EASA
European Union Aviation Safety Agency

Research project: Helicopter Underwater Evacuation (HUE2)

Webinar: final dissemination event
25/04/24, 15:00-17:00 CET

An Agency of the European Union

This project is funded by the European Union's Horizon 2020 Programme

Disclaimer

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Welcome to this webinar!

This webinar is the final dissemination event of this research project

This project has received funding from the European Union’s Horizon Europe Research and Innovation Programme

The EC delegated the contractual and technical management of this research action to EASA

EASA contracted CAAi as Consortium lead for the implementation of the research action following a public tender procedure

EASA-managed projects are addressing research needs of aviation authorities and are an important pillar of the EASA R&I portfolio

The agenda

TIME	TITLE, SPEAKER
15:00 – 15:05	**Welcome to the webinar** Willy Sigl, EASA
15:05 – 15:15	**Research scope and objectives** Emily Lewis, EASA
15:15 – 16:00	**Overview of the project implementation and key results** Stuart Brown, CAAi - Dave Howson, CAA UK - Dr Susan Coleshaw, independent consultant
16:00 – 16:10	**Benefits from the project, planned follow-up actions** Emily Lewis, EASA
16:10 – 16:55	**Questions and answers** Participants, Project Team from CAAi and EASA
16:55 – 17:00	**Concluding remarks** Willy Sigl, EASA

Note: this webinar will be recorded and made available at the EASA website after the event.

Question and Answers

→ For sending questions and comments, please use the slido app, which is also accessible through WebEx:

- www.slido.com
- event code: 1903223

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European Union Aviation Safety Agency

Research Scope and Objectives

This project is funded by the European Union's Horizon 2020 Programme

Research Overview and Objective

Research Project **EASA.2021.HVP.17**: Helicopter Underwater Escape #2

- Received funding from the **European Union's Horizon Europe Research and Innovation Programme**

Awarded to: UK Civil Aviation Authority International

OBJECTIVE: To address Safety Recommendation 2026-016 from the UK AAIB on the accident of G-WNSB, 23 August 2013

*"It is recommended that the European Aviation Safety Agency instigates a **research programme** to provide **realistic data** to better **support regulations** relating to **evacuation and survivability of occupants** in commercial helicopters operating offshore. This programme should better quantify the characteristics of **helicopter underwater evacuation** and include conditions representative of actual offshore operations and passenger demographics."*

April 2022 to April 2024

€ 545,502

EASA

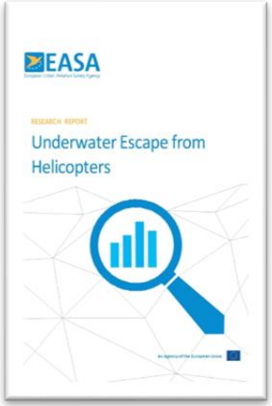
https://www.easa.europa.eu/en/research-projects/helicopter-underwater-escape-2

Helicopter Underwater Escape (#1)

UK Civil Aviation Authority International

EASA.2019.LVP.102

Nov. 2020



Initial review into the nature of the research that could be envisaged:

TASKS:

1. Analysis of the currently available information
2. Analysis of shortfalls
3. Recommendation of future research activities

3 high potential benefit projects identified:

Forces required to jettison push-out underwater emergency exits

Underwater escape from the passenger cabin with a full complement of passengers

Passenger training fidelity and frequency

Helicopter Underwater Escape (#2)

Task 1: Forces required to jettison push-out underwater emergency exits	Task 2: Underwater escape from the passenger cabin with a full complement of passengers
• Evaluate influence of being underwater on the required force • Determine the forces that human test subjects can apply when underwater • Establish an appropriate maximum force for underwater exits	• Quantify underwater escape process in capsized helicopter using a full complement of test subjects • Determine if expectation of 60sec escape is achievable using test subjects representative of the demographic of the European offshore fleet

Confirm the current Certification Specifications and AMC Material or propose future revisions

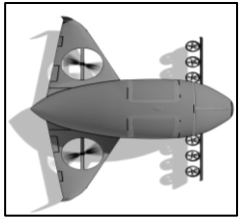
CS-27

CS-29

AIR OPS

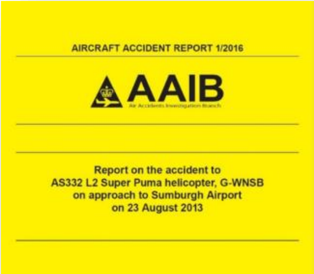
ETSO

PART-26



SC VTOL MOC

Address the S.R.


AIRCRAFT ACCIDENT REPORT 1/2016

AAIB

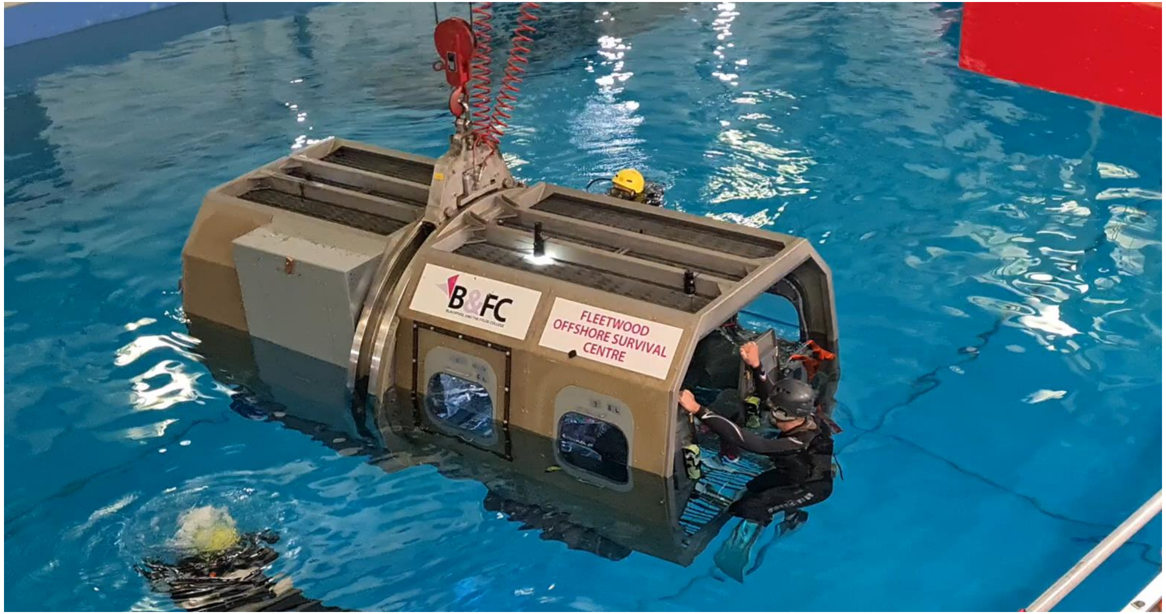
Report on the accident to
AS332 L2 Super Puma helicopter, G-WNSB
on approach to Sumburgh Airport
on 23 August 2013

SR 2016-016

Overview of the project implementation and key results

Test Facility

Fleetwood Test House
environmental pool



Helicopter underwater
escape simulator

Test Facility

Seating arrangement

Test Subjects

→ Total of 18 test subjects recruited:
- 9 size categories (taken from survival equipment standards)
- Ages 16 to 63
- 3 females, 15 males

→ Survival equipment and standard clothing similar to current offshore kit

→ Ethical approval granted by Blackpool and Fylde College Ethics Committee

→ Test subjects received advance training

Selection of Exit Designs – Review of Underwater Emergency Exits

- Fleet survey performed to establish a representative selection of underwater emergency exits.
- Majority of underwater emergency exits are push-out windows, most of which include removable pull-out strips to facilitate jettison of the window.
- There are also a significant number of lever operated hatches.
- Minimum unrestricted size of push-out window exits is Type IV (19 in x 26 in) or 19 in x 26 in ellipse, which also corresponds to the minimum size required by the current certification specifications. This is important for Task 2.
- The size of the majority of lever operated hatches is Type III (20 in x 36 in). Note that this is a similar size to the 'double ellipse' (26 in x 38 in) mentioned in the certification specifications which is relevant to Task 2.

Selection of Exit Designs – Exits Selected

Type IV push-out window

Type III lever-operated hatch

Simulation of Exits – Type IV Push-Out Window

- Operating force varied via adjustable sprung ball detents
- Validated against AW189 aircraft window
- Optimum location for hand push/hand strike operating technique – lower corner of window
- Optimum location for elbow strike operating technique – half way along long side of window

Simulated Type IV push-out exit in HUET

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Simulation of Exits – Type III Lever Operated Hatch

- Operating force varied via adjusting torque loading on lever spindle to vary friction
- Large double ellipse exit simulated using baffle plates

Task 1 – Objective & Methodology

Objective

To determine the forces that human test subjects are capable of applying to successfully operate an underwater emergency exit when they are inside a flooded and inverted helicopter cabin to establish an appropriate maximum permissible operating/jettison force.

Methodology

- Implement simulations of representative underwater emergency exits in a helicopter underwater escape trainer (HUET) which allow the operating/jettison forces to be varied.
- Conduct human subject trials to establish the worst case maximum permissible operating/jettison forces.

Task 1 – Test Protocol

→ Type IV push-out window

- Dry trials:
  - Seat position - stroked and unstroked
  - Jettison technique - hand push, hand strike and elbow strike
- Wet trials:
  - Test condition – test subject seated (worst case of seat stroked/unstroked) / floating in cabin using hand-hold / floating in cabin not using hand hold
  - Jettison technique - hand push, hand strike and elbow strike techniques
  - Left and right hand/elbow
  - Effect of capsize immediately prior to exit operation

Task 1 – Test Protocol

→ Type III hatch

- Dry trials
    - Seat position - seat stroked and unstroked
- Wet trials
    - Test condition – test subject seated (worst case of seat stroked/unstroked) / floating in cabin using hand-hold / floating in cabin not using hand hold
    - Effect of gloves - with/without gloves
    - Left hand and right hand
    - Effect of capsize immediately prior to exit operation

Task 1 – Test Protocol

→ **General**

- Dry experiments started at an operating force of 55lbs (FAA AC 29.809) and were reduced in approx. 5 lb (2.3 kg/222 N) increments until all test subjects were able to operate the exit.

  NB: If all test subjects were able to operate the exit at 55lbs, the operating force was increased.
- Wet experiments were started at the lowest maximum operating force established during the dry experiments.
- During both the dry and wet experiments, test subjects that had already successfully operated the exit were not required to repeat the test at lower operating forces.
- The order of completing the experiments was randomised across the subject group using a Latin square.

Task 1 – Results

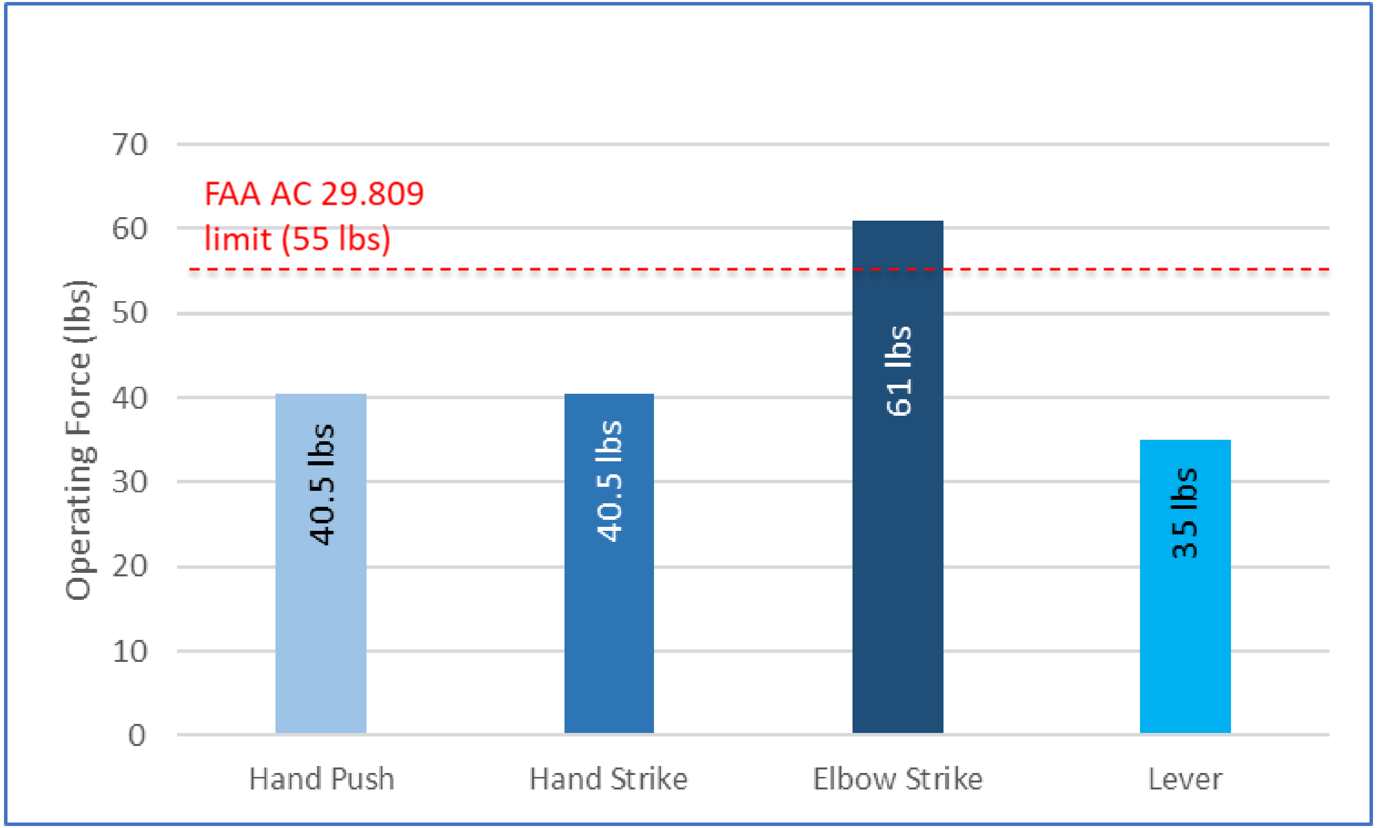
→ Type IV push-out window

The worst case (lowest maximum permissible operating force) was found to be under wet conditions, seated with the seat in the stroked condition and with the exit to the right.

→ Type III lever operated hatch

The worst cases (lowest maximum permissible operating force) were found to be under wet conditions, seated with the seat in the stroked condition and with the exit to the left, and free floating in the cabin.

Task 1 – Results



Task 1 – Results

→ General results

- Use of gloves:
    - Evaluated for Type III lever-operated hatch only
    - No significant effect
- Handholds:
    - Very beneficial for operating Type IV push-out window when free-floating in the cabin
    - No significant benefit for operating Type III lever-operated hatch
- Effects of capsize:

  Inversion did not increase the difficulty of operating either the Type IV or Type III exits
- Effect of harness:

  Some test subjects were unable to reach the lower corner of the window to apply the hand push or hand strike techniques with the harness fully secured – trials performed with two-point waist harness only

Task 1 – Evaluation of results against regulatory aspects

→ Type IV push-out window

- The lowest maximum permissible operating forces for test subjects using the hand push and hand strike techniques were lower than the maximum average and individual load limits defined in FAA AC 29.809 cited in CS 27/29. The lowest maximum permissible operating forces for using the elbow strike technique were instead greater than the AC 29.809 load limit.
- Either:
  - The maximum average and individual load limits in CS 27/29 should be lowered for certification testing, or
  - The current force limits can be retained for certification testing and, operationally, passengers should be briefed to use the elbow strike technique to operate the exit.
- The operating forces measured for the hand and elbow strike techniques were highly variable. The hand push (steady push) technique was more repeatable, produced more consistent results and should be used for certification testing.

Task 1 – Evaluation of results against regulatory aspects

→ Type III lever-operated exit

- The lowest maximum permissible operating force for test subjects was lower than the maximum average and individual load limits defined in FAA AC 29.809 cited in CS 27/29.
- Either:
  - The maximum average and individual load limits in CS 27/29 should be lowered for certification testing, or
  - Some other means of ensuring that the operating force is acceptable should be applied for certification testing, or
  - Some form of operational mitigation should be applied.

Task 1 – Evaluation of results against regulatory aspects

→ General

- Handholds:
  - Exit handholds were found to be of significant benefit in assisting the operation of Type IV push-out exits when the test subject was not secured by a harness
  - Exit handholds should be located to be accessible to a passenger who is free-floating underwater in the capsized helicopter to help overcome buoyancy forces and react against to generate force
- Seat/exit position:
  - The seat/exit positions need to be designed such that the occupant can reach and operate the exit with the seat harness secured

Task 2 – Aims & Objectives

→ **Overall aim:**

Determine how long it takes for all the occupants of a submerged helicopter cabin to complete an underwater escape

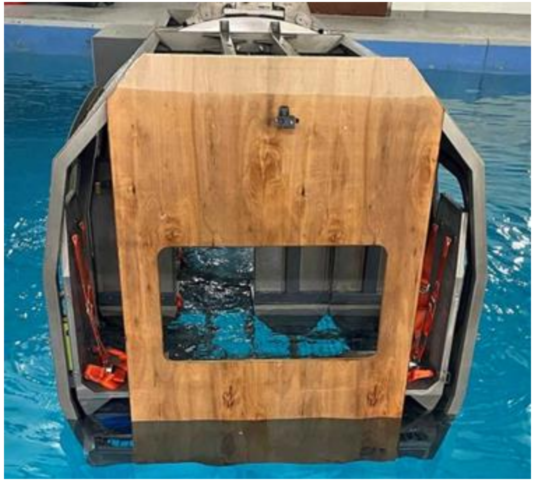
→ **Objectives:**

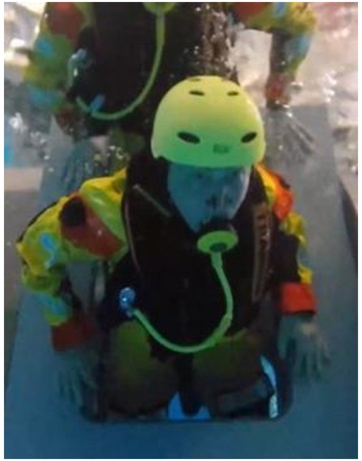
- Measure escape time for a full complement of occupants from a capsized helicopter cabin and validate the 60 s escape time in AMC to HOFO operating rules.
- Assess escape from different seating configurations.
- Determine escape routes and exits used and difficulty of escape.
- Validate whether two occupants can escape through a large double ellipse exit at one time.
- Determine the effect of blocking certain exits.

Task 2 – Large exit validation

Exit encompassed two ellipses of 0.48 m x 0.66 m (19 in x 26 in), side by side, with the overall dimensions of 0.96 m x 0.66 m (38 in x 26 in).

Landscape and portrait orientations





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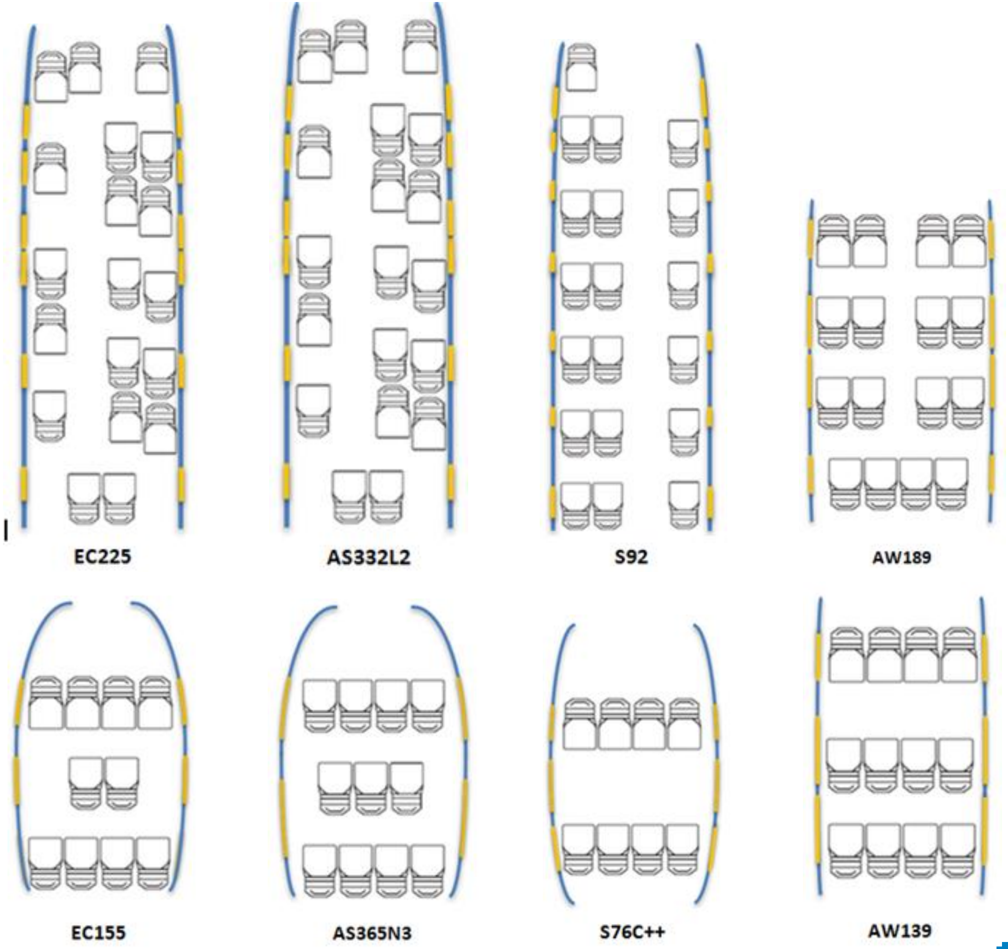
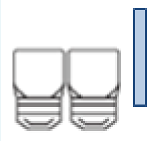
Task 2 – Review of helicopter seating layouts

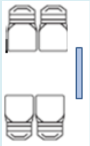
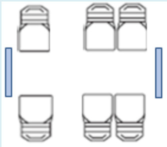
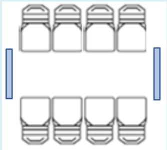
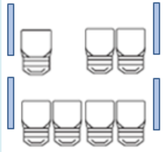
- 3 and 4 seats across cabin;
- 1 or 2 seats per exit;
- Some rows have an aisle between seats, some have no aisle;
- ‘Use of ‘club’ layouts with facing seats



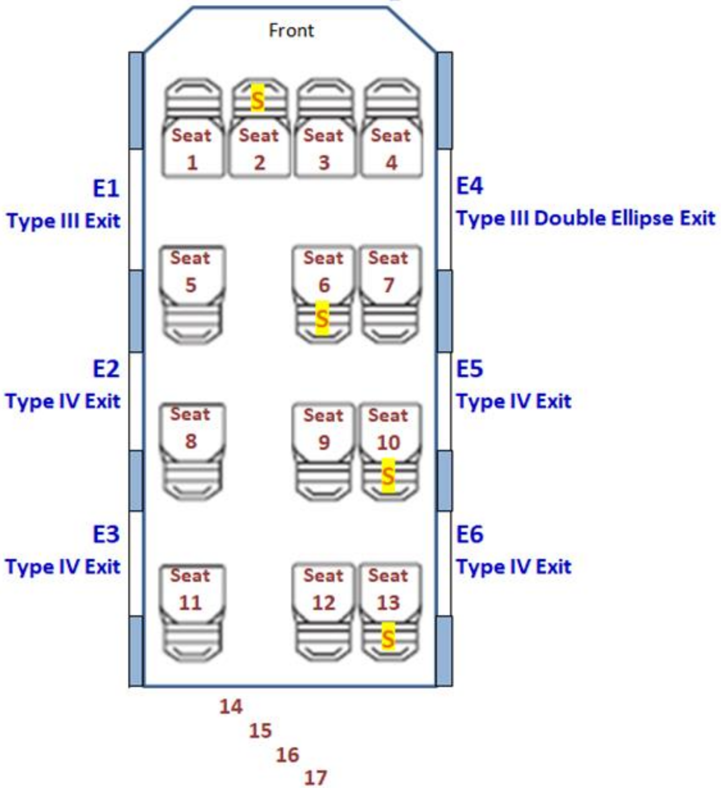
Task 2 – Single row seating arrangement trials

Seating configuration	Total escape time Mean ± SD (s) (without handhold)	Total escape time Mean ± SD (s) (with handhold)
Single row, 2 subjects, 1 Type IV exit 	25 ± 6	26 ± 6
Single row, 3 subjects, 1 Type IV exit 	35 ± 4	35 ± 4
Single row, 4 subjects, 2 Type IV exits 	33 ± 5	28 ± 5*

Task 2 – Double row seating arrangement trials

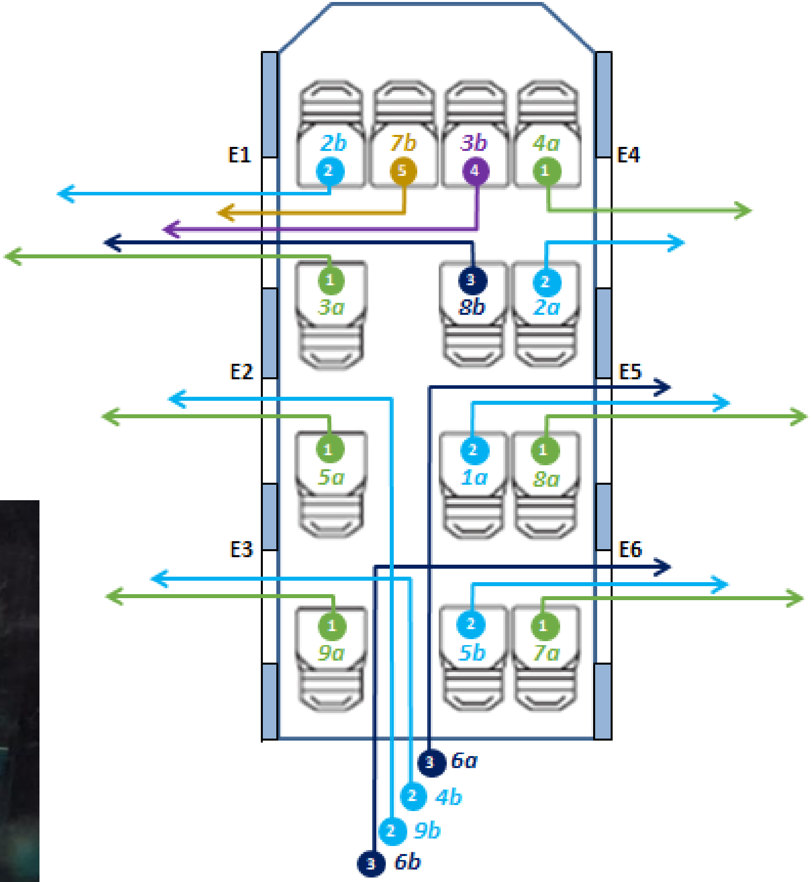
Seating configuration		Total escape times (mean ± SD)	
		(without handhold)	(with handhold)
Double row (club), 4 subjects, 1 Type III (double ellipse) exit		39 ± 7	-
Double row (club), 6 subjects, 2 Type III (1 double ellipse) exits		36 ± 3	36 ± 1
Double row (club), 8 subjects, 2 Type III (1 double ellipse) exits		40 ± 3	38 ± 3
Double row, 6 subjects, 4 Type IV exits		30 ± 2	36 ± 7
Double row, 7 subjects, 4 Type IV exits		31 ± 1	39 ± 15

Task 2 – Full cabin escape trials

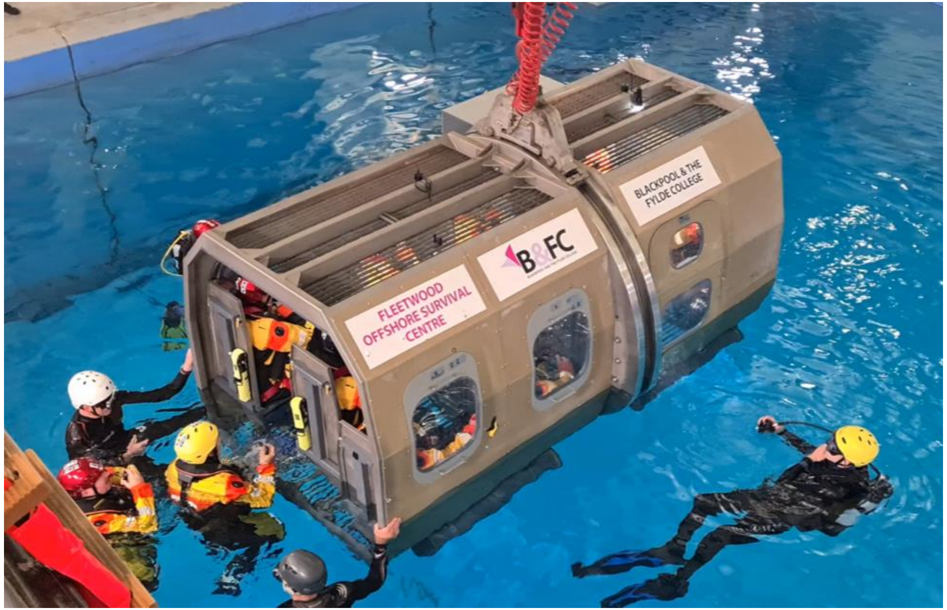


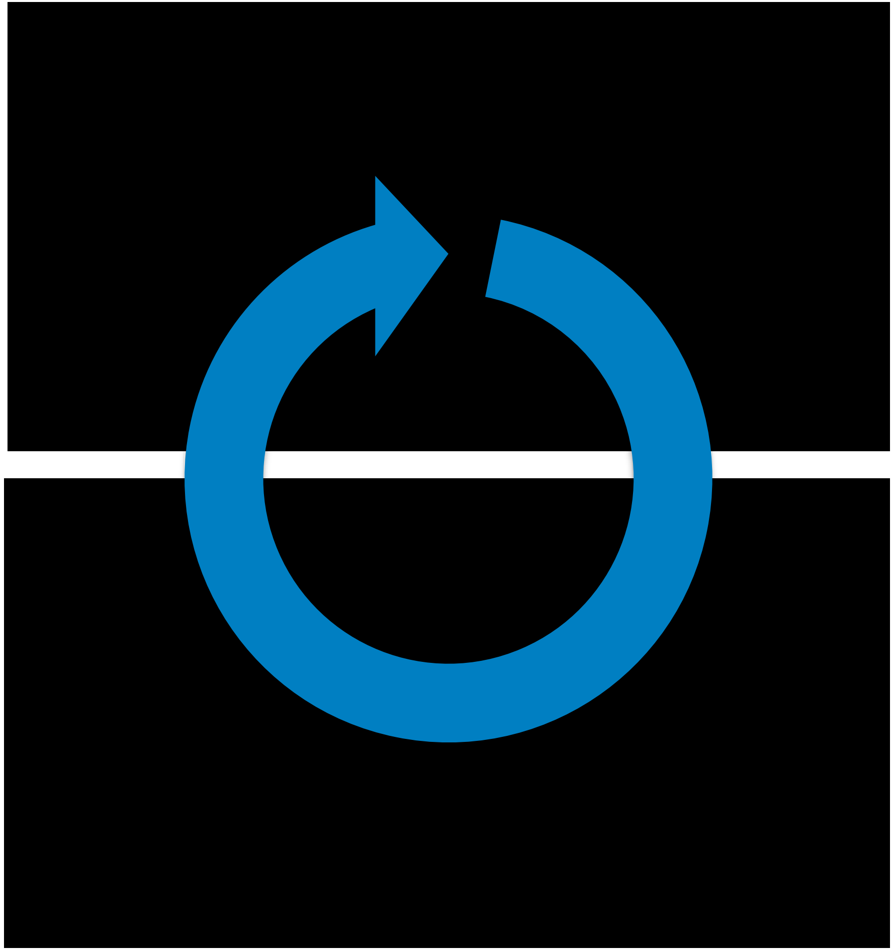
Task 2 – Submersion

- First subject (8a) escapes in 8 s
- Last seated subject (7b) escapes in 35 s, from stroked seat.
- Subjects swimming in from rear escape in 19 to 30 s
- *"Aisle was a bit narrow to move through"*

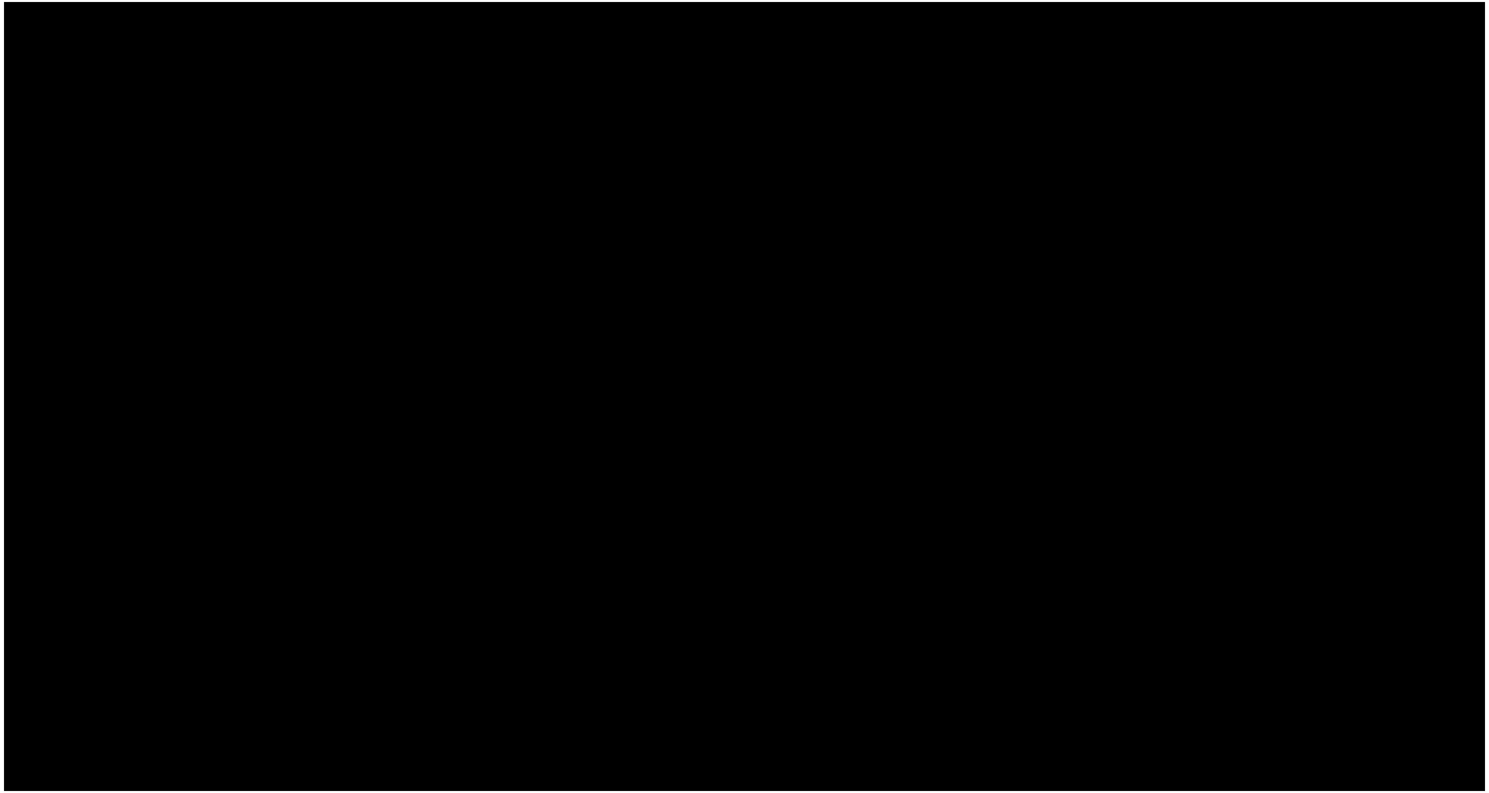


Task 2 – First Capsize



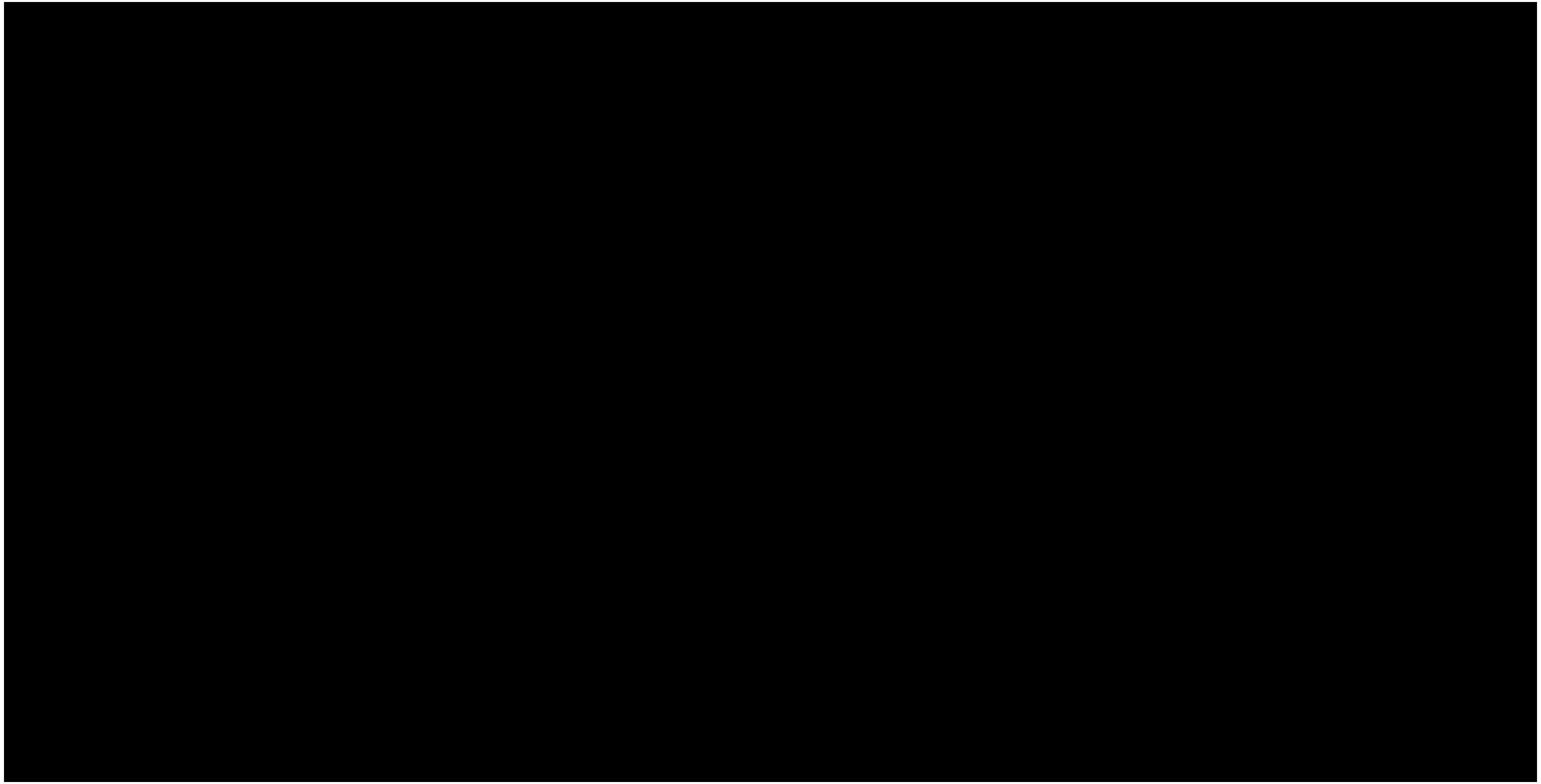


Task 2 – First Capsize



Forward facing camera

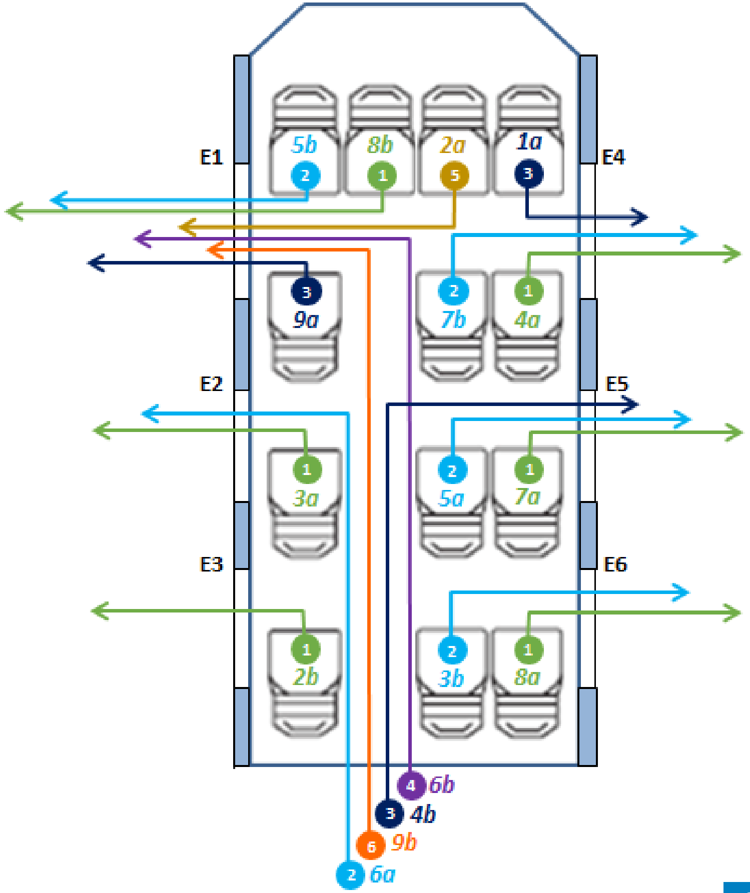
Task 2 – First Capsize



Rear facing camera

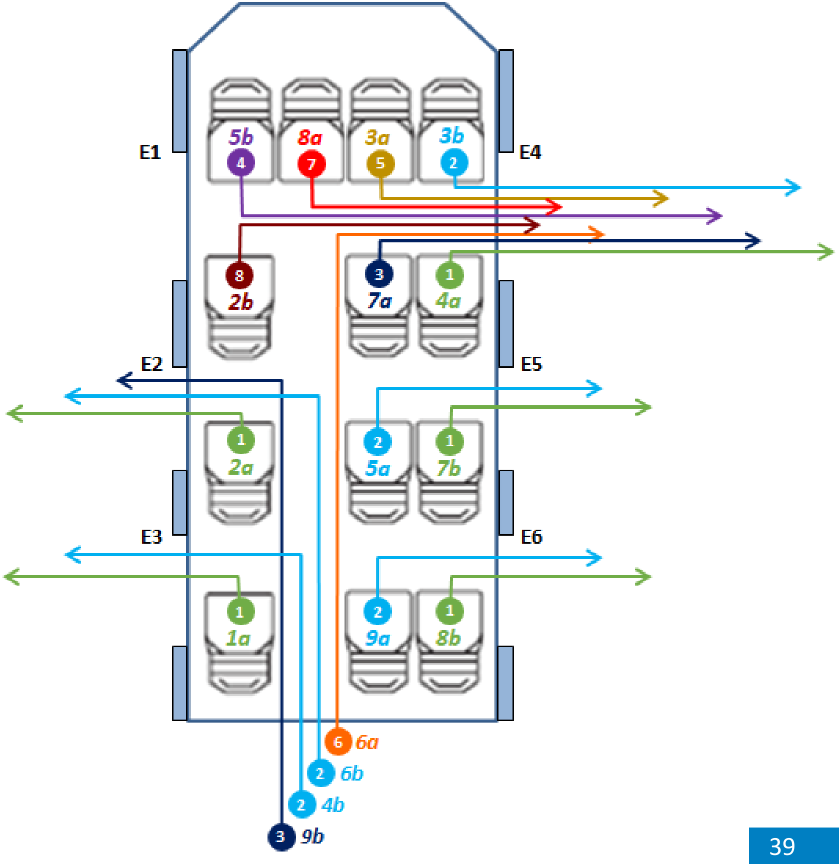
Task 2 – First Capsize

- First subject (2b) escaped in 19 s
- Last subject (6a) escaped in 65 s (swam in from rear of cabin)



Task 2 – Second capsize - Type III exit blocked

- First subject (8b) escaped in 23 s
- Last subject (9b) escaped in 70 s (swam in from rear of cabin)



Task 2 – Evaluation of results against regulatory aspects

- The results of the study support AMC1 SPA.HOFO.165(h); it should be possible for a full complement of helicopter passengers to escape from the inverted helicopter within the underwater survival time of 60 s, in the best case.
- The additional blocked exit increased escape time (as did problems releasing an exit and releasing seat harnesses).
- An exit which provides an unobstructed area that encompasses two ellipses of 0.48 m x 0.66 m (19 in x 26 in) is large enough to permit the simultaneous egress of two broad shouldered passengers, supporting the material included in AMC1 SPA.HOFO.165(h)(c).
- It is recommended that the term 'side by side' should not be used in the regulations when referring to double ellipses and the simultaneous escape of passengers.
- Use of compressed air EBS allowed test subjects to stay calm and escape without signs of panic.
- The width of any aisle will affect the difficulty of escape for passengers having to move between rows due to a blocked exit(s).

Benefits from the project, planned follow-up activities

This project is funded by the European Union's Horizon 2020 Programme

Benefits and Future Activities

Confirm the current Certification Specifications/Regulations and AMC Material or propose future revisions:

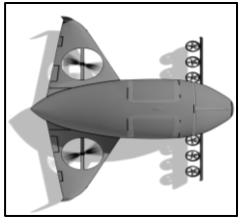
CS-27
from Amdt. 5

CS-29
From Amdt. 5

PART-26

AIR OPS

ETSO



SC VTOL MOC

Certification Specifications Confirmed

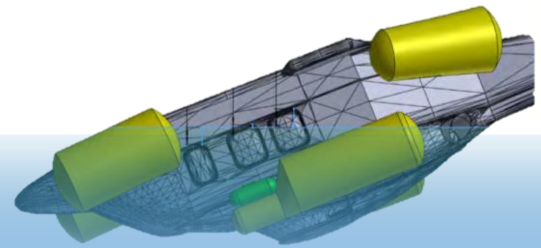
AMC Material to be reviewed

Certification Specifications and Regulations Confirmed

MOC Material to be reviewed

Benefits and Future Activities: Timescale

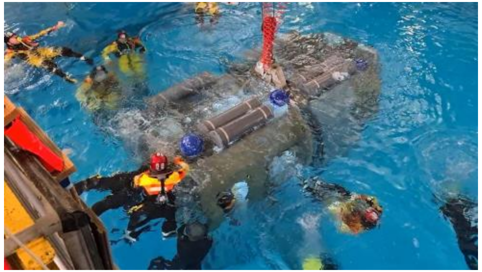
Research Project **EASA.2019.HVP.18**:
New Flotation Systems



https://www.easa.europa.eu/en/research-projects/helicopter-shore-operations-new-flotation-systems

EASA.2021.HVP.17: HUE#2

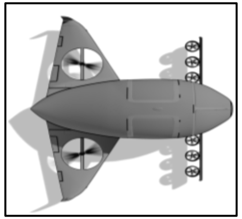
- CS-27 and CS-29 AMC Material to be reviewed
- SC VTOL MOC to be reviewed



NPA for Initial Airworthiness expected Q1 2025

RMT.0120 Phase 3

EPAS Update



SC VTOL MOC

SC VTOL MOC updated expected Q2 2024

Benefits and Future Activities: HUE#2 Conclusion

- Research Project **HUE#2** has fully addressed the Safety Recommendation from 2026-016 from the UK AAIB on the accident of G-WNSB, 23 August 2013
- The current Certification Specifications, CS-27, CS-29 and CS-ETSO have been confirmed
- Rotorcraft ditching Air Operation and Part-26 regulations do not require further rulemaking activity related to underwater escape
- CS-27 and CS-29 AMC material to be reviewed. This rulemaking activity will be included in RMT.0120 Phase 3 (target Q1 2025 NPA)
- SC VTOL MOC will be updated according to the research recommendations, as appropriate

Questions and answers

Question and Answers

→ For sending questions and comments, please use the slido app, which is also accessible through WebEx:

- www.slido.com
- event code: 1903223

Concluding Remarks

This project is funded by the European Union's Horizon 2020 Programme

Aviation Authorities Research Agenda – topics

Environment
- New SAF production pathways

Artificial intelligence
- Human factors

Security impacting safety
- AI aspects, conflict zones

Health / medical
- Obstructive sleep apnea, high air space operations

Automation
- Impact on responsibilities of flight crews and air traffic controllers

Air operations
- Flight time limitations for EMCO

ATM / ANS
- Performance of ground equipment, airspace classifications

Drones
- BVLOS operations

Data for Safety
- Research on future uses cases

PNT

Icing


EASA
MAB RESEARCH Group
Proposed research topics for
Horizon Europe Work Programme(s) 2025-2027
Aviation authority needs – proposed as indirect managed topics

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Proposed research topics for
Horizon Europe Work Programme(s) 2025-2027
Aviation

European Union Aviation Safety Agency

Thank you for joining this webinar!

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