Allowable Service Life Extension Determinations

Presented to:

2022 CAD/PAD Technical Exchange Workshop

Presented by:

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Assignment: Ordnance Assessment/Logistics Branch

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CAD/PAD Life

- Cartridge Actuated Devices (CAD) and Propellant Actuated Devices (PAD) begin their lives in manufacturing → Packaging
  - Complete manufacturing starts “shelf” life
  - Open package starts “install” life

CAD/PAD Evaluation

- CADs & PADs perform various functions in all critical military egress aircraft systems
  - CADs & PADs performance changes with time
  - The Ordnance Assessment (OA) Group assesses change using
    - OA/Quality Evaluation/Surveillance Test
    - Lot Acceptance Test
    - Qualification Test

Initial/Current CAD/PAD Life

- The latest ***approved*** Ordnance Evaluation Indian Head Technical Report determines current:
  - Allowed Shelf Life
  - Allowed Install Life and
  - Life limiting issues include:
    - Test Failure(s)
    - In-service Failure(s)
    - Out of specification with age and
    - Lack of long term data

Fleet Availability

- The fleet tries to schedule their deployment/maintenance cycles to accommodate unit replacement before they become overaged.
- Frequently, these deployment/maintenance cycles conflict with shelf/installed life predictions or stock availability. The choices are:
  - Deploy at risk,
  - Ground the aircraft, or
  - Deploy under a granted service life extension.

Request Service Life Extension

- The least risk to Aircrew Safety *and* Aircraft Availability is to operate under an approved Service Life Extension (SLE) request.
- SLE requests are submitted to the Virtual Fleet Support (VFS) SLE request module.
- VFS provides two types of data to evaluate SLEs:
  - Unit Identification and
  - Unit Shelf & Installed Age

VFS SLE Data

Unit Identification

- Assigned SLE Request No.
- Department Of Defense Identification Code (DODIC)
- Lot No.
- Part No.
- Part Serial No.
- Installed Aircraft Type
- Installed Aircraft Tail No. (BUNO)

VFS SLE Data

Unit Shelf & Installed Age

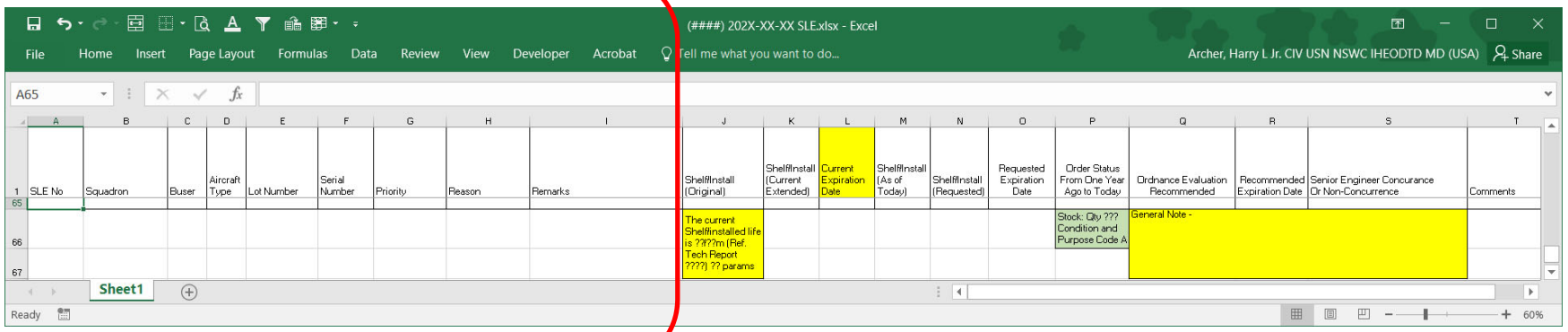
- Ordnance Evaluation Initial Life
- Latest Life Extension
- Current Life Requested Extension

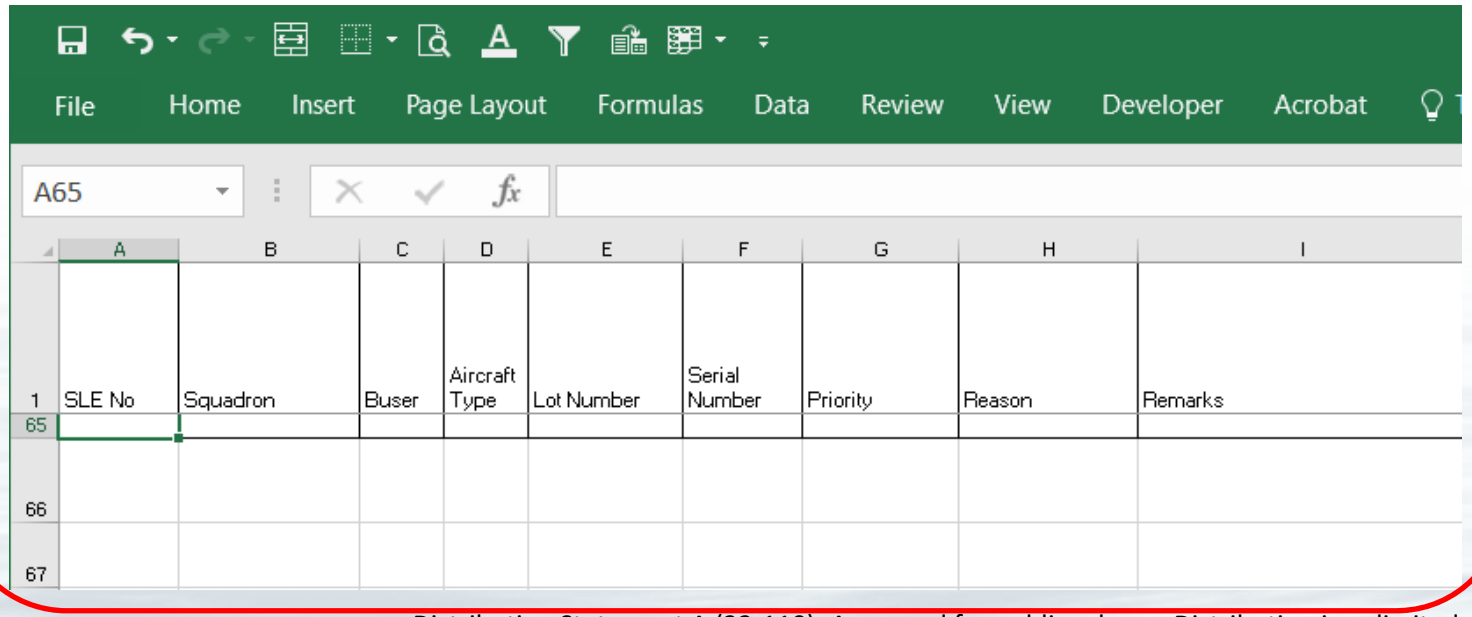
Ordnance Evaluation Download

A VFS Feature allows SLE Download

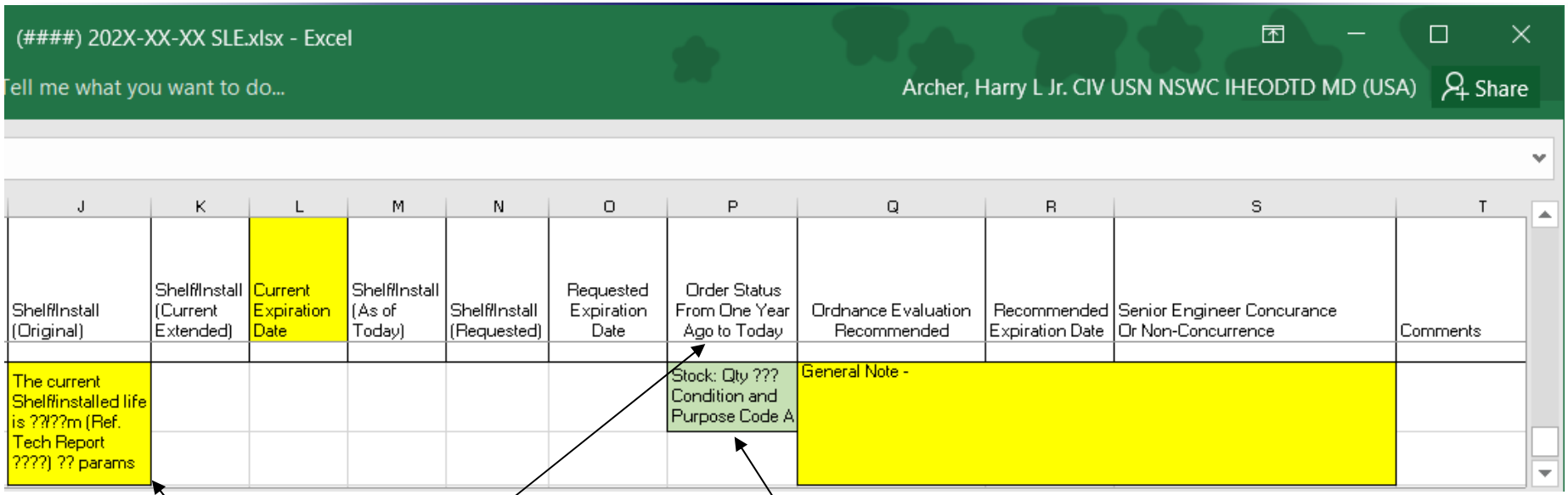
- Ordnance Evaluator (OE) downloads VFS data into an Excel® spreadsheet
- OE sorts data by the earliest expiration date
  - ➢ Determines the highest priority + LMS requests
- OE filters data by assignment aircraft
- OE populates data in a separate spreadsheet with one or more DODIC(s) *New*

Ordnance Evaluation Spreadsheet





Ordnance Evaluation Spreadsheet



Units on Order Status

Code A Stock

- Reference Unit Life Determination Technical Report Document
- VFS params give allowed extra shelf and installed life

SLE Ordnance Evaluator's Role

- The **Ordnance Evaluator**'s role is to recommend a service life and an install life that minimizes risk to the aircrew and aircraft.

- The Ordnance Evaluator's role *isn't* to maximize aircraft availability.

SLE LMS's Role

- The Logistics Management Specialist (LMS)'s role is to maximize aircraft availability by managing CAD/PADs supplied to aircrafts as need if available.

- The LMS's role *isn't* to evaluate a service life's affect on aircrew or aircraft safety.

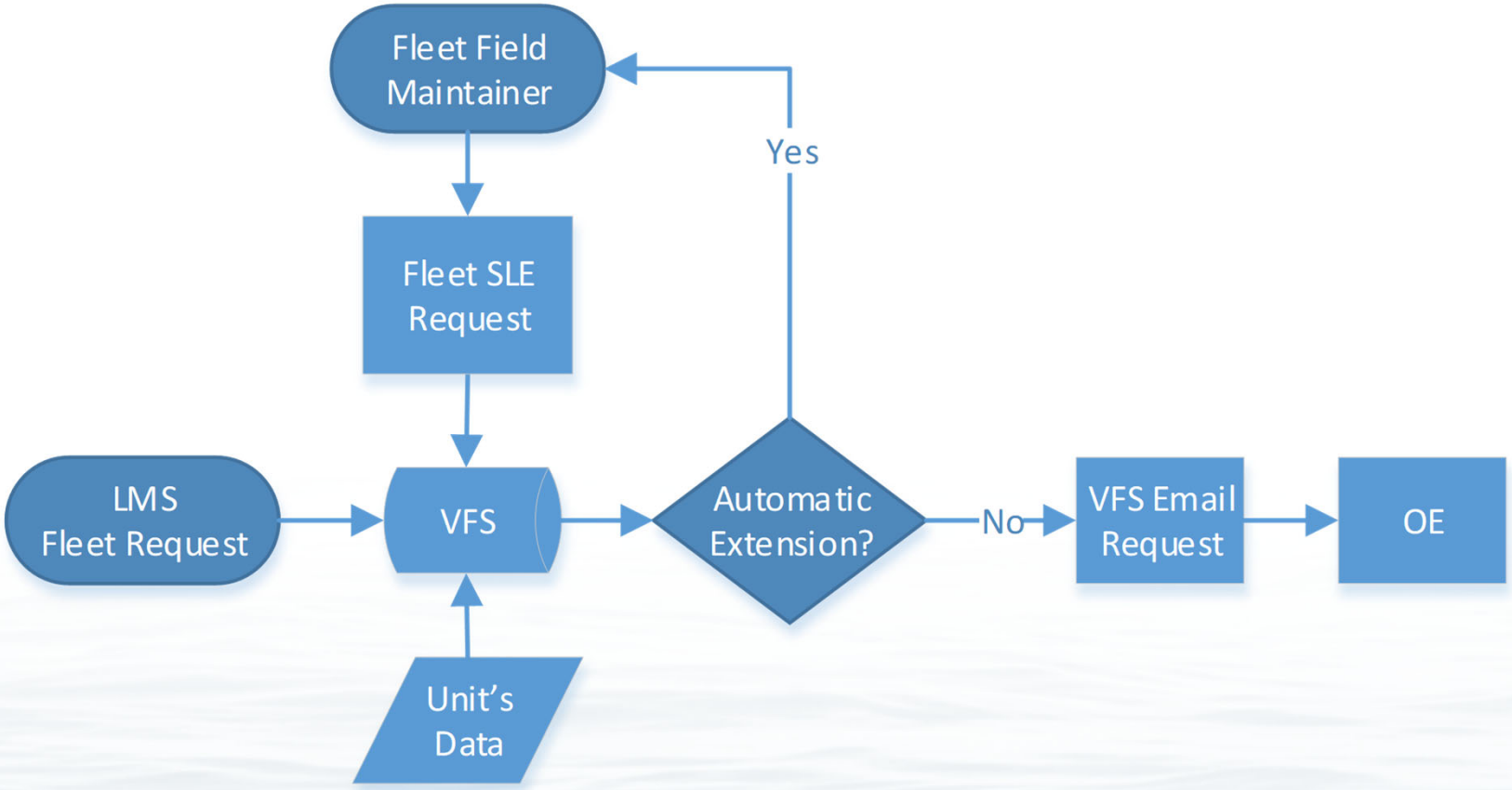
SLE Senior Engineer's Role

- The **Senior Engineer's** role is to concur or not concur with the Ordnance Evaluator's recommended allowable service life and install life

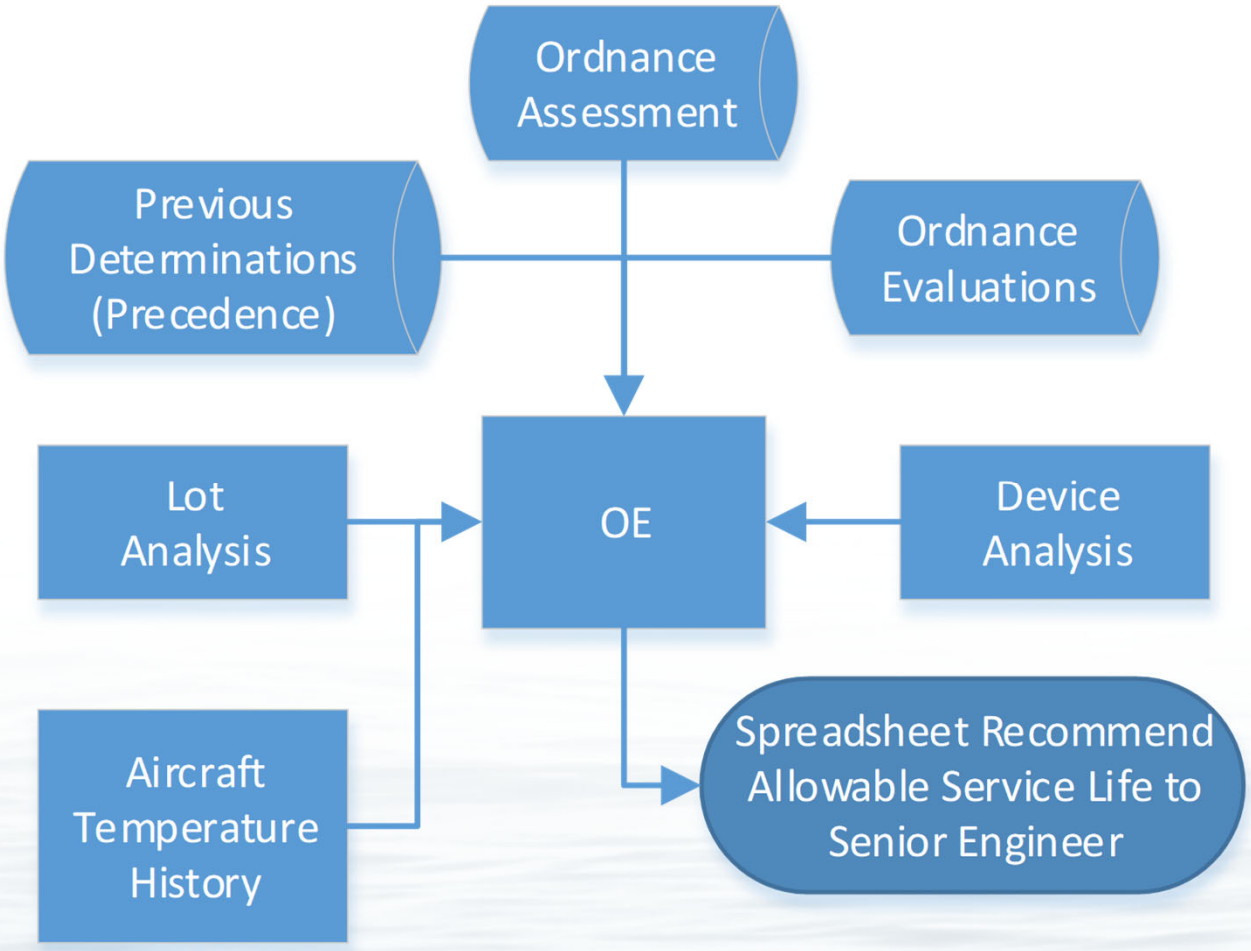
- If non-concurrence, the **Senior Engineer's** recommends a service life and install life that minimizes risk to the aircrew, aircraft and aircraft availability to the Ordnance Evaluator.

- The Program Office ultimately dictates what service life and install life the **Senior Engineer** may allow.

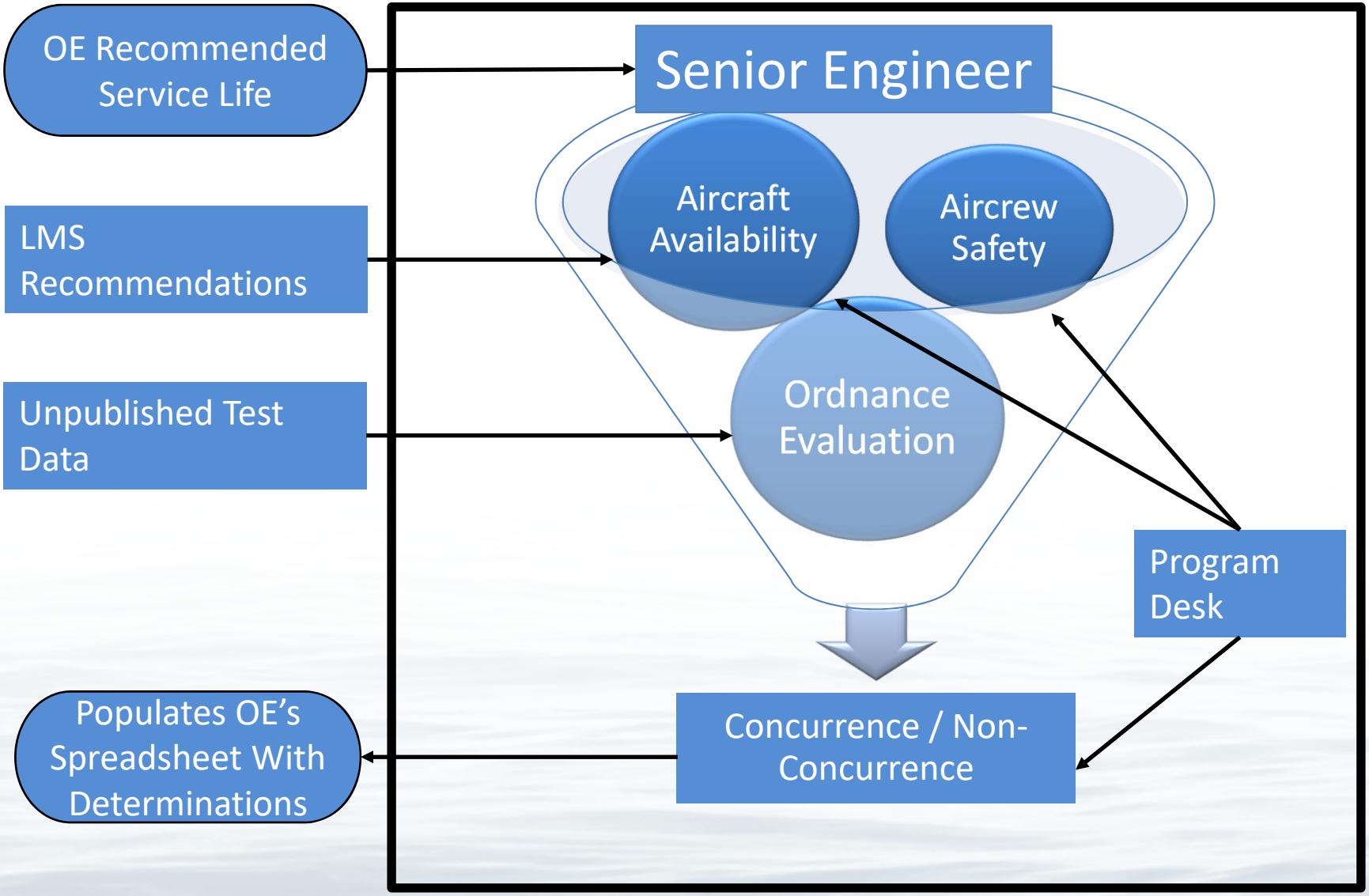
Ordnance Evaluator's SLE Recommendation



Ordnance Evaluator's SLE Recommendation



SLE Determination Data Flow

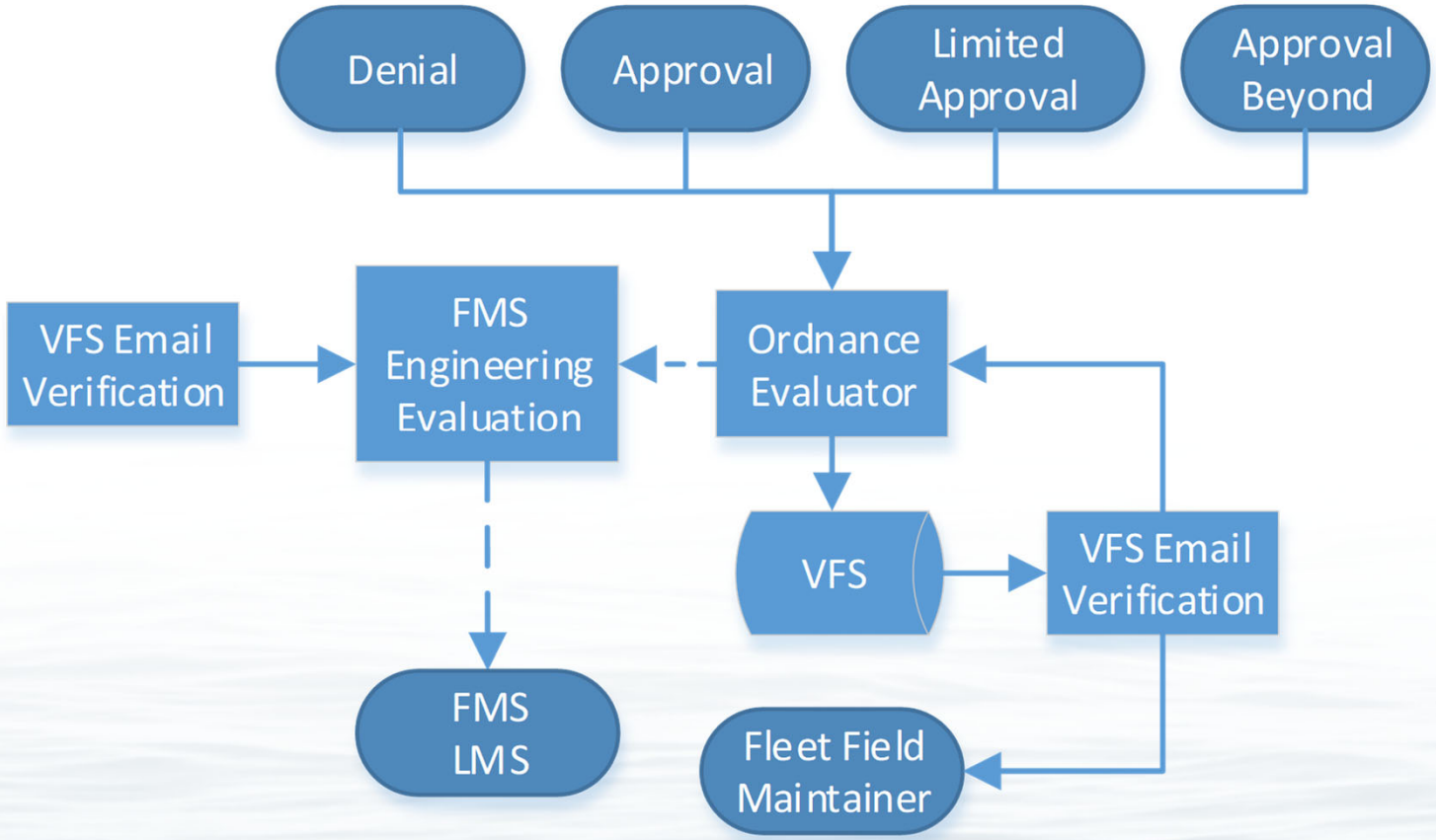


SLE Request Limited Approval

- Limits Shelf Life and/or Install Life
  - Shelf life limits are based on unit deterioration/uncertainty in storage and in an aircraft
  - Install Life limits are based on unit deterioration/uncertainty in an aircraft

SLE Spreadsheet Determinations

SLE Request Bottom Line



Same DODIC ≠ Same Life

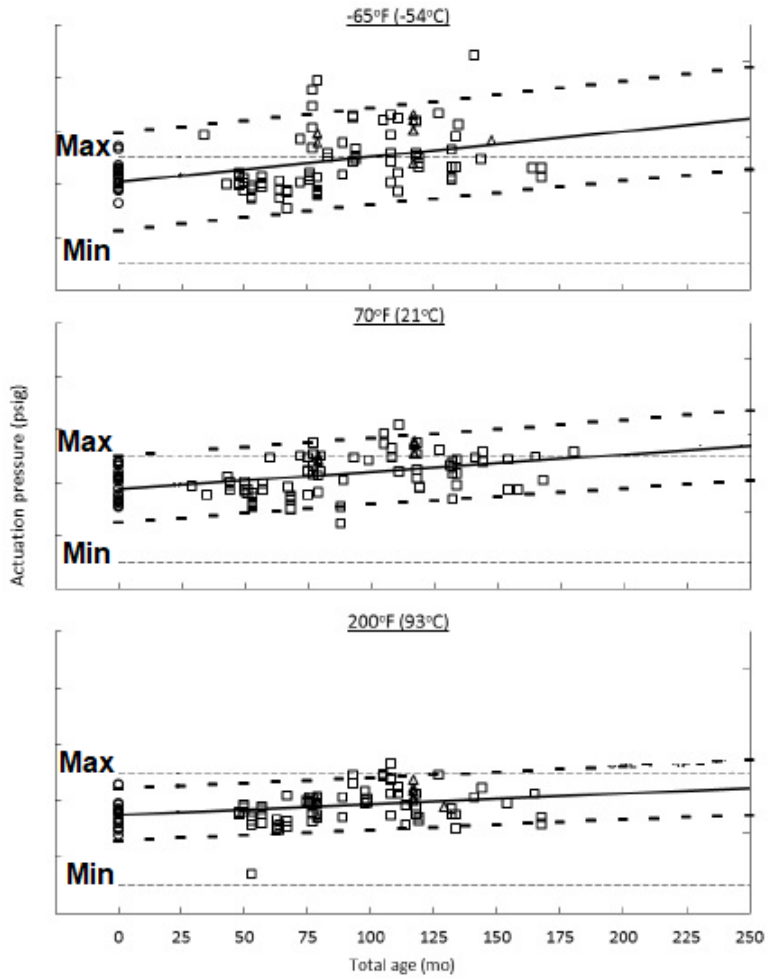
- The same DODIC may have difference extension lives
  - Some devices have stabilizer depleted by heat influenced by its aircraft ambient temperature history
  - DODICs produced with performance near or far from its limits have life determinations based how long it takes to exceed those limits.
  - Some producer make units with better aging performance than others.

SLE Determination Tools

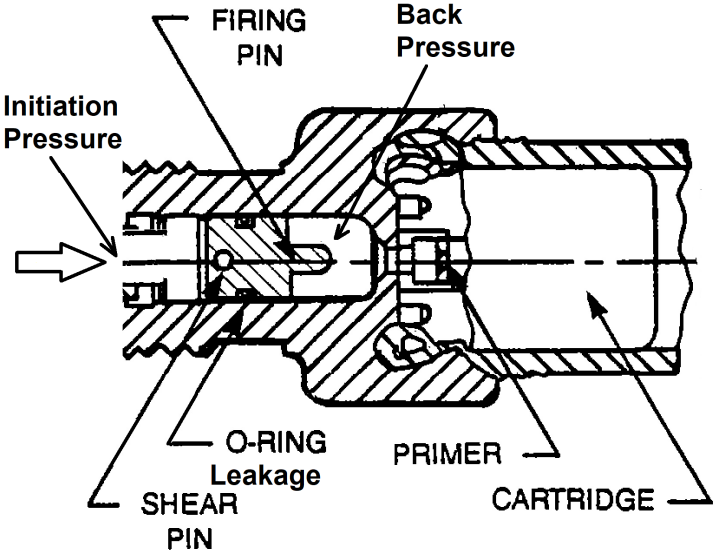
- Ordnance Assessment
  - Unit's test performance changes with time
  - Linear trends with tolerance bands
    - Where there is a 90% confidence that 99% of the inventory population will perform within those bands.
    - Projection of curves
- Device analysis
- Rates of aging ***New***
- Precedence

SLE Determination Tools

Project of Curves

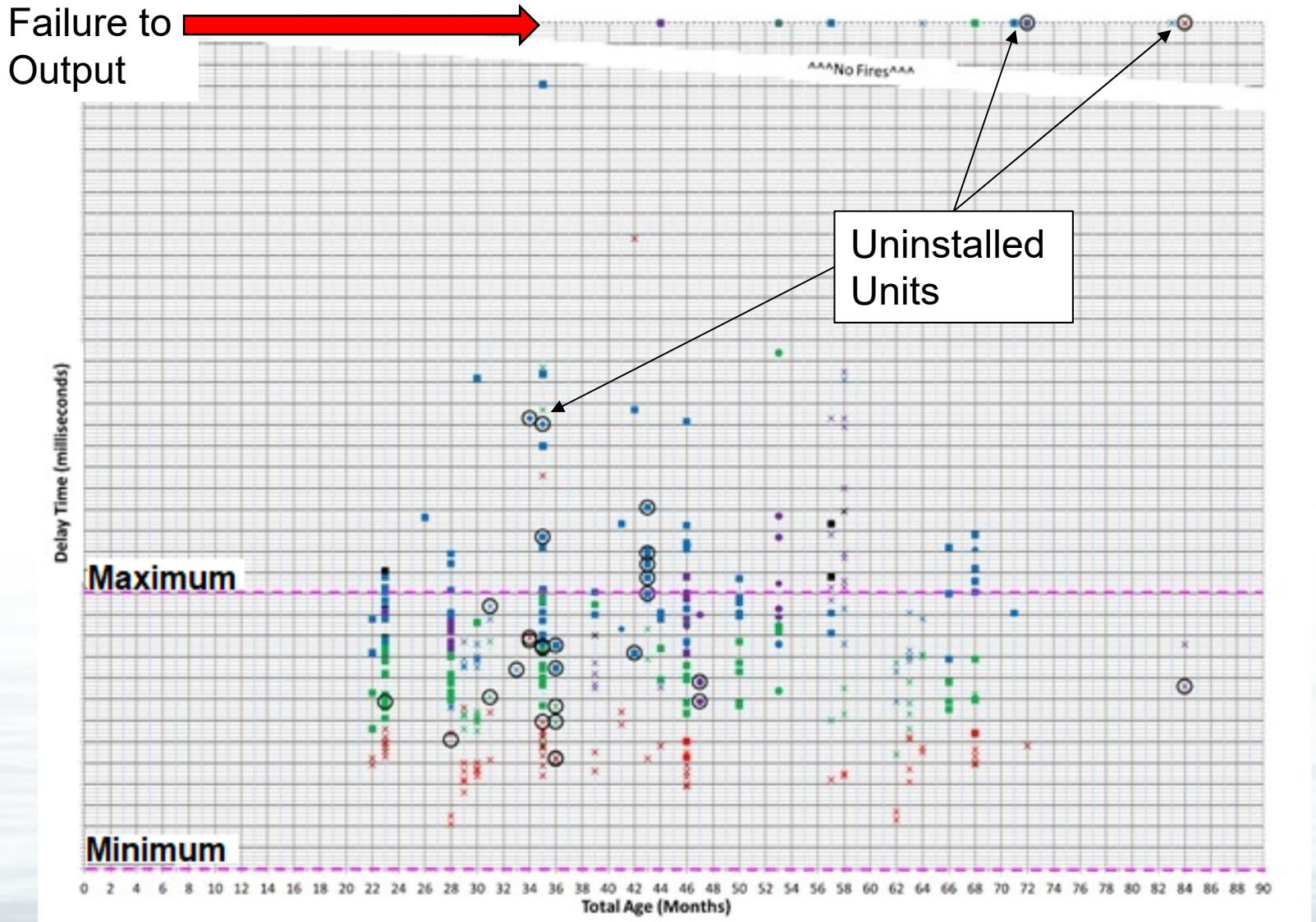


Device Analysis

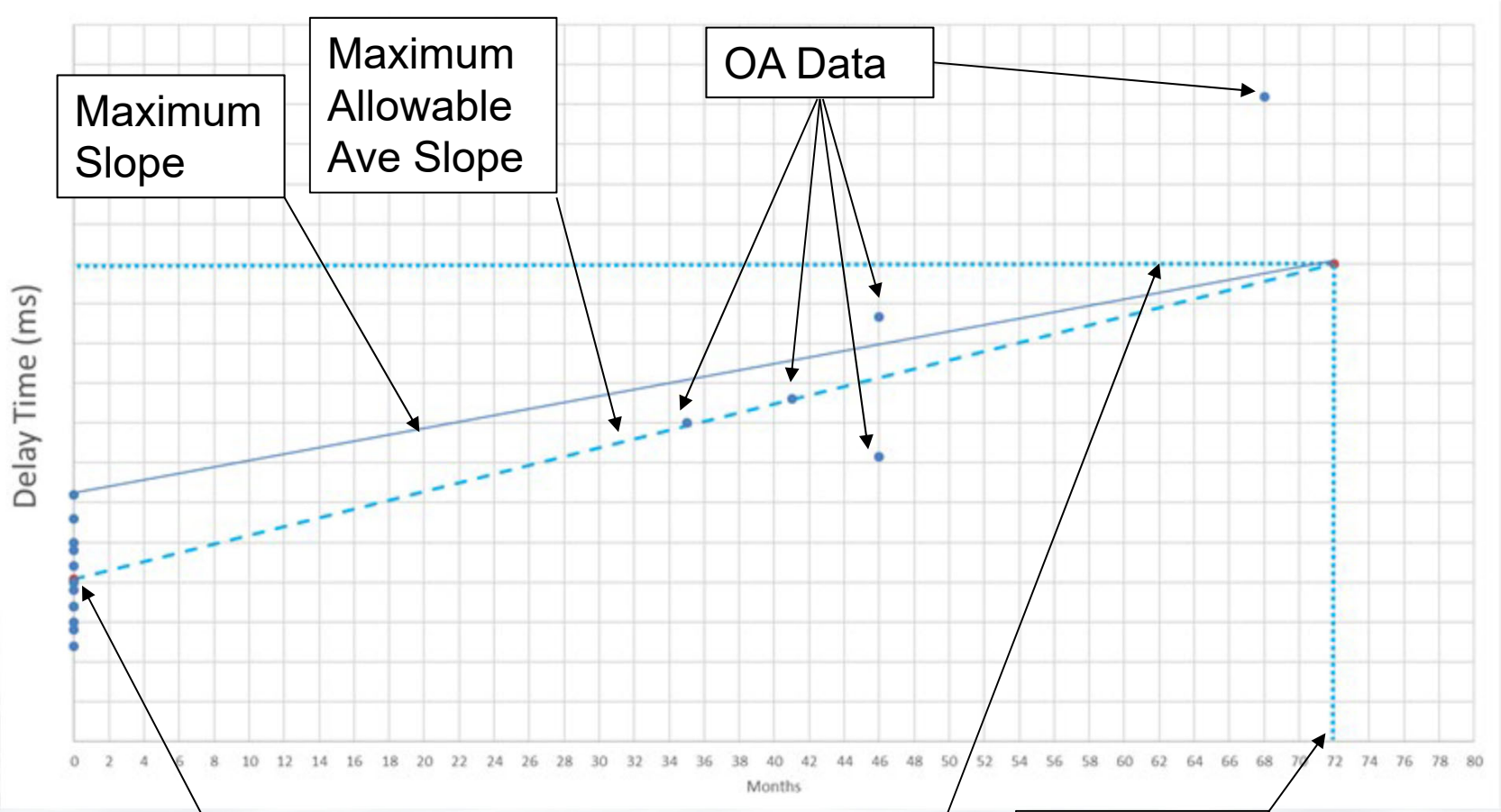


- Shear Pin Force = Initiation force – Back Pressure force
- Back Pressure force increases with increased O-ring leakage
- Aged Nitrile O-rings tend to shrink
- O-ring on shear pin hole may damage O-ring → leakage

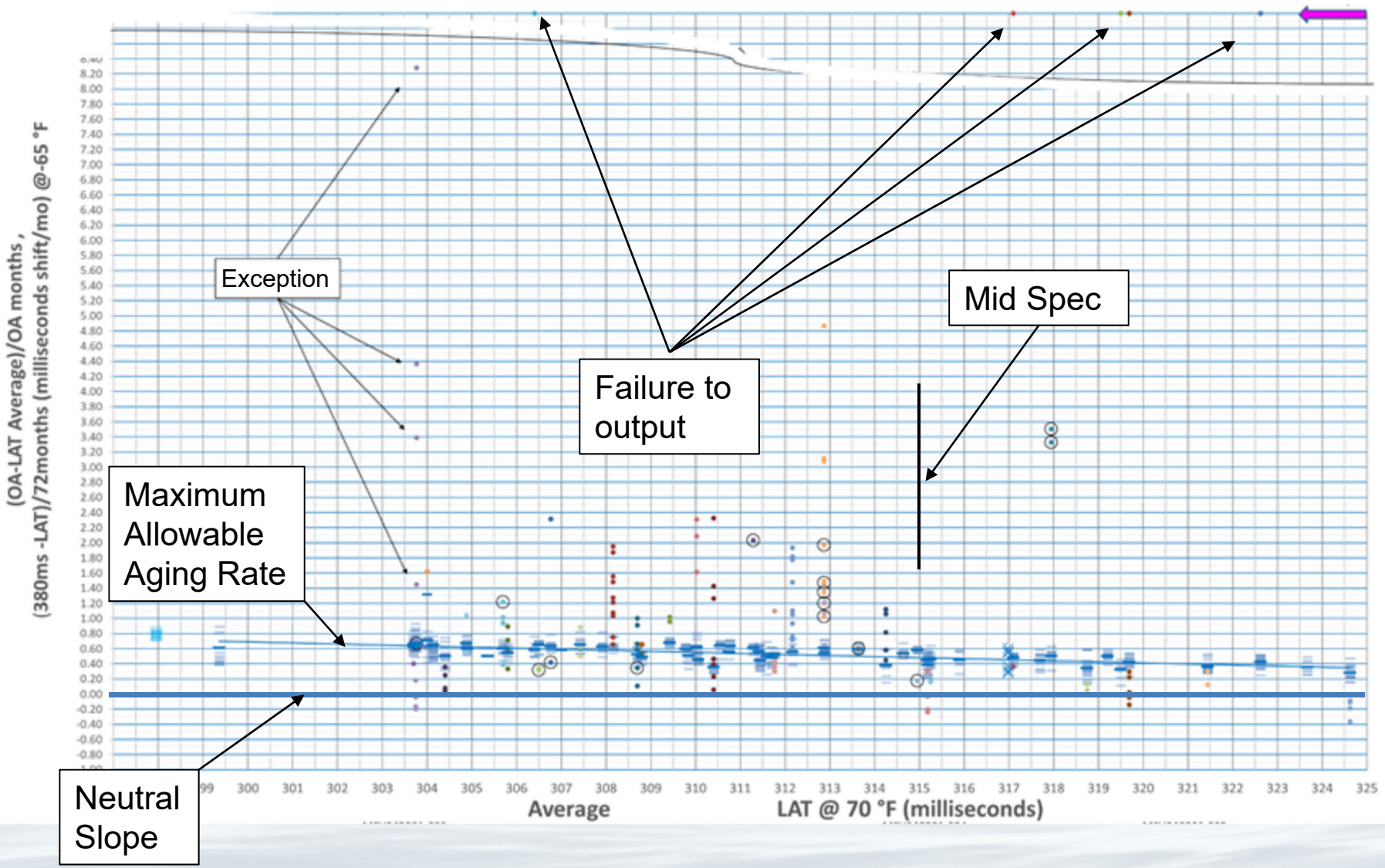
An Uninstalled DODIC Can Fail



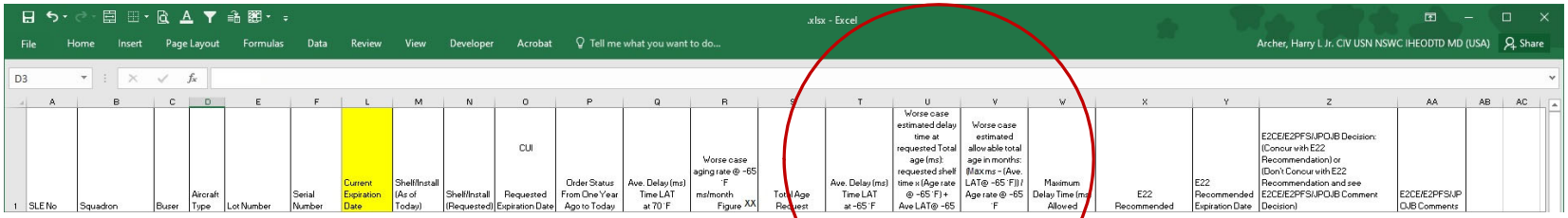
What's the Difference?

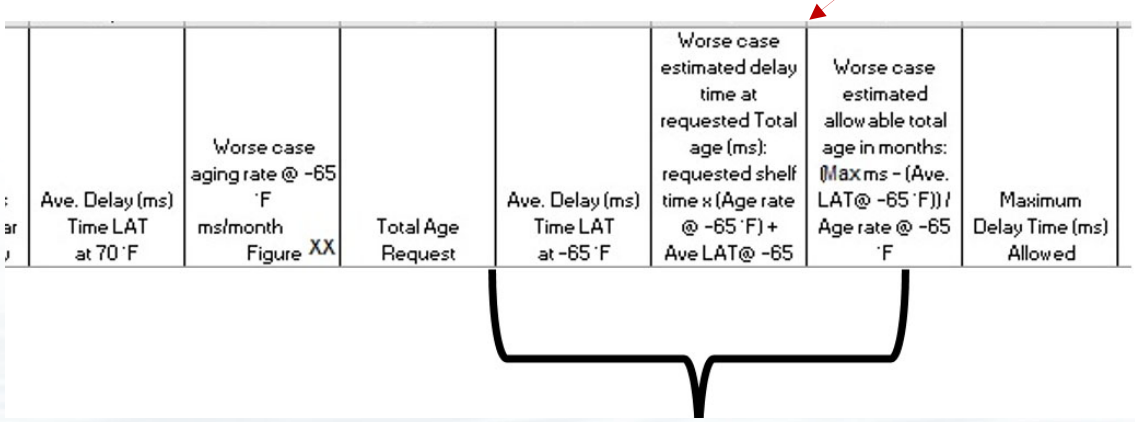


OA Rates of Aging



Rates of Aging Spreadsheet *New*





Calculated worse case service life based on aging rate

SLE Data Uncertainty

- Test results may falsely indicate less life due to excessive bending/damage during uninstalling, packaging or testing:
  - Mild Detonating Cord Sets (MDCS)
  - Thin Layer Explosive lines (TLX)
  - Mild Detonating Cords (MDC)
  - Flexible Linear Shape Charges (FLSC)
- Excessive bending may cause charge separation or excessive compression and large variations in propagation velocities.

SLE Data Uncertainty

- Ballistic ordnance assessment testing may show successful testing; however, false positives may happen because
  - Long out of conditioning times bring the unit closer to ambient
  - Some uninsulated units reach ambient temperature quickly out of conditioning
  - Fixture can bring a unit to its temperature
  - An inadequately cleaned closed bomb volume decreases with each test
  - Inadequate or unmeasured stabilizer

SLE Data Uncertainty

- Qualification may not simulate aging
  - Current temperature extreme cycling may not adequately simulate long term aging
  - Real aging requires multiple cycles that simulate day and night exposures
    - In storage and
    - In its appropriate aircraft

Conclusions

Predicting allowable service life accurately requires:

1. A well understood installed/storage environment and its impact on performance
2. Representative unit ballistic testing performance
3. Measuring chemical/mechanical changes that correlate well with performance
4. An accurate performance analysis of trend data with sufficient data at the requested age

Acknowledgements

- Ordnance Assessment/Logistics Branch