

***Satellite Remote Sensing and Monitoring of Nuclear
Treaties by Non-State Actors***
- A Case Study on Iran -

A Masters Thesis

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'For "civilians" like myself, GoogleEarth is truly a unique and exciting tool. Only a few years ago, one would have needed national security clearance to see such images. Now we can all go verify.'

Hans M. Kristensen

(Director, Nuclear Information Project, Federation of American Scientists)

Chapter 1: Introduction

The proliferation of weapons of mass destruction is one of the biggest challenges for the international community and international security today. With the end of the cold war, the likelihood of a global nuclear war decreased, but new nuclear weapons states emerged and some states strengthened their efforts to get into the group of nuclear weapons possessors. As a consequence, new international binding treaties were created and old agreements were strengthened to increase the efficiency of controlling their compliance. The verification of weapon of mass destruction related activities is conducted by international institutions in the framework of international law. The International Atomic Energy Agency (IAEO), the Organization of the Prohibition of Chemical Weapons (OPWC) and as latest example, the Comprehensive Test Ban Treaty Organization (CTBTO) are bodies within the United Nations Family with the United Nations Security Council as executive body.

In this paper the focus is put on the verification system of the Treaty on the Nonproliferation of Nuclear Weapons (NPT)². The NPT aims to prevent the spread of nuclear weapons. It furthermore support the access to peaceful nuclear technology for all member states. The Treaty defines two types of member states, the nuclear weapons states (NWS)³ and non-nuclear weapon states (NNWS). Nuclear weapon

1 Hans M. Kristensen response No. 14 to Article: Where the Bombs Are; Federation of American Scientists, 25th November 2006;

http://www.fas.org/blog/ssp/2006/11/new_article_where_the_bombs_ar.php

2 The original text of the NPT can be found at <http://www.iaea.org/Publications/Documents/Infcircs/Others/infcirc140.pdf>

3 These states are United States, Soviet Union , United Kingdom, France, and China, which had before 1967 exploded nuclear weapons.

states are prohibited from providing non nuclear weapons states with nuclear weapon related technology. Further, the nuclear weapon states should “pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control”.⁴ Non nuclear weapon states are not allowed to produce nuclear weapons. For that reason they have to accept safeguards to control their compliance with the treaties obligations. The countries have to conduct a safeguard agreement with the International Atomic Energy Agency (IAEA) and all nuclear materials in civil facilities have to be declared to the Agency.⁵

The experience from the Iraq's hidden nuclear program in the early 1990's forced the international community to strengthen the means of the verification regime of the NPT. For this purpose the NPT Additional Protocol was created, which allowed the IAEA to use broader tools to strengthen the control mechanisms. With the new abilities implemented in the Additional Protocol, the IAEA could use open source information, such as satellite imagery to verify nuclear facilities. But open source information is available for civil society as well and could be a tool to for civil society to operate its own analysis of the compliance of treaty agreements.

Civil society, especially academia, developed new tools to make the verification more efficient, by giving the new technical developments to the authorized verification bodies. But because of new technologies and easier access to data, civil society now has more means as well to monitor suspected facilities and programs. With better access to commercial satellite imagery and its higher quality, it is now possible to gain the view from above on sites which are hard or not to reach. The verification of treaties relied in the past mostly on data collected at the sites and countries of interest. However, the member states have to declare their nuclear related sites to the institution in charge. The tools the IAEA uses to detect undeclared facilities have stayed limited. In regard to that point, the IAEA still relies on information purchased by intelligence and governmental means.

4 Federation of American Scientists: Treaty on the Non-Proliferation of Nuclear Weapons [NPT]; <http://www.fas.org/nuke/control/npt/>

5 See 4

As described in the quotation of Hans M. Kristensen at the beginning of this paper, it is often emphasized that civil society, with the availability of more open source satellite imagery, can now verify compliance with international agreements. New actors' arises, who often have the aim to strengthen verification by using their tools and independently assessed data. Nongovernmental Organizations (NGOs) are not bound to governments and do not rely on the rules implemented in a treaty or in verification procedures. For example the Institute for Science and International Security (ISIS) or the Federation of American Scientists (FAS) purchases and assesses satellite imagery and connect their conclusions from other sources with the images. The conclusions are available to the public and media and often aimed at gaining more transparency. But do they support transparency in reality? The aim of this paper is to show what impact the availability of satellite data has on peace and what influence these new tools can have on an existing verification regime? How do the international organizations react to the conclusions made by nongovernmental actors? Nonproliferation of weapons of mass destruction and its verification is a highly political field where solutions often are found within negotiations on the diplomatic level. How do new actors influence these established systems with their assessments efforts? In regards to that, in this paper, the opportunities and the influence of non governmental actors and the benefit of commercial satellite imagery will be analyzed.

In the first section the methodology will be discussed and parameters will be defined. This will be done in order to measure the influence and the efforts of nongovernmental actors in regards to satellite imagery. Furthermore, the scope for the chosen case study will be defined.

In the second section the technical parameters of satellite images and its fields of application within the verification system of the NPT will be described. Certain technical parameters had to be described because they have influence on the benefit for monitoring purposes. Furthermore the terms verification and monitoring will be defined.

The third section gives an overview on the case study of the Iranian nuclear conflict and the chronology of the events within the case study will be described. Furthermore, the groups of actors and their important representatives will be described more detailed.

In the next section an analysis of the case study is conducted. The influence of nongovernmental actors within the chosen case will be put into connection to the actors reactions. Additionally, the proportion of satellite imagery used as a monitoring tool in the case study will be assessed and the benefits of satellite imagery for nongovernmental actors will be described. Furthermore, the parameters defined in section two, with regards to disadvantages and advantages of non state actors, will be adopted for the chosen case study. In addition, the impact of nongovernmental actors on international security, in relation to the case study, will be analyzed.

This paper was written in conjunction with a separate master's thesis in which the same questions concerning the role of non state actors, but with regards to environmental measurement tools, were analyzed using the case study of North Korea. In the final section the conclusions from that paper will be compared to the results displayed in this paper. Furthermore, the final section will include an analysis of the role of satellite imagery and nongovernmental actors in monitoring and verification of nuclear treaties and its possible benefits for future nonproliferation agreements.

Chapter 2: Methodology

Within the field of verification of nuclear treaties, the reliance on satellite imagery is increasing. With the creation of the Additional Protocol to the NPT the IAEA is allowed to use satellite imagery as an additional tool. With regards to nongovernmental actors, especially those in media and science, satellite imagery is used increasingly. The aim of this paper is to show how and if the use of commercial satellite images by civil actors influences the verification systems of the NPT. Therefore the technical side of the satellite imagery is not the focus, but the political impact of its use by civil society.

Approach:

In the article “Non-governmental monitoring of international agreements” the authors name certain strengths and weaknesses of nongovernmental actors in the field of monitoring the compliance of treaties.

In the article it is emphasized that non governmental actors have better *access to information*, because they are not limited to the determination, what kind of data can be used, defined by a verification organization. Nongovernmental actors are able to use any data that is available or collected on their own.⁶ On the other hand the authors pointed out that limited access to information can also be an disadvantage. For example in case of arms control agreements, where the sites and areas of interest are often military related and not allowed to be visited because of security interests.⁷

Furthermore the article defines the *assessment capabilities* of nongovernmental actors as an advantage. Nongovernmental organizations have often more technical competence, the amount of actors and connection with others nongovernmental actors increase their monitoring efforts.⁸

6 Oliver Meier / Clare Tenner: Non-governmental monitoring of international agreements; in Verification Yearbook 2001, VERTIC, London, 2001, p. 213;
http://www.vertic.org/assets/VY01_Meier_Tenner.pdf

7 See 6, p. 217

8 See 6, pp. 214

Another mentioned strength of NGO's is the *speed* with which they provide assessment of their monitoring because they are not bound within formal verification procedures.⁹

The *focus* of NGO's is said to be a advantage because sites and countries can be monitored which are of special concerns and interest. Their work is not determined by an approach to monitor treaties universally, which official verification organizations are subject to.¹⁰

In contrast to that, nongovernmental actors are also able, because of their wider *scope*, to monitor parties which are not members to treaties. This broader scope enables NGO's to monitor non state actors and states and help by strengthening the norms embodied in treaties.¹¹

The last strength of NGO's defined in the article is *political independence*. It is emphasized that nongovernmental actors act independently and that they have no responsibility to political decision making bodies. Because of that, they can use means like 'naming and shaming' to expose non-compliance.¹²

Contrary to these points the authors names certain disadvantages of nongovernmental actors. An example is *limiting reporting*. Many NGO's act in a non-comprehensive manner and put a focus on monitoring the government of the country they are located in. NGO's are often based in developed countries, where they can act more freely and have sophisticated technical and more monetary means. So there could be imbalance in the monitoring of developed and undeveloped countries. Furthermore NGO's often put focus on issues which are more likely to attract media and public attention.¹³

Another described disadvantage is *inconsistency* in monitoring. While verification organizations are forced to do a continuous monitoring, NGO's often are limited by funding opportunities or preferences of their staff members. Beyond that, the

9 See 6, p. 215

10 See 6, p. 216

11 See 6, p. 216

12 See 6, pp 216

13 See 6, pp 217

attention of NGO's might be higher when treaty violations are expected.¹⁴

The article also emphasized that NGO tend to act *unreliably*, because of lack of access to information or technical limits. It is added that volunteer organizations often do not have the means to check the reliability of the information.¹⁵

The last defined weakness is *bias*. Nongovernmental organizations could have an underlying political bias because their members or funding sources have certain political priorities. The article stressed out that NGOs also can be influenced by media and could put a focus on the interests of journalists. Along with this comes the reliance on media to publicize the NGO's findings.¹⁶

The disadvantages and advantages defined above are basic for the assessment of the influence of nongovernmental actors and their use of satellite imagery in a chosen case study. In this paper the case of the controversy concerning the Iranian nuclear program is assessed. In this conflict many actors play various roles. The aims of these actors often could not be defined clearly. But the paper tries to put the actors' reactions into the context of the incidents within the conflict. In order to do this, statements, interviews and reports given by official sides and the nongovernmental actors are compared. Many conclusions can simply be taken from the actors' reactions, which are sorted within the time frame. Many of the conversations had been held during negotiations and also in unofficial negotiations. A firm conclusion or a reliable connection between these statements and their impact often can not be verified because of missing sources. Therefore the documents have been put in a chronological order and have been checked for relations and references within the statements given by other actors. Reliable conclusions could be hard to gain in regards to the complexity and the connections formed within non-official conversations behind the closed doors of diplomatic scenes. The paper is based on the analysis of the sources which are freely accessible.

14 See 6, p. 218

15 See 6, pp. 218

16 See 6, p. 219

Choosing a case:

The Iranian nuclear controversy has had a high amount of public attention. Besides the strong contrast of Iran on the one side and the U.S. Government on the other side, the conflict had been followed by media and civil society increasingly. On the one hand, there are the aggressive comments by the Iranian regime and its effort to expedite the nuclear program, and on the other there is the U.S. Government, which defined Iran as part of “The Axis of evil”. This occurred because of the suspicion that Iran was trying to develop a weapons of mass destruction program and the U.S. ambition to adopt a hard line towards Iran, with possible consequences ranging from the implementation of sanctions to a military strike. Furthermore, the Islamic republic of Iran is member of the NPT since 1968 and therefore is bounden by the obligations within the verification regime. The country had been accused of violating these obligations, several times in the past years.

Time frame:

The time frame, which is assessed in this paper, is defined from the first disclosure to the public of two unknown nuclear related sites in Iran in summer 2002. The information about the Arak and Natanz sites was first given to the public on the 14th of August 2002. The development of the incidents will be assessed until summer of 2003 when the mentioned facilities were put under IAEA safeguards (as defined in the IAEA Board Report from the 6th of June 2003).

Involved actors:

In the controversy over the Iranian nuclear program, various groups were involved. The actors had to be defined and put into these groups, from which the most influential representatives were chosen for each group. This was done by choosing the actors who had a key role in the controversy and by the amount of statements, interviews, reports and documents that were released by these actors.

The actors are defined by their institutional status, whether they are international or supranational actors, sovereign states with national interest or civil society actors not bounded to an international or governmental institution. At this point the first problems occurred in deciding in which group an actor should be put. How can an

opposition group, who has no power as an governmental institution, but has built up an exile parliament, be put into an above defined guidelines? To that affect it is difficult to draw a concrete line between the groups. But nevertheless a group had to be chosen for each actor. To solve this problem, their group was determined by if they represent a nation state or not and if the actor is accepted by the international community.

The above described parameters, the defined groups of actors and the time frame will be the basis for the analysis of the chosen case study. The case study, the involved actors, and the chronology of the events, will be described in more detail in chapter 4. The disadvantages and advantages are the parameters that will be applied to the case study in chapter 5.

Chapter 3: Satellite images monitoring and verification of nuclear treaties

Commercial satellite imagery has been used in the last years increasingly by states, governmental actors and civil society in different fields of application. The technical aspects of commercial satellite images, its benefits for different actors and certain applications in the field of nuclear treaties will be described briefly in this section.

3.1. Technical aspects of satellite imagery

Satellite images have certain characteristics which are important for their field of application. In general, two kinds of sensor systems can be distinguished. First, there are passive sensor systems, which measure the reflected sunlight from objects on the ground. These sensor systems are dependent on the energy which is reflected from the ground. If there is a high amount of cloud cover or little sunlight available, these sensor systems are not able to provide high quality and usable data. Active sensor systems, on the other hand, send their own energy, which is reflected and then measured. Examples of these kind of sensors are Synthetic Aperture Radar (SAR) or laser systems. These systems are not dependent on weather or illumination. Because the use of active systems is not discussed in the case study, the technical parameters of passive imaging sensors are described below.

Imaging sensor parameters are defined by the quality of their resolution. Three types of resolution can be distinguished, these are spectral, spatial and the temporal resolution.

Spectral resolution:

The spectral resolution of a sensor system describes the wavelength interval of the electromagnetic spectrum and the number of spectral bands which are recorded. In general there are three kinds of sensor systems, panchromatic, multispectral and hyperspectral. Panchromatic sensor systems acquire data over a wide range of wavelengths in one spectral band. Multispectral resolution images have three to ten spectral bands with a medium wavelength range. Hyper-spectral data otherwise can

detect several hundred spectral bands with relatively narrow wavelengths.¹⁷

Spatial resolution:

The spatial resolution of a sensor system describes the smallest area on the ground which is covered by a pixel. The spatial resolution is important for the recognition of objects and has influence on the accuracy of discrimination.¹⁸

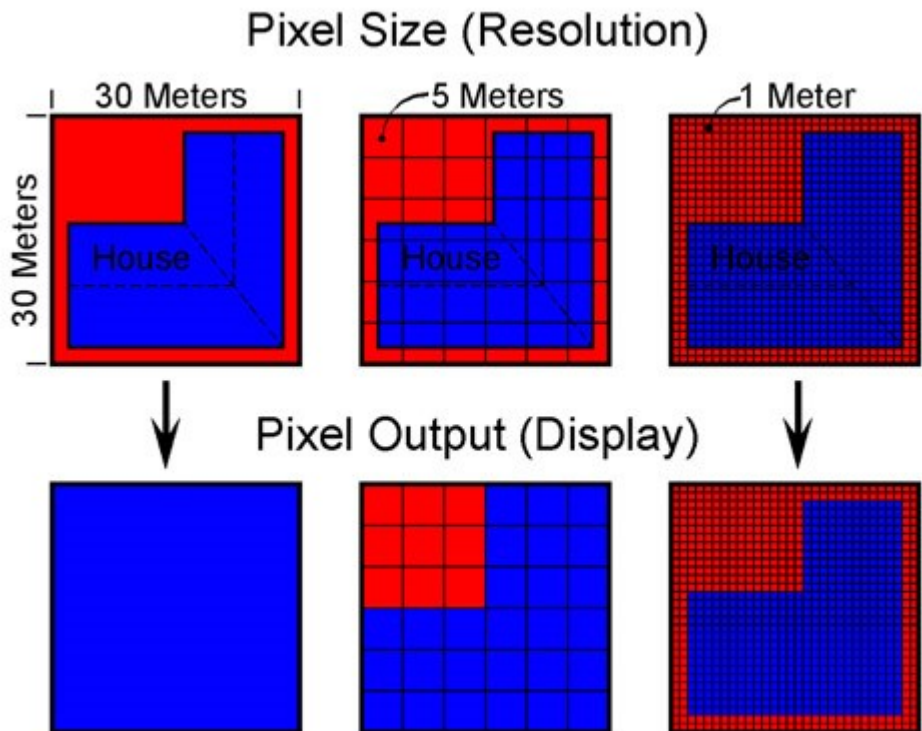


Figure 1: Principle of spatial resolution in satellite images

Temporal resolution:

The temporal resolution describes the time frequency an object on the ground can be recorded. This has an influence on the availability of data. The temporal resolution depends on the orbit of a satellite, and with that, the speed the satellite is able to circle the globe.

In addition to that, satellite images have certain limits. The first limit is the availability of data. The availability is dependent on the area and the point in time data is recorded. Because of the technical limits of satellite systems, comprehensive

17 Bhuprenda Jasani / Gotthard Stein: Commercial Satellite Imagery. A Tactic in Nuclear Weapon Deterrence; Springer, 2002; pp. 57

18 See 17; pp. 54

availability can not be guaranteed. Furthermore, the costs, especially for nongovernmental users, are often too high to purchase image data from certain areas or certain points of time. That is to say, that with a rising resolution the costs are increasing and that for certain applications a high quality of data is essential. A third point is the limitation of access to data by states. For certain regions in the world states regulate the access to satellite data. For example the U.S. Government puts regulations on images from Israel. U.S. companies are not allowed to provide images from this region with a resolution higher than of 2 meters.¹⁹ These limitations are often justified by security interests and could be also adopted, for instance, in armed conflicts.

Nevertheless, commercial satellite imagery is used increasingly by states, international institutions and nongovernmental actors. Table 1 gives an overview on providing companies, the systems and their technical parameters.

System	Operator	Current Satellites	Type	Highest Resolution (meters)
EROS	ImageSat International	EROS A	Optical	1,5
		EROS B	Optical	0,7
		EROS C	Optical	0,7
IKONOS	GeoEye	IKONOS-2	Optical	0,8
OrbView	GeoEye	OrbView-1	Optical	10.000
		OrbView-2	Optical	1.000
		OrbView-3	Optical	1
		OrbView-4	Optical	1
QuickBird	DigitalGlobe	EarlyBird	Optical	3
		QuickBird-1	Optical	1
		QuickBird	Optical	0,6
Radarsat	MDA	Radarsat-1	Radar	8
		Radarsat-2	Radar	3
SPOT	Spot Image	Spot 2	Optical	10
		Spot 4	Optical	10
		Spot 5	Optical	2,5
WorldView	DigitalGlobe	WorldView-1	Optical	0,5
Disaster Monitoring Constellation	DMC International Imaging	AISAT-1 (Algeria)	Optical	32
		NigeriaSAT-1 (Nigeria)	Optical	32
		UK-DMC (United Kingdom)	Optical	32
		Beijing-1 (China)	Optical	4
TerraSar		TerraSar-X	Radar	1

Table 1: Commercial satellite systems

¹⁹ Digital Globe: <http://www.digitalglobe.com/index.php/18/Company+FAQs?cat=7>

3.2. Satellite imagery in verification of nuclear treaties

The compliance control for binding agreements in the field of nuclear nonproliferation are limited by certain specifications. In case of the NPT, the member states are bound to a verification system, which controls states compliance to treaties obligations. In this case, the terms monitoring and verification are often not well-defined. Thus these terms had to be defined in order to use them in this paper.

Verification:

The term verification is used in connection within treaty agreements. Member states have to be checked for their compliance with treaties obligations. For that a verification system is implemented which monitors the actions and facilities of a member state. The conclusions made from the verification have to be reported to the authorized bodies.

Monitoring:

Monitoring could part of verification systems. Monitoring systems collect and interpret data. There are no limits to monitoring for non governmental actors, because they are not bound to the rules of a verification system. Sources of data can be anything and the used information is not limited to the rules of a verification system. Furthermore, nongovernmental actors can monitor states which are not within an verification system.

The use of satellite images within the safeguard system of the IAEA

The IAEA Satellite Imagery Analysis Unit (SIAU) purchases and assesses satellite images for various fields of nuclear verification, for example, the monitoring of changes at nuclear sites. Furthermore, the unit verifies Additional Protocol declarations and the accuracy of design information of nuclear facilities provided by the member states. Based on third party or open source information SIAU tries to detect alleged undeclared facilities.²⁰

²⁰ See 17; pp 23

Chapter 4: Case study Iran

4.1. *The Iranian nuclear program*

Iran started its nuclear program in 1957 under the Shah, Mohammed Reza Pahlavi. The country was provided, within the Atoms for Peace Program, with nuclear equipment and expertise. One of the main supporters was the United States. Iran signed the NPT in 1968 and ratified it in 1970. Over the next few years the country was provided with nuclear material, techniques and expertise by several western states. The construction on the Buser reactor complex had been started in 1975 with the help of German engineers.²¹

After the Islamic Revolution, the country stopped its nuclear program, but did not suspend its nuclear research. The Iraq-Iran War, from 1980 to 1988, constrained Iran's work and the Buser reactors were seriously damaged by an Iraqi air strike. In 2002 work on the reactors had been resumed, this time with the support of Russian technicians.²² Furthermore, Iran has received equipment and training support from China and Russia from the late 1980s on. But Iran has not just relied on this source of support. Iran is said to have contacts with the nuclear trafficking network of Abdul Quader Kahn, the "Father of the Pakistani Bomb".

In 2002 the existence of the Arak heavy water production plant and the uranium enrichment plant at Natanz came to public. With this incident the controversy about the nuclear program reached a new dimension and Iran declared its plan to build up a complete nuclear cycle. Through these incidents several violations of Iran's NPT agreements had been exposed by the IAEA and the country agreed to sign the Additional Protocol in 2003, but did not ratify it. Furthermore, negotiations with the EU²³ began in 2003 with the aim to suspend uranium enrichment and conversion

21 Nuclear Threat Initiative (NTI): Nuclear Chronology 1957-1985;
http://www.nti.org/e_research/profiles/1825_1826.html

22 Götz Neuneck: Der Atomstreit mit dem Iran: Einzelfall oder Ende des Nichtweiterverbreitungsvertrages?; in: Gerhard Beestermöller/ Heinz-Gerhard Justenhoven, (Hg.): Der Streit um die iranische Atompolitik. Völkerrechtliche, politische und friedensethische Reflexionen (Beiträge zur Friedensethik, Band 40, Stuttgart, 2006, pp 16

23 United Kingdom, Germany, France

activities.²⁴ Iran agreed on the suspension for the time but restarted uranium enrichment in 2005. Iran was accused of non compliance with the NPT several times in the last years. The Iranian case was sent to the UN-Security Council, who adopted sanctions against Iran. But the country still pursued its nuclear program with great efforts. The following figure shows the known Iranian nuclear sites.

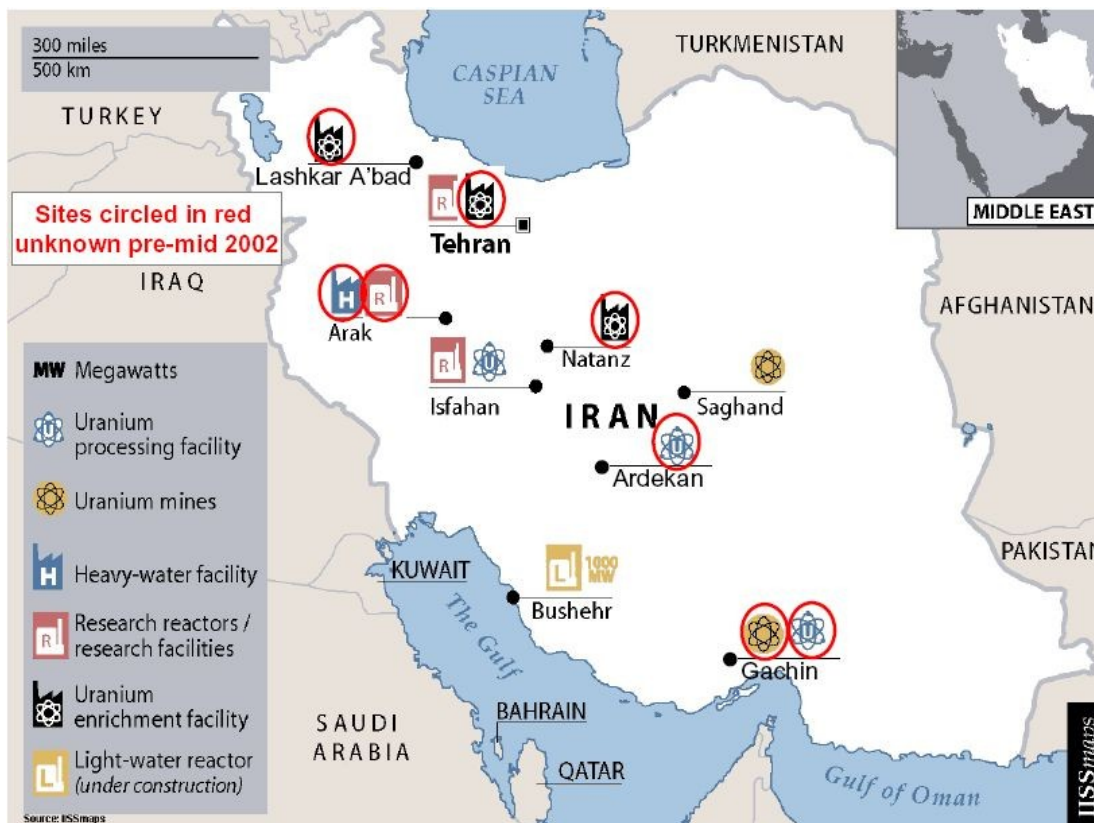


Figure 2: The Iranian nuclear sites and facilities

4.2. Actors

In the case study of this paper, the above defined three groups of actors are examined. These groups are; international organizations, nation states and civil society or nongovernmental actors. In the following section the groups and the actors within these groups are defined.

²⁴ Nuclear Threat Initiative (NTI): Nuclear overview; http://www.nti.org/e_research/profiles/Iran/Nuclear/index.html

International Organizations

International Atomic Energy Agency (IAEA):

The International Atomic Agency (IAEA) is an independent institution within the United Nations framework. The IAEA started its work in 1957. Today the Agency has 146 member states.²⁵ Its main tasks are divided into three pillars: safeguards and verification, safety and security, and science and technology.²⁶ Concerning this paper the field of nuclear verification will be to put into focus. The Agency's task is to verify the compliance of its member states regarding the obligations defined in the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). Therefore, the IAEA has built up a verification and safeguards system, which allows it to control the peaceful use of nuclear energy by the member states.²⁷ These control mechanisms include tools like seals, camera surveillance, material accountancy and on site inspections. Since the early 1990's, after the discovery of a clandestine nuclear program in Iraq, the NPT Additional Safeguards Protocol was created. The Additional Protocol aims to increase the likelihood of detecting undeclared nuclear facilities.²⁸ Therefore, the use of open source information, like media and commercial satellite images, could be used to strengthen the safeguards activities.

States

Iran:

Iran had been working since the 1950s on a nuclear program and was one of the first countries which signed (1968) and ratified (1970) the Treaty on Non-Proliferation of Nuclear Weapons. The nuclear program is a project of national prestige for Iran and an expression of independence from other countries. The country claims it has an inalienable right to a civil nuclear program, because of its membership to the NPT. Furthermore, Iran accused western countries of discriminating against Iran by not supporting the country in its nuclear ambitions, which is said to be guaranteed under the NPT. In addition, Iran claims it is using nuclear power for peaceful purposes and

25 <http://www.iaea.org/About/index.html>

26 <http://www.iaea.org/OurWork/index.html>

27 <http://www.iaea.org/About/mission.html>

28 International Atomic Agency (IAEA): IAEA Safeguards: Stemming the Spread of Nuclear Weapons; http://www.iaea.org/Publications/Factsheets/English/S1_Safeguards.pdf

wants to build up a complete nuclear cycle. Iran has always denied its pursuit for nuclear weapons and underlined that weapons of mass destruction are against Islamic principles. However, the country had been accused of violating the obligations of the NPT several times in the last years.

In addition the country had been in the focus of the international community in the last years because of the increasing aggressive anti Israel and anti Western rhetoric. This could have been caused by possible outside threats, such as the U.S. military engagements in Afghanistan and Iraq and the nuclear weapons in Israel. Another concern of the international community is Iran's possession of capable delivery systems, like ballistic missiles, for weapons of mass destruction. This is based on the advancement of Iran's space program.

United States of America:

The United States of America has not had diplomatic relations to the Islamic Republic of Iran since the Islamic Revolution. The relations between the two countries has been affected by mistrust and confrontation since that time. In 2001, after the September 11th terrorist attacks, the Bush Administration changed U.S. foreign policy to a more realist and unilateralist approach. International agreements, especially disarmament and arms control agreements, were seen more critically because they were said to weaken America's power. Through these policies, democratization and nation building efforts, like the invasion in Iraq in 2003, were justified.²⁹ The U.S. Middle East policy is often criticized because of the country's military engagement in Iraq and Afghanistan and their support of Israel.

George Bush labeled Iran as part of the "Axis of Evil" and accused the country of supporting terrorism in Middle East. Furthermore, the country was accused by the U.S. of developing weapons of mass destruction and the U.S. stated that it would keep military options on the table with regards to Iran.

²⁹ Jack Mendelsohn: US Foreign Policy, the Iran and next Steps; in: Beestermöller, Gerhard / Justenhoven, Heinz-Gerhard (Hg.): Der Streit um die iranische Atompolitik. Völkerrechtliche, politische und friedensethische Reflexionen (Beiträge zur Friedensethik, Band 40, Stuttgart, 2006, pp 69

Civil Society

National resistance council of Iran (NCRI):

The NCRI is a group of Iranian organizations which was founded in 1981 in Teheran. As is said on the homepage of NCRI, five organizations are members of the NCRI, including the People's Mojahedin Organization of Iran (MKO). The NCRI emphasizes the MKO as the largest and most popular resistance group inside Iran.³⁰ NCRI and MKO are classified as terrorist groups by the U.S. State Department and the EU, but there are suspicions that the group has been supported by U.S. Officials.³¹ The NCRI works towards a regime change in Teheran. Concerning this matter, the group has reported human rights violations in Iran and the supposed clandestine nuclear weapons program continuously to the public.

Institute for Science and International Security (ISIS):

ISIS is a U.S. think tank founded by David Albright, a physicist and former U.N. Weapons inspector. The institute puts its focus on the monitoring of facilities in proliferation suspected countries. Therefore, its main working field is the assessment of commercial satellite imagery. The data is purchased mostly by the U.S. Company DigitalGlobe. The think tank has published reports and statements on the proliferation of weapons of mass destruction routinely. Using the staff members nuclear expertise in connection with the assessment of satellite images, conclusions are drawn. The institute is very willing and able to work with the media. David Albright is often interviewed and asked to give his opinion as an nuclear expert, especially by U.S. Media.

Media / Public:

In the case of the Iranian nuclear controversy, media and civil society play the same role. Because the public does not usually have access to national data or scientific reports, the most used source for gaining information is the media. However, in the

³⁰ <http://ncr-iran.org/content/view/6046/>

³¹ BBC: Profile: Maryam Rajavi; http://news.bbc.co.uk/2/hi/middle_east/2980279.stm

media, the information gained from officials, academia and others is often filtered. During the Iranian nuclear conflict the well known U.S. News Channel, CNN, put much effort into their media coverage. CNN is one of the most well known broadcasters in the U.S. and has a Washington based location, where they have access to people from politics and think tanks. They will be the main source of information, in this paper, for the media/public group.

4.3. Publication of the satellite images from Natanz and Arak

The following section gives an overview of the documents and statements given by the different actors from late summer 2002 to summer 2003. The statements are in a chronological order to show the development of the incidents in this time frame. It illustrates how the different actors reacted to the publications of the different interest groups involved in the conflict.

In the presentation of the National Resistance Council of Iran on the 22nd of August 2002, the spokesman Ali Jafarzadeh gave the first hints of secret nuclear facilities in Iran. It was the first naming of the facilities in Arak and Natanz in the media. According to Jafarzadeh, in Natanz there was said to be a nuclear fuel production facility, for which construction started in 2000. The other secret facility near Arak was, according to the speaker, a heavy water fabrication facility, for which construction started in 1996. After the introduction of this information to his audience, he answered the press' questions. When asked if the information had been shared with the U.S. government, he answered that the information had been available to the authorities of the United States, but that he was not aware of the government's reaction at that moment.³² Additionally, Jafarzadeh gave an explanation of the connections between United Nations bodies and agencies and the information given by the NCRI. He reiterated that the National Council of Resistance of Iran worked closely with United Nations organizations and he also said that his

32 Alireza Jafarzadeh: New Information on Top Secret Projects of the Iranin Regime's Nuclear Program; Remarks by Alireza Jafarzadeh, U.S. Representative Office, National Council of Resistance of Iran, Press conference, Washington D.C. 14th August 2002; p. 5, <http://www.iranwatch.org/privateviews/NCRI/perspex-ncri-topsecretprojects-081402.htm>

group instantly asked for more serious monitoring systems and intervention on the part of the UN.³³ Jafarzadeh did not mention the International Atomic Energy Agency to that effect.

Jafarzadeh emphasized that Iran was able to build nuclear sites secretly and without being recognized by the International Atomic Energy Agency.³⁴ Furthermore, Jafarzadeh denied having satellite images of the facilities, but he pointed out that the details the informants gave, like names, addresses, facilities and sizes, could not be shown on satellite photos.³⁵

In a statement given by H.E. Reza Aghazadeh, Vice-President of the Islamic Republic of Iran and President of the Atomic Energy Organization of Iran, at the 46th General Conference of the International Atomic Energy Agency in September 2002, it was said that at that moment Iran had a plan to build up a closed nuclear cycle with power plants within the next two decades. He also emphasized in the statement that the country had the inalienable right to gain peaceful nuclear power. In addition Aghazadeh confirmed that Iran fulfilled its cooperation with the IAEA by submitting all nuclear activities. Aghazadeh mentioned the Buser power plant but not the Arak and Natanz facilities. He also claimed that Iran supported its commitments in regards to the nuclear activities by having had complete transparency.³⁶

In the ISIS-Issue Brief published on the 12th of December 2002 satellite photos from the Natanz and the Arak facilities were shown. In the publication the authors mentioned that ISIS had located and purchased Digital Globe satellite images of the two sites by using the information released by the NCRI in August 2002.³⁷

The images of the facilities were provided by Digital Globe, a company offering high resolution satellite imagery from different sensor systems like QuickBird or

33 See 32, p. 6

34 See 32, p. 7

35 See 32, p. 7

36 H.E. Reza Aghazadeh, Vice-President of the Islamic Republic of Iran and President of the Atomic Energy Organization Of Iran: Statement; 46th General Conference of the International Atomic Energy Agency, Vienna, 16th of September 2002, p. 4

37 Institute for Science and International Security (ISIS): Iran Building Nuclear Fuel Facilities: International Transparency Needed; ISIS-Issue Brief, Washington D.C., 12th of December 2002; <http://www.isis-online.org/publications/iran/iranimages.html>

WorldView-1.³⁸ The published images showed an overview and a close up of both facilities. The satellite image of Arak was taken on the 26th September 2002, with annotations included by ISIS on security perimeters and the heavy water plant under construction. (see figure 3)



ARAK, IRAN -- SITE OVERVIEW

INSTITUTE FOR SCIENCE AND INTERNATIONAL SECURITY

IMAGE CREDIT: DIGITALGLOBE
DATE OF IMAGE: 26 SEPT 2002

THE ARAK SITE APPEARS TO BE A HEAVY WATER PRODUCTION FACILITY. IT IS LOCATED ABOUT 150 MILES SOUTH OF TEHRAN



ARAK, IRAN -- CLOSE-UP

INSTITUTE FOR SCIENCE AND INTERNATIONAL SECURITY

IMAGE CREDIT: DIGITALGLOBE
DATE OF IMAGE: 26 SEPT 2002

CLOSE-UP OF THE ARAK HEAVY WATER PLANT UNDER CONSTRUCTION.

Figure 3: Overview and Close Up of the Arak facility - 26th of September 2002



NATANZ, IRAN -- SITE OVERVIEW

INSTITUTE FOR SCIENCE AND INTERNATIONAL SECURITY

IMAGE CREDIT: DIGITALGLOBE
DATE OF IMAGE 16 SEPT 2002

THE NATANZ SITE IS A POTENTIAL URANIUM ENRICHMENT FACILITY, POSSIBLY A GAS CENTRIFUGE SITE. IT IS LOCATED APPROXIMATELY 100 MILES SOUTH OF TEHRAN.



NATANZ, IRAN -- CLOSE-UP

INSTITUTE FOR SCIENCE AND INTERNATIONAL SECURITY

IMAGE CREDIT: DIGITALGLOBE
DATE OF IMAGE: 16 SEPT 2002

THIS IS A CLOSE-UP OF SOME OF THE MORE ADVANCED CONSTRUCTION AT THE NATANZ SITE. THIS SITE IS A POSSIBLE URANIUM ENRICHMENT FACILITY, MAYBE FOR GAS CENTRIFUGES.

Figure 4: Overview and close up of the Natanz facility - 16th of September 2002

38 www.digitalglobe.com

The image of Natanz was taken on the 16th September 2002. It showed the whole area with marks of the construction site underground. (see figure 4)

In the Issue Brief it was said that Iran, according to the IAEA General Conference in September 2002, was pursuing a long term plan to construct nuclear power plants and the associated technologies, such as fuel cycle facilities. Furthermore, the authors stated: "A few years ago, a senior Iranian official told ISIS that Iran was pursuing a complete fuel cycle."³⁹ In addition it was suggested that Arak was a heavy water production facility and that the Natanz site was, contrary to the statement of the NCRI in August 2002, a uranium enrichment facility.⁴⁰

The following day CNN broadcasted multiple interviews, statements and reports on the topic of the secret Iranian nuclear facilities. First there was a report with the focus on the satellite images published by ISIS, where it was said that the long contended suspicion by Iranian dissidents about a secret nuclear program could be confirmed by the conclusions drawn from the satellite images.⁴¹ The report also emphasizes that the satellite images concerned nuclear experts. For Example the Arak facility resembles heavy water plants found in Pakistan. Furthermore, in the news coverage it was stated that the Natanz facility appeared to U.S. Intelligence officials and civilian experts from ISIS to be a uranium enrichment plant.⁴²

On the 13th of December 2002 a press briefing with U.S. State Department spokesman Richard Boucher took place.⁴³ In this briefing Boucher spoke about Iran's clandestine nuclear program, which is, according to him, well known and based on hard evidence. He noted particularly that the uranium enrichment plant and the heavy water plant could be used to produce weapon grade material. According to him these facilities were not justified within the parameters of a civil nuclear program. He went on further to say that a civil nuclear program is not necessary and would have no substantial economic gain for resource-rich country like Iran. He added that the sites

39 See 37

40 See 37

41 David Ensor (CNN): U.S. has photos of secret Iran nuclear sites; Report, 13th of December 2002, <http://edition.cnn.com/2002/WORLD/meast/12/12/iran.nuclear/>

42 See 41

43 Richard Boucher, Spokesman U.S. State Department: Daily Press Briefing; Washington, DC; 13th of December 2002; <http://2001-2009.state.gov/r/pa/prs/dpb/2002/15976.htm>

had been discussed with allied countries who share the concerns and the IAEA. He pointed out that the first disclosures occurred in public in summer 2002. Furthermore, he focused on the satellite images, which, according to him, showed that certain areas of the Natanz site were constructed underground. He said that it appeared from the imagery that a service road, several small structures, and perhaps three large structures, were being built below ground, and some of these were already being covered with earth. According to Boucher, the facility probably never would have been declared to the IAEA.⁴⁴

On the same day Ari Fleischer, U.S. press secretary, was faced in a press briefing with several questions on the Iranian nuclear program. On the question of the governments assessment, in regards to the new detected facilities covered by the media, Fleischer answered that there were serious concerns and that the recent disclosures of the secret sites reinforce the concerns.⁴⁵ When asked about the announced visit of Director General ElBaradei and the possible outcome that the sites were being used in a nuclear weapons related manner, Fleischer answered that the government was looking forward to a report from the IAEA, but he did not answer on possible reactions of the U.S.⁴⁶

On the 13th of December an interview with the ambassador of Iran Javad Zalid concerning the two facilities was published by CNN.⁴⁷ On the question of what he could tell about the two facilities, he answered that all facilities, the ones that already had been constructed and the ones which were under construction, had always been transparent. In regards to satellite images he said that it was no secret that the U.S. had photos and that nuclear facilities could not be hidden. He also gave a statement regarding the obligations to report facilities to the IAEA. He added that his country had always fulfilled these obligations within the legal time limit. Furthermore he said that the Director General ElBaradei had already been invited to visit the new

44 See 43

45 Ari Fleischer: White House Press Briefing; Washington D.C., 13th of December 2002;
<http://georgewbush-whitehouse.archives.gov/news/releases/2002/12/20021213-6.html#7>

46 Ari Fleischer: White House Press Briefing; Washington D.C., 13th of December 2002;
<http://georgewbush-whitehouse.archives.gov/news/releases/2002/12/20021213-6.html#7B>

47 CNN: Iranian diplomat denies nuclear weapon program; Interview with Ambassador of Iran Javad Zalid; 13th of December 2002;
<http://edition.cnn.com/2002/WORLD/meast/12/13/zarif.transcript/index.html>

facilities and take part in the inauguration of one of the facilities. When asked which facility this would be, Zarif answered that it would be the facility at Esfahan.⁴⁸

Zarif was next asked if the two new facilities were allowed to be visited by IAEA officials also, he answered that there was a legal time frame of 180 days before the construction was finished to report the facilities. Iran had always fulfilled that obligation and would continue to do so.⁴⁹ On the next question, if the two new facilities were part of a peaceful nuclear program, Mr. Zarif said that, even though he had not seen the satellite images at the time of the interview, he could categorically say that any facility in Iran, dealing with nuclear technology, was peaceful.⁵⁰ During the whole interview the ambassador never mention the Arak or the Natanz facility by name.

The following interview was broadcasted by CNN the same day. Director General of IAEA, Mohammed El Baradei, gave information about the chronology of the nuclear facilities related events and talks between Iran and IAEA. He informed the interviewer that the IAEA had the first information about the two facilities in August 2002 and that IAEA procured satellite images of the sites. He added that he personally talked to the Iranian head of the Atomic Energy Commission in September. In this meeting he confirmed that Iran was building a number of nuclear facilities, but also invited El Baradei and IAEA technical specialists to visit the facilities. Director General ElBaradei was supposed to visit the facilities during the week the interview was broadcasted in mid December 2002. However, Iranian officials rescheduled it to February 2003.⁵¹ He pointed out that the sites were under safeguards and said to be for peaceful use according to Iranian officials. But nevertheless it was important to visit the facilities early to make sure that they were under full control.⁵² In Addition he also confirmed that the Iranians informed him about an ambitious nuclear power program with nuclear fuel and enrichment facilities, but that they did not go into technical details. Nevertheless, they welcomed

48 See 47

49 See 47

50 See 47

51 CNN: Interview with Mohammed ElBaradei; Transcript, Washington D.C., 13th of December 2002, <http://edition.cnn.com/TRANSCRIPTS/0212/13/lt.01.html>

52 See 51

the IAEA to visit the facilities and put them under safeguards. Mr. Baradei confirmed, again, that he was informed by the Iranians in September 2002.⁵³

Furthermore a report, with the title “U.S.: Iran working on nuclear weapons”, on the reaction of US-Officials was published by CNN, that day.⁵⁴ It was an abstract of the statements given by the different groups associated with the publication of the satellite images. Over all the report quoted the statements mentioned above, but added a quote of an IAEA spokesman, Mark Gwozdecky, in which he said that the facilities at Natanz and Arak were of particular interest for the agency. He added that everybody was looking at the same images and that they confirmed what purpose the two sites have, an uranium enrichment facility and a heavy water plant. Beyond that he pointed out that Iran was allowed to have the facilities as long they are declared and put under safeguards.⁵⁵

In the ISIS Issue Brief, with the title; “Iran at Nuclear Crossroads”, published on 20th of February 2003, David Albright said that Natanz and Arak sites were unknown to the IAEA until the summer of 2002 and that IAEA was, with the help of satellite images provided by IAEA member states, able to define the purpose of the facilities, namely a heavy water plant at Arak and an uranium enrichment plant at Natanz. He also referred to December 2002 when ISIS first published commercial satellite images and gave the information about the two facilities to the public. Today on the ISIS homepage there is a link, in the February 2003 brief, to the satellite images published in the next Issue Brief, which was published on 14th of March 2003.⁵⁶

A CNN report one day later dealt with the visit of Director General El Baradei to Arak and Natanz that month. Furthermore it was said that the suspicions concerning the two facilities were confirmed by U.S. Officials and that satellites photos of the two sites were first broadcast on CNN.⁵⁷

53 See 51

54 CNN: U.S.: Iran working on nuclear weapons; Washington D.C., 13th of December 2002; <http://archives.cnn.com/2002/WORLD/meast/12/13/iran.nuclear/>

55 See 54

56 David Albright: Iran at a Nuclear Crossroads; Institute for Science and International Security (ISIS), Washington D.C., 20th of February 2003; <http://www.isis-online.org/publications/iran/crossroads.html>

57 David Ensor (CNN): 'Secret' Iran nuke plant, as probe begins; Washington D.C., 21st of February 2003; <http://edition.cnn.com/2003/WORLD/meast/02/20/iran.nuclear/index.html>

The third ISIS Issue Brief was published on the 14th of March 2003. In the statement it was said that, based on the crude geographical information from NCRI and archives from Digital Globe, ISIS had found images from the Natanz facility in Iran. The authors also argued that from assessing the images and from the use of information from other sources, a more complete understanding of the Natanz facility could be gained. The images are of the same nature as the ones published in December 2002, but only from the Natanz facility. Again, there were close-ups available and annotations on the structure of the facilities inserted. Special attention was paid to the progress of the construction in the annotations.⁵⁸

The new images were compared with the ones taken in September 2002, in which further annotations were inserted.⁵⁹ (see Figure 5)

Three more images can be seen in this Report. There was an overview and two close-ups taken on the 7th of



NATANZ, IRAN -- CLOSE-UP
 INSTITUTE FOR SCIENCE AND INTERNATIONAL SECURITY
 IMAGE CREDIT: DIGITALGLOBE
 DATE OF IMAGE: 16 SEPTEMBER 2002
 THE GAS CENTRIFUGE URANIUM ENRICHMENT PLANT AT NATANZ, IRAN.

Figure 5: Overview Natanz facility with further annotations - 16th of September 2002

Natanz facility. Again, there were close-ups



NATANZ, IRAN
 INSTITUTE FOR SCIENCE AND INTERNATIONAL SECURITY
 IMAGE CREDIT: DIGITALGLOBE
 DATE OF IMAGE: 7 FEBRUARY 2003
 THE GAS CENTRIFUGE URANIUM ENRICHMENT PLANT AT NATANZ, IRAN.

Figure 6: Overview Natanz facility with further annotations - 7th of February 2003

58 David Albright / Corey Hinderstein: The Iranian Gas Centrifuge Uranium Enrichment Plant at Natanz: Drawing from Commercial Satellite Images; Institute for Science and International Security (ISIS), Washington D.C., 14th of March 2003; http://isis-online.org/publications/iran/natanz03_02.html

February 2003 available. Again, annotations are inserted, which point out the buildings in detail. They assume that the underground area contains gas centrifuge cascades and a smaller building with a pilot centrifuge plant with less than 200 machines. (see Figure 6)⁶⁰

In addition the authors gave a detailed description of the construction and the buildings on the ground. For example, it was said that the underground facilities were able to hold over 50.000 centrifuges. Three main areas had been identified; three underground structures (which are said to be uranium enrichment buildings), an aboveground area with six buildings (which are said to contain centrifuge assembly facilities), and the centrifuge pilot plant (which was, according to IAEA, not operating with uranium as of late February 2003). Furthermore, details of the progress in construction and security measures had been pointed out in the images by annotations and in the text.⁶¹ (see Figure 7)

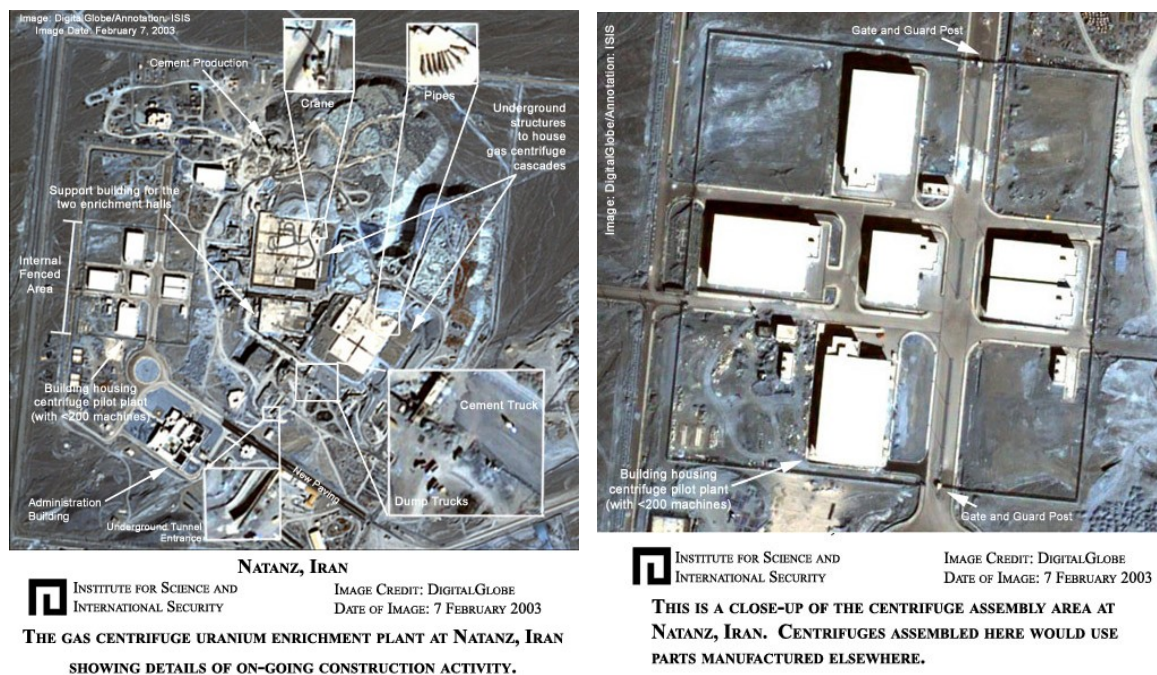


Figure 7: Overview and close up from the Natanz facility - 7th of February 2003

In the Issue Brief the authors also emphasized that a large military strike would be necessary to destroy the underground buildings. Even if that happened, they assumed that Iran could rapidly build a small gas centrifuge facility, because of its

59 See 58
60 See 58
61 See 58

decentralized gas centrifuge program.⁶²

On the 6th of May 2003 H.E. Mr. Reza Aghazadeh, Vice President of the Islamic Republic of Iran, gave a statement about his countries nuclear policy.⁶³ He stressed that the speculations raised over the secrecy of Natanz and Arak facilities were unfounded and irrational. He pointed out that the Arak facility did not have to be declared, because it produced heavy water, which did not fall under the IAEA safeguard agreement. For him it was irrational to speak about secrecy because of the huge installations and towers at the site, as well as the satellite images and the reports in the international media. Another reason, he pointed out, was that Iran was obliged to report the Natanz facility to the IAEA 180 days before the date of transporting nuclear material into the facility. For him, Iran had no legal obligation to declare it before that date.⁶⁴ Furthermore, he added: “However, we decided to formally inform IAEA of the existence of this facility in September 2002 before the hue and cry that was raised by the Western media and their propaganda machine. Although we were under no legal obligation to do so we, as a sign of goodwill, invited the IAEA Director General and his colleagues to visit the Natanz facility.”⁶⁵

In the Report from IAEA from the 6th of June 2003⁶⁶ it was said that the Director General Mohamed ElBaradei met with the Vice President Reza Aghazadeh, during the IAEA General Conference in September 2002. The Director General asked if Iran was building a large underground nuclear related facility at Natanz and a heavy water production plant at Arak, as reported by the media in August 2002. According to the report, the Vice President provided information on his countries intention to develop its nuclear fuel cycle. The Vice President agreed on a visit to the two sites by the IAEA later in 2002.⁶⁷

62 See 58

63 H.E. Mr.Reza Aghazadeh, Vice President of the Islamic Republic of Iran: Iran’s Nuclear Policy (Peaceful, transparent, Independent); Statement, IAEA Headquarters - Vienna, 6th of May 2003, pp. 6 , <http://www.iranwatch.org/IAEAgovdocs/iran-iaeastatement-aghazadeh-050603.pdf>

64 See 63, p. 7

65 See 63, p. 7

66 International Atomic Energy Agency (IAEA): Implementation of the NPT safeguards agreement in the Islamic Republic of Iran; Vienna, 6th of June 03, <http://www.iaea.org/Publications/Documents/Board/2003/gov2003-40.pdf>

67 See 66, p. 2

Chapter 5: Analysis of the case study

5.1. Proportion of civil verification

The Satellite images, as a part of civil monitoring, were actively submitted to the public by David Albright's Institute for Science and International Security (ISIS). The main problem with acquiring the proper satellite data for a point of interest is to find the correct location on the ground. Without knowledge of the correct location the site is hard to detect on a satellite image with a high spatial resolution. The area covered by such an image is on too large a scale. So it is a precondition to know the area where the sites of interest are assumed to be. In case of the satellite images of Natanz and Arak the location was roughly known because of the information given by the NCRI. David Albright confirmed that fact in his statement in the March 2003 ISIS-Issue Brief by saying that the institute found the sites with the help of the crude geographical information given by NCRI.⁶⁸ In addition to the knowledge of the geographical location the purpose of the facilities could be determined by the optical interpretations of the analyzer in charge. In case of the Natanz facility the nuclear experts came to the conclusion that Natanz was not a nuclear fuel production facility, as the NCRI had affirmed, but an uranium enrichment plant. In the December 2002 ISIS Issue Brief the assumption was justified with the nature of the buildings.⁶⁹ In the case of the Arak facility, the NCRI said that it was a heavy water fabrication facility, ISIS came to the conclusion that it appeared to be a heavy water plant under construction.⁷⁰

In conclusion it seems to be necessary for the interpreter of the satellite images to have the knowledge of the design and structures of nuclear facilities, in general, in order to draw conclusion from satellite imagery, in regards to the purpose of observed sites. The secrecy of the Natanz facility has been often ascribed by the construction of a below level facility. This fact was one of the main conclusions derived from the assessment of the images. Furthermore, the suspected secrecy was

68 See 58

69 See 37

70 See 37

one of the main argument given by officials, researchers and other experts for assuming there was a clandestine nuclear program in Iran.

These conclusions from the optical image interpretations are easy to reach, even for non-experts on the structure and design of nuclear facilities. The fact that the changes in structures can be seen from the sky is a benefit for the analysis of satellite images. To obtain knowledge of the incidents happening in the building the interpreter has to put his knowledge, the design of facilities, and the change in their structure and the surrounding area into context. The efforts of commercial satellite images, with increased spatial and temporal resolution, are offering more opportunities for interpreters and the public. In case of the publication of the images, not just from Natanz and Arak, by ISIS and other researchers and institutes, have an increasing amount of information. This could be a source for civil society and science to get to know what is happening in countries, which are, whether because of security or political causes, not reachable. Another important aspect is, if the location of the sites are known, the public and researchers are able to survey the sites instantly. The conclusions which are driven by such a instant surveillance have to be interpreted carefully, as to not draw hasty and wrong conclusions.

5.2. The actors' reactions and relations between the statements

With the release of the satellite images in December 2002 the representatives of the different groups seemed to be forced to take action. The publication of the satellite images from Natanz and Arak caused many reactions from the different actors. Many of the conversation took place unofficially, so it is hard to find evidence about the intentions and the willingness to make public statements. It must just be assumed which incident caused which reaction. Nevertheless, when the statements, their date and the actor are put into context to the time frame conclusions can be drawn as to the intention. The relations between statements given in the different phases of the event can be drawn from their reference to other statements from the actors. The images were displayed in the media and in scientific reports far longer than in the time between December 2002 and late summer 2003. This means, that officials from

the states and academia dealing with nuclear non proliferation, continuously used the images to underline their assessments of the possible intensification of Iran and the purpose of the nuclear program, even after the IAEA had been aware of the facilities.

International Atomic Energy Organization (IAEA):

The uncovering of information by the NCRI caused reaction from the IAEA, this fact is confirmed by the IAEA-Report on the implementation of safeguards in Iran from June 2003. It was said that, according to the media coverages in summer 2002, Iranian officials had been asked about the facilities.⁷¹ Furthermore, in the December 2002 interview, with Director General ElBaradei, it is stated that the Agency purchased satellite imagery from the two sites to analyze them with their technical means, right after the August 2002 disclosures by the NCRI. It cannot be determined whether the purchase of satellite took place before or after the 46th General Conference of the IAEA .

In conclusion it must be emphasized, that the IAEA was not surprised about the content of the new satellite images published in December 2002 and that there had not been much new information given to the agency.

Nevertheless, the IAEA seemed to be alerted by the publication of the ISIS satellite images. The high amount of media reports, statements and interviews around the 12th of December 2002 could be hints to that fact. Furthermore, the interview with Director General ElBaradei on the 13th of December 2002, with the focus on the fulfillment of Iran's obligations could have been done with the aim to mitigate the allegations in connection to the secret facilities, about which the IAEA had already been informed. Later in February 2003 the visit to the two sites by Director General ElBaradei and IAEA technicians took place. The question could be raised concerning the justification for Iran's delay of the announced visit in 2002. The conclusions of the visit were described in the June 2003 Board report, in which no violations according to the declaration of the Arak and Natanz facilities had been ascertained.

In conclusion the IAEA had been aware of the facilities before the publications in

71 See 66, p. 2

December 2002 and that the Agency was working towards a visit to the facilities right after the NCRI statements in August 2002. This took place in the above described steps within the framework of the NPT-agreement and its reporting system. Finally the Agency had been allowed to visit the new discovered sites and put them under safeguards. The statements in the described time frame given by IAEA showed no concerns about an evadable secret nuclear program of Iran, but described other violations like incorrect material accountancies, which are described in the June 2003 Board Report.

Islamic Republic of Iran:

The statements given by Iranian officials in September 2002 in front of the 46th General Conference of the IAEA had no detailed information about the Natanz and the Arak facility. Nevertheless, the declaration of the facilities by Iran took place at the September 2002 General Conference. To that effect, Director General Mohamed ElBaradei raised that issue and pointed out his concerns about the reports by NCRI and asked Iran's delegates about the aroused suspicion, as he affirmed in the December 2002 CNN interview. Iran could have been forced to take action because of the disclosures by NCRI.

Another point which should be kept in mind is the fact that the Iranian government rescheduled the visit of IAEA at the sites from late fall 2002 to February 2003. There has been no explanation for the cause of this action from Iranian officials or members of the IAEA. Speaking to this point an IAEA spokesman stated on the 2nd of January 2003 that there was no reason given by Teheran for the rescheduling.⁷²

The reaction, in the case of the publication of the satellite images, was given in the interview by CNN with Ambassador Javid Zalid. He denied that the facilities had been hidden and said that he was aware of the fact that the U.S. has satellite images. If he referred in this case to the U.S. based institute ISIS or the U.S. government it was not obvious.

In the statement of Reza Aghazadeh from the 6th of May 2003 a reference is seen to

⁷² Paul Kerr: IAEA to Visit Two 'Secret' Nuclear Sites in Iran; Arms Control Today, January/February 2003; http://www.armscontrol.org/act/2003_01-02/irannuclear_janfeb03

the publication of the satellite images. The reference occurs when he stated that Iran decided to formally inform the IAEA of the sites in September 2002 “before the hue and cry that was raised by the Western media and their propaganda machine”.⁷³ The question could be raised whether the remarks he made about the media coverage had been a cause for the rescheduling of the IAEA visit to February 2003 and whether the media reports were seen as an affront towards the Iranian government.

Furthermore, it is questionable whether or not Iran would have declared the facilities to the Agency if the NCRI has not given the first hints in summer 2002. In his speech, Supreme Security Council Secretary Hassan Rohani, in front of the Supreme Cultural revolution Council, stated that Iran had not planned to report the Natanz facility, but had to do so after the spies had exposed it. He also gave reasons why the facility should not be reported to the IAEA. For example, the West could deny Iran the access to needed materials. Rohani admitted that the Natanz facility should have been kept in secret for at least for a while, but he was aware that such a facility would eventually be exposed at some point to the public.⁷⁴

After the summer and winter of 2002 disclosures, Iran allowed the visit to the sites, but in case of the Natanz facility the country went on to bury the facility.

United States of America:

U.S. Officials under the Bush administration often pointed out their concern about a possible Iranian nuclear weapon program. Nevertheless, the publication of ISIS caused some statements by U.S. officials and was often referred to in later interviews. U.S. officials often expressed that it seemed that the underground nature of the Natanz site was a sign that this facility was trying to be hidden from the international community. The analysis of the images underlined this assumption, especially the conclusion drawn from the further construction at the Natanz facility. In the next months after the first release, new satellite images occurred. But in

⁷³ See 63, p. 7

⁷⁴ The date and place of speech is not given [Rohjani, Hassan, Secretary of the Supreme National Security Council: Speech before the Supreme Cultural Revolution Council, "Beyond the Challenges Facing Iran and the IAEA Concerning the Nuclear Dossier", 30 September 2005, p. 36; <http://www.bits.de/public/documents/iran/Rahbord.pdf>]

regards to the U.S., the statement by the State Department and the reference to the commercial satellite images within the statement seems to underline efforts to put the Iranian nuclear program into a clandestine context. The happenings in late 2002 and in the year 2003 nevertheless strengthened confrontations with Iran.

National Council of Resistance of Iran (NCRI):

The first hint for the public, as well as for officials from IAEA, about the Natanz and Arak facilities were given by the NCRI during the press conference in August 2002. Many experts from nongovernmental organizations as well from international organizations assumed that the information about the location of the two sites had not been discovered by the NCRI and that the group has been supported by western intelligence.⁷⁵

Iranians officials commented on the NCRI and the exposure of information by the group. In a speech given by Supreme Security Council Secretary Hassan Rohani in front of the Supreme Cultural Revolution Council, it is stated that the NCRI had informants within Iran who had access to the Natanz facility, where they took pictures and collected information. He also pointed out that one or two employees at the Iranian Atomic Energy Agency were spies for other countries, who also took pictures at the site. He accused the West of collecting information from several sources, including satellite imagery and information from the NCRI.⁷⁶

After the discoveries of the summer of 2002 the NCRI tried to deliver more information about Iran's supposed clandestine nuclear program to the public. All the assumptions were said to be reported by dissidents and members of the opposition movement within Iran. In the presentation of Jafarzadeh, based on the remarks he gave, was confirmed that the group supplied officials from the U.S. and from international organizations, like the UN, with the information. The speaker did not refer to the IAEA, but in the case of Arak and Natanz he underline that the IAEA had not been able to detect the sites.

⁷⁵ Reference: Interview conducted at the IAEA in Vienna with and agency representative in May 2009 whose name cannot be disclosed.

⁷⁶ See 74, p. 36

After the discoveries of 2002, the dissident-group started to use satellite images in their presentations increasingly. Their efforts to put the Iranian nuclear program in a clandestine context increases after 2002. Because of the achievements from the summer 2002 discoveries, the NCRI tried to circumstantiate its further discoveries through the use of commercial satellite images. The group underlined the allegations with further satellite images, for example at a press conference in February 2008 in Brussels, the group claimed that Iran produced nuclear warheads at a complex near the city Khojir.⁷⁷

Institute for Science and International Security (ISIS):

After the extensive media coverage in December 2002 it appeared that all actors orientated their actions and next steps towards the visits of Director General Mohamed ElBaradei and his Team to Iran. However, ISIS went on to purchase more satellite images of the sites. The concerns of a possible nuclear weapons program were not the focus of the ISIS statements, but the conclusions taken from the analysis of the new images raised more questions. The IAEA's work was in place in February 2003 and ISIS put that fact into regard. The Issue Briefs from February and March were a description of the possible



Before -- August 11, 2003



After -- March 22, 2004



New -- May 10, 2004

Lavizan-Shian Site in Iran
All Images Credit: DigitalGlobe/ISIS

Figure 8: Change detection on the Lavizan site

⁷⁷ David Brunnstrom / Reuters: Iranian dissidents urge immediate nuclear check; 20th February 2008; <http://www.alertnet.org/thenews/newsdesk/L20165281.htm>

purposes of the facilities. Besides that, ISIS bought more satellite images of sites, that were based on further NCRI presentations to the public.

For example, the ISIS, based on information from NCRI, purchased satellite data from the so called Lavizan-Shian site. The Lavizan-Shian site is where a suspected nuclear related site seemed to be dismantled and the ground had been removed. The assumption was raised that this could have been done to conceal evidence against the IAEA environmental sampling capacities. The images were then given to ABC News.⁷⁸ (See Figure 8)

The reports published by ISIS raised concerns in media, as in public, and David Albright had been consulted several times by media to give his opinion concerning the nuclear program of Iran. On the other hand David Albright gave his advice several times against any military strike on Iran's nuclear facilities. In a Washington Post report, Albright emphasized that a military strike on Iran's nuclear program would have little effect on the countries strongly protected and dispersed nuclear facilities. The consequences of such a strike could be that the country would be pushed to build up a “crash” nuclear weapon program and try to produce weapon grade plutonium in small hidden production facilities.⁷⁹

Media / Public:

The reaction of the public seemed to be low in regard to the few media reports after the NCRI presentation in summer 2002. The high reaction came with the release of the images by ISIS and especially their publication in media in December 2002. CNN, for example claims to be the first who brought the satellite images to public. In the next months the news agency distributed many reports and interviews that had to do with the controversy. The media coverage was high, especially right before the visit of IAEA to Iran. In the media coverage, images of the two sites were shown

78 Institute for Science and International Security (ISIS): Destruction at Iranian Site Raises New Questions About Iran's Nuclear Activities; ISIS Imagery Brief, Washington D.C., 17th of June 2004; <http://isis-online.org/publications/iran/lavizanshian.html>

79 Joby Warrick: Study Cautions Against Strike on Iran's Nuclear Facilities; Washington Post, Washington D.C. 8th of August 2008, <http://www.washingtonpost.com/wp-dyn/content/article/2008/08/07/AR2008080703026.html>

with growing use and were often connected with an interview of representative of ISIS or referring to the institutes's reports.

5.3. Impact analysis of governmental verification and civil monitoring

The incidents and the reactions, which took place between summer 2002 and 2003, could be seen, in general, as an intensifying of the conflict. This took place at different levels. It began with the discovery of Natanz and Arak sites in summer 2002. Because Iran did not officially declare the facilities in the September 2002 General Conference, the question could be raised whether Iran planned to declare the facilities to the International Atomic Energy Agency or if the country was forced to take action. But after the request from Director General ElBaradei the country reacted and allowed the visits to the two new sites. In this case, commercial satellite imagery played no role. All the findings were brought by intelligence or sources of NCRI within Iran. In this case the IAEA was alerted and began its work by purchasing satellite images and then analyzing them. To that effect the role of verification within the NPT agreement with Iran was fulfilled. The IAEA, with its technical possibilities, seemed to be quite aware of the situation related to the sites in Iran. The IAEA began investigating Iran under their operating procedures.

The next step was the media coverage after the actual release of the satellite images by ISIS, or rather the media, in December 2002. It seems after this action, all the involved actors seems to be forced to react. The IAEA had been aware of all facilities, so it could not have been in the Agencies interest that the findings came to public without the Agency responding. The work of the organization, concerning the incidents with Arak and Natanz, with the IAEA's verification and later with its safeguard mechanism, had already been started.

The satellite images, which proved nothing more then that there are two new sites in Iran, whose purpose needed to be determined, could have been used to get a justification to tighten the pressure on Iran. The Natanz facility, with its partly buried parts, could have been used as definite proof of a secret Iranian nuclear program,

which could have had serious consequences. This could have invoked on the one hand, tighter controls by the international community, including stronger sanctions, or a justification for a military attack on Iranian facilities by countries like U.S.A. or Israel. In addition the assessment and disclosure from a nongovernmental actor could have been used as a justification to confirm the long existing suspicions of a state.

On the other hand the use of the satellite images went beyond the first findings mentioned in this case study. After the 2002 disclosures, more than just the two sites in Iran were monitored permanently by nongovernmental actors. Other suspected sites were for the most part monitored by David Albright's ISIS. So it could be said that the use of satellite imagery can be a tool for the public and especially for the research community who are dealing with nonproliferation and security issues to monitor known sites permanently. These groups have normally limited or zero access to data and information from national intelligence and international organizations, like the IAEA. The majority of the information given by these institutions are based on general statements in reports, which are often not published with reliable data.

Finally, the incident resulted in the implementation of safeguards on the facilities, as described in the Board Report from June 2003. The question of whether the satellite images have a determinant influence or not, can not be clearly answered. On the one hand the use of the satellite images put a new view on Iran's nuclear program. The media, and with this the public, received a new source of independent surveying from official sources from the satellite images. But the question could also be raised of how the public should interpret this information and with what intentions correspondents and officials gave statements about this topic. The images are just a small part of the whole field of monitoring. Without further knowledge of the design and structure of nuclear facilities it is hard to draw a conclusion towards its purpose. But nevertheless, what is obvious and can be seen even by non experts is the change in the structure because of construction. In the case of Natanz, it is obvious that Iran buried the facility. Different groups have given different reasons on the intention for burying the site. After the first accusations that the underground character was based on hiding the facility, Iran expressed that burying the facility is a security measure against a possible air strike. Nonetheless, the publication in the media made a step

towards more transparency in monitoring nuclear facilities in Iran. The media coverage provided pictures that showed what was happening in a country and an area, which normally can not be reached.

5.4. Advantages and disadvantages of non state actors in monitoring and verification of nuclear treaties

The following section shows how the parameters, defined in chapter 2, apply to the case study. The disadvantages and advantages are shown by the actors reactions and which role satellite imagery played in this context. The focus is put on ISIS as a non governmental actor, which used satellite imagery within the time frame.

Access to information:

The case study shows that non state actors and international organizations, are highly dependent on information, which is normally gathered by political institutions or intelligence units. In the case of Iran the IAEA and ISIS seems to had the same information on which their work relied. This had been the first revelations by NCRI in summer 2002. The question could be raised of what access to information ISIS had concerning to the concrete location of the site. The satellite images had been purchased based on the information by NCRI, were the rough location of Arak and Natanz had been given, but whether that information is enough to find a concrete location in a large scale satellite image is questionable. Further information seemed to be gathered independently by ISIS. These sources can not be found in the officials documents. The only hint of other sources was mentioned in the march 2003 Issue Brief, but it cannot be determined by the documents which source further information concerning the purpose of the facilities was derived from. The information concerning the purpose of the facilities, which the IAEA received in the General Conference in September 2002 by Iranian officials, can also not be reconstructed from the documents. The documents do not show if civil society, except NCRI, had more information than the IAEA. In conclusion, it can be said, that the IAEA had more information about the sites than civil society, after the visit in February 2003 to Iran.

Assessment capabilities:

In the case study, ISIS appear not to have more assessment capabilities than the IAEA. In a article column by former U.N. Weapons inspector Scott Ritter, the author claims that Albright never had formal training as an image interpreter.⁸⁰ The IAEA with its technical means is strongly dependent on the visual interpretation by image analyst experts. It can be assumed that the number of experts in the nuclear field at the Agency is much higher than at ISIS. Furthermore, it could not be determined how many satellites images were gathered, whether by ISIS or IAEA, or how many had been assessed. Governmental actors in this field have more financial and technical means to gather and to assess satellite images. The technicals means of an international organization seems to be more sophisticated in the field of automatized assessment, with tools like change detection or an automatized classification.

Speed:

ISIS as IAEA, concluded from the available documents, started the work and the assessment shortly after the disclosure by the NCRI in August 2002. While both actors purchased satellite imagery, the IAEA started its diplomatic machinery and verification system to get awareness of the facilities. The IAEA did that with diplomatic efforts within the IAEA framework and in negotiations and not in public. The Agency did not go to public before it had been assure that it had the cooperation of the Iranian government. It seems that the Agency was awaiting the results of its analysis and the visit to Iran before drawing conclusions and releasing information to the public. The conclusions were presented in the Board of Governors report from June 2003. ISIS, on the on the other hand, knew about the IAEA's work on the issue and addressed the media anyways in December 2002, which lead to a high media coverage. ISIS stated his assessment efforts instantly to public and it seemed by that the interest in public had been kept up.

Focus/Scope:

ISIS deals in particular with proliferation related countries like North Korea, Iran or Syria or at least places a focus on these countries. Critics claim that this is a

⁸⁰ Scott Ritter: The Nuclear Expert Who Never Was; 26th of June 2008;
http://www.truthdig.com/report/item/20080626_the_nuclear_expert_who_never_was/#166524

unbalanced research approach in regard to a serious field like nuclear proliferation. Opponents of this assessments say that researchers like Albright do not have the time to wait to go to public with their results as other researchers do because of the speed with which circumstances change in the field of nonproliferation. For example, suspected countries could react quickly by fastening their programs or decentralizing facilities because of the knowledge of monitoring or verification efforts. The conclusion which Albright reached, lead to respect from the media, NGO's and even the IAEA.⁸¹ Furthermore ISIS is able to monitor states which are not members to treaty regimes. For example, in the case North Korea, ISIS put high efforts into monitoring the countries nuclear and weapons of mass destruction activities. Even though the country withdrew from the NPT, it is still a great concern for the international community and should be monitored.

Political independence / bias / limiting reporting:

Political independence of science is often criticized as in the case of David Albright's ISIS. Scott Ritter accuses ISIS of working towards a "worst-case scenario" by using speculative conclusions.⁸² Moreover ISIS and Albright have been criticized for not naming the sources of its funding.⁸³ In regards to this, the assessments by ISIS seems to have been influenced by the media. With the publication of the images in public, U.S. officials seemed to have a justification to implement a stronger stance towards Iran. The publication and the ongoing use of the satellite images, especially from the Natanz site, were used as an argument that the country had a secret nuclear program. The fact that the IAEA had been aware of the facilities, was mentioned marginally and the focus was put on the possible clandestine dimension of Iran's nuclear program. This could have been used to underline and legitimate the confronting US policy towards Iran.

Inconsistency:

ISIS, as a nongovernmental organization, put a focus on certain countries, which are connected to the proliferation of weapons of mass destruction. These countries are

81 Frank von Hippe / Response on the column: The Nuclear Expert Who Never Was; 2nd July 2008; http://www.truthdig.com/report/item/20080626_the_nuclear_expert_who_never_was/#166524

82 See 80

83 Muhammad Sahimi: A New Judith Miller for Iran Hawks?; 18th of March 2009; <http://www.antiwar.com/orig/sahimi.php>

assessed constantly by ISIS, within its available means. In regards to the use of satellite imagery, ISIS tries to constantly purchase data from certain sites or facilities of concern. The institute seemed to be highly dependent on the availability of usable and high quality image data. In order to conduct constant surveillance, the institute is dependent on any data which is assessable. In order to do this, the institute also assesses the reports and statements of IAEA instantly and provide by that a verification of the conclusions of the official verification system.

Unreliability:

The actors who have the information typically have the jurisdiction over the interpretation. So civil society is largely dependent on the conclusions taken from the governmental side. In regards to the verification of nuclear treaties it is hard to obtain reliable information. But in the field of satellite images it is often obvious what is happening on the ground. ISIS assumptions that Natanz purpose is uranium enrichment, were verified by the IAEA when the agency visited the site and presented its conclusions in summer 2003.

Nevertheless, the ISIS conclusions are hard to verify, by third persons or other non governmental actors, because they have the same access to information and are often limited by that.

5.5. Impact on peace and international security

The use of satellite imagery in the above described case study impacts peace and international security on several dimensions. At first it can be said, that the disclosures by ISIS in December 2002 seemed to effect the debate towards an intensification of the controversy. This means that it is questionable whether the publication of the satellite images had been in the interest of the IAEA. The Agencies verification system was implemented already and the media coverage could have been more balanced. The focus of the media reports was put more on the possible secrecy of the new facilities rather than on the declaration and the cooperation of Iran.

The IAEA is dependent on information that the agency assesses on its own.

Nonetheless, the reached conclusions had to be discussed in a diplomatic manner with the accused country. The independent assessment of satellite imagery cannot be a the only instrument used to monitor a states nuclear program. As can be see in the Iranian case, the assumptions which were made were always based on the additional knowledge of the analyst and further sources of information had to be used to draw conclusions.

In the field of nuclear nonproliferation, using satellite images to monitor known facilities is conducted by several actors from civil society. The ISIS Institute is just one of many that assess satellite images. Representatives from academia and civil society use satellite imagery permanently to monitor critical sites.

The surveillance has more dimensions. On the one hand satellite images can be used to survey the progress of construction at a site. From this surveillance it is possible to forecast or draw conclusion as to when the facility will be working. If this has already happened, the activities on the ground could be monitored. For example, more traffic could be sign of more activity in the facility. Furthermore, changes in the infrastructure of the surrounding area could be a hint of further progress with the nuclear facility or a change in production processes.

In general, more monitoring actors have a positive effect on transparency because of the high amount of analysis and several different views and interpretations. This fact could put more pressure on a suspected country. Positively, it could aim in more cooperation because the program could not be hidden anymore, negatively a program could be designed from the beginning in secret with underground or decentralized facilities which are harder to detect.

Chapter 6: Conclusion

6.1. Comparison with other remote sensing and environmental sampling applications

In his master thesis “Environmental Measurements and Non-State Monitoring of Nuclear Treaties”⁸⁴ Michael Schöppner described the influence of non state actors with regard to their use of environmental measurement tools on the monitoring of nuclear testing. The case study is based on the assessment of these tools in regards to the Comprehensive Test Ban Treaty (CTBT) and the first nuclear weapon test in North Korea in October 2006. In the paper measurement tools, like radionuclide measurements and other techniques, like seismic, infrasound, hydroacoustic networks are described and their use by non-state actors is determined. In this section the benefits of these tools are compared to the use of satellite imagery in monitoring the compliance of nuclear treaties by non state actors.

Environmental measurement tools are used to locate an area where an event, for example a nuclear explosion, took place. Furthermore, the analyses of radionuclide measurements are able to determine whether the event had a nuclear character or not. The monitoring system offers comprehensive surveillance and records data permanently by using the existing monitoring networks. The data is accessible and can be assessed by institutions which are able to interpret it. In regards to nuclear testing, the verification system assembles the different information and is able to draw conclusion about the occurrence of an event and its location. The aim of such monitoring networks is to be aware of whether an event took place or not. Satellite images, on the other hand, can just be part of a monitoring system as well, but cannot be implemented globally due to their technical limits. Further knowledge has to be added and the area of interest has to be determined before a site can be monitored. Satellite imagery cannot offer an comprehensive monitoring system, because data is not available for every site.

Nongovernmental actors assessing environmental or satellite data have an advantage

⁸⁴ Michael Schöppner: Environmental Measurements and Non-State Monitoring of Nuclear Treaties - A Case Study on North Korea; Masterthesis, ZNF, Hamburg 2009

because they are not bound to reporting guidelines or diplomatic rules within an agreement. But still the speed of the assessment relies on the availability of data. Environmental measures and seismic networks allow continuous and comprehensive surveillance, which draws conclusion about an event that has already occurred. Satellite data puts a focus on selected areas and relies on further information and are aimed to control compliance with an agreement. In case of binding agreements, satellite imagery can be a tool to forecast a country's ability to built up a clandestine program and by doing that, can prevent these kinds of programs, if non compliance is detected. In case of a country's capability to do nuclear testing, monitoring systems are not able to forecast or prevent a nuclear explosion.

The environmental measurement tools are not limited to a special area. The monitoring is comprehensive, while in the case of imagery, an area of interest has to be chosen. Therefore, nongovernmental actors, who asses satellite imagery are bound to its limits. The focus is mostly put on proliferation suspected countries. Global and not discriminating satellite observation can not be implemented because of the technical limits of satellite images and the high amount of information which has to be analyzed in this case.

Furthermore environmental measurements and monitoring networks collect data continuously and therefore data is always available to give hints that an event did occur, for example, a nuclear weapon test. Satellite imagery on the other hand needs additional information to detect a site or observe a certain area.

Another difference between environmental measurements tools and satellite imagery is the definitiveness. On the one hand, environmental sampling tools and monitoring networks provide data which is easy to interpret and the network of different sources making assessments allows for a clear interpretation. In case of nuclear testing the aim is to determine if a nuclear device had been explode or not and the nuclear explosion location has to be found. Satellite images display the events and situation on the earth's surface, but if a nuclear facility has a clandestine purpose is hard to detect because of the dual-use character of most of the facilities. The existence of a nuclear site does not proof a clandestine nuclear program. The purpose of a facility is

often not definitively detectable.

6.2. The role of satellite images in civil monitoring and verification

The assessed case study in this paper showed that satellite imagery is used increasingly by civil society to monitor nuclear and proliferation related events. The role of satellite images in civil monitoring of nuclear treaties has reached new levels in the last years. This development is based on the better access to commercial satellite data and the better quality of the data. Furthermore, civil society is no longer dependent on national and governmental access to information. Consequentially, governmental institutions no longer have the role as the only interpreters of data. With respect to this, a greater transparency has been achieved and, in addition, the verification systems can be monitored as well.

Civil society is said to be transparent and objective, and it should be. But tools of civil society are limited. Financial independence and technical knowledge is not available for all the groups working in non-proliferation. So these groups can only draw their conclusion from declassified reports from governmental sources or international organizations. The data on which these reports rely are difficult or not verifiable by public. Therefore, commercial satellite imagery, as an open source tool, could be a data source for civil society to monitor nuclear facilities. It seems to be useful, because unreachable areas could now be assessed. Furthermore, the validity of assumptions raised by governmental actors could be checked.

But reliance on nongovernmental groups has to be verified as well. As we can see in the case of NCRI, the groups aim was to provoke a regime change in Iran. So the claims of a clandestine nuclear program were published to the public with great effort and with less attention paid to the reliability of the information. Many of the assumptions raised were not as urgent as the group claims.

Furthermore, claims by nongovernmental actors can be used as justification for intensification of a conflict, because civil actors are said to be independent from

governmental influence. The public sees NGOs as a more trustworthy source of information because of their independence. As seen in the case of ISIS, the conclusions of the institute had been used to put the Iranian nuclear program in a clandestine context. ISIS assessment efforts seemed to have been used to influence public opinion, in the direction of a stricter policy towards Iran.

Civil actors can, with the help of satellite imagery, strengthen institutional verification. For example, civil actors can monitor states, who are not within a treaty, or provide additional tools which are not defined within a verification system. In case of the NPT the IAEA is not allowed to apply the measures described in the Additional Protocol to non-signatory states, but civil society can. Therefore the monitoring by civil actors strengthens existing verification systems by more transparency and as an information source for the public. But their results have to be looked at critically and with regard to biases they may have.

The verification of nuclear treaties relies on data from different sources. Not just satellite imagery has to be assessed, but the connection between the different kinds of data has to be conducted to draw reliable conclusions. Satellite images should never be the only tool used to verify nuclear treaties. The further expertise of the person in charge has to be added or other information has to be used in connection with the image. Satellite imagery can be a useful tool, if the location of facilities is known. Steady surveillance is, in this case, the most used application. As mentioned above the construction of known sites or the events on the ground can be monitored continuously, but continued surveillance has limits. These limits are based in the nature of satellite images.

Satellite imagery is a useful tool for verification of future disarmament and nonproliferation treaties. It should not only be used as a source of information by the verification systems but also by NGO's. Furthermore, the use of satellite imagery by nongovernmental actors and their use of open source information should be defined in a verification system as a legal monitoring source. In case of a Fissile Material Cut Off Treaty or a Nuclear Weapon Convention, NGO assessment efforts should be regarded as a tool with which the official verification bodies can gather information.

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Figure 2: The Iranian nuclear sites and facilities; Source: <http://cns.miis.edu/research/iran/images/mapbig.gif>

Figure 3: Overview and Close Up of the Arak facility - 26th of September 2002; Source: http://isis-online.org/images/iran/iran_image_index.html

Figure 4: Overview and close up of the Natanz facility - 16th of September 2002; Source: http://isis-online.org/images/iran/iran_image_index.html

Figure 5: Overview Natanz facility with further annotations - 16th of September; Source: <http://isis-online.org/images/iran/natanzfigure1.html>

Figure 6: Overview Natanz facility with further annotations - 7th of February 2003; Source: <http://isis-online.org/images/iran/natanzfigure2.html>

Figure 7: Overview and close up from the Natanz facility - 7th of February 2003; Source: <http://isis-online.org/images/iran/natanzfigure3.html> and <http://isis-online.org/images/iran/natanzfigure4.html>

Figure 8: Change detection on the Lavizan site; Source: http://isis-online.org/images/iran/lavizanshian_joint.html

Tables:

Table 1: Commercial satellite systems; Source: Space Security 2008; p. 102;
<http://www.spacesecurity.org/SSI2008.pdf>

Personal Statement

Tim Buchholz was born on the 10th of October 1978 in Buchholz, Germany. From 2001 to 2007 he studied Environmental Sciences at the University of Vechta, Germany. Within his Studies he put a focus on geo-informatics applications and remote sensing, especially in the field of satellite imagery. His diploma thesis was titled; “Data fusion tools and their benefits for the automatized classification of satellite data from different sensors”.

From 2008 on Tim Buchholz participated in the program “Master of Peace and Security Policy Studies” at the “Institute for peace and Security Studies at the University of Hamburg”. Within this program his focus was on nonproliferation and the verification of arms control and nonproliferation agreements in connection to remote sensing applications. In May 2009 Tim Buchholz participated in a simulation of a Nuclear Weapons Convention at the NPT PrepCom in New York.

Honor Statement

I pledge that this Masters Thesis, entitled “Satellite Remote Sensing and Monitoring of Nuclear Treaties by Non-State Actors- A Case Study on Iran” has not been submitted for academic credit in any other capacity, and that this Masters Thesis has not yet been published. I further pledge that I have written this Masters Thesis myself, on my own. I have not employed any sources or aids other than those listed. I have appropriately identified and acknowledged all words and ideas taken from other works.

Hamburg, 15th of July 2009
