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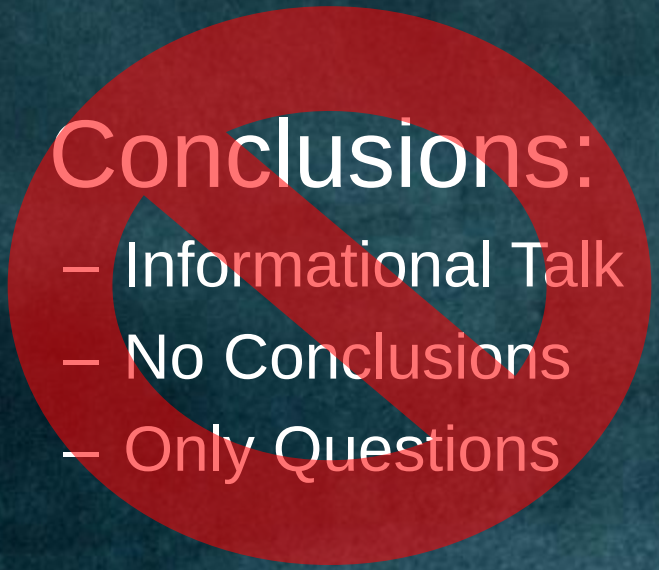
ATR
PRACTICAL DEVELOPMENT CONSIDERATIONS

Mandatory ADSA Conclusion Page



Agenda / Questions

– What is certification?

– How do you prepare?

– How do you know when you're ready?

– How Does the 'test' translate into real life?

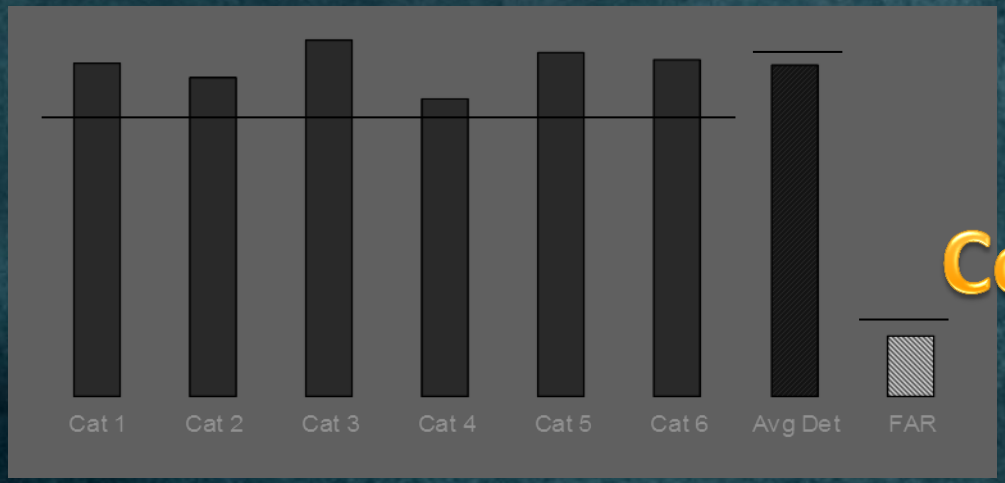
TSA, ECAC, ISA, China, ROW

WHAT IS CERTIFICATION?

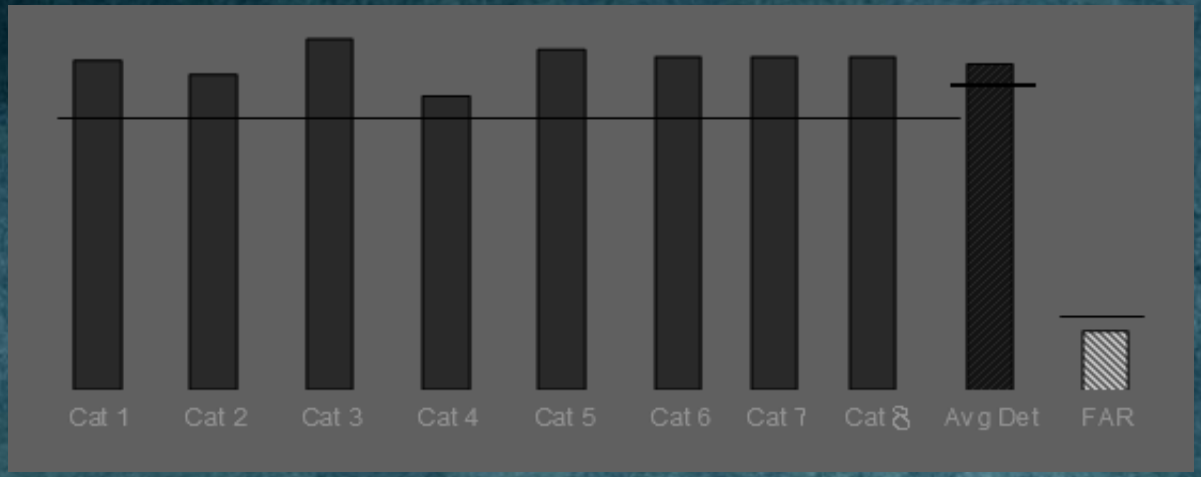
Certification

- Many standards exist:
  - TSA 2005
  - TSA 2010
  - ECAC EDS, standards 1,2,3
  - ECAC LEDS, Types A,B,C, standards 1,2
  - China EDS
  - ROW
- Common Elements:
  - Database runs and pre-test showing compliance and ability to pass
  - Machine installed in the designated lab
  - Blind test, no visibility to vendor on nature of bags and explosives
  - Physical bags scanned (retests could be done offline under certain conditions)
  - Binary test results, Pass/Fail

EDS Certification



Conventional Cert.



HME Cert.

Explosive Detection Systems

- EDS designed to detect:
  - Conventional Explosives:
    - Military/Commercials/Low Velocities
  - Home-Made Explosives

- Know your explosives:
  - Explosives 101 should be required for all players in this industry

‘Conventional’ Explosives

- Military/Commercials/ Low Velocities
  - Manufactured in a factory
  - *Some* level of QA
  - Known variability of material and ingredients

Categories of Explosives (courtesy of TSL)

Typical MSDS

Known Unknowns!

ORICA

Material Safety Data Sheet

Preparation Date: 22-Mar-2006 **Revision Date:** 15-Jul-2008 **Revision Number:** 1

SECTION 1 – PRODUCT AND COMPANY IDENTIFICATION

Supplier(s):

Orica Canada Inc.
Maple Street
Brownsburg, QC
For MSDS Requests: 450-533-4201

Orica USA Inc.
33101 E. Quincy Avenue
Watkins, CO 80137-9406
For MSDS Requests: 1 303-268-5000

Product Name: [redacted]

Product Code: 109
Alternate Name(s): [redacted]
UN-No: UN0241
Recommended Use: A detonator sensitive emulsion explosive.

Emergency Telephone Number: FOR CHEMICAL EMERGENCIES (24 HOUR) INVOLVING TRANSPORTATION, SPILL, LEAK, RELEASE, FIRE OR ACCIDENTS: **IN CANADA CALL:** THE ORICA TRANSPORTATION EMERGENCY RESPONSE SYSTEM AT **1-877-561-3636. IN THE U.S. CALL: CHEMTREC 1-800-424-9300. IN THE U.S.:** FOR LOST, STOLEN, OR MISPLACED EXPLOSIVES CALL: BATF **1-800-800-3855.** FORM ATF F 5400.0 MUST BE COMPLETED AND LOCAL AUTHORITIES (STATE/MUNICIPAL POLICE, ETC.) MUST BE ADVISED.

SECTION 2 – HAZARD IDENTIFICATION

Emergency Overview:
Risk of explosion by shock, fire of other sources of ignition. May cause skin irritation and/or dermatitis. Irritating to eyes. Harmful if swallowed. Oxidizing agent. May cause methemoglobinemia. May cause liver damage. May cause kidney damage.

Appearance:	Physical State:	Odor:
White/ Pink opaque, viscous putty-like	Viscous, putty-like	Odorless

SECTION 3 – COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS-No	Weight %
Ammonium Nitrate	6484-52-2	60-100
Sodium Nitrate	7631-99-4	10-30
Mineral Oil	64742-53-6	0-3
Aluminum	7429-90-5	0-15

Sensitivity to Ingredients

Homemade Explosives

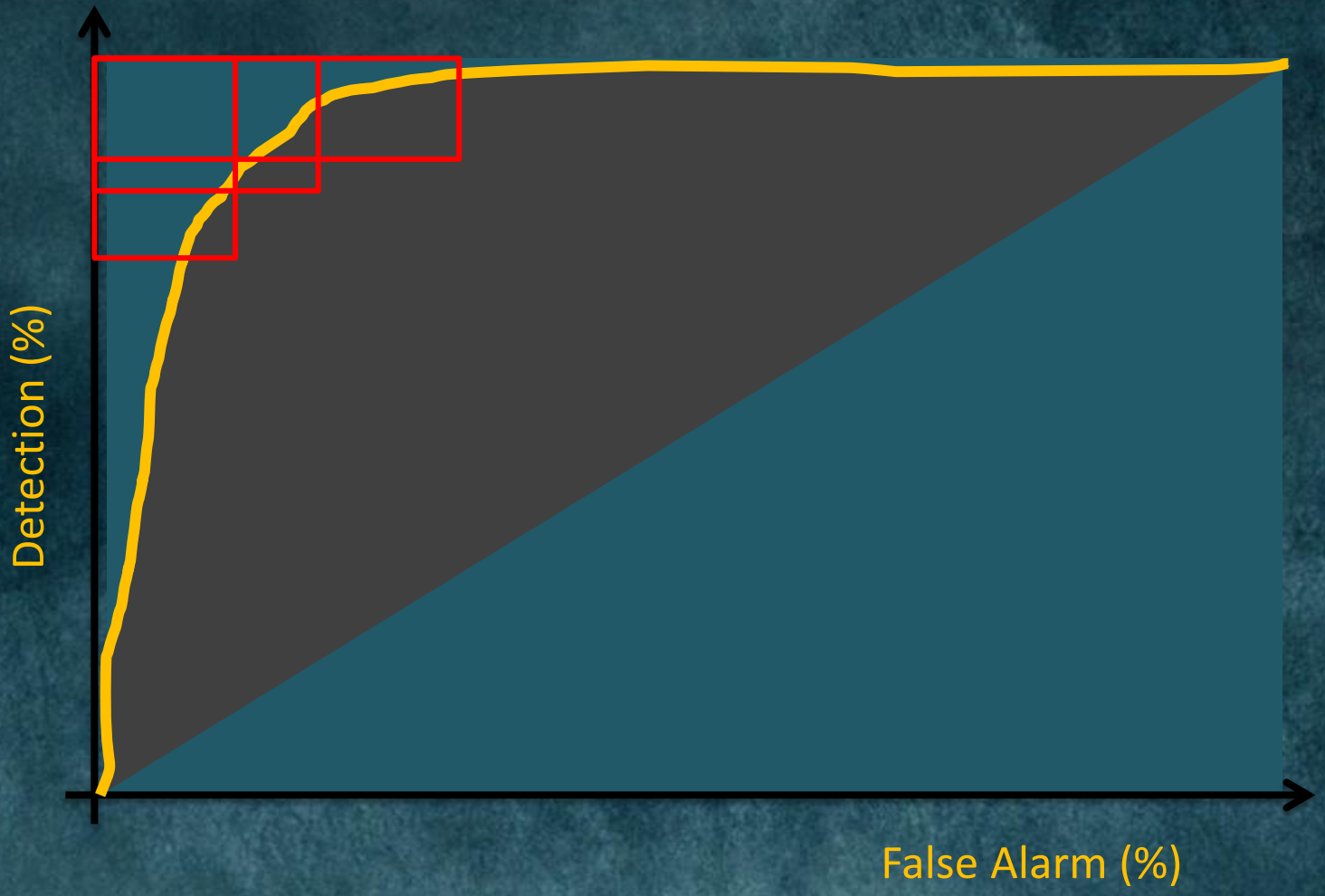
- What are they?
  - Liquids or solids/powders
  - Unknown formulations
  - Unknown ingredients
  - Unknown Contaminants
  - Unknown tapping pressure
  - No QA
- What do we know?
  - Explode
  - *Limited* list of known oxidizers
  - Unlimited list of fuels
  - Certain requirements for oxidizer/fuel ratios

Homemade Explosives

Are all EDS standards the same?

- Test methodology is relatively similar
- Material detected is slightly different between TSA and ECAC
- Threat Masses different as well
- TSA does not have LEDS standard, ECAC does
- ROW mostly follows ECAC or TSA

ROC, effect of requirements



Find anything that can explode!

HOW DO YOU PREPARE?

Preparation (the long winding road to Certification)

- Get Data
- Develop Algorithms
- Take Test

Rinse and repeat

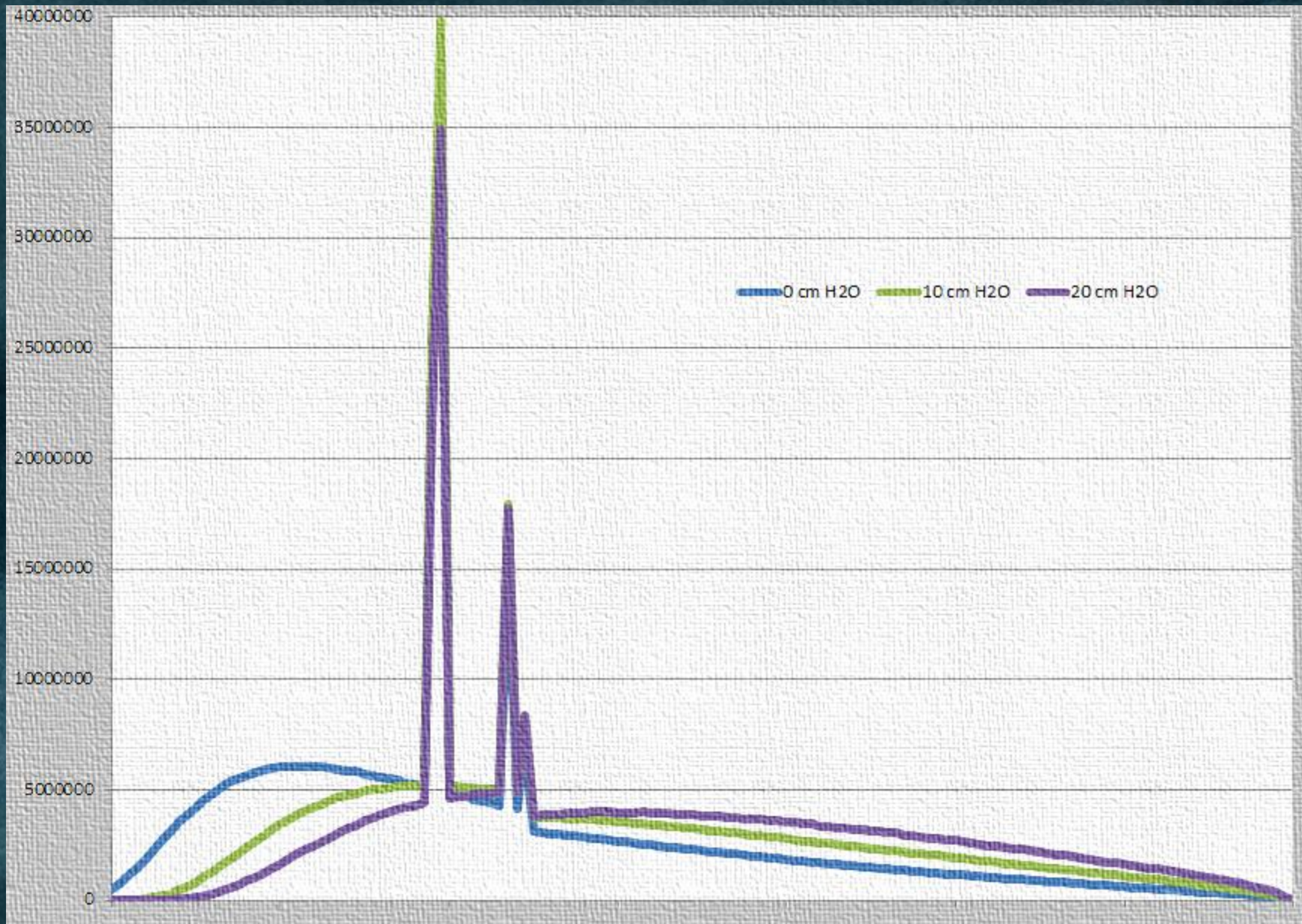
CERT Management Plan (2/2010)

Carl's Difficult Questions

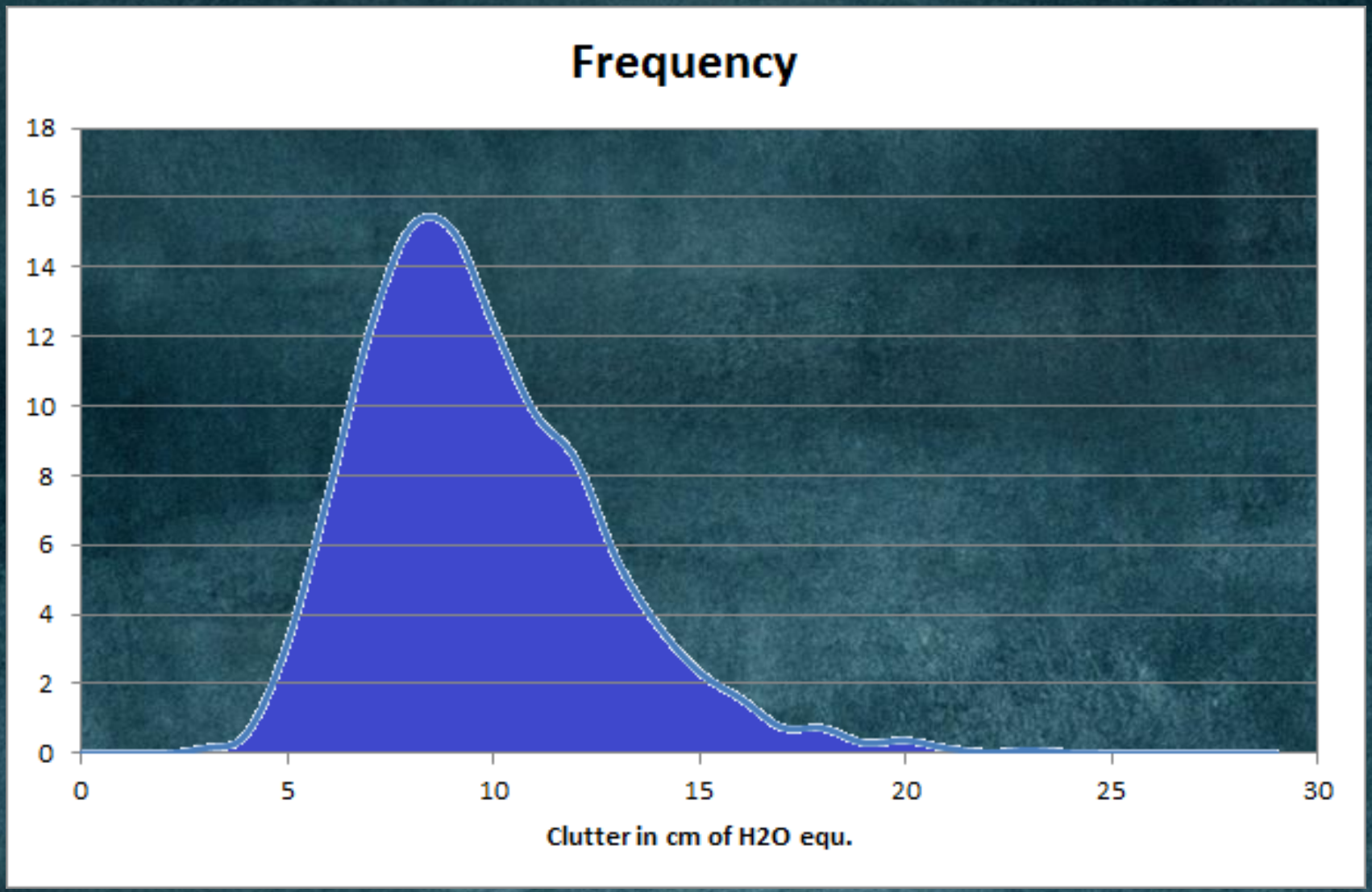
- *How to develop an ATR for hypothetical situations in which the following occur?*
  - *statistically insignificant number of samples for training and/or testing*
  - *overtraining may be 'required' to pass a test*
  - *requirement specifications make it difficult or impossible to pass testing*
- *How to prevent overtraining?*
- *What features are legal in an ATR?*

We lack a proper theory for how terrorists might behave, react and adjust tactics. Despite the massive amount of data available to the nature of possible future attacks, we are mostly in the dark.

Start with your system's Specs



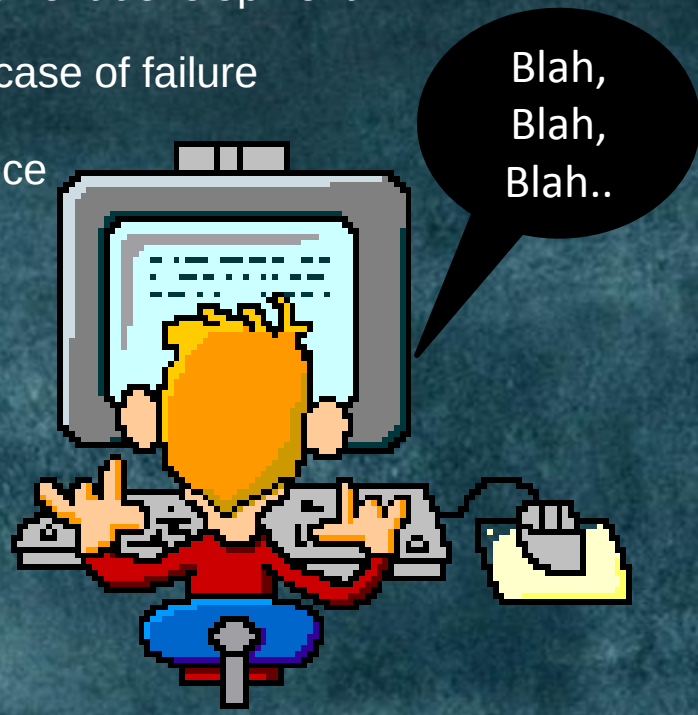
Analyze Clutter in Airport Bags



Predict effect of clutter on measured properties of novel explosives

Algorithm Black Box

- Algorithm Development
  - Concentrate on edge and corner cases first
  - Cycle back to ‘normal’ cases
  - Design and implement an architecture to support current development plan, future improvement plan, and backup plan in case of failure
  - In your schedule allow for failing the test at least once



Principal of Good Enough (POGE)

WHEN ARE YOU READY?

Are You Ready?

- Close obvious detection holes
  - Think like a terrorist, how can I defeat the system?
  - Discuss ‘holes’ with regulators
- Prevent overtraining
  - Use the ranges of explosive properties, not samples
  - Simulate concealment effects using existing data
    - One cannot realistically expect to get HME’s in every viable configuration

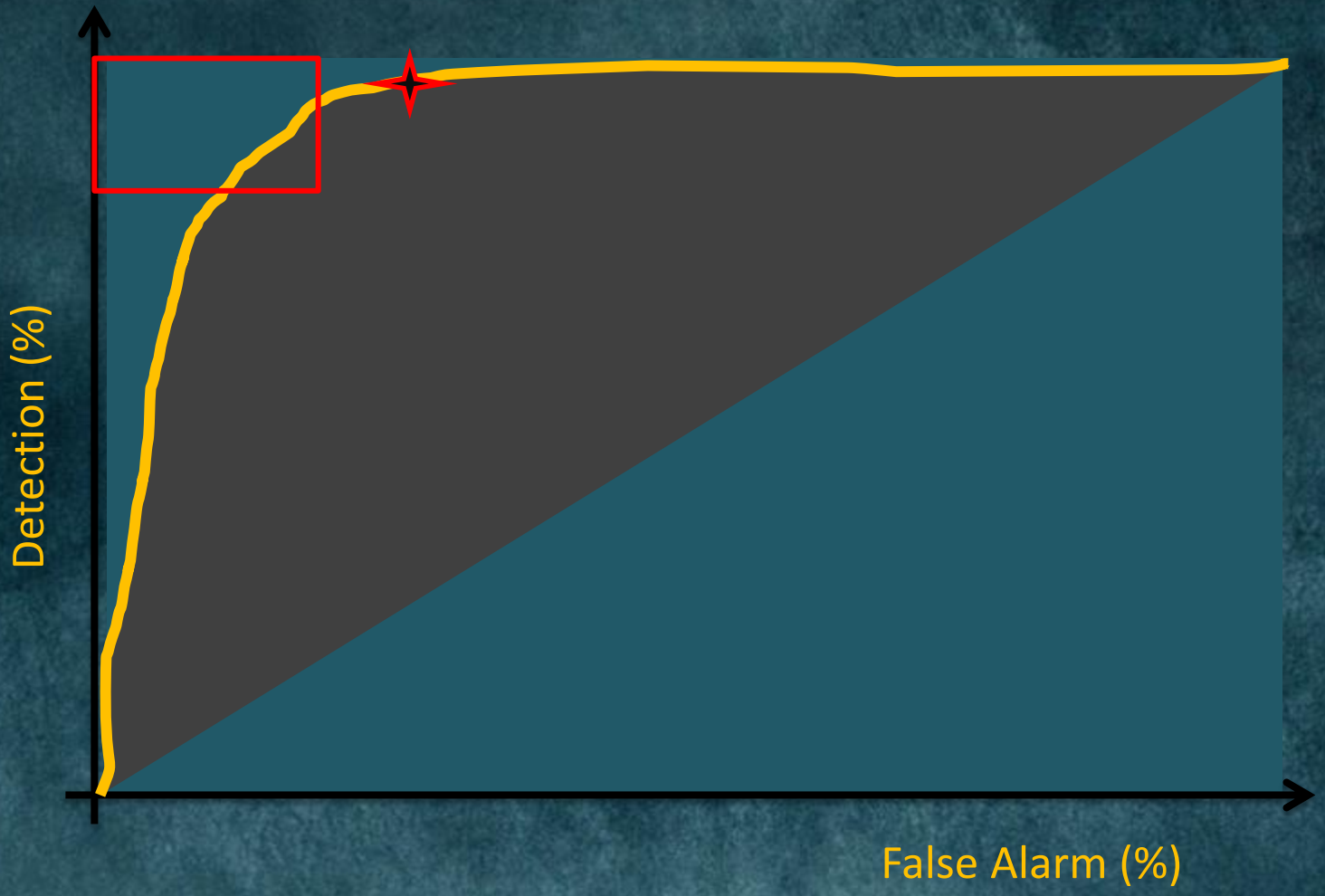
Warning 1:

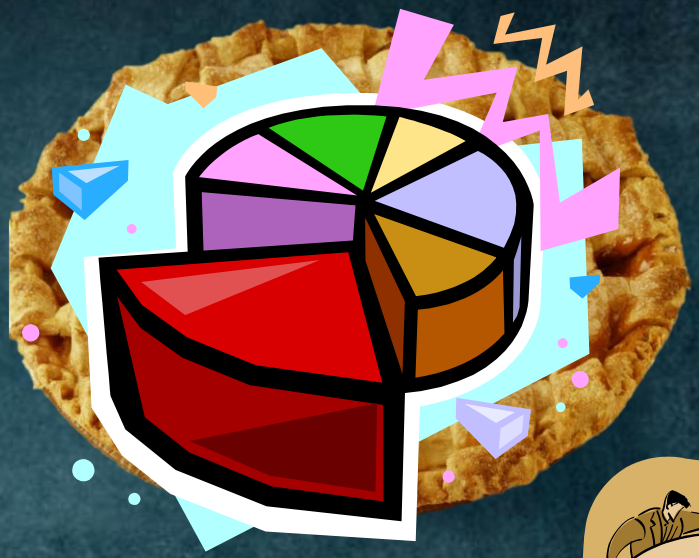
We can never make perfectly objective predictions. They will always be tainted by our subjective point of view. If you don’t look down, you can’t see holes.

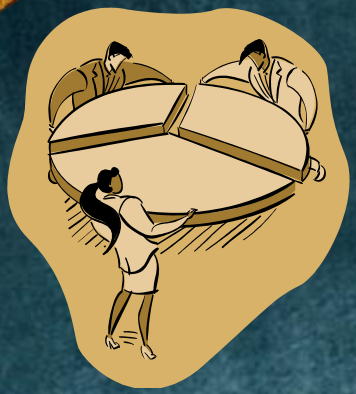
Warning 2:

In the era of big data and cheap storage, it’s common to believe that sheer volume of data obviates the need for theory and analysis . **Not So!**

ROC, Selecting Your Operating Point







Real Life Issues

YOU PASS, NOW WHAT?

Life of an EDS, outside the labs

- The impact of testing on field performance
  - Great variability between airports, destinations and season
- PD is less than 100%
  - What are the ramifications of a successful terrorist attack?
  - Scientists in Italy got jailed for failing to predict an earthquake!
  - Companies are indemnified by the government, but should we educate the public?
- The role of the human in the loop
  - These are automated detection systems, BUT if bag alarms, a human resolves the alarm. Give them tools, help improve the overall system performance
- How do you prove that a machine in the field operates equally well to that ‘golden’ machine tested in the labs?
  - Utilize the industry designed CT test phantom (the ‘NIST’ bags)
- MTBF, uptime, service costs, service availability, parts in stock. Take PRIDE in your product!

Thank You!

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Listen, I've got my own problems!