CSIS_____
Center for Strategic and International Studies
1800 K Street N.W.
Washington, DC 20006
(202) 775-3270
(To comment: Acordesman@aol.com
For Updates see CSIS.ORG, "Military Balance")

The Great Iraqi Missile Mystery:

The Military Importance of the Ababil, Al Samoud II, Al Fatah, Badr 2000, and Al Huysayn

Anthony H. Cordesman
Arleigh A. Burke Chair for Strategy
Center for Strategic and International Studies

Revised February 25, 2003

The last few days have left many people deeply puzzled about the nature of the Iraqi missile effort, the scale and importance of Iraqi violations of the UN Security Council Resolutions, and the difficulty of carrying out UN inspections. There have also been many press reports that have confused the names of various Iraqi missiles, or made serious technical errors.

The following analysis draws on UNMOVIC and UNSCOM reports, CIA and IC reports, and NGO reports from groups like the Federation of American Scientists and Global Security Organization. It involves a wide range of complex issues, but it also provides a great deal of insight into just how thorough Iraq's efforts to lie and conceal have been, how serious its current violations are, and how difficult and uncertain the task UNMOVIC faces really is.

The Ababil-100 is a Free Rocket, Not a Missile UNMOVIC Has Charged with Violation of the 150-Kilomter Limit

A great deal of confusion has arisen because many sources are using the term “Ababil” to describe one of the missiles UNMOVIC believes is in violation of the UN Security Council Resolutions. The problem has arisen because such reporting used the “cover” name Iraq applied to secret programs in an effort to disguise them.

Iraq developed a serious of long-range rockets during the Iran-Iraq War called the Ababil series. It extensively deployed the Ababil-50 and developed the Ababil -100.

These developments were based on programs where Iraq had extended the range of the Luna-M (FROG-7A) h from 70,000 to 90,000 meters. Iraq experimented with eight different MRLS using a wide range of technologies from around the globe develop a system that could be made in Iraq and mass produced for use by Iraqi forces and for export.

The Ababil-50 is believed to be with Iraqi forces, but the operational status of the Ababil-100 is more uncertain. The Ababil-100 is 400 mm diameter rocket that is designed to be truck mounted in an MLRS with a four round capability. Each rocket is designed to carry a warhead capable of dispensing 300 antitank bomblets and 25 antitank minelets. The "Ababil-100" is designed to have a range of up to 130 to 140 km. However, the Ababil does not appear to have been fully flight-tested and it is uncertain how many Ababil-100s have been deployed – if any. This is a potentially important issue for several reasons. It would be the only artillery rocket with a warhead large enough to carry secret chemical or biological payloads any serious distance, its conventional warhead is the only one with enough firepower to cover a significant area and be lethal against US forces at a long distance, and it is large enough to create targeting problems for US forces as to whether they are striking at an Al Samoud II or Scud.

Reports of the destruction of the Ababil-100 in recent US air raids in Iraq raise questions because it is not clear that the Ababil-100 has actually been deployed. The rocket actually

involved may really be the Ababil-50 -- or M-87 Orkan -- which is a 12 tube 262 mm Iraqi MRL that was jointly developed with Yugoslavia. This multiple rocket launcher is also used by Bosnia, and Croatia. The rocket has a range of about 50 km. It is mounted on a heavy truck chassis. A battery consists of four launchers, four resupply trucks each carrying one set of rockets, a FDC truck with a van body, a light vehicle for surveying, a FIST vehicle (usually a light armored vehicle), and a weather vehicle truck with a van body. The trucks and the light vehicle are all armed with DShKs for the vehicle commanders.

What is clear is that the Ababil artillery rockets are not among the systems that Blix has found to be in possible violation.

The problem of nomenclature gets complex, however, because Iraq used the name "Ababil" as a cover name for other programs that were in violation of the UN Security Council Resolutions. UNSCOM discovered that Iraq was claiming to develop new SRBMs under the cover name of the Ababil well before it was expelled from Iraq in 1998.

Around August 1991, Iraq started a secret project to construct a surface-to-surface missile called "J-1" without notifying the UN Special Commission [UNSCOM] as required by the Security Council resolutions. UNSCOM described this Iraqi effort to disguise the true nature of its missile programs as follows in its final report in January 1999:

> "Available evidence revealed that Lt. General Hussein Kamil had a meeting with senior engineers in May 1993 to assess missile activities ongoing in Iraq at that time. Notes taken of the meeting indicated that among the issues discussed were a turbo pump to feed four Volga/SA2 missile engine combustion chambers and a design of the engine for a "larger missile." These activities were not declared to the Commission at that time. Such activities could have been of a proscribed nature.
>
> Iraq declared that work on the turbo pump to feed simultaneously four Volga/SA2 missile engine combustion chambers actually started at the beginning of 1995. Assistance from abroad had been sought by Iraq for this project. Iraq stated that the effort achieved no tangible results. According to the Commission's assessment, a single stage missile with four engines of this type could have a range in excess of the permitted limit of 150 kilometers.
>
> Iraq declared that work on the 7-ton thrust missile engine had only started in June 1995. Such an engine could increase substantially the propulsive force of the then-declared missile system under development, which already had a range just below the permitted threshold of 150 kilometers. The engineer involved in the project claimed to have no knowledge of the purpose of the development of the new engine. He stated that no designs had been completed. No documentation has been provided by Iraq regarding these activities.
>
> ...Available evidence shows that around August 1991, Iraq started a secret project to construct a surface-to-surface missile called "J-1" without notifying the Commission as required by the Security Council resolutions. No aspect of the J-1 program -- from design, to parts manufactured, to flight-testing -- was declared to the Commission until late 1995 i.e. some two years after it was allegedly aborted. Iraq states that Lt. General Hussein Kamil issued the orders both for the project itself and for the requirement to keep it a secret from the Commission.

> During the period when work on the J-1 project was ongoing, the Commission's inspectors were told by Iraq that it was merely developing a non-proscribed Ababil-100 missile that it had declared to the Commission. As it is known now, the Ababil 100 had some specifications similar to the J-1. Iraq admitted later that its intention had been to hide the "covert" undeclared project from inspectors within "open" work being done at declared missile facilities. Specific measures were taken by Iraq to conceal the J-1 effort from the inspection teams. Components for J-1 missiles were hidden or removed before visits of inspection teams.
>
> The J-1 project was declared abandoned in May 1993. According to Iraq's declarations, prototypes of the J-1 missile were built and six flight tests were conducted in January - April 1993. Iraq provided several documents as well as imagery showing some of the test launches. Some components said to be produced under the J-1 program were also shown to inspectors. The Commission has conducted document and computer searches at the relevant facilities to find additional supporting data - such as contemporaneous production records - to verify Iraq's declarations, albeit without success. Iraq stated that some of the hardware associated with the project had unilaterally been melted in foundries after the J-1 project had been stopped in May 1993.
>
> Iraq's development of the J-1 surface-to-surface missile was based on the Volga/SA2 surface-to-air missile with certain modifications, particularly to its engine and guidance and control system. There were key similarities between the J-1 missile and the Fahad missiles that were under development in Iraq before the adoption of resolution 687 (1991). The Fahad missiles, based also on modification of Volga/SA2 systems, were proscribed weapons with declared ranges of 300 or 500 kilometers.
>
> Iraq declared that the J-1 missile had never been intended to reach proscribed ranges, and stated that the longest range achieved during the tests in 1993 was 134 kilometers. The Commission has no independent information that verifies the ranges achieved in the J-1 missile flight tests. The Commission's analysis indicates that the system, as tested, was inherently capable of reaching proscribed ranges. Given certain technical aspects associated with this project, it will be difficult to conclusively verify Iraq's declarations."
>
> There were key similarities between the J-1 missile and the Fahad missiles that were under development in Iraq before the adoption of resolution 687 (1991). Iraq's development of the J-1 surface-to-surface missile was based on the Volga/SA2 surface-to-air missile with certain modifications, particularly to its engine and guidance and control system. During the period when work on the J-1 project was ongoing, UNSCOM inspectors were told by Iraq that it was merely developing a non-proscribed Ababil-100 missile that it had declared to UNSCOM.

This use of Ababil as a cover name led a number of analysts and NGOs to start using the terms Ababil, Al Fatah, and sometimes Al Samoud, -- confusing the cover story for the F-1 and the new missile with the Ababil.

The CIA used the Ababil cover name in its fall 2002 report on Iraqi missile efforts,

> "Iraq continues to work on UN-authorized short-range ballistic missiles (SRBMs)—those with a range no greater than 150 km—that help develop the expertise and infrastructure needed to produce longer-range missile systems. The al-Samoud liquid propellant SRBM and the Ababil-100 solid propellant SRBM, however, are capable of flying beyond the allowed 150 km range. Both missiles have been tested aggressively and are in early deployment. Other evidence strongly suggests Iraq is modifying missile testing and production facilities to produce even longer-range missiles."

The British intelligence report did the same thing,

> In mid-2001 the JIC (Joint Intelligence Committee) drew attention to what it described as a "step-change" in progress on the Iraqi missile program over the previous two years. It was clear from intelligence that the range of Iraqi missiles which was permitted by the UN and supposedly limited to 150kms was being extended and that work was under
> way on larger engines for longer-range missiles. In early 2002 the JIC concluded that Iraq had begun to develop missiles with a range of over 1,000kms. The JIC assessed that if sanctions remained effective
> the Iraqis would not be able to produce such a missile before 2007. Sanctions and the earlier work of the inspectors had caused significant problems for Iraqi missile development. In the previous six months Iraqi foreign procurement efforts for the missile program had been bolder. The JIC also assessed that Iraq retained up to 20 al-Hussein missiles from before the Gulf War.
>
> Since the Gulf War, Iraq has been openly developing two short-range missiles up to a range of 150 km, which are permitted under UN Security Council Resolution 687. The al-Samoud liquid propellant missile has been extensively tested and is being deployed to military units. Intelligence indicates that at least 50 have been produced. Intelligence also indicates that Iraq has worked on extending its range to at least 200 km in breach of UN Security Resolution 687. Production of the solid propellant Ababil-100 (Figure 4) is also underway, probably as an unguided rocket at this stage. There are also plans to extend its range to at least
> 200 km. Compared to liquid propellant missiles, those powered by solid propellant offer greater ease of storage, handling and mobility. They are also quicker to take into and out of action and can stay at a high state of readiness for longer periods.

(Please note that further confusion can arise over names because Iraq referred to its satellite booster as the Al-Abid and the very long-range ballistic missile version of the Scud it was developing as the Al-Abbas.)

The Al Samoud and Al Fatah

All of this background explains why Blix, quite correctly, does not refer to the Ababil as one of the SRBMs that may violate the 150-kilometer range limit. He instead refers to the Al Samoud II and the Al-Fatah. The Al-Samoud II is clearly in violation of the range limit. The status of the Al-Fatah is uncertain.

On January 27, Blix stated,

> "Two projects in particular stand out. They are the development of a liquid-fuelled missile named the Al Samoud 2, and a solid propellant missile, called the Al Fatah. Both missiles have been tested to a range in excess of the permitted range of 150 km, with the Al Samoud 2 being tested to a maximum of 183 km and the Al Fatah to 161 km. Some of both types of missiles have already been provided to the Iraqi Armed Forces even though it is stated that they are still undergoing development.
>
> The Al Samoud's diameter was increased from an earlier version to the present 760 mm. This modification was made despite a 1994 letter from the Executive Chairman of UNSCOM directing Iraq to limit its missile diameters to less than 600 mm. Furthermore, a November 1997 letter from the Executive Chairman of UNSCOM to Iraq prohibited the use of engines from certain surface-to-air missiles for the use in ballistic missiles.
>
> During my recent meeting in Baghdad, we were briefed on these two programs. We were told that the final range for both systems would be less than the permitted maximum range of 150 km.

> These missiles might well represent prima facie cases of proscribed systems. The test ranges in excess of 150 km are significant, but some further technical considerations need to be made, before we reach a conclusion on this issue. In the mean time, we have asked Iraq to cease flight tests of both missiles.
>
> In addition, Iraq has refurbished its missile production infrastructure. In particular, Iraq reconstituted a number of casting chambers, which had previously been destroyed under UNSCOM supervision. They had been used in the production of solid-fuel missiles. Whatever missile system these chambers are intended for, they could produce motors for missiles capable of ranges significantly greater than 150 km.
>
> Also associated with these missiles and related developments is the import, which has been taking place during the last few years, of a number of items despite the sanctions, including as late as December 2002. Foremost amongst these is the import of 380 rocket engines which may be used for the Al Samoud 2.
>
> Iraq also declared the recent import of chemicals used in propellants, test instrumentation and, guidance and control systems. These items may well be for proscribed purposes. That is yet to be determined. What is clear is that they were illegally brought into Iraq, that is, Iraq or some company in Iraq, circumvented the restrictions imposed by various resolutions.

On February 14, Blix stated,

> "In my January update to the Council, I referred to the Al Samoud 2 and the Al Fatah missiles, reconstituted casting chambers, construction of a missile engine test stand and the import of rocket engines, which were all declared to UNMOVIC by Iraq. I noted that the Al Samoud 2 and the Al Fatah could very well represent prima facie cases of proscribed missile systems, as they had been tested to ranges exceeding the 150-kilometre limit set by the Security Council. I also noted that Iraq had been requested to cease flight tests of these missiles until UNMOVIC completed a technical review.
>
> Earlier this week, UNMOVIC missile experts met for two days with experts from a number of Member States to discuss these items. The experts concluded unanimously that, based on the data provided by Iraq, the two declared variants of the Al Samoud 2 missile were capable of exceeding 150 kilometers in range. This missile system is therefore proscribed for Iraq pursuant to resolution 687 (1991) and the monitoring plan adopted by resolution 715 (1991).
>
> As for the Al Fatah, the experts found that clarification of the missile data supplied by Iraq was required before the capability of the missile system could be fully assessed."

These statements have led to a great deal of additional confusion over why what seems like a minor increase in range is meaningful. Converted into miles, the difference for the Al Samoud is only the difference between 93 and 124 miles.

In practice, however, this increase in range is much more important than it seems. If it is only considered in tactical terms and in potential use against British and American troops, it amounts to the ability to increase the warhead weight by some 50%, and any chemical or biological payload by about 70% -- allowing for the dissemination mechanism and fusing. Alternatively, it increases the search area necessary to find the missile' location in rear areas by 50%. Like the Ababil rocket, such missiles would also be one of the few ways Iraq could make up for the fact its airpower cannot survive in combat. Some 76 Al Samoud IIs are known to have been produced. The total is now more likely to be 100,

and some 50 are believed to be in the field. If they have biological or chemical warheads, this may help explain Iraq's reluctance to destroy them.

The current range-payload of the Al Samoud II, however, is only part of the problem. It is a liquid fueled missile with some Scud components. This means it can be increased in range fairly easily by stretching its length to have more fuel, scaling it up to make it bigger, or making it into a two stage missile. Work by Richard Spiers for the Washington Institute notes that the Al Samoud missile has grown from a diameter of 400 mm (SA-2) to 500 mm to 760 mm. While it has only been tested to 123 miles, the increase from 500-mm to 760-mm allows the amount of fuel to double. Rapid growth to 200-300 kilometers is possible.

Spiers notes that,

> In creating the al-Samoud, Iraq took the liquid-fuel SA-2 rocket engine and incorporated it into a missile based heavily on Scud technology. The al-Samoud's thrust vector controls, which aim the rocket in a precise direction, are those of the Scud rather than the SA-2. The design of the al-Samoud's components and geometry are clearly similar to those of the Scud as well; even its guidance system bears more resemblance to the Scud's than to the SA-2's. Moreover, the al-Samoud missile system includes an Iraqi- designed transporter-erector-launcher for quick deployment, similar to the Scud; the SA-2 does not have this feature. Perhaps most important, the manufacturing technology developed for the al- Samoud -- particularly brazing technology, in which missile parts are metallically fused -- solved many of the problems that had hindered Iraq's Scud production prior to the Gulf War. Indeed, Robert Schmucker, a former missile inspector with the UN Special Commission on Iraq (UNSCOM), argued in 1999 that the al-Samoud "should be considered as a simplified Scud B system on a 25 percent scale."
>
> … Under UNSCOM monitoring during the 1990s, the missile had a diameter of 50 centimeters. In spite of explicit UNSCOM prohibitions, however, it acquired a bigger brother (sometimes called the al-Samoud 2) with a diameter of 76 centimeters, close to the Scud's diameter of 88 centimeters. The issue of diameters is not a quibble; for a missile of a given length, the amount of propellant it can hold grows with the square of its diameter. Hence, the al-Samoud 2 could carry 2.3 times as much propellant as the smaller variant, leading Schmucker to estimate that it could fly nearly twice as far.
>
> …These performance estimates do not account for the possibility that improvements may have been made to the missile in the years since UNSCOM monitoring. Schmucker's 1999 estimates envisioned "medium term" improvements that could extend the range of the smaller al-Samoud to 230 kilometers with its full 300-kilogram payload. With a payload reduced to 200 kilograms, the range would rise to 300 kilometers. Presumably, the larger missile's range could be increased correspondingly.
>
> Moreover, as with the Tammuz II (an SA-2 on top of an al-Husayn), the al-Samoud could be incorporated into a two-stage missile. Depending on the specifics of the design, a 300-kilogram payload could be delivered to a range in excess of 1,000 kilometers. Such a missile is not publicly reported to exist at present, but many former UNSCOM inspectors fear that it may be the next step.

The Al Fatah is a solid-fueled missile derived from the SA-2 and the J-1. Just to make things even more confusing, however, the al Fatah seems very similar or identical to what UNSCOM called the Fahad missile. UNSCOM said in its last 1999 report that,

> In July 1991, UNSCOM supervised the destruction of 9 Fahad missiles. The Fahad missiles were Volga/SA2 surface-to-air missiles that Iraq modified for a surface-to-surface application, with ranges over 150 kilometers. Twenty-one flight tests of Fahad missiles were declared to have been conducted by Iraq before the Gulf War. No supporting documentation has been provided by Iraq to ascertain how many such missiles were modified. Unmodified Volga missiles declared by Iraq in 1996 are currently under the Commission's monitoring in order to ensure their non-modification for a surface-to-surface application or for delivery of non-conventional warheads.

The range-payload of the Al Fatah remains unclear. What is clear is that Iraq illegally imported 380 SA-2 engines after UNSCR 1441 was passed. This is violation that Blix has said must result in the destruction of the engines.

Spiers also notes that,

> China used the SA-2 as the basis for its 150-kilometerrange "8610" missile, which it later exported to Iran. India used a cluster of two SA-2 rocket engines for the propulsion system of its land-based Prithvi missile, which has a range a 250 kilometers (the seabased version, the Danush, has a range of 350 kilometers). Prior to the Gulf War, Iraq used the SA-2 as the template for the Fahad missile family, with the hope of achieving ranges of 300 to 500 kilometers.
>
> Iraq also planned to use the SA-2 as the second stage of the Tammuz II missile; by installing it on top of an al-Husayn missile (a stretched Scud), designers hoped to attain a range of 2,000 kilometers.
>
> After the Gulf War, Iraq tried to adapt the SA-2 as a secret missile (termed the G-1 or J-1), but all flight tests failed. Iraq had far better success transforming the SA-2 into the al-Samoud, whose claimed range fell below the 150-kilometer limit prescribed by the ceasefire terms. In order to make this adaptation, Iraq combined the technology of the SA-2 with that of a proscribed missile, the Scud.

Furthermore, the ability to stack or cluster solid fuel engines allows a rapid increase in range, and the ability to test solid fuel technology would aid Iraq in developing the much longer range Badr-2000 described later – a project where Iraq is also in violation for keeping illegal engine castings and building a large rocket motor test stand only needed for much longer range missiles than are permitted.

Badr-2000

A further note of confusion has arisen over Blix's reference to the Badr-2000:

> "UNSCOM ordered and supervised the destruction of the casting chambers, which had been intended for use in the production of the proscribed Badr-2000 missile system. Iraq has declared that it has reconstituted these chambers. The experts have confirmed that the reconstituted casting chambers could still be used to produce motors for missiles capable of ranges significantly greater than 150 kilometers. Accordingly, these chambers remain proscribed."

The Badr-2000 is part of a program that British intelligence described as follows in its fall 2002 white paper,

> Prior to the Gulf War, Iraq had a well-developed ballistic missile industry. Many of the missiles fired in the Gulf War were an Iraqi modified version of the SCUD missile, the al-Hussein, with an

extended range of 650 km. Iraq had about 250 imported SCUD-type missiles prior to the Gulf War plus an unknown number of indigenously produced engines and components. Iraq was working on other stretched SCUD variants, such as the al-Abbas, which had a range of 900 km. Iraq was also seeking to reverse-engineer the SCUD engine with a view to producing new missiles. Recent intelligence indicates that they may have succeeded at that time. In particular, Iraq had plans for a new SCUD-derived missile with a range of 1200 km. Iraq also conducted a partial flight test of a multistage satellite launch vehicle based on SCUD technology, known as the al-Abid. Also during this period, Iraq was developing the Badr-2000, a 700-1000km range two-stage solid propellant missile (based on the Iraqi part of the 1980s CONDOR- 2 program run in cooperation with Argentina and Egypt). There were plans for1200–1500km range solid propellant follow-on systems.

The CIA described these efforts as follow in its fall 2002 report,

"Most of the approximately 90 Scud-type missiles Saddam fired at Israel, Saudi Arabia, and Bahrain during the Gulf war were al-Husayn variants that the Iraqis modified by lengthening the airframe and increasing fuel capacity, extending the range to 650 km. Baghdad was developing other longer-range missiles based on Scud technology, including the 900 km al-Abbas. Iraq was designing follow-on multi-stage and clustered medium-range ballistic missile (MRBM) concepts with intended ranges up to 3,000 km. Iraq also had a program to develop a two-stage missile, called the Badr-2000, using solid-propellants with an estimated range of 750 to 1,000 km.

Iraq never fully accounted for its existing missile programs. Discrepancies in Baghdad's declarations suggest that Iraq retains a small force of extended-range Scud-type missiles and an undetermined number of launchers and warheads. Further, Iraq never explained the disposition of advanced missile components, such as guidance and control systems, that it could not produce on its own and that would be critical to developmental programs.

To put this reporting in context, UNSCOM stated in its final report in 1999 that Iraq signed contracts in 1984 for the importation of 115 surface-to-surface missiles called the Badr 2000, and for the establishment in Iraq of the infrastructure for the production of the first stage solid propellant rocket motors for missiles of this class. The construction of the infrastructure, including a facility for the final integration and testing of the complete missile, started in 1985.

" Iraq declared that it had experienced difficulties with the supplier Government with regard to the provision of the missiles as well as support and production equipment. After contract delays and in an effort to receive some of the contracted items, Iraq signed another contract, in 1987, for the provision of only 17 complete BADR 2000 missiles and missile ground support equipment. Iraq declared that it soon realized that it would not receive any of the contracted missiles, nor most of the contracted infrastructure. Iraq terminated the contracts with this supplier Government in late 1988.

Iraq declared that, in the beginning of 1989, it attempted to complete the BADR 2000 project by itself, in particular the production of solid propellant motors. This time it decided to deal directly with the supplier companies or their middlemen, as well as to rely on indigenous capabilities. Some additional materials, equipment and technologies were received by Iraq in 1989 and 1990. In late 1995 and early 1996, Iraq provided to the Commission substantial documentation, including contracts with suppliers, to support its declarations on the BADR 2000 project. UNSCOM was unable to verify Iraq's declarations with the original supplier Government.

Iraq declared that it had never been successful in commissioning the production or integration facilities it had been building, nor in manufacturing any complete BADR 2000 missiles, nor had it received from abroad any operational missiles of this system.

> In response to resolution 687 (1991), Iraq declared three facilities which had been under construction in Iraq as part of the BADR 2000 infrastructure as well as some of the equipment and materials procured for the program. The Commission supervised the destruction of all declared items. In February 1992, the Commission also identified, for destruction in accordance with resolution 687 (1991), additional critical equipment and buildings at these facilities. Initially, Iraq refused to comply with this decision. Following Iraq's disclosure of the unilateral destruction in March 1992, Iraq relented and the equipment and buildings at the BADR 2000 facilities were destroyed under the Commission's supervision. In 1996, Iraq declared that it had diverted critical tools and materials from the BADR 200 program and buried them in a hide site. These items had been declared unilaterally destroyed and were shown to the Commission in May 1992. "

The problem here is that the Badr-2000 not only was supposedly destroyed by UNSCOM in 1992, it is also is a long-range missile derived from the Iraqi-Egyptian-Argentine program called the Condor, with ranges of up to 900-kilometers. As a result, the fact that Iraq still has castings for the engine shows it is in violation of the UN Security Councils, and is working on a very long range missile that would have to have a chemical, biological, or nuclear payload to have any meaningful military lethality.

Regular Scud vs. Al Hussein vs. Al Abid

Many reports make the additional mistake of confusing the regular Scud, with a range of 300-kilometers, with the Al Hussein -- a greatly modified version of the Scud that is really a very different missile and has a range of some 650 kilometers.

These are the missiles that UNSCOM concluded Iraq probably retained at least 12-25 of and which Secretary Powell said Iraq had in the low dozens. (The worst case would give Iraq some 80 missiles; UNSCOM credited Iraq with destroying engines without demanding full proof.)

There are probably far more Al Husseins than regular Scuds left. UNSCOM reported in January 1999 that,

> "Iraq declared that it imported 819 long-range combat missiles(2) that fall under prohibitions established by resolution 687 (1991). Over half of them were modified by Iraq, since 1987, into missiles known in Iraq as Al Hussein class missiles. Al Hussein missiles used by Iraq during recent wars had a range of some 650 kilometers. Iraq declared that, during the Gulf War, it had 14 combat mobile launchers for Al Hussein class missiles, including ten which had been imported and four which were indigenously produced. It also imported one launcher of this type for training purposes."
>
> These are the only missiles known to have had chemical and biological warheads. Iraq declared that it had imported 819 combat warheads for proscribed missiles of SCUD/Al Hussein class and that 121 combat warheads of the same type had been produced indigenously or had been under production at the time of adoption of resolution 687.
>
> There is no evidence Iraq ever successfully tested a 900 kilometer missile based on the Scud. It did successfully test the booster for the Al Abid. The maximum range of Iraq's surviving missiles, therefore, is 650 kilometers.

Missing Chemical and Biological Warheads

Another aspect of this technical and reporting nightmare is that the warheads for Iraq's Scud missiles are separate from the Scud and Al Hussein body, and some chemical and biological warheads are not accounted for. There are two different issues for UNMOVIC: Missing missiles and missing warheads.

UNSCOM's final report describes the missile warhead situation as follows:

> "Iraq stated that it had produced 25 combat special warheads for BW (16 warheads filled with botulinum toxin, 5 warheads with anthrax and 4 warheads with aflatoxin(4)) and 50 combat special warheads for CW (16 warheads filled with sarin and 34 warheads with the alcohol component of the binary system). Out of 75 declared combat special warheads, 25 warheads were declared as indigenously produced (15 CW and 10 BW warheads) and 50 warheads were modified from imported warheads (35 CW and 15 BW warheads). In addition, Iraq declared that it had produced 3 special warheads for training purposes, and that 3 additional special warheads had been used in static tests and 2 special warheads had been used in flight tests.
>
> The 30 CW combat warheads (16 filled with sarin and 14 with the alcohol component) were destroyed under UNSCOM supervision in 1991-1993. Iraq's declarations on the disposal of the remaining 45 combat special warheads out of the 75 declared as produced, stated that they had been unilaterally destroyed in early July 1991. The assessment of the warhead remnants excavated since August 1997 allows for the identification of 43-45 special warheads coming from the sites of the declared unilateral destruction.
>
> Iraq's declarations and supporting documents include a specific distribution, by their type and warfare agent filling, of the 45 special warheads unilaterally destroyed in July 1991. According to Iraq's declarations, 20 of them were chemical weapons and contained only the alcohol component of the CW binary system. Analysis at the laboratories designated by the Commission has detected the presence of degradation products of nerve agents, in particular VX, on a number of warhead remnants which were excavated. A meeting of international experts, including representatives of the three laboratories, which was held on 22-23 October 1998 concluded that "the existence of VX degradation products conflicts with Iraq's declarations that the unilaterally destroyed special warheads had never been filled with any chemical warfare agents. The findings by all three laboratories of chemicals known to be degradation products of decontamination compounds also do not support Iraq's declarations that those warhead containers had only been in contact with alcohols." Clarification by Iraq of these issues as recommended by the meeting would allow the Commission to make a determination whether or not the current assessment of the quantity of special warheads identified amongst the remnants excavated, accounts for all special warheads declared to have been produced by Iraq and provides for the verification of their unilateral destruction.
>
> Iraq described in detail the procedures and methods of unilateral destruction of the special warheads by explosive demolition. After examination of the relevant destruction sites and the special warhead remnants recovered from them, the Commission found that Iraq's explanations were, in general, plausible. However, in one aspect dealing with the destruction of BW warheads, the Commission, after consulting a group of international experts, assessed that Iraq's declaration that 15 warheads had been destroyed simultaneously conflicted with physical evidence collected at the declared location of their unilateral destruction. This finding indicated that not all BW warheads had been destroyed at the same time as declared by Iraq and that Iraq had retained some BW warheads after the declared July 1991 unilateral destruction date. The discrepancies between Iraq's current declarations on its unilateral destruction of the special warheads and the physical evidence collected at the destruction site need to be clarified. In addition, the Commission's investigations showed that Iraq had not provided the true locations of the hiding, prior to the

declared unilateral destruction, of at least half of the special warheads including the abovementioned 15 BW warheads. In December 1998, Iraq again identified new locations of storage pits from where the warheads had been moved to the unilateral destruction sites. The Commission could not again confirm that the newly identified locations had been used for hiding warheads. Iraq's continuous inability to disclose hide sites of the special warheads has also prevented the Commission's verification of declared unilateral destruction of the special warheads.

Evidence has been recovered pointing to Iraq's attempts to design and produce non-conventional warheads for missiles other than Al Hussein. Despite available documentary evidence of work on non-conventional warheads for so called FROG short-range missiles in 1990, Iraq insisted that all such work was done only in 1988 without any success or follow-up attempts. Iraq denied any activities related to non-conventional warheads for Volga/SA 2 surface-to-air missiles that it was modifying for surface-to-surface application."

This issue has immense practical meaning because Iraq's ability to bring Israel into a war or do serious damage to any distance target is dependent on its ability to either strike with chemical and biological warheads, or carry out such attacks covertly or with terrorist proxies. Moreover, if Iraq has gone on to develop more advanced warheads that are fuzed to explode at the right altitude, and which can disseminated chemical or biological agents non-destructively, such missile hits could easily be 10 to 100 times more lethal than the crude unitary warheads Iraq had at the time of the Gulf War. In fact, such a warhead with dry storable Anthrax micropowder could have the lethality of a small nuclear weapon.

A Separate Illegal Iraqi Missile Effort with Links to the J-1 Program

UNSCOM never resolved the fate of yet another long-range missile program. In its final 1999 report, UNSCOM stated that,

"After the adoption of resolution 687 (1991), Iraq attempted to retain all available production equipment from its factories to manufacture liquid propellant engines for proscribed Al Hussein class missiles. As reported above, this equipment was destroyed or rendered harmless by the Commission only in July 1995. Up to November 1995, Iraq had been misleading the Commission as to the nature and capabilities of the equipment retained.

After the adoption of resolution 687 (1991), Iraq also retained specialized tooling and fixtures that had been used with production equipment for proscribed missile production. Only after the submission of its latest FFCD in the missile area in June 1996 and after the Commission presented its evidence, did Iraq declare that "most important" tooling for missile production equipment - in particular, for proscribed Al Hussein missile airframe and engine manufacturing - had been purposefully diverted from the earlier declared July 1991 unilateral destruction. According to Iraq, these tools and some missile components were then buried at a site of the Special Republican Guard in a manner such that they would be preserved for future use. Iraq claimed that the tooling hidden at this site had been excavated secretly by Iraqi personnel in March 1992 and had been subsequently unilaterally destroyed.

Iraq declared that, at the time of the adoption of resolution 687 (1991), it had also decided to retain components and assemblies of proscribed missiles but then unilaterally destroyed them in the second half of 1991. As reported above, Iraq stated that most of the items had been melted in secret.

Iraq also retained technological and know-how documentation required for the production of proscribed missiles, in particular of the Al Hussein class. Boxes of such documentation were obtained by the Commission in August 1995 at the so-called "Chicken farm". The documentation

included detailed plans, procedure manuals and drawings for production of proscribed missiles and their components. It should be noted that technological documentation for the final assembly of Al Hussein missiles was not found either in the boxes of August 1995 or since.

Iraq retained, until late 1995, a parachute device for retarding Al Hussein warheads despite repeated questions posed by the Commission concerning such a proscribed device. Iraq has not provided technically consistent explanations for the procurement of such systems prior to adoption of resolution 687 (1991) nor for the retention of the set until 1995.

Work on proscribed key missile components and designs; importation of proscribed missile components and secret acquisition of items declarable under the Monitoring plan

The Commission has obtained evidence that Iraq continued work on some key proscribed missile components after the adoption of resolutions 687 (1991) and 715 (1991). In particular, this involved such areas as gyroscope instruments for prohibited missile guidance and control systems, a technology Iraq had not fully succeeded in developing itself prior to the Gulf war. Most of these prohibited activities were declared by Iraq only in late 1995 or early 1996.

After the adoption of resolution 687 (1991), Iraq continued to import components for gyroscope instruments until at least November 1991. These components had been ordered by Iraq prior to the Gulf war specifically for use in proscribed missiles. Iraq initially denied any dealing with the supplier of these components but, given the information obtained by the Commission, admitted extensive deals with the supplier. Iraq could not provide evidence to support its statements that, contrary to available evidence and documentation, only a single contract was signed with this supplier in May 1988 for the delivery of proscribed gyroscope instruments and their components had been in force.

In November 1993, "working groups" were established in Iraq tasked to work on gyroscope instruments of the proscribed missile. Iraq declared that the order to begin this effort was issued by Lt. General Hussein Kamil. To accomplish the task, samples of original SCUD-B gyroscopes were required. As Iraq's officials told the Commission, one engineer, of his own accord, had kept one set of three such gyroscopic instruments in his home as a "souvenir". The engineer then decided to turn these instruments over to the new working groups. In addition, a technician is said to have turned in microfilmed drawings of proscribed gyroscopic instruments done by a foreign supplier prior to the Gulf War. Iraq declared that the gyroscope project had been stopped after only two weeks of work. Drawings produced by the working groups, along with the gyroscopes themselves, were claimed to have been confiscated by Iraqi authorities in 1993, but it was decided not to hand them over to the Commission at that time. The microfilm with drawings was said to have been destroyed. Due to the lack of supporting documentation, the Commission is not able to verify Iraq's declarations on the nature and duration of these proscribed activities nor on disposal of all proscribed items and drawings involved.

Evidence available to the Commission shows that during the same period of time, in 1993, Iraq attempted to procure from abroad guidance components for proscribed Al Hussein missiles. This poses the obvious question why there was a need to procure, in 1993, components specifically used in proscribed missiles when all such missiles had been allegedly destroyed in 1991. A missile facility in Iraq signed a contract with a foreign middleman to acquire a key component (potentiometers) for proscribed SCUD-B/Al Hussein gyroscopes that Iraq stated it was not able to produce or procure before the Gulf war. Under the contact, the middleman purchased and brought to Iraq a number of components and samples of proscribed missile gyroscopes. According to Iraq, its officials learned of the content of the shipment and ordered it to be removed from the country. They warned missile establishments in Iraq not to deal further with this middleman. The shipment was declared removed from Iraq in May 1994. The Commission was not able to verify the content of the shipment nor its removal from Iraq.

In August 1994, two major missile facilities in Iraq signed new contracts with the same middleman whom they had been warned not to deal with. According to Iraq, the director of one of them included in his order a "secret list" detailing a wide variety of production and other technologies including missile gyroscope instruments that the middleman was to deliver. The "secret list" from this contract was worth several million dollars. After several months, the middleman obtained from a foreign supplier a cache of gyroscopes and accelerometers for long range missiles proscribed under resolution 687 (1991). The middleman managed to ship some of these proscribed items to Iraq in July 1995. A shipment of additional gyroscopes under the contract was intercepted in Jordan in November 1995. Iraq initially denied that it had been involved in this acquisition of proscribed items. When it admitted its involvement in December 1995, it stated that the middleman mistakenly purchased gyroscopes which Iraq had never ordered. The Government of Iraq declared that it had formally investigated this case. Documents related to the middleman's activities were provided to the Commission. The Commission has conducted an extensive investigation into this case. The investigations confirmed that Iraq's authorities and missile facilities had been involved in the acquisition of proscribed components.

At the end of 1994 or the beginning of 1995, an order was issued to design a multi-stage Space Launch Vehicle capable of placing a small satellite into a very low orbit. Such a missile system would be capable of carrying weapon payloads far beyond permitted ranges. According to Iraq's declarations, missile establishments started a feasibility study. Several designs based on Volga/SA2 surface-to-air missiles were simulated. The report on this study was prepared in February 1995, concluding that the idea was not feasible given the capabilities available to Iraq. Allegedly the project was stopped shortly thereafter. This project was declared to the Commission in August 1995. Simulations of the system's trajectory, some minutes of meetings and a portion of the final report were provided by Iraq as supporting evidence. The chief engineer involved in the project stated that he knew at the time that this subject was prohibited by the United Nations and that clustering and multi-stage techniques as well as separation techniques were proscribed under resolution 715 (1991).

Until late 1995, Iraq retained a number of original gyroscope instruments for proscribed SCUD-B/Al Hussein missiles. In October 1995, Iraq turned over to the Commission more than a dozen proscribed gyroscopes and related technical drawings. Iraq explained that, following Lt. General Hussein Kamil's defection, an "amnesty" order was issued by the Government. By this order, retained proscribed components could be turned over "anonymously" at various collection points. The gyroscopes appeared as a result of this campaign. The Commission asked for specific explanations regarding the reasons for retention of proscribed items, the "collection" sites, dates of collection of items etc. Iraq has not provided complete clarifications of these events.

In January 1996, a Commission inspection team discovered, during an on-site inspection of a missile facility, computer files with a missile simulation program. They contained evidence that in July 1992, a flight simulation of a 3-stage missile had been executed. The simulated missile was based on proscribed SCUD-B missiles. Iraq described the product of the simulation as a "Space Launch Vehicle" that was an effort of an unidentified engineer working on his own. The inspection team later determined that the input/output data, as well as the simulation program itself, had been copied to floppy diskettes in September 1992. Forensic examination also revealed that the diskettes obtained by the team were part of a larger collection of computer disks that were not found by the team nor provided by Iraq. Due to the manner in which Iraq interfered with the team's analysis of the acquired diskettes, a proper chain of evidence was not maintained, resulting in additional questions related to the nature and implications of the proscribed activities discovered.

In late 1995, Iraq declared that it had imported, in 1994, a large vacuum furnace without providing a notification to the Commission. According to Iraq, it ordered this equipment from a foreign supplier prior to the adoption of resolution 687 (1991) and specifically for production of engines for Al Hussein missiles. Pending results of its investigation of this illegal procurement, the Commission tagged components of the furnace and placed them under monitoring. In mid 1998,

Iraq undertook to assemble the furnace and began its installation at one of its declared facilities for production of missile engines. The ongoing installation activities were under the Commission's monitoring.

In late 1993, a large shipment of ammonium perchlorate, a key ingredient of missile solid propellant, was intercepted in one of the regional sea ports outside Iraq. The shipment was intended for Iraq's missile programs. This attempt to import missile-related materials, explicitly covered under the Monitoring plan, was not voluntarily declared by Iraq until the Commission's knowledge of this attempt was revealed to Iraq by the Commission.

Concealment of ballistic missile projects and facilities specifically established for missile-related production

Available evidence revealed that after the adoption of resolution 687 (1991), Iraq operated in secrecy a facility for the production of liquid propellant missile engines. The facility known as the Sadiq factory was established by a team from Project 1728 (production of proscribed Al Hussein missile engines). The facility's activity was not declared to the Commission until December 1995. Iraq stated that the work on liquid propulsion missile engines began in early 1992. This effort was declared as directed at the reverse-engineering and production of the Volga/SA2 missile engine as well as the manufacture of certain components such as missile engine shut-off valves, which the original Volga/SA2 engine did not have, but which are required for a surface-to-surface ballistic missile. Specific measure were taken to conceal this effort from inspection teams.

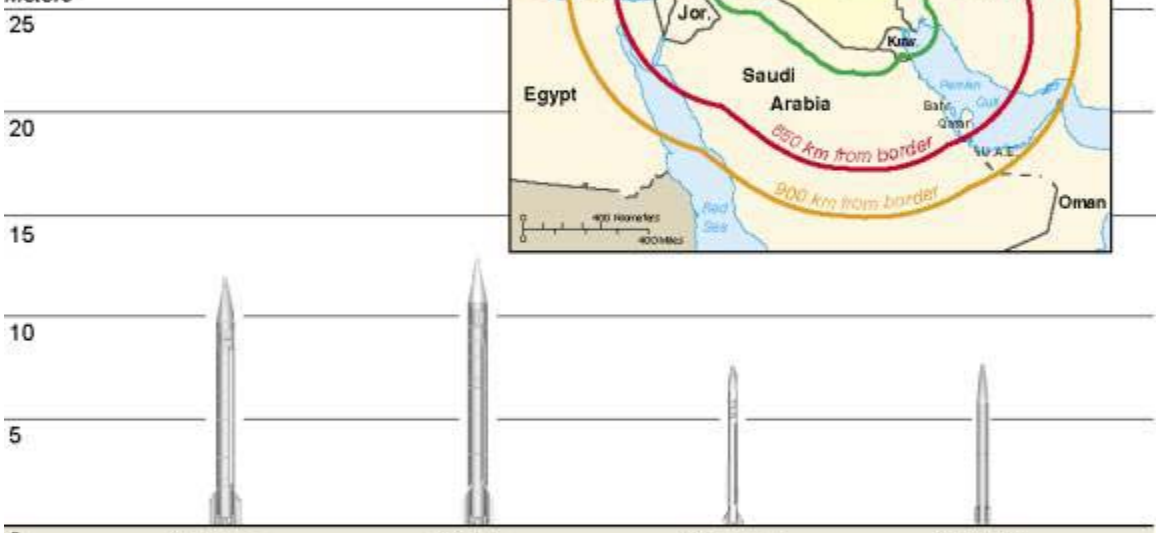
A series of static tests under this project were conducted by Iraq in 1992 and 1993. The first five tests were not declared to the Commission and were thus not monitored by inspection teams. While the plan called for production of five sets of engine hardware, Iraq declared that a smaller number of parts and components had been actually produced but that no engine had ever been assembled. Some of these parts and components were later shown to an inspection team while others were declared to have been unilaterally melted. Little documentary evidence has been made available by Iraq to support its declarations regarding the nature of missile engine production activities at the Sadiq Factory.

Iraq had a project, prior to the Gulf War, to construct a dedicated facility to indigenously produce proscribed missile propellants for Al Hussein missiles (for details, see Section 2, above). The project continued after the adoption of resolution 687 (1991) in April 1991. After the Commission presented its evidence of such activities to Iraq, Iraq admitted in 1996 that such a project had existed and its construction had continued after April 1991. Iraq explained that the completion of the construction of the project's buildings had been accomplished as a part of the "reconstruction campaign" and the project had not been fully implemented due to technical difficulties in the procurement of some equipment. No supporting documentation has been provided by Iraq to support its declarations.

Available evidence shows that since the adoption of resolutions 687 and 715 (1991), Iraq has been seeking foreign assistance to support its declared and undeclared efforts in the missile area. The assistance sought ranged from the acquisition of particular missile parts and components, to the provision of comprehensive support for the development and production of missiles in Iraq. In most cases, Iraq did not declare these efforts or its foreign partners to the Commission until they were either fulfilled, declared abandoned by Iraq, or discovered by the Commission."

The ultimate fate of this program is still unknown.

Iraqi Ballistic Missiles



	Al Husayn	Al Abbas	Al Samoud	Ababil-100
Estimated range (*km*)	650	900	150[a]	150[a]
Propellant type	Liquid	Liquid	Liquid	Solid
Use	Iran/Iraq and Gulf war 1987-91	Flight tested 1988-90	Early deployment	Early deployment

[a]Capable of flying beyond the allowed 150-km range.