RNLA IFV Firepower

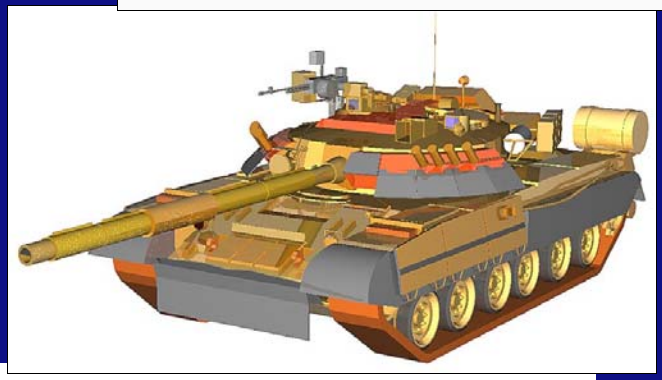
30 mm versus 35 mm

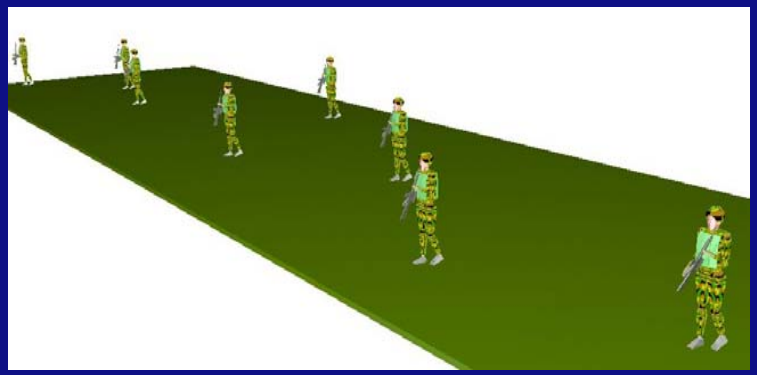
35 mm KETF Firing doctrine

TNO | Knowledge for business

RNLA IFV Firepower

- Ammunition selection & modelling
- Caliber determination : 30 vs. 35 mm
- Ammunition optimization
- Firing doctrine

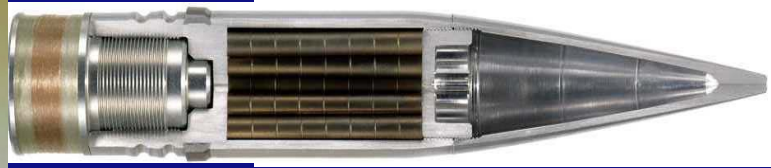


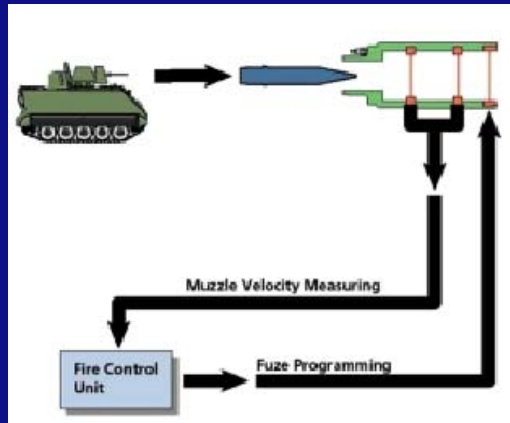


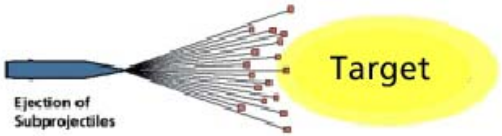
Ammunition selection

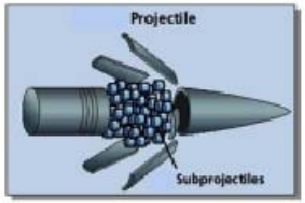
- RFI review

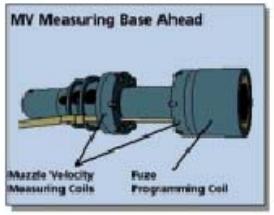
Air Burst Munition
HETF & KETF





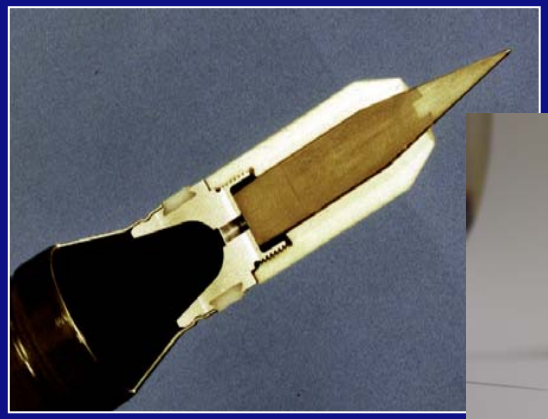




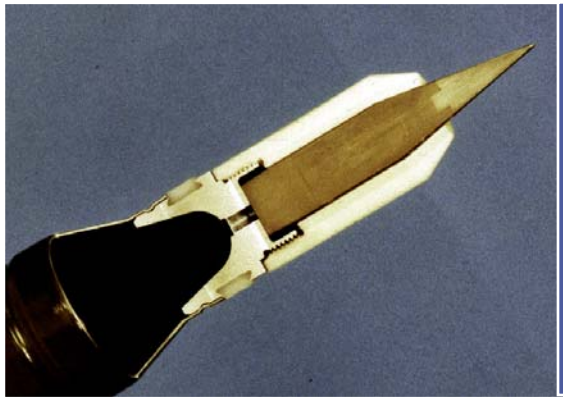


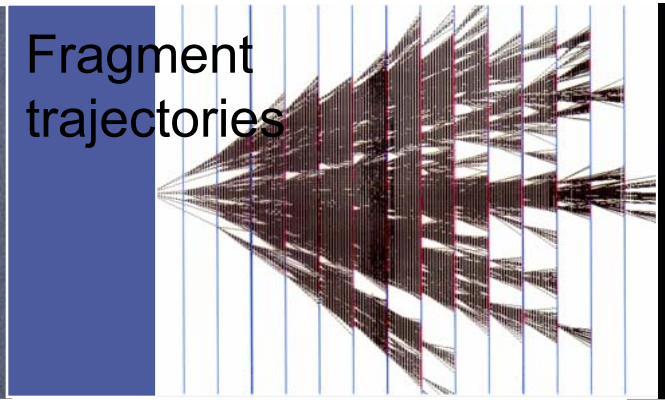
APFSDS

FAPDS/PELE



Frangible ammunition modelling



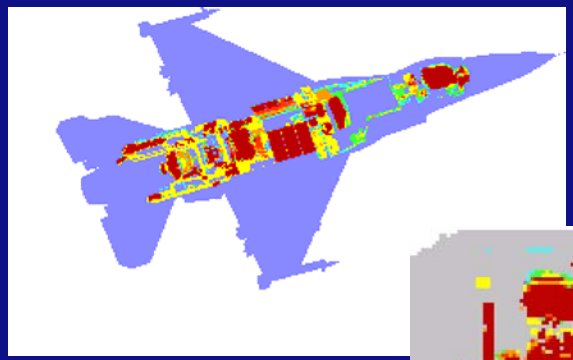


Experimental

- Plate - arrays
- Fragment Simulating Projectiles
- Flash X-ray
- Imax
- Real targets

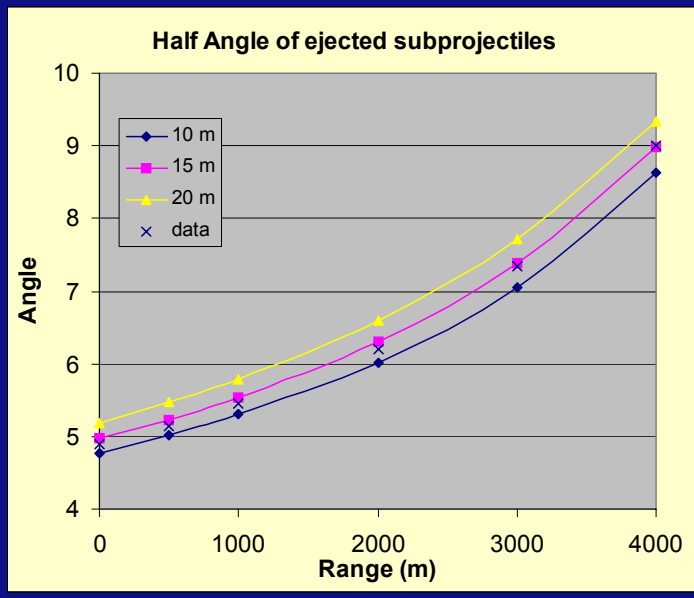
Simulations

- Terminal ballistic model
- Lethality model

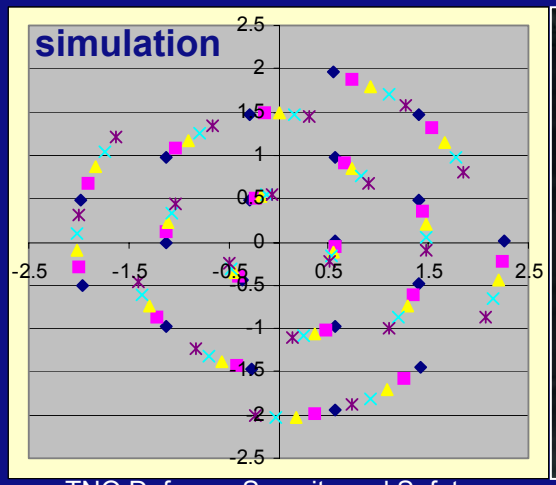


KETF modelling
subprojectile dispersion model

- **Required input:**
  - Ground firing table
  - Projectile spin as a function of the range
  - Shape of subprojectiles, drag

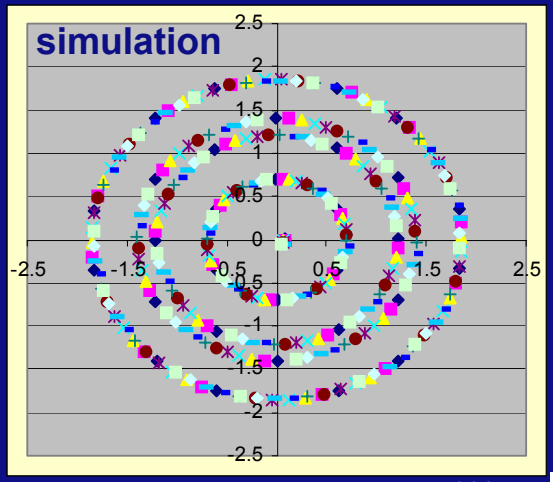


30 mm KETF with 135 subprojectiles of 1.5 gram



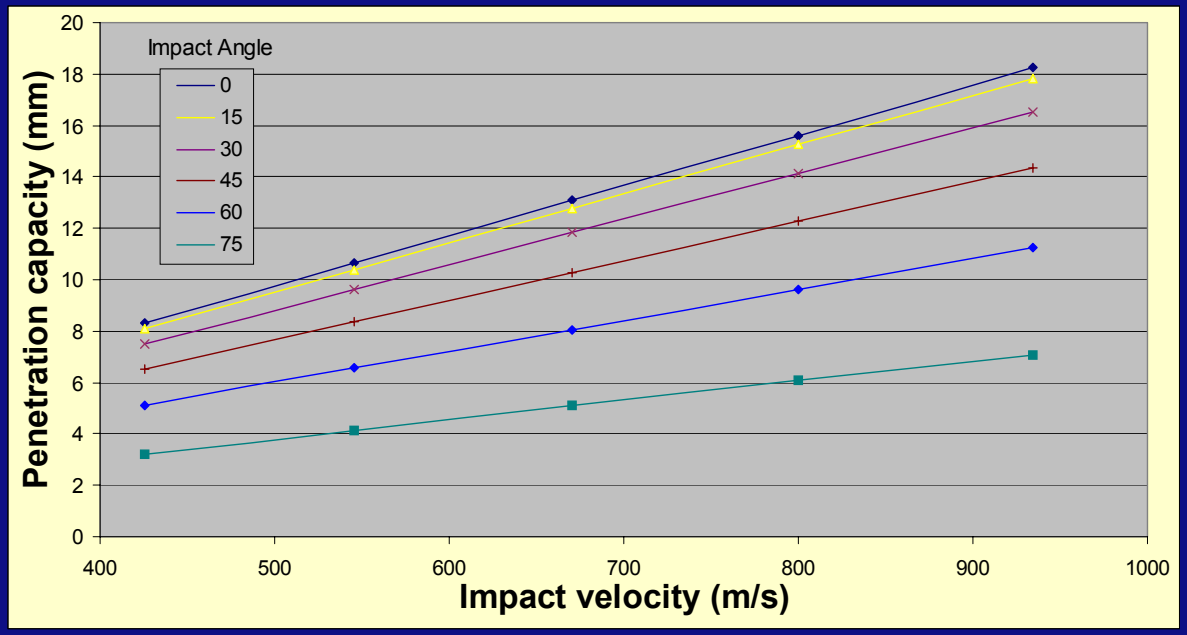
35 mm KETF with 341 subprojectiles of 1.5 gram

Note: this is not the existing 35 mm KETF!



KETF modelling
subprojectile penetration model

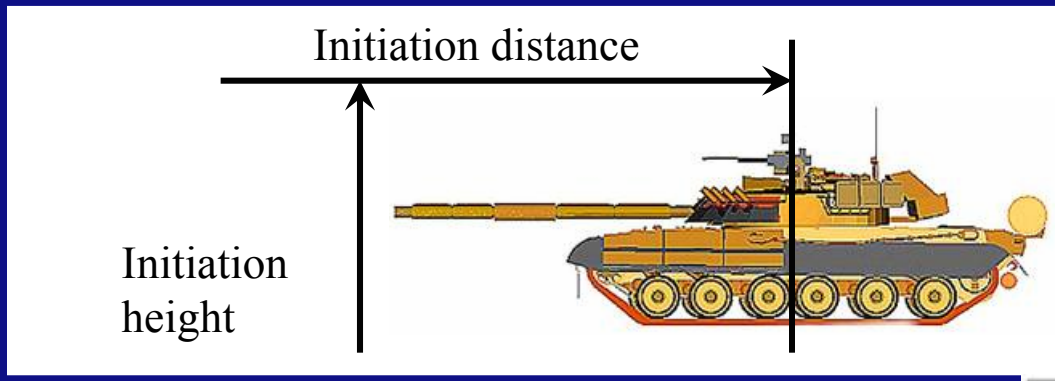
- Penetration capacity in Aluminium of 1.5 gram subprojectile

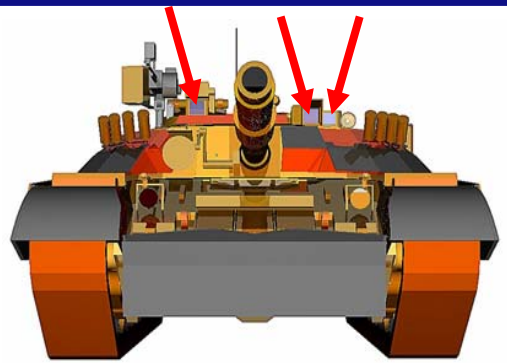


- Penetration capacity in helmets and fragment resistant vests
- Penetration capacity in optical sights

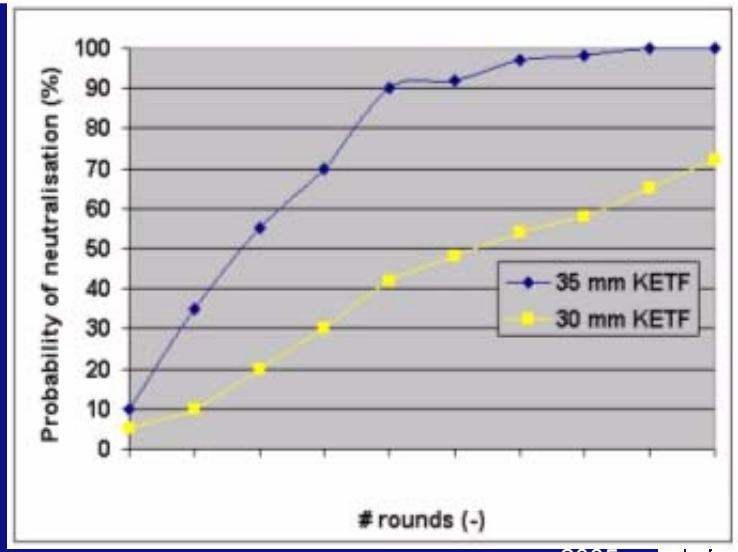
KETF ammunition vs T-80U

- Neutralise T-80U by killing all optical sights as a function of the initiation distance and height and number of fired projectiles





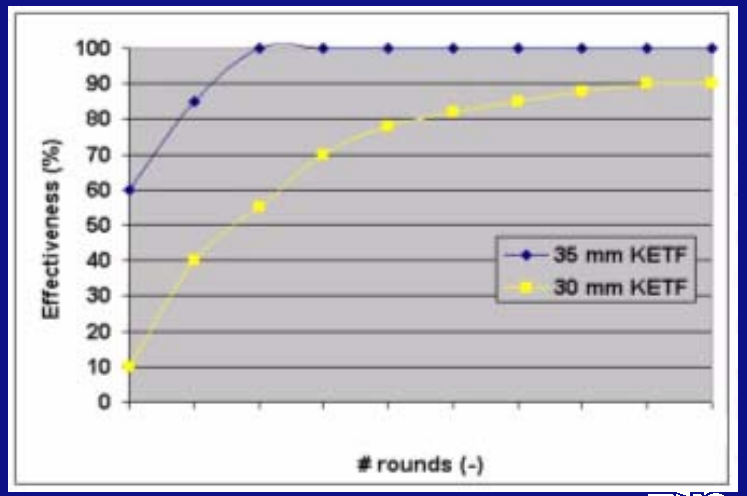
- Conclusion: Compared to the 35 rounds, over twice as much 30 mm rounds have to be used to achieve the same effectiveness explained by the much larger number of subprojectiles



KETF ammunition vs Foxhole

- Kill two men covered Foxhole as a function of the initiation distance and height and number of fired projectiles

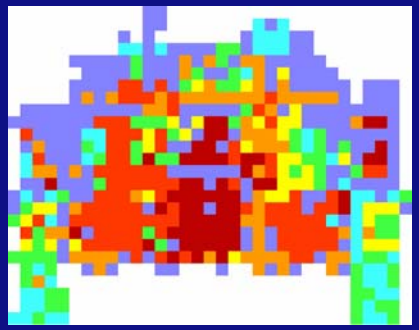
- Conclusion: Compared to the 35 rounds, over twice as much 30 mm rounds have to be used to achieve the same effectiveness explained by the much larger number of subprojectiles



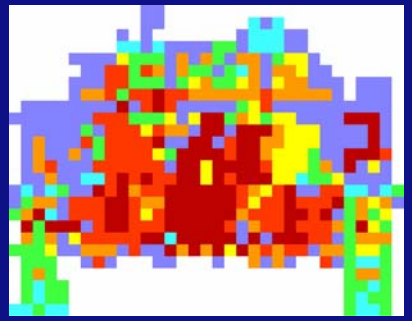
APFSDS ammunition

- BMP-3 (+ add-on armour)
  MorFinC kill
  (TARVAC simulation)

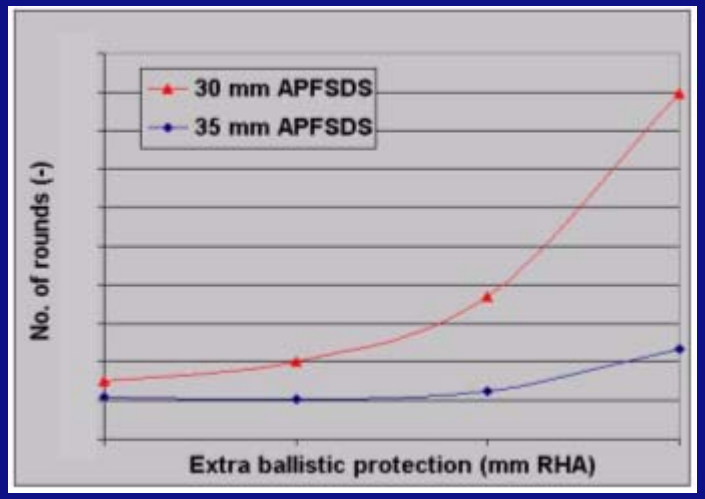
Frontal attack, no add-on armour



30 MM



35 MM



- Conclusion: 30 mm APFSDS is able to perforate the main armour of BMP-3, however with “add-on” armour (BMP-3+) the 30 mm APFSDS is stopped by the armour where the 35 mm APFSDS can easily perforate the armour

Conclusion

- Based on requirements, effectiveness results, logistics, etc …… the RNLA selected the 35 mm caliber for the new Infantry Fighting Vehicle

- Next step:
  - KETF Ammunition optimization against infantry soldiers
  - KETF Firing doctrine against:
    - T-80U
    - Mi-24 Hind
    - Foxhole
    - Dismounted soldiers

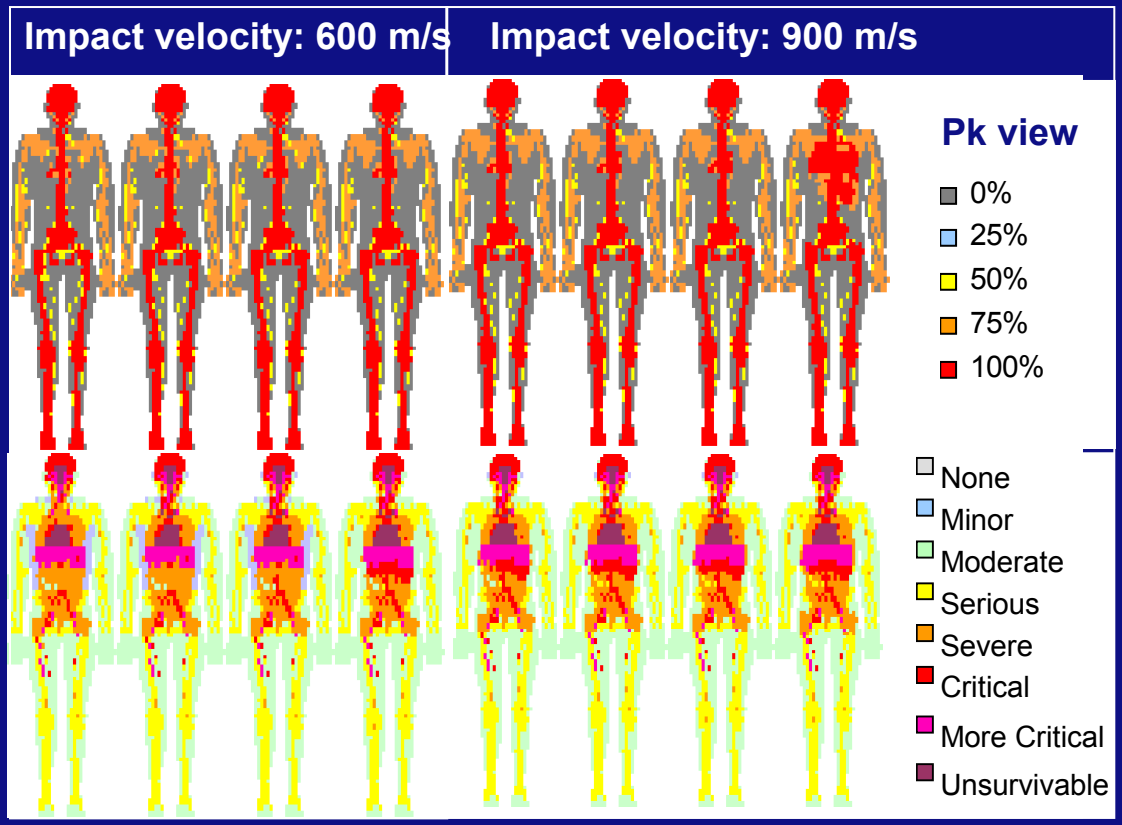
ABM subprojectile lethality

- Standing soldier, including helmet and vest, 30. sec assault
- Ballistic protection is based on experimental data

- Fixed total payload mass: heavier subprojectiles results in smaller density of fragment cloud
- TNO requested to find most optimal solution

- Result: 35 mm KETF prototype is redesigned by manufacturer on request of RNLA -> subprojectile mass: 1.24 gram

Increasing Subprojectile mass ->



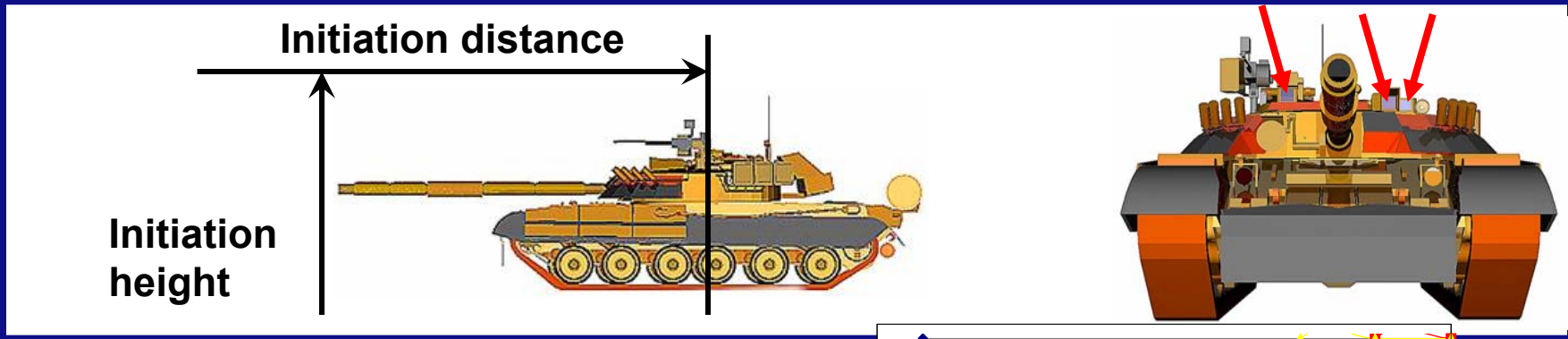
Injury indication view

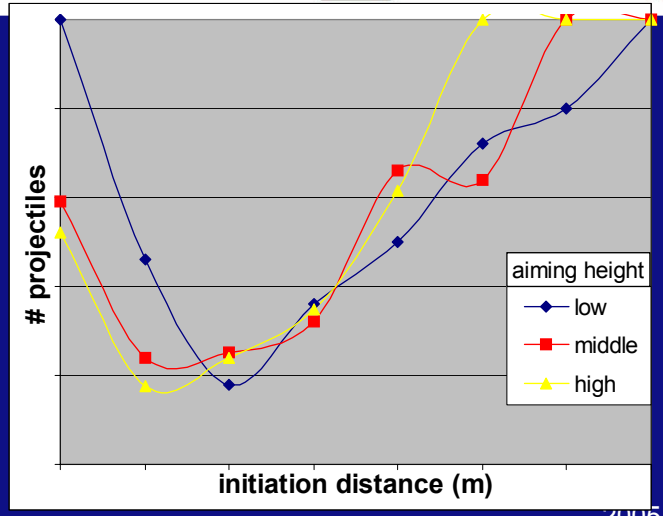
Conclusion KETF optimization

- All subprojectiles can be classified as heavy fragments in the anti-personnel role and very lethal
- With higher subprojectile velocities the soldier was completely perforated
- Difference in injuries is due to subprojectile dimensions
- Fragment resistant vest is always perforated
- At lower impact velocities the heavier subprojectiles result in higher kill probabilities
- Kill probability conclusions are based on standing soldier for a 30 sec. assault

Firing doctrine
35 mm KETF ammunition vs T-80U

- Neutralise T-80U by killing all optical sights as a function of the initiation distance and height and number of fired projectiles

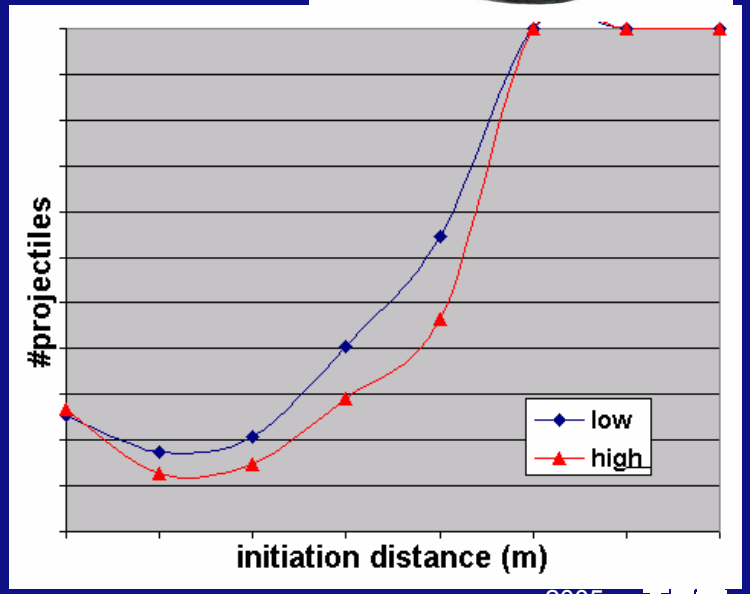




- Conclusion: selection of initiation distance and height is very important to achieve best effectiveness for KETF

Firing doctrine
35 mm KETF ammunition vs Foxhole

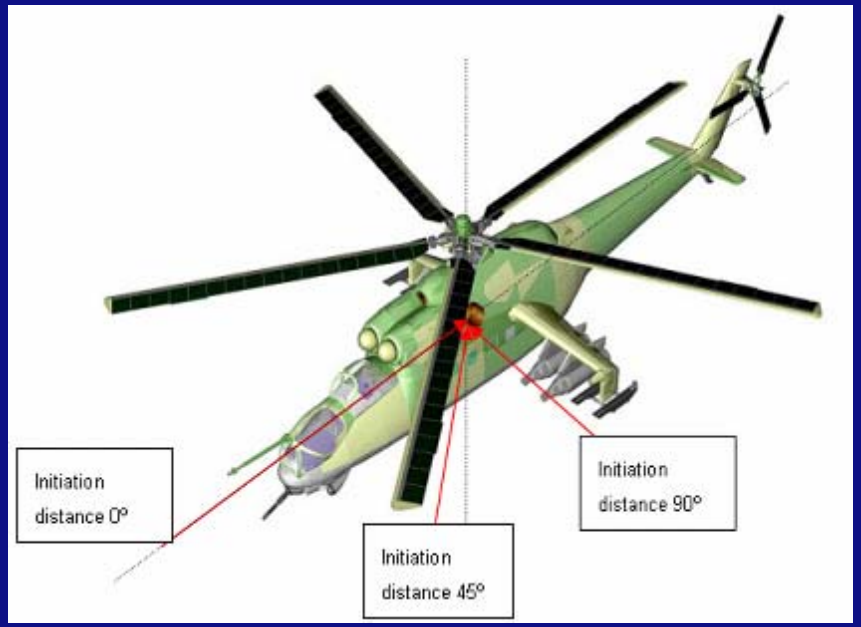
- Kill two men covered Foxhole as a function of the initiation distance and height and number of fired projectiles

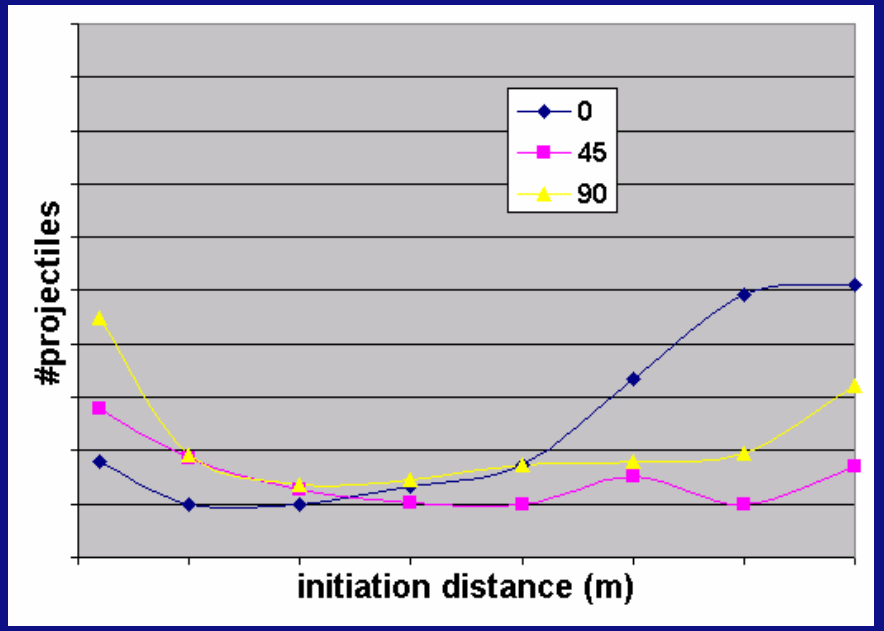


- Conclusion: selection of initiation distance and height is very important to achieve best effectiveness for KETF very effective against this target

Firing doctrine
35 mm KETF ammunition vs Mi-24 Hind

- Scenario: three azimuth angles, 2000 m range
- Kill category: K-kill, without manned control within 30 sec.

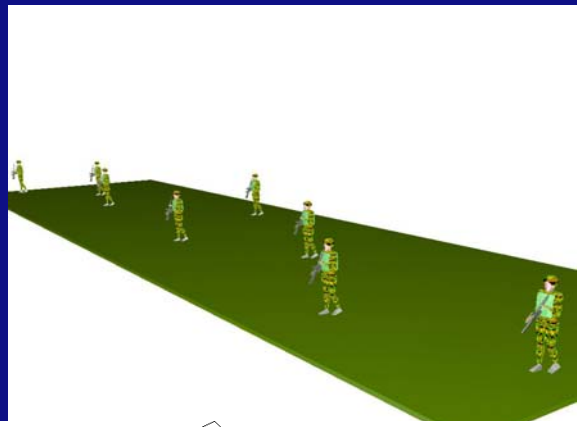




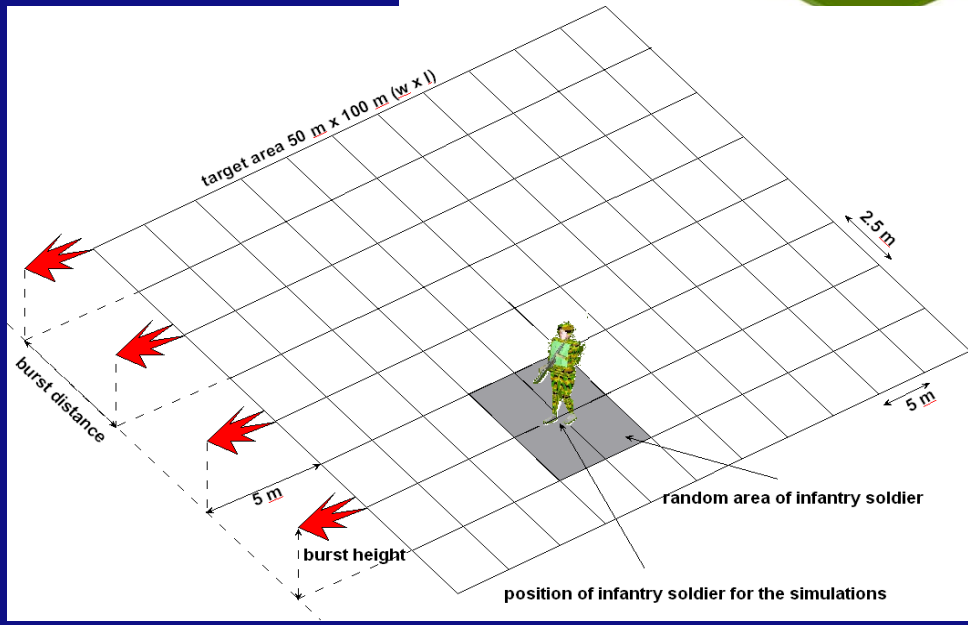
- Conclusion: for KETF the selection of initiation distance is very important to achieve best effectiveness and KETF is very effective against helicopter

KETF firing doctrine: dismounted soldiers in open field

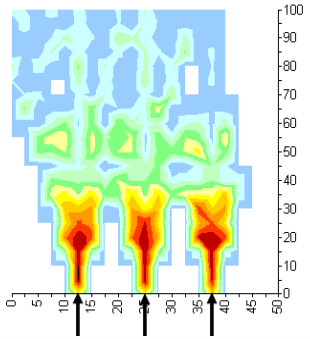
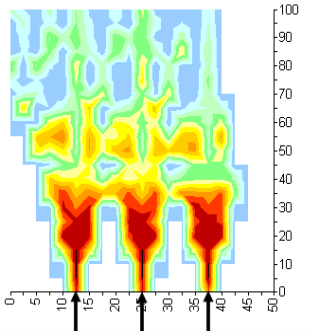
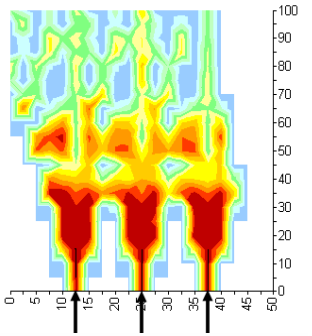
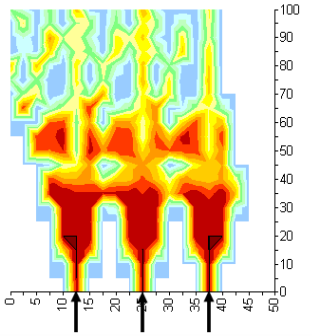
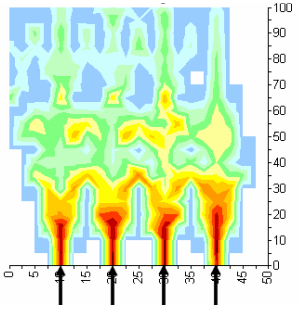
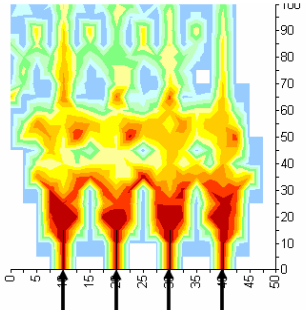
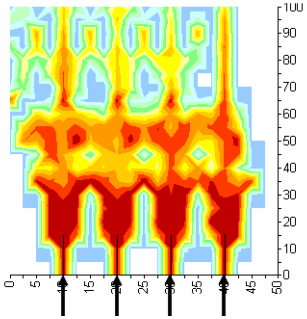
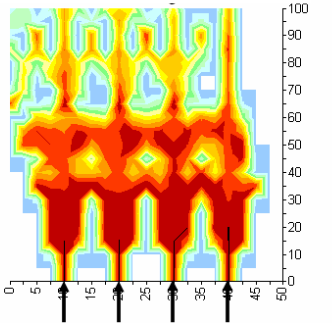
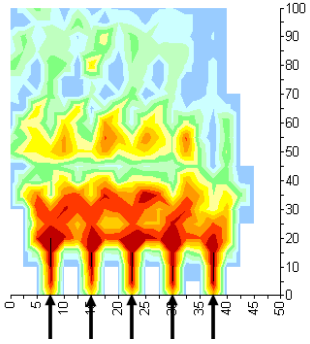
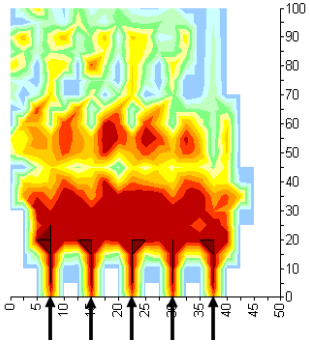
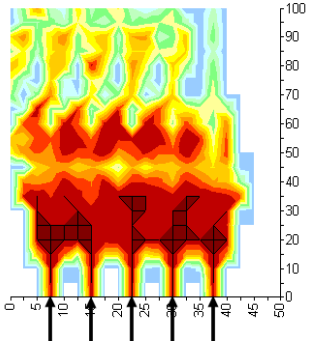
- Soldiers next to each other (line formation):
  8 men covering an area of 10 x 40 m
- Soldiers in column formation:
  5 men covering an area of 50 x 10 m



- Doctrine determined by variation in:
  - Initiation height
  - Initiation distance
  - Number of rounds in initiation point
  - Distance between initiation points



KETF versus dismounted soldiers

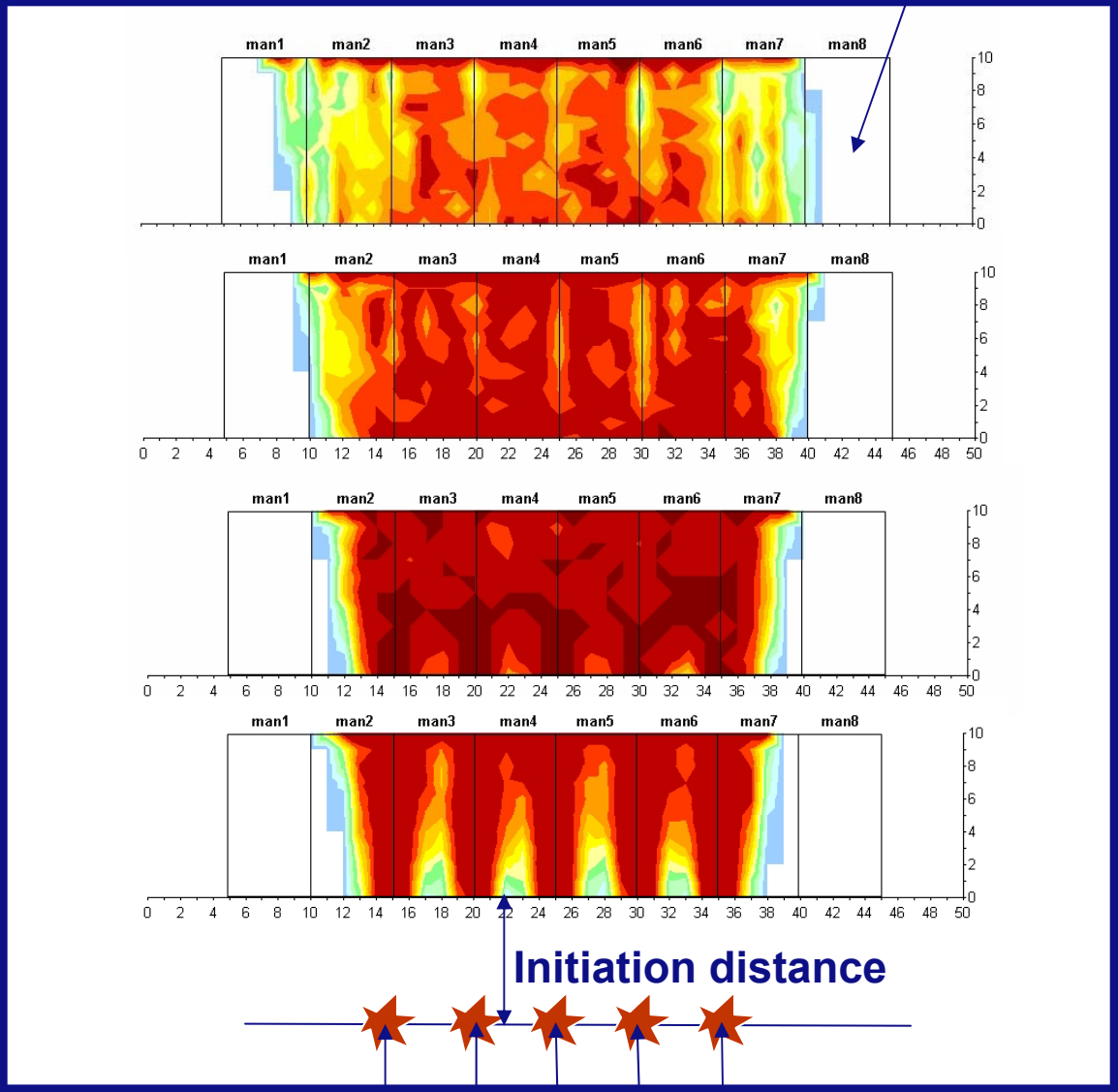
	1 proj.	2 proj.	3 proj.	4 proj.
3 aim Points				
4 aim points				
5 aim Points Pk =				
				

Infantry soldiers positioned in area of 50 m wide x 100 m deep.

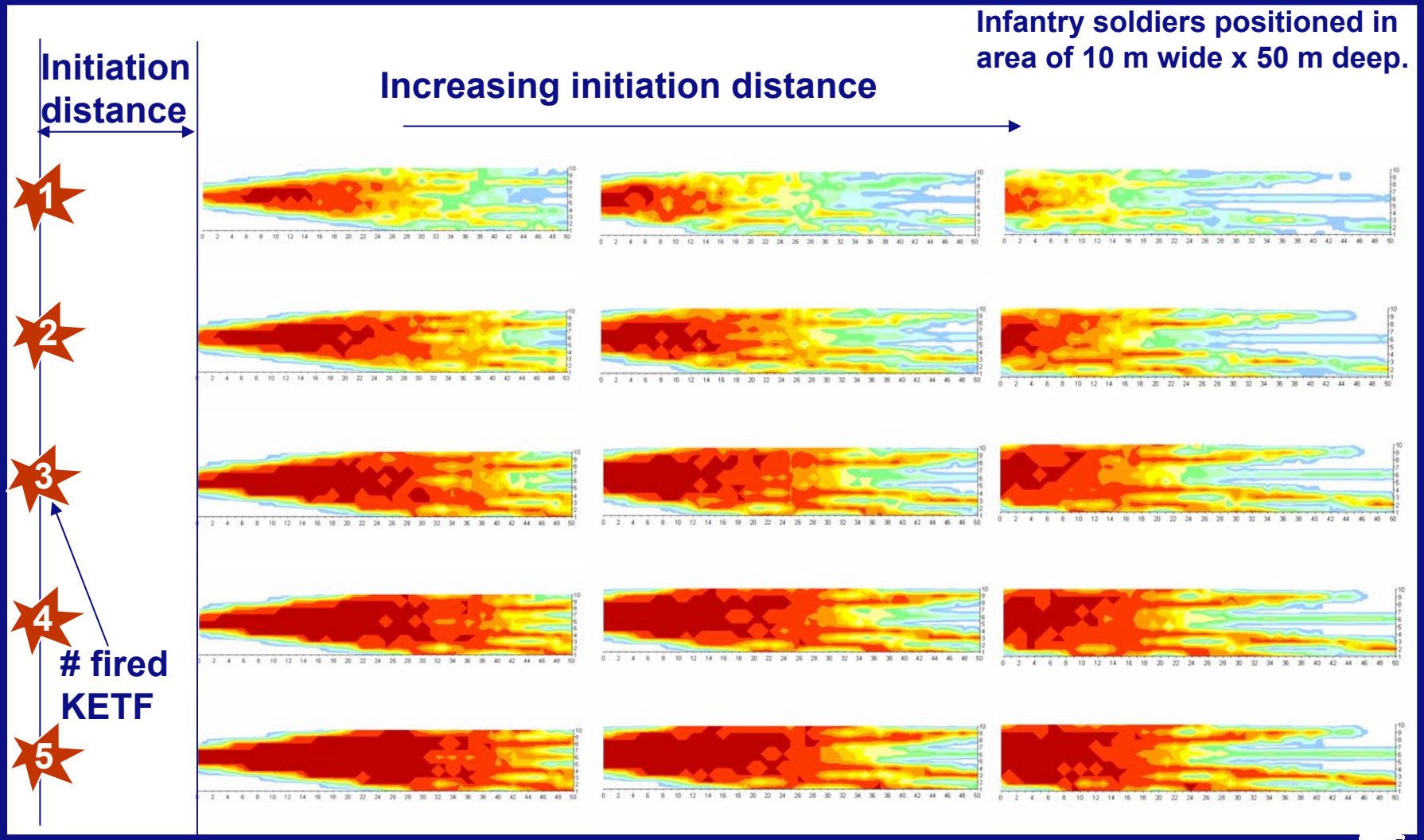
Firing doctrine
35 mm KETF vs line formation

Infantry soldier positioned in area of 5 x 10 m.

Increasing initiation distance



Firing doctrine
35 mm KETF vs column formation

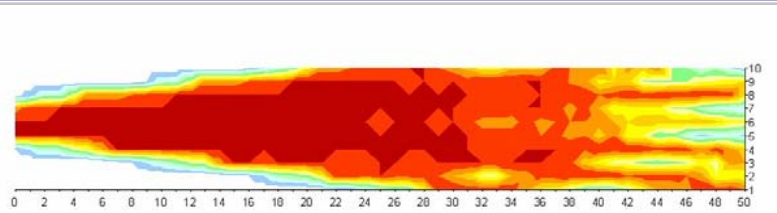


Firing doctrine
35 mm KETF vs column formation

1 aim point

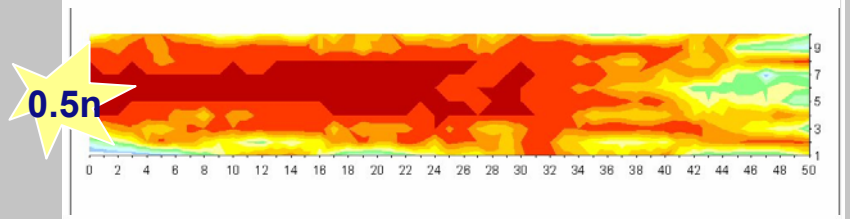
Initiation distance

n

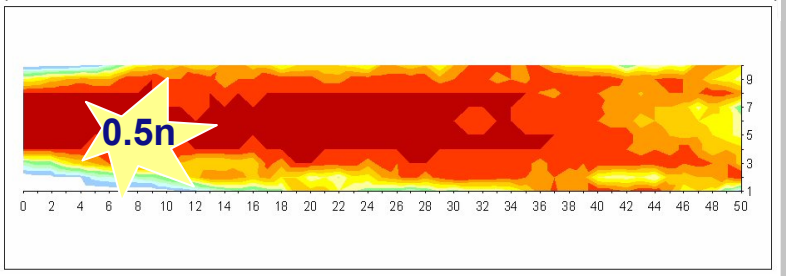


0.5n

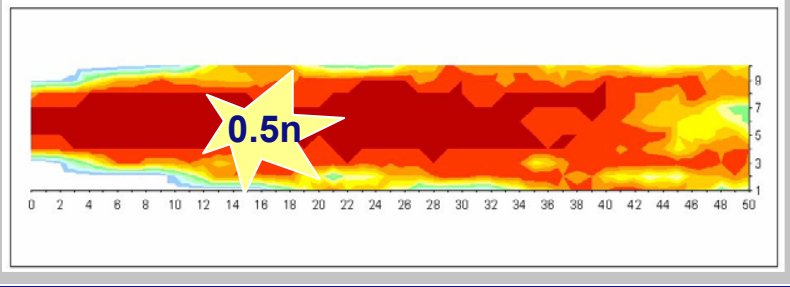
N = # fired KETF



0.5n



0.5n



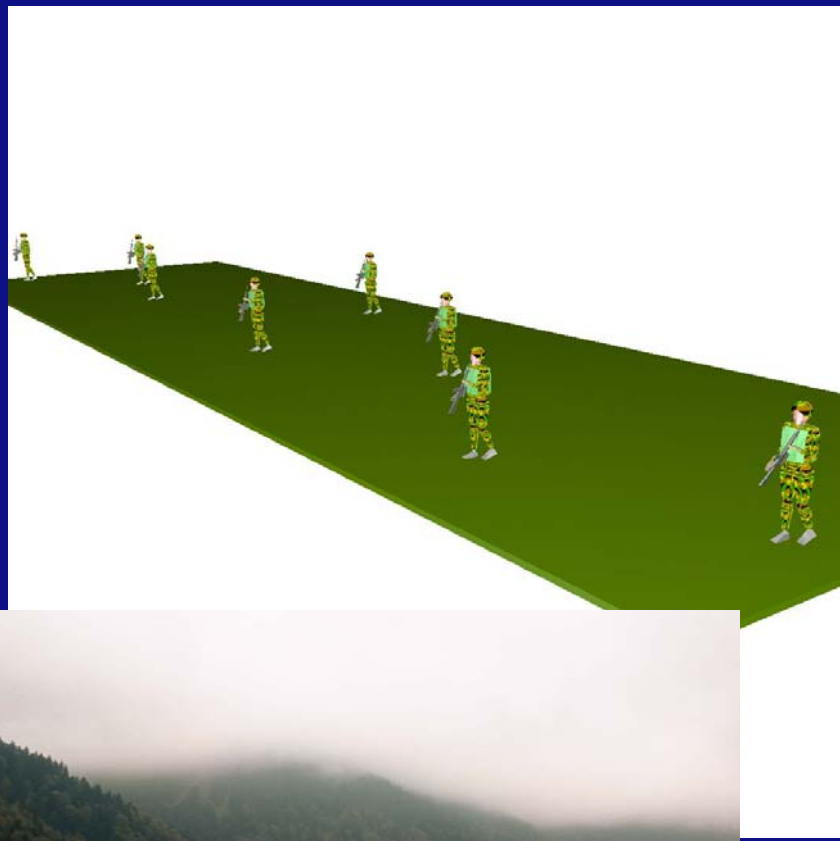
2 aim points

Using different time settings

Infantry soldiers positioned in area of 10 m wide x 50 m deep.

KETF firing doctrine: dismounted soldiers in open field

- Conclusions:
  - The KETF is very effective against infantry soldiers
  - The effectiveness is influenced by:
    - number of rounds
    - initiation distance
    - initiation height
    - distance between initiation points
    - time setting of the fuze ("string of pearls option")



Conclusion

- The 35 mm caliber was selected for the RNLA IFV to fulfil the Firepower requirements
- The ABM ammunition can be very effective against a range of targets
- To achieve the best effectiveness for the ABM ammunition the balance has to be found between:
  - The number of fired projectiles
  - Initiation distance
  - Initiation height
  - Distance between initiation points
  - Time setting of the fuze