SOUTH AFRICAN THREAT HAZARD ANALYSIS APPROACH – PROPOSAL

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DENEL NASCHEM

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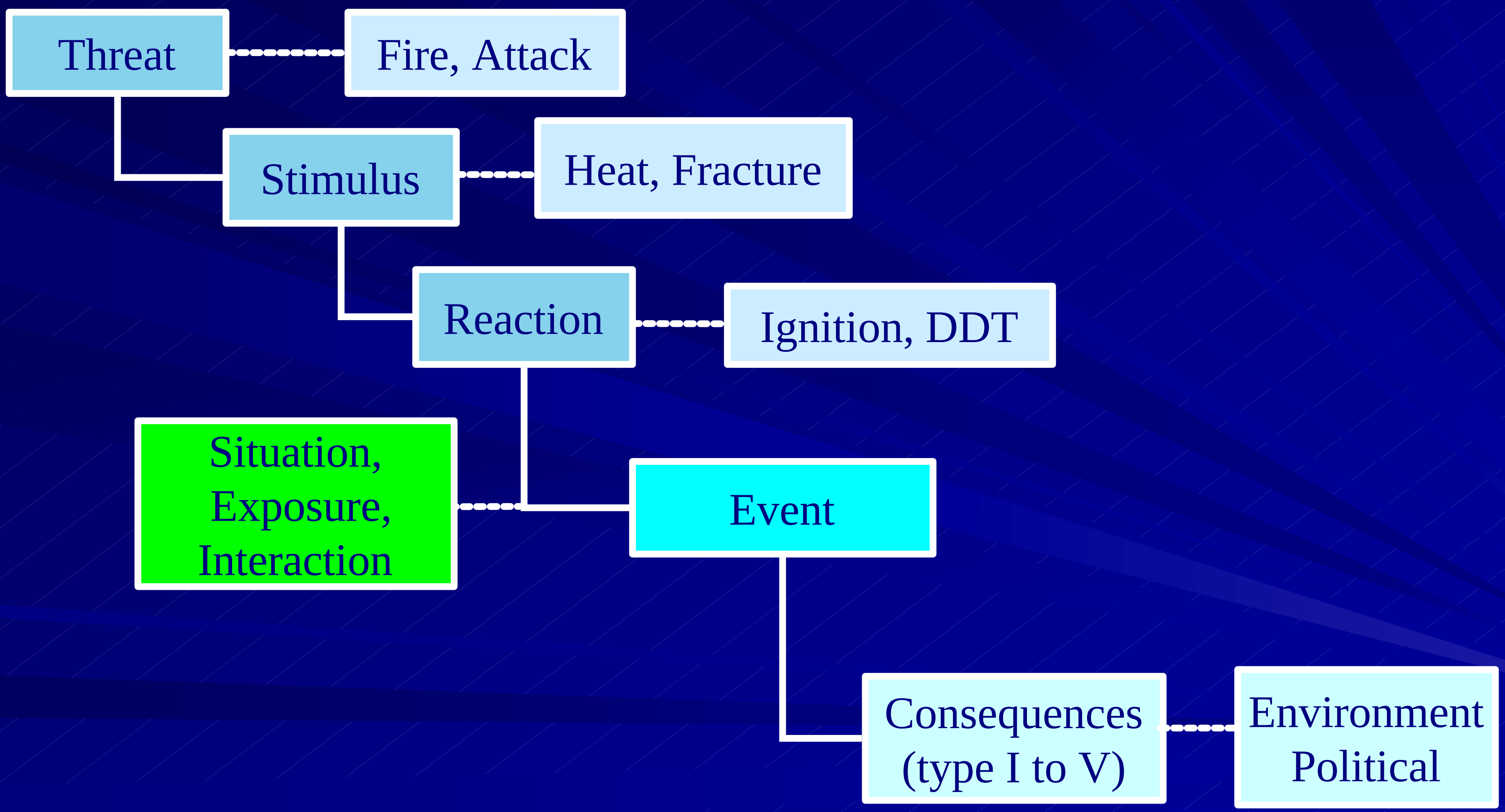
RSA IM Policy THA requirements

- Users of all classes of munitions shall develop threat definitions i.t.o. all possible unplanned stimuli.
- Hazard analysis shall be carried out on each new and existing munition to determine threat scenario.
- Levels of acceptable reaction must be agreed upon.
- The above is to be supported by sub-scale and/or full-scale tests.

THA Definition

A THA is a systematic methodology used to assess the potential for damage/injury from stimuli/aggressions throughout the life cycle of a munition.

THA Environment



THA Systematic Methodology

1. Establish Life Cycle
2. Identify threats
3. Predict probability of stimulus
4. Establish response to stimulus
5. Predict probability of event
6. Determine effect on surroundings
7. Determine consequences of event
8. Assess the risk

1. Establish Munitions Life Cycle

Inputs

Phases

R&D
Production
Operation & Support
Phase Out/Disposal

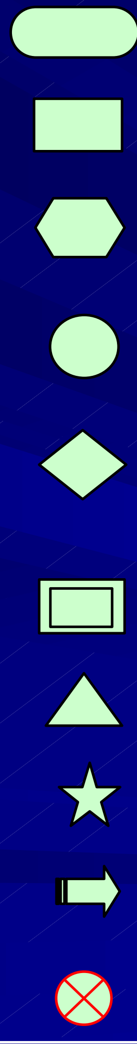
Service environment

Land

Air

Sea

Process



- Factory
- Handling
- Action on munition
- Storage
- Tactical/ log transport
- Install on Site
- Tactical Carriage
- Firing
- Flight
- Disposal

Outputs

- Generic life cycle
- Situation occasion duration

2. Identify Threats

IM Threats ⟶ **NOT** ⟶ **Safety**

- Magazine Store or vehicle Fuel Fire
- Fire in adjacent store
- Small arms attack
- Fragmenting Munitions attack
- Behind armour debris
- Shaped charge weapon
- Dropping/mishandling
- Mass Reaction

Impact

Electrostatic Discharge

Shock

Vibration

Friction

Identifying Tests to Simulate Threats

- Identify the IM tests that best simulate the threats identified viz.

  - Bullet impact (BI)
  - Fast cook-off, Fuel Fire (FF)
  - Slow cook-off (SC)
  - Sympathetic detonation (SD)
  - Fragment impact (FI)
  - Shaped charge jet impact (SCJI)
  - Spall impact (Spall)
  - 12 meter drop (D)

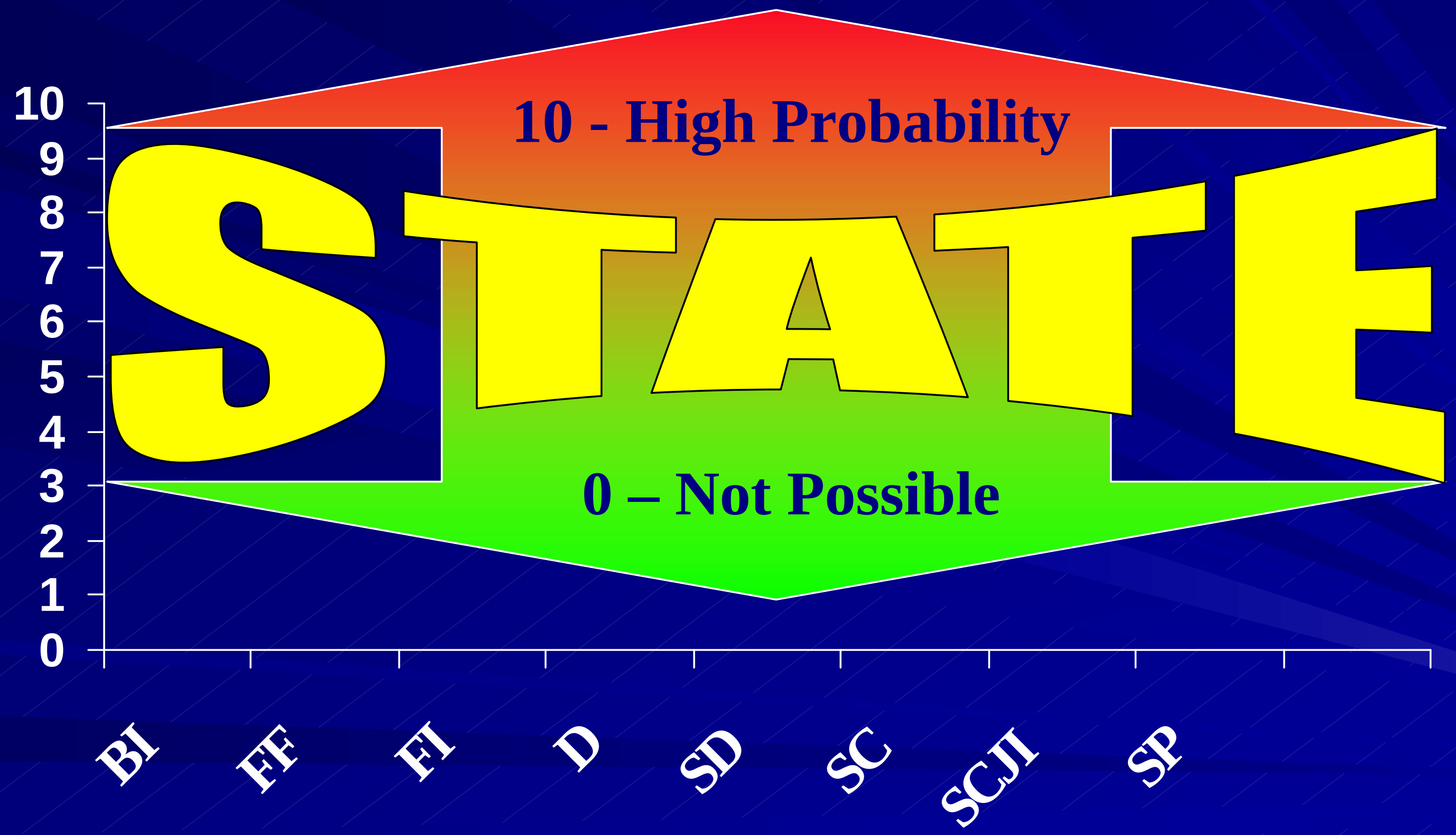
3. Predict probability of stimulus

Probability of Exposure to a Threat in a Given Situation

- A weight is given to the threat occurring.

0 = Not Possible
2 = Highly Improbable
4 = Improbable
6 = Possible
8 = Probable
10 = Highly Probable

Threats and Weight



EXPLANATION

- Once a weight is given to each threat, the weights are added.
- A normalized probability is determined.
- The normalized probability is used in the calculation.

4. Establish Munitions Response to Stimulus

Inputs

- Use Sub-Scale Testing
- Modeling
- Full scale testing

The state of the munition (unpacked etc.)

Outputs

Type I : Detonation

Type II : Partial Detonation

Type III : Explosion

Type IV : Deflagration

Type V : Burning

Reaction

- The reaction that will be used in the formula is the reaction that will be obtained should the munition be subjected to a certain threat.
- STANAG criteria is used to indicate reactions / no reactions. A reaction obtained that does not conform to the STANAG criteria is considered to be a reaction. A reaction that does conform to the STANAG criteria is considered not to be a reaction.

Pr

Threat	Det	P. Det.	Expl.	Defl.	Burn	N/R
BI						
FF						
SC						
SCJI						
SD						
FI						
SPALL						
D						

5. Predict Probability of an Event

Outputs

Probability of a major event arising should any one of the threats occur.

The value of the Probability (Pn)

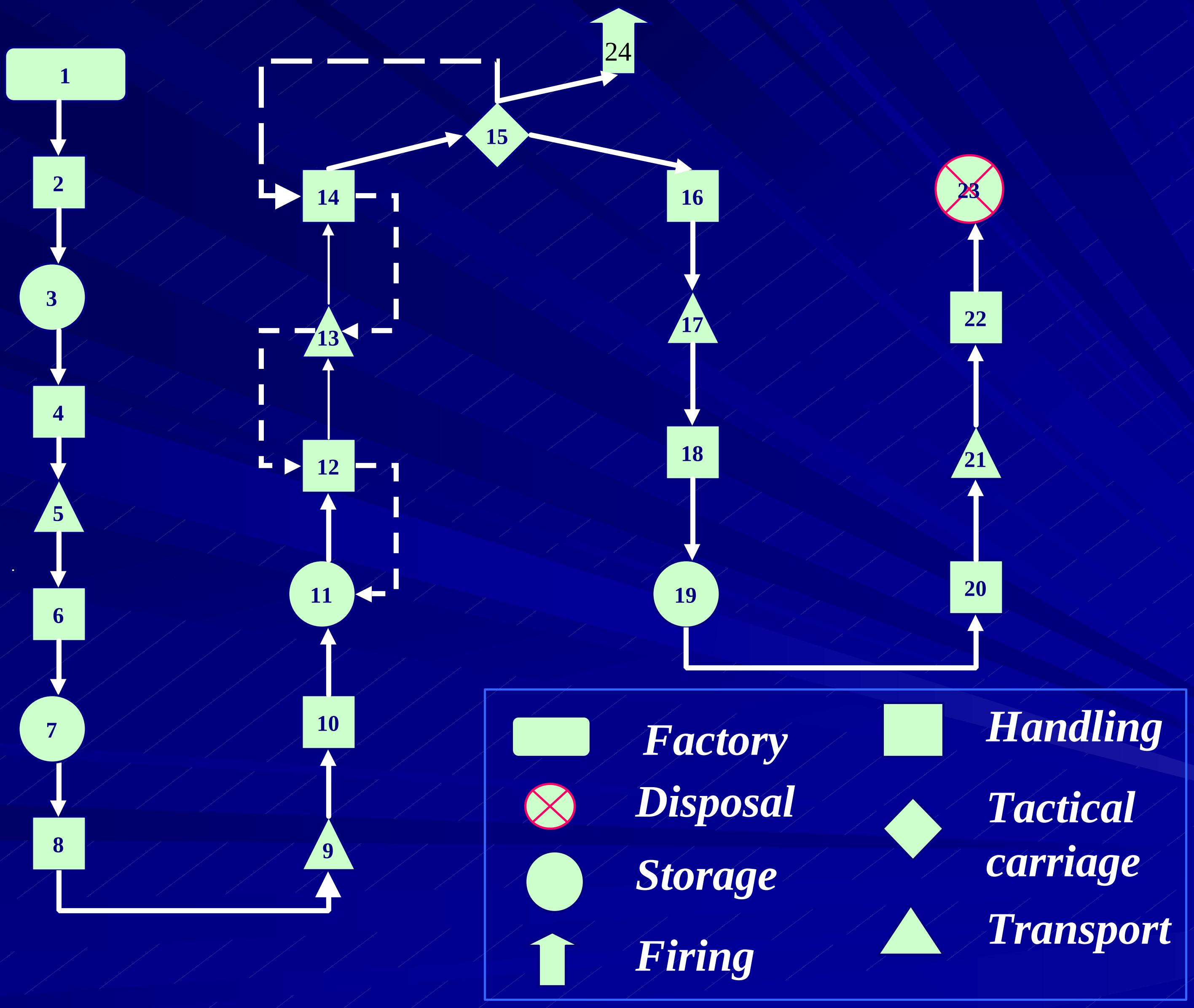
- The value of the Probability (Pn):

$$Pn = 1- [(1-Ps) \times (1-Pt) \times (1-Pr)]$$

- Ps = Probability of munition being in a particular situation.
- Pt = Probability of exposure to a certain threat in a certain situation.
- Pr = Response obtained when subjected to a certain threat.

Example

Life Cycle Determination



Life Cycle Duration e.g.

#	Environment	Duration (Days)
1	Factory	20
2	Handling	1
3	Storage	20
4	Handling	1
5	Transport	2
6	Handling	1
7	Storage	14

continue ---------------------

Life Cycle Duration cont.

#	Environment	Duration(Days)
15	Tactical carriage (ship)	2737
22	Handling	1
23	Disposal	7
	Total	**5741**

Probability of munitions being subjected to a certain threat - Pt

Threat	Weights of threat occurring	Normalized probability (Pt)
BI	2	0.065
FF	5	0.194
SPALL	2	0.065
SCJI	2	0.065
DROP	6	0.194
FI	5	0.194
SC	5	0.194
SD	5	0.194

Probability of munitions producing a reaction – Pr

Pr for conventional explosives

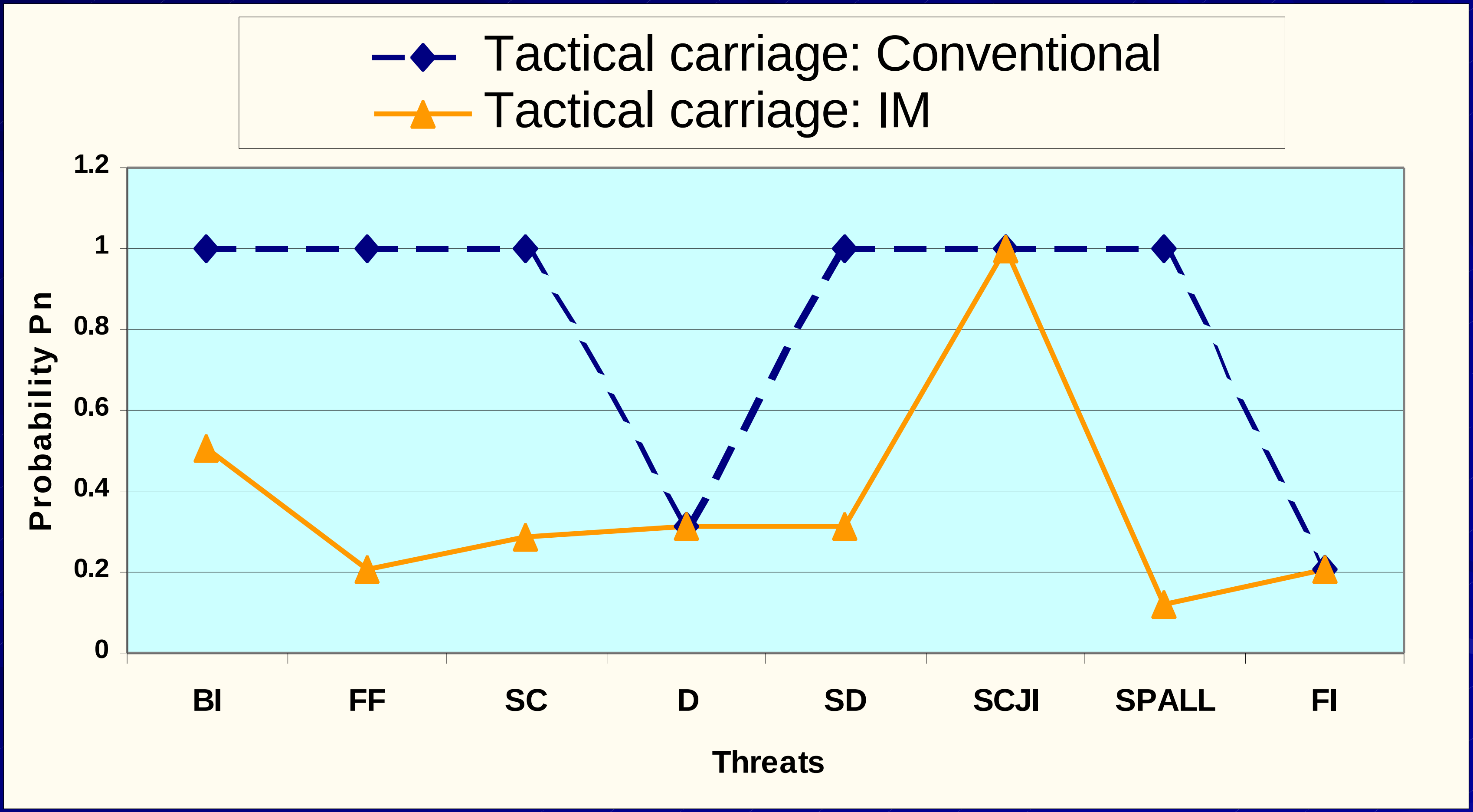
Threat	# Tests	# Reactions	Pr
BI	4	4	1
FF	2	2	1
SPALL	2	2	1
SCJI	4	4	1
DROP	2	0	0
FI	2	2	1
SC	2	2	1
SD	2	2	1

Probability of munitions producing a reaction – Pr

Pr for IM explosives

Threat	# Tests	# Reactions	Pr
BI	4	0	0
FF	2	0	0
SPALL	2	0	0
SCJI	4	4	1
DROP	2	0	0
FI	2	0	0
SC	2	0	0
SD	2	0	0

Results of Example (Situation X)



6. Determine Effect on Surroundings

Inputs	Processes	Outputs
Munitions Response (4) Munition Life Cycle (1)	Personnel Buildings Infrastructure Stockpile Platform Other material assets Environment	Hazard Assessment

Note : Quantitative data regarding output of reaction are required.

7. Determine Consequences of Event to Stakeholders

Inputs	***Processes***	***Outputs***
Stakeholder concerns	Production Operational/Logistic/Mission Financial Political Health and Safety Environmental Program	Consequence Assessment

<u>Note :</u> Short term……………….Long term consequences

8. Assess the Risk

Inputs	*Processes*	*Outputs*
Probability of a major event (5) Consequence of that event (7)	Casualties Public perception Loss of capacity Loss of flexibility/tempo Storage and Transport Interoperability Programme Risk Future market	Risk assessment

Note : Project Team should identify and rate, potential risk areas and introduce solutions to reduce vulnerability to external stimuli.

Conclusions

- The THA is complex and some data (probabilities) can only be obtained qualitatively.
- This generic method can be used to determine the vulnerability of munition systems.
- The THA may save costs in terms of full scale IM tests.

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