



Photograph: Copyright Paul Shambroom

APPROACHES TO NUCLEAR WARHEAD COUNTING

Alexander Glaser

Princeton University

PVTS-SGS Workshop on Verification Technologies
Beijing, June 15–16, 2015

BACKGROUND

VERIFICATION CHALLENGES OF DEEP(ER) REDUCTIONS

KEY VERIFICATION CHALLENGES

OF TREATIES THAT LIMIT TOTAL NUMBER OF WEAPONS



CORRECTNESS OF DECLARATIONS

- Warhead Counting
Verify that numerical limit of declared items is not exceeded
- Warhead Authentication
Verify authenticity of warheads prior to dismantlement



COMPLETENESS OF DECLARATIONS

Most promising may be techniques to verify completeness of fissile material declarations; nuclear forensic analysis can be used to estimate historic fissile material production (“nuclear archaeology”)

Source: U.S. Department of Energy (top) and U.S. Department of Defense, www.defenseimagery.mil (bottom)

WARHEAD COUNTING

TAGGING

TRANSFORMING A “NUMERICAL LIMIT” INTO A “BAN ON UNTAGGED ITEMS”



Source: www.automoblog.net

Steve Fetter and Thomas Garwin, “Using Tags to Monitor Numerical Limits in Arms Control Agreements”
in Barry M. Blechman, ed., *Technology and the Limitation of International Conflict*, Washington, DC, 1989, pp. 33–54

TAGGING

TRANSFORMING A “NUMERICAL LIMIT” INTO A “BAN ON UNTAGGED ITEMS”



Source: www.automoblog.net

Steve Fetter and Thomas Garwin, “Using Tags to Monitor Numerical Limits in Arms Control Agreements”
in Barry M. Blechman, ed., *Technology and the Limitation of International Conflict*, Washington, DC, 1989, pp. 33–54

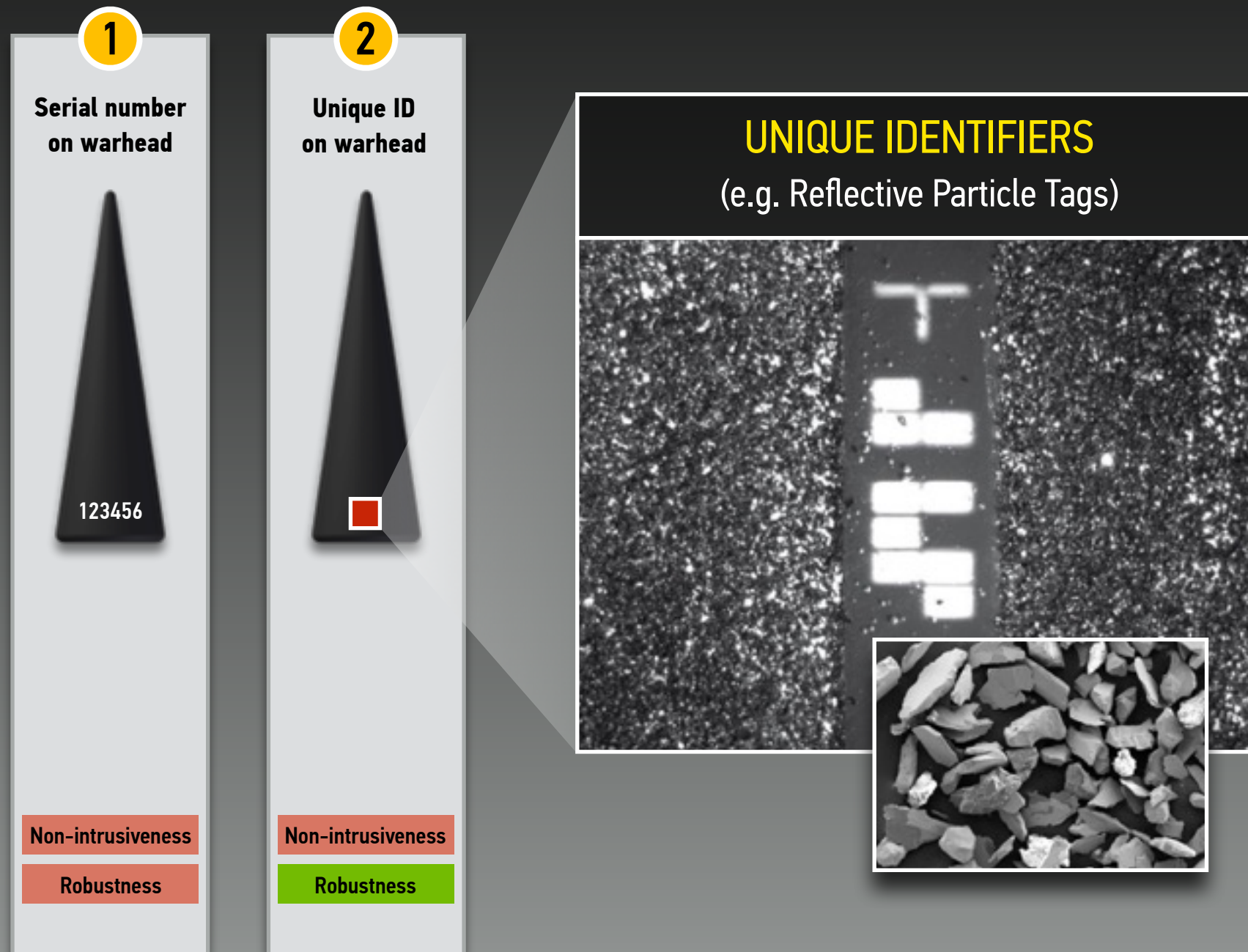
WARHEAD COUNTING OPTIONS

WITH VARIOUS LEVELS OF NON-INTRUSIVENESS AND ROBUSTNESS



WARHEAD COUNTING OPTIONS

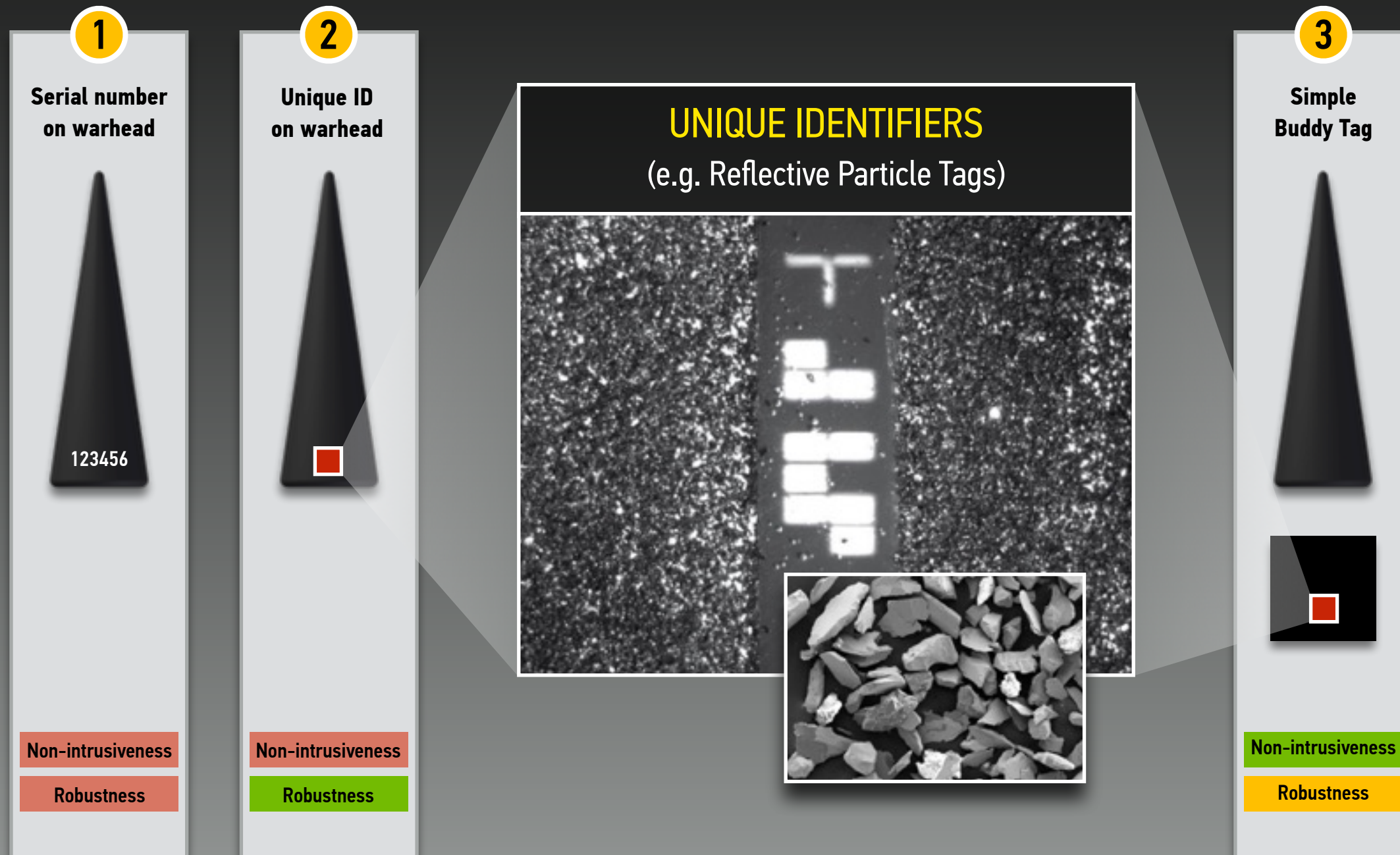
WITH VARIOUS LEVELS OF NON-INTRUSIVENESS AND ROBUSTNESS



Reflective particle tag concept: A. Gonzales, Reflective Particle Tag for Arms Control and Safeguards Authentication, Sandia National Laboratories, 2004

WARHEAD COUNTING OPTIONS

WITH VARIOUS LEVELS OF NON-INTRUSIVENESS AND ROBUSTNESS



Reflective particle tag concept: A. Gonzales, Reflective Particle Tag for Arms Control and Safeguards Authentication, Sandia National Laboratories, 2004

Buddy tag concept: S. E. Jordan, Buddy Tag's Motion Sensing and Analysis Subsystem, Sandia National Laboratories, 1991

WARHEAD COUNTING OPTIONS

WITH VARIOUS LEVELS OF NON-INTRUSIVENESS AND ROBUSTNESS



Reflective particle tag concept: A. Gonzales, Reflective Particle Tag for Arms Control and Safeguards Authentication, Sandia National Laboratories, 2004

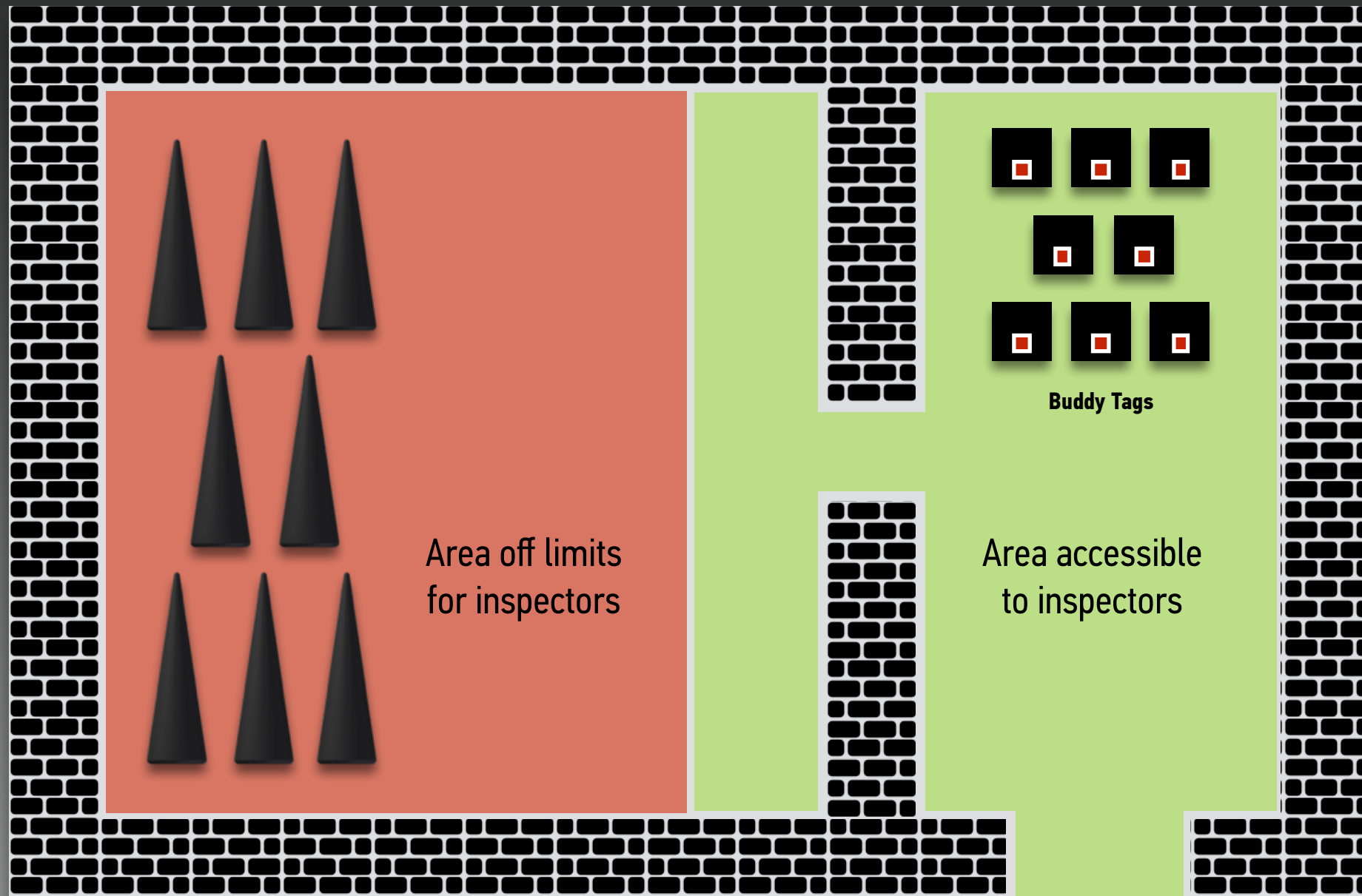
Buddy tag concept: S. E. Jordan, Buddy Tag's Motion Sensing and Analysis Subsystem, Sandia National Laboratories, 1991

EXAMPLE

BUDDY TAG CONCEPT

OPTION FOR A MINIMALLY INTRUSIVE ONSITE INSPECTION

USING BUDDY TAGS WITHOUT DIRECT ACCESS TO TREATY ACCOUNTABLE ITEMS



Hypothetical nuclear warhead storage facility

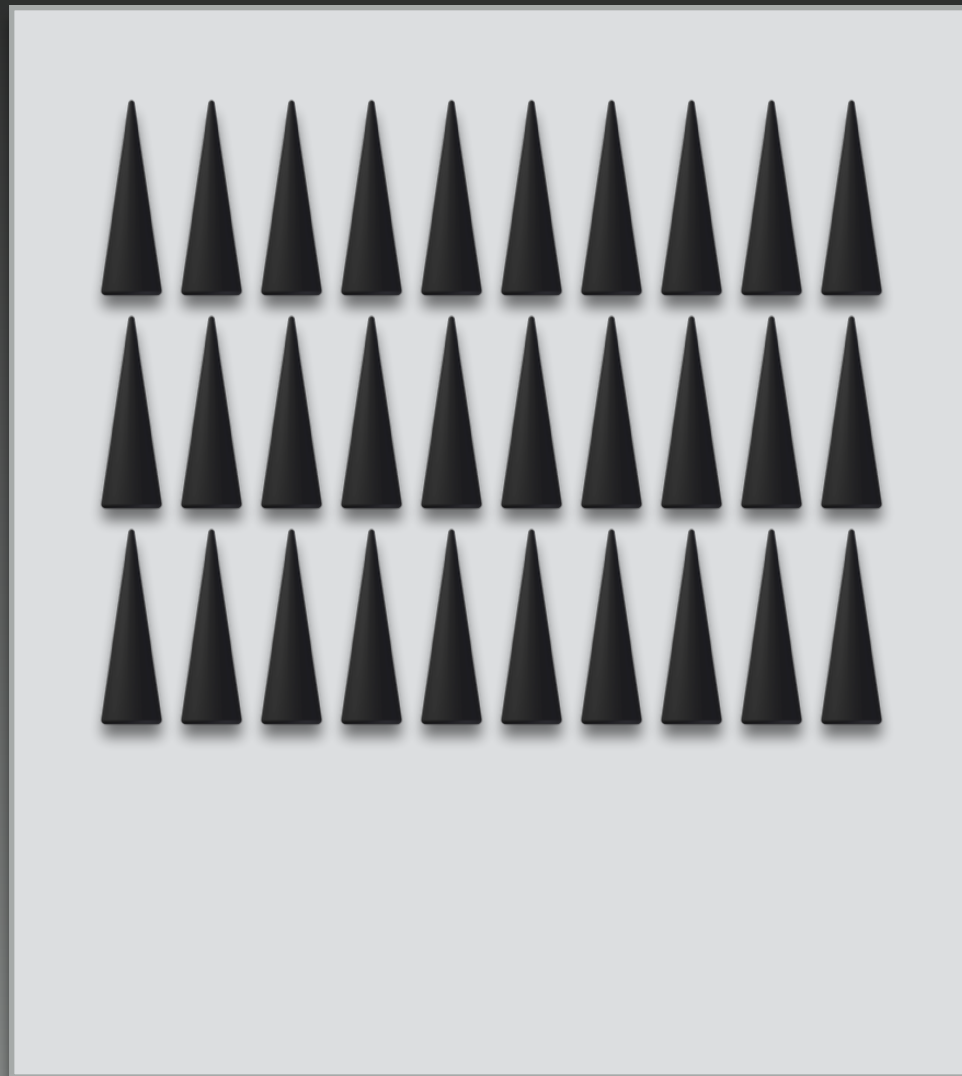
SCENARIO 1

(“DISHONEST HOST”)

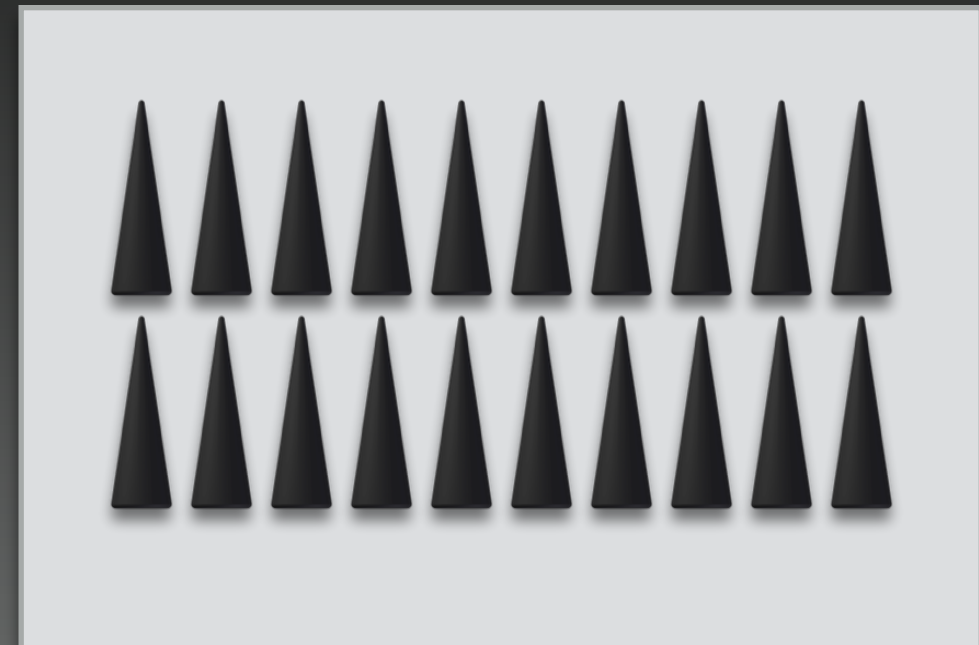
SCENARIO 1

PARTY HAS DECLARED 50 WARHEADS; THEY ARE STORED AT TWO (DECLARED) SITES

SITE A



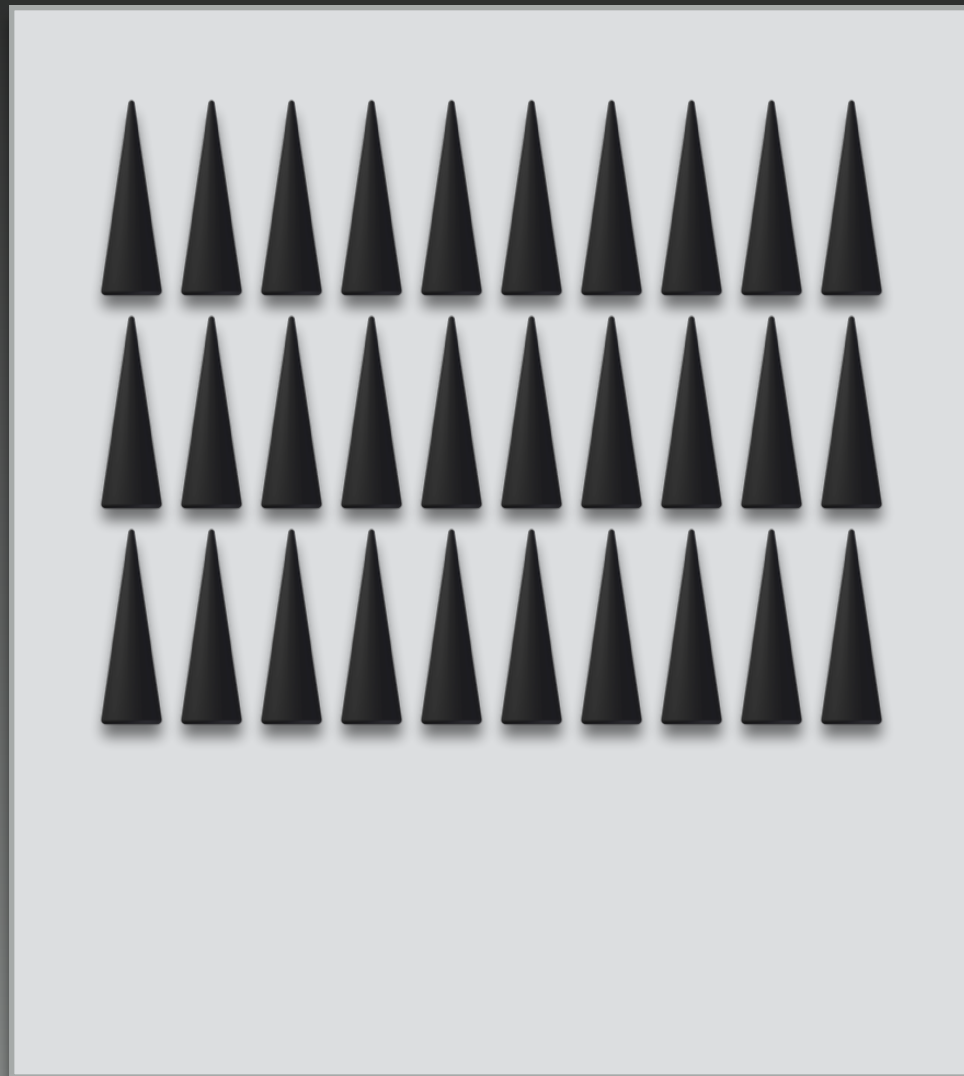
SITE B



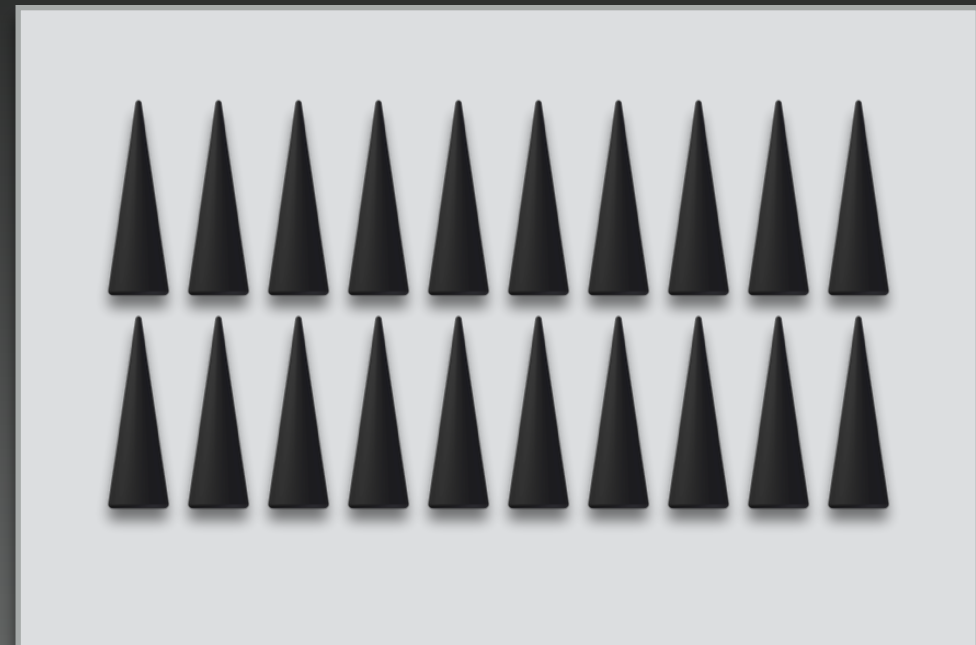
SCENARIO 1

PARTY HAS DECLARED 50 WARHEADS; THEY ARE STORED AT TWO (DECLARED) SITES

SITE A



SITE B

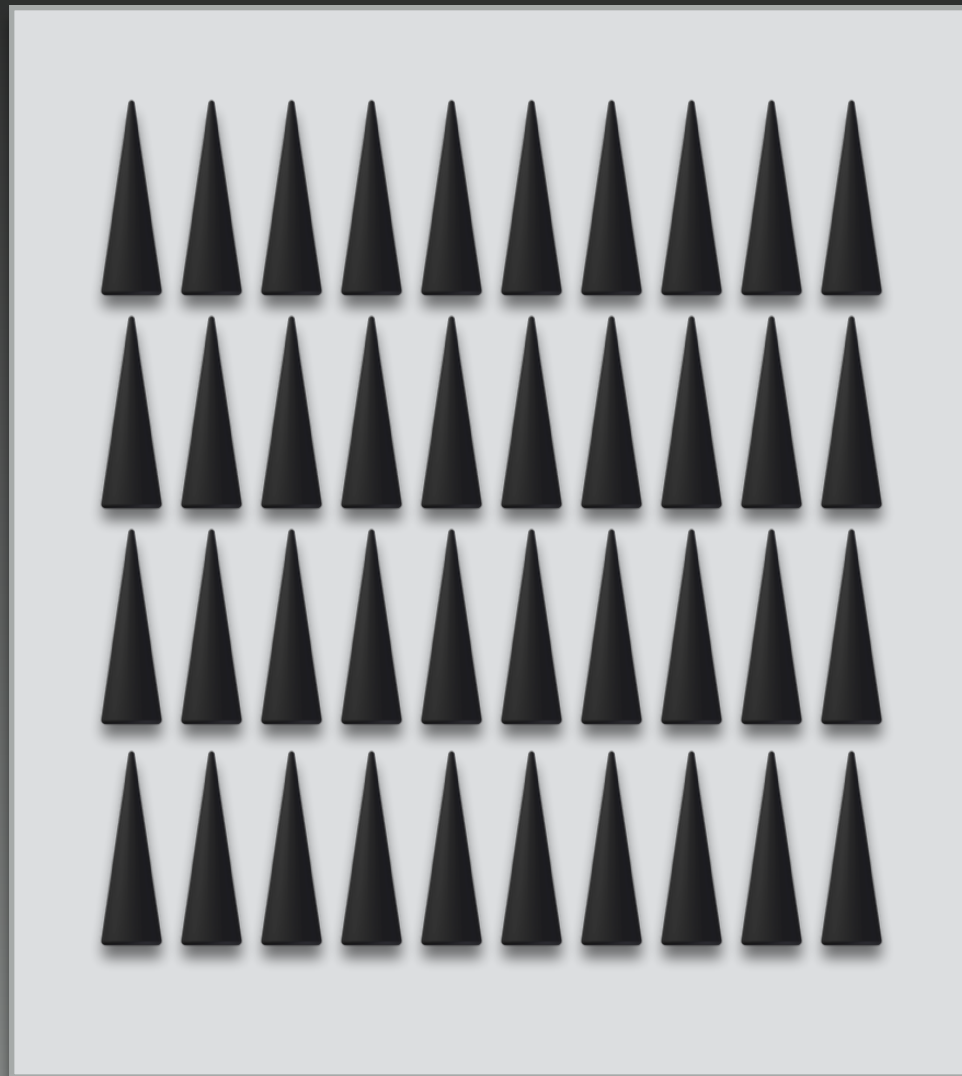


In reality, there are 60 warheads

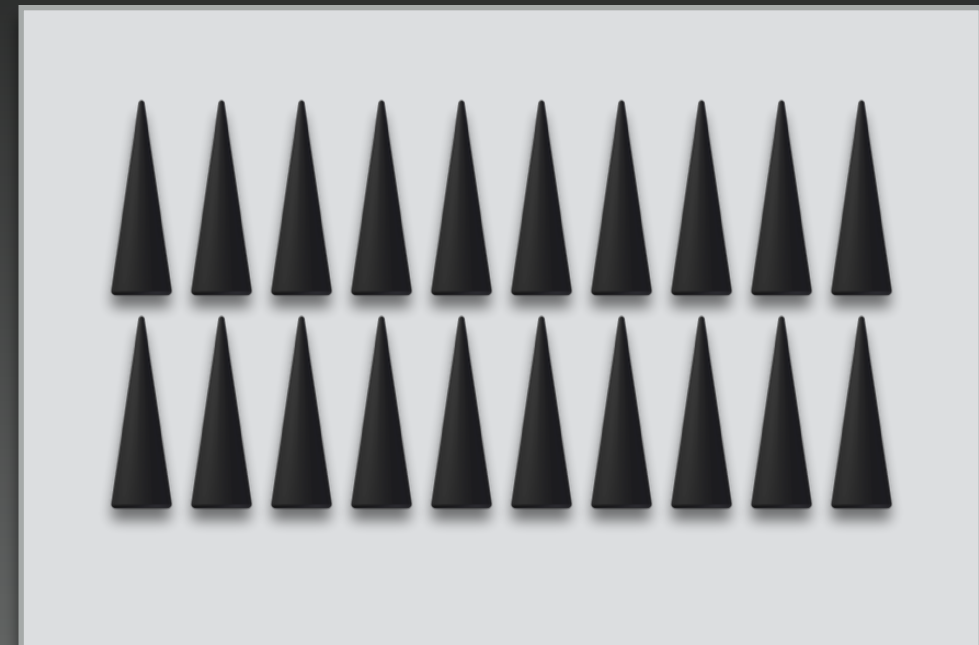
SCENARIO 1

PARTY HAS DECLARED 50 WARHEADS; THEY ARE STORED AT TWO (DECLARED) SITES

SITE A

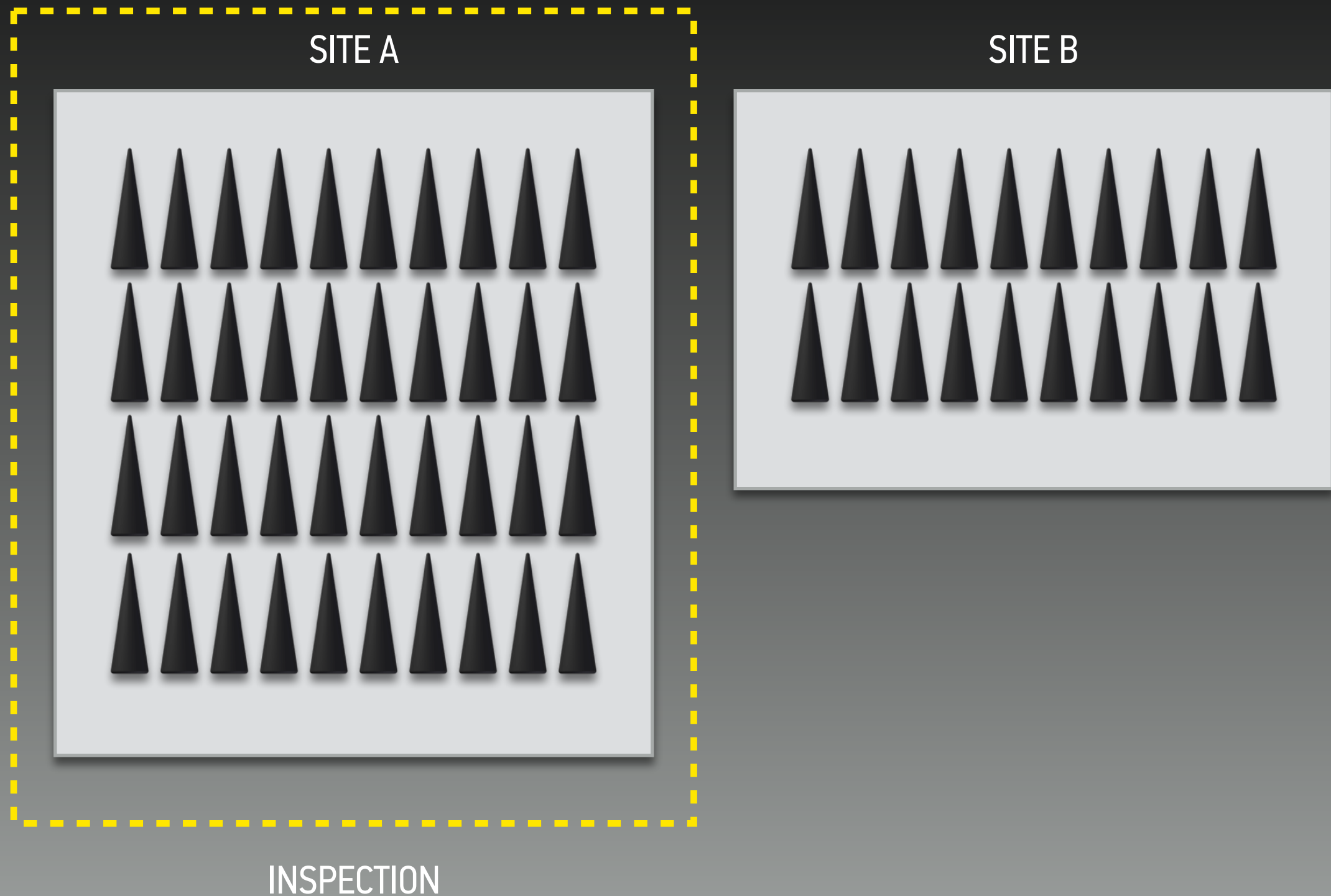


SITE B



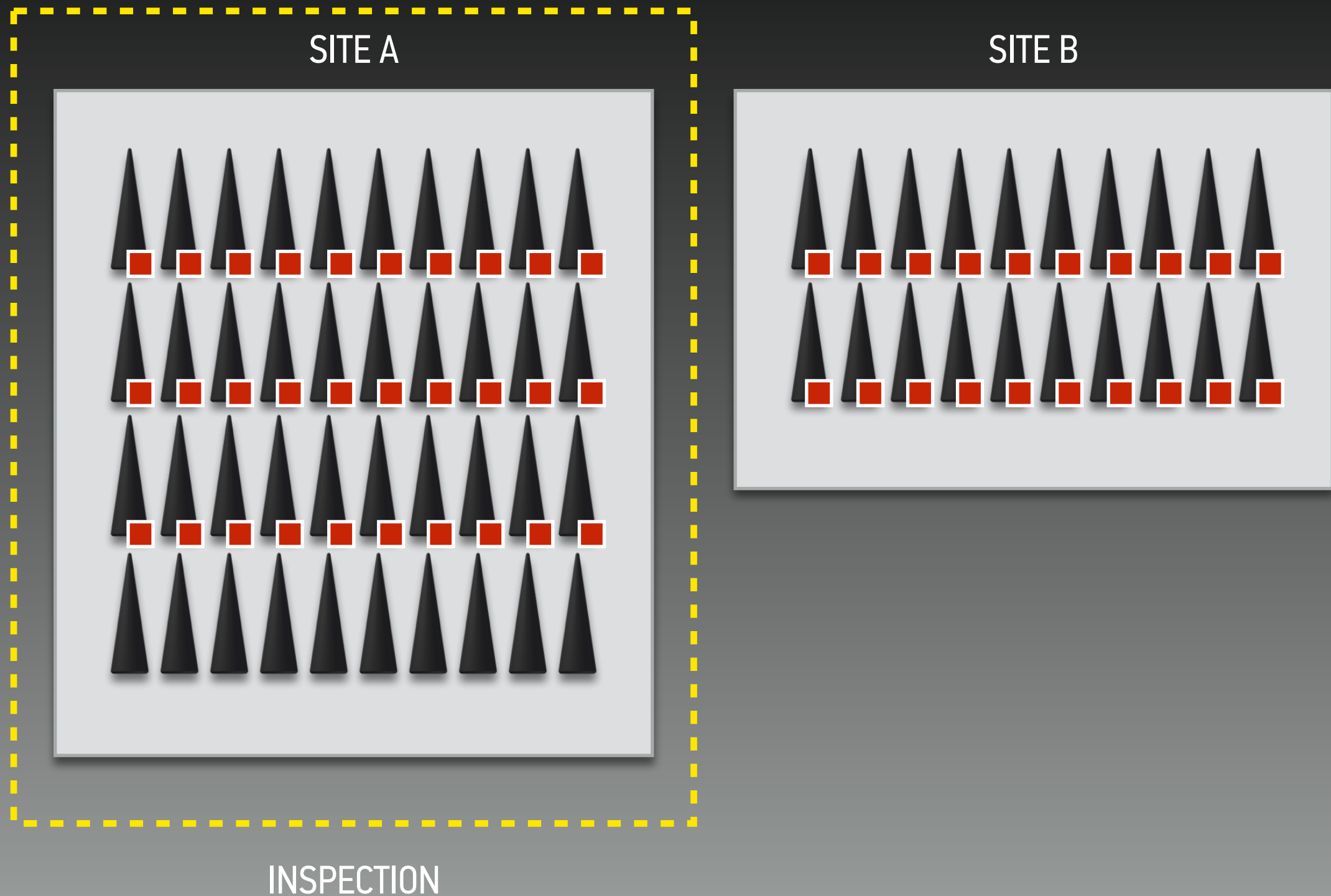
SCENARIO 1

PARTY HAS DECLARED 50 WARHEADS; THEY ARE STORED AT TWO (DECLARED) SITES



SCENARIO 1

PARTY HAS DECLARED 50 WARHEADS; THEY ARE STORED AT TWO (DECLARED) SITES



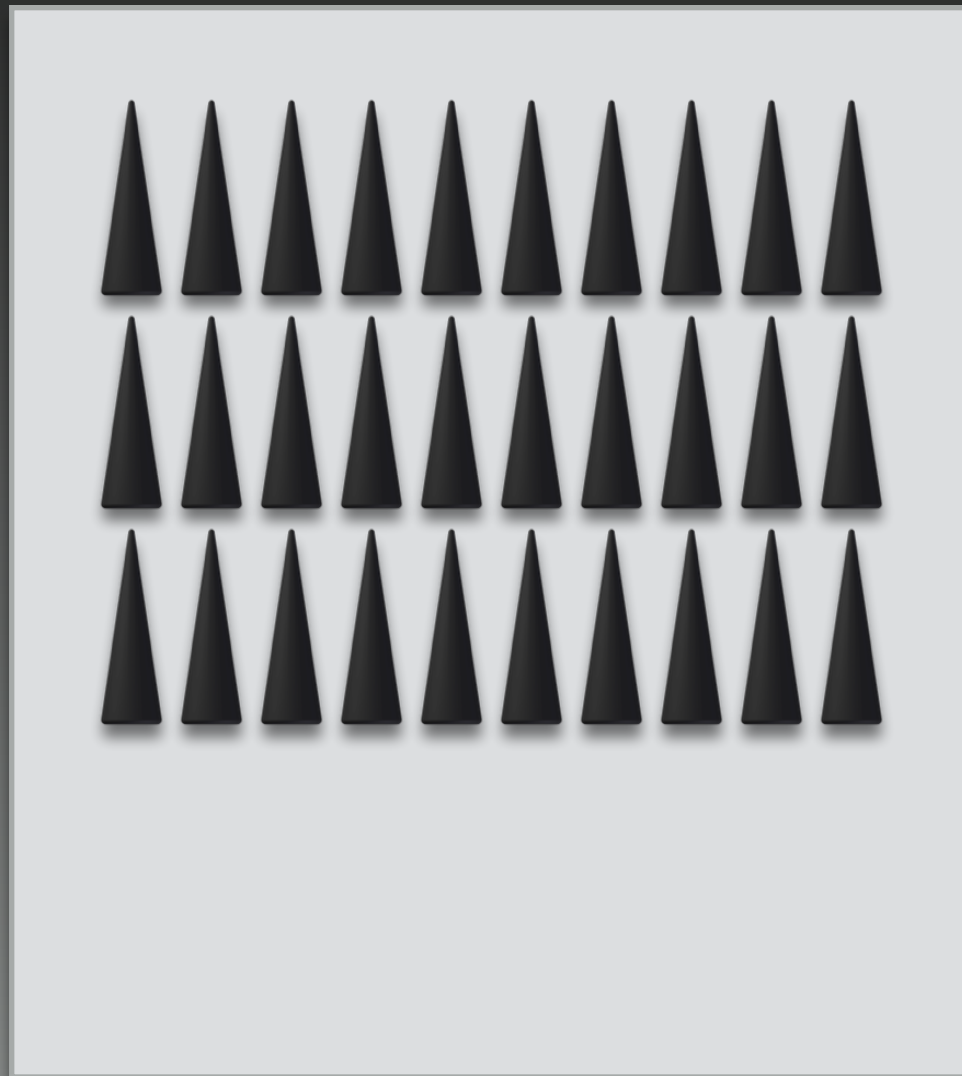
SCENARIO 2

("HONEST HOST")

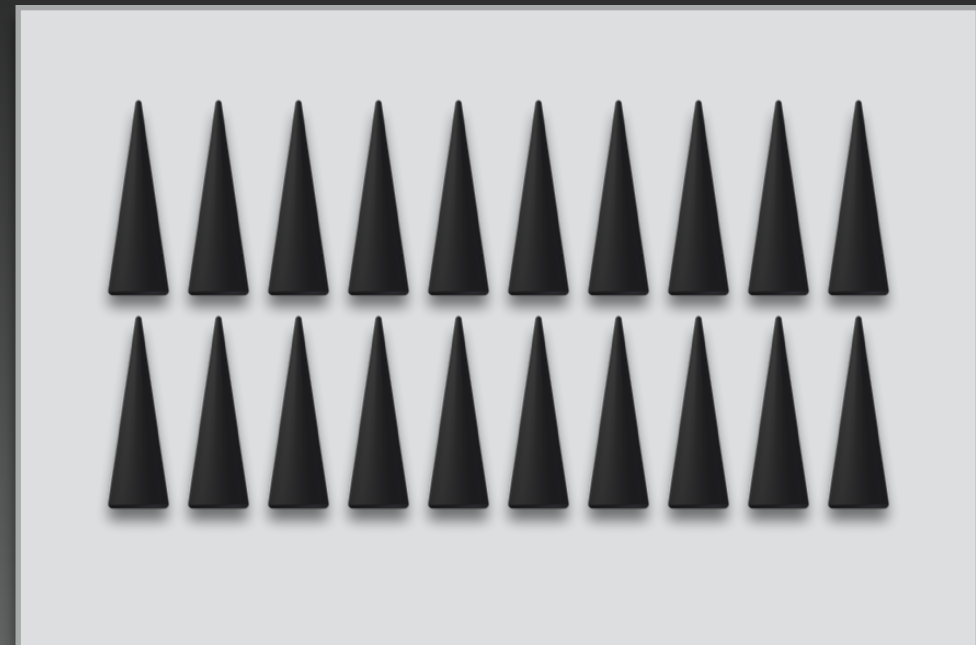
SCENARIO 2

PARTY HAS DECLARED 50 WARHEADS; THEY ARE STORED AT TWO (DECLARED) SITES

SITE A



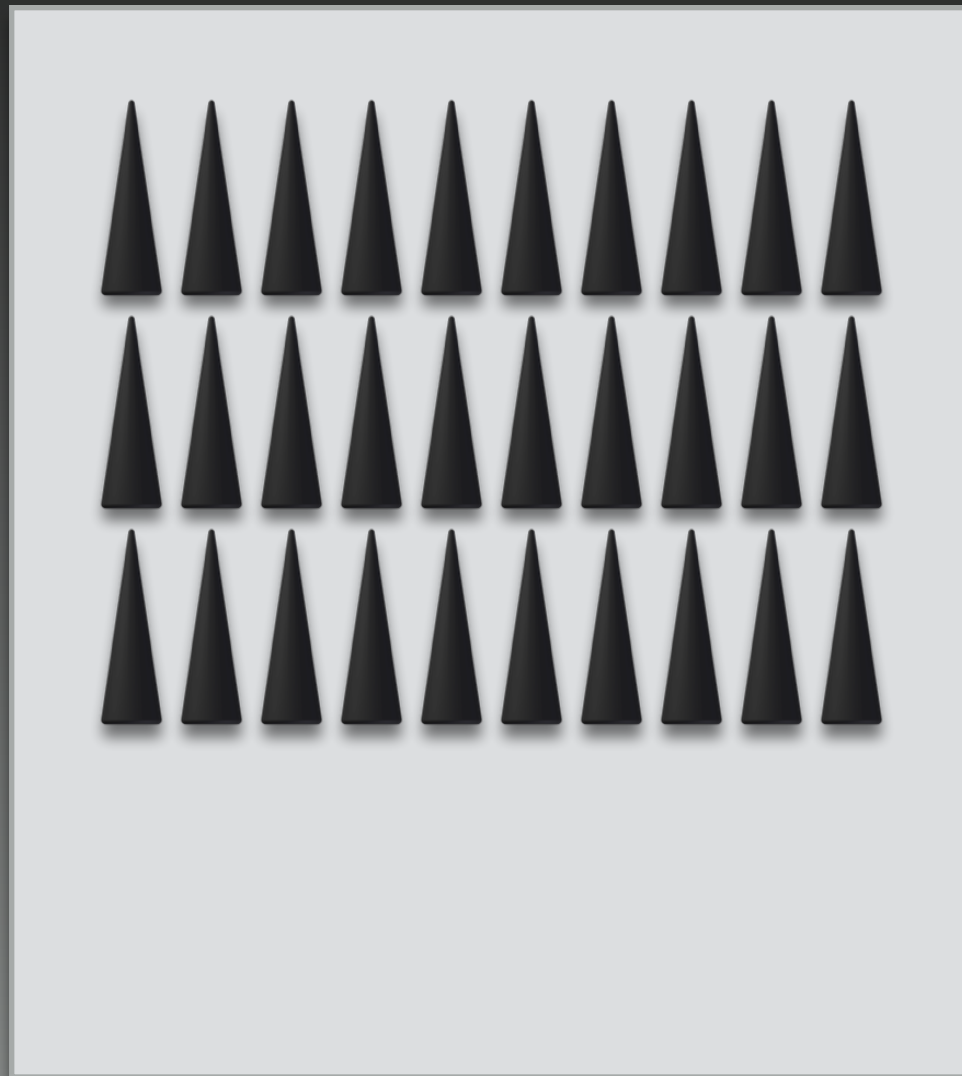
SITE B



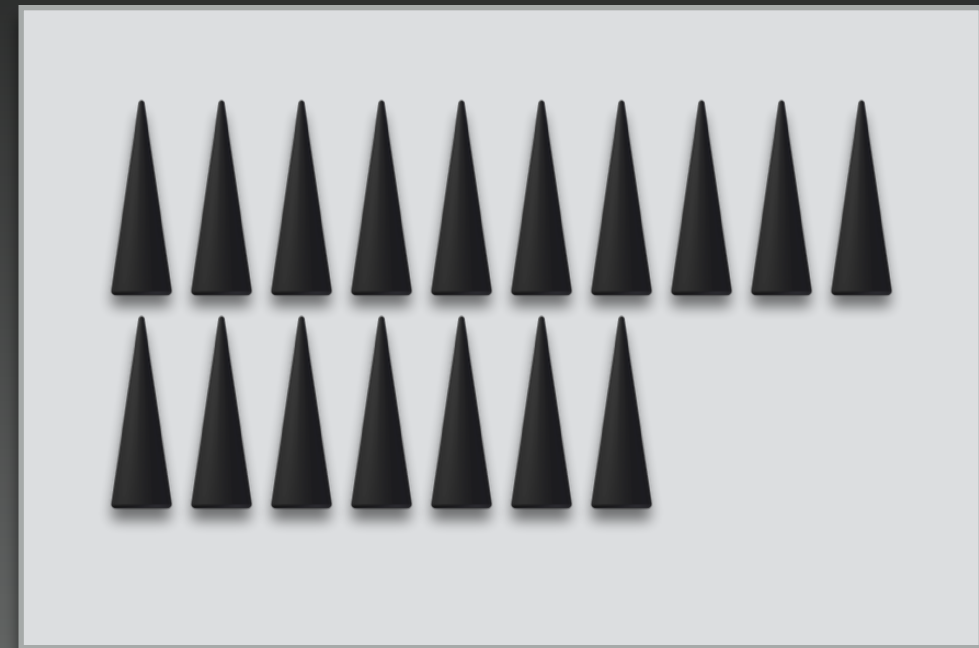
SCENARIO 2

PARTY HAS DECLARED 50 WARHEADS; THEY ARE STORED AT TWO (DECLARED) SITES

SITE A



SITE B

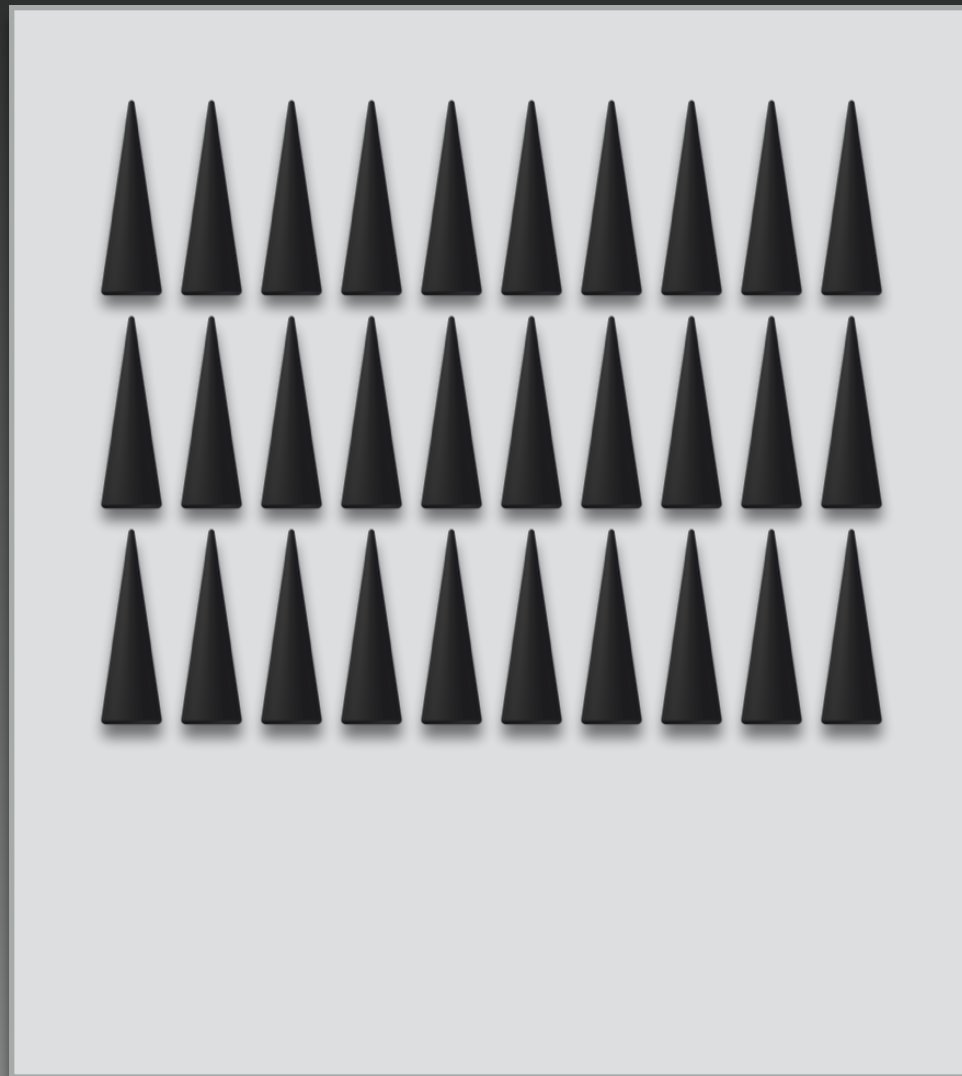


Some items are moved to a previously unknown third site (perhaps for maintenance)

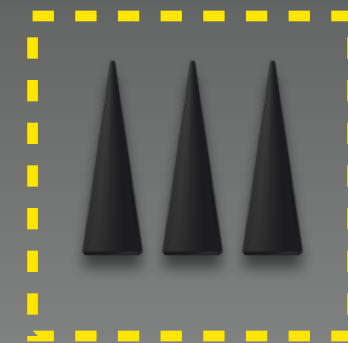
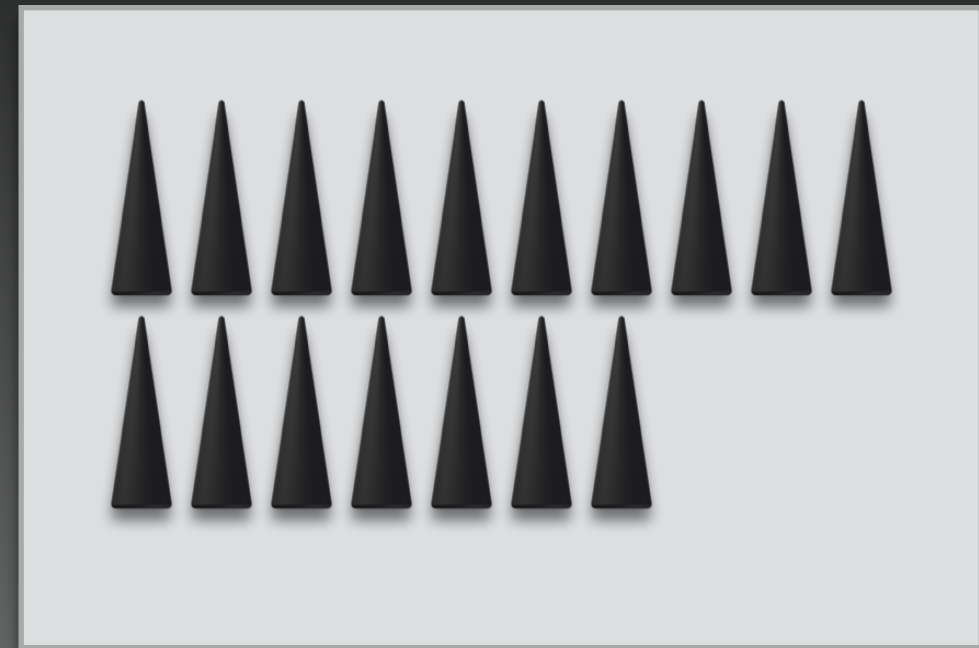
SCENARIO 2

PARTY HAS DECLARED 50 WARHEADS; THEY ARE STORED AT TWO (DECLARED) SITES

SITE A



SITE B



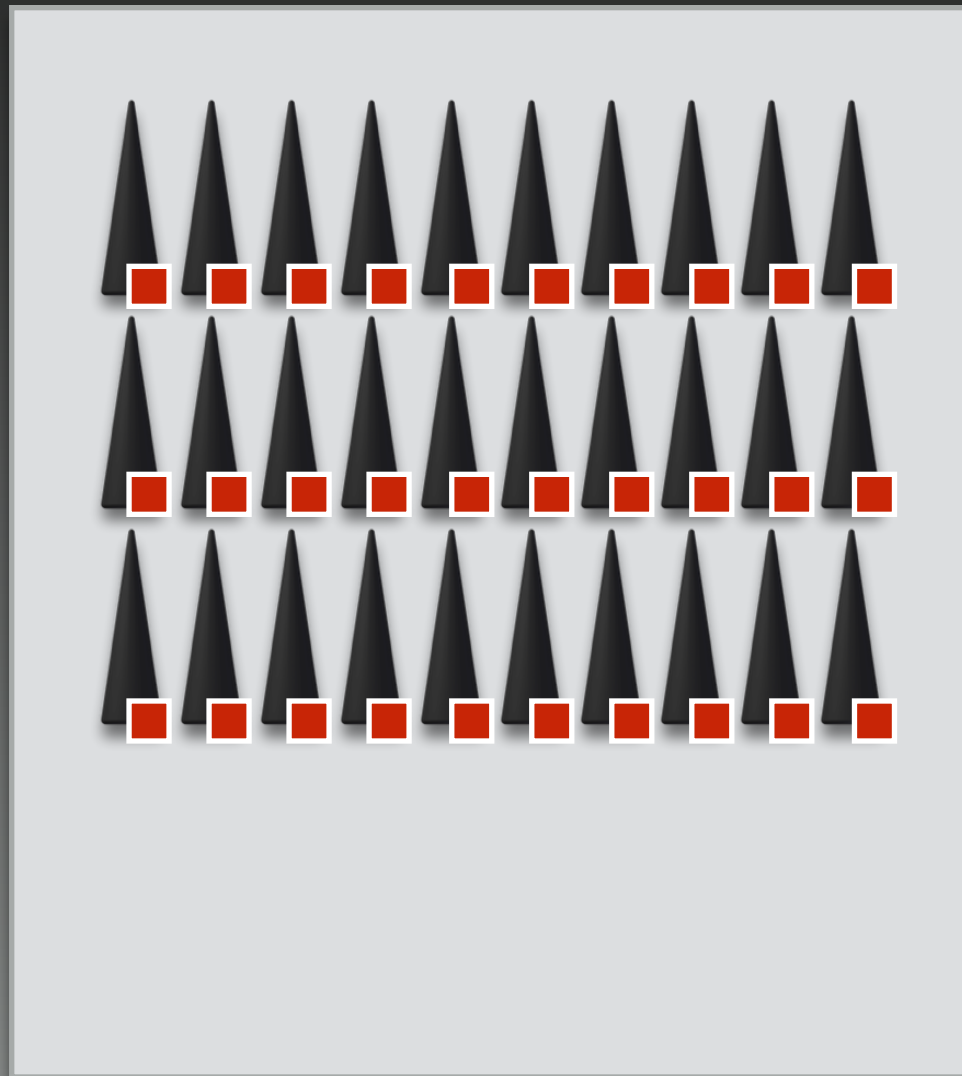
Some items are moved to a previously unknown third site (perhaps for maintenance)

Without buddy tags, the presence of these items may be considered suspect

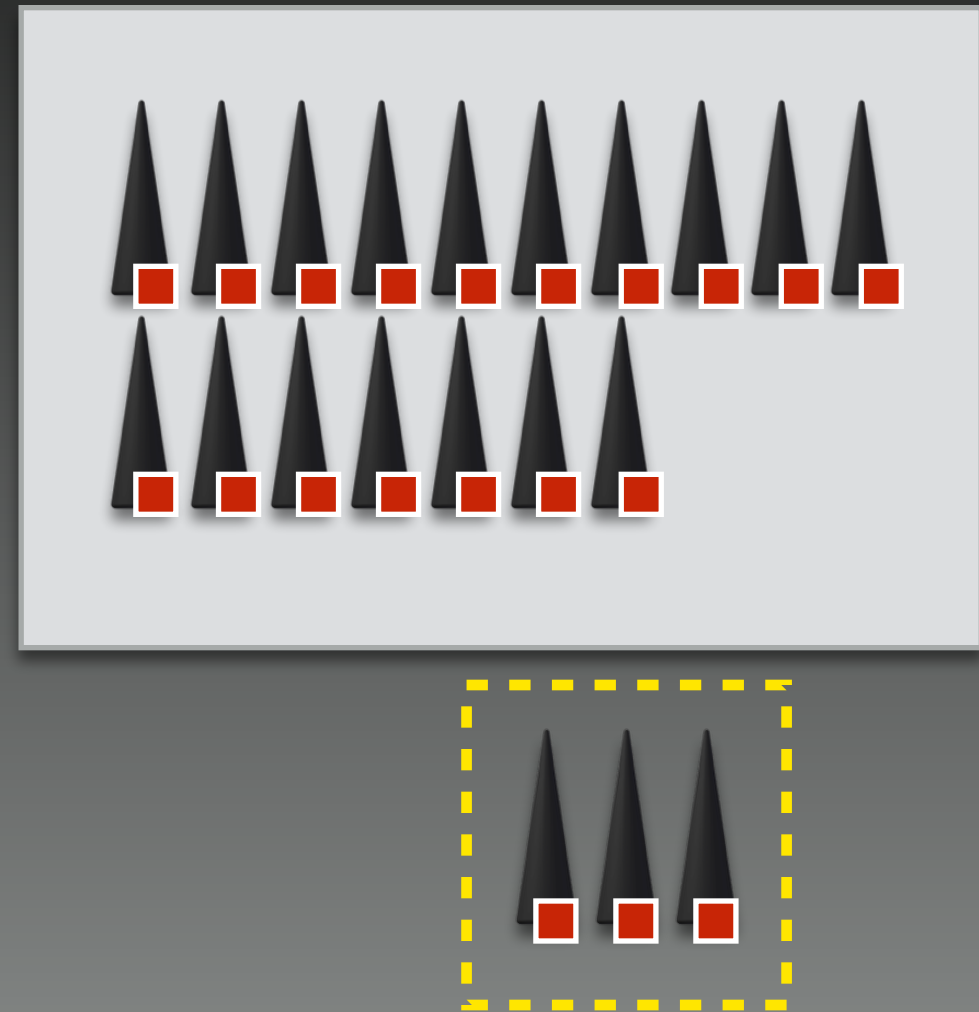
SCENARIO 2

PARTY HAS DECLARED 50 WARHEADS; THEY ARE STORED AT TWO (DECLARED) SITES

SITE A



SITE B



Some items are moved to a previously unknown third site (perhaps for maintenance)

Without buddy tags, the presence of these items may be considered suspect