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**MISSILE TECHNOLOGY CONTROL REGIME
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Paper by the Netherlands

**IRAQ - UAVs, another way to deliver WMD,
- related procurement activities**

Overview

UN sanctions and inspections have been important for obstructing, charting and destroying Iraqi Weapons of Mass Destruction (WMD) programmes. Nonetheless, Iraq still possesses the infrastructure and the expertise needed to reactivate non-conventional programmes. Relevant control procedures losing their value due to the prolonged absence of UN weapon inspectors. It can be assumed that the termination of the UNSCOM inspections in 1998 have expanded Iraqi liberties to procure for its WMD programmes. The objective of non-proliferation export control regimes like the MTCR is to prevent the procurement of strategic and/or dual-use goods. There are indications that Iraq is developing means of delivery for chemical or biological agents which do not have the full attention of the control-regimes. For example, the conversion of a military aircraft to an Unmanned Aerial Vehicle (UAV), as a way to deliver chemical or biological weapons, instead of a ballistic missile.

BM & WMD judged to be available In Iraq

Ballistic Missiles range > 150 km	10 – 20 Al Hussein missiles (with TEL)
Chemical weapons:	VX 200-300 ton Sarin, GF 200 ton Mustard gas 200 ton
Biological weapons:	Several kilotons biological agents.
Nuclear weapons:	Most of the infrastructure is destroyed. There is no evidence that Iraq is in possession of reasonable amount of fissile material.

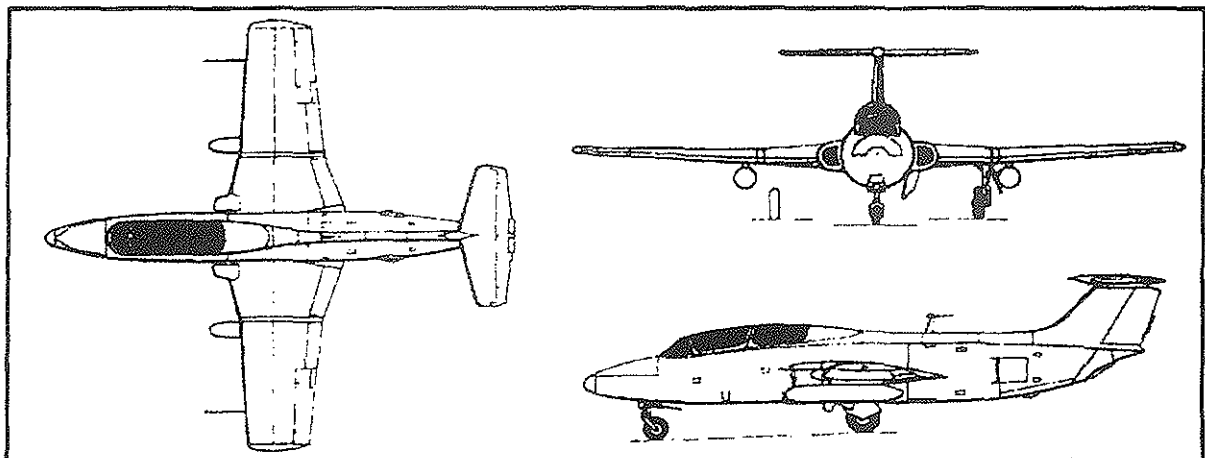
UAV in relation with WMD

Under certain circumstances a UAV may be a more appropriate means of delivery for chemical or biological agents than a missile. Besides the lack of attention, the conversion of an aircraft into an UAV intended to deliver biological and chemical agents is much cheaper and technically less advanced than the development of a ballistic missile with a chemical or biological warhead. An other important reason: the high stresses, gravitational forces (G-forces) and heat generated by the acceleration and re-entry of ballistic missiles make them a less-than-ideal method of delivering live biological agents. Considerable technical efforts are required to store live agents in a missile warhead and ensure that the agent is dispersed at the correct height and angle of delivery to create an aerosol. Chemical agents are not as sensitive to external factors as biological agents are, however the problem of creating a suitable aerosol remains the same. Mounting delivery systems on cruise missiles or unmanned aerial vehicles overcome some of these disadvantages. An aerosol delivery system mounted on a Unmanned Aerial Vehicle (UAV) or cruise-missile, would be an effective way of deploying biological or chemical agents over a determined target area.

There are also disadvantages, a UAV is much slower, easier to detect and to destroy. Moreover, an UAV or cruise missile does not have the political-strategic impact of a ballistic missile. The critical success factor by the development of a UAV or cruise missile is that navigation, guidance and control systems must be state of the art. We have no indications that Iraq is developing a cruise missile, there are however indications that Iraq is converting a standard aircraft to an UAV.

The Al-Bal'aa UAV Programme

Since the late 1980s Iraq has a programme to develop Unmanned Aerial Vehicles. The Iraqis tried to modify MiG-21 fighters for unmanned air-to-surface operations with chemical and biological weapons but were not successful. In a further attempt they adapted this technique to a more stable platform, the L-29 jet trainer. The slower and simpler L-29 is easier to modify than the MiG-21 and because it is a tandem seat trainer it can operate with an optional test pilot to reduce development time. Approximately 10 of the 55 L-29s that were delivered to the Iraqi Air Force are being used as technology demonstrators.



L-29 General Layout

Dimensions and performance data of the L-29 trainer	
Payload	200 – 400 kg biological or chemical weapons
Range	100 - 650 km (dependent on data link)
Length	9.63 m (31.6 ft)
Wingspan	10.29 m (33.8 ft)
Wing Area	19.78 m ²
Empty weight	2195 kg (4839 lb)
UAV equipment weight	235 kg (520 lb)
Speed	650 km/u

L-29 programme

The L-29 Delfin is converted for a remotely controlled flight by a ground crew. Flight preparation, including fuelling, communication checks with the Ground Control Station and a general technical inspection are done by a pilot. He starts the engine and hands over the control to the Ground Control System and leaves the aircraft. During all test flights, the L-29 UAV was flown manually. This means that the aircraft had to be controlled by the Ground Control System continuously. The maximum data-link range is assessed to be lower than 100 km. The data link range can decrease further when operating in hilly or mountainous terrain. The existing prototypes are equipped with an auto-pilot, however, this flight mode has never been observed.

Navigation

The navigation method is not clear. During all test flights a chase aircraft accompanied the L-29 UAV and provided the Ground Control Station with data. In addition, an (extra) ground-based radar is used to track the L-29 UAV. The use of tracking radar and a chase aircraft during test flights is not unusual and does not give any indication about the navigation capability. Iraq has the Inertial Navigation System (INS) of the Italian Mirach-100 at its disposal, but there is no evidence that it is used. The data-link system has some tracking capability, but is not precise enough for accurate navigation. The GCS needs a telemetry signal to track the UAV. However, there is no evidence that Iraq has integrated the telemetry-link in the L-29 UAV. This indicates that an electronic plotting system is probably not used. As a result, the Ground Control System operators would have to plot the position of the aircraft on a map, resulting in a high workload for the operator.

Targeting

If the L-29 UAV is used as weapon it is only suitable to attack large area targets, like troop concentrations, urban- and industrial areas. When the auto-pilot and Inertial Navigation System are fully integrated, the navigation system can be programmed before flight and the operator is only needed for take-off. In this case the Circular Error Probability (CEP) is expected to be rather large. When using the data-link in the terminal phase, precision attacks are possible if a nose camera with a suitable data link is activated. This implies that the UAV has to remain within the reach of the data link, thereby limiting its combat range. The L-29 is not assessed to be a good platform to operate as weapon carrying UAV, due to its limited speed and combat range. The Radar Cross Section RCS is rather large and the L-29 UAV is totally dependent on its data-link capability during its entire flight. This limits the operational range severely and increases the vulnerability to jamming. A possible combined attack with other weapon systems, Surface to Surface missiles (SS missiles) and fighters aircraft's could easily draw attention away from the relatively slow flying L-29 UAV and

thereby enhance the chance of success. Besides, A critical success factor would be the procurement of state-of-the-art guidance and control systems and advanced electronics.

Procurement activities

In the Iraqi procurement of proliferation-relevant goods, the Mukhabarat, the Iraqi secret service, plays a key role. The method of procurement can be described as follows. Iraq uses several small import-export companies as (logistical) intermediary for their procurement activities. The companies are based in a number of countries from which goods and know-how are desired. The intermediaries will attempt to approach targeted businessmen and broker. Several front-companies formally commission the deal, and divert the goods to Iraq. These Iraqi front-companies are largely based in Jordan and Syria, where Amman, Aqaba and Tartus are important transit cities. Both Syria and Jordan have also concluded a free trade agreement with Iraq.

Outlook

The presence of remaining and possibly recently produced WMD in addition to the willingness of Saddam Hussain to use them, as was shown in the past, continues to pose a real threat. Meanwhile delivery, of biological and chemical weapons by ballistic missiles is technically difficult to accomplish. The gravitational forces and the heat generated during re-entry and the inaccuracy of the missile make this delivery system less than ideal. An UAV like the L-29 could therefore serve as an alternative. It is a low cost platform with a rather high threat factor, especially when armed with a chemical or biological payload. In addition, it can be used with relatively low operational risk for own military personnel. Finally, the development and maintenance costs are rather low. On the other hand it is relatively slow, dependent on a data-link and has therefore a very short range and is easy to detect.

However, in combination with other weapons or an attack by surprise the L-29 can be effective. If Iraq overcomes the present technical problems and is capable to apply the UAV technology too much more advanced aircraft's than the L-29 the UAV threat will become much greater. To realise this Iraq will be dependent on foreign assistance and procurement activities abroad.