



EASA

European Aviation Safety Agency

Work-stream “Helicopter Rotor and Rotor Drive System Safety – Achieving Expectations for the Next Generation”

Conclusions and Recommendations of the Meeting

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Presentation Subjects

- Enhancing Rotor and Transmission Safety: The Critical Challenges and the Potential Opportunities – Andy Evans, Aerossurance
- How can we further improve Rotorcraft Transmissions? - Prof. M. Weigand, TU Wien
- Safety Considerations in the Design and arrangement of the 525 Relentless Drive System - Scott Poster, Manager Drive System Design, Bell Helicopter
- Rotors and Transmissions Design Assessment: Experience and the Regulators Viewpoint – Alastair Healey, Rotor Drive System Expert, EASA.



•The Relentless Drive System incorporates an innovative arrangement and construction of components that collectively minimize the possibility of a loss of lubrication event and ensure that the maximum flight time is achieved if such an event does occur.

•Transfer tubes for all pressurized oil interfaces to eliminate the loss of lubricant in the event of loss of attachment fastener torque

•Oil cooler mounted directly to the main rotor gearbox

•Separate non pressurized accessory gearboxes eliminating the oil leak paths that could lead to a loss of lubrication event

•All oil filter bowls are screw on in lieu held on with small fasteners eliminating fastener failure issue from repeated removals

•Elimination of a high speed planetary and the heat generation associated with it during a loss of lubrication event.

•No external oil lines on MRGB

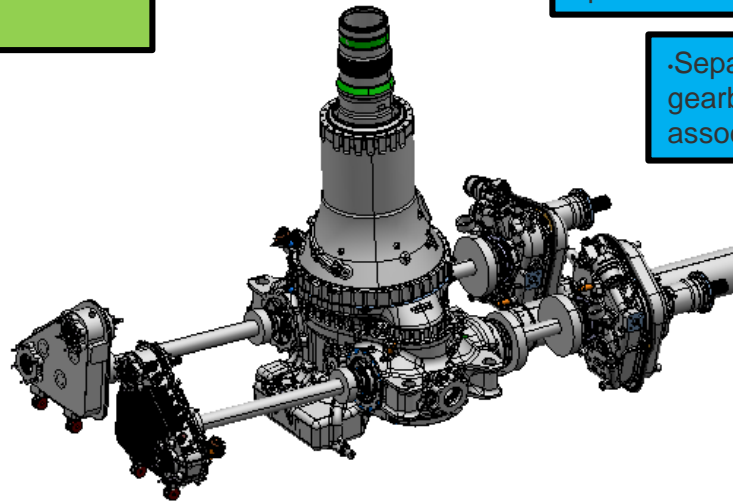
•Isotropic Super finished gear teeth resulting in an improved surface finish and maximizing the ability of these gears to operate in a reduced lubrication environment

•Separate, isolated, and redundant engine reduction gearboxes that take the high speed gearing and associated heat generation out of the MRGB

•Ring gear and case joint design to efficiently transmit heat away from the planetary gears in the event of a loss of lubrication

•The use of high hot hardness material utilized for primary torque carrying components and supporting bearings maximizing their continued operation in the event of a loss of lubrication

•The use of coarse pitch power gears with clearance or backlash allowing for the expansion during high heat loss of lubrication events

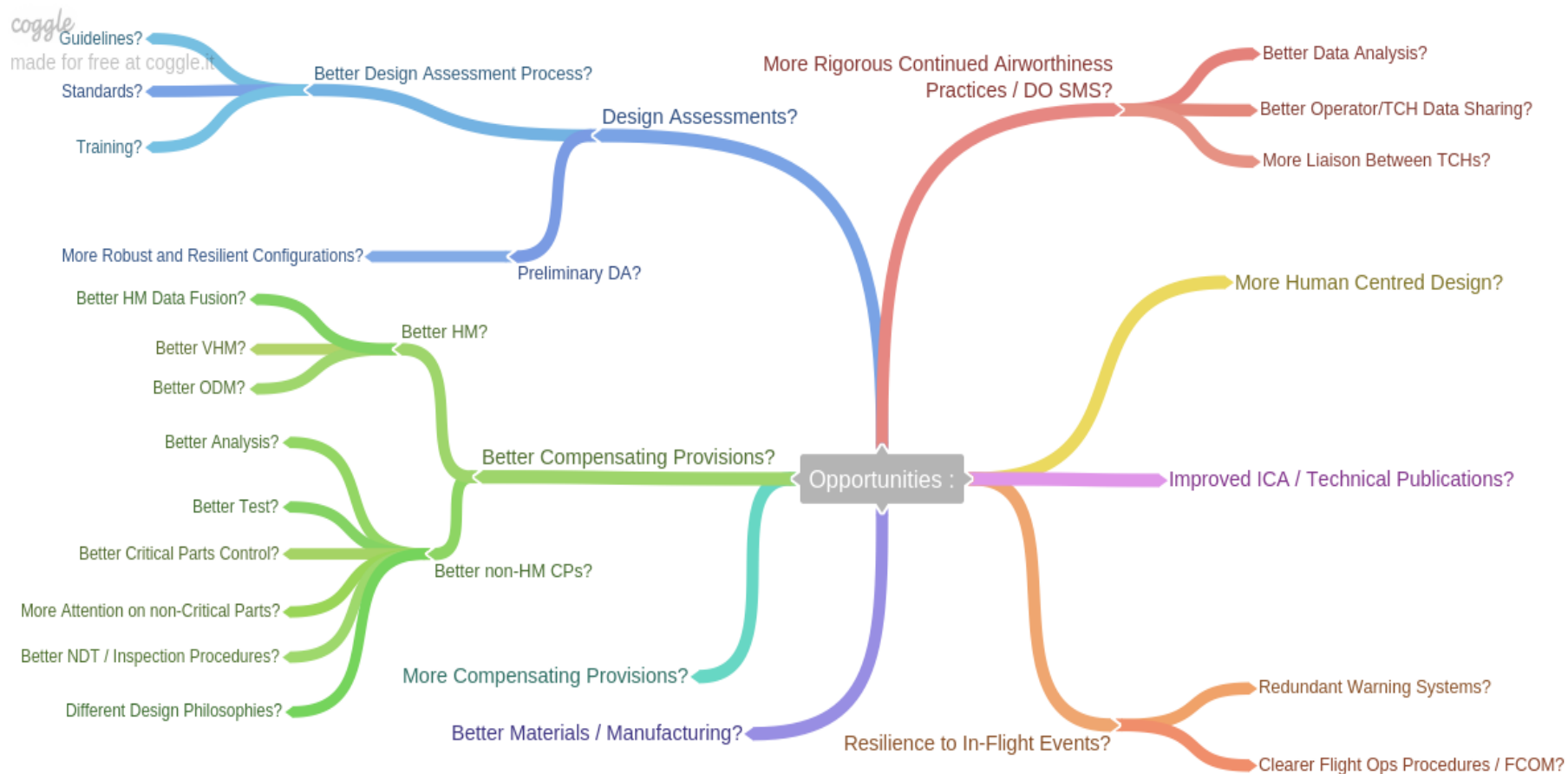


•Minimize the probability of a loss of lubrication (LOL) event
•Maximize the flight time after LOL if such an event does occur

•Gear tooth geometry specifically designed to minimize sliding reducing heat generation at the teeth and the tendency to score during a loss of lubrication event.



Safety Opportunities





Review of Accidents

12 potentially fatal accidents (occurring since 1996) resulting from rotor or rotor drive system failure have been analysed to assess if primary contributory causal factors are;

- Known Known, Known Unknown or Unknown Unknown?
- Failure Analysis could have identified adequate provisions?
- Involving Critical Part? => 9 out of 12
- Considered to be preventable? => 10 out of 12
- Influence of POA / MOA issues? => Half
- Preventable by better health monitoring? => Half the accidents had potential for prevention by health monitoring. ODM is as at least as important as VHM.



Conclusions

- Discussion covered numerous issues including;
 - Understanding accident rates
 - Use of new technology
 - Design architecture to reduce critical parts
 - Design provisions to improve loss of oil performance
 - Understanding and managing different types of risk.
- Many good ideas regarding safety shared within the group.
- High quality of discussion
- Both interesting and useful to have discussion between designers, operators, customers and regulators.
- Actions: ??



Any Questions ?