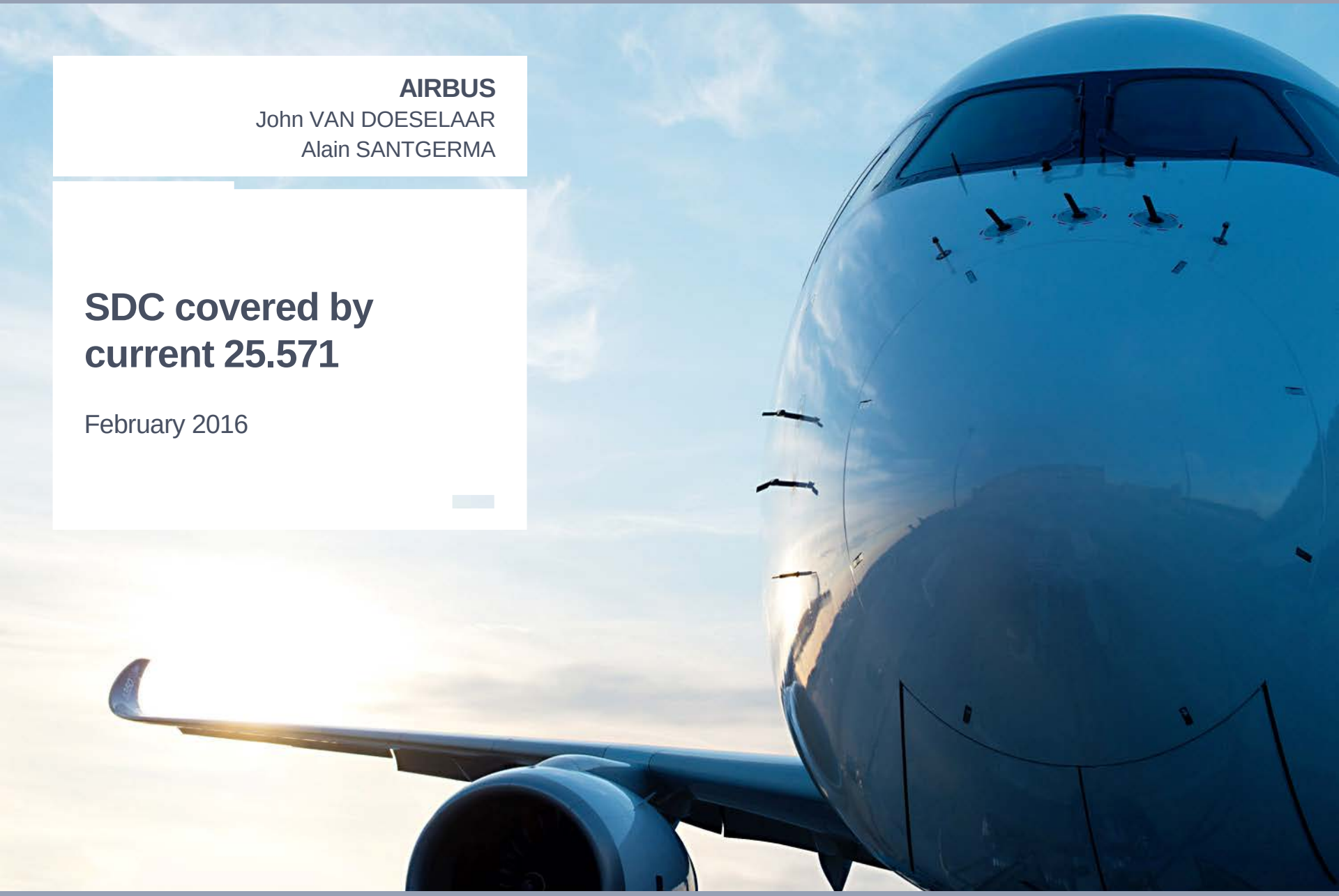

AIRBUS
John VAN DOESELAAR
Alain SANTGERMA

SDC covered by current 25.571

February 2016

SDC – covered by existing rule/ guidance

SDC could be seen as covered by 3 existing aspects in CS/FAR/AMC/AC:

- Design principles
- Partial failures to be considered
- Promoting Multiple Load Path

AMC 25.571 relevant – Design principles used

- 2.1.1 Design features which should be considered in attaining a damage-tolerant structure include the following:

a. Multiple load path construction and the use of crack stoppers to control the rate of crack growth, and to provide adequate residual static strength;

b. Materials and stress levels that, after initiation of cracks, provide a controlled slow rate of crack propagation combined with high residual strength.

c. Arrangement of design details to ensure a sufficiently high probability that a failure in any critical structural element will be detected before the strength has been reduced below the level necessary to withstand the loading conditions specified in CS 25.571(b) so as to allow replacement or repair of the failed elements

AIRBUS

AMC 25.571 relevant – Design principles used

Remarks:

- For PSE generic areas, not practicable to inspect a whole area with NDT -> MLP structure driven
  - Example: Fuselage, wing, empennage, control surfaces, doors, attachments/ Load introduction
- Simple inspection is preferred ->complete failure of primary load path via visual inspection.

AMC 25.571 relevant – Partial failures to be considered

- The following are typical examples of partial failures which should be considered in the evaluation:

2.3.1 Detectable skin cracks emanating from the edge of structural openings or cutouts;

2.3.2 A detectable circumferential or longitudinal skin crack in the basic fuselage structure;

2.3.3 Complete severance of interior frame elements or stiffeners in addition to a detectable crack in the adjacent skin;

2.3.4 A detectable failure of one element where dual construction is utilised in components such as spar caps, window posts, window or door frames, and skin structure;

2.3.5 The presence of a detectable fatigue failure in at least the tension portion of the spar web or similar element; and

2.3.6 The detectable failure of a primary attachment, including a control surface hinge and fitting.

AMC 25.571 relevant – partial failures to be considered

Remarks:

- Generic areas are already covered with this guidance to consider partial failures -> inherent SDC for generic PSE areas.
- Introduction of DCF to meet 2.3.5, for example spars.
- Even engine mounts are MLP design, considering partial failures.
- Link is made with par 2.4 to avoid inaccessible areas.

AC25.571-1D paragraph 6j- promotes MLP/ discourage SLP

(1) Where it can be shown by observation, analysis, and/or test that a load path failure in multiple load path "fail-safe" structure or partial failure in crack-arrest "fail-safe“ structure will be detected and repaired during normal maintenance, inspection, or operation of an airplane prior to failure of the remaining structure, the thresholds can be established using either:

(a) Fatigue analysis and tests with an appropriate scatter factor; or

(b) Slow-crack-growth analyses and tests, based on appropriate initial manufacturing damage.

(2) For single load path structure and for multiple load path and crack-arrest "fail-safe“ structure - where it cannot be demonstrated that load-path failure, partial failure, or crack will be detected and repaired during the normal maintenance, inspection, or operation of an airplane prior to failure of the remaining structure - the thresholds should he established based on crack-growth analyses and/or tests, assuming the structure contains an initial flaw of the maximum probable size that could exist as a result of manufacturing- or service-induced damage.

AIRBUS

AC25.571-1D paragraph 6j- promotes MLP/ discourage SLP

Remarks:

- Some OEM apply more stringent Scatter Factors for SLP structure
- Use of A-basis values for static design
- SLP likely need NDT, visual inspections not practicable
- SLP will be analysed using crack growth analysis with quality flaw or service damage.
- Normal inspection on MLP relaxes the analysis requirements

Conclusion

- SDC could be considered to be already covered in existing regulatory material, at least for generic PSE areas.
- Current OEM airframe design is in line with the fail safe principles advocated by 25.571 and AC
- Guidance material could be slightly updated to further strengthen this message, building on the existing good material.

Pros and Cons

Pros:

- No change to current regulation, minor update of AC.
- Most important drivers for SDC already there.
- Keep same effort to show compliance while maintaining existing high safety level.
- Give positive safety message to community

Cons:

- Not in the rule, but in Advisory Circular (=Acceptable Means Of Compliance with the rule).
- AC cover only generic PSE areas