NASIC-1031-0985-06
MARCH 2006

National
Air and Space
Intelligence
Center

Wright-Patterson
Air Force Base, Ohio

BALLISTIC AND CRUISE MISSILE THREAT

Key Findings

Many countries view ballistic and cruise missile systems as cost-effective weapons and symbols of national power. In addition, they present an asymmetric threat to US airpower.

Many ballistic and cruise missiles are armed with weapons of mass destruction.

North Korea is continuing to develop an intercontinental ballistic missile (ICBM) that could reach parts of the United States with a nuclear payload. A new intermediate-range ballistic missile (IRBM) also is under development.

Iran is continuing to modify its Shahab 3 medium-range ballistic missile (MRBM) to extend its range and effectiveness. With continued foreign assistance, Iran could have an ICBM capable of reaching the United States before 2015.

China's ballistic missile force is expanding in size and types of missiles. New theater missiles continue to be deployed in the vicinity of Taiwan, while the ICBM force will soon be adding the new road-mobile, solid propellant DF-31 and DF-31A ICBMs. The new JL-2 submarine-launched ballistic missile (SLBM) is also under development. Future ICBMs could include some with multiple independently targetable reentry vehicles, and the number of ICBM warheads capable of reaching the United States could expand to well over 100 in the next 15 years.

India and Pakistan continue to develop new short- and long-range ballistic missiles. Pakistan first tested its new solid-propellant Shaheen 2 MRBM in 2004 and India is expected to test its new solid-propellant Agni III IRBM in the near future.

Russia still has several thousand nuclear warheads deployed on ballistic missiles capable of reaching the United States. Although the size of the Russian strategic missile force is shrinking, development of new ICBM and SLBM systems is proceeding, and Russia is expected to retain the largest force of strategic ballistic missiles outside the United States.

Land-attack cruise missiles (LACMs) are highly effective weapon systems that can present a major threat to military operations.

At least nine foreign countries will be involved in LACM production during the next decade, and many missiles will be available for export.

CONTENTS

PHOTO CREDITS

Associated Press (p. 3, bottom center; p. 5 bottom left; p. 6, all; p. 7 top, center and bottom left; p. 7, top right; p. 8, bottom; p. 11, top left and right; p. 18, left)

Aviation Week (p. 27, bottom right)

Center for Defense Information (p. 20)

China Pictorial (p. 17 bottom left)

Dausslt (p. 27, top right)

Defense Nuclear Agency (p. 2, top left)

Department of Defense (p. 3, bottom left)

FARS News Agency (p. 14-15)

German Museum, Munich (p.1, bottom right)

Gunter's Space Page (back cover)

Imperial War Museum (p. 1, top left)

India Defence Consultants (p. 11, top right)

Iranian Television (p. 13, top right)

Kentron Division of Denel (Pty) Ltd (p. 27, top left)

MBDA (p. 26, bottom left)

National Air & Space Intelligence Center (p. 5, top right; p. 13, bottom left; p.27, 2nd down on left; 3rd down on left; center right)

National War College (p. 7, center)

North Korean Television (p. 9, bottom)

PLA Pictorial (p. 23, bottom left)

Reuters (p. 3, bottom left and center; p. 10, all; p. 11, bottom; p. 12, top; p. 28, top)

Russian Military Review (p. 19, right)

Rossiya TV (p. 22, top right)

TommaX, Inc./Military Parade Ltd. (front cover; p. 2, bottom; p. 3, bottom right; p. 17, top, center, and bottom right; p. 18, all; p. 19, left; p. 21, all; p.22, top left and bottom left; p. 24, bottom; p.25, all ; inside back cover, top)

Topham Picture Agency (p. 1, left center and left bottom)

Wforum (p. 5, bottom right; p. 7, middle right and bottom right; p. 12, bottom; p. 13 upper left and bottom right; p. 16, all; p. 20, bottom; p. 22, bottom right; p. 23, top series; p. 23, bottom right; inside back cover, bottom)

Front cover photo: Russian SS-19 ICBM

Threat History

Ballistic and cruise missiles present a significant threat to US and Allied forces overseas, as well as to the United States and its territories. Missiles are attractive to many nations because they can be used effectively against an adversary with a formidable air defense system where an attack with manned aircraft would be impractical or too costly. In addition, missiles can be used as a deterrent or an instrument of coercion. Missiles also have the advantage of fewer maintenance, training, and logistic requirements than manned aircraft. Even limited use of these weapons could be devastating, because missiles can be armed with chemical, biological, or nuclear warheads.

The ballistic and cruise missile threat continues to increase with the proliferation of missile technology. Over 20 countries have ballistic missile systems, and it is likely that missiles will be a threat in future conflicts involving US forces. Ballistic missiles have been used in several conflicts over the last 20 years, including the Iran-Iraq war, the Afghan civil war, the war in Yemen, the 1991 and 2003 Persian Gulf conflicts, and the Russian military action in Chechnya. Although LACMs have not yet been widely proliferated, as many as 20 countries could possess cruise missiles in the next decade.

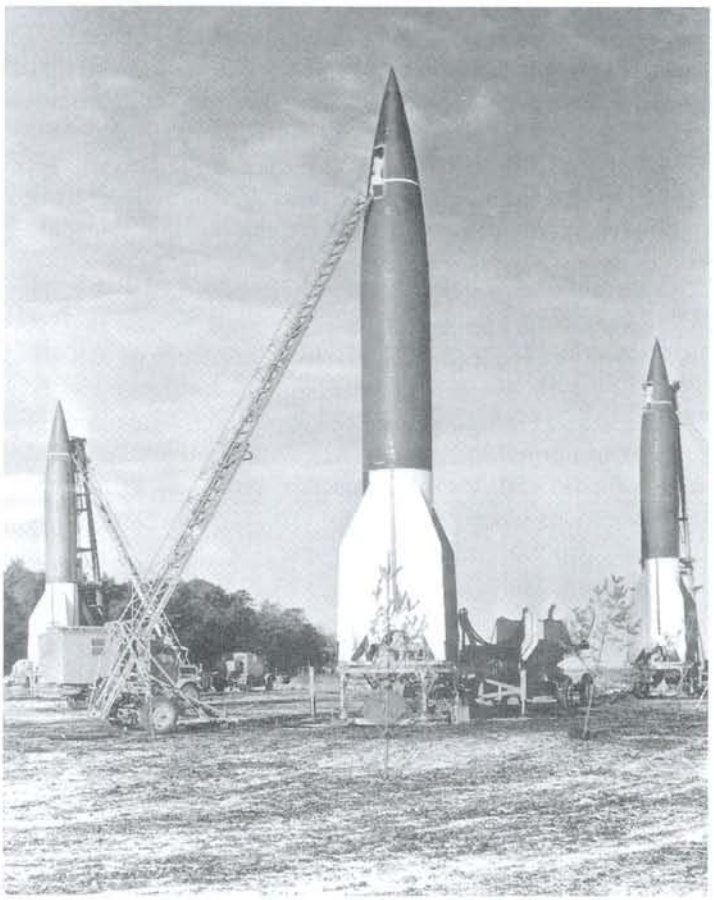
The US Air Force, in cooperation with the other services, is responsible for countering the ballistic and cruise missile threat through deterrence and, if necessary, active suppression. Threat suppression may include attacks on missile systems, both before launch and in flight, as well as attacks on their supporting infrastructure. This document includes information on some of the major current and projected foreign ballistic and cruise missile systems.

V-1 in Flight

V-1 about to Impact in London

V-2 Damage (160 people were killed in this attack.)

Guided cruise and ballistic missiles were first used when Germany attacked targets in England and Northern Europe with V-1 cruise missiles and V-2 ballistic missiles during World War II. Although these missiles were inaccurate, their use resulted in tens of thousands of Allied casualties.



V-2 Ballistic Missiles

Warheads and Targets

Many ballistic and cruise missiles are armed with nuclear warheads.

Chemical and biological weapons can be packaged in submunitions to be dispersed over a wide area.

Ballistic and cruise missiles can be armed with conventional or nonconventional warheads. Conventional warheads are filled with a chemical explosive, such as TNT, and rely on the detonation of the explosive and the resulting metal casing fragmentation as kill mechanisms. Nonconventional warheads include weapons of mass destruction (nuclear, biological, and chemical weapons), as well as nonlethal warheads, a relatively new class of warhead designed to disable equipment rather than harm personnel. Conventional, biological, and chemical weapons can be packaged in unitary (single) warheads and in submunitions (multiple small bomblets that are released at altitude to disperse over a wide area).

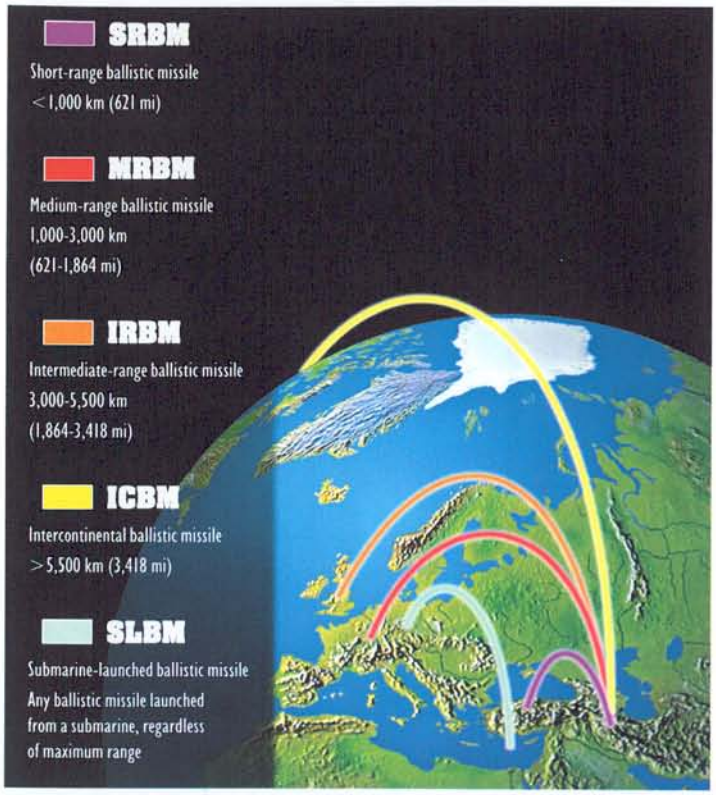
Conventional warheads can be optimized for specific types of targets. For example, submunitions can be used to create craters in an aircraft runway or destroy armored vehicles. A penetrator warhead, which uses a relatively small amount of explosive surrounded by a heavy metal casing, can pass through a hardened structure, such as a bunker, to destroy its contents.

Almost all of the longer range ballistic missiles, and several types of LACMs, carry nuclear warheads. Most of these warheads have an explosive force that is tens to hundreds of times more powerful than the atomic bombs used in World War II.

Chemical and biological weapons are attractive to many Third World countries because they are much easier to produce than nuclear weapons. Many countries with chemical and biological warfare programs also are equipped with ballistic and/or cruise missiles. Accuracy is not very important for these weapons when used against urban areas or large concentrations of military forces. Chemical and biological weapons are capable of producing massive casualties, inducing panic and chaos in civilian populations, and severely degrading military operations.

Ballistic Missile Warhead with Submunitions

Ballistic Missiles



Operational ballistic missiles are deployed in silos, on submarines, and on land-mobile launchers. Mobile missiles are favored by many nations because they can be hidden, which greatly increases their survivability.

In many short-range ballistic missiles, the entire missile remains intact until the warhead detonates. In longer range ballistic missiles, warheads are contained in separating reentry vehicles. Some long-range ballistic missiles carry multiple independently targetable reentry vehicles (MIRVs), with up to 10 reentry vehicles (RVs) per missile. RVs reenter the Earth's atmosphere at very high velocities, on the order of 4-5 miles per second at ICBM ranges.

Ballistic missiles can use solid- or liquid-propellant rocket propulsion systems. The trend in modern missile systems has been toward the use of solid propellants because of their reduced logistical requirements and simplicity of operation. However, some Third World nations have greater access to liquid-propellant technology and, therefore, continue to develop new liquid-propellant missiles.

Multiple-stage missiles, with each stage having its own independent propulsion system, are more efficient for longer range missions. ICBMs typically have two or three stages, with powerful liquid-propellant engines or solid-propellant motors to propel the payload toward its target, besides a postboost vehicle with a much smaller propulsion system. A postboost vehicle can be used to improve the RV deployment accuracy for a single-RV missile. For a missile with a MIRV payload, the postboost vehicle is used to release RVs so that they follow different trajectories, allowing them to hit targets that may be separated by over 1,000 miles.

A ballistic missile with a high-quality inertial guidance system is capable of delivering an RV within a few hundred feet of the target after a flight of over 6,000 miles. For many missiles, accuracy can be greatly improved by utilizing satellite-aided navigation. Missiles also can use maneuvering reentry vehicles (MaRVs) with terminal sensors to attain very high accuracy.

As more modern guidance technology is proliferated, countries will be able to improve the accuracy and lethality of their missile forces. However, even a missile with a guidance system only accurate enough to hit a large city is capable of inflicting massive casualties when armed with a weapon of mass destruction. Therefore, many Third World ballistic missiles, though inaccurate, have the potential to pose a serious threat to urban targets.

Many ballistic missiles carry penetration aids to improve the chances of an RV penetrating a ballistic missile defense system. Penetration aids are devices intended to deceive or jam sensors used to detect and track missiles and RVs. Penetration aids are of increasing importance to countries developing and operating ballistic missiles.

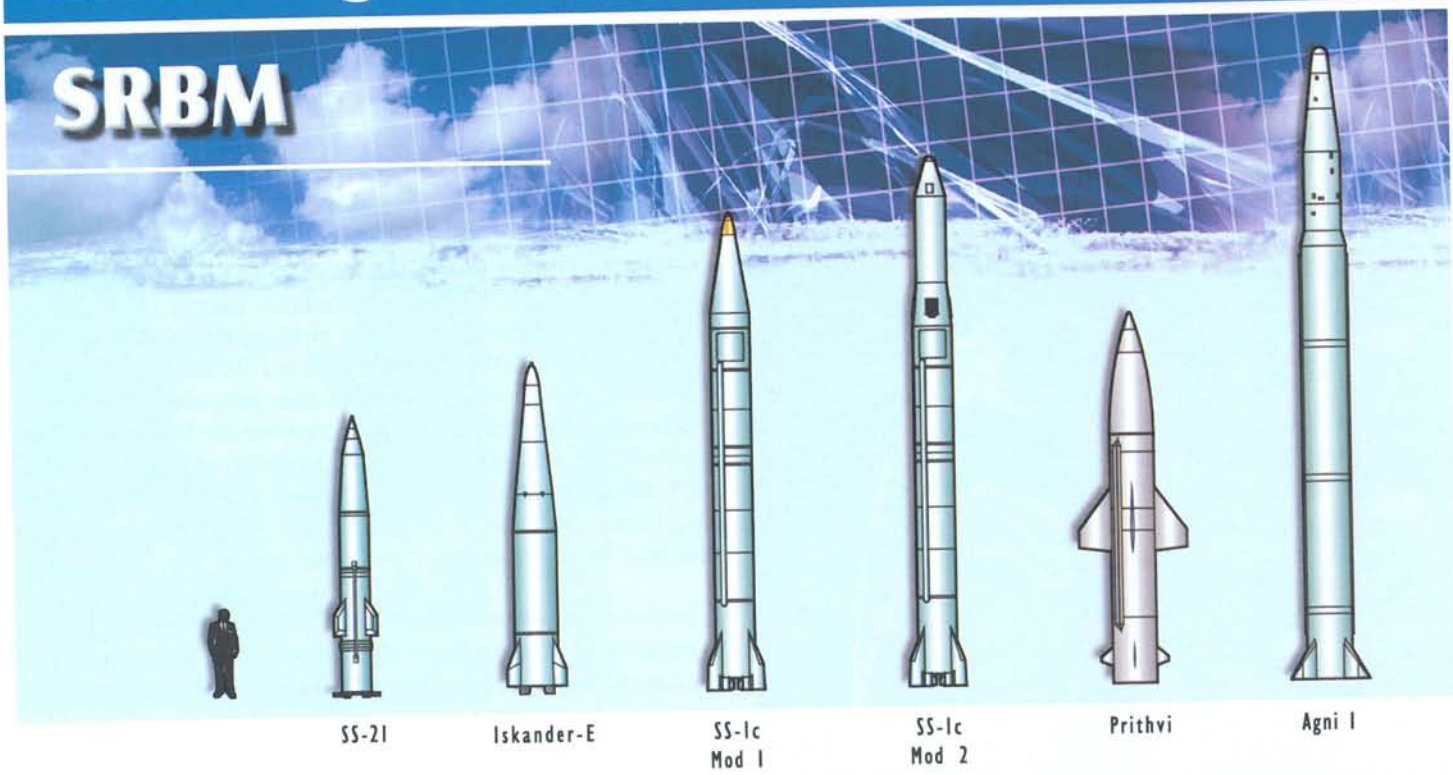
Mobile missiles can move frequently to avoid being targeted by hostile forces.


Russian Iskander-E Road-Mobile Missile System


Indian Agni II Mobile MRBM


Russian SS-25 Road-Mobile ICBM

Short-Range Ballistic Missiles

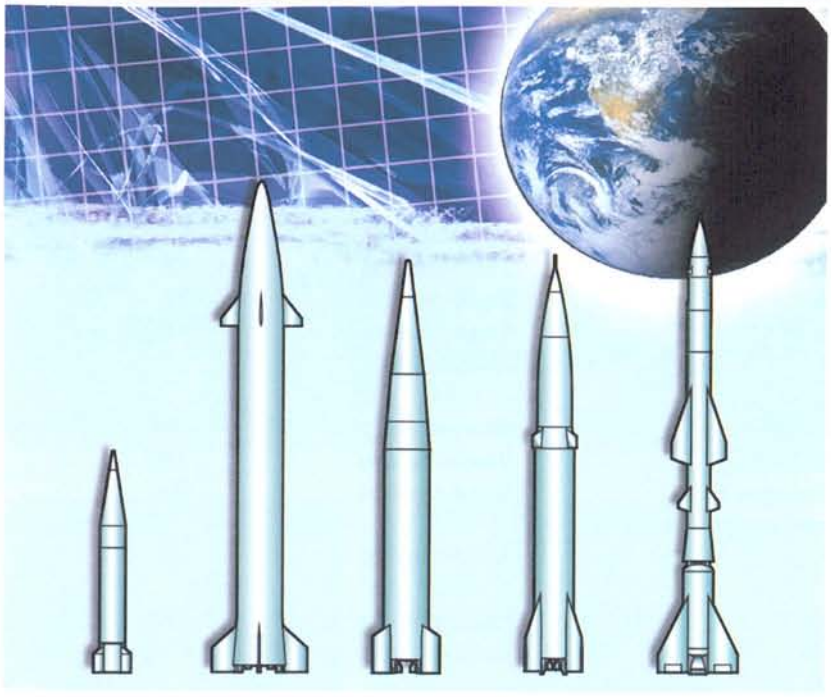


SRBM Launcher Order of Battle SELECTED COUNTRIES

Country / Missile System	Number of Launchers*
Belarus	
SCUD B	Fewer than 50
SS-21	Fewer than 100
China	
CSS-6	Fewer than 100
CSS-7	Fewer than 150
Egypt	
SCUD B	Fewer than 50
India	
Prithvi	Fewer than 50
Dhanush**	Not yet deployed
Agni I	Not yet deployed
Iran	
CSS-8	Fewer than 50
SCUD B	Fewer than 50
SCUD C	Fewer than 50
Fateh-110	Fewer than 50
Kazakhstan	
SCUD B	Fewer the 50
SS-21	Fewer than 50
Libya	
SCUD B	Fewer than 100
North Korea	
SCUD B	Fewer than 50
SCUD C	Fewer than 50
Pakistan	
Ghaznavi	Fewer than 50
Hatf-1	Fewer than 50
Shaheen I	Fewer than 50
Russia	
SS-21	More than 200
SS-26	Fewer than 50
Syria	
SCUD B	Fewer than 50
SCUD C	Fewer than 50
SS-21	Fewer than 50
Turkmenistan	
SCUD B	Fewer the 50
Ukraine	
SCUD B	Fewer than 100
SS-21	Fewer than 100
Vietnam	
SCUD B	Fewer than 50
Yemen	
SCUD B	Fewer than 50
SS-21	Fewer than 50

*The missile inventory may be much larger than the number of launchers, because launchers can be reused to fire additional missiles.

** Ship-launched ballistic missile.



SCUD B on Road-Mobile Launcher

Several countries are now producing and/or developing SRBM systems, while many other countries have purchased missiles or missile technologies from one or more of the missile producers. New SRBM systems are in development in several countries. China has deployed a very large force of modern solid-propellant SRBMs in the vicinity of Taiwan.

The Russian SS-1c Mod 1, also called the SCUD B, has been exported to more countries than any other type of guided ballistic missile and has proven to be a versatile and adaptable weapon. For example, the Iraqi SCUD missiles used during the 1991 Persian Gulf War had been modified to double their range. North Korea has produced its own version of the SCUD B, as well as the SCUD C, an extended-range version of the SCUD B.

Although the SCUD was originally designed as a tactical battlefield support weapon, many countries view it and other SRBM systems as strategic weapons to be used against urban areas. Iraq used extended-range SCUD missiles as strategic weapons during both the Iran-Iraq war and the 1991 Persian Gulf War. In the future, other countries could modify SCUD missiles to significantly improve their accuracy and use them against high-value military targets and cities.

The Chinese CSS-8 has been exported to Iran.

Chinese CSS-7 SRBM being Launched from Road-Mobile Launcher

SRBM Characteristics

Missile	Producer	Propellant	Deployment Mode	Maximum Range (miles)
SCUD B	Russia	Liquid	Road-mobile	185
(SS-1c Mod 1)				
SS-1c Mod 2	Russia	Liquid	Road-mobile	150+
SS-21 Mod 2	Russia	Solid	Road-mobile	43
SS-21 Mod 3	Russia	Solid	Road-mobile	75
SS-26	Russia	Solid	Road-mobile	185+
Iskander-E	Russia	Solid	Road-mobile	170+
CSS-6	China	Solid	Road-mobile	370
CSS-7	China	Solid	Road-mobile	185
CSS-8	China	First stage: solid Second stage: liquid	Road-mobile	93
B611	China	Solid	Road-mobile	93
SCUD B	North Korea	Liquid	Road-mobile	185
SCUD C	North Korea	Liquid	Road-mobile	310
Prithvi I	India	Liquid	Road-mobile	93
Prithvi II	India	Liquid	Road-mobile	155
Dhanush	India	Liquid	Ship-based	250
Agni I	India	Solid	Road-mobile	435
Hatf-1	Pakistan	Solid	Road-mobile	50
Shaheen I	Pakistan	Solid	Road-mobile	280+
Ghaznavi	Pakistan	Solid	Road-mobile	250
Fateh-110	Iran	Solid	Road-mobile	120+
SCUD D	Syria	Liquid	Road-mobile	435

Note: All ranges are approximate.

Pakistani Ghaznavi Road-Mobile SRBM

Pakistani Ghaznavi Road-Mobile SRBM Launch

Indian Prithvi Road-Mobile SRBM

Indian Agni I Road-Mobile SRBM

Pakistani Shaheen I on Road-Mobile Launcher

Indian Prithvi SRBM Launch

Chinese CSS-7 SRBM on Road-Mobile Launcher

Pakistani Shaheen I Road-Mobile SRBM Launch

Chinese CSS-6 SRBM on Road-Mobile Launcher

Medium-Range/Intermediate-Range Ballistic Missiles

The Chinese CSS-5 is a two-stage, solid-propellant MRBM capable of reaching targets in the Pacific Theater and most of Asia (the missile is in a canister on a towed-erector-launcher).

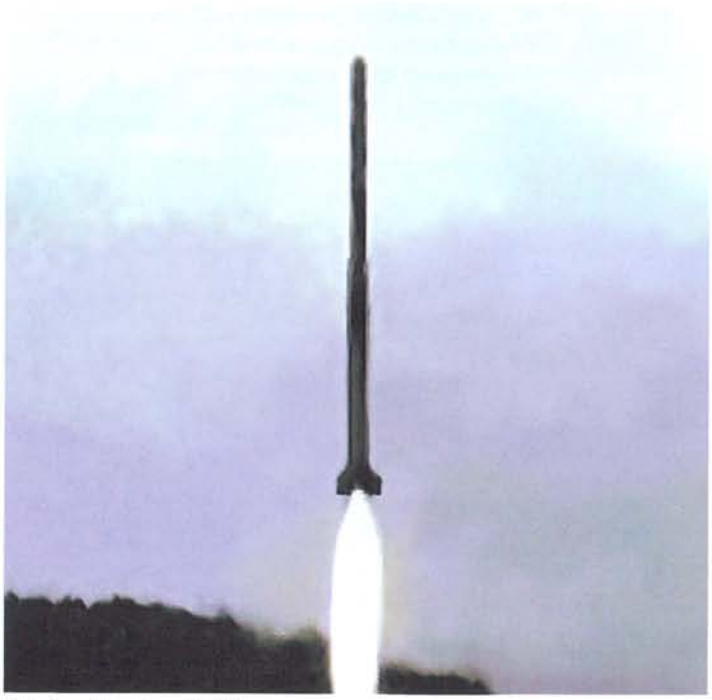
The Iranian Shahab 3 is a single-stage, liquid-propellant missile based on the North Korean No Dong MRBM.

New MRBM and/or IRBM systems are in development in China, North Korea, Iran, India, and Pakistan. These are strategic systems, and most will be armed with nonconventional warheads. (Both India and Pakistan tested nuclear weapons in 1998.) Russia no longer produces or retains any MRBM or IRBM systems, because they are banned by the Intermediate-Range Nuclear Forces (INF) Treaty, which entered into force in 1988. China has been very active in its development of MRBMs.

North Korea has an ambitious ballistic missile development program and has exported missile technology to other countries, including Iran and Pakistan. North Korea has also admitted its possession of nuclear weapons. The North Korean Taepo Dong 1 was used in an attempt to orbit a satellite in August 1998. Although a small third stage failed to place the satellite in orbit, the two-stage booster apparently performed successfully. The Taepo Dong 1 tested technologies necessary for longer-range missile development. North Korea has a new IRBM in development; this system could be exported to other countries.

Iran has an extensive missile development program and has received support from entities in Russia, China, and North Korea. The Iranian Shahab 3 MRBM is based on the North Korean No Dong missile. Iran continues to modify the Shahab 3 to extend its range and effectiveness. Iran claimed it tested an improved version of the Shahab 3 in 2004. Subsequent statements by Iranian officials suggest the range is up to 1,250 miles for the improved Shahab 3 and that Iran has the capability to mass produce Shahab 3 missiles. Iran has also indicated it has a solid-propellant MRBM in development.

India and Pakistan are continuing development of MRBM systems capable of carrying weapons of mass destruction. India has indicated it plans to deploy the new solid-propellant Agni II MRBM. A longer-range Agni III IRBM is also under development and its first flight test could occur soon. Pakistan conducted the first flight test of its new two-stage, solid-propellant Shaheen II MRBM in 2004. The Shaheen II could have a range of 1,250 miles or more, in the same class as the Indian Agni II.



North Korean Taepo Dong 1 in Flight

MRBM and IRBM Characteristics

Missile	Country	Number of Stages	Propellant	Deployment Mode	Maximum Range (miles)	Number of Launchers*
CSS-2	China	1	Liquid	Transportable (limited mobility)	1,900	Fewer than 50
CSS-2**	Saudi Arabia (Chinese-produced)	1	Liquid	Transportable (limited mobility)	1,750	Fewer than 50
CSS-5 Mod 1	China	2	Solid	Road-mobile	1,100+	Fewer than 50
CSS-5 Mod 2	China	2	Solid	Road-mobile	1,100+	Fewer than 50
No Dong	North Korea	1	Liquid	Road-mobile	800	Fewer than 50
Taepo Dong 1***	North Korea	2	Liquid	Undetermined	1,250+	Not deployed
IRBM****	North Korea	1	Liquid	Mobile	2,000+	Not yet deployed
Agni II	India	2	Solid	Mobile	1,250+	Not yet deployed
Agni III****	India	2	Solid	Mobile	2,000+	Not yet deployed
Ghauri	Pakistan	1	Liquid	Road-mobile	800	Fewer than 50
Shaheen II	Pakistan	2	Solid	Road-mobile	1,250+	Not yet deployed
Shahab 3	Iran	1	Liquid	Road-mobile	800	Fewer than 20
Shahab 3 Variant	Iran	1	Liquid	Road-mobile	1,200+	Not yet deployed
New MRBM****	Iran	Undetermined	Solid	Undetermined	1,200+	Not yet deployed
IRBM/ICBM****	Iran	Undetermined	Undetermined	Undetermined	Undetermined	Not yet deployed

Note: All ranges are approximate.
* There may be several missiles available for each launcher.
** The exported CSS-2 has a conventional warhead.
*** Booster was used in an attempted satellite launch.
**** Missile has not yet been flight-tested.

Pakistani Ghauri Liquid-Propellant MRBM

Pakistani Ghauri MRBM Launch

Pakistani Shaheen II Launch

Indian Agni II Launch

Pakistani Shaheen II Solid-Propellant MRBM on Road-Mobile Transporter

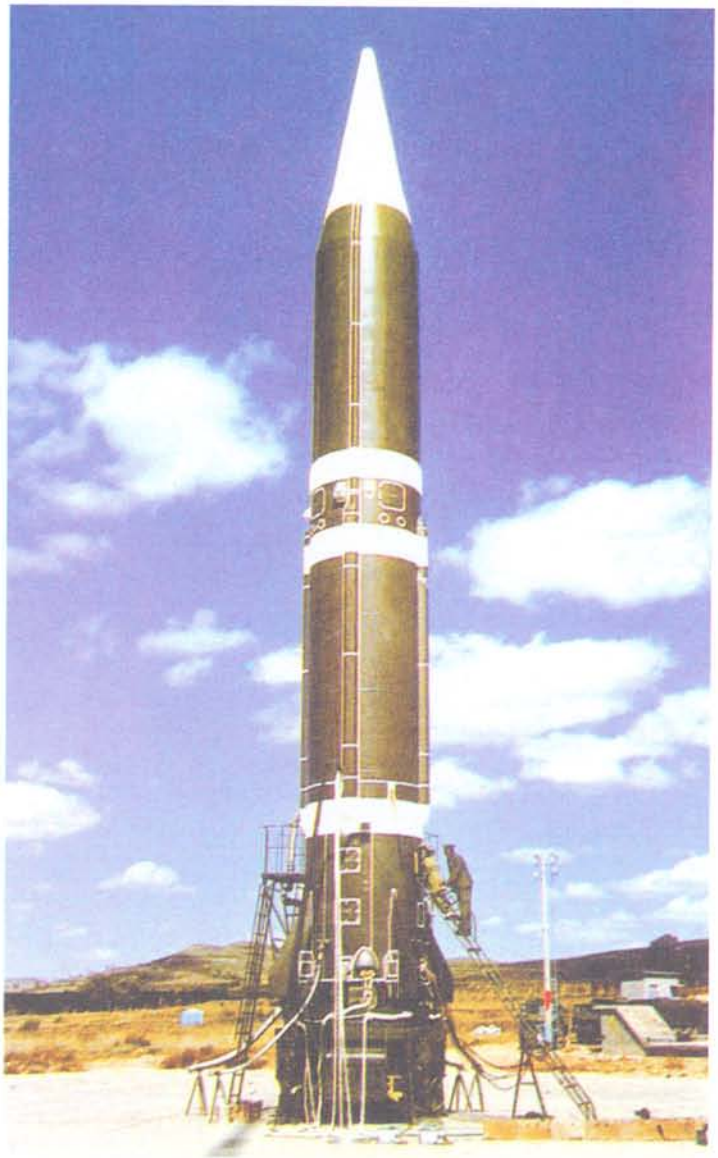
The Indian Agni II MRBM is capable of carrying weapons of mass destruction.

Display of Chinese CSS-5 MRBM Launchers and Support Equipment

Chinese CSS-5 Road-Mobile Launchers

Iranian Shahab 3 Road-Mobile MRBM Launch

Chinese CSS-5 Mod 1 MRBM Launch from a Mobile-Erector-Launcher



Chinese CSS-2 IRBM

The Shahab 3 is a single-stage, liquid-propellant MRBM. The original Shahab 3 has a range of about 800 miles. In 2004, Iran tested a new version of the Shahab 3 with a claimed range of about 1,250 miles. The missile also carried a new type of reentry vehicle.

Intercontinental Ballistic Missiles

China is continuing development of the new DF-31 road-mobile ICBM (a three-stage, solid-propellant missile carried inside a canister).

Chinese CSS-4 ICBM

Russia retains almost 2,000 nuclear warheads on ICBMs and most of these missiles are maintained on alert, capable of being launched within minutes of receiving a launch order. Although the size of the Russian ICBM force will continue to decrease because of arms control agreements, aging missiles, and resource constraints, Russia probably will retain the largest ICBM force outside the United States. Efforts to maintain and modernize the force are underway. The Russian SS-27 ICBM, a missile designed with countermeasures to ballistic missile defense systems, is now deployed in silos in five regiments (42 missiles). The road-mobile version of the SS-27 completed its flight test program in 2004. A new strategic missile that could be deployed in both land-based and sea-based versions may also be under development. President Putin and other Russian officials claim that a new class of hypersonic vehicle is being developed to allow Russian strategic missiles to penetrate missile defense systems.

The Strategic Arms Reduction Talks (START I) treaty, which entered into force in December 1994, limits the United States and Russia to no more than 6,000 warheads each (including those on ICBMs, SLBMs, and heavy bombers). The 2002 Moscow Treaty on Strategic Offensive Reductions limits Russia and the United States to no more than 1,700-2,200 warheads each by the end of 2012.

China has a relatively small force of nuclear-armed, liquid-propellant ICBMs capable of reaching the United States. China has been developing advanced new mobile, solid-propellant ICBMs, including the DF-31 which was flight-tested for the first time in August 1999. The DF-31 is a three-stage missile carried inside a canister. The deployment of road-mobile ICBMs will enhance the survivability of the Chinese strategic missile force. The DF-31 will be capable of reaching targets throughout Europe and Asia as well as parts of Canada and the northwestern United States. A longer range mobile ICBM, the DF-31A, also is under development. China could develop MIRV payloads for some of its ICBMs,, and the number of warheads on Chinese ICBMs capable of threatening the United States is expected to grow to well over 100 in the next 15 years.

North Korea is developing the Taepo Dong 2 ICBM, which could reach at least Alaska and Hawaii from North Korea. The missile could be flight-tested soon after a political decision to do so. The Taepo Dong 2 may be exported to other countries in the future.

Iran has an ambitious ballistic missile development program and, with continued foreign assistance, Iran could have an ICBM capable of reaching the United States before 2015.

The Russian SS-25 missile is launched from a canister carried on a seven-axle transporter-erector-launcher.

Russian road-mobile SS-27 is carried in a canister on a new eight-axle transporter-erector-launcher.

Chinese CSS-4 ICBM Launch

Russian SS-27 ICBM Launch

ICBM Characteristics

Missile	Country	Number of Stages	Warheads per Missile	Booster Propellant	Deployment Mode	Maximum Range* (miles)	Number of Launchers
SS-18 Mod 4	Russia	2 + PBV	10	Liquid	Silo	5,500+	79 (total for Mods 4 and 5)
SS-18 Mod 5	Russia	2 + PBV	10	Liquid	Silo	6,000+	
SS-19 Mod 3	Russia	2 + PBV	6	Liquid	Silo	5,500+	126
SS-25	Russia	3 + PBV	1	Solid	Road-mobile	7,000+	273
SS-27	Russia	3 + PBV	1	Solid	Silo and road-mobile	7,000+	42
New ICBM**	Russia	Undetermined	Undetermined	Solid	Silo and/or mobile	5,500+	Not yet deployed

Russian SS-25 Launch

Front View of a Russian SS-25 Transporter-Erector-Launcher

Missile	Country	Number of Stages	Warheads per Missile	Booster Propellant	Deployment Mode	Maximum Range* (miles)	Number of Launchers
CSS-3	China	2	1	Liquid	Silo and transportable	3,400+	Fewer than 25
CSS-4 Mod 1	China	2	1	Liquid	Silo	8,000+	About 20
CSS-4 Mod 2	China	2	1	Liquid	Silo	8,000+	(total for Mods 1 and 2)
DF-31	China	3	1	Solid	Road-mobile	4,500+	Not yet deployed
DF-31A	China	3	1	Solid	Mobile	7,000+	Not yet deployed
Taepo Dong 2**	North Korea	2	1	Liquid	Undetermined	3,400+	Not yet deployed

Note: All ranges are approximate.

* These estimates do not include range extension from the postboost vehicle; some postboost vehicles provide substantial range extension.

** Missile has not yet been flight tested.

Launch of the SS-18 Mod 4 Liquid-Propellant Russian ICBM

The six-warhead SS-19 ICBM could remain in Russia's ICBM force for many years.

Submarine-Launched Ballistic Missiles

Russian SS-N-18

Russia still maintains a substantial force of nuclear-powered ballistic missile submarines (SSBNs) with intercontinental-range missiles. Russia is developing new and improved SLBM weapon systems to replace its current inventory of Cold War vintage systems. An upgrade to the SS-N-23, named Sineva, is intended to replace the existing SS-N-23 on DELTA IV Class SSBNs. The Bulava-30 SLBM is a new solid-propellant SLBM that is primarily intended for deployment on new DOLGORUKIY class SSBNs. Russian SLBMs are capable of launch from surfaced and submerged SSBNs from a variety of launch locations.

China currently has a single XIA-class SSBN that is intended to carry 12 CSS-NX-3 missiles. In addition, the Chinese have designed a new SSBN, Type 094, that will carry the new JL-2 ballistic missile. This missile will, for the first time, allow Chinese SSBNs to target portions of the United States from operating areas located near the Chinese coast.

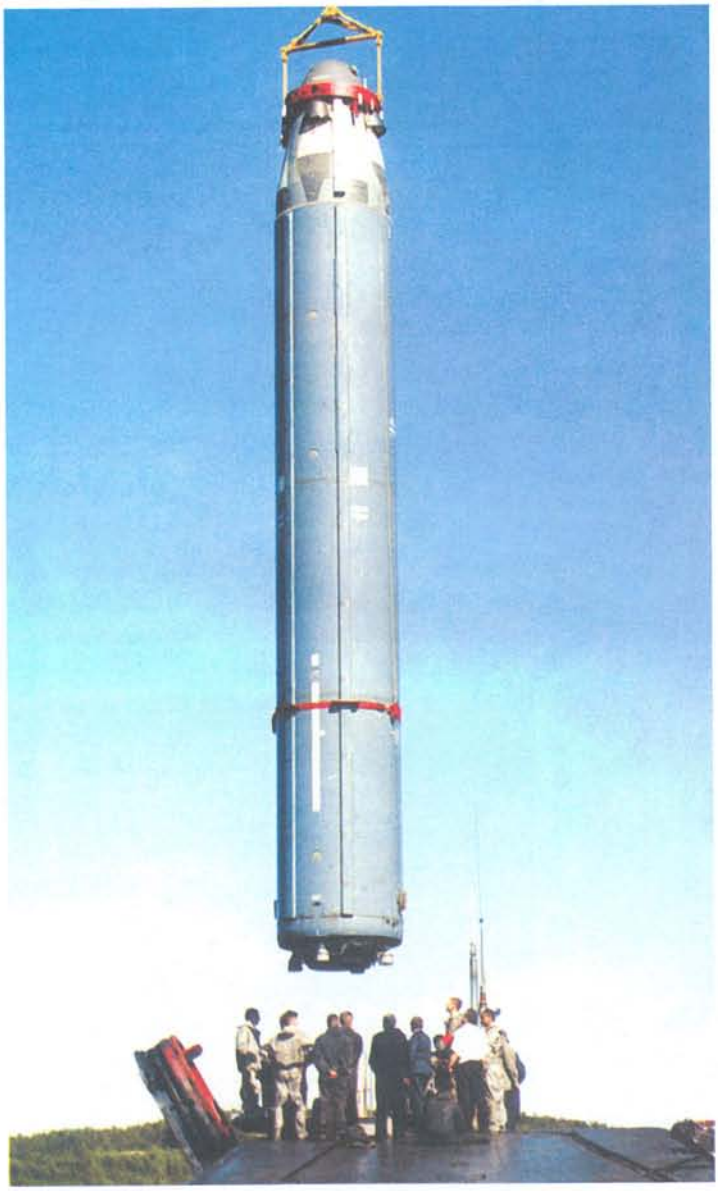
India is developing two new naval systems, the Sagarika SLBM (which is expected to become operational after 2010) and the Dhanush ship-launched ballistic missile (a naval version of the Prithvi land-based ballistic missile). The Dhanush is undergoing sea-based flight tests from an Indian naval surface ship.

Russian TYPHOON SSBN with Launch Tube Doors Open

Russian SS-N-20 SLBM

Each Russian TYPHOON SSBN can carry 20 SS-N-20 missiles.

Russian SS-N-20 SLBM Launch



Russian SS-N-23 SLBM

Each Russian DELTA IV SSBN can carry 16 SS-N-23 missiles.

Russian Bulava SLBM Launch from a Typhoon Submarine

Chinese CSS-NX-3 SLBM Launch

SLBM Characteristics

Missile	Country	Number of Stages	Warheads per Missile	Booster Propellant	Submarine Class	Maximum Range (miles)	Total Number of Launch Tubes
SS-N-18	Russia	2 + PBV	3	Liquid	DELTA III	3,500+	96
SS-N-20	Russia	3 + PBV	10	Solid	TYPHOON	5,500+	80
SS-N-23	Russia	3 + PBV	4	Liquid	DELTA IV	5,000+	96
Sineva	Russia	Undetermined	Up to 10	Liquid	DELTA IV	5,000+	Not yet deployed
Bulava-30	Russia	3 + PBV	Undetermined	Solid	TYPHOON/ DOLGORUKIY	5,000+	20; not yet deployed
CSS-NX-3	China	2	1	Solid	XIA	1,000+	12; not yet deployed
JL-2	China	3	1	Solid	Type 094	4,500+	Not yet deployed
Sagarika	India	Undetermined	Undetermined	Undetermined	Undetermined	180+	Not yet deployed

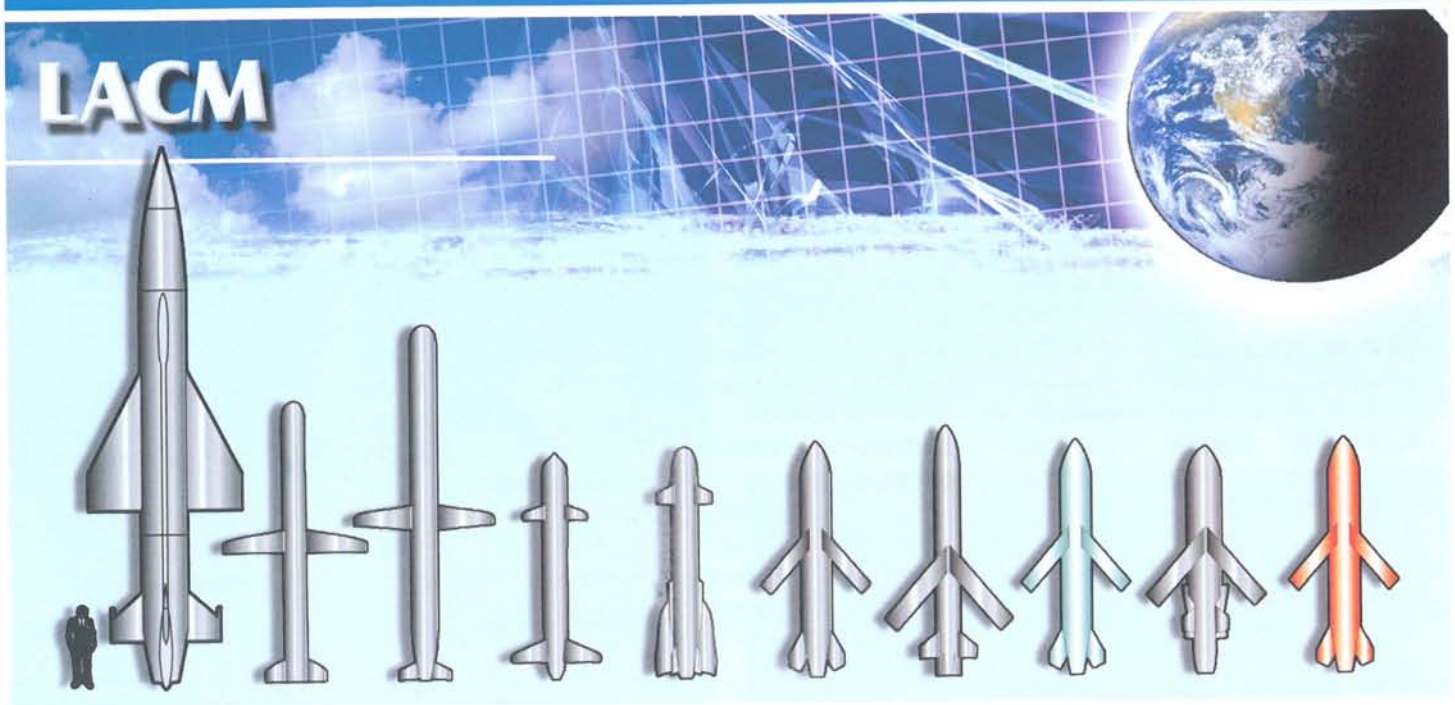
Note: All ranges are approximate.

CSS-NX-3 Launch Sequence

Chinese CSS-NX-3 SLBM

The Chinese XIA SSBN can carry 12 CSS-NX-3 missiles.

Land-Attack Cruise Missiles



Russian AS-4 Cruise Missile on a Tu-22 Bomber

Unlike ballistic missiles, cruise missiles are usually categorized by intended mission and launch mode (instead of maximum range). The two broadest categories are land-attack cruise missiles (LACMs) and anti-ship cruise missiles (ASCMs). Each type can be launched from an aircraft, ship, submarine, or ground-based launcher. LACMs are addressed in this document.

A LACM is an unmanned, armed aerial vehicle designed to attack a fixed or mobile ground-based target. It spends the majority of its mission in level flight, as it flies a preprogrammed path to a predetermined target. Propulsion is usually provided by a small jet engine.

Because of highly accurate guidance systems that can place the missile within a few feet of the intended target, the most advanced LACMs can be used effectively against very small targets, even when armed with conventional warheads. LACM guidance usually occurs in three phases: launch, midcourse, and terminal. During the launch phase, a missile is guided using only the inertial navigation system (INS). In the midcourse phase, a missile is guided by the INS updated by one or more of the following systems: a radar-based terrain contour matching (TERCOM) system, a radar or optical scene matching system, and/or a satellite navigation system such as the US Global Positioning System (GPS) or the Russian Global Navigation Satellite System (GLONASS). The terminal guidance phase begins when a missile enters the target area and uses either more accurate scene matching or a terminal seeker (usually an optical or radar-based sensor).

Defending against LACMs will stress air defense systems. Cruise missiles can fly at low altitudes to stay below enemy radar and, in some cases, hide behind terrain features. Newer missiles are incorporating stealth features to make them even less visible to radars and infrared detectors. Modern cruise missiles also can be programmed to approach and attack a target in the most efficient manner. For example, multiple missiles can attack a target simultaneously from different directions, overwhelming air defenses at their weakest points. Furthermore, the LACMs may fly circuitous routes to get to the target, thereby avoiding radar and air defense installations. Some developmental systems may incorporate chaff or decoys as an added layer of protection, though concealment will remain a cruise missile's main defense.

The cruise missile threat to US forces will increase over the next decade. At least nine foreign countries will be involved in LACM production during the next decade, and several of the LACM producers will make their missiles available for export.

The success of US Tomahawk cruise missiles has heightened interest in cruise missile acquisition in many countries. Many cruise missiles available for purchase will have the potential to perform precision-strike missions. Many of these missiles will have similar features: a modular design, allowing them to be manufactured with a choice of navigational suites and conventional warhead options; the incorporation of stealth technology; the ability to be launched from fighter-size aircraft; and the capability to fly high-subsonic, low-altitude, terrain-following flight profiles.

Russian AS-15 Cruise Missile

Russian AS-15 Cruise Missile Dropped from a Russian Tu-160 Bomber

Russian 3M-14E Cruise Missile

LACM Characteristics

System	Country	Launch Mode	Warhead Type	Maximum Range (miles)	Initial Operational Capability
YJ-63	China	Air	Conventional	Undetermined	Undetermined
New cruise missile	China	Undetermined	Conventional or nuclear	Undetermined	Undetermined
APACHE-AP	France	Air	Conventional/ submunitions	100+	2002
SCALP-EG	France	Air and ship	Conventional/ penetrator	300+	2003
Black Shaheen*	United Arab Emirates	Air	Conventional penetrator	250+	2006
KEPD-350	Germany/ Sweden/ Spain	Air and ground	Conventional/ penetrator/ submunitions	220+	2004
Brahmos-A	India/Russia	Air	Conventional	150+	2008
Popeye Turbo	Israel	Air	Conventional/unitary	200+	2002
Babur	Pakistan	Ground/Ship /Submarine/Air	Conventional or nuclear	200	Undetermined
AS-4	Russia	Air	Conventional or nuclear	185+	Operational
AS-15	Russia	Air	Nuclear	1,500+	Operational
SS-N-21	Russia	Submarine	Nuclear	1,500+	Operational
Kh-555	Russia	Air	Conventional/unitary or submunitions	Undetermined	Undetermined
3M-14E	Russia	Ship and Submarine	Conventional	185+	Undetermined
MUPSOW	South Africa	Air and ground	Conventional/unitary or submunitions	125+	2002
Torgos	South Africa	Air and ground	Conventional/unitary or submunitions	185+	2006+
Wan Chien	Taiwan	Air	Conventional/ submunitions	150+	2006
Storm Shadow	United Kingdom	Air	Conventional/ penetrator	300+	2003

Note: All ranges are approximate and represent the range of the missile only. The effective system range may be greatly increased by the range of the launch platform.
*The Black Shaheen is an export version of the SCALP-EG.

A Tornado tests the French APACHE cruise missile.

Chinese YJ-63 cruise missile is carried by the H6 bomber aircraft.

South African MUPSOW Cruise Missile Dropped from a Cheetah D Aircraft

Rafale with APACHE Cruise Missile

The Black Shaheen is an export version of the French SCALP-EG cruise missile.

KEPD-350 in Foreground; Storm Shadow in Background

Brahmos-A Indian/Russian Cruise Missile

Pakistani Babur Cruise Missile Launch

Wan Chien Taiwan Cruise Missile on Taiwan Indigenous Defense Fighter

Summary

Ballistic missiles are already in widespread use and will continue to increase in number and variety. The availability of weapons of mass destruction for use on ballistic missiles vastly increases the significance of this threat.

Despite an ongoing reduction in the size of the Russian strategic missile force, Russia probably will retain the largest force of strategic ballistic missiles outside the United States. The development of new ballistic missile systems (i.e., the road-mobile SS-27 ICBM and the Sineva and Bulava-30 SLBMs) is a high priority for Russia. President Putin and other Russian officials have claimed that a new class of hypersonic vehicle is being developed to allow Russian strategic missiles to penetrate missile defense systems. Russia is also offering the advanced new Iskander-E SRBM for export.

China is capable of producing technologically advanced ballistic missiles and has sold ballistic missile technology to other countries. China has an extensive theater missile program and has deployed a large force of ballistic missiles in the vicinity of Taiwan. China can already target the United States with a relatively small force of liquid-propellant ICBMs, and China's ICBM force will grow considerably. The DF-31 ICBM has been flight-tested and probably will be deployed soon. The DF-31A ICBM, which will have a longer range than the DF-31, and the JL-2 SLBM are in development.

North Korea is continuing the development of the Taepo Dong 2 ICBM and has a new IRBM in development. Any North Korean ballistic missiles may be exported to other countries in the future. With continued foreign assistance, Iran also could have an ICBM capable of reaching the United States by 2015.

Proliferation of LACMs will expand in the next decade. At least nine countries will be involved in producing these weapons. The majority of new LACMs will be very accurate, conventionally armed, and available for export. The high accuracy of many LACMs will allow them to inflict serious damage on important targets, even when the missiles are armed only with conventional warheads. US defense systems could be severely stressed by low-flying stealthy cruise missiles that can simultaneously attack a target from several directions.

Ballistic and cruise missiles, with their relatively low operating costs, their high probability of penetrating existing defense systems, and their value as a symbol of national power, will continue to be the offensive weapons of choice for many nations. As such, they are threats that must be carefully considered in future military planning and operations.

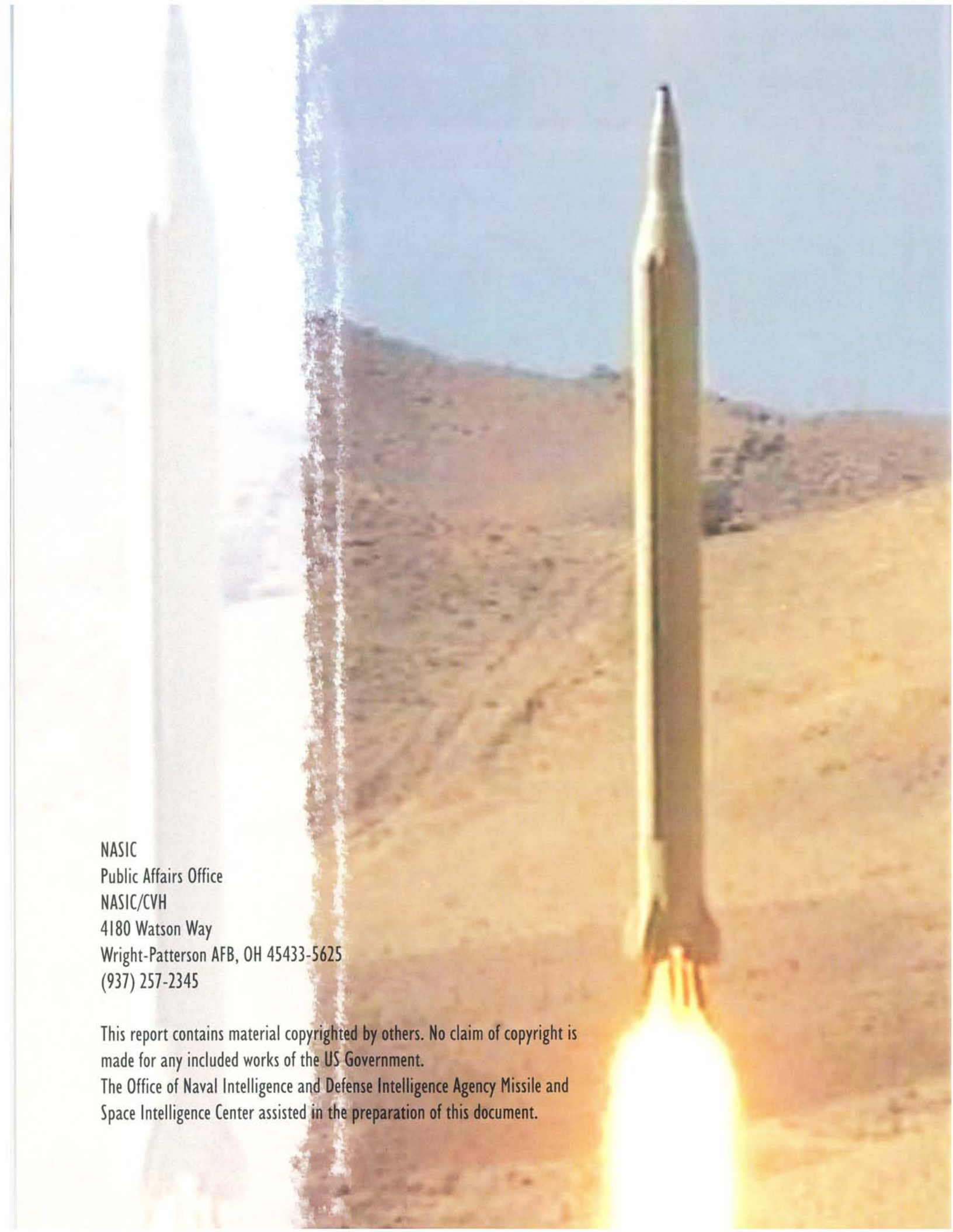
Agni II MRBM

New Chinese DF-31 ICBM in Flight

Russian Road-Mobile SS-27 ICBM on its Transporter-Erector-Launcher

Chinese Road-Mobile Missiles (left to right) CSS-5 MRBM (missile is inside canister), CSS-7 SRBM, and CSS-6 SRBM

Back cover photo: Iranian Shahab 3 MRBM



NASIC
Public Affairs Office
NASIC/CVH
4180 Watson Way
Wright-Patterson AFB, OH 45433-5625
(937) 257-2345

The Office of Naval Intelligence and Defense Intelligence Agency Missile and Space Intelligence Center assisted in the preparation of this document.