



## REASSESSMENT OF THE RESPONSE TO AVIATION SAFETY RECOMMENDATION A11-02

### **Main gearbox certification: Adequacy of the 30 minute main gearbox run dry requirement**

#### **Background**

On 12 March 2009, at 0917 Newfoundland and Labrador Daylight Time, a Cougar Helicopters' Sikorsky S-92A (registration C-GZCH, serial number 920048), operated as Cougar 91, departed St. John's International Airport, Newfoundland and Labrador, with 16 passengers and 2 flight crew, to the Hibernia oil production platform. At approximately 0945, 13 minutes after levelling off at a flight-planned altitude of 9000 feet above sea level (asl), a main gearbox (MGB) oil pressure warning light illuminated. The helicopter was about 54 nautical miles (nm) from the St. John's International Airport. The flight crew declared an emergency, began a descent to 800 feet asl, and diverted back towards St. John's. At 0955, approximately 35 nm from St. John's, the crew reported that they were ditching. Less than 1 minute later, the helicopter struck the water in a slight right-bank, nose-high attitude, with low speed and a high rate of descent. The fuselage was severely compromised and sank quickly in 169 metres of water. One passenger survived with serious injuries and was rescued approximately 1 hour and 20 minutes after the accident. The other 17 occupants of the helicopter died of drowning.

The Board concluded its investigation and released report A09A0016 on 09 February 2011.

#### **Board Recommendation A11-02 (February 2011)**

The last major update of rotorcraft airworthiness standards took place in the 1980s. This update flowed from the phenomenal growth of the rotorcraft industry and the recognition by the United States government and industry that existing certification rules had been outdated by rapidly advancing rotorcraft technology. The rules specifically recognized the need for a high level of safety in the design requirements for rotorcraft.

The 1980s update provided for the optional certification of dual engine helicopters to permit continuous operation in the event of an engine failure to complete the flight with the remaining engine. This rule supplemented the existing optional certification rule which provided 30 minutes of operation following one engine failure. In support of the proposed rule the Federal Aviation Administration (FAA) stated: "Originally, the 30-minute rating was adequate for the relatively short route structure of first generation helicopter air carrier service. Industry needs for the new "continuous OEI [One Engine Inoperative] rating" were generated primarily by the extensive operation of helicopters serving the distant offshore petroleum drilling and services activities. Many, if not most, of these activities involved dispatching helicopters on route structures which precluded a planned landing within 30 minutes in the event of engine failure."

Another change introduced was the 30-minute run dry provision for MGB. This rule was justified on the grounds that Category A helicopters must have a significant continued flight capability after a failure in order to optimize eventual landing opportunities.

Since the last major update of certification rules, there have been continued improvements in technology. At the same time, the helicopter industry has grown with the increased use of large, transport helicopters in the offshore sector. The original 1980s rationale for increasing safety margins remains valid today.

If a helicopter has to ditch in hostile waters such as those off the Canadian east coast, the occupants are at considerable risk. Many of these offshore facilities now have flight times over 2 hours and future development of offshore petroleum resources include plans for facilities even further from land.

Available information indicates that other helicopters are now capable of run dry performances that exceed 30 minutes. It may now be both technically feasible and economically justifiable to produce a helicopter that can operate over 30 minutes following a massive loss of MGB lubricant. Therefore, the Board recommends that:

The Federal Aviation Administration assess the adequacy of the 30 minute main gearbox run dry requirement for Category A transport helicopters.

**TSB Recommendation A11-02**

### **Response of the Federal Aviation Administration to Recommendation A11-02 (April 2011)**

“In conjunction with the proposed rule (14 CFR 29.927(c)) change to remove or clarify the term ‘extremely remote’ (see FAA response to Recommendation A11-01), the FAA will assess the adequacy of the 30-minute loss of lubrication requirement.”

### **Transport Canada’s response to Recommendation A11-02 (June 2011)**

Recommendation A11-02 was not directed to Transport Canada (TC) and, as such, it was not required to respond. However, TC indicated that:

“[It] has initiated...a coordinated formal review with the Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA) of the rules related to the extremely remote provision and the 30 minute requirements. The objective of the review is to reach an international agreement on what changes may be required to the rules... Any amendments to the airworthiness rules would then follow the regulatory process in each jurisdiction.”

### **Board assessment of the Federal Aviation Administration’s response to Recommendation A11-02 (June 2011)**

The FAA's response indicates agreement with the course of action contained in Recommendation A11-02 since, as part of the proposed rule change, the FAA will assess the adequacy of the 30-minute loss of lubrication requirement.

Therefore, the response is assessed as **Satisfactory Intent**.

### **Request for an updated response from the Federal Aviation Administration to Recommendation A11-02 (November 2011)**

On 02 November 2011 the TSB wrote to the FAA asking it to provide an update as to the progress of its activities taken to mitigate the residual risks associated with Recommendation A11-02. A response was requested before 02 December 2011. To date, no reply has been received.

### **Transport Canada's response to Recommendation A11-02 (September 2011)**

#### **September 2011 update:**

Recommendation is directed to the FAA. However, TCCA is addressing this recommendation concurrently with A11-01.

### **Board reassessment of the Federal Aviation Administration's response to Recommendation A11-02 (March 2012)**

The TSB's recommendation called for the FAA to assess the adequacy of the 30 minute main gearbox run dry requirement for Category A transport helicopters that was conceived during the 1980s. Both the FAA and TC initially indicated that they would assess the adequacy of the 30-minute loss of lubrication requirement in concert with EASA. It is unclear if an assessment to consider continued improvements in technology, given the growth in the offshore helicopter industry since the last major update of certification rules, has been completed or what the results are.

While the FAA did not provide an update on the progress of its assessment of the adequacy of the 30-minute loss of lubrication requirement, the Board expects that the FAA is continuing with its assessment. The TSB also expects that the FAA will provide it with the results once the assessment is complete.

The response is considered **Satisfactory Intent**.

### **Response of the Federal Aviation Administration to Recommendation A11-02 (November 2012)**

A group of technical specialists from the Federal Aviation Administration, Transport Canada and the European Aviation Safety Agency formed a Joint Cooperation Team (JCT). The JCT was chartered by a Certification Management Team (CMT) to review the current design standards and accompanying guidance material relating to the certification of helicopter gear boxes. As a part of this review, the JCT was tasked to address TSB Recommendations A11-01 and A11-02

and their underlying safety issue, specifically with respect to loss of lubrication. The JCT has completed their task and will be presenting a report to the CMT. We have no further updates on these safety recommendations until the CMT reviews and either accepts, rejects, or modifies the JCT's report.

We will continue to provide periodic updates to TSB safety recommendations A11-01 and A11-02 until final resolution.

### **Board reassessment of the Federal Aviation Administration's response to Recommendation A11-02 (March 2013)**

In the last TSB assessment of the latest FAA response to A11-02 dated 07 March 2012 it was noted that both the FAA and TC indicated that they would assess the adequacy of the 30-minute loss of lubrication requirement in concert with EASA. However the response was unclear as to whether a review of the design standards for the certification of helicopter gear boxes would consider continued improvements in technology, given the growth in the offshore helicopter industry.

The current FAA response indicates that the review by the Joint Cooperation Team of the current design standards and accompanying guidance material relating to the certification of helicopter gear boxes has been completed. The FAA has declined to provide any additional details regarding the results of this review until management accepts, rejects, or modifies the JCT's report.

The response is considered **Satisfactory Intent**.

### **Response of the Federal Aviation Administration to Recommendation A11-02 (November 2013)**

In response to Safety Recommendations A11-01 and A11-02, the FAA is able to provide an update on the activities of the Joint Cooperation Team (JCT) which consisted of technical specialists from the FAA, Transport Canada, and the European Aviation Safety Agency. The JCT was chartered by a Certification Management Team (CMT) to review the current design standards and accompanying guidance material relating to the certification of helicopter gear boxes and the underlying safety concerns, specifically with respect to loss of lubrication. The JCT has completed its task, and we have enclosed the final report that was accepted and signed by the CMT team.

The final report provided by the JCT has effectively addressed the intent of Safety Recommendations All-01 and All-02. The FAA considers these recommendations closed, and no further action is planned.

Enclosure:

September 28, 2012

## **Report of the Joint Cooperation Team (JCT) on the Review of Helicopter Main Gearbox Certification Requirements for TCCA/FAA/EASA**

### **Joint Cooperation Team:**

Transport Canada (TCCA), the Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA) agreed to create a Joint Cooperation Team (JCT) to conduct a review of the current design standard and guidance material relating to the certification of helicopter MGBs, specifically with respect to loss of lubrication including AWM 529.927(c), 14 CFR § 29.927(c), and CS 29.927(c). In light of the above safety recommendations and in accordance with terms of reference document, this joint review was intended to review the adequacy of transport category rotorcraft standards with respect to gearbox loss of oil and consider potential areas for improvement with the intention that the certification requirements remain harmonized among TCCA, FAA, and EASA.

The terms of reference did not address any other TSB (operational) recommendations.

### **Approach and Scope of the JCT:**

Technical specialists from TCCA, FAA and EASA formed a JCT to review the current design standards and accompanying guidance material that address loss of lubrication from pressure lubricated gearboxes and are the subject of TSB recommendations A11-01 and A11-02.

Specialists from all three national civil airworthiness authorities (CAAs) have arrived at a common recommendation maintaining a harmonized airworthiness framework. This report states the findings of the JCT which are to be provided to the FAA, EASA and TCCA management for their consideration.

Regarding loss of oil endurance capability, the current loss-of-lubrication test requirement for MGB of a transport category rotorcraft sets a minimum objective for the applicant to demonstrate a minimum of 30 minutes of safe operation for Category A rotorcraft. FAA Advisory Circular (AC) AC29-2C provides guidance on failures of interest in the oil system sub-components (see section AC29.927A). This AC is referenced by all three CAAs as acceptable guidance; however, it does not provide guidance on application of the "extremely remote" failure criteria.

The JCT have examined the adequacy of these regulations, including the provision of the "extremely remote" criteria in the standard, and provided recommendations for revising 14 CFR § 29.927(c) and the related AC material. These recommendations identify the need to clarify the application of "extremely remote" and the failure conditions that must be considered when performing loss-of-lubrication tests.

### **JCT Recommendations:**

This report to the FAA, EASA and TCCA management presents recommendations for harmonized action to improve the design standards and guidance material, or elsewhere, which address the safety risk associated with loss of oil from pressure lubricated gearboxes. These recommendations address gaps identified between the existing requirements, clarification of the intent of the rule and redefinition of test requirements to meet the safety standard. This final report also provides technical justification to support those recommendations.

**General Recommendation:**

An FAA Advisory Rulemaking Committee (ARC), or European equivalent should be formed with multi-lateral CAA participation and/or a multi-lateral CAA working group (WG) which will consider the subject of loss of oil as follows:

- a. Consider further technical detail in requirements
- b. Include helicopter design and manufacturing industry representation
- c. Consider rule changes at the 14 CFR part 29/CS-29/ AWM 529 level
- d. Consider impact on other categories
- e. Consider impact on operating rules and emergency procedures

The JCT is of the opinion that the scope of this rulemaking activity should only be applicable to new Part 29 Cat A helicopter types (i.e. not applicable to variants unless considered to be a “significant change”). Though TSB recommendation A11-01 applies to “all newly constructed Category A transport helicopters and, after a phase-in period for all existing ones”, the JCT believe that once the certification basis for an aircraft type is set, and the type approval has been granted the certification basis should remain fixed. If subsequently an unsafe condition is found to exist this should be addressed using the continued operational safety or continued airworthiness procedures of the NAA of the state of design. These procedures usually require any unsafe condition to be managed using one or more Airworthiness Directives (ADs). Accordingly an AD will not change the design standards applied to the aircraft, but can mandate a design change to restore the level of safety to that envisioned by the requirements defined in the certification basis.

The specific recommendations made below are the current opinion of the JCT but may be subject to change after review by an ARC.

Note 1: Near-term action (pre-ARC review) - AC stand-alone changes have already been pursued, independent of 14 CFR part. (FAA AC was published and posted in the FAA Regulatory Guidance Library (RGL) internet website in July2012.)

Note 2: ARC review will include an initial feasibility study.

### **Recommendations Relating to Title 14 Code of Federal Regulations Part 29.927(c) and Advisory Circular**

**Recommendation 1:** All part 29 Cat A new types (i.e. not applicable to variants unless 21.101 significant change) should comply with a loss of oil test and "extremely remote" should be removed from the requirement.

**Recommendation 1.1:** Interim position to issue revised AC to clarify intent of 29.927(c) Amdt 26. Accordingly, FAA, TC and EASA should continue to progress the draft revision of the loss of lubrication guidance material that is currently in work for AC 29.927 and publication of the material prior to the end of calendar year 2012.

Note: Since drafting this recommendation FAA AC has been published and posted in the FAA RGL internet website in July 2012.

Supporting Rationale: The AC revision provides an explanation of the phrase "unless such failures are extremely remote" as used in the context of 14 CFA § 29.927(c)(1). The explanation brings to attention that unforeseen variables and complexity associated with predicting potential failure modes and their associated criticality and frequency of occurrence make it challenging to employ the "extremely remote" concept.

**Recommendation 1.2:** Propose a new amendment to AWM 29.927(c), 14 CFR § 29.927(c), and CS 29.927(c) as a test requirement, similar in format to that of 29.923 and 29.927(b). This will require the creation of an aviation authorities and industry working group (ARC). This group should consider removal of the term "extremely remote" and rewriting the requirement to become a prescriptive "oil out" durability test of the rotor drive system gearboxes used on Category A rotorcraft. The JCT recommends that this test be of duration to be agreed by the ARC group but in any case not less than 30 minutes. The test should prescribe the torque(s) and rotational speed(s) that must be applied to the rotor drive system. The type of operation, such as search and rescue, human external cargo, emergency medical systems, and the operating environment, i.e., hostile terrain, over water, etc., should also be considered when determining the appropriate test duration, torque(s), and rotational speed(s). At a minimum, the torque and rotational speed-should not be less than that required to maintain continued level flight at maximum takeoff gross weight (applicant may elect to consider some adjustment to gross weight as a result of fuel burn). On completion of the test, the test results and the duration of the test should be taken into consideration when developing the appropriate emergency procedures in the rotorcraft flight manual for loss of lubrication.

Supporting Rationale: The 29.927(c) 30 minute loss of lubrication regulatory requirement was always intended as a test requirement to ensure that the rotor drive gearbox designs used on Category A rotorcraft are capable of operating

safely for an extended period of time under various operating conditions following a loss of lubrication to the rotor drive gearboxes. The opportunity to extend the period of operation following a loss of lubrication was deemed essential in order to increase the eventual landing opportunities that are available to the flight crew.

**Recommendation 2:** Ideally a new 29.927(c) requirement should define a test which can justify confidence that 30 minutes of continued flight would be probable. This test data could be used to allow emergency operation up to 30 minutes in flight manual emergency procedures. This will be a subject for review by the ARC group and any determination on this subject should be made in association with each Authority's flight test department. The JCT believe that this would be consistent with the intention of 29.927(c) amendment 26 text which requires 30 minutes of continued safe operation in service to be shown by test.

Note: The JCT consider that operation of an independent auxiliary lubrication system to achieve this duration would be acceptable.

**Recommendation 3:** Propose a change to AC 29.927(c) to state the method for draining oil from the gearbox.

Note: Since drafting this recommendation FAA AC has been published and posted in the FAA RGL internet website in July 2012. This describes that the method for draining oil should be determined by identifying and simulating the worst-case oil leak.

### **Recommendations Relating to AC Sections 29.917**

**Recommendation 4:** In conjunction with the JCT's review of the current 29.927(c) regulatory requirements and associated guidance material, the team found it necessary to review the rotor drive system related guidance material in AC 29.917 and, as a result, makes the following additional recommendation to the CMT:

Lubrication system design should be subject to a drive system design assessment to assess failures in the lubrication system. Accordingly, JCT recommends revising the guidance material in AC 29.917 to include the rotor drive lubrication system as part of the rotor drive system and therefore include lubrication system failures in the rotor drive system design assessment. Under the 29.917(b) rotor drive system design assessment requirement, a failure analysis would be required to identify all lubrication failures that will prevent continued safe flight or safe landing. Consideration should be given to extending the AC to provide specific advice for the assessment of lubrication system reliability in addition to minimizing the likelihood of individual lubrication system failure modes;

Supporting Rationale: The lubrication system is an integral part of the rotor drive system and is necessary to achieve continued safe operation of the rotor drive system.



**Current Status:**

The JCT recommendations fit into near and far term strategies. Some of the near-term strategies, such as revising AC 29.927 have already been accomplished. Further revisions will be required as other changes are implemented; however, these initial steps begin to address some of the weaknesses identified by the JCT.

**Next Steps:**

The JCT members recommend to the FAA, EASA and TCCA management that these recommendations be endorsed and initiated in a timely fashion.

Respectfully,

Joint Cooperation Team

**Board assessment of the Federal Aviation Administration's response to Recommendation A11-02 (May 2014)**

For Recommendation A11-02 the TSB requested that: "The Federal Aviation Administration assess the adequacy of the 30 minute main gearbox run dry requirement for Category A transport helicopters". In the Report of the Joint Cooperation Team (JCT) on the Review of Helicopter Main Gearbox Certification Requirements for TCCA/FAA/EASA, the JCT recommends rewriting the requirement to become a prescriptive "oil out" durability test of the rotor drive system gearboxes used on Category A rotorcraft. This test should be of duration to be agreed by the ARC group but in any case not less than 30 minutes.

Notwithstanding the FAA's position that this recommendation is closed, the TSB will require confirmation of actions the FAA will take in response to the JCT recommendations regarding the rotor drive system gearboxes used on Category A rotorcraft.

Therefore, the response is considered **Satisfactory Intent**.

**Response of the Federal Aviation Administration to Recommendation A11-02 (November 2014)**

On 19 November 2014, in response to the annual TSB request for information update regarding the status of Recommendation A11-02, the FAA forwarded the following message with a copy of the FAA's response from the previous year (dated 14 November 2013) attached.

"Thank you for providing us with the Transport Safety Board of Canada's Annual Reassessment of Active Aviation Recommendations for year 2014/2015. Your recommendations in question A11-02, A11-01, A06-10 and A06-09 have been addressed in last year's FAA response to your annual reassessment and were considered closed, with no further action planned by the FAA.

Please let me know if you have any new information regarding recommendations A11-02, A11-01, A06-10 and A-06-09, that would require reconsideration."

### **Board reassessment of the Federal Aviation Administration's response to Recommendation A11-02 (March 2015)**

The TSB's recommendation called for the FAA to assess the adequacy of the 30 minute main gearbox (MGB) run dry requirement for Category A transport helicopters that was conceived during the 1980s. Both the FAA and TC initially indicated that they would assess the adequacy of the 30-minute loss of lubrication requirement in concert with EASA by establishing a Joint Cooperation Team (JCT) to conduct a review.

In the 28 September 2012 report produced by the JCT for TCCA/FAA/EASA, the JCT recommended rewriting the MGB requirement to become a prescriptive "oil out" durability test of the rotor drive system gearboxes used on Category A rotorcraft. This test should be of duration to be agreed by an aviation authorities and industry working group (ARC group) but in any case not less than 30 minutes. The ARC group was convened to review the JCT teams report and recommendations.

In a FAA response, 27 November 2012, the FAA advised it would have no further updates on these safety recommendations until the CMT reviews and either accepts, rejects, or modifies the JCT's report.

In the FAA's response 14 November 2013, it advised the JCT had completed its task, and the JCT final report was accepted and signed by the CMT team. Despite repeated attempts by the TSB, the FAA has provided no additional information as to whether the CMT had modified the JCT's report. Also no update has been provided regarding the formation of an ARC group or any work that group may have completed.

The FAA response 14 November 2013 reaffirmed the FAA considers TSB Recommendation A11-02 to be closed and no further action is planned. Since no additional information has been provided regarding the adequacy of the 30 minute run dry requirement, the content of the final JCT report or the action taken by the CMT and ARC groups, the TSB must conclude that the FAA believes the existing MGB run dry requirement is still adequate 30 years after it was first conceived.

Therefore the response is considered **Satisfactory in Part**.

### **Board reassessment of the Federal Aviation Administration's response to Recommendation A11-02 (March 2016)**

There has been no response from the FAA as of 02 March 2016. The last response from the FAA, in November 2014, indicated that they considered the recommendation closed and proposed no further action.

The Board believes that the risks identified in Recommendation A11-02 have not abated and remain significant. To date, no direct action has been taken or proposed that will reduce or eliminate the deficiency. The FAA has not provided the TSB with information to support its

decision not to take further action. The overall response to Recommendation A11-02 is rated **Unable to Assess**.

### **Next TSB action**

The Board concludes that, as no further action is planned by the FAA to address the risks identified in Recommendation A11-02, continued assessments will not likely yield further results.

The TSB will continue to monitor and investigate main gearbox occurrences and communicate its findings to the FAA.

This recommendation will not be reassessed on a regular basis.

This deficiency file is **Dormant**.