	AP and subsidiary arrangements to AP (as applicable)
	Metric	Noncompliance with safeguards agreements; confirmed undeclared nuclear facilities or materials	Full compliance with safeguards agreements; no undeclared nuclear facilities or materials	No undeclared facilities or materials; confirmed correct and complete expanded declaration per AP
	Metric	Interference with, suspension, or prevention of safeguards inspections	Full cooperation in conduct of safeguards inspections	Complementary access per AP
	Metric	Inadequate or poorly functioning SSAC	SSAC satisfies IAEA guidelines	Exemplary SSAC
	Metric	Exports of EDP[3] equipment or materials not under safeguards (noncompliance with NPT III.2)	Exports of EDP equipment or materials under safeguards (complies with NPT III.2)	Export information per AP provided to IAEA
	Metric		Research base supporting technical studies ensuring safety of nuclear program; nuclear operator training; nuclear regulatory body	

The third category of indicators is the **Coherence of a State's Nuclear Energy Program**. The indicators are intended to answer the question - Are the elements of this state's current and planned nuclear program logical and consistent economically, technically, with the state's stated peaceful purposes? The indicators in this category are more subjective than those in the first two categories.

[3] Especially designed or prepared (EDP).

The most powerful metric for this indicator deals with any possible identification of a state's activities that fall into the weaponization category. States pursuing any activities that lay solely on the weapons development pathway as indicated in Figure 1 raise immediate concern about their peaceful intent. Indeed, this metric is a "smoking gun" for non-peaceful use.

The other metrics for this indicator which demonstrate a state's good peaceful use bona fides are agreement not to operate reactors powered by highly-enriched uranium fuel, agreement to forsake enrichment and reprocessing facilities, agreement to fuel leasing, and/or not to store highly-enriched uranium fuel (either spent or fresh) in country. These indicators do require some judgment and should be used to add to an analysis rather than as the basis for a conclusion on a state's peaceful use bona fides.

Nuclear program coherence may be illustrated by some remarks by Joseph Cirincione, previous Director for Nonproliferation at the Carnegie Endowment for International Peace. He wrote, "It does not make economic sense for any nation to invest the billions of dollars needed for indigenous fuel fabrication unless the national infrastructure consists of twenty or more nuclear reactors."[4] While 20 reactors may represent an outside limit, if a state embarks on enrichment and/or reprocessing technology before its first power reactor is even operational, it certainly may find itself subject to significant suspicion regarding its nuclear program goals.

A state's choice to develop enrichment or reprocessing facilities raises cause for serious concern if the state is unable to articulate a reasonable economic, technical or energy security justification for such an investment. While evaluating the justification is inherently somewhat subjective, the economics of nuclear energy do allow for some uniformity of analysis. A review of costs and benefits from a nuclear program could allow the IAEA and member states to reach consensus on a nuclear program's coherence.

Another means to demonstrate peaceful use bona fides is for a state to share its facility ownership with another state or accept multilateral ownership or control over its nuclear facilities. In 2005, an expert group convened by the IAEA positively evaluated the concept of multilateral ownership of nuclear fuel cycle facilities.[5] Multilateral ownership, such as exists with EURODIF and URENCO, increases the transparency of the facility operations and makes it difficult for a state to turn the facility to non-peaceful use.

A significant indicator of peaceful use bona fides can be a state's acceptance of fuel leasing and/or to forgo enrichment and reprocessing plants of its own. This concept is basis for the U.S. Government's Global Nuclear Energy Partnership (GNEP). One of the program's goals is to limit further development of these sensitive nuclear facilities beyond the countries where they already exist. Some initial evaluation of the practicality of fuel leasing indicates that the states that currently possess enrichment capability are

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[4] Joseph Cirincione, *Controlling Iran's Nuclear Program*, http://www.issues.org.3/cirincione.html.

[5] Multilateral Approaches to the Nuclear Fuel Cycle - Expert Group Report to the Director General of The International Atomic Energy Agency, 2005, p. 6.

sufficiently spread across the political spectrum to virtually assure that if any supplier state should choose to block fuel supplies to a particular recipient for political reasons (as opposed to basing the decision on legitimate proliferation concerns), there would be another supplier state willing and able to fill the breach.

Table 3 – *Peaceful Use Indicators (Coherence of Nuclear Energy Program)*

		Non-peaceful Use Indicator	**Peaceful Use Minimum Indicator**	**Elevated Peaceful Use Indicator**
Coherence of Nuclear Energy Program	Metric	Development, acquisition, or plans for sensitive nuclear facilities lacking reasonable economic or energy security justification	Current and planned nuclear fuel cycle facilities have reasonable economic or energy security justification	Agreement to forego enrichment and reprocessing and other sensitive facilities or implement multilateral ownership/control of facilities
	Metric	Operating research reactor(s) fueled with HEU and no willingness to decommission or convert to LEU; retains sensitive nuclear facilities	Commitment to decommission or convert and HEU research reactors to LEU; agreement on multilateral ownership/control of sensitive facilities	No research reactors operating with HEU; agreement to close sensitive nuclear facilities
	Metric	Fresh or spent HEU fuel in storage with no willingness to plan or arrange for return to supplier	Commitment or arrangement for return of fresh or spent HEU to supplier	No fresh or spent HEU in storage; active arrangements for HEU return to supplier
	Metric	Fuel cycle activities lay solely on weapons development pathway	Fuel cycle activities do not lay solely on weapons development pathway	

The fourth indicator is **Geopolitical Cooperation**. Many sources have cited the importance of political integration as an indicator of a state's willingness to follow international norms and treaty commitments such as those for nonproliferation.[6] These states are also most likely to turn to the international community for help rather than view the international community as the problem or worse. Countries which choose to isolate themselves may believe they have fewer options within the international context and pursue drastic means such as nuclear or radiological weapons for security. When considered singularly, treaty commitments or other political cooperation mechanisms are unlikely to be conclusive indicators. But as an influencing factor considered together

[6] Etel Solingen,

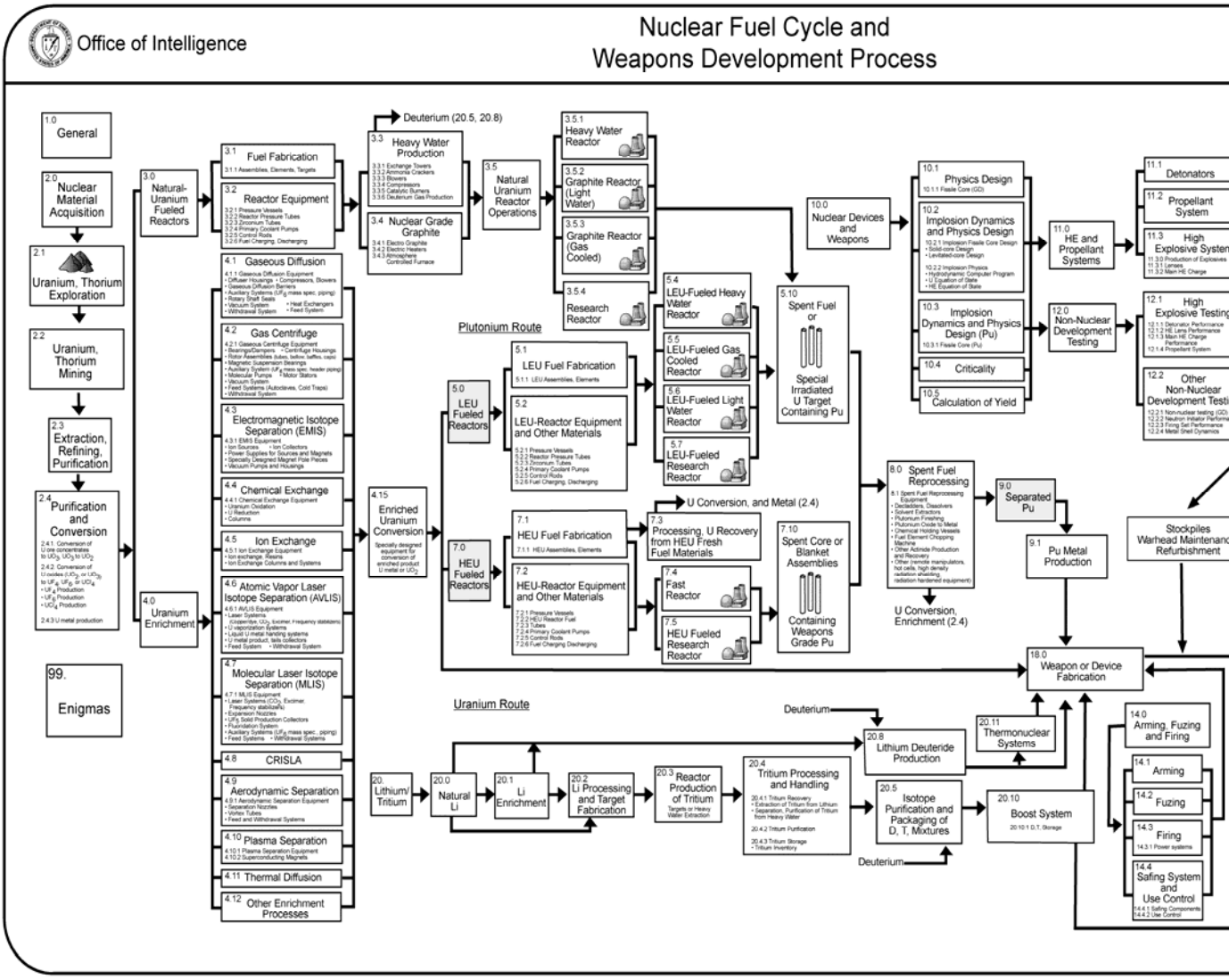
with the other indicators, however, political cooperation by a state can help refine an analysis developed from the preceding criteria. For example, the international community seems to have found Brazil's plans to develop commercial-scale enrichment facilities less objectionable than similar plans announced by Iran. One of the notable differences between Brazil and Iran is the relative political isolation that Iran appears to have chosen rather than to cooperate more broadly with the international community. Brazil, on the other hand, is an active player in many international fora and appears more concerned with behaving in a manner that is more or less acceptable to the international community, which is an indication that nonproliferation norms may be respected. Also, if governments have good track records with respect to implementation of international treaties, especially of the NPT, this can provide a reassurance of their peaceful intent. For example, it is hard to imagine proliferation concerns with respect to Belgium or Canada which have long and strong track records of biding by international commitments.

Its sense of position in the regional hierarchy or of its region's stability may also be contributors to a state's proliferation decision. The degree to which a state feels stable and/or is satisfied with its position in its region can be factors in its evaluation of the need for nuclear weapons. When considered by itself, a state's perception of its position vis a vis regional stability may be unlikely to be sufficient to make a conclusion concerning a state's nuclear intentions. But when considered with the other indicators, a state's perception of its regional position or its region's stability (or lack thereof) can be judged as part of the factors which might motivate it to develop stronger security mechanisms such as nuclear weapons.

Table 4 – *Peaceful Use Indicators (Geopolitical Cooperation)*

		Non-peaceful Use Indicator	**Peaceful Use Minimum Indicator**	**Elevated Peaceful Use Indicator**
Geopolitical Cooperation	Metric	Country located in area of regional or interstate instability or perceives its position in regional hierarchy to be unacceptable	Country located in area of moderate to high regional or interstate stability; its position in regional hierarchy is acceptable	Country located in area of high overall stability and/or its position in regional hierarchy is satisfactory
	Metric	Few to no international treaty obligations or commitments	Member of major international nuclear treaties (Nuclear Safety Convention; CPNMM; Spent fuel and Nuclear Waste Convention; Nuclear Terrorism, Assistance and Notification Conventions)	Member of other multilateral nonproliferation mechanisms (Proliferation Security Initiative; Nuclear Suppliers Group)

Figure 1 – *Nuclear Fuel Cycle and Weapons Development Process*



Prepared by Pacific Northwest National Laboratory

Peaceful Use Bona Fides: Brazil Case Study

1.0 Summary

Brazil joined the Treaty on the Nonproliferation of Nuclear Weapons (NPT) in 1997 and is considering concluding an Additional Protocol (AP) with the International Atomic Energy Agency (IAEA). Brazil has come a very long way in its commitment to nonproliferation in the last 15 years. Through a series of extraordinary political changes and achievements, Brazil diffused its nuclear rivalry with Argentina in the 1990s, which included a weapons program. It created a unique bilateral state system of nuclear materials accounting and control with Argentina, the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC). The two states built upon that agreement in the Quadripartite Agreement, which provides full-scope nuclear safeguards for Brazil and Argentina and includes ABACC and the IAEA as parties. The IAEA Safeguards Statement for 2005 declared that Brazil has no declared nuclear materials that are unaccounted for. Brazil either meets the minimum or higher standards for peaceful uses bona fides in each of the four categories of indicators identified to demonstrate strong nonproliferation commitments as presented in "Peaceful Use Bona Fides: Criteria for Evaluation" (see Table 1).[7]

Brazil, while not perfectly satisfying the higher standard in every indicator category, appears to have transparent and coherent nuclear programs. In addition to meeting its obligations under its IAEA safeguards agreement, it has allowed additional visits by outside nonproliferation and safety experts and inspectors such as through the IAEA Operational Safety Review Team (OSART) Services. Brazil possesses an open nuclear fuel cycle and has placed its centrifuge enrichment plant under safeguards. It plans to expand its nuclear power production capacity to meet its economy's growing energy demand as well as to produce nuclear fuel for export. Brazil took two years at considerable industrial cost to negotiate mutually acceptable arrangements with the IAEA for safeguarding its centrifuge enrichment facility at Resende, Rio de Janiero. Some may view this effort as evidence of an uncooperative attitude or of Brazil being overly protective of industrial secrets, but in the end a mutually safeguards approach was agreed by Brazil and the IAEA, evidencing Brazil's commitment to the NPT.

Brazil is well integrated into the international nonproliferation system and is party to numerous nonproliferation regimes and international agreements. It currently chairs the Nuclear Suppliers Group. It is currently operating three research reactors with low enriched uranium. Based on Brazil's record of moving away from development of nuclear weapons to full NPT membership and consideration of an Additional Protocol, it is now clear that Brazil meets the minimum good peaceful use bona fides (PUBF) standard and appears to be progressing toward the higher standard.

[7] Frederic A. Morris, et al., "Peaceful Use Bona Fides: Criteria for Evaluation." PNNL, 2006.

2.0 Case Study Background

This study applies the criteria developed in the previous study, "Peaceful Use Bona Fides: Criteria for Evaluation", to evaluate the peaceful uses bona fides of Brazil. Table 1 shows the four indicators identified for assessing a country's peaceful use of nuclear energy: (1) nonproliferation credentials, (2) transparency and fulfillment of NPT Article III safeguards obligations, (3) coherence of a country's nuclear programs from an economic and technology standpoint, and (4) the country's engagement in geopolitical cooperation.

3.0 Brazil's Peaceful Uses Bona Fides

3.1 Brazil's Nonproliferation credentials

The first indicator for a state to demonstrate its peaceful use bona fides is its nonproliferation credentials. The minimum standard for this indicator is to be a member of and adhere fully to the NPT. It is considered of higher value if the country has adhered to any other applicable regional nonproliferation regimes. Brazil's nuclear nonproliferation policy has come a very long way in the last 15 years. Its secret nuclear weapons program that it publicly revealed of its own accord is now ended and it has publicly committed to peaceful use. It joined the NPT in 1997. The IAEA Safeguards Statement for 2005 categorized Brazil as a State Party that does not have an Additional Protocol (AP), but whose "declared nuclear material remained in peaceful activities."[8] By virtue of its rigorous state accountancy system and its NPT commitment status, Brazil meets the minimum standard for the first PUBF nonproliferation indicator.

A higher level of nonproliferation commitment can be demonstrated by a country working with others to facilitate their compliance with the NPT, as well as through ratification of regional nuclear weapons-free zones. Brazil is party to several nonproliferation treaties and the Latin American nuclear free zone treaty, including, respectively, the Comprehensive Test-ban Treaty (CTBT), Partial Test-ban Treaty and the Tlatelolco nuclear weapon free zone Treaty.[9] Brazil is a member of the New Agenda Coalition (NAC), which holds that the slow pace of disarmament by nuclear weapons states (NWS) undermines the NPT.[10] See Table 2 at the end of this case study for a complete list of Brazil's membership in international nuclear treaties and other political organizations. Taken together, these factors indicate that Brazil has a strong nonproliferation commitment and meets the higher level criteria for PUBF in this first category.

[8] IAEA Safeguards Statement for 2005, p. 1, para. 2; http://www.iaea.org/OurWork/SV/Safeguards/es2005.pdf.
[9] NTI Brazil page: Treaties and Organizations; http://www.nti.org/e_research/official_docs/inventory/pdfs/brazil.pdf.
[10] Miles A. Pomper and William Huntington, Arms Control Association, "Coming to Terms with Brazil's Nuclear Past," Interview with Odair Gonçalves, President of Brazil's Nuclear Energy Commission, FN 7; http://www.armscontrol.org/interviews/20050928_Goncalves.asp#note05.

Table 5 - *Indicators of Brazil's Nonproliferation Credentials*

		Non-peaceful Use Indicator	Peaceful Use Minimum Indicator	Elevated Peaceful Use Indicator
Nonproliferation Credentials	Metric	Threatened or actual withdrawal from NPT	Ratification and full adherence to NPT	Declared policies supporting NPT regime; enables NPT compliance by other countries
	State action/ activity		**Brazil ratified the NPT in 1997; Brazil's nuclear materials were determined in 2005 to have remained in peaceful activities**[11]	**Quadripartite/ABACC agreements require close Brazilian-Argentine and IAEA cooperation for full-scope safeguards compliance**
	Metric	No signature to any nonproliferation treaty		Member NWFZ; ratified other nonproliferation treaties
	State action/ activity			**Party to Treaty of Tlatelolco (and amendment); CTBT and PTBT**

3.2 Brazil's Fulfillment of Article III Obligations and Transparency of Program

The second PUBF indicator evaluates how a state demonstrates fulfillment of its NPT Article III safeguards obligations and transparency in its nuclear program. A state does the first by concluding a comprehensive safeguards agreement and subsidiary arrangements with the IAEA, declaring all nuclear materials and activities, fully complying with the safeguards agreement, developing a complete and effective SSAC, fully cooperating with IAEA inspectors, and conducting trigger list exports and imports in compliance with NPT Article III.2.

Brazil has not concluded an Additional Protocol with the IAEA, but is considering doing so Its joint system of nuclear materials accounting and control with Argentina, the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials, ABACC) is a unique, two-state regional nonproliferation regime employing a rigorous state system of accounting for and control of nuclear materials (SSAC) in both countries.[12] The

[11] IAEA Safeguards Statement for 2005, p. 1, para. 2; p. 11, "List of States" "The 77 states listed in paragraph 2 are…Brazil…."

[12] See INFCIRC/435, "Agreement of 13 December 1991 between the Republic of Argentina, the Federative Republic of Brazil, the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials and the International Atomic Energy Agency for the Application of Safeguards" (March 1994).

subsequent quadripartite agreement (signed by Brazil, Argentina, the IAEA and the ABACC) provides for full-scope IAEA safeguards on Argentine and Brazilian nuclear materials, full rights over any proprietary technology developed by both countries, and nuclear energy for the propulsion of submarines. Brazil's Quadripartite Agreement with Argentina provides for full-scope IAEA safeguards on Argentine and Brazilian nuclear installations. As mentioned above, ABACC provides Brazil with a complete and effective SSAC. Brazil's two-year long negotiations with the IAEA over to the safeguards approach at its Resende enrichment facility raised some concern as to its over-protectiveness or uncooperativeness with the IAEA. However, the safeguards approach was agreed and Brazil has committed to adhere to the safeguards requirements despite the initial concerns over the high industrial cost of protecting proprietary technology. As for trigger list export and import control, Brazil is a member of the Nuclear Suppliers Group (NSG) and assumed its chairmanship in January 2006.[13] It is a member of the Missile Technology Control Regime, and has submitted timely UNSC resolution 1540 reports. Brazil therefore appears to meet the minimum PUBF standard for transparency and Article III compliance.

For a state to demonstrate the higher level of transparency it can volunteer for additional visits of the IAEA or international organizations such as the World Association of Nuclear Operators (WANO). Or, with access to the site in question, the IAEA's OSART or International Physical Protection Advisory Service (IPPAS) could provide additional assurances of the state's openness and peaceful intent. IAEA publications indicate Brazil has received five OSART visits, the most recent being in 2005,[14] and that Brazil has taken part in IAEA workshops to formulate its own design basis threat programs to design and evaluate physical protection for its nuclear facilities.[15] These instances may have provided the IAEA additional transparency as to Brazil's commitment to peaceful use of nuclear energy. Brazil appears to be just short of achieving the highest level of demonstrating transparency and fulfillment of NPT Article III obligations, due primarily to its lack of an AP.

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http://www.iaea.org/Publications/Documents/Infcircs/Others/inf435.shtml

[13] Steve Kidd, "A Latin Nuclear Revival?" Nuclear Engineering International, January 26, 2006; http://www.neimagazine.com/story.asp?sectionCode=147&storyCode=2034782.

[14] IAEA OSART 2005 Brochure, p. 4; http://www-ns.iaea.org/downloads/ni/s-reviews/osart/OSART_Brochure.pdf#search=%22Brazil%20IAEA%20Operational%20Safety%20Review%22.

[15] IAEA Annual Report 2004 - Nuclear Security, p. 54; http://www.iaea.org/Publications/Reports/Anrep2004/nuclear_security.pdf#search=%22brazil%20International%20Physical%20Protection%20Advisory%20Service%22.

Table 6 - *Indicators of Brazil's Fulfillment of Article III Obligations*

		Non-peaceful Use Indicator	Peaceful Use Minimum Indicator	Elevated Peaceful Use Indicator
Fulfillment of Article III Obligations	Metric	Safeguards agreement not in force; subsidiary arrangements not in place	Safeguards agreement and subsidiary arrangements in force	AP and subsidiary arrangements to AP (as applicable)
	State action/ activity		**Quadripartite/ABACC provides for full-scope IAEA safeguards; subsidiary arrangements in place**	**AP is under consideration**
	Metric	Noncompliance with safeguards agreements; confirmed undeclared nuclear facilities or materials	Full compliance with safeguards agreements; no undeclared nuclear facilities or materials	No undeclared facilities or materials; confirmed correct and complete expanded declaration per AP
	State action/ activity		**Full compliance with Quadripartite/ABACC agreements; extensive recent negotiations regarding Resende enrichment facility successfully completed**	
	Metric	Interference with, suspension, or prevention of safeguards inspections	Full cooperation in conduct of safeguards inspections	Complementary access per AP
	State action/ activity		**Past disagreement with IAEA over protection of centrifuge enrichment technology at Resende is now resolved; IAEA is now confident that it has necessary information to make safeguards conclusions about he facility.**	
	Metric	Inadequate or poorly functioning SSAC	SSAC satisfies IAEA guidelines	Exemplary SSAC

		Non-peaceful Use Indicator	Peaceful Use Minimum Indicator	Elevated Peaceful Use Indicator
Fulfillment of Article III Obligations, cont.	State action/ activity			**Highly effective SSAC per Quadripartite/ABACC agreements**
	Metric	Exports of EDP[16] equipment or materials not under safeguards (noncompliance with NPT III.2)	Exports of EDP equipment or materials under safeguards (complies with NPT III.2)	Export information per AP provided to IAEA
	State action/ activity		**Brazil is a Nuclear Supplier Group member; Brazil chaired NSG plenary in 2006**	
	Metric		Research base supporting technical studies ensuring safety of nuclear program; nuclear operator training; nuclear regulatory body	Sponsorship of international forum, meetings or workshops promoting nuclear safety and/or nonproliferation training and cooperation
	State action/ activity		**Brazil has five nuclear research centers; the Angra power plant simulator has provided operator training for utilizes from countries such as Spain, Switzerland, Germany and Argentina**[17]	**Brazil hosted the IAEA's 2002 Conference on Safety Culture in Nuclear Installations**[18]

3.3 Coherence of Brazil's Nuclear Programs

The third PUBF indicator is the coherence of a state's nuclear energy program. Coherence refers to whether a state's current or planned nuclear program is logical and consistent economically and technically, and is operated within its stated peaceful purposes. For example, the size of any enrichment facility must be congruent with a country's stated purpose for it. If a country states that its enrichment is for domestic use, then the size of its facility should be sufficient to fuel existing and planned power plants. If it is to sell fuel to other countries, it could be larger. Thus, how sensibly a state relates its needs to its goals for peaceful use of nuclear energy offers an indication of its programs' coherence.

[16] Especially designed or prepared (EDP).
[17] IAEA Brazil Country Profile 2003.
[18] IAEA International Conference on Safety Culture in Nuclear Installations 2002, Rio de Janiero, Brazil: Announcement and Call for Papers; http://www.iaea.org/worldatom/Meetings/2002/infcn97.shtml.

Brazil's rationale for developing domestic enrichment capability is to make operation of its nuclear power plants more economical by eliminating the cost of overseas enrichment services.[19] Brazil is the world's fifth-largest country and has extensive developed and undeveloped hydroelectric power and natural uranium reserves. Hydroelectric power plays the paramount role in the Brazilian electricity system while thermal power plants (both conventional and nuclear) are minor contributors.[20] Its economy and demand for electricity are growing and its two reactors provide only 4% of its electricity supply.[21] By enriching domestically, Brazil expects to save at least $12 million per year. This is not much compared with the approximately $180 million investment Brazil Nuclear Industries (INB) is making at Resende, not including operational costs.[22] However, one possible scenario is that Brazil will finish the 1300MW Angra 3 reactor, build another 1,300MW plant and two more Brazilian-designed 300 MW plants. This potential expansion in power capacity would be designed to meet the growing need for electricity in Brazil's most population dense state of Rio de Janiero where hydropower is over-tapped.

In addition to domestic energy production, Brazil hopes in the future to participate in the $5-billion-a-year global nuclear fuel market.[23] About 90 percent of the world's nuclear power plants depend on foreign enrichment services to get their fuel. Demand for enriched uranium over the next two decades could justify Brazil's investment in the capability.[24] More recent estimates of output at the Resende enrichment facility vary between 200,000[25] and 300,000 SWU annually.[26] Current goals are to produce 20 to 30 metric tons of enriched uranium per year, or about 60 percent of domestic fuel requirements, by 2008 or 2009, possibly reaching 100 percent by 2010.[27] Therefore, with rising electricity demand, adequate natural uranium reserves, the possibility of constructing several more power plants and a stated desire to sell nuclear fuel, Brazil's justification for domestic enrichment is coherent on its face.

Beyond these requirements are crucial technical policy choices a state makes on whether to convert its reactors powered by highly enriched uranium (HEU) to low enriched uranium (LEU) and, if relevant, to forgo reprocessing spent fuel to separate the plutonium. Brazil has four operating research reactors, all of which now operate with

[19] See more about Brazil's nuclear program and history in the appendix to this paper.
[20] IAEA Brazil Country Profile 2003.
[21] Steve Kidd.
[22] Erico Guizzo, "How Brazil Spun the Atom," Spectrum Online (IEEE) March 2006, http://www.spectrum.ieee.org/mar06/3070.
[23] Ibid. See quotes by Samuel Fayad Filho, director of nuclear fuel production at Nuclear Industries of Brazil; http://www.spectrum.ieee.org/mar06/3070.
[24] IAEA, INFCIRC/640, "Multilateral Approaches to the Nuclear Fuel Cycle: Expert Group Report submitted to the Director General of the International Atomic Energy Agency," p. 49, para. 129; http://www.iaea.org/Publications/Documents/Infcircs/2005/infcirc640.pdf#search=%22IAEA%2C%20INFCIRC%2F640%22.
[25] Steve Kidd, "A Latin Nuclear Revival?" Nuclear Engineering International, January 26, 2006; http://www.neimagazine.com/story.asp?sectionCode=147&storyCode=2034782.
[26] IAEA Brazil Country Profile 2003.
[27] Erico Guizzo, "How Brazil Spun the Atom," Spectrum Online (IEEE) March 2006, http://www.spectrum.ieee.org/mar06/3070.

LEU. In the past Brazil did receive stocks of HEU from the United States and China. All spent HEU fuel has been returned to the US.[28] Of the 200 kg of 20.05% HEU received from China, about 30-50 kg was mixed with LEU and used in a small indigenous reactor and the remainder was blended down to slightly below 20% enrichment.[29]

With respect to reprocessing, in 1989 Brazil purportedly closed a small military reprocessing center; and in 1990 President Collor de Mello closed a test site at Cachimbo, Pará related to Brazil's then nuclear weapons program. These actions brought the weapons program to a close.

It plans to expand its low enrichment capability at Resende over time. It has closed its previous nuclear weapons related nuclear facilities. It has concluded extensive agreements with its former nuclear rival, Argentina, which assist both with meeting their obligations under the NPT. Brazil exceeds the minimum PUBF standard for program coherence and transparency, but falls just short of meeting the higher standard.

Table 7 - *Coherence of Brazil's Peaceful Nuclear Energy Program*

		Non-peaceful Use Indicator	**Peaceful Use Minimum Indicator**	**Elevated Peaceful Use Indicator**
Coherence of Nuclear Energy Program	Metric	Development, acquisition, or plans for sensitive nuclear facilities lacking reasonable economic or energy security justification	Current and planned nuclear fuel cycle facilities have reasonable economic or energy security justification	Agreement to forego enrichment and reprocessing and other sensitive facilities or implement multilateral ownership/control of facilities
	State action/ activity		**Brazil's stated plans for power generation and sale of enriched fuel meet output estimates for its Resende enrichment facility**	**Brazil's spent fuel reprocessing capability has been shut down; no active commercial reprocessing of spent reactor fuel**
	Metric	Operating research reactor(s) fueled with HEU and no commitment to decommission or convert to LEU; retains sensitive nuclear facilities	Commitment to decommission or convert and HEU research reactors to LEU; agreement on multilateral ownership/control of sensitive facilities	No research reactors operating with HEU; agreement to close sensitive nuclear facilities

[28] "The NRC records 9 kg of US-origin HEU exported to Brazil, while and Argonne National Laboratory study counts only 8 kg… the additional kg of US-origin HEU recorded by the NRC may remain in Brazil." David Albright and Kimberly Kramer, "Tracking Inventories of Civil Highly Enriched Uranium," ISIS Civil HEU Watch, February 2005, revised August 2005; http://www.isis-online.org/global_stocks/end2003/civil_heu_watch2005.pdf

[29] Ibid.

		Non-peaceful Use Indicator	Peaceful Use Minimum Indicator	Elevated Peaceful Use Indicator
Coherence of Nuclear Energy Program, cont.	State action/ activity			**No research reactors operating with HEU**
	Metric	Fresh or spent HEU fuel in storage with no plans or arrangement for return to supplier	Commitment or arrangement for return of fresh or spent HEU to supplier	No fresh or spent HEU in storage; active arrangements for HEU return to supplier
	State action/ activity		**HEU fuel assemblies returned to U.S. under the Foreign Research Reactor Spent Fuel Acceptance Program**[30]	**All spent HEU fuel has been returned to the U.S.; only other HEU was received from China and has been downblended to LEU just under 20%**[31]
	Metric	Fuel cycle activities lay solely on weapons development pathway	Fuel cycle activities do not lay solely on weapons development pathway	See minimum peaceful use indicator
	State action/ activity		**Once secret weapons program discontinued; light water reactors; enrichment facility under full-scope safeguards**	**Former prototype naval propulsion program redirected to possible peaceful applications for small power plants**

3.4 Brazil's Geopolitical Cooperation

The fourth and final PUBF indicator is geopolitical cooperation. The level of a state's political integration can be an important factor in illustrating its willingness to follow international norms and honor treaty commitments. History has shown that countries perceiving themselves to be isolated may believe that nuclear or radiological weapons are the only security option.

Brazil is an active participant in many international efforts such as the Generation IV International Forum and International Project on Innovative Reactors (INPRO) programs,[32] multiple treaties and organizations, and appears to be concerned with acting in a manner that is acceptable to the international community. Moreover, Brazil has given up a nuclear weapons program and formed a partnership with its former enemy and the IAEA. See Table 2.

[30] http://www-pub.iaea.org/MTCD/publications/PDF/te_1508_web.pdf
[31] http://www.isis-online.org/global_stocks/end2003/civil_heu_watch2005.pdf
[32] IAEA Brazil Country Profile 2003.

Table 8 - *Indicators of Brazil's Geopolitical Cooperation*

		Non-peaceful Use Indicator	Peaceful Use Minimum Indicator	Elevated Peaceful Use Indicator
Geopolitical Cooperation	Metric	Country located in area of regional or interstate instability	Country located in area of moderate to high regional or interstate stability	Country located in area of high overall stability
	State action/ activity		**Former nuclear competition with Argentina has subsided**	**Some degree of low-level regional conflict and some internal but strong economic and cultural ties across region**
	Metric	Few to no international treaty obligations or commitments	Member to major international nuclear and nonproliferation treaties	Member to other multilateral nonproliferation mechanisms (Proliferation Security Initiative; Nuclear Suppliers Group)
	State action/ activity		**Party to Nuclear Safety Convention; CPNMM; Spent fuel and Nuclear Waste Convention; Nuclear Terrorism, Assistance and Notification Conventions**	**Nuclear Suppliers Group member**

4.0 Conclusion

Brazil's peaceful uses bona fides are strong. In all four criteria Brazil meets either the minimum or higher standard for peaceful use bona fides. After revealing and disavowing its clandestine nuclear weapons program, Brazil joined and has adhered to the NPT. It has not concluded an AP, but is considering doing so and has engaged in recent, extensive safeguards negotiations with the IAEA over its Resende enrichment facility, which reached a mutually satisfactory outcome. Brazil currently chairs the Nuclear Suppliers Group (NSG) and appears to have a coherent, transparent nuclear power program and Brazil is party to most important international nuclear and nonproliferation treaties and organizations. Therefore, it is arguable that Brazil meets the higher PUBF standard.

Peaceful Use Bona Fides: Iran Case Study

1.0 Summary

Iran does not meet either the minimum or higher standards for peaceful uses bona fides in each of the four categories of indicators identified to demonstrate strong nonproliferation commitments as presented in Part I "Peaceful Use Bona Fides: Criteria for Evaluation." See Table 1. "Indicators of Peaceful Uses". Iran's nuclear program is the subject of much international concern and speculation. Iran claims the program is solely peaceful in its intent. The scope of its program is broad. It involves the full front end of the nuclear fuel cycle, because Iran desires to achieve energy independence by being able to supply its reactor(s) with fuel itself. The purpose of this study was to explore the elements of Iran's nuclear program, its statements and actions vis a vis the Nonproliferation Treaty and other international treaties, its cooperation with the International Atomic Energy Agency (IAEA) and the agency's inspections, and Iran's public and private actions and statements on its nuclear program and see what insight they give into Iran's peaceful uses intentions.

The exploration of Iran's actions and statements regarding its nuclear program since 2002 have indicated that Iran has made contradictory statements, inflammatory statements, denied IAEA safeguards inspectors access to some if its facilities at varying times, signed the Additional Protocol allowing interim right of its use for inspections and then taken back that right, refused IAEA inspections on some of its facilities until the facilities were complete, refused to hand over design information on some of its nuclear facilities to the IAEA, and generally made international verification of its nuclear program activities difficult if not impossible.

Iran's lack of willingness to recognize international concerns and to negotiate in good faith with the IAEA and the EU-3 has added to concerns that Iran's program is not fully peaceful. The evaluation below presents the details that led to the conclusion that it is not possible to declare that Iran's program is only peaceful in intent.

2.0 Case Study Background

In order to evaluate whether a country is using its nuclear programs solely for peaceful uses, a series of indicators were identified to describe why a country's actions and words can help determine whether it is keeping its commitment to a peaceful only nuclear program. These indicators are presented in the previous study, "Peaceful Use Bona Fides: Criteria for Evaluation".

Iran denies the existence of a nuclear weapons program, and maintains that as a party to the Nonproliferation Treaty, it has rights to the pursuit and development of nuclear energy for peaceful purposes. It argues that it must diversify its energy sources in the face of growing energy constraints and dwindling oil fields, and sees its civilian nuclear energy program as both a right and a necessity for the Islamic Republic. To this end, Iran is vigorously pursuing an indigenous fuel cycle capability.

These next sections apply the criteria for peaceful use bona fides in order to evaluate Iran's claims as to the non-weapons character of its nuclear program. Four categories of indicators will be used in this analysis to assess the State's peaceful use commitment: (1) nonproliferation credentials, (2) transparency and fulfillment of NPT Article III obligations, (3) coherence of its nuclear program, and (4) geopolitical cooperation.[33]

3.0 Iran's Peaceful Use Bona Fides

3.1 Iran's Nonproliferation Credentials

Nonproliferation credentials refer to a State's adherence to and participation in nonproliferation regimes, taking into account any leadership role. The minimum standard for a state to demonstrate the peaceful purposes of its nuclear program is ratification and full adherence to the NPT and any applicable regional nonproliferation regimes. A higher level of nonproliferation commitment can be demonstrated by a country working with others to facilitate their compliance with the NPT, or ratification of regional Nuclear Weapons-Free zones. In contrast, failure to sign and/or ratify the NPT, expressed reservations about adherence to, or threats to withdraw from the Treaty are indications that serve to undermine a State's peaceful use credentials.

As previously noted, Iran signed the NPT on the day it opened for signature, July 1, 1968, and ratified the Treaty on February 2, 1970. It signed the Additional Protocol on December 18, 2003, is a signatory to the Comprehensive Test Ban Treaty (CTBT), and State Party to the Partial Test Ban Treaty (PTBT). Iran does not participate in any regional nonproliferation regimes because there is no regional agreement in its region.

[33] See "Peaceful Use Bona Fides: Criteria for Evaluation." Chris Ajemian, Michael Hazel, Carol Kessler, Carrie Mathews, and Fred Morris. August 2006. The authors develop the methodology to assess the peaceful use intent of a state's nuclear program used in this analysis.

Although Iran is a party to the NPT, it has made inflammatory statements regarding the nonproliferation regime, and has threatened to withdraw from the NPT. It has made contradictory and proven to be untrue statements regarding its nuclear activities. In 2002, the National Council of Resistance of Iran provided information to the international community on the existence of two clandestine nuclear facilities in Iran—a uranium enrichment facility at Natanz and a heavy water production plant near Arak.[34]

The IAEA Board of Governors imposed an October 31, 2003 deadline on Iran to "resolve all outstanding issues and to provide full and complete declaration of its nuclear material and nuclear activities," to suspend all enrichment activities, and sign an Additional Protocol. Iran agreed to suspend sensitive activities in exchange for economic assistance from Germany, France, and the UK (collectively known as the EU-3) and to cooperate with the IAEA with full transparency and disclosure. The Islamic Republic further consented to signing the Additional Protocol and commencing its ratification procedures, as well as suspending all enrichment and reprocessing activities for an "interim period." In December 2003, Iran signed the Additional Protocol and agreed to its interim application in Iran.

The unnannounced inspections provided for under the Additional Protocol granted the IAEA greater access within Iran and the option to carry out intrusive inspections at Iran's nuclear facilities. Subsequent inspections in Iran provided a wealth of new information—and prompted a number of questions— related to the development and scale of Iran's nuclear program. Iran is generally viewed as having been "forthcoming and helpful to these IAEA efforts," yet its cooperation "has clearly not been absolute."[35] In June 2004, IAEA board members voted to reprimand Iran for not providing the Agency with more timely and comprehensive support, and rebuked Iran for postponing IAEA visits to a number of locations.

In August 2005, Iran resumed uranium conversion activities at Esfahan, thereby reversing the commitment to suspend all enrichment-related and reprocessing activities that it had made in November 2004. In February 2006, Iran abandoned negotiations with the EU-3, resumed small-scale uranium enrichment activities at the Natanz facility, and suspended interim application of the Additional Protocol.

These actions by Iran appear to indicate that although it has signed and ratified the NPT early, its succeeding governments did not see that commitment as critical. It appears they may have viewed the NPT commitment as a useful means to dissuade the international community and the IAEA from digging too deeply into its nuclear program activities. By words and actions indicted above it is questionable whether Iran meets the minimum standard for good nonproliferation credentials and falls into the non-peaceful category of this indicator wherein it has stated reservations about continued adherence to the NPT.

[34] The Natanz facility includes a pilot-scale enrichment facility planned to have 1,000 centrifuges and a commercial-scale plant under construction that will have 50,000 centrifuges. Both are subject to IAEA safeguards.
[35] http://www.nti.org/e_research/profiles/Iran/1819.html

Table 9 – *Indicators of Iran's Nonproliferation Credentials*

		Non-peaceful Use Indicator	Peaceful Use Minimum Indicator	Elevated Peaceful Use Indicator
Nonproliferation Credentials	Metric	Threatened or actual withdrawal from NPT	Ratification and full adherence to NPT	Declared policies supporting NPT regime; enables NPT compliance by other countries
	State action/ activity	**NPT withdrawal threatened since 2005**		
	Metric	No signature to any nonproliferation treaty	Participation in regional nonproliferation regimes if applicable; signature to nonproliferation treaty	Member NWFZ; ratified CTBT
	State action/ activity		**Signed CTBT**	

3.2 Iran's Fulfillment of NPT Article III Obligations/Transparency

Under the second category of indicators, States may demonstrate a peaceful intent commitment through the conclusion of comprehensive safeguards agreements and subsidiary arrangements with the IAEA, declaration of all nuclear materials and activities, full compliance with the safeguards agreement, development of a state system of accounting for and control of nuclear material (SSAC), full cooperation with IAEA inspectors, and control of exports and imports in full compliance with NPT Article III.2.

Iran has a comprehensive safeguards agreement in place with the IAEA; however, there have been many instances of non-compliance with this agreement. Subsidiary agreements are not fully in place. Moreover, Iran has not kept those subsidiary arrangements that are in place consistent with Agency practice. For example, the Agency modifies the standard text in 1992 to require early provision of the design information, but Iran did not accept this language until 2003.

In November 2004, an IAEA Board resolution noted Iran's agreement with the EU-3 to extend a previous decision to suspend all enrichment-related and reprocessing activities, to be verified by the Agency, and welcomed the IAEA Director General's intention to investigate such outstanding issues as the extent of Iran's centrifuge enrichment program as well as full implementation of Iran's safeguards agreement and Additional Protocol.

In refusing agreeing to the resolution, Iran simultaneously declared that it had no intention of completely abandoning its nuclear program.

In December 2004, the Agency sought access to two secret Iranian military sites where the main Iranian opposition group alleged nuclear activities have taken place: Parchin and Lavizan. Intelligence data indicated the potential conduction of explosives testing and the purchase of equipment that may be used for uranium enrichment. Iran then refused IAEA inspectors a second visit to Parchin in March 2005, thus hindering the Agency's ability to complete its investigation into Iran's centrifuge equipment and the source of nuclear contamination detected during earlier visits.

In August 2005, Iran notified the IAEA of its decision to resume uranium conversion activities at its conversion facility at Esfahan, a decision widely viewed as a breach of the November 2004 Paris Agreement holding Iran's suspension of all uranium-related activities as a prerequisite for dialogue. One month later, the IAEA Director General's report confirmed Iran's resumption of uranium activities and describing new findings in two main areas: one related to the origin of the low enriched uranium and highly-enriched uranium contamination found at various locations in Iran and the second related to the issue of the P-1 and P-2 technology used in its centrifuge program.

Iran's P-1 and P-2 centrifuge program has been an area of Agency investigation that characterizes the Iranian response to Agency requests for clarification. The IAEA criticized Iran for a "lack of forthrightness" about its possession of P-2 design drawings and other related research, [36] and information regarding its manufacturing and testing activities. This information, which was revealed in inspections following Iran's acceptance of the Additional Protocol, had been omitted from Iran's October 2003 declaration to the Agency. The Agency voted to reprimand Iran in June 2004 for not providing more timely and comprehensive support and rebuked its postponement of IAEA visits to a number of locations related to the centrifuge program.

In September 2005, the IAEA Board declared Iran "failed in a number of instances over an extended period of time to meet its safeguards agreements with respect to the reporting of nuclear material, its processing and its use, as well as the declaration of facilities where such material has been processed and stored."[37] Additionally, the IAEA found that Iran's "many failures and breeches" of its Safeguards Agreement constitute non-compliance within the meaning of the Agency's statute and that the absence of confidence that Iran's nuclear program is exclusively for peaceful purposes gives rise to questions that are within the competence of the United Nations Security Council (UNSC).[38]

After several more months of negotiations, Iran abandoned talks with the EU-3 and resumed uranium enrichment activities—the testing of a 10-centrifuge cascade with uranium hexafluoride gas (UF6)—and further suspended the interim application of the

[36] In particular, it is unclear whether Iran conducted any work between 1995 (when Iran received the centrifuges from oversees) and 2002, when Iran claims work on the centrifuges began.
[37] http://www.iaea.org/Publications/Documents/Board/2005/gov2005-67.pdf
[38] http://www.nti.org/e_research/profiles/Iran/1819.html

Additional Protocol. Iran informed the Agency that "our commitment to implementing safeguards will only be based on the NPT safeguards agreement" and that "all voluntarily suspended non-legally binding measures including the provisions of the Additional Protocol and even beyond that will be suspended."[39] According to IAEA Director General ElBaradei, Iran's suspension of the Additional Protocol has hindered the Agency's ability to "assess fully Iran's enrichment related research and development activities, including the possible production of centrifuges and related equipment."[40]

Iran has not adopted the Nuclear Suppliers Group's Nuclear Export Guidelines. In fact, it revealed that it has received information from the Pakistani A.Q. Khan network on processes key to weapons production, including uranium conversion into metal and casting uranium metal hemispheres. Iran also admitted to receiving 1.8 tons of nuclear material (UF6, UF4, and UO2) used to manufacture uranium metal.

In March 2006, The IAEA Board of Governors voted to report the Islamic Republic to the UNSC,[41] a move Iran labeled "illegal, illogical, and politically-motivated."[42] The UNSC in July 2006 stated in its resolution, "Adopting resolution 1696 (2006), under Chapter VII, by a vote of 14 in favour (sic) to 1 against (Qatar), the Council expressed its conviction that such suspension, as well as full, verified Iranian compliance with the IAEA Board of Governor's requirements, would contribute to a diplomatic, negotiated solution that guaranteed Iran's nuclear programme (sic) was for exclusively peaceful Iran did not comply and a September 2006 Agency report to the Board indicated that Iran "has not addressed the long outstanding verification issues or provided the necessary transparency to remove uncertainties associated with some of its activities."[43]

If Iran were seeking to inspire confidence and credibility in its intent of peaceful use, it might have demonstrated this intent by fully cooperating with the IAEA in allaying such concern, willingly providing requested documentation, as well as comprehensive and timely access to records, facilities, and people. To the contrary, Iran has not only been slow and unwilling to provide the IAEA with information concerning its nuclear activities, but has assumed an uncooperative and often confrontational posture in doing so as noted above. While the IAEA has not determined that Iran is pursuing a weapons program, Iran has been cited for numerous violations of its Safeguards Agreement, has consistently been less than forthright about its nuclear activities, and has blocked IAEA inspections, each indicating that Iran's peaceful uses intent under Article III and with respect to transparency has not meet the minimum peaceful use criterion, and falls accurately in the non-peaceful use category.

[39] "Implementation of the NPT Safeguards Agreement in the Republic of Iran. IAEA Board of Governors Report by the Director General." GOV/2006/15. 27 February 2006.
[40] http://www.iaea.org/NewsCenter/News/2006/dgbriefsboard.html
[41] The Resolution passed with 27 votes of approval, 5 abstentions, and 3 opposing votes. This was the first time that Russia and China agreed to go along with the position of the EU-3 and the United States over Iran. CRS Report for Congress. "Iran's Nuclear Program: Recent Developments." Sharon Squassoni. 3 August 2006.
[42] http://www.nti.org/e_research/profiles/Iran/1819.html
[43] http://www.iaea.org/Publications/Documents/Board/2006/gov2006-53.pdf

Table 10 – *Indicators of Iran's Fulfillment of Article III Obligations*

Fulfillment of Article III Obligations	Metric	Safeguards agreement not in force; subsidiary arrangements not in place	Safeguards agreement and subsidiary arrangements in force	AP and subsidiary arrangements to AP (as applicable)
	State action/ activity		**Safeguards agreement and subsidiary arrangements in force AP signed, not ratified; until February 2006 AP provisionally implemented;**	
	Metric	Noncompliance with safeguards agreements; confirmed undeclared nuclear facilities or materials	Full compliance with safeguards agreements; no undeclared nuclear facilities or materials	No undeclared facilities or materials; confirmed correct and complete expanded declaration per AP
	State action/ activity	**Undeclared uranium enrichment and plutonium separation facilities revealed by IAEA since 2003; undeclared import and use of natural uranium in 1991 and 1993; undeclared import of UF6**[44]		
	Metric	Interference with, suspension, or prevention of safeguards inspections	Full cooperation in conduct of safeguards inspections	Complementary access per AP
	State action/ activity	**Failure to provide one year multiple reentry visas to IAEA inspectors; inspector access prevented, postponed or restricted; AP suspension has limited inspector access to Iran's enrichment facilities**		
	Metric	Inadequate or poorly functioning SSAC	SSAC satisfies IAEA guidelines	Exemplary SSAC

[44] Representative examples; not an inclusive list.

Fulfillment of Article III Obligations	State action/ activity	**Failure to report nuclear material, its processing and use, and to declare the existence of fuel cycle facilities; Iranian Nuclear Regulatory Authority (INRA) maintains SSAC**		
	Metric	Exports of EDP[45] equipment or materials not under safeguards (noncompliance with NPT III.2)	Exports of EDP equipment or materials under safeguards (complies with NPT III.2)	Export information per AP provided to IAEA
	State action/ activity		N/A	
	Metric		Research base supporting technical studies ensuring safety of nuclear program; nuclear operator training; nuclear regulatory body	Sponsorship of international forum, meetings or workshops promoting nuclear safety, training and cooperation
	State action/ activity		**Atomic Energy Organization of Iran (AEOI) National Nuclear Safety Department (NNSD); Iran Nuclear Regulatory Agency (INRA)**	

3.3 Coherence of Iran's Nuclear Energy Program

The third category of indicators, the coherence of a country's nuclear program, describes the extent to which the elements of its current and planned nuclear program are logical and consistent economically and technically with a peaceful nuclear program, and are executed in accordance with a stated peaceful purpose. For example, a state's choice to develop enrichment or reprocessing facilities may be cause for concern if the state is unable to articulate a reasonable economic, technical or energy security justification for such an investment.

Iran is aggressively pursing a self sufficient fuel cycle with the stated goal of energy independence. Yet upon examination Iran's energy investments "remain skewed in favor of a nuclear program which does not accord with its resource endowments or its near-

[45] Especially designed or prepared (EDP).

term energy sector needs."[46] Iran's argument for energy independence is further weakened by the fact that its own uranium resources are not enough to attain a self-sufficient fuel cycle and the cost of indigenous fuel manufacture (including uranium enrichment) far exceeds the price at which fuel could be purchased on the open market.[47] Iran's stated goal of energy independence "could be pursued much more effectively through any number of projects formulated to efficiently utilize natural gas or increase refinery production."[48] Currently, the natural gas sector is so poorly managed that a significant portion of its annual gross production is flared at the wellhead, and due to limited refinery capacity and low production at existing refineries, Iran imports some 40% of its gasoline needs.[49]

The tremendous cost for Iran to attain a front end fuel cycle is another factor which weakens the credibility of Iran's nuclear program, and detracts from the coherence argument. The existence of a "robust and economically competitive set of enrichment providers casts…doubt on Iran's motives for pursing enrichment on such an accelerated and (previously) secretive basis."[50] Iran has not accepted a Russian proposal for a fuel-leasing arrangement in which enrichment and reprocessing would be carried out on Russian territory; rejecting such an arrangement is difficult to justify on economic grounds given that the return on investment in the front end of the fuel cycle would not be seen for at least a decade.[51] Indeed, the reactors at Bushehr will not be operational for some 18 months, and additional reactors are several years into the future. Russia has strongly advised Iran against seeking to manufacture its own fuel for Bushehr and has pointed out that Iranian production of fuel for Bushehr would not be economically viable.[52]

3.3.1 Iran's development or acquisition of sensitive technologies

Iran is pursuing the development and acquisition of sensitive nuclear technologies. Iran has declared 22 facilities at nine locations involved in the country's nuclear program. Several new facilities of sensitive nature are currently under construction: the Natanz uranium enrichment plant, a uranium metal purification and casting laboratory, and a 40 MW heavy water research reactor (IR-40) at Arak.[53]

In August 2005 Iran resumed uranium conversion and in June 2006 began testing of UF6 conversion to hexafluoride on the 64 cascade machine at the Esfahan Uranium Conversion Facility.[54] In June, Iran announced that it had achieved enrichment of 5% U-

[46] Thomas Wood and Matthew Milazzo. "Iran's Energy Options." 2006.
[47] Thomas Wood and Matthew Milazzo. "Iran's Energy Options." 2006.
[48] Thomas Wood and Matthew Milazzo. "Iran's Energy Options." 2006.
[49] Iran possesses some 90 years worth of oil at current domestic production rates and some 220 for natural gas reserves. Thomas Wood and Matthew Milazzo. "Iran's Energy Options." 2006.
[50] http://www.state.gov/t/isn/rls/rm/66419.htm
[51] Thomas Wood and Matthew Milazzo. "Iran's Energy Options." 2006.
[52] http://www.state.gov/t/isn/rls/rm/66419.htm
[53] Reactors of this design are notorious for producing plutonium suitable for a weapons program.
[54] Approximately 6kg of UF6 was fed into the machines and enriched to various levels of U-235.

235 in the cascade. Feeding of UF6 into the machine resumed in August, and the installation of a second 164 cascade machine is underway.[55]

Iran is also conducting research on P-1 and P-2 centrifuge technology, including the testing of P-1 centrifuges at the Pilot Fuel Enrichment Plant at Natanz. The IAEA continues to investigate the acquisition of centrifuge designs, and the "reasons given by Iran for the apparent gap between 1994/1995 (when the P-2 centrifuge was said to have been received) and 2002, and the evidence provided to date...do not provide sufficient assurance that no related activities were carried out during that period."[56] Iranian officials recently announced that research on new types of centrifuges is underway, which provoked the IAEA to seek clarification on the content and scope of such work. Iran described "an ongoing and progressing R&D activity without using nuclear materials."[57]

Iran has under construction a larger commercial enrichment plant at Natanz. Iran has indicated to the IAEA that while its pilot plant will eventually contain approximately 1,000 centrifuges, it is planned that the commercial facility will contain some 50,000 centrifuges.[58] Both use gas centrifuge technology for uranium enrichment. Despite repeated calls by the IAEA and the international community for Iran to halt its uranium enrichment, Iran resumed enrichment at the pilot plant in 2005 and construction on the larger plant is underway.

Iran also is constructing a uranium metal purification and casting laboratory at Jabr Ibn Hayan Multipurpose Laboratories (JHL), a facility which Iran claims conducts research in fuel fabrication, production, and shielding materials. Iran indicated in a July 2003 letter to the IAEA that 113 experiments had been carried out at the "using imported UF4 with a view to optimizing reaction conditions and parameters for producing uranium metal." Iran further clarified the rational for producing the uranium metal: "In the early [90's] when the country decided to reconsider its nuclear program, we were not sure whether it will consist of CANDU reactors, Magnox reactors or light water reactors. Therefore it was decided to include a U-metal production line in the Uranium Conversion Facility (UCF) which could also be used to produce shielding material. However, as the picture is now more clear, uranium metal experiments could be considered as a process to gain know-how in nuclear material production."[59] The Agency is pursuing the issue of Iran's uranium metal purification and casting activities.

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[55] "IAEA Report on the Implementation of the NPT Safeguards Agreement in the Republic of Iran." GOV/2006/53. 14 September 2006.
[56] http://www.iaea.org/Publications/Documents/Board/2005/gov2005-67.pdf
[57] "IAEA Report on the Implementation of the NPT Safeguards Agreement in the Republic of Iran." GOV/2006/53. 14 September 2006.
[58] http://search.netscape.com/ns/boomframe.jsp?query=Arms+Control+Association&page=1&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3Db8513efb377598b4%26clickedItemRank%3D1%26userQuery%3DArms%2BControl%2BAssociation%26clickedItemURN%3Dhttp%253A%252F%252Fwww.armscontrol.org%252F%26invocationType%3D-%26fromPage%3DNSBoom%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.armscontrol.org%2F
[59] http://www.iaea.org/Publications/Documents/Board/2003/gov2003-63.pdf

Work also continues on a heavy water research reactor at Arak. The IAEA requested in September 2005 that Iran terminate this project as a "confidence building measure," while later that same year the EU-3 urged Iran to "stop construction of its Heavy Water Research Reactor at Arak."[60] The UNSC further called for Iran to "reconsider" the project.[61] Iran argues that the facility is intended to produce medical isotopes[62] and will "increase capacity, safety and security of nuclear material"[63] Iranian officials have further stated that Iran had tried unsuccessfully on several occasions to acquire from abroad a research reactor suitable for medical and industrial isotope production and for R&D to replace the old research reactor in Tehran. Iranian officials had concluded, therefore, that the only alternative was a heavy water reactor, which could use the UO2 produced in UCF and the Zirconium Production Plant in Esfahan.

3.3.2 Iran's retention of sensitive materials

Uranium contamination of Iranian nuclear equipment remains an issue that the IAEA is working with Iran to resolve. In 2005, the Agency determined that traces of LEU and HEU discovered at several sites in 2003 in Iran were indeed from imported equipment, not from Iranian enrichment activities. Samples of the HEU were matched definitively with centrifuge equipment turned over by the government of Pakistan, a finding which supported Iran's assertion that the material came from centrifuge parts provided by the Pakistani Khan network.[64]

However, Agency inspectors again found small quantities of natural and highly enriched uranium on equipment at a technical university in the spring of 2006. The equipment had been shown to the Agency "in connection with its investigation into efforts made by the Physics Research Centre (PHRC) to acquire dual use material and equipment." [65] The IAEA has not yet determined the origin of the contamination at the technical university, and according to a September 2006 Agency report there has been "no further progress" on resolution of this issue. Iran has also "not yet responded to the Agency's requests for clarification concerning, and access to carry out environmental sampling of, other equipment and materials" related to the PHRC.[66]

3.3.3. Iran's potential weaponization activities

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[60] http://www.nti.org/e_research/profiles/Iran/1825_4968.html

[61]http://search.netscape.com/ns/boomframe.jsp?query=Arms+Control+Association&page=1&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3Db8513efb377598b4%26clickedItemRank%3D1%26userQuery%3DArms%2BControl%2BAssociation%26clickedItemURN%3Dhttp%253A%252F%252Fwww.armscontrol.org%252F%26invocationType%3D-%26fromPage%3DNSBoom%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.armscontrol.org%2F

[62]http://search.netscape.com/ns/boomframe.jsp?query=Arms+Control+Association&page=1&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3Db8513efb377598b4%26clickedItemRank%3D1%26userQuery%3DArms%2BControl%2BAssociation%26clickedItemURN%3Dhttp%253A%252F%252Fwww.armscontrol.org%252F%26invocationType%3D-%26fromPage%3DNSBoom%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.armscontrol.org%2F

[63] http://www.nti.org/e_research/profiles/Iran/1825_4968.html

[64] http://www.washingtonpost.com/wp-dyn/content/article/2005/08/22/AR2005082201447.html

[65] http://www.iaea.org/Publications/Documents/Board/2006/gov2006-53.pdf

[66] http://www.iaea.org/Publications/Documents/Board/2006/gov2006-53.pdf

Iran's nuclear research and development activities aim towards the development of a complete nuclear fuel cycle, which would potentially enable Iran to weaponize without outside assistance. Questions remain about whether Iran has an active nuclear weapons development program. Feeding this concern is the fact that several of Iran's nuclear activities could potentially lie on the weapons development pathway.

In particular, Iran's possession of a document detailing the procedures for reducing uranium hexafluoride into small quantities of metal and casting uranium metal into hemispheres has raised concern, as this process is used to develop the explosive core of a nuclear weapon. Iran has shown the document to the IAEA, but maintains that it never received any such equipment.[67]

The Parchin military complex, located some 30 kilometers outside Tehran, is a large military complex that produces ammunition, rockets, and high explosives. The site has hundreds of buildings and test sites, and satellite images depicting an isolated, separately secured site raised questions as to the possibility that the site is host to nuclear weaponization activities.[68] In January 2005, IAEA inspectors seeking to visit the site were told by an Iranian official that it "is not necessary for the inspectors to enter the installations. They are authorized to take samples outside (the buildings) using their equipment."[69] In response to a June 2005 Agency request for greater cooperation from Iran on determining activity at the sites, Iran indicated that visits to these sites "go beyond IAEA required inspections."[70] Iran finally granted the inspectors access to the Parchin complex in November 2005. Inspections did not reveal "any unusual activities in the buildings visited," but environmental samples taken during the visit have not yet been fully analyzed.[71]

Additionally, in February 2006, the IAEA reported on receipt of a four-page report, which officials say was based at least in part on intelligence provided by the United States, and referred to the so-called "Green Salt Project".[72] The "Green Salt Project" derived its name from uranium tetrafluoride, known as Green Salt, which is an intermediate product in the conversion of uranium ore into uranium hexafluoride. Although the most recent documents related to the project are dated 2003, it is not known whether the project ended at that time.

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[67] http://search.netscape.com/ns/boomframe.jsp?query=Arms+Control+Association&page=1&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3Db8513efb377598b4%26clickedItemRank%3D1%26userQuery%3DArms%2BControl%2BAssociation%26clickedItemURN%3Dhttp%253A%252F%252Fwww.armscontrol.org%252F%26invocationType%3D-%26fromPage%3DNSBoom%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.armscontrol.org%2F

[68] http://www.thebulletin.org/print.php?art_ofn_nd04albright_037

[69] http://www.nti.org/e_research/profiles/Iran/1825_4968.html

[70] http://www.nti.org/e_research/profiles/Iran/1825_4968.html

[71] http://search.netscape.com/ns/boomframe.jsp?query=Arms+Control+Association&page=1&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3Db8513efb377598b4%26clickedItemRank%3D1%26userQuery%3DArms%2BControl%2BAssociation%26clickedItemURN%3Dhttp%253A%252F%252Fwww.armscontrol.org%252F%26invocationType%3D-%26fromPage%3DNSBoom%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.armscontrol.org%2F

[72] http://www.armscontrol.org/factsheets/Iran-IAEA-Issues.asp

The intelligence from the United States also indicated Iran was working on high explosives and a missile warhead design. The combination of the Green Salt Project and these activities suggests a "military-nuclear dimension," the report said, that if true would undercut Iran's claims that its nuclear program was solely aimed at producing electrical power. The tests of high explosives are of particular concern: one of the key challenges in making a nuclear weapon is designing the ring of conventional explosives that can be used to compress the nuclear material, setting off a nuclear chain reaction. It is highly unusual, Western experts said, for a group of uranium conversion experts ostensibly making fuel for nuclear reactors to also have administrative ties to people doing studies on explosives and re-entry vehicles, which is the technical name for missile warheads. [73]

Iran stated that the allegations over the so-called Green Salt Project "are based on false and fabricated documents" and are therefore "baseless," and that such a project never existed or exists.[74] Iran has yet to address the topics of high explosives testing and the design of a missile re-entry vehicle. Iran denied allegations that it was pursuing an indigenous capability to produce UF4, as this technology "had already been acquired from abroad" and it would not make sense to develop the capability at home.[75] Rather, Iran claims that its national program was centered on the Uranium Conversion Facility (UCF) at Esfahan. However, Iran had previously indicated that "the company alleged to have been associated with the Green Salt Project had been involved in procurement for UCF and in the design and construction of the Gchine uranium ore processing plant.[76]

The IAEA is evaluating at least two sites in Iran for potential weaponization activities. After satellite images revealed the razing of large building surrounded by a secure perimeter in 2003, the IAEA requested access to the Lavizan Shian Physics Research Center, which had operated in connection with the military. Iranian officials stated that site contained no material there requiring a declaration and that no fuel cycle activities took place there. It claimed that the site was being razed due to a municipal land dispute. The IAEA took environmental samples from dual-use equipment located on the site,[77] which revealed no HEU or undeclared plutonium. No "direct evidence points to the site being involved in nuclear weaponization…but the IAEA investigation remain incomplete."[78] The Agency sought to interview Iranian officials who had been involved in the procurement of equipment related to uranium enrichment, but interviews with a key official at the site were denied.[79]

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[73] http://www.nci.org/06nci/01-31/06.htm

[74] http://www.isis-online.org/publications/iran/IAEAreport28Apr06.pdf

[75] http://www.isis-online.org/publications/iran/IAEAreport28Apr06.pdf

[76] http://www.isis-online.org/publications/iran/IAEAreport28Apr06.pdf

[77]

http://search.netscape.com/ns/boomframe.jsp?query=Arms+Control+Association&page=1&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3Db8513efb377598b4%26clickedItemRank%3D1%26userQuery%3DArms%2BControl%2BAssociation%26clickedItemURN%3Dhttp%253A%252F%252Fwww.armscontrol.org%252F%26invocationType%3D-%26fromPage%3DNSBoom%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.armscontrol.org%2F

[78] http://www.thebulletin.org/print.php?art_ofn_nd04albright_037

[79]

http://search.netscape.com/ns/boomframe.jsp?query=Arms+Control+Association&page=1&offset=0&result_url=redir%3Fsrc%3Dwebsearch%26requestId%3Db8513efb377598b4%26clickedItemRank%3D1%26userQuery%3DArms%2

The activities described, and unresolved in the paragraphs above indicate that the origin and use of Iran's sensitive nuclear facilities raise many questions which have not been answered satisfactorily form the IAEA's standpoint. This indicates according to the criteria in this category, the Iran has not demonstrated it meets the minimal requirements for peaceful use bona fides in the area of coherence of its nuclear program. Instead, Iran falls into the category of non-peaceful use again.

Table 11 – *Coherence of Iran's Nuclear Energy Program*

Coherence of Nuclear Energy Program	Metric	Development, acquisition, or plans for sensitive nuclear facilities lacking reasonable economic or energy security justification	Current and planned nuclear fuel cycle facilities have reasonable economic or energy security justification	Agreement to forego enrichment and reprocessing and other sensitive facilities or implement multilateral ownership/control of facilities
	State action/ activity	**Fuel cycle infrastructure development largely not justified by existing or planned nuclear power generation; ongoing suspension of international nuclear cooperation (Russia; IAEA) reinforces lacking justification**		
	Metric	Operating research reactor(s) fueled with HEU and no commitment to decommission or convert to LEU; retains sensitive nuclear facilities	Commitment to decommission or convert and HEU research reactors to LEU; agreement on multilateral ownership/control of sensitive facilities	No research reactors operating with HEU; agreement to close sensitive nuclear facilities
	State action/ activity	**Several new facilities, including heavy water research reactor currently under construction despite international concern**		
	Metric	Fresh or spent HEU fuel in storage with no plans or arrangement for return to supplier	Commitment or arrangement for return of fresh or spent HEU to supplier	No fresh or spent HEU in storage; active arrangements for HEU return to supplier

BControl%2BAssociation%26clickedItemURN%3Dhttp%253A%252F%252Fwww.armscontrol.org%252F%26invocationType%3D-%26fromPage%3DNSBoom%26amp%3BampTest%3D1&remove_url=http%3A%2F%2Fwww.armscontrol.org%2F

	State action/ activity			
	Metric	Fuel cycle activities lay solely on weapons development pathway	Fuel cycle activities do not lay solely on weapons development pathway	
	State action/ activity	**Production of uranium targets; unresolved questions over two military sites that may house undeclared nuclear activities: Parchin and Lavizan; *Green Salt Project* high explosive testing and missile reentry vehicle design may have military nuclear dimension**		

3.4 Iran's Geopolitical Cooperation

The fourth category for indicators of peaceful use is geopolitical cooperation and integration. Political cooperation and integration are key indicators of a state's willingness to follow international norms and adhere to treaty commitments such as those for nonproliferation. Well-integrated states tend to view international standards and obligations as beneficial to their security; states that remain outside international regimes may believe they have fewer options and that such obligations threaten or diminish their security. In pursuit of greater security, such states may turn to more extreme options such as the development of a nuclear weapon capability.

When taken alone, the level of a state's integration into the international community, measured by its treaty obligations or other political cooperation mechanisms, is unlikely to be a conclusive indicator of its peaceful use commitment. However, when weighed together with the other three indicators, it is an influential element that can be useful in refining an analysis developed from the preceding criteria.

Iran is a member and co-founder of the United Nations, the Non Aligned Movement (NAM), the Organization of the Islamic Conference (OIC), and the Organization of the Petroleum Exporting Countries (OPEC). Iran has not signed and or is not party to several major international treaties in the nuclear field, including the Nuclear Safety Convention, the Convention on the Physical Protection of Nuclear Material, the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, the International Convention for the Suppression of Acts of Nuclear

Terrorism. It has ratified the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency and the Convention on Early Notification of a Nuclear Accident. Iran has signed, but not ratified the UN Convention for the Safety of Life at Sea (UNCLOS).

Iran maintains great geostrategic importance because of its central location in Eurasia, its vast energy reserves—in particular its large petroleum supply—, its large population and economic output, its growing military power, and its regional influence. Iran was recently elected vice-chair on the UN Disarmament Commission, and has solid support from much of the developing world in its standoff with the EU-3, United States, and their supporters over its uranium enrichment program. During the summit of the Nonaligned Movement (NAM) in Havana, Cuba, all of the 118 NAM member countries declared support for Iran's nuclear program in their final written statement.[80]

Iran's relations with the United States are tense at the governmental level. Although many Iranians would like to improve relations with the US, hard-line fundamentalists who control Iran's foreign policy and its nuclear program do not view a good U.S. relationship in their interests. Iran has been active engaged in Iraq since the March 2003 war and is criticized in the Wets for contributing to destabilizing Iraq. It is also identified by the United States as a state sponsor of terrorism, particularly in its support of Lebanon-based Hezbollah. The installation of President Mahmoud Ahmadinejad in 2005 has led to a more confrontational strategy over its nuclear program. In sharp contrast to former President Mohammad Khatami, Ahmadinejad has returned to the fiery rhetoric of the Khomeini era, advocating a clash of civilizations between the Islamic world and the West. In a September 2006 speech at the United Nations, he warned "foreign governments against meddling in Iranian affairs."[81] A month later, he attacked Israel by quoting Khomeini: "Israel must be wiped off the map."[82] While not admitting to nuclear weapons development, Iran has maintained that it reserves the right to possess nuclear weapons to counter Israel's conventional and nuclear capabilities.

Weighing its limited participation in international treaties related to nuclear issues, its confrontational strategy with the Board of Governors of the IAEA, the EU and the UNSC, the oral statements of its President against Israel's right to exist, it is hard to find that Iran has a relationship with the international community that would alter the evaluation of its peaceful uses bona fides in the previous categories in the non-peaceful use category.

Table 12 - *Indicators of Iran's Geopolitical Cooperation*

Geopolitical Conne	Metric	Country located in area of regional or interstate instability	Country located in area of moderate to high regional or interstate stability	Country located in area of high overall stability

[80] http://www.spacewar.com/2006/060915014519.dq13xl76.html
[81] http://www.heritage.org/Research/MiddleEast/Iraq/bg1903.cfm
[82] http://www.heritage.org/Research/MiddleEast/Iraq/bg1903.cfm

	State action/ activity	**High regional instability**[83]		
	Metric	Few to no international treaty obligations or commitments	Member to major international nuclear nonproliferation treaties (Nuclear Safety Convention; CPNMM; Spent fuel and Nuclear Waste Convention; Nuclear Terrorism, Assistance and Notification Conventions)	Member to other multilateral nonproliferation mechanisms (Proliferation Security Initiative; Nuclear Suppliers Group)
	State action/ activity	**Few obligations to international nuclear norms and conventions**		

4.0 Net Assessment of Iran's Peaceful Uses Bona Fides

In each of the first three categories of criteria to assess the peaceful nature of a State's nuclear program— nonproliferation credentials, transparency and fulfillment of NPT Article III obligations, coherence of its nuclear program— Iran fails to satisfy even the minimum standards that would inspire confidence in its bona fide peaceful use commitment. Its geopolitical interaction and integration do not add evidence to change this rating. According to this methodology, despite Iran's arguments that it is an NPT party and meets some of the IAEA requirements, it is not possible to declare that Iran is not going to try to develop nuclear weapons alongside its civilian program.

[83] Not specific to Iran but instability prevalent across region.

Appendix A

Background and Overview of Brazil's Nuclear Power Programs

From the 1960s to the early 1990s, Brazil pursued an ambitious program of nuclear energy and technological development, which included construction of an unsafeguarded uranium enrichment facility and design of nuclear weapons. However, Brazil has since disavowed nuclear weapons and joined the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) in 1998. And, with Argentina, its former enemy, Brazil established a bilateral inspection agency to verify both countries' commitments to use nuclear energy only for peaceful purposes. The government of Brazil is considering the possibility of signing an Additional Protocol with the IAEA.[84] Brazil currently mines uranium, which it ships to foreign countries for conversion and enrichment. The enriched uranium is then returned to Brazil where it is fabricated into fuel for use in its two power reactors. Brazil's new Resende uranium enrichment plant allows it to make its own low-enriched (3.5%) uranium fuel for its nuclear power industry and eventually for export.

Brazil's Nuclear Fuel Cycle

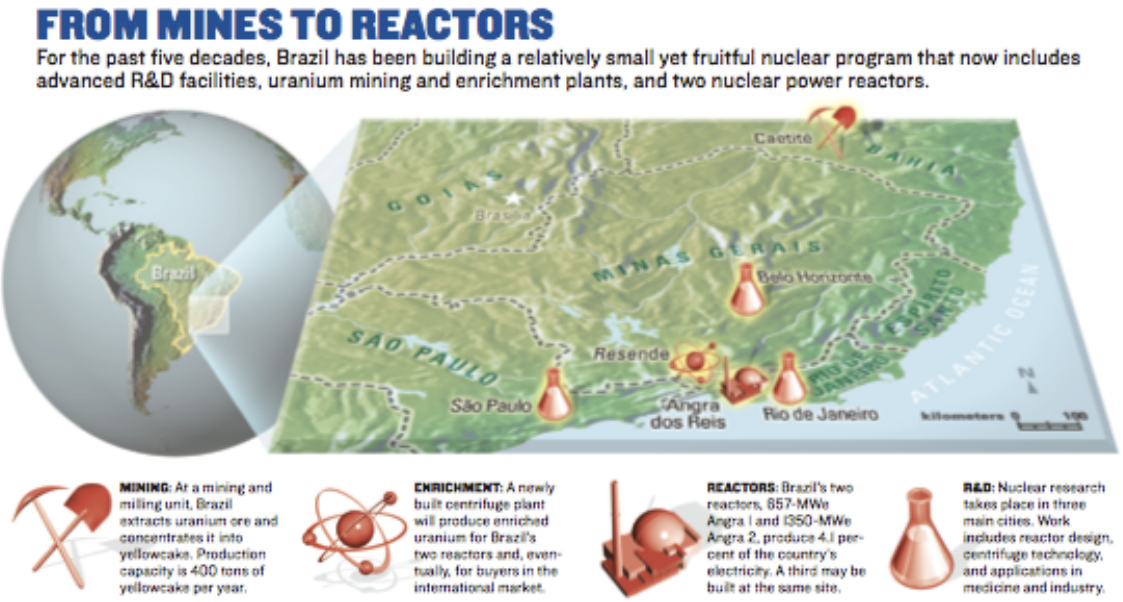

Figure 1 – Map of select Brazilian fuel cycle facilities[85]

[84] Nuclear Threat Initiative Brazil country profile; http://nti.org/e_research/profiles/Brazil/index.html.
[85] http://www.spectrum.ieee.org/images/mar06/images/atomf2.pdf

Mining

All of Brazil's mined uranium is for domestic use. Brazil's short term uranium production capability is 340tU/year. From 1982 to 2002 Brazil's cumulative uranium production was 1570tU, roughly two thirds of which came from the Pocos de Caldas Unit, with the remainder from the Lagao Real Unit, which is the only currently operating commercial plant. Expansion to 670tU/year is being explored for Lagao Real but will be largely determined by the phosphate market, which will be a co-product of uranium production.[86]

Conversion

A UF6 pilot plant located in Iperó with a nominal production capacity of 40 tU/year is under construction at the Navy Research Institute (CTMSP).[87] There are no plans to install a commercial plant in the near future. Uranium will continue to be shipped abroad for conversion and enrichment, and then returned for fuel fabrication.

Enrichment

The Resende centrifuge enrichment facility formally opened in May, 2006.[88] Its primary purpose is to supply Brazil's two power production reactors. Brazil may later produce enriched uranium and or fuel for export when the Resende reaches full capacity in approximately eight years. The IAEA estimates its output will be up to 300,000 SWU/year.[89] A separate estimate of its capacity is 200,000 SWU per annum, sufficient for the two operating units.[90] Other estimates of varying dates, some several years old, range between 100,000-200,000 SWU.

Fuel fabrication

Brazil's fabrication facility is also located at the Resende nuclear complex. It has a production capacity of 280 tons of uranium per year. The facility also produces fuel rods and elements. The Re-conversion and Pellets Production Unit has operated since 1999 at a capacity of 160 tons of UO2 pellets/year under the AUC process. Other fuel element components, such as top and bottom nozzles, spacer grids and end plugs for export, are also produced at this facility.[91]

Power Production

[86] IAEA Brazil Country Profile 2003.
[87] Arms Control Association; http://www.armscontrol.org/act/2005_10/Oct-Brazil.asp.
[88] Steve Kingstone, BBC News, September 6, 2006; http://news.bbc.co.uk/2/hi/americas/4981202.stm.
[89] IAEA Brazil Country Profile 2003.
[90] Steve Kidd, "A Latin Nuclear Revival?" Nuclear Engineering International, January 26, 2006; http://www.neimagazine.com/story.asp?sectionCode=147&storyCode=2034782.
[91] IAEA Brazil Country Profile 2003.

Brazil's two operating nuclear power plants, Angra 1 and 2, located between Sao Paulo and Rio de Janiero, have output of 626MWe and 1270MWe, respectively. Together these reactors comprise 4% of the country's power generation. Construction on a third, Angra 3 (1224MWe) has barely been started, although 70% of its components have been purchased and are being stored on-site.[92] It is projected to cost $3.3 billion and could be completed by 2013 if begun in 2007.[93] Brazil is now seeking outside investment of $1.8 billion to complete the project.[94]

Research

Brazil has five research centers that house four research reactors.[95,96]

1. IPEN (São Paulo) – Inst. for Energy and Nuclear Research
   Research Reactors:
   IAE-R1 (pool-type, 5MW, LEU 19.75 – 19.9%, U_3O_8-Al and U_3Si_2-Al fuel material)
   IPEN/MB-01 (tank-type, 100W, LEU 4.3%, UO_2 pellets)

   Cyclotron
   Radioisotopes Production (99mTc; 131I; 121I)
   Research: fuel cycle and materials; reactor technology; safety; fundamentals; radiation and radioisotope applications; biotechnology; environmental and waste technology.

2. IEN (Rio de Janeiro) – Inst. for Nuclear Engineering
   Research Reactor:
   Argonauta (5kW[97], LEU 19.0 - 19.9%, U_3O_8-Al fuel material)

   Cyclotron
   Radioisotopes production
   Research: instrumentation, control and man-machine interfaces; chemistry and materials; safety; reactor technology.

3. CDTN (Belo Horizonte) - Center for Nuclear Technology Development
   Research Reactor:
   IPR-R1 ("Triga", 250 kW, LEU 19.9 – 20.0%, U-Zr-H fuel material)[98]

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[92] Ibid.
[93] "Brazil considers another nuclear reactor," Power Projects, June 06; http://www.ndtcabin.com/articles/power/0607001.php.
[94] http://world-nuclear.org/info/inf95.html
[95] IAEA-TECDOC-1508 "Spent fuel management options for research reactors in Latin America," June 2006; http://www-pub.iaea.org/MTCD/publications/PDF/te_1508_web.pdf
[96] Eduardo Figueira da Silva, "Legal and Regulatory Framework on Decpommissioning of Research Reactors: National Report of Brazil for the Research Reactor Decommissioning and Deomonstration Project (R^2D^2P), June 2006. http://www-ns.iaea.org/downloads/rw/projects/r2d2/national-reports/Brazil/R2
[97] Ibid.
Authorized operating power is 500W when operating continuously; 1kW during 1h of operation.
[98] If enrichment at 20%, qualifies as HEU.

Research: mining; reactor technology; materials, safety; chemistry; environmental and waste technology.

4. IRD (Rio de Janeiro) – Inst. for Radiation Protection and Dosimetry
   Research: radiation protection and safety; environmental technology; metrology; medical physics.

5. CRCN (Recife/PE) - Nuclear Sciences Regional Center
   Research: radiation protection, dosimetry and metrology.[99]

A Brief History of Brazil's Nuclear Program

The origin of Brazil's nuclear program can be traced to the early 1930s with initial emphasis centering on nuclear fission. Much of Brazil's early research was conducted at the University of São Paulo, some by scientists who had immigrated from abroad. By the mid-1930s, Brazil had discovered indigenous uranium deposits and in 1940 President Getúlio Vargas signed an agreement with the United States for cooperative mining of uranium and monazite. Three more agreements with the United States were arrived at later in the 1940s. In exchange for monazite, the United States transferred nuclear technology.[100]

Brazil's nuclear power industry began with technical assistance from the United States under the Atoms for Peace program. The United States agreed to share nuclear technology for peaceful purposes, but retained control over the process. In 1957, Brazil built the first of two nuclear research reactors in São Paulo. A second research reactor was developed in Belo Horizonte in 1960. In 1965, Brazil built its first indigenous research reactor in Rio de Janeiro, for which the United States supplied fuel.[101]

In the mid-1970's, Brazil's military governments became frustrated by restrictions imposed by the United States on its nuclear programs. They were also concerned with Argentina's rapid nuclear development and faced energy shortages brought on by the petroleum crisis of October 1973. Brazil chose in 1975 to import nuclear technology from West Germany despite strong protest from the United States. The agreement called for West Germany to supply the design and technology for eight nuclear reactors (each 1,300MW), a commercial-scale uranium enrichment facility, and a pilot plutonium reprocessing plant. West Germany's Kraftwerk Union, an affiliate of Siemens, was hired to build the power plants. The agreement was significant because it was the first instance of transfer of a complete nuclear fuel cycle.[102] However, six of the reactors stipulated by the agreement were never built.

[99] IAEA Brazil Country Profile 2003.
[100] Federation of American Scientists website, Brazil country profile: http://www.fas.org/nuke/guide/brazil/nuke/index.html.
[101] http://www.globalsecurity.org/wmd/world/brazil/nuke.htm.
[102] Ibid.

The operation of Brazil's nuclear power plants has been problematic. Angra 1 cost $2 billion to build, and began operation in 1983. When operated at full capacity, it produces 20 percent of the electricity used in the city of Rio de Janeiro. From 1985 through 1993, however, Angra 1 went offline more than thirty times because of technical and legal problems. Furnas Electric Power Plants, the state company that operates Angra 1, lost $100 million in operating costs in 1993 alone.[103]

In September 1994, Russia and Brazil agreed to cooperate in the peaceful use of nuclear energy and safety. During talks in April 1995, the two sides considered the construction of small nuclear power plants in Brazil using small Russian reactors like those in icebreakers. [104] In the last decade this issue has been silent in the press.

Brazil's Nuclear Weapons Program

Brazil's 1975 transfer agreement with West Germany did not require IAEA safeguards. As a result, Brazil was able to develop a clandestine nuclear weapons program amid serious tensions with neighboring Argentina. Code-named "Solimões" after a river in the Amazon, the secret program eventually came to be known publicly as the "parallel program."[105]

In 1990, ending a long period of military-led governments, President Fernando Collor de Mello reversed his country's policy of developing nuclear weapons. He formally exposed the military's secret program and symbolically closed a test site at Cachimbo, Pará. An investigation revealed that Brazil had plans for two atomic weapon designs: one with a yield of twenty to thirty kilotons and a second with a yield of twelve kilotons. In addition, Brazil's military regime had secretly exported eight tons of uranium to Iraq in 1981.[106]

Relations with Argentina

Through a series of extraordinary political achievements and multiple nonproliferation agreements, Brazil and Argentina defused their nuclear rivalry. On May 20, 1980, both countries signed the Brazilian-Argentine Agreement on the Peaceful Use of Nuclear Energy, coordinating nuclear policy and establishing technical cooperation in developing their fuel cycles.[107] President Sarney and Argentine president Raúl Alfonsín strengthened this cooperation in 1985, with the Joint Declarations on Nuclear Policy of Foz do Iguaçu. The presidents and their technical staffs made reciprocal visits to non-safeguarded nuclear installations in both countries. Additional joint declarations followed: in Brasília (1986); Viedma, Argentina (1987); Iperó, Brazil (1988); and Buenos Aires (1990).[108]

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[103] Ibid.
[104] Ibid.
[105] http://www.globalsecurity.org/wmd/world/brazil/nuke.htm.
[106] Ibid.
[107] Brazilian-Argentine Accounting and Control website chronology of agreements page: http://www.abacc.org/engl/agreements_statements/index.asp.
[108] Ibid.

On November 28, 1990, Presidents Collor de Mello and Carlos Saúl Menem of Argentina signed the second Foz do Iguaçu declaration (Argentine-Brazilian Declaration on Common Nuclear Policy of Foz do Iguaçu), in which both governments pledged their commitment to an exclusively peaceful use of nuclear energy and established their Common System for Accounting and Control of Nuclear Materials (SCCCMN).

On July 18, 1991, Presidents Collor de Mello and Menem signed the Agreement on the Exclusively Peaceful Use of Nuclear Energy, which created the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC).[109] With headquarters in Rio de Janeiro, ABACC provides on-site inspections of nuclear facilities in Argentina and Brazil and monitors inventories of nuclear materials in both countries.[110]

Later in 1991, full-scope safeguards were applied in both countries by ABACC and the IAEA under the Quadripartite Safeguards Agreement.[111] The Quadripartite Agreement also provides for rights to refuse inspection on proprietary technology (especially enrichment centrifuges), and for nuclear energy to be used for the propulsion of submarines.[112]

Recent developments and current status

Brazil's Resende centrifuge enrichment facility was formally opened on May 6, 2006. Brazil claims it will save money by enriching its uranium domestically rather than sending it overseas to Urenco, the European enrichment consortium. It also claims its enrichment facility is 25 percent more efficient than those in France or the United States. Negotiations with the IAEA took over two years to devise a mutually agreed safeguards approach that protects Brazilian proprietary interests.[113]

[109] Ibid.
[110] http://www.globalsecurity.org/wmd/world/brazil/nuke.htm.
[111] Sharon Squassoni and David Fite, "Brazil as Litmus Test: Resende and Restrictions on Uranium Enrichment," Arms Control Today, October 2005; http://www.armscontrol.org/act/2005_10/Oct-Brazil.asp#note16.
[112] http://www.globalsecurity.org/wmd/world/brazil/nuke.htm.
[113] Steve Kingstone, BBC News, September 6, 2006; http://news.bbc.co.uk/2/hi/americas/4981202.stm.

Table 1 - *Brazil International Treaties and Organizations*
Source: Nuclear Threat Initiative

INTERNATIONAL ORGANIZATIONS	**STATUS**[114]
United Nations (UN)	Member
Conference on Disarmament (CD)	Member
International Atomic Energy Agency (IAEA)	Member
Organization for the Prohibition of Chemical Weapons (OPCW)[115]	Member
Comprehensive Test Ban Treaty Organization Preparatory Commission	Member
TREATIES & AGREEMENTS ***Nuclear:***	
Nuclear Non-proliferation Treaty (NPT)	State Party
Comprehensive Nuclear Test Ban Treaty (CTBT)	State Party[116]
Partial Test Ban Treaty (PTBT)	State Party
IAEA Safeguards Agreement	In force (INFCIRC 435)
IAEA Additional Protocol	----------
Nuclear Safety Convention	State Party
Joint Spent Fuel Management Convention	Signatory
Convention on the Physical Protection of Nuclear Material	State Party
Latin America/Caribbean Nuclear-Weapon-Free Zone (Treaty of Tlatelolco)	State Party
Chemical& Biological:	
Chemical Weapons Convention (CWC)	State Party
Biological and Toxin Weapons Convention (BTWC)	State Party
BTWC Confidence Building Measures (CBMs)[117]	Submitted[118]
Geneva Protocol	State Party

[114] The **Status** of a State's participation in treaties and organizations is defined in terms of its membership of and adherence to international organizations, treaties and agreements. A **State Party** fulfilled and implemented domestic legislative legal practices to bring about the legal application of the Treaty on the government and other entities to which the Treaty is applicable, such as formal approval by parliament or legislative bodies, and the Treaty is formally declared to be applicable on the State Party, and the required legal instrument of ratification has been duly deposited with the depositary. A **Signatory State** refers to a State whose competent authority or representative has affixed its signature to a Treaty text thus indicating acceptance of the Treaty and a commitment not to undertake any actions that would undermine the purpose of the Treaty, according to the Vienna Convention on the Law of Treaties, pending formal ratification.
[115] Membership requires ratification of the Chemical Weapons Convention.
[116] Brazil's ratification required for the CTBT to enter into force.
[117] A set of voluntary confidence building measures agreed to at the Second Review Conference of the States party to the BTWC (1986) under Article V.
[118] Submitted information on BWC CBMs for 1997-1999 and 2001, did not submit information in 2000 and 2002.

WMD delivery systems:	
International Code of Conduct against Ballistic Missile	----------
Other:	
Proliferation Security Initiative[119]	----------
EXPORT CONTROL CONVENTIONS	
Zangger Committee	----------
Nuclear Suppliers Group	Member
Australia Group	----------
Missile Technology Control Regime	Member
Wassenaar Arrangement	----------
UN Security Council resolution 1540 (2004)[120]	Report submitted 10/29/04 Add.1 submitted 09/22/05 Corr.1 submitted 09/22/05 Add.2 submitted 03/17/06
COUNTER-TERRORISM CONVENTIONS & OBLIGATIONS	
UN Security Council resolution 1373 (2001)[121]	Report submitted 08/08/05
UN Security Council resolution 1267 (1999) and 1455 (2003)[122]	Report submitted 04/17/03
Suppression of the Financing of Terrorism	State Party
Suppression of Terrorist Bombings	State Party
Marking of Plastic Explosives for the Purpose of Detection	State Party
Against the Taking of Hostages	State Party
Offences and Certain Other Acts Committed on Board Aircraft	State Party
Suppression of Unlawful Seizure of Aircraft	State Party
Suppression of Unlawful Acts against the Safety of Civil Aviation	State Party
Protocol for the Suppression of Unlawful Acts of Violence at Airports Serving International Civil Aviation	State Party
Suppression of Unlawful Acts against the Safety of Maritime Navigation	State Party
Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf	State Party
Prevention and Punishment of Crimes against Internationally Protected Persons, including Diplomatic Agents	State Party
Suppression of Acts of Nuclear Terrorism	Signatory

[119] Core members of the Proliferation Security Initiative include only Australia, France, Germany, Italy, Japan, the Netherlands, Poland, Portugal, Spain, the United Kingdom, Canada, Norway, Russia, Singapore, and the United States, but many other States have issued statements of support in favor of it.
[120] Adopted under Chapter VII of the United Nations Charter.
[121] Adopted under Chapter VII of the United Nations Charter.
[122] Adopted under Chapter VII of the United Nations Charter.

Appendix B

Background and Overview of Iran's Nuclear Power Programs

Iran's nuclear program began in the mid-1960s. Under the Atoms for Peace program, the United States cooperated extensively with the government of the Shah, including the provision of technical assistance and the lease of several kilograms of enriched uranium to Iran. The Tehran Nuclear Research Center (TNRC) was established at Tehran University in 1967, the same year in which the United States supplied TNRC with a 5MW water-moderated nuclear research reactor.[123] Iran signed the Nonproliferation Treaty (NPT) on the day it opened for signature, July 1, 1968, and ratified the Treaty on February 2, 1970. Its full-scope safeguards agreement with the International Atomic Energy Agency (IAEA) entered into force in May 1974.

Although suspicions did exist, the Iranian nuclear program under the Shah was generally "not regarded as a 'back door' to a nuclear weapons program."[124] A statement by the Shah that Iran will have nuclear weapons "without a doubt and sooner than one would think" was subsequently denied by Iran's embassy in France; the Shah later reaffirmed that "not only Iran, but also other nations in the region should refrain from planning to gain atomic arsenals." Tehran asserted it had "no intention of acquiring nuclear weapons, but if small states began building them, then Iran might have to reconsider its policy."[125]

The 1979 Islamic Revolution and subsequent Iran-Iraq War (1980-88) brought the Iranian nuclear program to a halt. After the fall of the Shah, many of Iran's nuclear scientists were forced to leave the country by the incoming Khomeini regime, which was initially opposed to nuclear technology and suspended work on the Bushehr reactors.[126] The site was bombed so persistently during the Iraq war that the reactor cores in both units were destroyed. The war shifted the regime's view of the value of a nuclear program, but Germany, concerned over Iran's nuclear weapons ambitions, refused to resume work that would bring the Bushehr reactors into operation. Iran lobbied other governments unsuccessfully to procure components for the facility.[127] A 1991 agreement with China for the supply of two 300 MWe PWR units never came to fruition, but in 1995 an $800 million contract was signed with Russia for the completion of Bushehr unit one with a 1000 MWe VVER-1000 PWR.

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[123] http://www.payvand.com/news/03/oct/1015.html
[124] CRS Report for Congress. "Iran's Nuclear Program: Recent Developments." Sharon Squassoni. 3 August 2006. http://fpc.state.gov/documents/organization/72449.pdf
[125] http://www.nti.org/e_research/profiles/Iran/1825.html
[126] http://www.nti.org/e_research/profiles/Iran/1819.html
[127] 8 steam condensors from Italy, discussed with the Czech firm Skoda Plzen the sale of reactor components, and attempted to buy parts from an unfinished VVER-440 reactor in Poland

A second nuclear research center opened at Esfahan in 1984. Over the next several years, a number of western intelligence sources indicated Iran had established experimental programs in fissile material production including centrifuge uranium enrichment and plutonium reprocessing.[128] Unknown at the time, Iran was also secretly tapping into the Pakistani nuclear black market run by A.Q. Khan.[129]

The United States' 1992 Iran-Iraq Non-Proliferation Act specifically prohibited transfers of nuclear equipment and materials to Iran, as well as exports to Iran of all dual-use commodities. Amid heightened concern about the nature of Iran's nuclear program, Iran agreed that, in addition to permitting routine IAEA inspections on all declared nuclear material and activities, it would allow the IAEA to visit any location in the country to check for undeclared nuclear activities. Two such visits took place in 1992-93, and no undeclared activities were found. Yet towards the mid-1990s rumors of a clandestine procurement network involving western suppliers spurred a stricter U.S. policy towards Iran and helped to prompt a U.S.-led embargo on nuclear sales to Iran.[130]

In 2002, the National Council of Resistance of Iran provided information on the existence of two clandestine nuclear facilities in Iran—a uranium enrichment facility at Natanz and a heavy water production plant near Arak.

Recent Plans and Current Status

Iran has an ambitious nuclear program, with plans for the development of seven light-water power reactors over the next fifteen years and the attainment of an indigenous fuel cycle capability.[131] Iran has declared 22 nuclear facilities at nine sites to the IAEA, including the TNRC, the Esfahan Nuclear Technology Center (ENTC), and a Pilot Fuel Enrichment Plant (PFEP) at Natanz. Several facilities are currently under construction: the Bushehr nuclear power plant, a Fuel Enrichment Plant at Natanz (FEP), a fuel fabrication plant at Esfahan, and a 40 MW heavy water research reactor (IR-40) at Arak. In addition, a uranium ore concentrate production plant is being sited near Bandar Abbas. Research and development on uranium metal purification and casting takes place at Jabr ibn Hayan Multipurpose Laboratories at TNRC.

The Bushehr reactor, once completed, will be the first of several planned nuclear power plants in Iran. The unit will contribute 1000 MWe to the national energy grid and provide approximately 4% in total national electricity generation, equal to that supplied to Brazil by its nuclear power reactors. Russia will deliver all supplies and services on a turn-key

[128] www.carnegieendowment.org/pdf/npp/15-Iran.pdf
[129] Jon Wolfsthal. "Understanding Iran's Nuclear Maneuvers." CSIS. 12 January 2006. www.csis.org/media/csis/pubs/060112_wolfsthal.pdf
[130] Contradicting US policy, Russia has continued trade and cooperation in nuclear materials and technology. China has also contributed to the development of the Iranian civilian nuclear program since the mid-1980s, supplying Iran with two mini research reactors at Esfahan and a calutron, in addition to a plan that fell through on the supply of two 300 MWe reactors at Bushehr.
[131] Wood et al.

basis, and supply $30 million worth of nuclear fuel each year from 2001-11.[132] Iranian and Russian officials have indicated that once Bushehr-1 is completed, Russia could complete the second unit at Bushehr and eventually construct two VVER-440 reactors there.[133] Another deal is on hold with China for the construction of two 300 MW PWRs reactors.

Table 1 - *Iran's Nuclear Facilities: Overview of Key Safeguarded Sites*[134]

Location	***Facility***
Tehran Nuclear Research Center	Tehran Research Reactor (TRR) Molybdenum, Iodine and Xenon Radioisotope Production Facility Jabr ibn Hayan Multipurpose Laboratories
Esfahan Nuclear Technology Center (ENTC)	Miniaturized Neutron Source Reactor LWR Sub-Critical Reactor HWR Zero Power Reactor Uranium Conversion Facility (UCF) Fuel Manufacturing Plant
Natanz	Pilot Fuel Enrichment Plant (PFEP) Fuel Enrichment Plant (FEP)
Arak	Iran Nuclear Research Reactor (IR-40) Hot Cell Facility (radioisotope production) Heavy Water Production Plant (HWPP)

Iran's nuclear program is highly contentious, as many fear that its peaceful use of nuclear technology may serve as a cover to nuclear weapons development. Following the 2002 outing of Iran's clandestine nuclear program, IAEA inspections "revealed almost two decades worth of undeclared nuclear activities in Iran," including uranium enrichment and plutonium separation efforts.[135] Environmental samples taken during a June 2003 inspection of the Natanz PFEP revealed the presence of highly enriched uranium (HEU),

[132] The contract had originally called for the provision of a 30-50 Megawatt thermal (MWt) light water research reactor, 2,000 tons of natural uranium, and training for 20-30 Iranian scientists annually. The centrifuge deal was later cancelled under US pressure, and the light water reactor deal also was called off.
[133] Andrew Koch and Jeannette Wolf. "Iran's Nuclear Facilities: A Profile." 1998. cns.miis.edu/pubs/reports/pdfs/iranrpt.pdf
[134] Chart based on that provided by the IAEA. http://www.iaea.org/Publications/Documents/Board/2004/gov2004-83_annex1.pdf
[135] CRS Report for Congress. "Iran's Nuclear Program: Recent Developments." Sharon Squassoni. August 2006.

and in October 2003 Iran admitted to conducting plutonium reprocessing experiments in a hot cell at TNRC.[136]

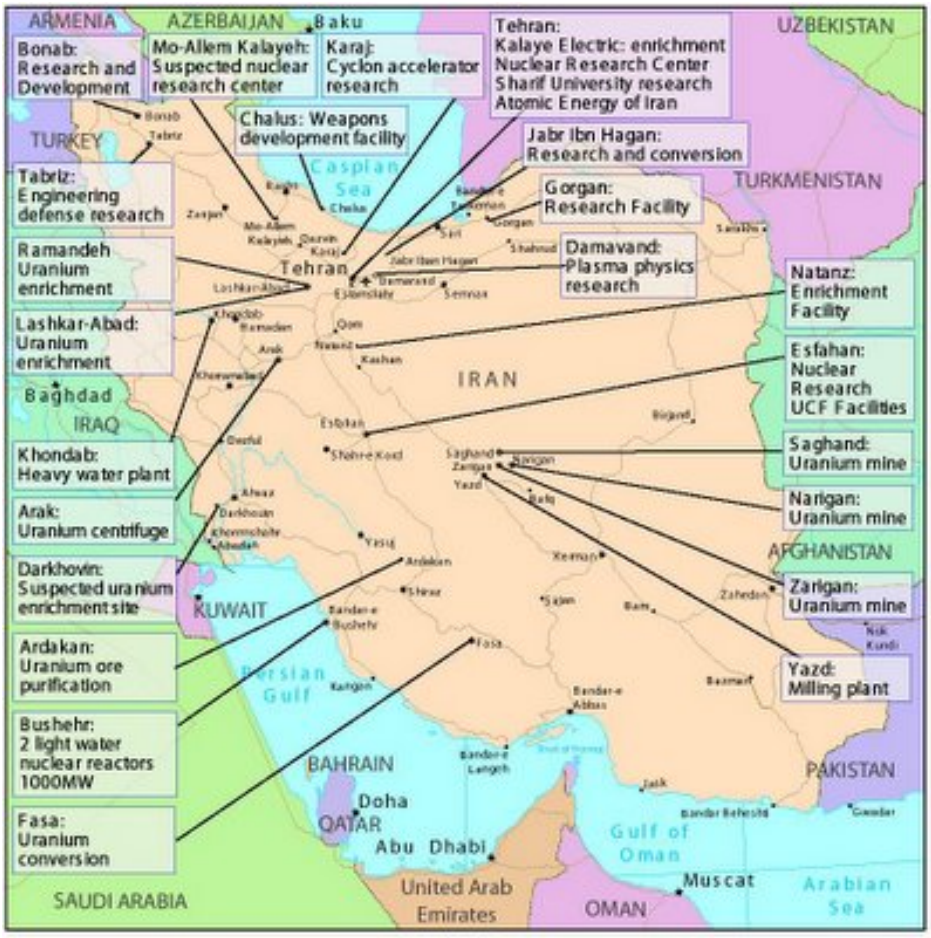

Figure 1 – Map of Iranian Nuclear Cycle Facilities[137]

The IAEA Board of Governors called for Iran to "resolve all outstanding issues and to provide full and complete declaration of its nuclear material and nuclear activities," to suspend all enrichment activities, and sign an Additional Protocol. Iran agreed to suspend sensitive activities in exchange for economic assistance from Germany, France, and the UK (collectively known as the EU-3) and to cooperate with the IAEA with full transparency and disclosure. Iran consented to sign the Protocol, commence its ratification procedures, and suspend all enrichment and reprocessing activities for an interim period.[138]

The unannounced inspections provided for under the Additional Protocol—which Iran signed in December 2003— granted the IAEA greater access within Iran and the option

[136] Iran later admitted that it had understated the amount of plutonium produced.
[137] http://ccablog.blogspot.com/2006/02/nuclear-map-of-iran.html
[138] http://www.nti.org/e_research/profiles/Iran/1819.html

to carry out more intrusive inspections at Iran's nuclear facilities. Subsequent inspections provided a wealth of new information—and prompted numerous questions— concerning the intent and extent of Iran's nuclear program.

> [W]hile the Agency is able to verify the non-diversion of declared nuclear material in Iran, the Agency will remain unable to make further progress in its efforts to verify the absence of undeclared nuclear material and activities in Iran unless Iran addresses the long outstanding verification issues, including through the implementation of the Additional Protocol, and provides the necessary transparency. Progress in this regard is a prerequisite for the Agency to be able to confirm the peaceful nature of Iran's nuclear programme.[139]

IAEA Board Members voted in June 2004 to reprimand Iran for not providing the Agency with more timely and comprehensive support, and rebuked Iran for postponing IAEA visits to a number of locations. With a November IAEA compliance deadline looming, the EU-3 presented Iran with a deal promising nuclear technology, access to nuclear fuel, trade incentives, and regional security assistance in return for Iran's suspension of uranium enrichment activities.[140] Iranian President Mohammad Khatami indicated that Iran would consider an agreement that recognized Iran's right to peaceful use of nuclear technology. Such an agreement was signed, which also reaffirmed Iran's commitment to the NPT. Iran agreed "on a voluntary basis, [to] continue and extend its suspension to include all enrichment related activities." [141] The EU-3 hoped that with greater incentives and negotiation, this temporary suspension could be made permanent.

Meanwhile, two issues were identified in the IAEA Director General's November 2004 report as particularly relevant to the Agency's efforts to provide assurance that there are no undeclared enrichment activities in Iran: the origin of low enriched uranium (LEU) and HEU particle contamination found at various locations in Iran and the extent of Iran's efforts to import, manufacture and use P-1 and P-2 centrifuges.[142]

The situation deteriorated in 2005 as both the United States and Iran stepped up the political rhetoric. Iran resumed uranium conversion activities in August 2005—the testing of a 10-centifuge cascade with uranium hexafluoride gas (UF_6) at the conversion facility at Esfahan—thereby breaking its suspension on enrichment activities, abandoning talks with the EU-3, and suspending the interim application of the Additional Protocol. At this time, Iran also revealed to the IAEA that it had received information from the Pakistani A.Q. Khan network on processes key to weapons production, including uranium conversion into metal and casting uranium metal hemispheres.

The IAEA's September 2005 Safeguards Report asserted that Iran's "many failures and breeches" of its Safeguards Agreement constitute non-compliance within the meaning of

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[139] IAEA *(GOV/2006/64)*
[140] http://www.nti.org/e_research/profiles/Iran/1825_4398.html
[141] http://www.iaea.org/NewsCenter/Focus/IaeaIran/bog092005_statement-eu.pdf
[142] IAEA *(GOV/2006/15)*

the Agency's statute and described an absence of confidence that Iran's nuclear program is exclusively for peaceful purposes.[143] The Board of Governors then voted to report the Islamic Republic to the United Nations Security Council (UNSC),[144] a move Iran labeled "illegal, illogical, and politically-motivated."[145] Iranian Foreign Minister threatened that in the case of Security Council referral, Iran will "have to stop all its voluntary cooperation with the UN nuclear watchdog."[146]

IAEA Board Members agreed to hold off on sending the case to the UNSC while Russia worked with Iran to find a diplomatic solution to the dilemma. Russia proposed to host Iran's uranium enrichment program, leaving only the uranium conversion to be carried out on Iranian soil. Iran rejected this proposal, however, continuing to insist on its right to the development an indigenous fuel cycle capability. Tehran began removing IAEA seals at some of its nuclear facilities, including Natanz, where small-scale enrichment activities were resumed.

Iran announced in April 2006 that it had succeeded in enriching uranium to 3.5% U_{235} with its 164 centrifuges at Natanz. [147] Iran thus claimed to have reached a critical juncture in its nuclear capability. Tehran had produced uranium of sufficient enrichment for use in nuclear power generation, and in theory, had mastered the technique necessary for enrichment to higher levels, thus suitable for use in a nuclear weapon. The Iranian government indicated that by the end of the year, they intended to have a plant which could produce up to 3,000 tons of enriched uranium annually.[148]

In June 2006, The EU-3 and the United States presented an incentive package to Iran consisting of affirmation of Iran's right to nuclear energy,[149] assistance in building light-water reactors, fuel supply guarantees, dismissal of UNSC consideration of Iran's NPT noncompliance, WTO membership, and a selective easing of U.S. sanctions. Iran rejected the offer as "unacceptable" because it did not include "Iran's right to enrich uranium."[150] Iran's rejection of the EU offer coincided with the inauguration of the newly-elected president, Mahmoud Ahmadinejad, who assumed a much more confrontational posture on the nuclear issue than his predecessor Khameini.

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[143] http://www.nti.org/e_research/profiles/Iran/1819.html

[144] The Resolution passed with 27 votes of approval, 5 abstentions, and 3 opposing votes. Though both abstained from voting, Russia and China agreed to go along with the position of the EU-3 and the United States over Iran. CRS Report for Congress. "Iran's Nuclear Program: Recent Developments." Sharon Squassoni. 3 August 2006.

[145] http://www.nti.org/e_research/profiles/Iran/1819.html

[146] http://www.nti.org/e_research/profiles/Iran/1825_6279.html

[147] Environmental sampling at this location in 2003 has detected HEU particles, but Iran maintained that the samples were contamination from foreign centrifuge plants. The samples ranged from 36-70% U-235, but Iran admitted enrichment only to 1.2%. CRS Report for Congress. "Iran's Nuclear Program: Recent Developments." Sharon Squassoni. 3 August 2006.

[148] http://www.pbs.org/newshour/bb/middle_east/jan-june06/iran_4-11.html

[149] The US receded from its long held position of opposing Iran's civilian nuclear program.

[150] http://news.bbc.co.uk/2/hi/middle_east/4126572.stm

Iran failed to comply with a July 31, 2006 UNSC Resolution[151] demanding a halt to all of its uranium-enrichment related and reprocessing activities by August 31, a move which prompted the IAEA to report Iran to the Security Council. The November 2006 IAEA Safeguards Report indicated that the Agency could not "conclude that there are no undeclared nuclear materials or activities in Iran."[152] In December 2006, the Security Council took action, unanimously voting to impose sanctions on the Islamic Republic.[153] The Council's resolution formalized a now international demand for Iran to suspend all enrichment and reprocessing activities, including research and development and work on all heavy-water related projects, including the construction of a heavy-water research reactor at Arak. The agreement of China and Russia was significant, as the action was then internationalized; it would be much harder for the action to be criticized as US-led western discrimination against Iran's right to the peaceful use of nuclear technology.

[151] UNSC Resolution 1696. http://www.un.org/News/Press/docs//2006/sc8928.doc.htm
[152] IAEA *(GOV/2006/15)*
[153] These sanctions block the import or export of sensitive nuclear material and equipment, as well as freeze the financial assets of persons or entities supporting its proliferation sensitive nuclear activities or the delivery of nuclear-weapon delivery systems. http://www.un.org/News/Press/docs//2006/sc8928.doc.htm