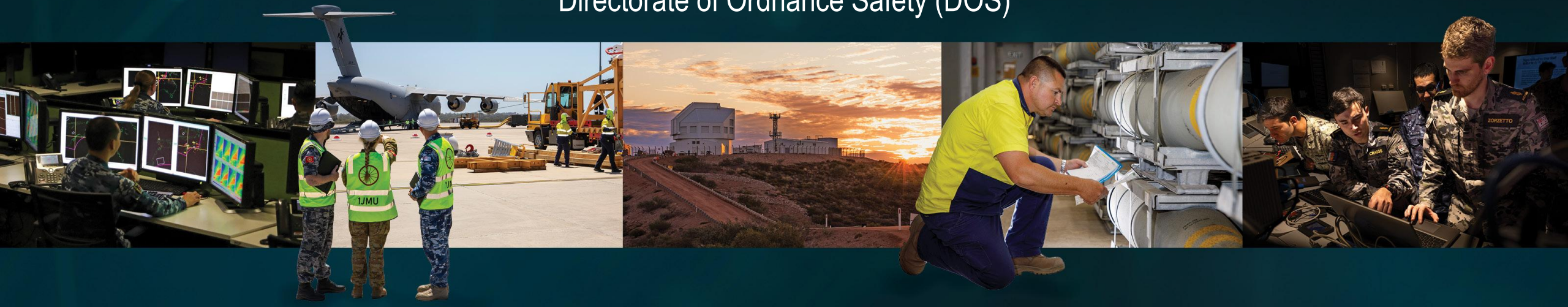
JOINT CAPABILITIES GROUP

JOINT LOGISTICS COMMAND

ENERGETIC MATERIAL QUALIFICATION (EMQ) REQUIREMENTS

Khuong Vuong
Technical Staff Officer – Explosives (TSO-X)
Directorate of Ordnance Safety (DOS)



Objective and Outline

To provide rationale, explain process, benefits and limitations of Energetic Material Qualification (EMQ)

Outline:

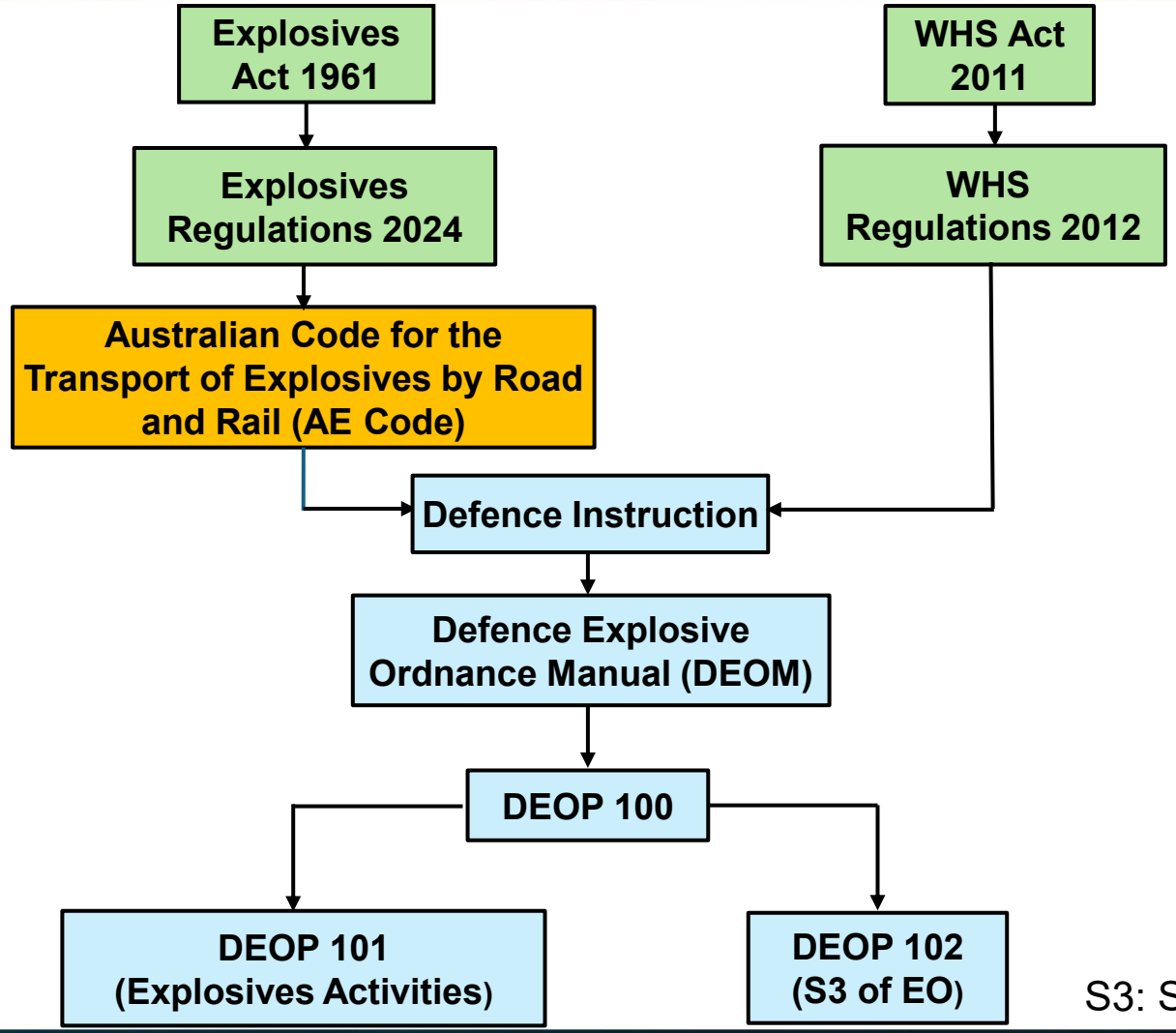
- Legislation and Defence Explosives Safety Regulatory Framework (ESRF)
- Defence EMQ policy & NATO standards
- Benefits and limitations of EMQ
- Examples of recent EMQs
- Summary and future policy update
- Acknowledgements.

Explosives Safety Policies

Commonwealth Legislation

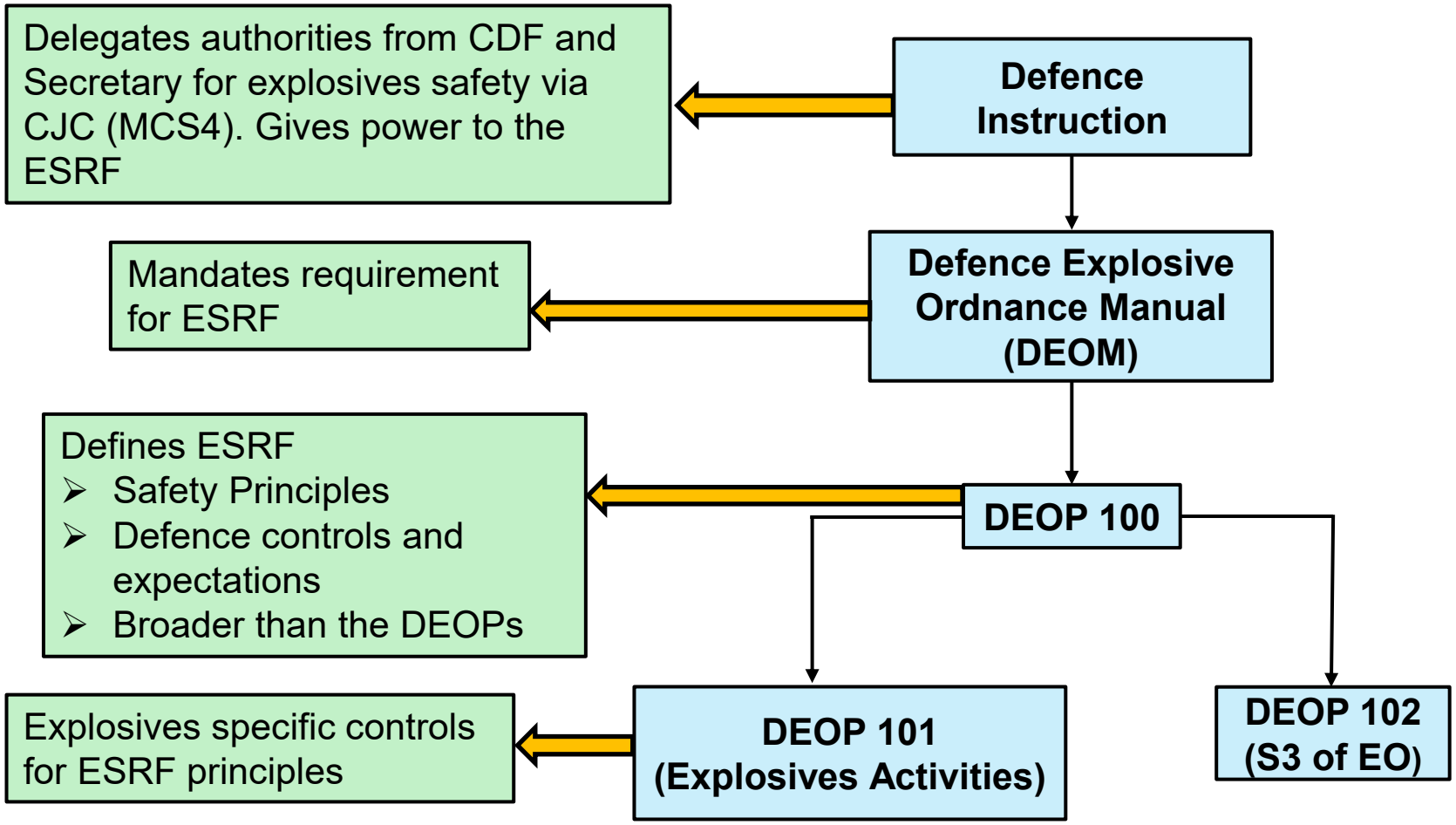
National Best Practice

Defence Policy



S3: Safety and Suitability for Service

Defence EO Publications - Roles



ESRF: Explosives Safety Regulatory Framework; S3: Safety and Suitability for Service

Explosives Safety – Fundamental Concepts

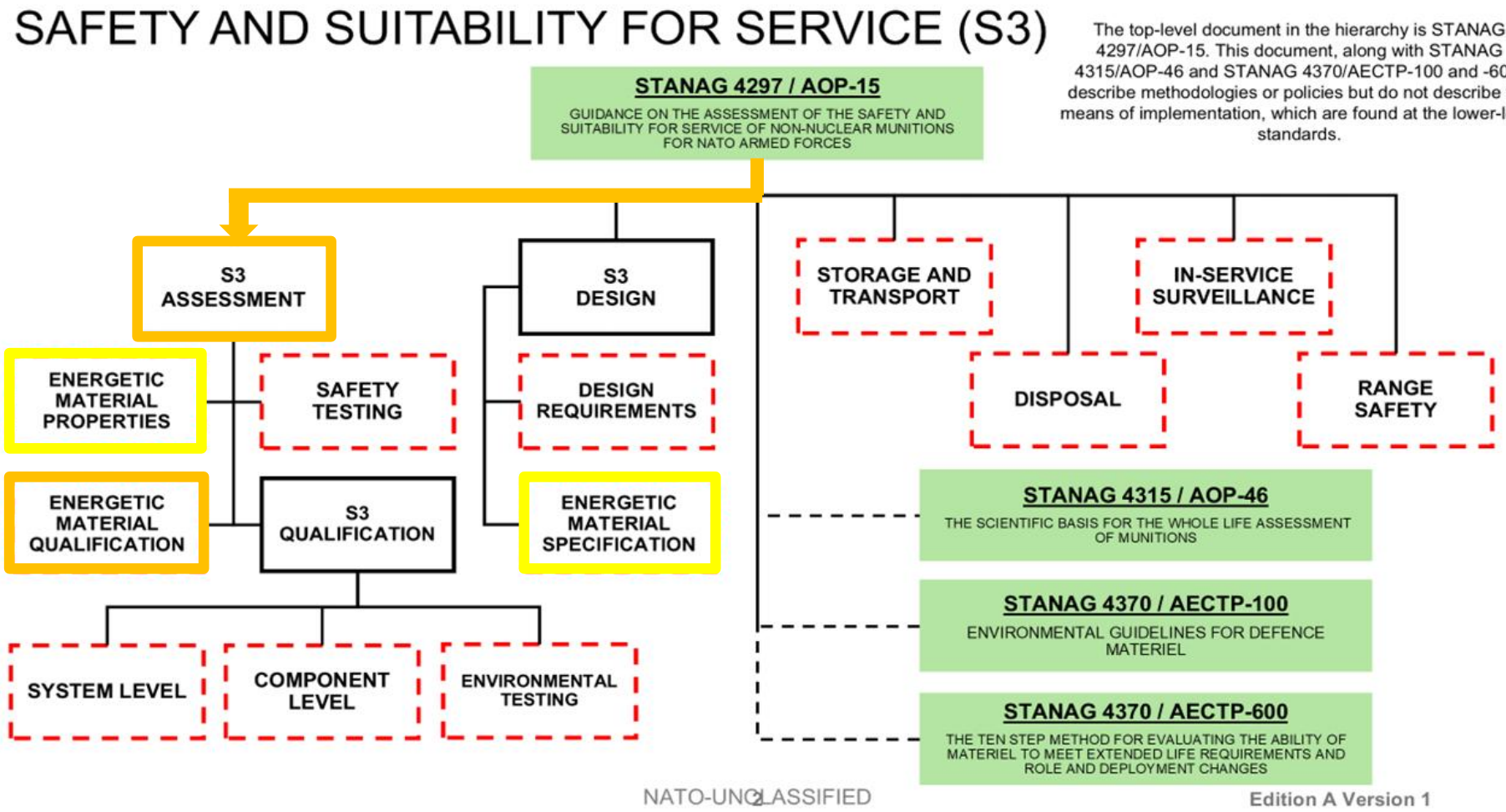
- **ESRF** - Outcome Focused, Principle Based



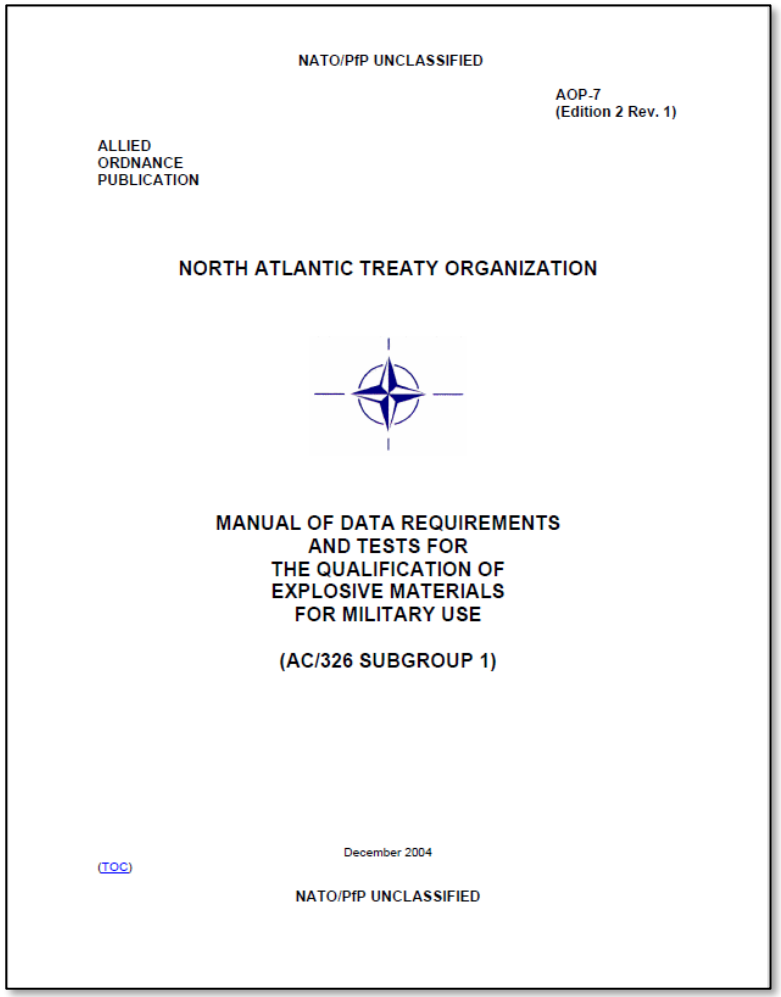
ESRF – Materiel Safety Principles – EMQ Purpose

- **Principle 5.** *Explosives and munitions are designed, manufactured and controlled throughout their life to* ***eliminate explosives safety hazards*** *and/or* ***minimise the risks of*** *an explosives safety mishap* ***so far as is reasonably practicable (SFARP****).*
- **Principle 6.** *The* ***explosives safety hazards*** *and* ***residual risks*** *of explosives and munitions shall be* ***determined*** *and* ***communicated*** *to affected Services, Groups and others (including non-Defence entities) so that* ***risks can be controlled and managed*****.**
- EMQ purpose: Ensure only EMs which are **sufficiently characterised** and **assessed as safe and suitable for use** are considered for military applications. Contribution to **materiel safety** concept, **minimising risk SFARP.**

Safety and Suitability for Service (S3)



STANAG 4170 / AOP-07



NATO/PfP UNCLASSIFIED

AOP-7
(Edition 2 Rev. 1)

ALLIED
ORDNANCE
PUBLICATION

NORTH ATLANTIC TREATY ORGANIZATION

MANUAL OF DATA REQUIREMENTS
AND TESTS FOR
THE QUALIFICATION OF
EXPLOSIVE MATERIALS
FOR MILITARY USE

(AC/326 SUBGROUP 1)

December 2004

(TOC)

NATO/PfP UNCLASSIFIED

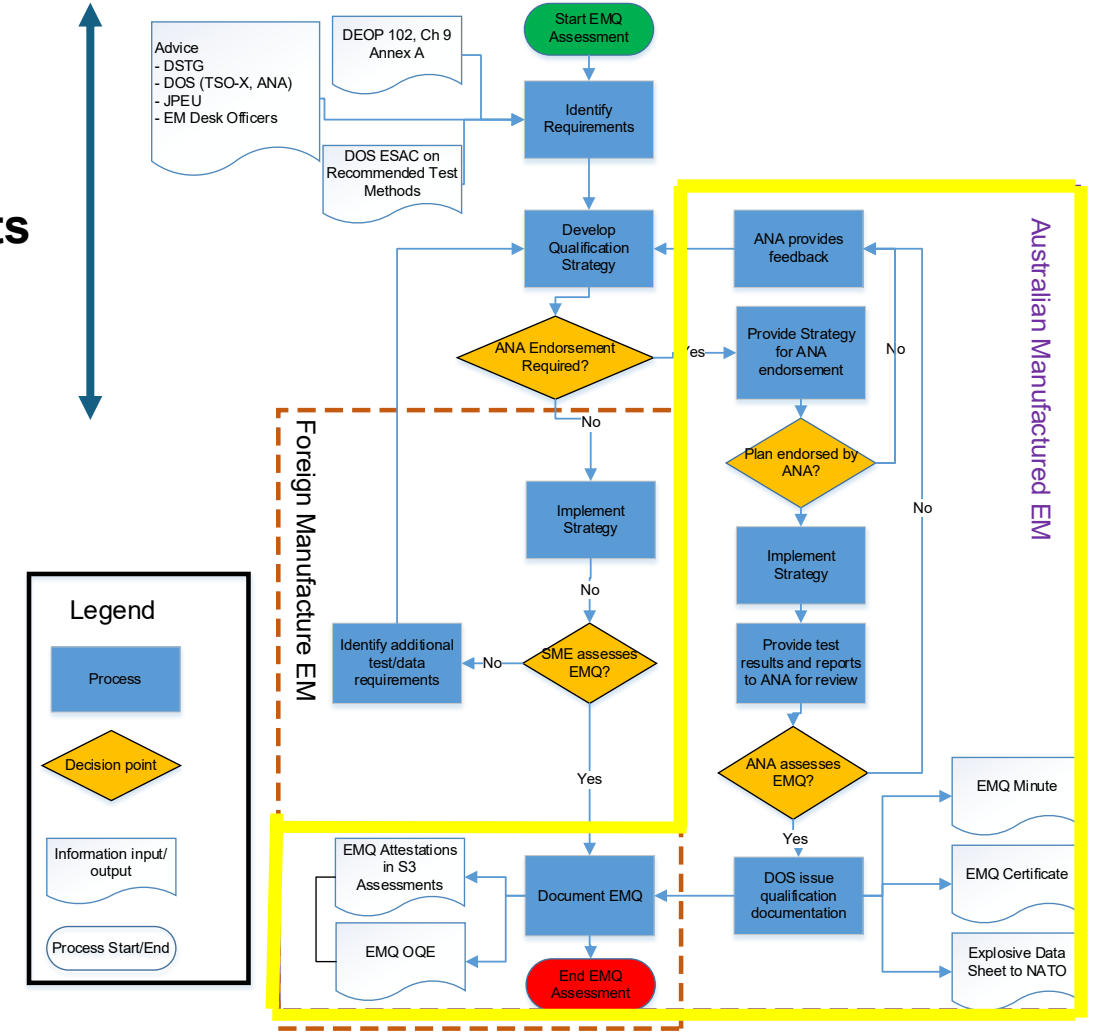
- **STANAG 4170 /** AOP-07
  - AOP-07.01 SRD: Catalogue of qualified EM
  - AOP-07.02 SRD: National requirements and test procedures
  - AOP-07.03 SRD: National Authorities
- **AOP-07 - Two-phase**: Qualification and Final (Type) Qualification → Australian context: EMQ (DOS) + Technical Certification (CENGR Cell)
- **DEOP-102, Part 2, Annex 9A** is Defence policy on Energetic Material Qualification.

Defence EMQ Policy – DEOP 102

- DEOP 102 – Part 2 – Chapter 9 - Annex 9A: *'All Energetic Materials (EM) intended for use by Defence **must be tested and assessed** to the requirements of the Australian National Authority (ANA) for qualification of EM to characterise the properties of the material and its **suitability** for use in the **intended role(s)** and Explosive Ordnance (EO).'*
- EMQ **must** be considered when:
  - Development/ Acquisition of a new capability
  - Change in the source of EM or components
  - Change in the production, manufacturing process or specification of the EM
  - Significant break in production or loss of manufacturing competence
  - EM degradation or materiel incompatibility of the EO are identified.

EMQ Process

Identify Requirements



Implementation

Assessment

EMQ Process - Identify Requirements

- The EMQ sponsor: to develop a qualification strategy
  - DEOP 102, Part 2, Annex 9A: Qualification of Energetic Materials
  - Explosive Safety Advisory Circular (ESAC) 2024/001 – Recommended EMQ Tests
  - **Advice**: DSTG, DOS (ANA, TSO-X), JPEU, EM Desk Officers
  - **ANA endorsement**.

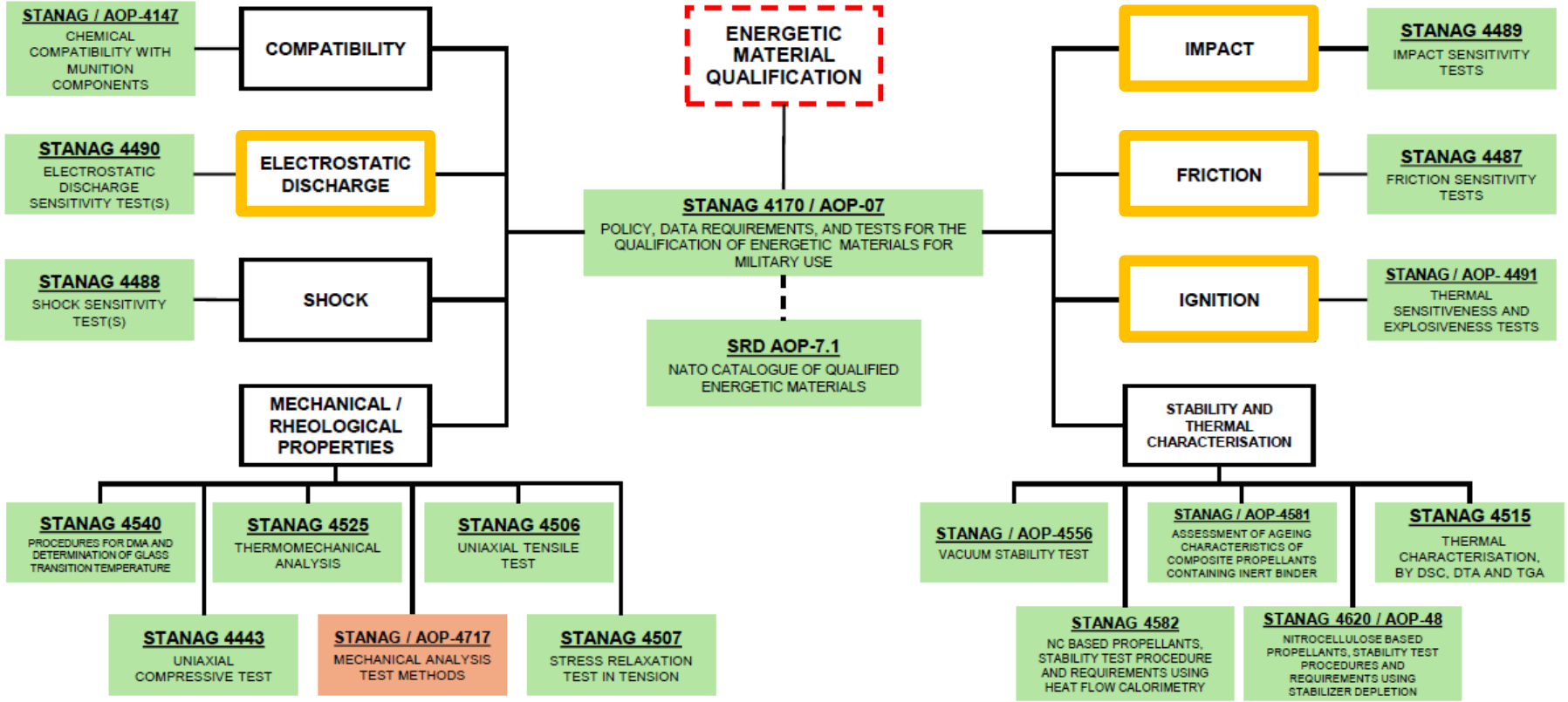
- Foreign produced EM: endorsement by ANA not required
  - Always obtain OQE
  - Suitable SME: assess if the data meets Australian EMQ requirements
  - If **doubt** exists consult with SMEs and DOS.

NATO - AOP-07 and Test Standards

ENERGETIC MATERIAL – QUALIFICATION

AOP-15.2

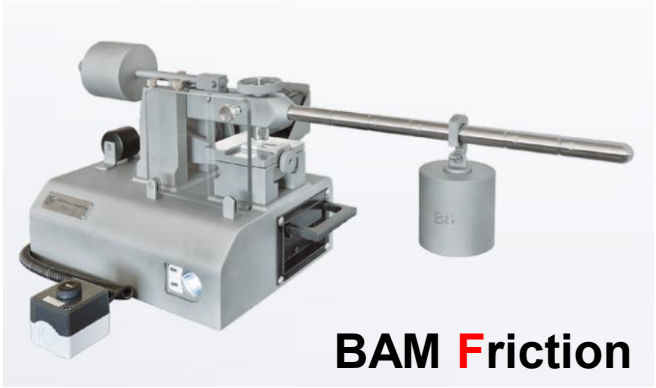
The purpose of Energetic Material Qualification is to determine whether an energetic material possesses properties which make it safe and suitable for consideration for use in its intended role. STANAG 4170/AOP-07 documents the agreement of participating nations to qualify energetic materials and provides a standardized methodology by which energetic materials are to be assessed.



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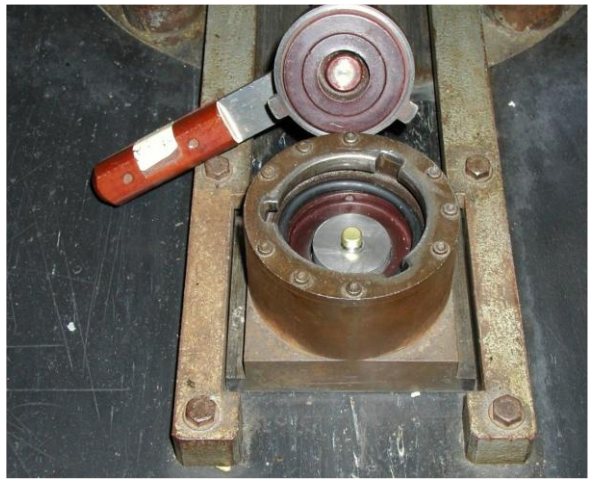
Edition A Version 1

FISH Tests



BAM Friction





Rotter Impact

Images from OZM Catalogue, DSTG SOPs and UK EMTAP



BAM Impact



ESD Test



Ignition Temperature (Heat) Test

EMQ Process – Implementation

- Conduct the tests
  - All tests **must** use the **final** formulation
  - Test samples representative of production
  - Consider additional tests to add value
  - On-going communications between stakeholders
- Test results: report(s) + other required documents *e.g.* EHDS, technical specifications.

EMQ Process – Assessment

- DOS- ANA for EMQ **assess** test results and **issue certificate** if EMQ is supported
  - **Minute** detailing EMQ assessment, any caveats and limitations
  - Update Australian qualified EM register (link on DOS Intranet)
  - Provide NATO AOP-07 custodian with data-sheet for addition of the composition to AOP-07.1 SRD Catalogue of Qualified Explosives.
- End of EMQ.

Benefits and Limitations of EMQ

- Policy compliance and supporting WHS SFARP
- Performing EMQ as per international standards AOP-07 have added benefits
  - Better understanding of properties
  - Enable comparison with allies' energetic materials
  - Support lifing determination *e.g.* accelerated aging
  - Interoperability and credibility of Australian EMs in support of sovereign manufacturing.
- EMQ small scale tests: do not always correlate to large scale characteristics
  - A qualified EM **does not** mean that the EM (or EO containing it) is safe
  - All S3 aspects of the EO must be considered for IIS.

AX-2001- RAM 5 (PBXN-109 (AUS))

- AX-2001 (PBXN-109 (AUS)): qualified in 2019, used in BLU-111 and BLU-126 bombs. Produced in a rotary mixer
- Change in production method in using Resonance Acoustic Mixing (RAM)





- Completed sensitiveness tests, mechanical properties, aging tests, shock test (Large Scale Gap Test)
- Successfully filled BLU-126 bombs
- First Qualified EM processed with RAM.

AX-2002 Interim EMQ

- AX-2002
  - Very similar to PBXN-111
  - DSTG designed PBXW-115(AUST): qualified, not introduced into service
- Change of manufacturer & significant gap in production: re-qualification was required
- EMQ plan endorsed: mechanical and aging tests
- Impact (Rotter) test of AX-2002: highly sensitive to impact, more sensitive than RDX
  - Sensitiveness of the AX-2002 charge and of powder samples are **not directly correlated**
  - Typical for high ammonium perchlorate (AP) formulations
  - Importance of mechanical integrity of the explosive charge: cracks, defects ➔ powders ➔ *increase vulnerability to impact*
- Interim EMQ (30 Gal) completed Jul 2026 – aging tests not completed
- EMQ update is required on scale up.

Primary Explosives

- Dextrinated Lead Azide (DLA), Lead Styphnate (LS) and Azide Styphnate and Aluminium (ASA): used in detonators
- Manufacturer change from Thales Australia to NIOA
- EMQ plan endorsed 2023, updated 2025
- Tests recently completed: the **sensitiveness** of the three materials are **comparable** with **available data**
- EMQ pending finalisation of required documentation.

Summary and Future Policy Update

- EMQ: policy requirement enabling understanding & minimising risks SFARP. Additional values:
  - Improve our understanding of the EM
  - Increase interoperability
  - Increase acceptance of EM produced in Australia.
- Process to attain EMQ.
- Future policy update:
  - Test requirements: mandatory and recommended
  - Information requirements
  - Periodic EMQ review.

Acknowledgements

- DSTG
- GWEO-DENG
- GWEO-MD

Thank you!

QUESTIONS ?