manoeuvering target at considerably beyond 60km, for example. The US Air Force's apparently relaxed attitude to extended-range fighter engagements is fuelled in part by the reduced radar cross-section (RCS) characteristics of its next-generation air-superiority fighter, the Lockheed F-22.

To engage a target at extended range, it first has to be acquired. It is of little benefit to have an extended-range missile if the associated radar is unable to locate a reduced RCS target until it is within its own engagement envelope. This, of course, is dependent upon the F-22 meeting the reduced radar-visibility requirement satisfactorily.

An aircraft equipped with a missile in the class of the Ks-172, such as the Sukhoi Su-35 could be used to engage high-value targets, such as tanker or airborne-early-warning aircraft without necessarily having first to deal with their fighter escorts.

The Novator design was a response to a Russian air force requirement for an ultra-long-range missile. While the Ks-172, on being revealed, attracted considerable attention, another missile to address a similar requirement, possibly from the Russian air defence forces (PVO), was already being tested on the Mikoyan MiG-31M Foxhound.

A Foxhound shown at the Akhtubinsk air force research and development centre was fitted with four Vympel R-37 long-range AAMs and two modified Vympel R-33s (AA-9 Amos), referred to as either the R-33M or R-33S. Both types were semi-recessed under the Foxhound’s fuselage. Although the R-37 shows a considerable design lineage from the R-33, the missile is thought to be a completely new system. It is associated with the Zaslon M radar, which is claimed to have an increased detection range. The exact status of the MiG-31M programme remains under question, with Mikoyan evasive about its future.

Also apparent on the Akhtubinsk Foxhound was that Vympel has developed an improved variant of the R-33, identified by fixed de-stabilisers just to the rear of the missile radome. This modification is believed to be intended to improve the poor manoeuvrability of the Amos and is likely to be in service.

LONG-RANGE ENGAGEMENT

Work on the R-33’s successor, the R-37, is thought to have begun in 1984-5. So far, the R-37 has only been shown without a booster. To allow long-range engagements, at ranges similar to those possible with the Ks-172, either a hybrid rocket-ramjet or a dual-rocket motor will be required.

Possible extended-range R-37 configurations have been examined by GoSNIIAS, the Russian State Research Institute of Aviation Systems. One examined a rocket/ramjet propulsion system with a solid-rocket booster, while the other looked at a rocket-ramjet-only configuration. The latter is similar to the General Dynamics/Westinghouse configuration.

So far, the R-37 has been associated with the MiG-31M, while the Ks-172, also known as the AAM-L, has been linked with the Su-35 development of the Flanker.

There are indications that the R-37, and the Vympel R-77 (AA-12), are also intended for internal carriage. Both missiles have folding rear control surfaces. This may be for fitting to rotary launchers as part of a self-defence installation for long-range bombers such as the Tupolev Tu-22M.

It may also be for equipping next-generation combat aircraft. Mikoyan’s now-cancelled Project 701, an intended replacement for the MiG-31, had internal missile bays. There is also speculation that Mikoyan’s Project 1.42 may have provision for the internal carriage of AAMs, although this remains unconfirmed. In terms of reduced RCS, Mikoyan claims to have successfully tested a MiG-29 Fulcrum with the critical surfaces treated with radar-absorbent material.

Russia’s continuing development of such systems is having a twofold effect on Western air forces. In the longer term, they are looking to their own missile inventories to consider the need for extended-range systems, while simultaneously considering tactics for countering long-range missiles. Co-operative fighter operations are viewed as one way of countering long-range engagement systems.

The Air Force’s Aeronautical Systems Center, at Wright-Patterson AFB, Ohio, under its Tactical Aircraft Cockpit Simulation programme, has looked at developing display formats for such operations. Pairs of aircraft would be data-linked, allowing one to launch a missile against the target while it was illuminated by the other.

In the case of such engagements, this would allow the launch aircraft to impart the greatest kinetic energy to the missile, accelerating up to Mach 2, then manoeuvring out of the engagement. The illuminator aircraft could remain subsonic, keeping the distance from the target as large as possible during the engagement, providing command-guidance updates or illuminating the target.

Alongside such tactical developments, the US Navy and the Royal Air Force are examining the development of extended-range radar homing systems.