

Iran and its Regional Environment

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- **Missiles**
- **Weapons of mass destruction**
- **Ballistic missile defense**
- **Conclusion and recommendation**

**The Nuclearization of the Broader Middle East as a Challenge for
Transatlantic Policy Coordination
Panel 1**

Second Transatlantic Conference, Berlin, March 27, 2006

Analysis Background

- **Many articles/studies/intelligence reports on Iran's missiles and WMD capabilities and situation**
 - **Mostly politically oriented**
 - **Often driven by estimates**
 - **Growing capability due to circle citation**
 - **Limited sensible technical data**
- **Detailed technical analysis required for sensible result**
 - **Missiles**
 - **WMD**
 - **Ballistic missile defense**

Iran's Medium-Range Missile Activities

- **Min. range requirement app. 1.300 km**
 - **Min. distance Iran – Israel 1.000 km**
 - **AWACS viewing distance app. 300 km**
- **Different realization routes**
 - **Cruise missile procurement**
 - **Ballistic missiles**
 - **Indigenous activities for solid system**
 - **Liquid missiles**
 - **Starting point Shahab 3**
 - **Various missile types**
- **Activity scope indication for national significance**

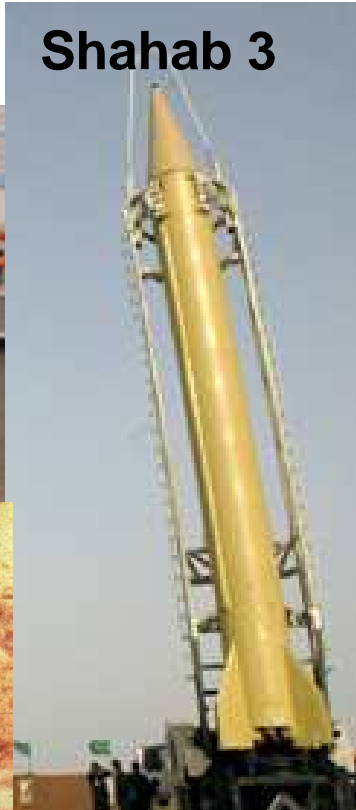
Iran's Medium-Range Missiles



AS 15 Kent



Fateh 110

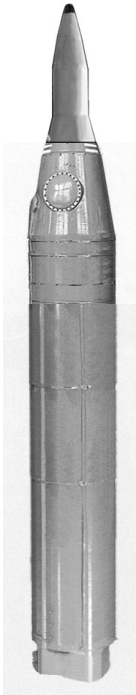


Shahab 3



improved Shahab 3

Mod R-27K (SSN6)



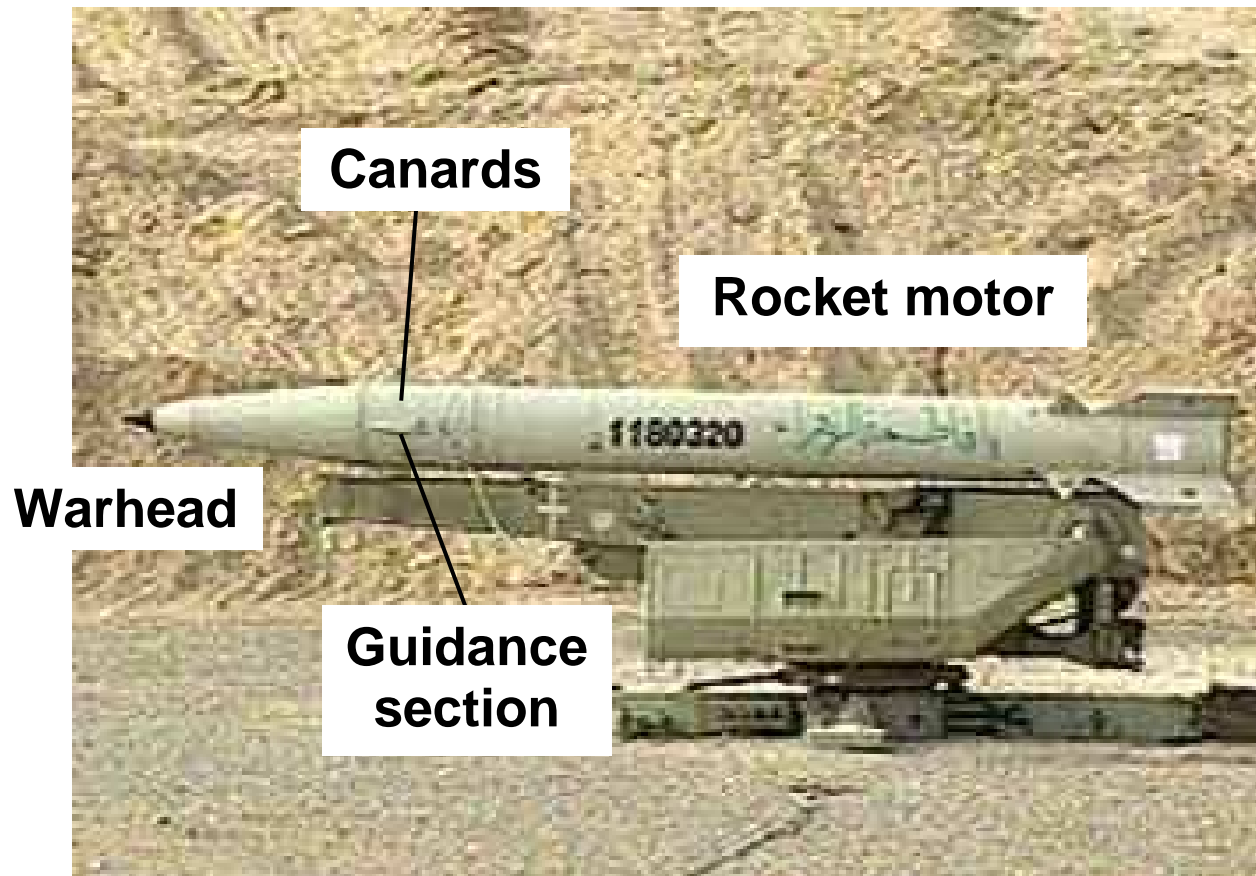
AS-15 Kent/Kh-55

- **Missile technical characteristics**
 - **Soviet land-attack cruise missile of the 70s**
 - **Range app. 2.500 km**
 - **TERCOM navigation system**
- **Significance for Iran**
 - **12 missiles procured from Ukraine**
 - **System obviously important for Iran**
 - **Small payload mass/compartment dimensions**
 - **Military value (at present) limited**
 - **Possibly support from PRC**
 - **Prospects/purpose unclear – weapon trade?**

Indigenous Solid Ballistic Missile Activities

- **Missiles w solid propulsion**
main topic for long-term indigenous activities
 - **National rocket motors manufacturing**
 - **Support mainly by PR China**
 - **Guidance (strap down) procurement**
 - **Support for solid propulsion**
- **Procedure**
 - **Starting point large size artillery rockets**
 - **Fateh 110 A 1st step towards guided missile**
 - **Gradual dimension/complexity increase**
- **Solid missile activity metric for national capability**

Iran's Fateh 110



Characteristics of Fateh 110 A

- **Artillery rocket based on Iran's Zelzal 2**
- **Simple system**
- **Technical characteristics**
 - **0,61 m diameter**
 - **Launch stabilization w canards**
 - **No thrust vector control/thrust termination**
 - **No ATACMS guidance principle**
- **Activity results**
 - **Many tests in few years**
 - **Operational status unclear**

Fateh's Gyro

- **Product of Iran's AIO**
- **Single DOF gyro**
- **Driven by high pressure gas – 30 s operation time**
- **Not applicable for guided missiles**
- **Indicative for Iran's present (2006) maximum guidance capability**



Shahab 3



Shahab 3 Overall Program

- **1st test July 1998**
- **App. 10 launches (early 2006)**
 - **Typically 1 to 2 launches/year**
 - **Apparently some malfunctions (app. 30 %)**
 - **Different configurations**
 - **(possible program support by Pakistan**
 - **6 launches w/o obvious malfunctions**
 - **2 payload configurations)**

Iran's Shahab 3 Statements

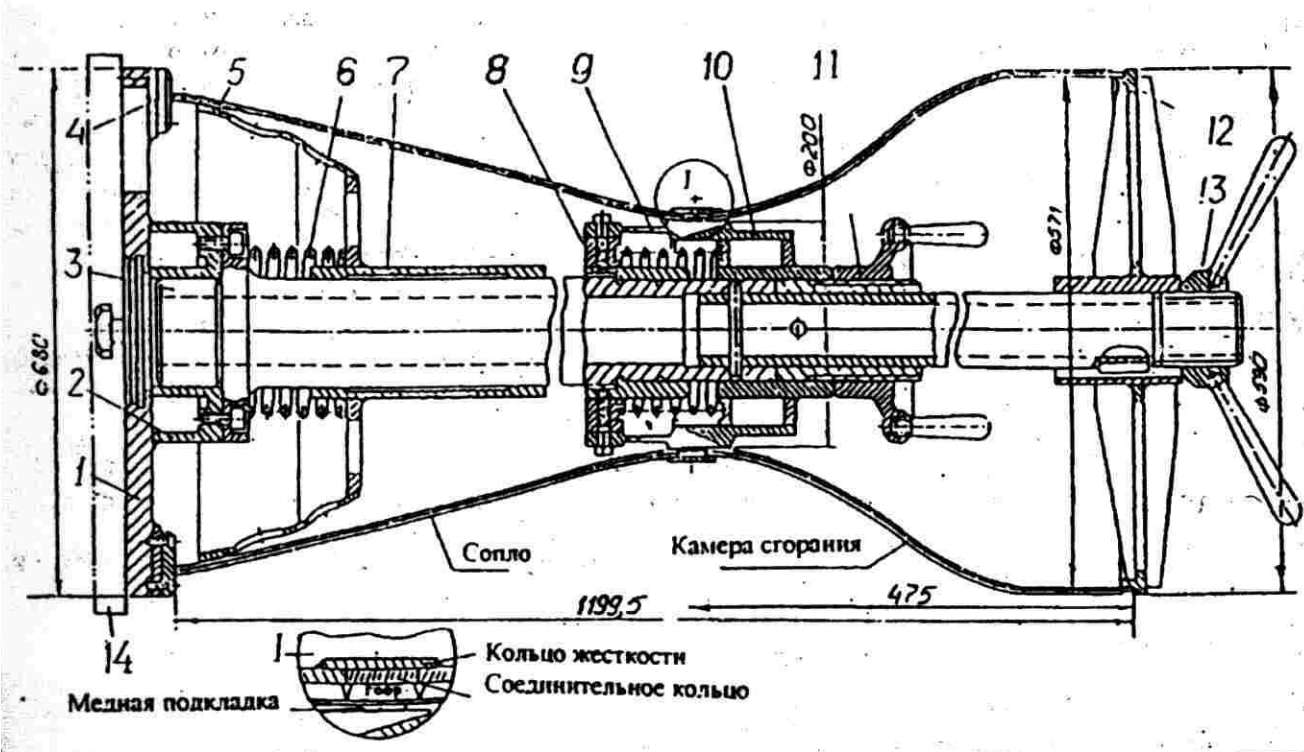
- **Iranian government**
 - **Shahab 3 result of indigenous activity**
 - **Development completion (2003)**
 - **Mass production start (2003)**
 - **Deployment w armed forces (2003)**
 - **Program start for system improvement (2004)**
 - **Completion of improvement program (2004)**
 - **Continuation w solid propulsion configuration**
- **Government announcements not consistent w observed activities/results**

Shahab 3 Characteristics

- **Soviet missiles of the early/mid 50s**
 - **Technical details as of early/mid 50s**
 - **OTR 22 performance class**
 - **Liquid missile w storable propellants**
- **Development not completed**
 - **Reason unknown**
 - **Possible bottlenecks accuracy, ...**
- **Shahab 3/Ghauri/Nodong identical**
- **No modified missiles (except for payload mass) – no Nodong 2, Ghauri 2/3, ...**

Shahab 3 Engine

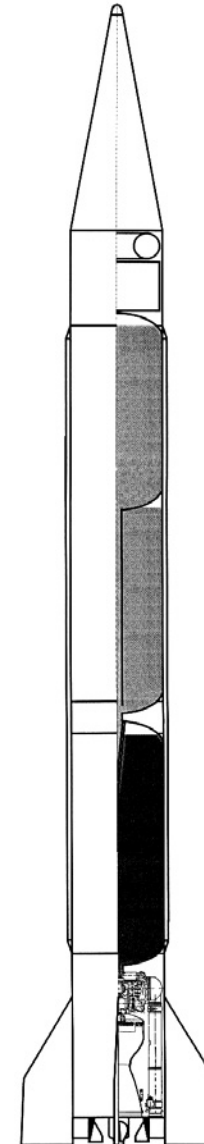
(Source: Russian Rocket Production Textbook)



Shahab 3 Data

- **Substantial information available (Iran, Pak, NK)**
- **Design concept**
 - **No scaled R-17/Scud B**
 - **Internal profile corresponding to R-12**
 - **Characteristic Soviet missile parameters**
- **Technical data**
 - **Overall mass 15,5 t**
 - **Max. range app. 820 km/1,3 t – (1.100 km/0,7 t)**
 - **No 1.300 km/sensible payload capability**
 - **Limited accuracy**

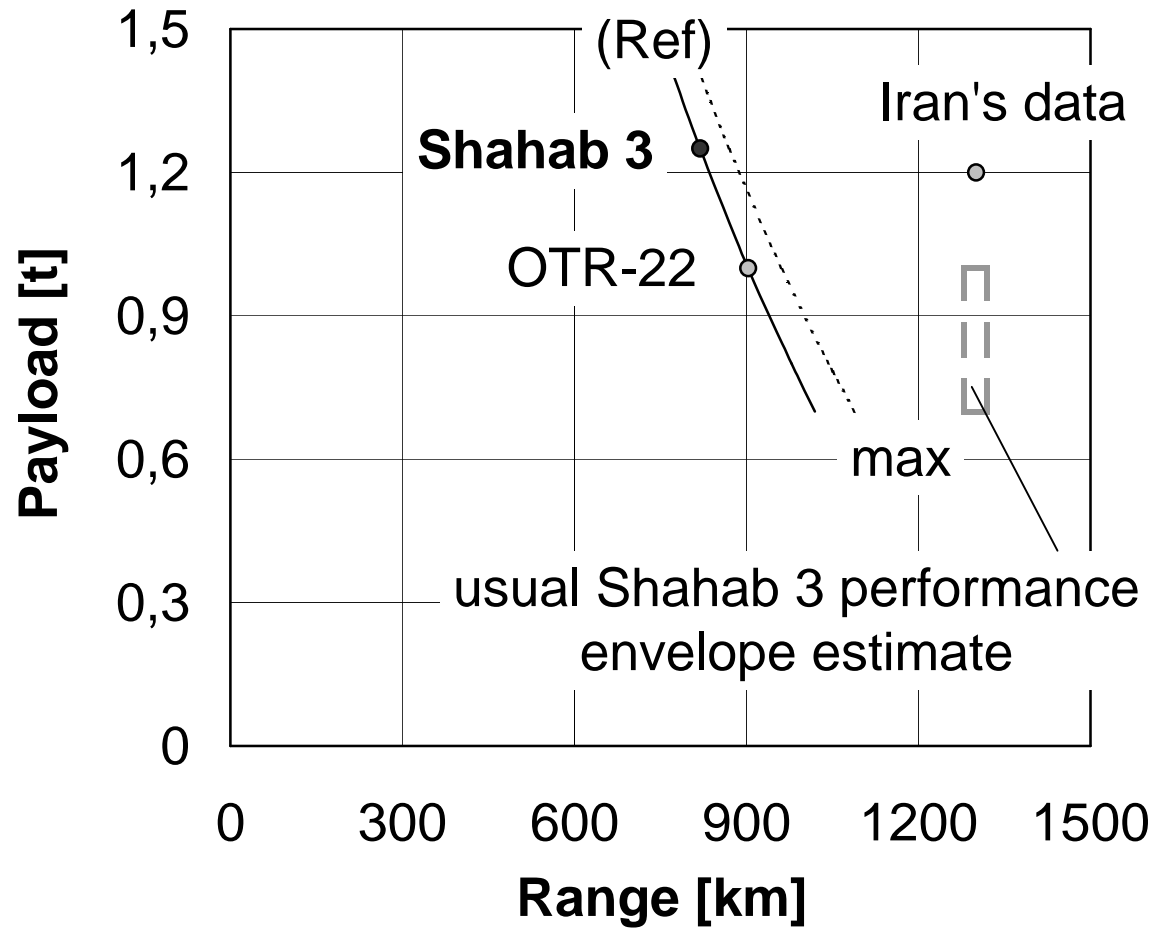
Shahab 3 – Reconstructed Internal Profile



Shahab 3, Soviet Missiles and Scud B Characteristic Parameters Comparison

	1950s Soviet missiles	Shahab 3	Scud B
Propellants	IRFNA/Kerosene		
Oxidizer tank position	front		back
Warhead type	separated		non-sep.
Initial accel. [g]	1,8		2,3
Chamber pressure [MPa]	5,5		6,8
Expansion ratio	9,3		10,2
Payload [t]	1,3		1

Shahab 3 Throw Weight Performance



Shahab 3 Situation – contd.

- **Iran's Shahab 3 production situation**
 - **No indigenous production of complete missiles**
 - **Missile procurement from Russia via North Korea**
 - **Complete systems – number limited**
 - **Critical components (engine, ...)**
 - **(North Korea's contribution limited to air frame production/assembly)**
 - **Network for component supply from non-Russian/non-North Korean sources**
 - **Training by Russian experts**

Shahab 3 Situation – concluded

- **Missile presentation at September parades**
 - **Up to 6 missiles (max)**
 - **Probably no life system – mock-ups**
 - **Different MEL – modified oil equipment**
- **Small number of Shahab 3 missiles available**
- **Probably not deployed w armed forces**
- **Shahab 3 at present not usable for sensible offensive operation**
 - **Missile's operational status questionable**
 - **No proven reliability**
 - **Insufficient range**

Iran's MEL for Shahab 3



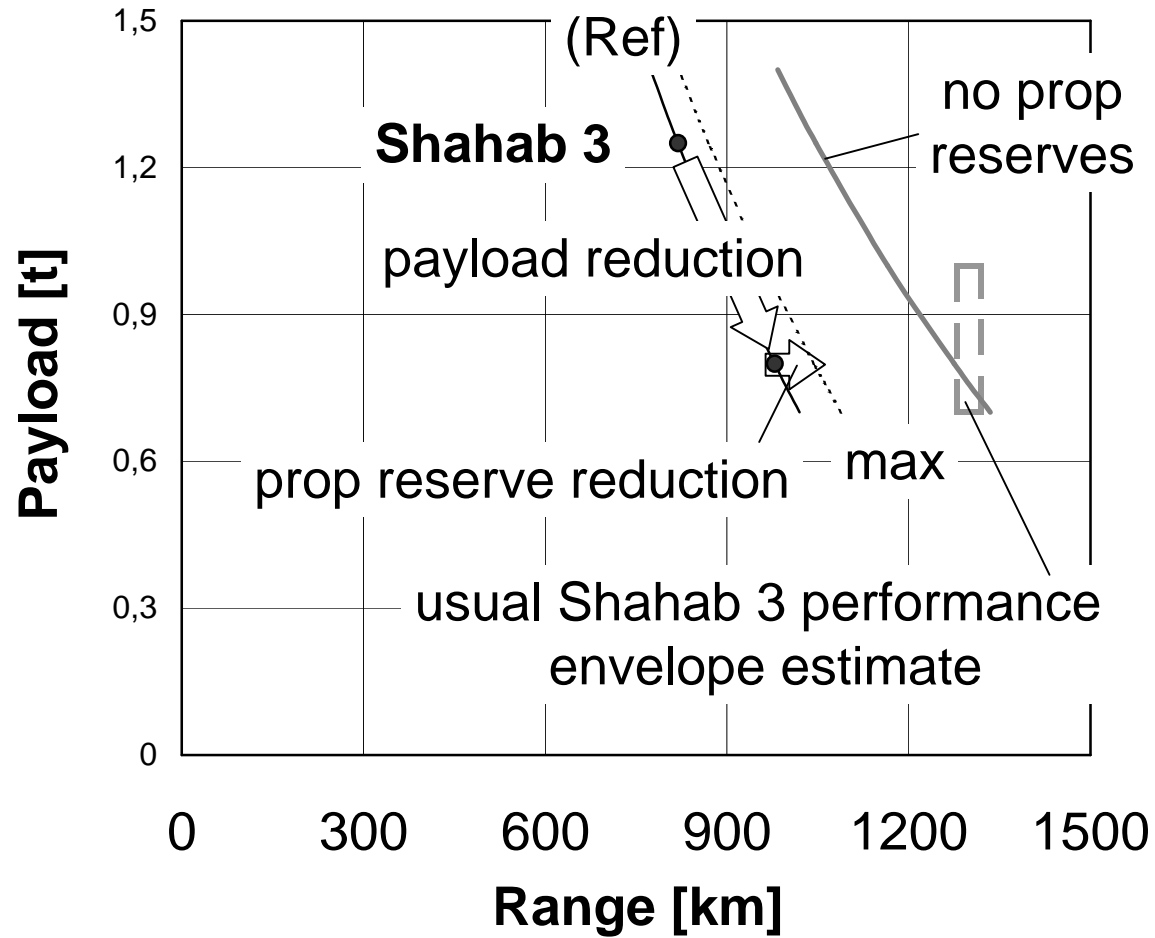
Iran's Shahab 3 Erector Front End Designs



Shahab 3 Range Increase

- **Burn time extension (propellant reserve reduction)**
 - **Test 1998**
 - **Malfunction**
- **Payload reduction**
 - **1,3 t (design mass) to app. 0,8 t**
 - **CG-shift required – payload adapter ring**
 - **Max. range app. 1.000 – 1.100 km**
 - **Not sufficient for specific Iranian purpose**
- **Alternative solution required**

Shahab 3 Range Potential



Alternative Routes

- **Taepodong 1 – North Korean offer**
- **Shahab 3 improvement**
- **New (already proven) missile**

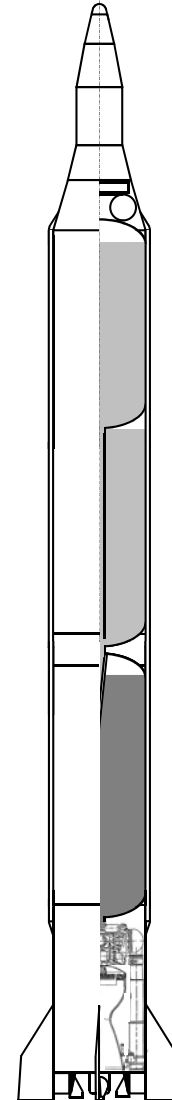
Taepodong 1

- **Shahab 3 range increase w 2nd stage**
 - **1st stage Shahab 3**
 - **2nd stage Scud D type w significant modifications**
 - **Guidance**
 - **Vernier system**
- **North Korean offer – flight demonstration 1998**
- **Old Soviet design**
 - **Basis R-55 – R-5/R-11**
 - **Status unknown – probably not beyond demo**
- **TP 1 not accepted by Iran – many bottlenecks**

Improved Shahab 3



Improved Shahab 3 – Reconstructed Internal Profile



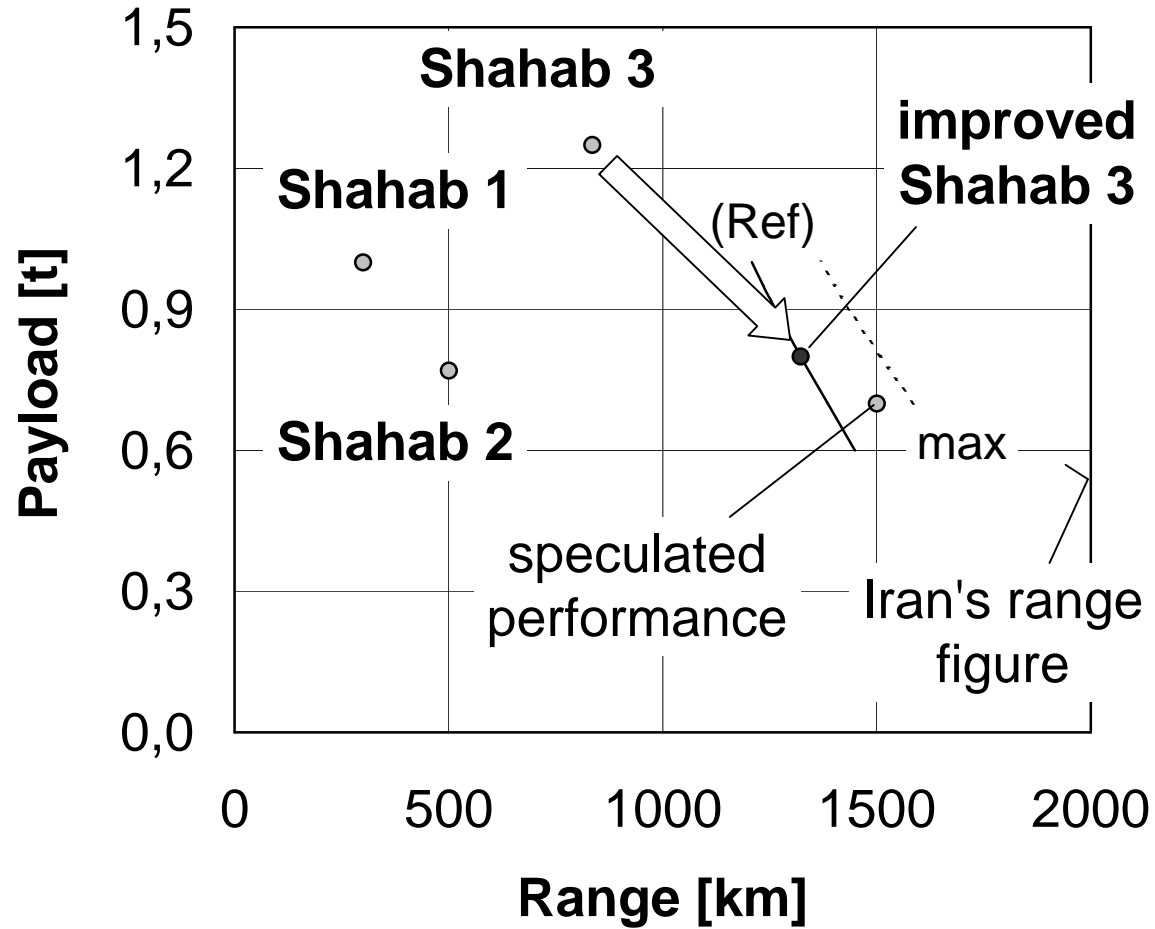
Shahab 3 Improvement Means

- **Burn out mass reduction decisive – difficult to accomplish**
 - **Light-weight (aluminum) air-frame design**
 - **Light-weight guidance**
 - **Payload mass reduction – less stable configuration**
 - **Possibly propellant residuals/reserves reduction**
- **Increased propellant load – burn time extension**
 - **Simple to accomplish**
 - **Minor effect**
- **Engine modification – no sensible procedure!**

Improved Shahab 3 Data

- **Extremely limited (unclassified) scope of information**
 - **Mainly photos, videos**
 - **No reliable information on range, payload**
 - **Problems w system parameter definition**
- **Reconstructed data**
 - **Overall mass app. 15,5 t**
 - **Max. range app. 1.500 km/0,8 t payload**
 - **Large uncertainty margin for payload**
 - **Small propellant reserves**
- **2.000 km range well beyond missile capability**

Improved Shahab 3 Performance



Present Situation w Improved Shahab 3

- **Two tests in 2004**
 - **August – malfunction (stability ?)**
 - **October**
 - **Modification likely**
 - **apparently successful – app. 1.500 km range**
- **No information on tests in 2005 and 2006**
- **Missile displays (September 2004 and 2005)**
 - **3 different versions – fins, length, cable, ...**
 - **Obviously mock-ups**
 - **Purposely – falsely arranged**
- **Further tests required for program completion**

Improved Shahab 3 Front Sections

September 2004

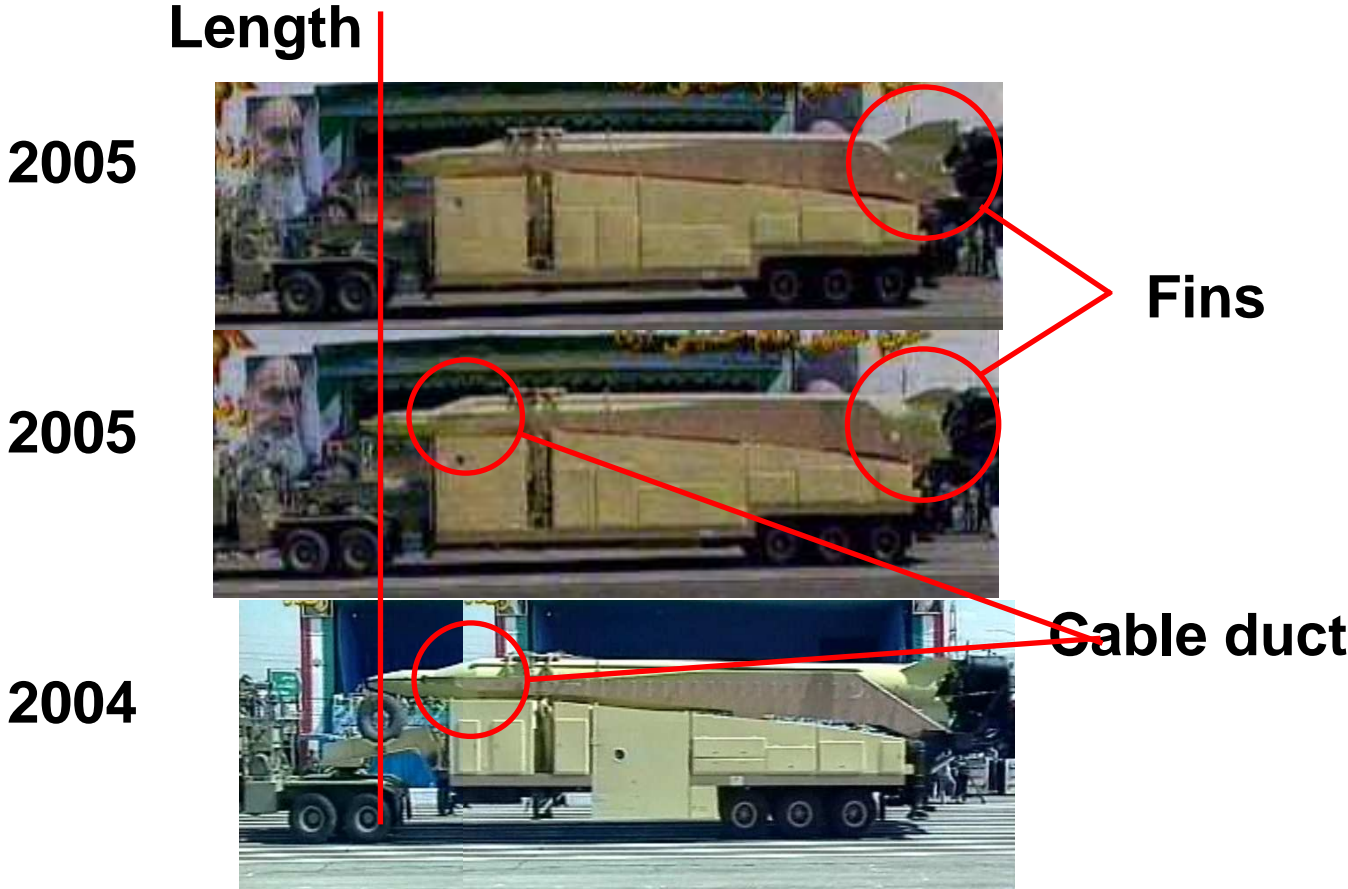


September 2005



Cable duct position

Improved Shahab 3 Missile Configurations



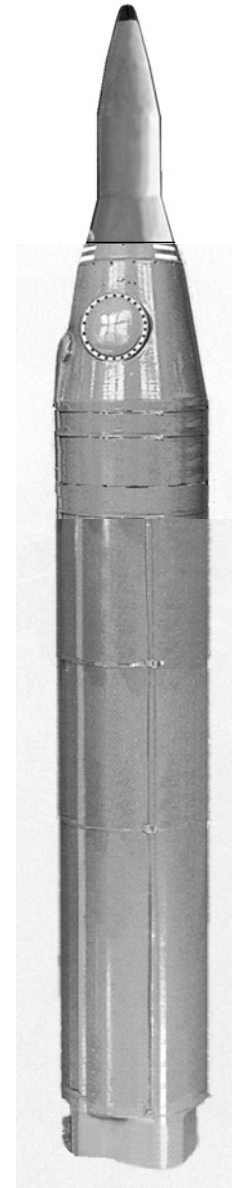
Probable Origin of Improved Shahab 3

- **Missile beyond Iran's indigenous capabilities – significant technical improvement**
 - **New tank design/material**
 - **New guidance**
 - **Extremely limited net mass margin – risky program**
- **Possible/likely background**
 - **Source/support SU/Russia – PR China not likely**
 - **Previous technology program (e.g. R-21, R-27, ...)**
 - **Russian design support**
 - **Supply of critical components (new guidance)**
 - **Manufacturing support**

Remarks on Improved Shahab 3 Accuracy

- **Missile/RV technical characteristics**
 - **No vernier system**
 - **No active trajectory control after cut-off**
 - **No terminal guidance**
 - **PR China standard strap-down system very likely**
- **Accuracy assessment**
 - **CEP app. 3 km**
 - **Max. deviation app. 11 km – decisive parameter**
- **Excessive for practical use**

Modified R-27 (SSN6) – Reconstructed Configuration



Modified R-27 (SSN6) Characteristics – contd.

- **Baseline system R-27**
 - **SSN-system of the 60s**
 - **START/INF-treaty – elimination**
- **R-27K missile probably not considered by treaties**
- **Technical aspects**
 - **2-stage system**
 - **Simple terminal guidance**
 - **Range 900 km**
- **Modified for competing w Pershing 2 design**
 - **App. 12 m length for propellant mass increase**
 - **Land-based version (propellant)**
 - **Range in excess of 1.500 km**

Modified R-27 (SSN6) Characteristics – concluded

- **Limited systems number available in Russia**
- **Iran's procurement via North Korea**
 - **No North Korean contribution**
 - **18 systems procured by Iran**
 - **Status unknown**
 - **MEL type unknown**
 - **No missile production in Iran**
 - **No missile modification in Iran**

Iran's Present Missile Situation

- **Proliferation/foreign support decisive instrument**
- **Important (liquid) missiles from foreign sources**
- **National capabilities still insufficient**
 - **No indigenous liquid system development**
 - **No Shahab series production – false official statements**
 - **Engine/guidance beyond present Iran's capability**
 - **Critical components proliferation**
 - **Probably air-frame production/missile assembly**
 - **Situation comparable to that of Iraq (80s and 90s)**
- **Intensive efforts for long-term autonomy**
- **Indigenous activities concentrated on solid missiles**

Iran's Present Medium-Range Missile Capability

- **Medium-range missile number at present small**
- **Operational capability unclear – probably nil**
- **Program number**
 - **5 different routes – indication for**
 - **national importance**
 - **realization problems**
 - **Usual 3rd World approach**
- **No immediate threat**
- **Some years allowance for counteractive measures**

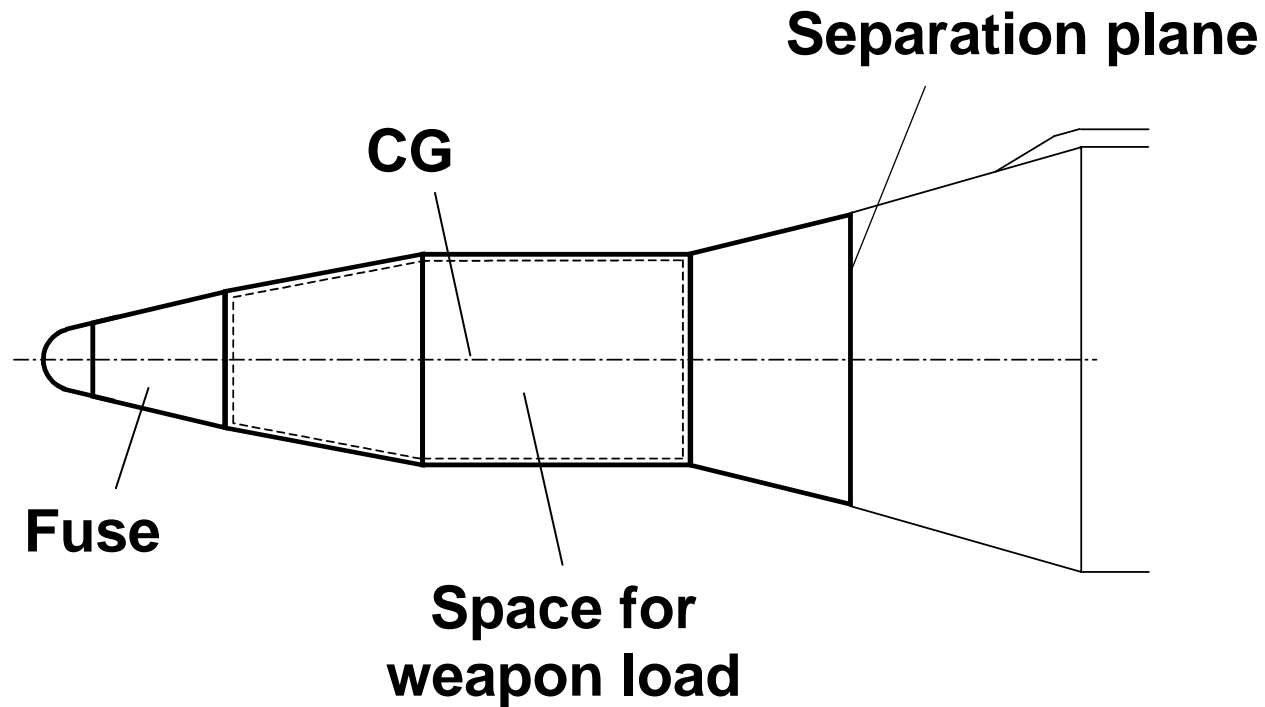
Iran's Probable Future Missile Situation

- **Iran's objective – indigenous missile capability**
- **Extreme challenge – limited resources (key aspect)**
- **Significant dependence on proliferation/support**
- **Technical side**
 - **Liquid missiles important for near/mid-term future**
 - **Long-term objective likely solid missiles**
 - **Cruise missile purpose unknown**
 - **Guidance long-term situation: procurement/license**
- **No indication for sensible long-range missile activity**
- **Time frame for national production**
 - **Proliferation/support decisive factor**
 - **Liquid: 3 - 5+ years; solid: 10+ years**

Iran's WMD Situation

- **Focus on improved Shahab 3 re-entry vehicle (RV)**
 - **Sufficient range**
 - **RV evaluation parameters**
 - **Geometry**
 - **Mass**
 - **Mean density**
 - **Aerodynamics characteristics/CG/RCS**
- **Possible weapon types**
 - **Conventional**
 - **WMD**

Improved Shahab 3 Re-entry Vehicle/Warhead



C/B Weapon Aspects

- **Agent mass limited by small volume (max. 0,3 t)**
- **Unitary C/B load**
 - **Agent degradation at impact**
 - **Limited dispersion**
- **C/B dispersion w submunitions**
 - **App. 50 % agent mass reduction (max. 0,15 t)**
 - **Altitude fuse (radar, laser, ...) etc. required**
- **No sensible military system – terror against unprotected population**
- **Less likely focus**

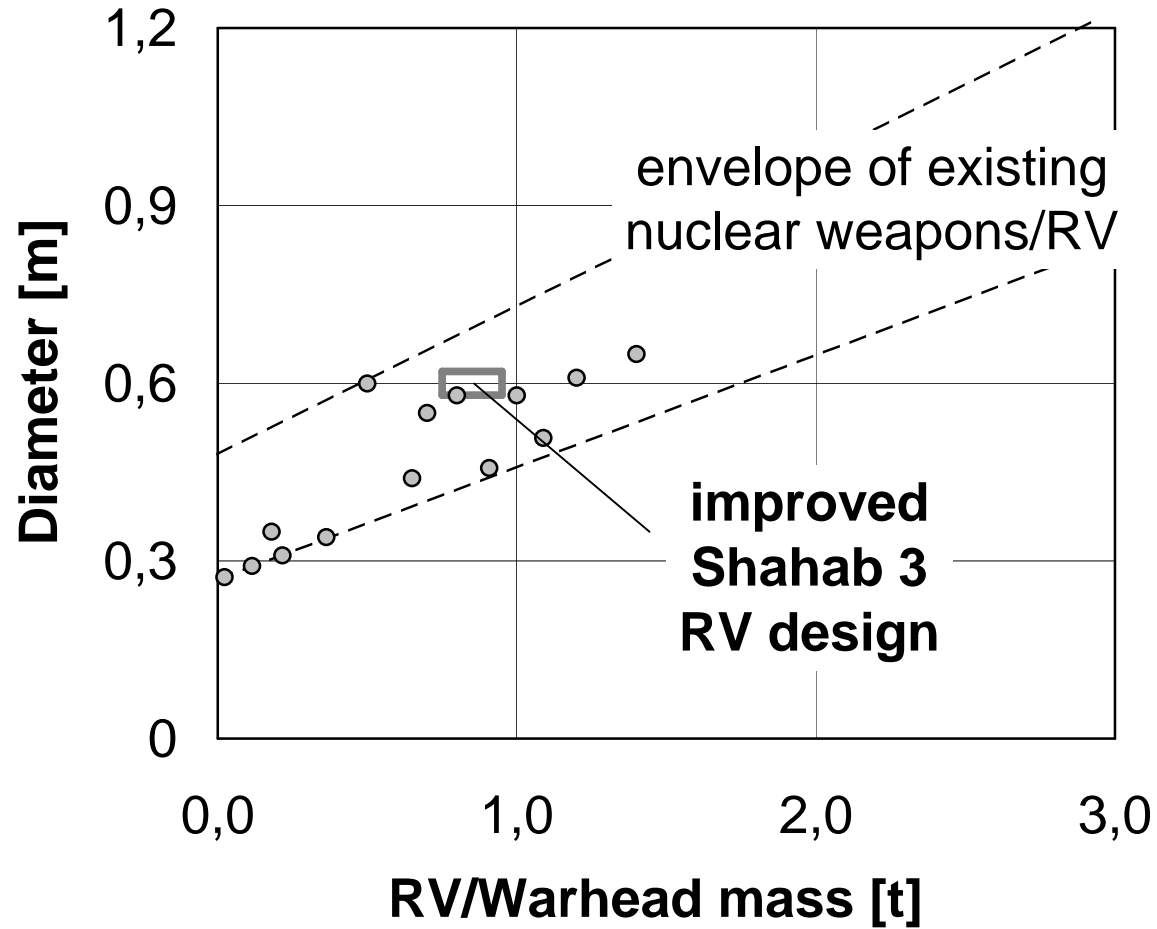
Nuclear Weapon Aspects – contd.

- **Reconstructed RV mass 0,75 – 0,9 t (0,825 t)**
- **Reconstructed weapon mass 0,6 – 0,7 t**
- **Diameter app. 0,6 m**
 - **Improved Shahab 3 RV**
 - **Fateh 110 A**
- **Mass/diameter compatible w implosion design**
 - **Overall conditions similar to nuclear weapons of other non-NPT countries**
 - **Foreign support very likely (Pakistan, ...)**
- **Improved Shahab 3 RV configuration suited for fission design**

Nuclear Weapon Aspects – concluded

- **Likelihood of nuclear weapon program difficult to assess**
 - **Verification at present impossible – just indications**
 - **Realization bottleneck – fissible material (HEU)**
 - **Improved Shahab 3 sensible only w nuclear weapon**
 - **Worst case scenario advisable**

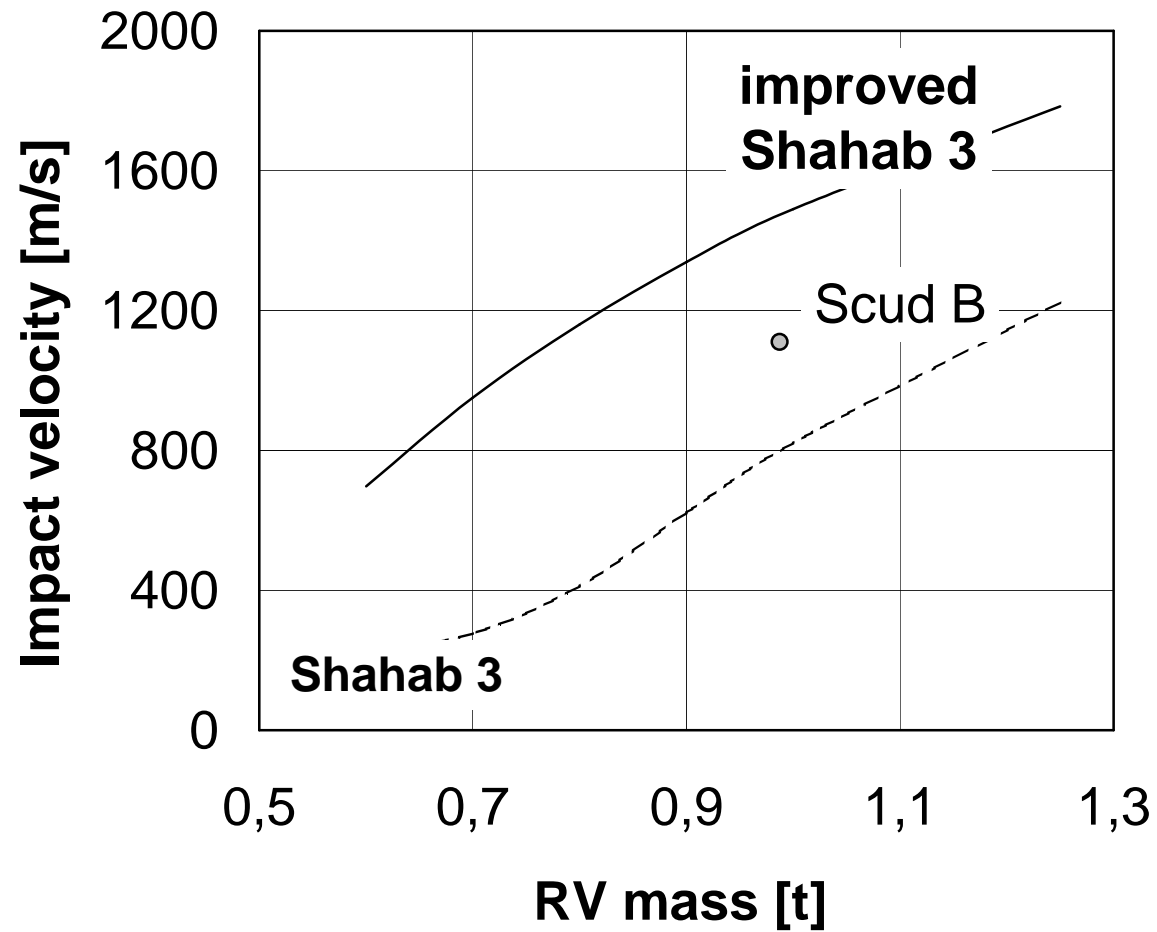
Mass and Diameter of Nuclear Weapons



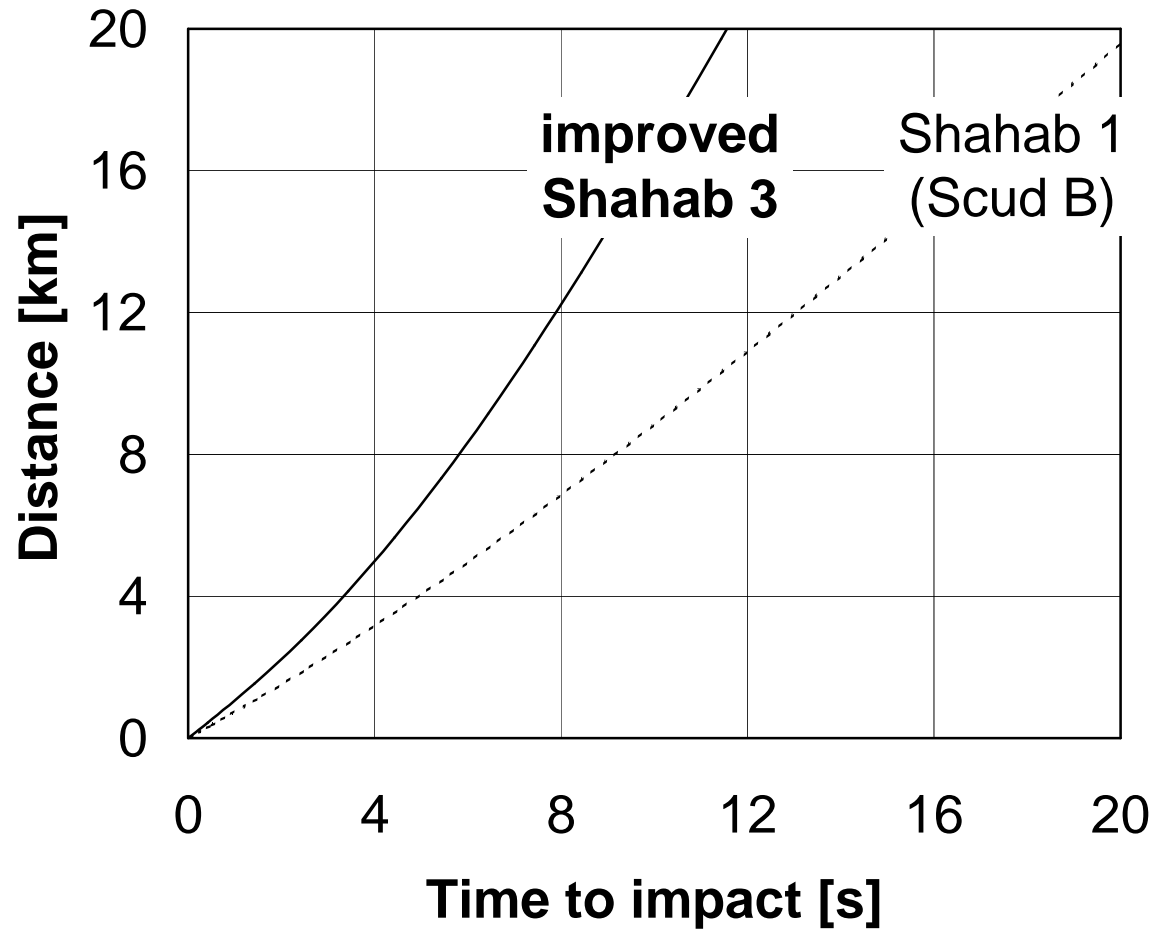
Missile Defense Aspects

- **Launch preparation/active trajectory visibility**
 - **Below visible/AWACS horizon (from Israel)**
 - **Forward (Iraq)/space based sensors required**
- **Max. app. 10 min effective reaction time**
- **Terminal phase**
 - **2 objects (no decoys, ...)**
 - **Missile body – large object**
 - **RV – small size**
 - **RV faster/quicker than Scud B/R-17**
- **Min. missile number for successful surprise attack**

Re-entry Vehicle Impact Speed (1.250 km Range)



Shahab Warhead Target Approach



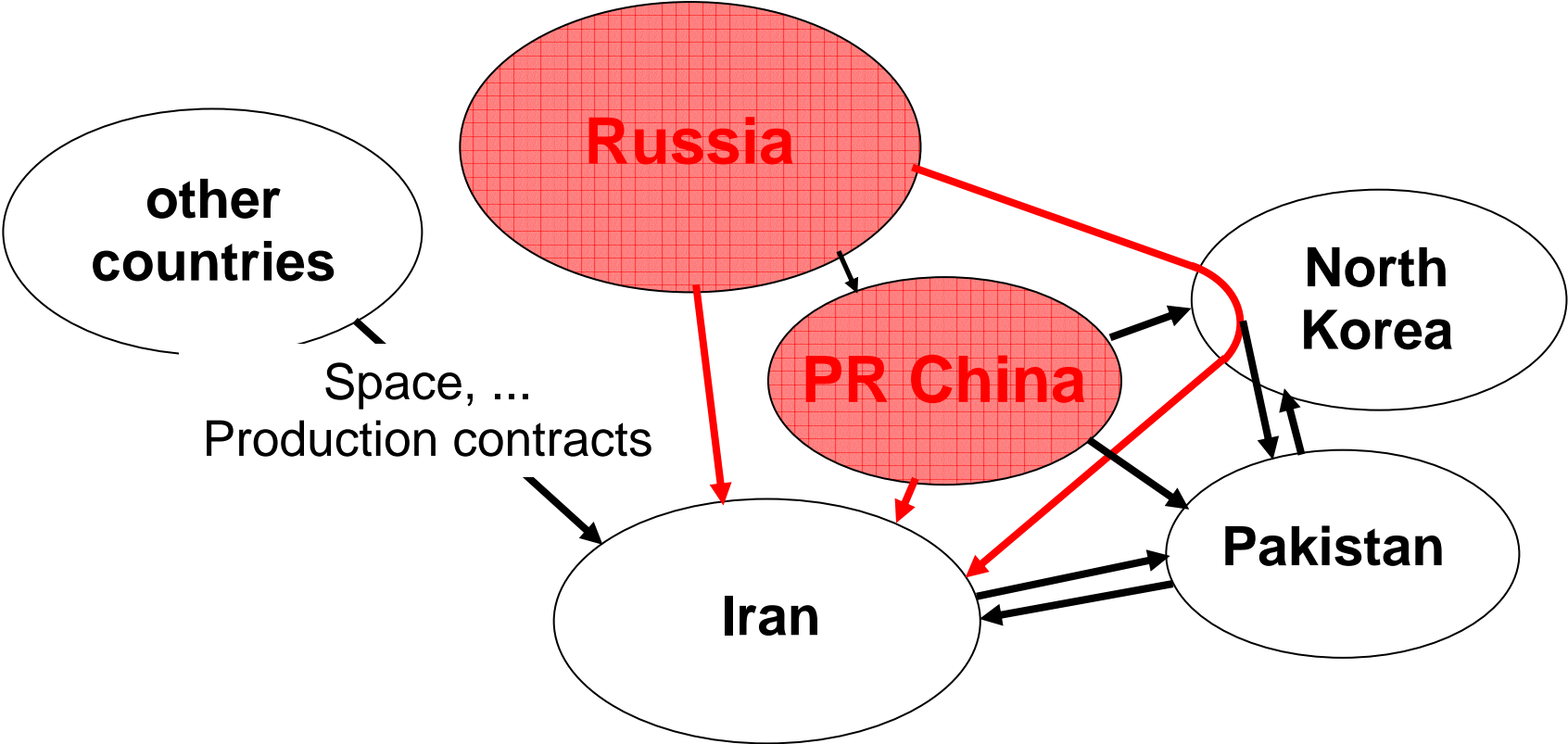
Iran's Nuclear Ambitions Clarification

- **Weapon plus delivery system important**
- **Missile situation evaluation from visible signatures**
 - **Performance**
 - **Status and outlook**
- **Weapon activities w/o significant signature**
- **Threat assessment – 3 aspects of importance**
 - **Delivery systems – massive activities**
 - **Nuclear ambitions – orientation difficult to proof**
 - **Government declarations – little doubtful**
- **Nuclear weapon capability probably Iran's objective**

Conclusion

- **Iran's medium-range missile capability gradually growing**
- **Iran's nuclear capabilities small at present**
- **No immediate threat at present**
 - **Missile operability**
 - **Nuclear warhead – HEU needed**
- **Proliferation decisive for Iran's success**
 - **Iran's situation identical to other 3rd World countries**
 - **Not any 3rd World country successful w/o proliferation**
- **Key supporters (Russia, PR China) UN-SC veto-members**
- **Consistent action for long-term threat elimination success**

Proliferation Routes (UN-SC veto-members)



Recommendation

- **Technical analysis continuation for Iran's missile and WMD activities**
 - **Capabilities**
 - **Progress**
- **Political**
 - **Israel's NATO-membership/...**
 - **Proliferation termination**
 - **Pressure on proliferators/... for support termination**
 - **Pressure on Iran – up to military actions**