Appendix II

The development of Iraq's missile capabilities

1. Since the end of inspections in mid-March 2003, UNMOVIC staff have spent considerable effort in collating and assessing the results of inspections to provide an understanding of the development of Iraq's missile capabilities as at March 2003. Some of the findings were not overtly apparent in March but emerged after careful analysis of missile and multidisciplinary inspection reports, documents obtained from Iraq and interviews of Iraqis involved in the missile development programme.

Liquid propellant missiles

2. Most of the knowledge developed by Iraq on liquid propellant missile technology was based on its earlier activities in using or in the reverse engineering of the foreign-made Scud and SA-2 missile systems. In the 1990s, Iraq started to develop different versions of a non-proscribed surface-to-surface missile based on the SA-2 liquid propellant engine. When UNMOVIC started its inspections in 2002, the missile programme had reached the production stage, and the version being produced was referred to as the Al-Samoud 2. As compared to the previous version, this missile featured an increase in airframe diameter from 500 mm to 760 mm. Iraq had imported, without going through the United Nations export/import regime, around 380 SA-2 engines and a number of guidance and control systems for the programme, in addition to scavenging the same items from around 180 of its own SA-2 missiles.

3. UNMOVIC focused a large number of inspections on evaluating the Al-Samoud 2 programme, especially since Iraq had declared that several flight tests had exceeded the permitted range limit of 150 km set by the Security Council in resolution 687 (1991). Following the conclusions of an international panel of experts convened in February 2003, UNMOVIC declared the Al-Samoud 2 missile prohibited and subsequently supervised the destruction (not fully completed by 17 March 2003) of the missile and its related major components.

4. Although the Al-Samoud 2 design was inherently capable of ranges greater than 150 km, during inspections UNMOVIC was vigilant in looking for any evidence of possible projects to use or modify the missile in a configuration that would achieve even longer ranges. Iraq could have pursued a number of ways to achieve longer ranges, such as the development of a larger engine, the use of extended fuel tanks and longer engine operation times, clustering two SA-2 engines or using a first-stage drop-off boost motor. A new, larger engine would also have required the development of a new, larger turbo pump. No evidence was found by inspectors indicating such activities. Furthermore, although Iraq had, in the past, acquired the technical knowledge for the design of such items, Iraq had struggled with the production and modification of the SA-2 engine used in the Al-Samoud and, therefore, it is deemed unlikely that those new items had been produced or could have been successfully produced in the near future.

5. The increase in airframe diameter of the Al-Samoud 2 from 500 mm to 760 mm would permit the airframe to accommodate two SA-2 engines clustered in a side-by-side configuration. This, together with extended propellant tanks, could extend the range of the missile to prohibited ranges. Again, no evidence was found by UNMOVIC inspectors that Iraq was attempting this modification. In addition, the

configuration would require a guidance and control system more capable than the one used in the Al-Samoud 2. Although research and development was actively being pursued on more sophisticated guidance and control systems, the work did not appear to be well advanced.

6. A third possible configuration to increase range would be to add a first-stage boost motor. While no direct evidence was found by inspectors that Iraq was pursuing such a project, there was circumstantial information that would have warranted a closer investigation of the issue had inspections continued. First, Iraq had declared in its most recent monitoring declarations projects to develop a new, more powerful boost motor for the SA-2 missiles and to use SA-2 boost motors with the SA-3 missiles. Both the projects would include studies of staging and separation mechanisms and those technologies would, hence, be available for transfer to other systems. In addition, some items that were observed during inspections required explanation, although they could not be investigated before the inspectors' withdrawal. Those items could conceivably be linked to the use of a first-stage boost motor with the Al-Samoud 2.

7. Several activities relating to liquid propellants were observed during inspections, all consistent with Iraq's declarations. Both research and some production were being pursued on the regeneration or manufacture of IRFNA liquid oxidizer, as well as the regeneration of TG-02 fuel. These propellants are used in several of Iraq's missiles. No evidence was found pointing to the manufacture of the fuel that is specific to the Scud missile. Pilot plant production of UDMH, a more energetic and advanced fuel, was also observed. Iraq declared that it had tested a fuel containing UDMH in SA-2 engines but because it was unsuccessful the project had been terminated. No evidence was found of any new, undeclared missile development using UDMH fuel. Iraq however continued its work on pilot plant production of UDMH, which is a component of the fuel used in other non-proscribed missiles it possessed.

Solid propellant missiles

8. Since late 1998, Iraq's activity and progress in solid propellant systems had increased substantially, particularly involving composite propellant, the preferred system in the world today. New missiles which were in development included (a) Al-Nidaa, a composite propellant variant of an earlier rocket, with a range increased from 50 to 70 km; (b) the Al-Raad, which is the foreign-made FROG missile, modified by replacing the original propellant in the sustainer motor with composite propellant; (c) the Al-Ubour, with a new composite propellant motor of 500 mm diameter and designed for use in a surface-to-air role with a stated range of 70 to 80 km (compared to the SA-2 range of 45 km); and (d) the Al-Fatah, the latest version of the former Ababil-100 (solid propellant). The latter missile has a diameter of 500 mm and a stated range of 144 km. Some of the initial unguided versions of the Al-Fatah had already been deployed to the army at the time of inspections. The international panel of experts UNMOVIC convened in February 2003 made an initial assessment of the Al-Fatah missile to determine if it complied with the 150 km-range limit. The panel concluded that further information was required before a proper assessment could be made. Time did not permit this additional information to be acquired before mid-March 2003.

9. As a consequence of the volume limits placed by the UNMOVIC monitoring regime on propellant mixers (210 litres), production by Iraq of larger size motors required the use of multiple batches of mixed propellant. For example, the Al-Fatah motor required five batches. Iraq did locally produce several new mixers that complied with the volume limit. UNMOVIC noted that Iraq was still having problems with the successful production of motors made using multiple batches, in large part owing to inconsistent quality of propellant raw materials. During UNMOVIC inspections, two large casting chambers were found. Because they were refurbished remnants from the former proscribed Badr-2000 missile project they were destroyed under UNMOVIC supervision. Although those chambers were large enough for the production of larger motors that could provide ranges of more than 150 km, no evidence was found that such production had occurred.

Missile launchers

10. Iraq had developed launchers for its new missile systems, the Al-Samoud 2, the Al-Fatah and the Al-Ubour. The Al-Samoud 2 launchers, one version with a single arm and the other with two arms, were based on knowledge Iraq acquired while developing Scud launchers before 1991. The two versions of the Al-Fatah launchers, one launching the missile from within the transport canister and the other from the launcher arm, were based on modified SA-2 launchers. Different declarations about the Al-Ubour launchers had been provided to UNMOVIC but the inspectors were not able to explore further the development of this launcher before their withdrawal. During the inspection process, UNMOVIC observed another type of launcher, similar to the Al-Fatah launcher, but with an extended arm. Inspections ceased before the purpose of this launcher could be ascertained.

Guidance and control systems

11. Iraqi engineers and scientists used their knowledge from Scud and several earlier projects for surface-to-air missile systems as the basis for their design, development, production and testing of the Al-Samoud 2 and Al-Fatah guidance and control systems. Only the Al-Samoud 2, however, had been fitted with a guidance and control system at the time of inspections. Hardware components were obtained from various other missiles in the army's inventory. Gyroscopes, batteries, actuators and high-pressure gas bottles from SA-2s and SA-3s were used, as well as several parts from the R-40, an old air-to-air missile. As a result, the guidance and control systems had a relatively poor performance but did permit stable flight.

12. UNMOVIC also found that, in parallel to the production of these guidance systems for the Al-Samoud 2 and Al-Fatah missiles, Iraq was working on the development of advanced digital guidance systems utilizing modern components, such as inertial navigation systems with fibre-optic gyroscopes, GPS navigation and more sensitive accelerometers. A number of these modern components had been acquired since 1998 from foreign sources, together with other newly procured test equipment and related spare parts. Iraq declared several projects involving improvements to the guidance and control systems of its missiles. The development of new systems using modern equipment and technology would have given Iraq the capability to improve greatly the performance of its missile systems, particularly in accuracy and, if desired, in range extension through the gliding effect. No evidence of any project to extend range by these means was found during the inspection period. Although UNMOVIC was paying considerable attention to this area, a full

exploration of Iraq's capabilities and projects in guidance and control was not possible by mid-March 2003.

Cruise missiles

13. Iraq possesses the ground-launched HY-2 anti-ship cruise missile and the similar air-launched versions, the C-601 and C-611, all of which use a liquid propellant engine. Iraq declared two projects in relation to the HY-2 missile that had been conducted since December 1998. The first was a project to increase the missile's range from the design range of 95 km. From the information provided, it appears that the project was based on placing the engine from the C-611 into the HY-2, perhaps with an extended burn time. Two tests were declared: the first was said to have resulted in engine failure shortly after launch and the second (13 August 2001) was stated to have been successful, achieving a range of 150 km, more than the expected 130 km. The second declared project was to change the guidance and control system of the HY-2 to enable the missile to attack ground targets by using GPS navigation. Only one test (12 August 2001) was declared. It was stated that the test was unsuccessful and that the project had recently been terminated. Time did not allow the investigation and verification of the declared information and activities.

Appendix III

UNMOVIC training

1. UNMOVIC training has been an intensive and innovative effort and achieved expected results in implementing the objectives set forth by the Security Council in its resolution 1284 (1999), namely, to provide high quality technical and cultural training for United Nations inspectors to be deployed in Iraq.

2. UNMOVIC training has been carried out on a continuous basis through a series of training courses. UNMOVIC conducted 22 training courses from June 2000 to April 2003. There were two main categories of training courses: basic and follow-up. The main emphasis of the basic training courses was on providing future inspectors with an understanding of the UNMOVIC mandate, UNMOVIC ongoing and anticipated activities and monitoring/inspection concepts, procedures and basic tools, as well as an overview of Iraq's proscribed weapons programmes and dual-use capabilities. Special efforts were made to underline the United Nations identity of UNMOVIC activities. UNMOVIC conducted seven basic training courses, which were attended by 381 persons from 59 countries. Upon completion of a basic course, a trainee was included in the UNMOVIC roster of inspectors available to serve in Iraq or at Headquarters.

3. Follow-up courses were organized for the roster personnel to upgrade their preparedness for inspection activities in Iraq. One set of courses (advanced courses) was aimed at developing practical skills to conduct on-site inspections. Eight such courses were held from May 2001 to December 2002, attended by 150 persons.

4. Another set of follow-up courses (enhanced courses) was organized to develop inspectors' capabilities to monitor dual-use equipment in Iraq. Four courses were conducted from May 2002 to March 2003, and one more course was conducted on dual-use biological production technologies. A total of 74 persons attended the enhanced courses.

5. Two specialized courses were also held for selected roster personnel, one on sampling procedures and the second on the use of chemical analytical laboratory equipment.

6. UNMOVIC has gained valuable experience and unique expertise in training international personnel to perform — effectively and professionally — inspection, monitoring and verification activities in the areas of weapons of mass destruction, in particular biological and chemical weapons and missiles. UNMOVIC has created specific programmes, curricula, study materials, manuals, handbooks and videos for various types of training; developed a unique set of training exercises, tutorials and drills to develop required inspectors' skills; identified and adapted a number of facilities worldwide suitable for training activities, including mock inspections, practical exercises and familiarization visits; and established administrative, logistical and supporting infrastructure for effective training.

7. UNMOVIC training has been conducted mainly through the efforts of the UNMOVIC staff. The Governments of Argentina, Austria, Brazil, Canada, China, Finland, France, Germany, Sweden, Switzerland, the United Kingdom of Great Britain and Northern Ireland and the United States of America provided excellent support for training courses conducted by UNMOVIC in their respective countries. The costs of the training courses were relatively low as a result of specific

arrangements established by UNMOVIC with the host States. The majority of the training expenses (some 97 per cent) for 22 courses during three years has been spent on participants' travel and daily subsistence allowance payments.

8. UNMOVIC training strengthened roster personnel readiness and willingness to participate in inspection and monitoring activities in Iraq as United Nations inspectors. It would be highly beneficial for future inspection and monitoring activities in Iraq if most of the personnel on the roster completed both advanced and enhanced courses.