EUROPEAN AVIATION SAFETY AGENCY
AGENCE EUROPÉENNE DE LA SÉCURITÉ AÉRIENNE
EUROPÄISCHE AGENTUR FÜR FLUGSICHERHEIT

Research Project EASA.2009/4

Regulation of Ground de-Icing and Anti-Icing Services in the EASA Member States

Final Report

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Disclaimer

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EASA.2009.OP 21

Study on the regulation of ground de-icing and anti-icing services in the EASA Member States

FINAL REPORT

INTRODUCTION

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In addition to this Introduction document, the Final Report also consists of the following documents:

- Impact Assessment
- Summary of Options to Recommendations (Spreadsheet)
- Cost of De-icing / Anti-icing Service Provision
- Cost Model (Spreadsheet)

0 Disclaimer

The contents, analyses, opinions and conclusions derived by the Study Team and presented in all published documents connected with this Study (Interim Report, Stakeholders' Representatives Briefing Report, and Final Report) do not represent or reflect an official EASA position or opinion concerning de-icing / anti-icing activities within the Member States. Furthermore, the Agency is not obliged to accept any of the recommendations made within the Final Report. However, in due course EASA may wish to publish an Opinion on the study and take some action in response, or in connection, to the recommendations made.

1 Executive Summary

In response to a number of incidents of restricted and stiff flying control systems caused by freezing anti-icing fluid residues, and following recommendations made by accident investigators and Industry stakeholders to address the situation, EASA.2009.OP 21 Study on the Regulation of De-icing / Anti-icing Services in the EASA Member States, commissioned by EASA and awarded to airsight GmbH, commenced in April 2010 and took 11-months to complete.

The scope of the Study was to investigate and recommend the means by which the Aviation Authorities of Member States (NAAs) manage matters with respect to the certification of service providers, and the availability of de-icing / anti-icing fluids: with the aim of making recommendations on how the quality of service provision and the availability of Type I fluids can both be improved.

Overall, the Study has been successful with regard to making practical recommendations to raise standards (and improve safety). Regarding the improvement of fluid availability, there are some outstanding issues that need resolving and therefore the Study has made practical recommendations for the “next steps” that will be necessary before a solution can be found.

Using on-line surveys for all the main stakeholder groups, face-to-face interviews, and follow-up calls and questionnaires, a broad analysis of the de-icing / anti-icing Industry within Member States was presented in the Interim Report to this Study (December 2010). Within that report 93, “Options for Change” were presented for consideration as potential recommendations. The key Options were presented to stakeholders at a purpose-held briefing and the feedback, together with data gathered through the Study, was used to develop the 26 Recommendations that are presented in this Final Report.

Each of the Recommendations has been assessed for their impacts concerning safety, economic, environmental, social and the regulatory framework. Overall, if EASA adopted the Recommendations there would be a beneficial reduction in the risks associated with de-icing / anti-icing. Implementing some of the Recommendations would have an initial negative economic impact, however, the gains expected, in the long-term, from reduced incidents and losses will more than compensate economically. Furthermore, with improved standards of de-icing / anti-icing it is expected that fluid use and application will become more efficient, thereby providing not just economic but also environmental benefits. There is expected to be a neutral social impact with the total number of jobs remaining the same overall.

Overall improvements to specific regulations for operators in particular, and possibly aerodromes, will enhance the current and proposed regulatory framework for de-icing / anti-icing. It is also expected that improvements to the regulations will have a positive effect on the safety of other ground-handling activities.

A Cost Model has also been presented in this Report to highlight the potential economic impacts of implementing de-icing / anti-icing operations at various average sizes of aerodrome, and also for upgrading one-step de-icing / anti-icing operations to include Type I fluid in a first step of a two-step procedure. It was concluded that the additional investment required to provide Type I fluid in addition to Type II and IV may increase the cost of de-icing / anti-icing operations by between 2.5% to 6.75%; with the major additional costs associated with fluid storage facilities and the replacement or upgrading of de-icing trucks. Whilst the investment required will be greater at larger aerodromes, and those aerodromes where de-icing / anti-icing operations are more numerous; because of their ability to recover these costs through de-icing / anti-icing operations, passenger taxes and/or landing charges, the impact will be less. Whereas the economic impact will be much higher for small and medium aerodromes, especially where the volume of de-icing/anti-icing activities and concomitant utilisation of de-icing / anti-icing equipment is low.

In conclusion, the Study recommends that EASA develop a work programme which aims to make improvements in six distinct areas, each built on tasks specific to the Recommendations made in this Report. If such a work programme were undertaken, it is expected that within 2 years de-icing / anti-icing operational standards will be generally higher than at present, harmonised more broadly across Member States, and introduce fewer risks into the aviation system. The six areas recommended for action are:

- Improving coordination between Industry and the NAAs.
- Collecting more safety data and analysing the existing risks.
- Ensuring regulations and guidance for air operations are comprehensive, unambiguous and practical.
- Conducting oversight activities to ascertain whether regulations are being harmoniously and consistently applied across Europe.

- Consider alternative regulatory means to support operators achieve acceptable service levels from their providers and to facilitate aerodromes and service providers in ensuring this.
- Engaging with all stakeholders to ensure that more focused research is conducted, and data gathered, into fluid qualities and performance.

2 Content & Structure of the Final Report

The fourth and Final Report to this Study on the Regulation of Ground De-icing and Anti-icing Services in the EASA Member States completes 11-months of work by airsight GmbH of Berlin, and represents the final deliverable to the Study as agreed at the kick-off meeting held in Köln, 13 April 2010. The three previous reports submitted to the Agency, as requirements of the Study, were:

- Inception Report, June 2010: presentation (for approval) of the Study Team's intentions for data gathering, classification, and final presentation.
- Interim Report, December 2010: summary of investigations, collected data, analyses of the data, and Options for possible action.
- Stakeholders Representatives' Briefing (SRB), December 2010: feedback from stakeholders on each of the Options presented in the Interim Report.

The agreed contents of the Final Report were:

- All relevant data collected during the Study.
- The Interim Report
- Summary of results from the SRB
- Impact Assessment for the Recommendations presented.
- An assessment of the costs involved in introducing de-icing / anti-icing services to a Station, as well as the costs to upgrade the fluid and treatment offered to include Type I fluid at an existing Station.

The relevant collected data, Interim Report and SRB Report have already been submitted to EASA. The Interim Report will be made publicly available by EASA, and contains:

- Interim Report – Introduction.
- Interim Report – Data summary and analysis.
- Interim Report – Options for change.
- Attachment A – Summary and analysis of available safety data.

- Attachment B – References: regulations and industry recommendations (a working document).
- Attachment C – Notes of FAA SIAGDP (FAA Standard International; Aircraft Ground De-icing Programme.

These documents will be referred to where appropriate within this Final Report, and where necessary, extracts and summaries are provided. In particular the results of the SRB are disseminated appropriately within the Impact Assessment.

The Final Report therefore consists of the following documents:

- Final Report – Introduction (this document).
- Final Report – Impact Assessment.
- Final Report – Summary of Options to Recommendations (spreadsheet).
- Final Report – Cost of De-icing / Anti-icing Service Provision.
- Final Report – Cost Model (spreadsheet).

3 Introduction

This Introduction paper to the Final Report includes:

- Executive Summary providing a short overview of the purpose of the Study, the analyses made, and the conclusions.
- Background information to the Study; from the original incidents involving frozen fluid residues up to the Terms of Reference (ToRs) for this Study.
- A brief description of the Study process and methodology.
- A detailed explanation of how the Options for Change were discarded, or adopted and amended to become Recommendations.
- A summary description of the cost of establishing de-icing / anti-icing services and upgrading to include Type I fluid.
- A summary of the Recommendations made.
- A summary of the results from the Impact Assessment (IA).
- By means of a conclusion, an introduction to a potential work programme for EASA to adopt, and making reference to the Recommendations as actions within the programme.

EASA will need to make consequential decisions regarding which of the presented Recommendations to adopt, modify, or discard.

The format and content of this Final Report is designed and tailored to assist EASA in making these decisions.

In several cases, it is likely that the Agency will wish to investigate some of the Recommendations more deeply, following further examination of the existing risks and potential impacts, and after seeking a broad consensus. The Report also indicates where this course of action may be useful.

For other readers of this Report, some background information is provided. However, for a full understanding, it is recommended that the Interim Report “Options for Change” is read beforehand.

4 Background to the Study

During the winters of 2005 and 2006 a large number of events of stiff or frozen flight control systems occurred, particularly on aircraft with non-powered flight control systems. These events were attributed to the re-hydration and subsequent freezing of the residues of thickened anti-icing fluids previously applied to the aircraft. At the time, a number of Safety Recommendations were made by accident investigation agencies on this subject, including the UK Air Accident Investigation Branch (AAIB)[1] and the German Federal Bureau of Aircraft Accident Investigation (BFU)[2]. The recommendations made by AAIB and BFU can be summarised as:

- improving the availability and encouraging the use of Type I fluids;
- the development of engineering and maintenance procedures to identify and remove fluid residues;
- give consideration to the approval and certification of de-icing / anti-icing providers and training organisations; and
- encourage the development of fluids which result in fewer residues, together with the establishment of certification criteria for all de-icing / anti-icing fluids.

All the AAIB and BFU recommendations are presented in Appendix 1 to this document.

At about the same time (April 2006), European Regions Airline Association (ERA), together with the JAA, held an Industry-wide Winter Operations Workshop[3] in Basel, Switzerland, to address both the issues surrounding fluid residues and also standards of de-icing / anti-icing. The conclusions from this Workshop were that the following goals were unanimously agreed upon:

- Type I de-icing fluid should be more readily available at more airports
- Operators should be able to receive, on demand, the service they request including two-step de-icing / anti-icing

[1] AAIB Bulletin – 7/2006, July 2006
http://www.aaib.gov.uk/publications/bulletins/july_2006/avro_146_rj100__g_jeav_and_others__and_embraer_145.cfm

[2] BFU Investigation Report 5X007-0/05 November 2006
http://www.dac.public.lu/documentation/comms/degivrage.pdf

[3] The Winter Operations Workshop is not available for download, but may be requested from ERA via info@eraa.org or +44 1276 856495.

- Service providers should be licensed and overseen by a regulatory body
- De-icing / anti-icing personnel should be licensed by a regulatory body
- Consideration should be given to the certification of de-icing / anti-icing products
- A greater amount of independent research and development should be conducted into the behaviour of thickened fluids and the prevention of residue formation

In response to the recommendations made by AAIB, BFU and Industry, EASA released Advance-Notice of Proposed Amendment (A-NPA) 2007-11[4]. The purpose of this was to consult stakeholders on the appropriate measures to be taken in order to address potential safety hazards associated with the residues of fluids used for the de-icing and anti-icing of aircraft, and also to give consideration to the options available for action. The Comment Response Document (CRD)[5] to this A-NPA concluded that most commentators would wish that:

- An appropriate range of fluids is maintained and offered at each aerodrome receiving commercial air transport aircraft
- De-icing / Anti-icing service providers be approved, and
- Fluids are certified

The Agency noted at the time that both certification of fluids and regulation of aerodromes were outside of the Agency's remit, and therefore these would remain long-term goals. This is still the situation today. However, EASA rulemaking tasks concerning the regulation of aerodromes are underway, and consultation on Implementing Rules (IRs), Acceptable Means of Compliance (AMC) and Guidance Material (GM) will occur during 2012 and 2013. Therefore, it should be possible for recommendations made in this Report, which directly affect aerodromes, to be considered by EASA.

In addressing the AAIB and BFU recommendations to *develop engineering and maintenance procedures to identify and remove fluid residues*, the Agency has since

[4] EASA A-NPA-2007-11, July 2007 http://www.easa.eu.int/ws_prod/r/doc/NPA/A-NPA-2007-11.pdf

[5] EASA CRD to A-NPA-2007-11, September 2008 http://www.easa.eu.int/ws_prod/r/doc/CRD%202007-11.pdf

amended PART M, in accordance with CRD to NPA 2009-09[6]; and also, in April 2009, requested Type Certificate Holders to submit information on their procedures for de-icing / anti-icing and residue detection and elimination for Continuing Airworthiness.

In conclusion, EASA stated that it was envisaging a number of medium and long-term actions for which a plan was laid out, as shown below:

1. Continue to take note of activities and progresses made by the relevant SAE Committee and subgroups on this subject and provide input as necessary (long-term).
2. Make proposals to the European Commission for studies to evaluate the feasibility of introducing in CS23 and CS25 a criterion for establishing sensitivity to fluid residues (long-term).
3. Investigate and recommend the means by which Aviation Authorities of Member States manage matters with respect to the certification of service providers, availability of fluids at aerodromes, etc (medium-term).
4. Make, as far as possible, provisions in the implementing rules on the safety of aerodromes with a view to make the operations of de-icing / anti-icing service providers safer and ensure the availability of fluids (medium-term).
5. Consider input from stakeholders regarding amendments to the operational rules on de-icing / anti-icing, during the forthcoming NPA consultation process of the implementing rules for air operations to the EASA Basic Regulation (medium-term).
6. Plan to introduce into the rulemaking inventory a task to extend the Agency's remit to fluids and materials in addition to parts and appliances. Such a task would be preceded by an A-NPA to explain and consult on the concept (long-term).

The Terms of Reference for this Study are based on item 3 above; however, many of the Recommendations made in this Report also encroach into items 4 and 5. Full support is also given here to item 1, especially as a mechanism to pursue more investigation into the need for item 6.

[6] EASA CRD to NPA 2009-09, May 2010 http://www.easa.eu.int/ws_prod/r/doc/CRD%202009-09.pdf

5 The Study

5.1 Terms of Reference

The Terms of Reference (ToRs) for the Study[7] required that the Study Team:

- Investigate and recommend the means by which the Aviation Authorities of Member States (NAAs) manage matters with respect to the certification of service providers, and

- Investigate and recommend the means by which the Aviation Authorities of Member States manage matters with respect to the availability of fluids at aerodromes.

The investigations required factual inputs, and the recommendations were to consist of informed advice, whilst focusing on the most effective ways in which the NAAs could regulate de-icing / anti-icing services in a harmonised way, so that the safety of air operations is maximised, and a level commercial playing field is maintained.

Specifically, recommendations were centred on how the availability of Type I fluids and the quality of service provision can both be improved.

EASA also required , as part of the Impact Assessment, estimates as to the cost (or cost range) of providing de-icing / anti-icing services (offering Type I and possibly other de-icing fluids) or to upgrade the fluid(s) and treatment(s) on offer (to include also Type I apart from the anti-icing fluids already offered) at various sizes of aerodromes (based on passenger numbers).

Full details of these figures are provided within the Final Report – Cost of De-icing / Anti-icing Service Provision.

[7] Specifications for EASA.2009.OP 21 Study on the regulation of ground de-icing and anti-icing services in the EASA Member States:
http://www.easa.europa.eu/ws_prod/g/doc/Procurement/2009/OP21/02.EASA.2009.OP.21%20TS.pdf

5.2 Data Collection

Data collection for the Study took place between April and Oct 2010 and involved gathering feedback from the following stakeholder groups:

- national aviation authorities (NAAs) from EASA Member States,
- operators
- aerodromes
- service providers
- aircraft manufacturers
- fluid manufacturers
- de-icing / anti-icing equipment manufacturers
- FAA

Included in this list are the main Industry associations such as: IATA (DAQCP), AEA, ERA, IACA, and ACI. Specific tailor-made questionnaires were employed in conjunction with face-to-face interviews and follow-up telephone calls and e-mail exchanges. Feedback was also obtained from the SAE G-12 conference held in Berlin, May 2010, an ERA Technical Services Working Group held in Innsbruck, June 2010, and a de-icing / anti-icing conference hosted by Clariant in Prague, June 2010. Full details of the response levels, data collected and subsequent analyses are available in the Interim Report – Data Summary and Analysis.

5.3 Feedback

It became clear during the Study that the majority of stakeholders' concerns, and their ideas for making progress, were centred on raising standards rather than increasing / improving the availability of fluids. This is partially to do with very real concerns about consistent levels of service provision (as highlighted at the ERA/JAA Workshop in 2006) and also that practical solutions to raising standards are easier to propose than improving the availability of fluids. From the data analysis and feedback obtained, the Study Team drew up a shortlist of actions that were aimed at addressing the most pressing concerns, and which also meet the EASA requirement to *maximise the safety of air operations*. The shortlist is shown below:

- collect and analyse more safety data in order to reduce risk and comply with performance-based regulation of safety;

- improve key stakeholders' knowledge through better awareness and training programmes;
- clearly define key stakeholders' and individual's responsibilities;
- enhance the consistent application of procedures and harmonised standards through more practical and specific guidance material for operators;
- introduce a level of oversight from the Authority;
- increase the involvement by aerodromes by defining a set of specific responsibilities;
- encourage more investment where necessary.

5.4 Safety Analysis

In addition to the above, consideration was also given to other existing and available information, especially safety data, a summary of which is available in Attachment A to the Interim Report.

The Study Team's analysis of the available safety data concluded that most of the known (reported and shared) accidents and serious incidents are what may be termed the "top of the triangle" (referring to the Heinrich Triangle).

Very little data exists concerning the hundreds of "low-level" events, unsafe acts, human errors, and other contributing factors - these are the precursors to accidents and incidents. There is a dearth of information in this area, even though some of these contributory factors *must* be "visible" and informally known to the de-icing / anti-icing operatives and to the organisations they work for.

This Study supports the use of ICAO Safety Management Systems (SMS) Standards and Recommended Practices (SARPs) as the means to encourage and require all those involved to report, collect, analyse and share such safety data. As well as lack of safety data, and the need to collect more, the conclusions from the analysis of available safety data were that effort and safety resources should be directed at improvements to:

- communication
- coordination
- inspections/checks
- procedures

- adherence to procedures
- knowledge
- training

The Study further concluded that these issues may be addressed via:

- the creation of new direct and indirect regulations
- the provision of clear, concise and unique regulatory interpretive and guidance material
- an industry-wide awareness programme and associated voluntary accreditation scheme for de-icing / anti-icing operations and training

6 Recommendations

A list of the Recommendations made as a result of this Study is provided in Annex 1. They are also shown and described within the Impact Assessment and summarised in the Summary of Options to Recommendations spreadsheet.

6.1 Developing the Recommendations

There have been four distinct stages to developing the Recommendations. Within this process, consideration has always been given to the conclusions, arrived at by the Study Team, as shown in Section 5 above, in conjunction with the existing recommendations and conclusions shown in Section 4.

The first step was to consider where existing and proposed regulations, and guidance material, met, or failed to meet, the needs identified by the Study. This preliminary examination of regulations is contained within Attachment B to the Interim Report: the appropriate explanations and references are also contained within this Final Report as part of the Impact Assessment. Several areas of inadequate regulation were uncovered, in that they were ambiguous, too generalised, and impractical. This is in stark contrast to equivalent regulations which address other, similar, operational activities. Evidence of this was provided by the wide variety of interpretations that stakeholders have made, together with their lack of understanding in certain areas.

The second step involved the development of possible Options for Action. Altogether 93 Options were presented within the Interim Report: many of these were in contradiction with other Options, some were mutually supportive, while others were inter-dependent.

Whilst all the Options had the possibility to provide practical solutions, some were conditional on major changes being made to the regulatory framework, sometimes in areas outside the remit or influence of EASA and the NAAs. Therefore, some of the Options would not be feasible in the short-term. At this stage it was necessary to consider the different regulatory pathways that were available, e.g. direct to service providers, or indirect via operators and aerodromes.

The third step involved presenting these Options, without any bias or indication of preference, to stakeholder groups' representatives. This was achieved at the SRB, where 37 Options were presented, including 2 additional Options required by EASA. The reason for the lower number of Options presented at the SRB compared to the Interim Report was that specific Options which supported a higher level Option were

omitted, to allow focus on the main concepts and not the detail of how to achieve it. Some of those omitted Options do survive as points to consider in support of adopting the appropriate Recommendations. Other Options were dismissed by the Study Team as impractical, or impossible, within the current regulatory framework, see sub-section 6.3 below.

Finally, the fourth stage, involved consideration of the feedback from stakeholders obtained during and after the SRB, combined with the Study Team's expertise, to refine and reduce the 93 Options to 26 practical and possible Recommendations; which are presented in the Impact Assessment.

6.2 Preferred Regulatory Path

Underpinning the Recommendations presented within this Report is the philosophy of continuing with the indirect regulation of service providers through regulation of Air Operations.

Firstly, there is no mechanism for regulating all aspects of service provision directly from either EASA or NAAs.

Secondly, the operators will always have a vested interest in ensuring that service providers comply with the operator's procedures and standards.

Thirdly, it still remains the preferred regulatory mechanism for ICAO.

There is one area where operators have no control. Despite being given total regulatory responsibility, setting the standards for the services they purchase, choosing their supplier (when a choice exists), and overseeing that the standards are attained, operators have no input as to which service providers are granted licences to operate at particular aerodromes.

That process involves (with some variance between Member States) local governments, aerodromes, NAAs and even other national government departments. There would be great benefit, and it would make sense, to allow operators to have an input into this process, in particular in establishing minimum standards appropriate to each aerodrome. Although this mechanism is beyond the "reach" of this Study, Recommendations have been made to clarify the roles and responsibilities of aerodromes concerning the de-icing / anti-icing activities that are undertaken at their "place of business", and also to establish how standards can be improved through

the mechanism of the Ground-Handling Directive[8]. These “alternative” or “additional” paths to regulation will complement the recommended changes to the regulation of operators.

Current trends are for NAAs to lighten their “touch” by devolving more oversight to the organisations they approve and certify (e.g. operators, maintenance, and aerodromes) through approved compliance and safety management systems.

However, there is an argument that NAAs should *increase* their involvement in the oversight of de-icing / anti-icing, and associated activities, undertaken within their territories. The reason for this is that levels of experience and understanding within NAAs concerning de-icing / anti-icing are very low. Implementing a suitable (direct, proportional and representative) oversight programme will improve the situation and create a greater understanding of the need to coordinate activities amongst all the stakeholders, thereby giving support to operators who find it difficult to ensure their responsibilities are always met.

Therefore, this Report recommends that NAAs fulfil their obligations by developing and implementing suitable direct oversight programmes of de-icing / anti-icing “activities” that are conducted within their territory.

6.3 Omission of Options

A brief explanation is required as to why certain Options were not promoted to full-blown Recommendations.

The omitted options are valid concepts, and they continue to exist as Options within the Interim Report. However, their adoption would either, be against the majority opinion, require major changes to the regulatory framework, involve great expense, or have very little positive impact. Furthermore, some of them would take considerable time to accomplish for, in some cases, little added value. Brief descriptions are given below as to why some of these Options were not adopted as Recommendations. The Impact Assessment provides further explanations concerning those Options that have been integrated within others.

[8] Directive 96/67/EC, 15 October 1996 on access to the ground-handling market at Community airports: http://eur-lex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=EN&numdoc=31996L0067&model=guichett Specifically Articles 6, 7, 9 and 11 concerning limiting free access, exemptions and lengths of contract for suppliers operating under a limitation or exemption.

6.3.1 Safety Initiative

The concept of launching a European and Industry-wide Safety Initiative was not well received at the SRB. Whilst noting this negative reaction by the SRB, the Study Team did not discard the concept of a Safety Initiative.

As EASA is committed to taking some actions, probably through the adoption of some of the Recommendations made in this Report, the Study Team felt that when these changes are announced through the normal consultation process, Industry's awareness will be raised sufficiently, and well beyond those present at the SRB.

Importantly, if and when changes are implemented, stakeholders' focus will be turned again towards matters of de-icing / anti-icing. Furthermore, as ICAO requirements for SMS start to develop and mature amongst stakeholders in and across Europe, NAAs will be obliged to require organisations oversee all aspects of their activities and to concentrate safety resources on those areas of greatest risk. Embodiment of SMS within organisations will inevitably require the development of a Safety Initiate, anyway.

It is for these reasons that the Option of EASA launching a Safety Initiative was not promoted into a Recommendation. However, The European Strategic Safety Initiative (ESSI) will continue to "own" the right to develop a Safety Initiative directed at Winter Operations whenever they consider that the existing risks are unacceptable.

6.3.2 Direct Regulation of Service Providers

Most stakeholders supported the concept of NAAs directly overseeing service providers and holding them accountable to a set of regulations.

However, no NAA amongst the Study respondents has a mechanism for achieving this, and neither does EASA; the focus remains with NAAs requiring operators to establish suitable arrangements with each service provider.

Although it is a supported concept, to achieve the necessary changes to the regulatory framework would take a long time, and also necessitate that consideration be given to other ground-handling activities as well. Furthermore, directly regulating de-icing / anti-icing service providers will remove the operators' fundamental element of control. Feedback to the Study did not indicate that operators would wish to do this.

The direct regulation of service providers has therefore been excluded on practical grounds from this Final Report. However, EASA may wish to consider, at some future

time, a limited framework for regulating service providers directly, whilst getting the correct balance between providers' responsibilities and operators' needs. It is recommended that any such limited framework should include training standards and qualifications.

More adventurous Options for directly regulating service providers were also dropped. These involved either making de-icing / anti-icing to be fully a maintenance task or else fully a responsibility of the aerodrome. Neither of these Options was supported, and both would impact heavily on the Industry, without necessarily gaining any safety or economic benefits.

The former is seen as a retrograde step where only Part 145 approved organisations can provide the service. This will put most ground-handling companies at a disadvantage, which may infringe certain EU Regulations and Directives: furthermore, it would require major amendment to Part M Rules, large movement of labour, and extensive training and qualification programmes for those approved organisations wishing to supply de-icing / anti-icing services. The latter option would involve even greater upheaval, and perhaps add an extra layer of bureaucracy (aerodrome management) between the operators and service providers. Both options would also be at variance to ICAO and the FAA.

6.3.3 Influencing Fluid Availability

Various Options were proposed to influence the availability of Type I fluid across Europe. The conclusion of the Study Team is that in order for EASA, or NAAs, to mandate certain fluids to be available at any number of aerodromes, there would need to be widely accepted scientific evidence that doing so would reduce the risks associated with residue formation, re-hydration and freezing.

The same argument exists for any mandate for operators, or operators of certain aircraft, to use e.g. Type I fluid. In addition, operators need to maintain the choice of application and fluid type to meet the environmental and operational conditions that exist "on the day".

It became clear during the Study that such evidence is not available; nor is it likely to become available in the short-term.

In brief, whilst it is proven that dried-out thickened Type II and IV fluids deposit residues, there is no agreement on the catalytic factors which increase, or decrease, the formation of these residues. There is anecdotal evidence that the use of Type I, in a two-step procedure, can reduce the formation of residues; however, anecdotal

evidence also exists that doing so can actually accelerate the formation of gel residues. Some operators who frequently use Type I continue to detect large quantities of residues, whilst others who mostly use one-step procedures with thickened fluids report low levels of residue. Furthermore, the employment of a two-step procedure does result in more applications of undiluted thickened fluids (during the second step) than perhaps occur during one-step procedures.

The fact is that there are many variables to consider, and one of the major ones is the sheer variability of the methods of application (e.g. spray direction and pressure). Other variables include the type of aircraft, climate and weather conditions, fluid brands applied, sequence of application, runway de-icing fluids, etc. A majority of Recommendations made in this Report addresses the standards of fluid application, and in this respect, if successful, fluid residue formation (quantity and location on/in the aircraft) may be reduced.

Also, since 2006 and the universal adoption by operators and maintenance organisations of residue inspection, detection and removal procedures, there has been a significant reduction in incidents of frozen and stiff controls attributed to frozen residue gel. The coincidental removal of some fluid brands from the market may also have contributed to this reduction. Whilst it may be tempting to declare that the risks have been sufficiently reduced by these actions, we just do not have the evidence to support these causes. There is no agreed method of measuring the residue quantities on aircraft, and no agreed best-practice for residue prevention, detection and elimination procedures. SAE fluid qualification tests, and other testing, cannot reproduce the full range of operational and environmental conditions - and they can also produce variable results.

For all the reasons quoted above, and also for those given in the Impact Assessment, the Study Team have withdrawn all the Options that mandated the availability of Type I fluids, either directly or indirectly.

However, Recommendations do include encouragement for aerodromes to ensure service providers provide the services demanded by their operators, whenever possible, whether this is Type I and/or two-step procedures. Operators may also have the ability to influence the (aerodrome) availability of fluids, and of procedures, through Quality Control Pools (provided such pools are acceptable to EASA). NAAs also retain the right to make evidence-based decisions to mandate the availability and/or use of Type I fluid at some, or all, of their aerodromes.

Because questions exist concerning the need for more Type I availability and its effect on residue formation, the Study Team has replaced the several FLUID Options presented in the Interim Report with Recommendations for EASA to facilitate the collection of more data concerning residues. Also to encourage more harmonised and focused fluid testing, and to discuss all these issues of fluid availability and residues at a Workshop, which should be held as soon as possible.

In the meantime, operators should be encouraged to stipulate their needs and requirements more precisely when negotiating contracts with de-icing / anti-icing service providers. This is something that the Study Team understands is not always the case.

6.4 Certification of De-icing and Anti-icing Fluids

The Option to consider the certification of de-icing / anti-icing fluids was presented to the SRB at the request of EASA. The rationale behind this was that it was one of the six actions comprising the Agency's proposed work programme, which was established following feedback from A-NPA-2007-11 (See Section 4 above). It was a long-term action to *plan to introduce into the rulemaking inventory a task to extend the Agency's remit to fluids and materials in addition to parts and appliances*. EASA took the opportunity during the SRB to obtain some preliminary feedback. As it was already established as a long-term action for the Agency, the Study Team has not promoted the Option to a Recommendation. However, it is worth remarking here the feedback obtained and the Study Team's own opinions on the matter.

It was explained at the SRB that EASA would not be looking to extend or expand current Society of Automotive Engineers (SAE) qualifications under the appropriate Aerospace Material Specifications[9] (AMS). The feedback was negative, suggesting that there would be no added benefit. A preferred alternative Option proposed by EASA at the SRB was to publish a list of fluids, which are "approved" for use by Operators (similar to the FAA). This, by itself, would be acceptable, but if future rules for operators contained the caveat that only SAE qualified fluids, or equivalent, could be used, then there would be no need for a list.

The Study Team is satisfied that the current SAE testing and qualification process is functional and the best system that currently exists. Rather than create a parallel, or different system of fluid testing and certification, it would be more effective and

[9] SAE AMS 1424 & 1428 De-icing / Anti-icing Fluid SAE Type I, and Non-Newtonian Types II, III and IV respectively. List of publications for sale: http://www.sae.org/technical/standards/aerospace/DEICE

efficient to build on the existing SAE system. To that end, NAAs, along with EASA, could improve their participation in the SAE G12 Committee and working groups.

Furthermore, Member States could contribute resources to assist in fluid testing to ensure future concerns are addressed scientifically, whether they are residue formation, interaction with runway de-icing fluids, interaction with aircraft brakes and other components and parts, and how variations in local water supplies affect fluid performance, etc. These Recommendations have all been incorporated by the Study Team and can be viewed in the Impact Assessment.

It may be a valuable exercise for NAAs, or EASA, to conduct sample testing of fluids “in the field” to obtain a greater understanding of the variations that can arise in operational conditions. This may form part of an NAA’s oversight programme as suggested in the Recommended “OVERS” (see Impact Assessment).

Further discussions and feedback on the need to certificate de-icing / anti-icing fluids can be considered at the Workshop mentioned in Section 5.2 above.

7 Impact Assessments

The reader should refer to the Impact Assessment within this Report for full details.

Each Recommendation has been assessed for its potential safety, economic and social impacts on the European Aviation Industry, as well as the possible environmental impacts. In addition to these overall impacts, the Study team has included specific resource impacts that may be incurred by EASA when adopting each Recommendation. Some of the information used to formulate these impacts has been collected during the Study. Also, previously existing data and the Study Team's experiences have been used.

The Impact Assessment (IA) lays out the 26 Recommendations into 12 different groups, each one given a separate impact assessment. Within these 12 groups each Recommendation has been presented as clearly as possible; however, the implementation of some of the recommendations will require several steps and other factors to be considered. Where this occurs, the Impact Assessment contains "Pathways" to their implementation, which provides the necessary guidance and details.

A short description of the situation leading to the need for each Recommendation is also provided. Further details are also available against the relevant Options in the Interim Report. However, the information provided in the Impact Assessment should be sufficient for a general understanding.

The Industry sectors impacted by each Recommendation are indicated, and a short summary of the overall impact is also given. Where impacts cannot be given in quantitative values, a qualitative scaling is used.

The IA concludes that overall the projected impacts for the majority of the Recommendations is overwhelmingly positive. This is to be expected because the Study has already eliminated many different Options, originally presented in the Interim Report, that were deemed impractical or ineffective.

In terms of meeting the requirements of the Study to raise standards and improve safety all the Recommendations offer something positive, whether in the short or long-term. Ultimately, it is recommended that they be combined within a work programme, as detailed in the relevant Section below.

In fulfilling some of the Recommendations there will be some initial negative economic impact and EASA will need to provide some resources to every Recommendation. However, the potential savings to Industry from reduced risk

leading to fewer incidents, accidents and losses, and also from more efficient application of fluids, are very considerable, and far outweigh any investments made initially.

With more efficient application of fluids there will be overall positive environmental benefits.

On balance, the social impact on employment is neutral.

8 Economic Study

The Cost Analysis of De-icing / Anti-icing Service Provision made in this Final Report provides an in depth analysis using the Cost Model. A short summary is provided here.

Regarding the cost composition, in general, just under a third of the cost is for de-icing trucks, and over a third for de-icing / anti-icing fluids. The remaining third of the cost is divided between personnel, storage, other facilities and equipment.

The aerodrome operators and service providers may adapt to a certain extent their cost structure to the size of their de-icing / anti-icing operations; however, the main cost driver is the number of de-icing trucks necessary to provide the required de-icing capacity during peak hours and severe winter conditions.

The cost of providing Type I fluid, in addition to Type II and IV, is driven by the storage and de-icing trucks upgrade cost (initial investment and additional annual cost). The additional investment required to provide Type I fluid in addition to Type II and IV may increase the cost of de-icing / anti-icing operations by between 2.5% to 6.75%.

In general, the investment per passenger (or movement) in de-icing / anti-icing services is much higher for small and medium aerodromes. At these aerodromes, where de-icing / anti-icing is often provided solely by the aerodrome itself, a larger proportion of their revenues needs investing. They will therefore be more affected if the provision of Type I fluids were made mandatory.

The variability of winter conditions (year on year) impacts on service providers' financials (operating costs and revenue) and potentially limits major investments. While a large part of the de-icing operating costs are "fixed" (e.g. equipment and facilities), the revenue is generally dependent on the winter condition. To illustrate this, in the very large aerodrome scenario, a reduction of 50% of the number of de-icing / anti-icing operations (532 operations, instead of 1065) would increase the cost per operation of the service provider by 51%.

9 Work Programme

This Section gives a brief overview of the rationale behind this Report's Recommendations, and presents them in a suitable manner which can be used by EASA as the basis for a work programme to improve standards of de-icing / anti-icing within Member States. To decode the Recommendations see Annex 1, the Impact Assessment and/or the spreadsheet Options to Recommendations.

9.1 Concept of the Work Programme

It has been consistently stated by accident investigators and Industry that doing nothing (specifically in relation to standards of de-icing / anti-icing) is not an option. It is also the overriding Recommendation of the Study Team that practical measures to reduce the risks associated with de-icing / anti-icing operations need to be taken.

This Study has provided EASA with a list of 26 Recommendations. The Agency may not wish to select all 26; however, a substantial number ought to be processed further as recommended.

The Recommendations cover a broad range of areas from the approval of operators' de-icing / anti-icing programmes to improving the coordination with stakeholders; and from implementing oversight of de-icing / anti-icing activities to clarifying aerodromes' responsibilities.

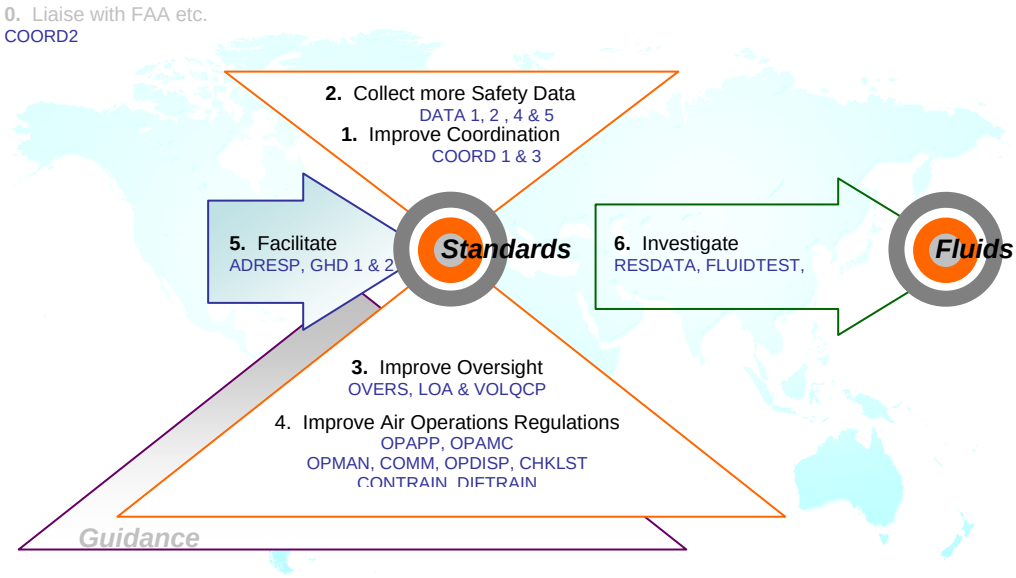
It would seem sensible for EASA to coordinate the adoption of its selected Recommendations within a work programme, and this Section lays out groupings of Recommendations as proposed by the Study Team.

Regardless of how many Recommendations are adopted by the Agency, taking action in the following areas is essential to improving the current situation, and to move matters in a satisfactory direction:

- Improving coordination between Industry and the NAAs.
- Collecting more safety data and analysing the existing risks.
- Ensuring regulations and guidance for air operations are comprehensive, unambiguous and practical.
- Conducting oversight activities to ascertain whether regulations are being harmoniously and consistently applied across Europe.

- Consider alternative regulatory means to support operators achieve acceptable service levels from their providers and to facilitate aerodromes and service providers in ensuring this.
- Engaging with all stakeholders to ensure that more focused research is conducted, and data gathered, into fluid qualities and performance.

9.2 Overview of the Recommended Work Programme



In order to raise standards, there needs to be a solid base of regulation and oversight (3 & 4) backed up and supported by robust guidance (whether from Industry or the Regulator); both the regulations and the guidance need to be applied consistently and equally across the Member States in order to promote the best practices. To ensure the harmonised application of regulations and guidance, good coordination (1) is required, as is suitable data (2) to support the *appropriate* emphasis and hierarchy.

Where regulation through operators may be inadequate, or inappropriate, other mechanisms (5) can be used which facilitate the relationship between aerodromes,

service providers and the regulator, thereby creating an environment where service providers are encouraged to invest.

To improve the availability of fluids, further investigation (6) is required, as follows:

- to further confront the “need” for greater availability
- to ascertain the scientific basis behind catalysts for residue formation and / or dispersal / limitation
- to ascertain the true extent of unfulfilled operators’ “demands”.

9.3 Course of Action and Associated Recommendations

The codes given in **BOLD** (below) refer to the specific Recommendations presented within the IA.

0. Liaise with the FAA and other global partners: **COORD2**

   EASA should engage with the FAA without delay in order to share its intentions concerning any changes to the regulation of operators and aerodromes. As the FAA continue with their own programme, it is necessary to keep informed of their progress. Any action taken by the FAA could impact on the decisions of EASA. Also, the FAA may likewise be affected by decisions that the Agency takes. A mutual sharing of ideas and a process where the two programmes can converge / complement is encouraged such that outcomes would be comparable, if not actually harmonised.

1. Improve Coordination: **COORD 1 & 3**

   It is expected that prior to changes being proposed or made, greater sustained coordination will be necessary. Within NAAs some amalgamation and sharing of experience and knowledge will be helpful. Establishing a permanent network of contributing experts across Member State NAAs will ensure that the process is viable, and it will also facilitate speedy progress. Cooperating with other stakeholder groups (aircraft, fluid and equipment manufacturers, operators, aerodromes and service providers) will be necessary prior to the release of any A-NPA or NPA. The network of stakeholder representatives already exists within different forums and associations. However, there is room for improvement concerning the dissemination of information and communication of issues internally within some stakeholder organisations. Improved coordination between NAAs and different sectors of the Industry is

key to ensuring harmonisation, clarity and consistency in the application of de-icing / anti-icing standards.

2. Collect more Safety Data: **DATA 1, 2, 4 & 5**

   To support some of the regulatory changes that EASA may wish to progress, it will be necessary to obtain specific Safety Data. Such data, concerning de-icing / anti-icing operations and related activities, is rarely reported, collated, analysed or shared. Therefore, in itself this is a necessary exercise, not just to ascertain risks in specific areas, but also to fully understand the total Industry exposure to risk. For the former, and to aid analysis, it will be necessary to agree a uniform dataset to be reported, and perhaps an accompanying taxonomy to assist analysis. Improved data collection and analysis is essential for development of any performance-based regulation, and in the context of de-icing / anti-icing this will give substance to any changes EASA, NAAs and Industry may wish to make in the near future.

3. Improve Oversight: **OVERS, LOA, and VOLQCP**

   Oversight of de-icing / anti-icing operations may be achieved either directly through NAAs, or indirectly through the operators: the latter is the current modus operandi, and as such has proved inadequate.

   Operators are exposed between their total responsibility for the standards of de-icing / anti-icing application and their inability to ensure that these responsibilities are met, all of the time. NAAs have responsibilities to ensure that activities conducted within their territory are safe – this includes de-icing / anti-icing. Increasing the involvement of NAAs in the oversight “loop” will increase their experience (where it is needed) and also provide them with greater ability to support their operators. The development of the current regulatory system to allow pooled auditing by approved organisations will help to raise standards across Europe, and will provide another avenue for regulatory influence of a practical nature directed where it is needed most.

4. Improve Air Operations Regulations: **OPAPP, OPAMC, OPMAN, COMM, OPDISP, CHKLST, CONTRAIN, DIFTRAIN**

   This is a pivotal element of the work programme. Regulations for Air Operations ought always to be optimised. In relation to de-icing / anti-icing current regulations are inadequate in that they are not comprehensive, do not provide operators with enough clear guidance, and allow for multiple and

ambiguous interpretation by operators. There is an opportunity with the forthcoming extension of EASA's competence in this area to ensure that the new Rules are clear, practical and unambiguous. Whether operators' programmes are approved, or not, there is a clear and present case for ensuring that operators interpret the existing best-practice in a harmonised and preferred manner. To achieve this EASA will need to ensure that its AMC and GM are both effective. In support of such AMC and GM, a more detailed and practical framework for the contents of Operations Manuals, and appropriate checklists, will assist operators in applying any new requirements and recommendations and flight crew in applying the operator's procedures. By ensuring that any operator's employees involved in the communication and decision-making process concerning de-icing / anti-icing are adequately trained will raise the standards of many operators to meet those of "benchmark" airlines.

5. Facilitate: **ADRESP, GHD 1 & 2**

   Both operators and service providers will be assisted by the clarification and the harmonised interpretation and application of ICAO Annex 14 requirements for aerodromes. Furthermore, the same applies for the EC Directive for Ground-Handling, amendment of which could greatly improve the level of investment and hence service at many aerodromes. Both Annex 14 and the Directive need to be "viewed" in toto with any regulations for operators; they need to complement each other to the best advantage of safe operations.

6. Investigate: **RESDATA and FLUIDTEST**

   The need for more data concerning residues, their prevention, formation, transformation and their elimination is clear.

   Whilst some of this data can be obtained from operators, much of this data can only be obtained from testing. In parallel with the regulatory activities described above, EASA can encourage, influence and even conduct activities that bring about an improved awareness concerning residues and the role of Type I and two-step applications play in their formation and elimination. With sufficient operational and maintenance data, and clear scientifically derived facts, the Industry will be better placed to make decisions concerning the provision and use of different fluid types.

Annex 1:
List of Study Recommendations

COORD1	*EASA to appoint its own subject-matter expert(s) for internal and external liaison, communication and coordination of de-icing / anti-icing issues.*
COORD2	*EASA to liaise closely with the FAA, and TC, with the aim of harmonising future de-icing / anti-icing regulations.*
COORD3	*NAAs to appoint their own subject-matter experts for internal and external liaison, communication and coordination of de-icing / anti-icing issues.*
COORD4	*Operators, Aerodromes and Service Providers to voluntarily appoint their own subject-matter-experts, and inform their NAA, for internal and external liaison, communication, and coordination of de-icing / anti-icing issues.*
DATA1	*EASA facilitate a universal reinterpretation of existing regulations for Operators and Aerodromes (including Directive 2003/42/EC) to motivate greater collection and analysis of relevant safety data.*
DATA2	*EASA amend proposed Authority Requirements, Organisation Requirements and Implementing Rules for Air Operations to ensure effective collection and analysis of relevant safety data.*
DATA3	*EASA to conduct an Industry-wide review of, and lobby for amendment to, Directive 2003/42/EC on Occurrence Reporting; in order to align the Directive with ICAO SMS requirements.*
DATA4	*EASA to facilitate Member State NAAs requirements for operators and aerodromes to develop targeted programmes within their SMS, specifically aimed at de-icing / anti-icing.*
DATA5	*EASA conduct an exercise to define, and then promote, a desired data-set for de-icing / anti-icing operations and activities, with related taxonomy and supporting data-sets to aid analyses.*

OPAPP	*EASA to amend Implementing Rules for Operators to require the approval of de-icing / anti-icing programmes against minimum requirements defined within the regulations.*
OPAMC	*EASA to develop an effective AMC in the form of an example of, or framework for, an operator's de-icing / anti-icing programme.*
OPDISP	*EASA to require Operators to devise and deliver their own specific and appropriate training programmes for any staff (e.g. operations and dispatch staff) involved in decision-making concerning de-icing / anti-icing.*
CHKLST	*EASA to require Operators to provide flight crew with a checklist system that specifically addresses aspects of de-icing / anti-icing.*
OPMAN	*EASA to review and expand the required contents of the operator's de-icing / anti-icing policy and programme that shall form part of the Operations Manual.*
CONTRAIN	*EASA to require the inclusion of an operator's de-icing / anti-icing programme and procedures within the operator's conversion course ground training.*
DIFTRAIN	*EASA to require the inclusion of applicable elements of an operator's de-icing / anti-icing programme, and any new knowledge, within the operator's differences and familiarisation training requirements.*
COMM	*EASA facilitate an International programme, involving Industry and Regulators, to standardise communication elements, their use, meaning, and methods of delivery.*
OVERS	*EASA to encourage all NAAs to establish and maintain a monitoring programme of de-icing / anti-icing service providers whose operations lie within their territory.*
LOA	*EASA to investigate the possibility, and the potential for an LoA system of quality assurance of de-icing / anti-icing service providers.*
VOLQCP	*Industry to voluntarily develop, or adjust, a system whereby service providers can opt to be accredited through a recognised audit scheme based on acceptable standards.*

ADRESP	*EASA to clarify within future rules for European aerodromes, the minimum responsibilities aerodromes have towards de-icing / anti-icing facilities and infrastructure, and the facilitation of safe de-icing / anti-icing operations.*
GHD1	*EASA to approach the European Commission with proposals and supporting arguments to amend Directive 96/67/EC on Ground-Handling, by including de-icing / anti-icing in the list of services which States can limit (ArtIcles 6 and 7), and by extending the maximum licence period (to at least 10 years) for de-icing / anti-icing contracts where the number of providers is limited further still under an exemption (Articles 9 and 11) due to safety, capacity or limited space.*
GHD2	*EASA to facilitate an Industry-wide voluntary agreed interpretation and implementation of Directive 96/67/EC on Ground-Handling, applied through a memorandum of understanding (or other such mechanism), concerning minimum criteria to be met by de-icing / anti-icing Service Providers in attaining their licences to operate, and use of AUCs.*
RESDATA	*EASA, in collaboration with Member State NAAs and Industry, to pursue, in open debate, the need to agree a dataset, and method of collection, distribution and analysis of data, for ascertaining the existing levels of risk from residue formation.*
FLUIDTEST	*EASA should investigate the ways and means of increasing and improving the number and quality of fluid testing activities in line with its own and Industry's current concerns.*
WORKSHOP	*EASA facilitate a workshop to discuss the possible need for, and the options available, to influence the availability of Type I fluid across Member State aerodromes.*

Appendix 1:
List of AAIB and BFU Recommendations

As presented in EASA A-NPA-2007-11.

The publication of recommendations for the use of un-thickened fluids for aircraft with non-powered flight controls

AAIB Safety Recommendation 2005-135

It is recommended, that the Joint Aviation Authorities, in consultation with the European Aviation Safety Agency, issue safety documentation to strongly encourage operators of aircraft with non-powered flight controls to use Type I de-/anti-icing fluids, in preference to 'thickened' fluids, for de-icing.

BFU Safety Recommendation 08/06

The European national accident investigation authorities should recommend to their respective aviation authorities to see that not only thickened (Type II or Type IV) but also un-thickened (Type I) de-icing fluids are applied on airports regularly used by aircraft with non-powered flying controls and offering de-icing services.

BFU Safety Recommendation 07/06

The Federal Ministry of Transport, Building and Urban Affairs should agree with the Laender aviation authorities responsible for the airports on a joint procedure of the cognizant supervisory authorities designed to urge the ground services responsible for de-icing to apply not only thickened (Type II or Type IV) but also un-thickened (Type I) de-icing fluids on airports regularly used by aircraft with non-powered flying controls and offering de-icing services.

The publication of requirements for operators of aircraft with non-powered flight controls to establish appropriate procedures for the identification and removal of residues.

AAIB Safety Recommendation 2003-119

It is recommended that the CAA require operators of aircraft with non-powered flying controls that are vulnerable to the effects of freezing of re-hydrated de-

icing fluid residues, to establish engineering procedures for the inspection and removal of such residues from critical control surfaces.

AAIB Safety Recommendation 2005-136

It is recommended that where the use of 'thickened' de-/anti-icing fluids is unavoidable, the Joint Aviation Authorities, in consultation with the European Aviation Safety Agency, ensure that operators of aircraft with non-powered flight controls who use such fluids, invoke controlled maintenance procedures for the frequent inspection for accumulations of fluid residues and their removal.

BFU Safety Recommendation 11/06

Considering the thickened de-icing fluids currently available EASA should impose a mandatory requirement on non-powered flying controlled aircraft manufacturers to develop reliable procedures for their aircraft types to ensure the identification and removal of re-hydrated de-icing fluid residues in such time as to prevent any risk to the safety of flight operation.

The certification/licensing of the providers of de-icing/anti-icing services

AAIB Safety recommendation 2005-148

It is recommended that prior to the European Aviation Safety Agency assuming responsibility for operational matters within Europe, they consider the future need for the training and licensing of companies who provide a de-/anti-icing service, so that anti-icing fluids are applied in an appropriate manner on all aircraft types, but specifically to ensure that the entry of such fluids into flight control mechanisms and control surfaces is minimised.

BFU Safety Recommendation 09/06

Aircraft de-icing to maintain the airworthiness of aircraft during winter operation should be accomplished by certified and approved companies under the supervision of civil aviation authorities. If aircraft de-icing is not accomplished by an operator or an approved maintenance organisation the ground service "aircraft de-icing" should be subject to appropriate aeronautical regulation. EASA should agree with the European national authorities on establishing such regulations.

The development and certification of the fluids

AAIB Safety Recommendation 2003-82

It is recommended that the CAA should consult with anti-icing fluid manufacturers with a view to encouraging them to develop fluids, with suitable 'holdover' times, that incorporate gelling agents that are not re-hydratable.

AAIB Safety Recommendation 2005-137

It is recommended that the European Aviation Safety Agency introduce certification requirements relating to de-/anti-icing fluids for use on aircraft with both powered and non-powered flight controls.

BFU Safety Recommendation 10/06

The expected drying and re-hydration properties of thickened de-icing fluids (Type II, III, IV) for aircraft de-icing should be described and defined by standardisation in such detail as to eliminate significant quality variations among the products of different manufacturers. EASA should develop certification criteria to establish mandatory limits for and require evidence of unrestricted suitability of such fluids for aircraft with non-powered flying controls.

EASA.2009.OP 21

Study on the regulation of ground de-icing and anti-icing services in the EASA Member States

FINAL REPORT

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Table of Contents

1 Introduction

This element of the Final Report details the estimated impacts, to the aviation Industry within EASA Member States, that may result from the implementation of the 26 Recommendations made by the Study Team. For an understanding of how these Recommendations were developed, through the process of this 11-month Study, refer to the Final Report – Introduction document, which should be read ideally before this Impact Assessment, and also the spreadsheet Final Report – Summary of Options to Recommendations.

This document includes a summary of the Study's Terms of Reference (ToRs) and the underlying objectives. The status of this Impact Assessment (IA) is discussed when compared with a standard EASA Regulatory Impact Assessment (RIA), and the variations are highlighted. The structure of each IA is briefly introduced before a clarification of the assumptions used to formulate the wider economic implications of each Recommendation. Finally, in Section 5, all the Recommendations are presented alongside their Impact Assessments, and these appear separated into 12 groupings, as follows:

IA 1. Liaison and coordination.

IA 2. Safety data.

IA 3. Operators' approval and compliance.

IA 4. Training of operators' operations dispatch staff.

IA 5. Ad-hoc regulations for air operations.

IA 6. Operational communications.

IA 7. Regulatory oversight of de-icing / anti-icing operations.

IA 8. Quality assurance of de-icing / anti-icing service providers.

IA 9. Responsibilities of aerodromes.

IA 10. Directive 96/67/EC on ground-handling.

IA 11. Fluid residues.

IA 12. Availability of type I fluid.

2 Objectives

The Objective of each of these Recommendations is to fulfil the underlying requirements of the ToRs to the Study - that is to develop the most effective ways in which the NAAs can regulate de-icing / anti-icing services in a harmonised way, so that the safety of air operations is maximised, and a level commercial playing field remains ensured. With specific focus on how the availability of Type I fluids and the quality of service provision can both be improved.

As explained within the Final Report – Introduction, the majority of Recommendations address the standards of service whereas the issue of fluid availability remains mostly an area for further discussion and development.

3 Background to the Impact Assessments

3.1 EASA Impact Assessments

The original Terms of Reference (ToRs) to the Study requested a Pre-Regulatory Impact Assessment (Pre-RIA) to accompany the recommendations made. However, at the Kick-off Meeting, in Köln, 13 April 2010, it was agreed that the Pre-RIA should be re-named as simply an Impact Assessment (IA). The reason for this was twofold: some Recommendations would not be linked to any Regulatory amendment and also, because prior to an regulatory changes, EASA would need to issue a Notice of Proposed Amendment (NPA), and perhaps even an Advanced NPA (A-NPA). In the latter case, the options open for consultation would vary between general and specific; when they become more specific, then the Agency would develop a full Pre-RIA. However, the IAs contained within this Report are based on a typical EASA template, and have been developed as much as possible with the information available. As such they will certainly assist the Agency to formulate any future Pre-RIAs. Likewise, within this Report, some Recommendations are very specific and include details of how to implement them (Pathways), whereas other Recommendations are more general, of a high-level nature, and their implementation would need further development and consultation.

3.2 Variations within this Study

Because of the nature of this Study, especially its open-ended remit to consider “all” options, the contents of this IA may differ slightly from the usual EASA RIA format.

It is usual practice (for EASA RIAs) that a specific issue is raised; in response an objective is set, and, options for achieving this objective are presented – each one assessed for impact. Finally, a recommendation is made concerning the preferred option, or options.

In this case, the Study Team took a broad look at the de-icing / anti-icing Industry, and considered as many options as possible that may help improve standards and the availability of fluids. These Options (93 in total) were presented and explained in the Interim Report[1], and discussed with stakeholders at the Stakeholder Representatives’ Briefing, in Köln, 6 Dec 2010. From these 93 Options the Study

[1] Interim Report – Options for Change.

Team developed 26 Recommendations, and these are presented here in this IA. Therefore, in a sense, the Recommendations have already been made; whittled – down from the Options. As a result, the Assessments below do not contain distinct "options", with each one assessed for impact, for the Agency to select. Instead, EASA is being requested to agree or not – accept or reject – each Recommendation. Within the Final Report – Introduction, a work programme is described which groups the Recommendations into distinct packages; ultimately, it is this work programme that the Study Team is fully Recommending to EASA. It is the adoption of this work programme that will help fulfil the underlying aims of the Study in relation to raising standards and safety, and to move closer towards understanding the need for greater availability of fluid and the mechanisms to achieve this.

3.3 Structure of Impact Assessments

Each Section within this Report contains the following:

- The Recommendation: Sometimes several Recommendations are assessed for impact in the same section. This occurs where the Recommendations are similar, supporting and/or dependent upon each other, and where separation and combination are considered to have no effect on the assessments.
- References to Options as presented in the Interim Report: An overview and summary of the transition from Options to Recommendations is available in the Final Report – Summary of Options to Recommendations spreadsheet.
- Situation: This details the issues giving rise to the Recommendation and some background information concerning existing risks.
- Pathways: Where several options to implement the Recommendation exist, these are considered.
- Impact Assessments: Safety, economic, environmental, social and regulatory.
- Summary of Impacts: An overall appraisal of the positive and negative impacts already discussed, and a resulting quantitative or qualitative value given.
- Impacted Stakeholder Groups: NAAs, aircraft manufacturers, aerodromes, operators, and service providers etc.

Finally, a table provides an overall view of the Impact summaries for each Recommendation.

4 Assumptions

4.1 Economic Impact Assessments

During the Study, data was gathered concerning the range of costs involved with providing de-icing / anti-icing services, as well as valuations of equipment and facilities. As a result, a mature cost-model has been produced and is presented in the Final Report – Cost of De-icing / Anti-icing Service Provision. This costing data, combined with the other data collected, forms the basis of the economic assessments made in this Report. Other assumptions have been made, and are explained here. However, due to the number of variables that exist across this industry the resulting averages (values and operations) may not be representative of any one particular location, operation and/or contract arrangement. These variables include: size of aerodrome, weather pattern and climate, aircraft types operated, traffic density, numbers of service providers and business models etc.

4.1.1 Manpower Costs

The figures used for estimating manpower costs are based on the current EASA model[2]. They are, as follows:

- Annual pay = EUR 150 000
- Working days per year = 210
- Billable hours per day = 6 hours
- Travel and subsistence costs = EUR 25/hour, or EUR 150/day
- Resulting in a figure used per man-day of EUR 864. We have used EUR 870 for convenience.

This figure is clearly high for many States and many organisations, perhaps the majority. In which case consideration should be given to using a multiplying factor to manpower costs in order to attain a more realistic total.

When estimating costs involving de-icing / anti-icing operatives we have used the figure of EUR 300 per day, based on our cost model of EUR 30 per hour.

[2] Regulatory Impact Assessment on the extension of the EASA system to the regulation of Air Traffic Management and Air Navigation Services (ATM/ANS)

4.1.2 Europe-wide Economic Impact

In estimating the total economic impact across all the Member States and all impacted Industries, other assumptions have been made to generate multiplying factors from the specific example to the general. They are as follows:

- EASA Member States: there are currently 31; however, as Liechtenstein has no airport it has been excluded from the calculations and therefore a factor of 30 is used.

- Aerodromes: it is estimated that there are over 800 aerodromes open to commercial traffic within Europe, and which will be subject to either EU Rules (in the near future) or Rules of similar stature from their respective NAA. Of these, 200 (estimated) have been discounted as not having any existing need for de-icing / anti-icing services, except for a rudimentary set-up for removing frost from cold-soaked wings. Therefore the figure used for our estimated economic impacts is 600 aerodromes.

- Commercial Air Operators: The main airline associations account for about 140 airlines (some of which are duplicate members). It is estimated that a further 280 airlines are not members of associations and there are also about 90 low-cost airlines operating in Europe. This makes a total of around 370 operators. Internet sources suggest that there are over 400 airlines registered within EASA Member States, which confirms our estimate – including freight carriers. By selecting 300 operators as the number likely to be affected by these Recommendations, we are thereby eliminating those airlines which do not conduct operations during winter conditions, those operating solely in climate zones without ice and snow conditions, and also those operating helicopters and light aircraft.

- Average airline fleet: The average fleet size for AEA member airlines is over 200 (counting KLM separate from AF, and BA separate from Iberia etc); we can estimate that 30 such airlines exist within Europe. The average fleet size of ERA member airlines is around 15; and it is estimated that out of a total of 300 airlines, 200 would be operating fleets of this size. The remaining 70 airlines, we can model on low cost carriers with fleet sizes between 10 and 200 aircraft per fleet, but use an average of 50. These figures would give a

European fleet size of 12 500. Overall, this provides an average operator fleet size of 40 aircraft.

- Number of service providers: Figures from the Study show that on average there are 1.3 service providers of de-icing / anti-icing per aerodrome. Therefore, using the derived applicable total of 600 aerodromes, we estimate that there are 780 service provider stations. Using the average figures from the cost model, we estimate on average that each service provider employs 24 de-icing / anti-icing operatives.

4.1.3 Qualitative Values

Within the economic impact assessments quantitative values are provided, based on estimates as described in the previous section.

However, all the impact categories, including economic, are given qualitative evaluations as described here:

-- very negative

- negative

0 neutral

+ positive

++ very positive

These evaluations are subjective and apply to each individual case and scenario; the “very” negative and positive categories should be considered as “relative” grades and not absolute. For example, an investment required per aerodrome of EUR 100 000 may be a minor negative economic impact for a very large aerodrome, but it will be a major consideration for a very small airfield.

Each of the 12 Impact Assessment groupings (IA1 – IA12) are also given an overall qualitative value, which is based on a subjective, but informed, “averaging” of the individual values rather than a mathematical addition and division to find a “mean” value. The reason for this is that (for example) a positive (+) safety valuation may be much greater than the associated negative (-) economic valuation.

5 Recommendations and their Impact Assessments

IA 1 Liaison and Coordination

IA 1.1 Recommendations

IA 1.1.1 Recommendation COORD1

EASA to appoint its own subject-matter expert(s) for internal and external liaison, communication and coordination of de-icing / anti-icing issues.

IA 1.1.2 Recommendation COORD2

EASA to liaise closely with the FAA, and TC, with the aim of harmonising future De-icing / anti-icing regulations.

IA 1.1.3 Recommendation COORD3

NAAs to appoint their own subject-matter experts for internal and external liaison, communication and coordination of de-icing / anti-icing issues.

IA 1.1.4 Recommendation COORD4

Operators, Aerodromes and Service Providers to voluntarily appoint their own subject-matter-experts, and inform their NAA, for internal and external liaison, communication, and coordination of de-icing / anti-icing issues.

IA 1.2 References to Options presented in the Interim Report

OPTIONS SME 1, 3, 4 & 5, REGAO4.

IA 1.3 Situation

Coordination, communication and clear channels of responsibility are all areas highlighted by existing documentation and safety data to be weaknesses in the system. During the Study, most NAAs and many operators found it difficult to identify or nominate a post-holder / employee to coordinate their response and also to provide feedback. In these cases, the lack of coordination within their own organisation (between departments and areas of responsibility) led to either

incomplete responses, or conflicting answers thereby further highlighting a potential lack of knowledge in some areas and a lack of shared knowledge in others. The lack of focal-points within NAAs reflects inadequate levels of oversight of de-icing / anti-icing operations. Of the 31 Member States, responses were only submitted by 13 NAAs and amongst these the majority of the questionnaires were incomplete.

Interpretation of existing regulations and guidance material is not harmonised. Such regulations and material include: EU OPS, JAA TGL 44, ICAO Doc 9640, ICAO Annex 14, Directive 96/67/EC, AEA Recommendations and SAE ARPs.

Dedicated technical forums exist for discussing specific elements of de-icing / anti-icing (AEA and SAE); the former has restricted membership and the latter is not European-centric. Although other forums exist and within which certain de-icing / anti-icing issues can be discussed (e.g. ESSI ECAST GSWG, IATA), it is only as just one of many other issues. There is little cooperation between these, and other, working groups, and where there is, it is not coordinated. EASA is committed to follow developments within the SAE G-12[3].

EASA has already established rulemaking coordination and cooperation with the FAA in pursuant of Articles 2 and 27 of the Basic Regulation[4]. However, FAA regulation and oversight of de-icing / anti-icing varies considerably from Member State NAAs (using the JAA model and in compliance with EU OPS). The FAA requires operators (carriers) de-icing / anti-icing programmes to be approved, and it provides comprehensive guidance material[5]. This Advisory Circular (AC) is currently being comprehensively revised by the FAA, and it will have training requirements added. The FAA is also examining the possibility of an oversight / auditing system using Letters of Acceptance / Approval (LoA) for foreign service providers. EASA is not currently involved in this process.

[3] EASA CRD to A-NPA-2007-11, September 2008 http://www.easa.eu.int/ws_prod/r/doc/CRD%202007-11.pdf

[4] EC Regulation 216/2008 on the establishment of EASA, February 2008
http://www.easa.eu.int/ws_prod/g/doc/Regulation/reg_216_2008/BR216_2008.pdf

[5] FAA AC 120-60B ground de-icing / anti-icing programme, December 2004
http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/key/AC%20120-60B!OpenDocument&Click=

IA 1.4 Pathways to improving liaising & coordination

Any work programme, and proposed regulatory changes, that emerge from this Study will likely need the establishment of a temporary working group of all stakeholder representatives to coordinate the activities. Individual working groups may be established to address specific technical issues otherwise currently existing forums may be used. If EASA and Member State NAAs appoint their own Subject-Matter Experts (SMEs) (Recommendations COORD 1 & 3) a framework for future cooperation and coordination, as well as oversight, is established. Sufficient operators, service providers and aerodromes are likely to be motivated to participate in any such programme and activities (Recommendation COORD4). It would also be feasible for EASA and NAAs to restrict their nominations to personnel as focal points who could then coordinate activities with their own SMEs.

The Recommendations proposed here will be ineffective unless initial aims, objectives and responsibilities are defined; these would be suitable subjects for preliminary meetings or correspondence.

The ethos of Recommendation COORD2 (liaison and cooperation with the FAA and TCCA) is already established within EASA's Rulemaking Programme[6]: the value of such liaison is therefore already clearly understood. However, as no activity is currently underway, any new venture would require the allocation of Agency resources.

IA 1.5 Impact Assessment

This IA is made specifically with respect to Recommendations COORD 1 & 3.

COORD2 *should* already be underway, although with regard to *these* Recommendations and other de-icing / anti-icing activities, it is not, and COORD4 is a voluntary measure.

IA 1.5.1 Safety

The need for this Study reflects the lack of information sharing and common understanding within this part of the Industry. Establishing focal-points within Member

[6] WI.RPRO.00049-001 Approval Date 16 Nov 2010: http://www.easa.eu.int/rulemaking/docs/procedures-and-work-instructions/WI%20RPRO%2000049-001%20-%20FAA%20%20EASA%20Rulemaking%20Co-operation.pdf

States, facilitated by EASA can improve the situation. This would allow effective implementation of other Recommendations made in this Study, thereby raising the standards of de-icing / anti-icing with consequent improvements to safety.

Harmonising the regulatory approach between Europe and North America should have a positive safety impact on two fronts: one, standards may be raised and two, implementing one system of regulation will reduce variations and therefore the likelihood of errors.

The risk of not adopting these Recommendations is that knowledge and experience levels within NAAs remain at their current inconsistent and low levels, and NAAs will continue to view de-icing / anti-icing from the perspective of their different departments, rather than the “whole”.

The safety impact from improving liaison and coordination between NAAs and facilitated by EASA is positive (+), and when used as the first stage of a coordinated work programme to implement further Recommendations the effect will ultimately be very positive (++).

IA 1.5.2 Economic

It is not anticipated, or suggested, that nominated personnel be dedicated post-holders. In fact, it is likely that EASA and NAAs already have SMEs in different (if not every) department. What *is* lacking are the coordinators, which are envisaged to be one of the SMEs nominated for this role. Therefore, no further employment is required within NAAs or EASA.

The size of EASA’s initial work programme emerging from this Study will determine the commitment required of these focal-points and SMEs. There is likely to be cost implications for EASA, each NAA, and those Industry groups and organisations motivated to participate.

Based on existing experience of rulemaking / advisory working groups, and a schedule of 4 meetings per annum (pa), the cost of participation would be approximate to 16 days pa for each delegate (EUR 13 920 pa)[7]. Overall, across the Member States, and including EASA, this equates to EUR 431 520 pa; and the task may run for a maximum of two years.

[7] For details concerning the assumed man-power costs, refer back to Section 4.1.1 earlier in this document.

Any common, or complementary system of regulation and oversight that can be established between Europe and North America, as a result of this liaison and coordination, has the potential to reduce operators' costs considerably. Therefore, there is likely to be a positive economic impact on those airlines which operate to North America.

The direct economic impact on EASA and NAAs is EUR 431 520 pa for two years, when restricted to the implementation of the Recommendations presented in this Report, which is slightly negative (-).

IA 1.5.3 Environmental

No impact anticipated.

IA 1.5.4 Social

No impact anticipated.

IA 1.5.5 Regulatory

The chance of harmonisation will be increased across Member States when interpreting existing, and future, regulations and guidance material concerning de-icing / anti-icing.

Recommendation OVERS will require the establishment of NAA focal-points and hierarchies of internal SMEs.

The effective adoption of those Recommendations from this Study which require re-interpretation and / or amendment of existing regulations and guidance material will benefit.

Overall there is a positive (+) regulatory impact.

IA 1.6 Summary of Impacts

- Safety (+) rising to (++) if used as the first step of a major work programme.
- Economic (-).
- Environmental (0).
- Social (0).

- Regulatory (+).

Overall a slight initial positive impact (+). However, the Recommendations are essential if a work programme to adopt other Recommendations is undertaken.

IA 1.7 Impacted Stakeholder Groups

EASA and NAAs.

IA 2 Safety Data

IA 2.1 Recommendations

IA 2.1.1 Recommendation DATA1

EASA facilitate a universal reinterpretation of existing regulations for operators and aerodromes (including Directive 2003/42/EC) to motivate greater collection and analysis of relevant safety data.

IA 2.1.2 Recommendation DATA2

EASA amend proposed Authority Requirements, Organisation Requirements and Implementing Rules for Air Operations to ensure effective collection and analysis of relevant safety data.

IA 2.1.3 Recommendation DATA3

EASA to conduct an Industry-wide review of, and lobby for amendment to, Directive 2003/42/EC on Occurrence Reporting in order to align the Directive with ICAO SMS requirements.

IA 2.1.4 Recommendation DATA4

EASA to facilitate Member State NAA requirements for operators and aerodromes to develop targeted programmes within their SMS, specifically aimed at de-icing / anti-icing.

IA 2.1.5 Recommendation DATA5

EASA conduct an exercise to define, and then promote, a desired data-set for de-icing / anti-icing operations and activities, with related taxonomy and supporting data-sets to aid analyses.

IA 2.2 References to Options presented in the Interim Report

OPTIONS SAF 1, 2, 3 & 4, and REGAO6.

IA 2.3 Situation

Whilst current operators' and aerodromes' regulations require accident and incident data to be reported[8], they are unclear, and inadequate concerning the reporting and analysis of those "lower-level" unsafe acts, slips, errors, omissions etc which inevitably must occur in their hundreds in relation to known accidents and incidents (Heinrich Occurrence Triangle), and some of which will be indicators and pre-cursors of more serious occurrences and incidents. Furthermore, current regulations do not require, nor adequately encourage, collection of such data from contracted-out third-parties, such as de-icing / anti-icing service providers. It is only from these sources that much of this data can be "collected". Consequently very little such data exists. Difficulties exist with ECCAIRS and the central repository. Examples of these difficulties are:

- quality issues,
- the reporting threshold,
- discouragement to access due to regulation for identity protection, and
- lack of a defined taxonomy and data-sets for de-icing / anti-icing activities and the necessary supporting data to aid analysis[9].

Furthermore, this situation will exist within certain other areas of activity, not only de-icing / anti-icing, which involve contracted-out services.

One key element of this Project is to make recommendations for improving standards of de-icing / anti-icing. To achieve this from an informed standpoint requires knowledge of which standards need improving and by how much. Therefore, the collection of any data that can highlight deficiencies will be extremely helpful to facilitate future decision-making in this respect.

The thrust behind all ICAO Standards And Recommended Practices (SARPs) for Safety Management Systems (SMS) is clear: that it is the responsibility of all organisations across the aviation industry to identify hazards in all areas of operation,

[8] Operators have to comply with EU OPS accident prevention and flight safety programme, and aerodromes with Annex 14 SMS requirements. Operators should comply with ICAO Annex 6 SMS requirements, however, uptake by NAAs has been slack due to pending EASA rules for operators. Both operators and aerodromes have to comply with Directive 2003/42/EC on occurrence reporting.

[9] All as reported at the Stakeholders Representatives' Briefing (SRB), in Köln, 6 Dec 2010, and recorded in the SRB Report submitted to EASA in Dec 2010.

to assess them for risk and to take mitigating actions where necessary. This should definitely include the hazards encountered by de-icing / anti-icing operatives. However, SMS requirements have not yet been (and will not be) defined in EU OPS; SMS evolution in Member States is slow and uncoordinated and EASA Rules for SMS (operators and aerodromes) have yet to be issued.

IA 2.4 Pathways to improving the collection of safety data

These five Recommendations complement each other, and they are also each capable of standing alone: the option remains to implement them all, or only a combination of some of them.

Whilst current regulations are unclear and amendment is an option (DATA1), EU OPS will be suspended soon and effort might be better directed at forthcoming Implementing Rules for Operations (DATA2). This latter Recommendation could also be used as a model for the medium-term development of Implementing Rules for Aerodromes. Whilst amending Directive 96/67/EC (DATA3) would be appropriate, the process will be time-consuming; speedier and more effective results may be gained from using SMS requirements and ethos to improve the collection of safety data (DATA4). By providing clear definitions of what to report (with appropriate taxonomy), and by whom (DATA5), it will be easier to encourage organisations to collect and analyse appropriate data. Motivating service providers within the “drive” to collect more “low-level” safety data may require a specifically tailored promotion campaign, which could be delivered through operators.

Deficiencies in current and proposed regulations are highlighted below. To implement the Recommendations (above) a combination of amendment, reinterpretation and publicity will be required. Even if no amendments are made, it will still be necessary to conduct an activity, or issue “information / guidance”, to promote the ways and means of collecting data of unsafe acts, slips, omissions and errors connected with de-icing / anti-icing. Otherwise, the existing situation will continue; therefore doing nothing is not an option.

IA 2.4.1 Directive 2003/42/EC

The EC Directive[10] for Occurrence Reporting: in both Article 4 1(g) and Annex 1 D (iv) de-icing / anti-icing personnel are clearly mentioned and inferred respectively. The scope of the Directive (Article 3) applies to occurrences which clearly include "unsafe acts"[11] (as defined by ICAO). However, interpretation of this Directive is within the remit of Member States, and since its publication there has been no amendment to JAR OPS 1.037 or EU OPS 1.037 providing guidance for authorities in this matter.

IA 2.4.2 EU OPS

Within EU OPS 1.037 (Accident Prevention and Flight Safety Programme) the emphasis is on Incident and Accident data, and not on "unsafe acts", and no reference is made to contracted organisations; furthermore, in EU OPS 1.035 (Quality System) any reference to contracted organisations is omitted, which was once contained in JAA AMC OPS 1.035.

IA 2.4.3 ICAO Annexes 6 & 14

ICAO Annexes 6 & 14 SMS Requirements are extant, and clearly require that NAAs shall require both aerodromes and operators to identify safety hazards, take remedial action and aim to make improvements to safety performance. This adequately covers all areas of operation on an aerodrome as well as those connected with continuing airworthiness and flight operations. However, without guidance from the NAAs specifically mentioning de-icing / anti-icing operations, it is unlikely that additional effort will be invested. In the event, EU OPS was not amended to accommodate the ICAO SARP for SMS, and OPS 1.037 continues as the focus for operators' safety programmes.

IA 2.4.4 EC Regulation 216/2008 (The Basic Regulation)

Annex Va to the Basic Regulation as last amended[12] (Essential Requirements (ERs) for Aerodromes) is clear that aerodrome management should: have access to relevant data (B1(a)); take some responsibility in ensuring risks are mitigated against

[10] Directive 2003/42/EC on occurrence reporting in civil aviation, June 2003: http://www.emsa.europa.eu/Docs/marine_casualties/directive_200342ec.pdf

[11] Article 2 to Directive 2003/42/EC: *'occurrence' means an operational interruption, defect, fault or other irregular circumstance that has or may have influenced flight safety and that has not resulted in an accident or serious incident'*

[12] Regulation EC 1108/2009 amending Regulation EC 216/2008 dated 21 October 2009.

(B1(e)); and, that relationships are established with relevant organisations, including service providers, such that the ERs can be fulfilled (B1(f)). Furthermore, safety data from these organisations collected through the aerodrome's occurrence reporting scheme shall be analysed (B2(b)).

IA 2.4.5 Proposed Implementing Rules for Operations (EASA NPAs 2008-22 and 2009-02)

AR.GEN.030(a) (Mutual Exchange of Information) requires Authorities to share all necessary information taken as a result of oversight of persons and organisations exercising activities on the territory of a Member State. However, service providers have not been included as they are not directly within the oversight of the Authorities unless such data is obtained as a result of the oversight of operators.

AR.GEN.040(a) (Reporting) requires NAAs to notify the Agency of any safety significant occurrences in addition to those required in Directive 2003/42/EC. No explanation is given as to what is meant by "significant", leaving the way clear for differing interpretations.

AMC 2 AR.GEN.300.2 (Continuing Oversight OPS) how an operator oversees all ground-handling services is omitted from the list of areas the Authority should at least inspect and monitor (see also Recommendation OVERS). It would be a beneficial condition of these contracts that safety data is collected from service providers by the operators.

AMC 2 to OR.GEN.200(a)(2) (Management System) fulfils the requirements of ICAO SMS SARPs, with some additional parameters. However, it still does not categorically focus the operator onto the collection of reports of "unsafe acts" from contractor organisations. Without such data, an operator will not be able to fulfil other elements of the Rule; i.e. to identify all the hazards associated with de-icing / anti-icing, assess the associated risk and make interventions to improve safety performance in this area. The outcome of this Rule depends on the interpretation.

AMC 2 to OR.GEN.200(a)(4) (Management System, Training and Communication on Safety) requires the organisation to establish communication so that safety matters can be explained. This is limited to within an operator's own organisation, and does not extend to contracted service providers.

AMC to OR.GEN.200(a)(5) (Management System, Occurrence Reporting): in contradiction to the title, this mirrors EU OPS 1.037 and only highlights the need to

report Incidents and Accidents, therefore excluding “unsafe acts” and other valuable safety data.

AMC to OR.GEN.205 (Contracting and Purchasing) re-introduces JAA AMC OPS 1.035 material on quality assurance of contracting organisations. It also clearly requires operators to specify in their contracts with service providers what safety services and safety related activities should be undertaken; thus providing a mechanism to include the collection, analysis and provision of specific safety data.

IA 2.5 Impact Assessment

Specifically with respect to Recommendations DATA 2, 4 & 5: DATA1 would be a wasted effort, and DATA3, although worthwhile, may become a distraction in the short-term, when more progress may be made more quickly through the other Recommendations.

IA 2.5.1 Safety

Collecting more data in itself will not lead to an increase in safety; however, such little data concerning de-icing / anti-icing occurrences exists, or is shared, that any improvement will be a positive step. If the right data is collected together with appropriate supporting data to aid analysis, then proper analysis applied, and the results shared and acted upon, there will be a significant improvement in safety.

Safety Initiatives in the past[13] that have resulted in increased rates of occurrence reporting, to fit a dedicated taxonomy, and effective analysis have demonstrated that risk can be reduced significantly within 24-months.

The safety benefits from successfully implementing these Recommendations may be enormous (++).

IA 2.5.2 Economic

EASA will need to invest resources into a coordinated work programme to:

[13] For example: European Action Plans for the Reduction of Runway Incursions and Prevention of Level Busts: http://www.eurocontrol.int/airports/gallery/content/public/pdf/EAPPRI%201_2.pdf and http://www.eurocontrol.int/safety/gallery/content/public/European%20Action%20Plan%20for%20the%20Prevention%20of%20Level%20Bust.pdf respectively.

- review and amend their proposed Authority and Organisation Requirements and Implementing Rules for Air Operations, and then open the necessary consultations;

- promote the use of SMS to target de-icing / anti-icing occurrences; and

- define appropriate data-sets to aid collection and analysis.

The first of these steps could simply be subsumed into the current activities concerning the pre-publication activities of ARs, ORs and IR OPS; therefore, no costs will be involved.

The other elements can be combined, and are likely to require preliminary groundwork and promotion, 2 working meetings with representatives from NAAs, and sustained support for one year. This would equate to around 16 man-days for the EASA coordinator (EUR 13 920), and assuming interest and participation from 15 NAAs – each committing to 8 man-days throughout the year – a further 120 man-days (EUR 104 400). Following at least one year's implementation EASA will need to collate data-sets provided by the Member State NAAs and draw conclusions for further action. Such activity will be subsumed within the existing responsibilities of the Safety Analysis and Research Department and possibly the European Strategic Safety Initiative (ESSI); therefore, the on-going economic impact will be neutral.

At some cost, NAAs will need to publicise the campaign and disseminate promotional and supporting information; they will also need to collate and conduct a meta-analysis on the new data. The former may involve 10 man-days for each NAA, equating to a total of 300 man-days (EUR 261 000). The latter task will be subsumed into the NAA's regular safety analysis activities and annual safety analysis reports – at no cost.

At some cost, operators, aerodromes and service providers will need to promote, educate and provide the means for reporting the necessary data: these activities are already required for aerodromes and operators, and all the service providers involved in this Study claim to have active reporting systems and regular safety training. Therefore, the economic impact here is expected to be neutral.

Overall, if useful data is collected, analysed and acted upon, there should be a great economic advantage to the Industry as a result of reducing risk and the associated costs. The average cost to Industry (World-wide) of incidents on the ramp involving

aircraft is US$ 10 billion per year[14], at an average cost of US$ 37 000 per incident. Injuries also occur at a rate of 9 per 1 000 departures. European departure numbers are around a 1/3 of the global total[15], equating to 9 000 incidents and accidents and 8 000 injuries per year within Europe. It cannot be estimated what the potential savings are from reducing the risks involved with de-icing / anti-icing operations, but as a risk-intense activity, they may be considered very large. If ten incidents can be prevented then the total costs to EASA and NAAs mentioned above (EUR 379 320) for the implementation of these Recommendations will be recovered, as well as injuries prevented, and other hidden (indirect) costs, such as labour replacement, medical bills, insurance premiums etc.

The total one-off direct costs to EASA and NAAs for implementing Recommendations DATA 2, 4 & 5, is estimated to be EUR 379 320, with no on-going costs. The total cost benefits from reduction of risk could be substantial, and should easily outstrip the initial investment; also the gains will be ongoing year-on-year. Therefore, the overall impact is (++).

IA 2.5.3 Environment

There is potential for reducing fluid loss caused by human error and technical malfunctions; this will have a positive effect on the environment (+).

IA 2.5.4 Social

No impact expected.

IA 2.5.5 Regulatory

To pursue the concept of performance-based regulation within Europe, it is essential that relevant data is collected, analysed and acted upon where necessary.

Some changes, concerning safety data collection, made to the forthcoming Implementing Rules for Air Operations will likely need to be reflected in future Implementing Rules for Aerodromes (see references above in Section IA 2.4).

These changes should result in greater harmonisation of regulations concerning safety data collection and use of SMS across Member States and between different elements of the Industry. Furthermore, these changes can be generalised to cover

[14] Flight Safety Foundation Ground Accident Prevention http://flightsafety.org/archives-and-resources/ground-accident-prevention-gap

[15] Eurocontrol CFMU “The Facts” http://www.eurocontrol.int/epr/gallery/content/public/docs/bro_cfmu_facts.pdf

other contracted-out activities where a similar lack of safety data probably exists, e.g. loading and fuelling.

The overall impact on the regulatory system should be positive (+).

IA 2.6 Summary of Impacts

- Safety (++).
- Economic (++).
- Environmental (+).
- Social (0).
- Regulatory (+).

Overall an initial positive impact (+). However, these Recommendations are essential if a work programme to adopt other Recommendations is undertaken.

IA 2.7 Impacted Stakeholder Groups

EASA, NAAs, aerodromes, operators, and service providers.

IA 3 Operators' Approvals and Compliance

IA 3.1 Recommendations

IA 3.1.1 Recommendation OPAPP

EASA to amend Implementing Rules for operators to require the approval of de-icing / anti-icing programmes against minimum requirements defined within the regulations.

IA 3.1.2 Recommendation OPAMC

EASA to develop an effective AMC in the form of an example of, or framework for, an operator's de-icing / anti-icing programme.

IA 3.2 References to Options presented in the Interim Report

OPTIONS REGAO 1, 2 & 2a to 2g; and TECIN 1, 2 & 3.

IA 3.3 Situation

It is not surprising that standards of de-icing / anti-icing vary so much when policies, planning, programmes and even procedures are left to the discretion of each operator to determine from a multitude of "best-practice" reference documents, and with so little guidance provided by the Regulator. Also, service providers are themselves developing procedures from these reference documents (and others) in an attempt to meet the demands of many different operators. A variety of different training syllabi and standards for service provider operatives are also developed in this manner. One key aim of this Study is to recommend how to improve these standards; one element of improving standards is to facilitate a universally consistent compliance with best-practice, and another key element is to raise and harmonise the standard of training.

Currently operators de-icing / anti-icing programmes and policies are not approved by Member State NAAs or by EASA. In the majority of cases these programmes and policies are "accepted" by NAAs[16] only as a component of the structure of the Operations Manual (OM). ICAO recommends[17] that the operator's de-icing / anti-icing programme, or procedures, is "approved" by the NAA; with special focus on responsibilities and training. However, ICAO Annex 6[18] only requires an "acceptance" through a technical evaluation. Furthermore, the Study has uncovered that experience levels within NAAs concerning de-icing / anti-icing operations and oversight varies and is generally low. There is very little direct oversight of de-icing / anti-icing operations in the field by NAAs, and probably none is conducted regarding the requisite training.

True "expertise" in these matters sits within certain elements of the Industry – predominantly the operators and service providers. However, each stakeholder group (including fluid manufacturers and aircraft manufacturers) hold the knowledge and experience in specific technical areas relevant to themselves. The only forum where all these "experts" cooperate and share information is the Society of Automotive Engineers (SAE) G-12 Committee and associated working groups. Operators, without guidance from the Regulator, must develop their de-icing / anti-icing policies, procedures and programmes from several informative and comprehensive reference documents. The outcomes will naturally vary and harmonisation of procedures is unlikely.

EASA no longer differentiates between "approval" and "acceptance", although the means of evaluation may vary. Such an evaluation must consider whether the specific policies and procedures would result in the desired outcome. The required contents of the OM (Appendix 1 to EU OPS 1.1045) concerning de-icing / anti-icing contains minimum guidance and focuses mainly on fluid types. There is no presentation of an "acceptable" set of procedures, standard operating procedures, training syllabus, coordination or communication. The proposed EASA Implementing Rules for Air Operations retain the same text, unchanged.

[16] Council Regulation 3922/91 on the harmonisation of technical requirements and administrative procedures in the field of civil aviation, December 1991, consolidation version September 208, otherwise known as EU OPS http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1991R3922:20080920:EN:PDF

[17] ICAO Document 9640 Manual of aircraft ground de-icing / anti-icing operations, 2nd edition, 2000.

[18] ICAO Annex 6 to the Convention on international civil aviation, Operation of aircraft, Part 1 International commercial air transport – aeroplanes.

The proposed OPS.GEN.100 appears less prescriptive than EU OPS 1.345 (The operator shall *apply* ground de-icing / anti-icing processes; as opposed to *establishing procedures*). The associated AMC2 and GM 1, 2 & 3 reflects the advice previously given by the Joint Aviation Authorities (JAA)[19], which remains extant through the JAA Temporary Guidance Leaflet (TGL) 44. This advisory material was published in 2005, and many operators would not have adopted it before EU OPS became valid in 2008 – without retaining the former advice. The status of the new EASA AMC is an improvement as it will now form part of a commercial operator's approval, and therefore have the same status as a regulation. However, there is an opportunity for reducing the options to interpret this material and to clarify the "essential" from the "supporting" elements and information.

IA 3.4 Pathways to Approval and Compliance

Four different pathways to implementing these Recommendations (OPAPP & OPAMC) are considered here:

1. Review and re-draft OPS.GEN.100, AMC2 to OPS.GEN.100, and GM 1, 2 & 3 to OPS.GEN.100, in order to be more specific concerning the minimum acceptable standards for operations and training. These actions will also be required if either of the other three Pathways below are adopted / adapted.
2. Include within OPS.GEN.100 a link to an acceptable external reference document such that operators de-icing / anti-icing policies, programmes, training and procedures are *"in accordance with"* e.g. ICAO Doc 9640, AEA Recommendations and Training Manual, or appropriate SAE ARP.
3. Issue a requirement for specific approval of operators' de-icing / anti-icing policies, programmes, procedures and training standards, e.g. OPS.SPA.DAI.
4. An amalgam of Pathways 1 & 2, whereby reference to external documents is made from the AMC as an "acceptable" source / standard to use.

Pathways 1 and 3 can be conducted and accomplished entirely "in-house" by EASA, together with the necessary consultation process. Pathway 2 may become reliant on a third-party accepting the use to which its document(s) are being used and becoming open to future input from EASA for amendment. In the opinion of the Study

[19] JAA JAR OPS 1, Section 2, ACJ 1.345.

Team, the only viable option for Pathway 2 is to refer to the AEA Recommendations and also the AEA Training Manual. However, even these documents may not be acceptable to EASA as a set of "technical instructions" with the same validity and effectiveness as e.g. ICAO Doc 9284-AN/905 – 'Technical Instructions for the Safe Transport of Dangerous Goods by Air'. Pathway 4 would solve this issue. Pathway 3 provides a mechanism for increasing the "requirements" within the Implementing Rules

Whichever Pathway is adopted, there are certain areas that the Study has uncovered that need greater clarity and improvement. These are:

- providing clear frameworks for acceptable de-icing / anti-icing policy, procedures, and training programme,
- providing clear guidelines for establishing and maintaining effective communication and coordination procedures,
- providing template communication messages and meanings connected with all inspections, checks and operations; in particular review of the anti-icing code, and clarification of the "all clear" signal / message (see Recommendation COMM below),
- providing a structured framework for the relevant section of the OM,
- clarifying responsibilities for key decision-makers within an organisation's hierarchical structure,
- requiring and defining the minimum elements necessary for an effective contract between operator and service provider (e.g. training standards and exchange of safety data etc.), and
- requiring (separate) approval for any deviations from the published AMC, or Instructions.

IA 3.5 Impact Assessment

All four of the alternative Pathways towards fulfilling recommendations OPAPP & OPAMC can be considered within the same Impact Assessment, as the effort and resources required, and the expected results, are very similar.

IA 3.5.1 Safety

Greater clarity for operators in developing acceptable programmes and procedures, and what to require from their service providers should result in improved technical contracts, more effective procedures and greater harmonisation. These will raise standards across EASA Member States and the Industry. Improved standards of application should reduce the overall risk to the Industry and make a significant long-term sustained improvement to safety.

These two Recommendations would represent a sound foundation upon which the other Recommendations can stand and endure. Therefore, provided the approval process is appropriately rigorous, and based on clear and comprehensive standards and guidance, the overall long-term safety impact will be very positive (++).

IA 3.5.2 Economic

Investment may be necessary to attain improved standards of training, procedures and operations. However, many service providers already base their training and procedures on AEA Recommendations and Training Manual, and these two documents complement SAE Recommended Procedures and ICAO Doc 9640. The improvement will come from correct and universally accepted interpretation of this guidance. Therefore, where standards are already high, the economic impact is likely to be small to insignificant. Where standards are variable, but the intention is correct, as shown by attention to training and procedures etc, then the investment required will be small. Where standards are not presently acceptable, the investment required may be significant, perhaps resulting in a reduction of the number of service providers at certain aerodromes. Any reduction will have a neutral economic impact as business levels will be maintained, and those providers who disengage from de-icing / anti-icing activities will be doing so to prevent financial losses. Any real increase in costs will be passed onto, or shared with the operators. Of the 780 service provider stations, perhaps 1/3 require a significant change to their training and operational standards (i.e. 260). This may involve an additional 2-days training per operative in the first year. At an average of 24 operatives per service provider, this equates to 12 480 man-days; equating to a total cost to service providers of EUR 3 744 000. This would average at EUR 50 per de-icing / anti-icing procedure during the first year.

Operators would need to conduct an awareness and training programme for pilots; this could be conducted within the normal allocated time for annual winter operations training, and is expected to be cost neutral.

EASA will need to invest resources to review, revise and re-issue certain proposed Implementing Rules for Air Operations. This task will also require some preliminary consultation. It is estimated that such work is suitable for one person to coordinate and would likely take a maximum of 26 man-days, including 2 meetings for consultation, before the revised Rules are ready for issue in an NPA. Each meeting may be attended by 20 stakeholders (another 80 man-days, including preparation and travel) and each NAA would need to invest time making adjustments to their oversight procedures in the first year (30 x 20 man-days = 600). In total 706 man-days - EUR 614 220. Operators de-icing / anti-icing procedures and programmes would require approval by their NAA. As a desktop exercise (see Recommendation OVERS for oversight impacts) this would involve approvals for 300 operators, each taking 2 man-days each, which equates to a total on-going cost to NAAs of EUR 522 000.

Ongoing annual costs would be minimal for service providers, operators and NAAs. Training is conducted and manuals are produced as per normal. Operators may require, in the first year, additional time to reorganise their de-icing / anti-icing training and operations manuals, estimated at 30 man-days per operator (300 x 30 = 9 000 man-days) at a cost to Industry of EUR 7 830 000.

The overall economic impact to the industry in the first year appears very negative (EUR 12 188 220); however, where standards of training and operation are improved there is likely to be a reduction in the use of fluids, as de-icing becomes more efficient and effective and fewer unnecessary treatments are applied. If 1% less fluid was used, this would amount to savings for the Industry of EUR 1 740 000[20] every year.

Therefore the overall total economic impact from introducing Recommendations OPAPP and OPAMC will be EUR 10 448 220 in the first year. Ongoing annual costs to NAAs would be EUR 522 000, offset by gains in economy of fluid use EUR 1 740 000; this results in a positive outcome annually of EUR 1 218 000. This means that the initial first year investment will be returned after 7 or 8 years.

[20] Average of 400 litres per application, 500 applications per year per aerodrome, 600 aerodromes, x 1% = 400x500x600/100 = 1 200 000 x [EUR 1.20/litre plus EUR 0.25 recycling costs].

The economic impact is positive in the long-term (+).

IA 3.5.3 Environmental

Improved standards should result in greater efficiency in fluid applications and less wastage of fluid through new investment in more capable de-icing / anti-icing vehicles, improved training and better adherence to effective procedures (+).

IA 3.5.4 Social

No impact expected. Some Providers may disengage from providing de-icing / anti-icing services, however, the business levels will remain and the labour will likely be transferred.

IA 3.5.5 Regulatory

There will be a necessary review and revision of all, or some of, the following: OPS.GEN.100, AMC2 to OPS.GEN.100, and GM 1, 2 & 3 to OPS.GEN.100. It may even be necessary (Pathway 3) to develop a new Implementing Rule – OPS.SPA.DAI. Conditions for the application and issue of an AOC (EU OPS 1.175 and 1.185, and OR.OPS.015 & 025.AOC) will be affected if Recommendation OPAPP is adopted. In the long-term, liaison with ICAO to improve and re-issue Doc 9640 may be a preferred solution.

These two Recommendations, if adopted, will form a framework for many of the changes proposed in the other Recommendations, and the opportunity should be taken to implement as many of those Recommendations in parallel with each other to gain cohesion. By doing this some duplication of tasks may be avoided and savings made. The impact on regulations should be positive (+).

IA 3.6 Summary of Impacts

- Safety (++).
- Economic (+). (long term)
- Environmental (+).
- Social (0).
- Regulatory (+).

Overall a positive long-term impact (+).

IA 3.7 Impacted Stakeholder Groups

EASA, NAAs, operators, and service providers.

IA 4 Training of Operators' Operations and Dispatch Staff

IA 4.1 Recommendations

IA 4.1.1 Recommendation OPDISP

EASA to require operators to devise and deliver their own specific and appropriate training programmes for any staff (e.g. operations and dispatch staff) involved in decision-making concerning de-icing / anti-icing.

IA 4.2 Reference to Options presented in the Interim Report

OPTION REGAO5.

IA 4.3 Situation

Communication (i.e. misunderstandings from poor communication) is one of the most frequent causes of incidents and accidents involving de-icing / anti-icing operations[21], and occurs in 25 to 30% of all accidents and incidents. These misunderstandings often stem from a lack of specific knowledge and of the awareness of the consequences of decision-making.

During this Study, it became apparent how critical the expertise and knowledge of personnel within operators' flight operations departments can be in either contributing to, or hindering, de-icing / anti-icing operations, through their role as a communication hub between the service provider, aerodrome and flight crews. It is also not uncommon for third-party ground-handling organisations to fulfil this coordination and communication role on behalf of operators.

Current and proposed regulations are not specific on the training, experience or qualification requirements for operators' or contractors' personnel involved in the

[21] Safety data analysis made in the Interim Report to this Study.

decision-making chain during de-icing / anti-icing operations. This is a role that can have a significant safety impact; however, this significance is "lost" within the generality of the current and proposed regulations.

- EU OPS 1.205 is directed at operators' personnel assigned to, or directly involved in, ground and flight operations. This will exclude (based on subjective interpretation) those "indirectly" involved.

- JAA ACJ OPS 1.205 is directed solely at Flight Operations Officers, and may exclude other staff involved in the coordination of de-icing / anti-icing operations, delivery of messages, giving advice and making decisions.

- OR.GEN.210 (c) requires the operator to have sufficient appropriately qualified staff for their planned tasks and activities, but without specific details or examples of these tasks.

- OR.GEN.205 addresses the conformance of contracted and purchased services however, this concerns the ground-handling services and not necessarily the coordination thereof.

Specifying in-house training requirements for operators' and contractors' personnel involved in coordination of de-icing / anti-icing matters and operations would rectify this situation.

- Areas of "competence" may be specified to cover all safety-critical activities.
- Expanding awareness training in de-icing / anti-icing to all flight and ground operations staff may be encouraged.
- Operators can be given their own flexibility to devise training syllabus and programmes – to meet their own needs.

IA 4.4 Pathways to Appropriate Training of Operations and Dispatch Staff

Implementing this Recommendation may be undertaken by issuing guidance material to the forthcoming OR.GEN.205 & 210, or by publishing interpretation and explanatory material to assist operators interpret current and future regulations. Both

methods would require the same development of information, but the former choice is more likely to be effective.

IA 4.5 Impact Assessment

IA 4.5.1 Safety

This Study has shown that available safety data highlights the key contributing factors to de-icing / anti-icing related accidents and incidents which are inadequate or ineffective:

- communication*,
- coordination*,
- inspections/checks
- procedures,
- adherence to procedures,
- knowledge*, and
- training*.

Implementing this Recommendation will make inroads into the highlighted (*) factors. Any change that can improve the assistance and support given to pilots during times of high workload will impact positively on their decision-making, resulting in fewer errors and omissions. Existing risk is difficult to estimate without further data collection (see Recommendations DATA 1 to 5 above), however, from the historic data that is available, 25 to 30% of accidents and incidents may be avoided.

Therefore, the overall safety impact is estimated to be positive (+).

IA 4.5.2 Economic

There will be minor economic impact on EASA. For EASA to merely issue a communication making clear that operators have an existing requirement, and that this includes operations and ground staff coordinating de-icing / anti-icing, could take only a few hours, and dealing with queries and returned messages several more hours. At the most it will be one day's work for one person – EUR 870. Developing

full guidance material for inclusion into Implementing Rules for Operations may involve some external consultation (1 day / 1 person), internal meetings (2 days / 3 persons), and time for compiling and editing the text (4 days / 1 person). About 11 man-days in total – EUR 9 570.

Initial investment for operators is likely to be minor; however, the size of investment will depend on the effectiveness, breadth and depth of an operator's current training programme. If 10 operations / dispatch staff per operator are given 1 day's training in the first year, that equates to 3 000 man-days, or EUR 2 610 000 of initial investment, assuming all operators have insufficient training currently. In reality, it is likely to be less than this. Refresher training may be 1/10th of this amount e.g. EUR 261 000 annual on-going costs.

There is potential for some operators to make significant savings which could adequately cover any necessary investment to make the changes necessary in response to this recommendation. Better decision-making may have a significant positive economic impact for operators if fewer wasted de-icing and anti-icing applications are made, and if the chosen fluids and procedures are the most effective for the existing conditions. Feedback suggests that applications of fluid are frequently made too early (before ATC slot) and re-applications are necessary to maintain or renew the HoT. By avoiding the need for re-application, perhaps on 1% of occasions, the annual savings to Industry will be EUR 1 740 000 (see Section IA 3.5.2 above).

Some operators may need to review their contracts with ground-handling organisations with a view to amending certain requirements and specifications therein. The associated impact is expected to be neutral.

Therefore, overall, the economic impact is expected to be EUR 2 619 570 in the first year, with on-going costs to operators of EUR 216 000. However, with the annual estimated savings to be made, the economic impact will be positive – EUR 1 479 000 every year, and the initial year's costs will be recouped after 2 years.

The long-term economic impact is expected to be positive (+).

IA 4.5.3 Environmental

Improved decision-making can result in fewer ineffective de-icing applications, or wasted anti-icing application, this would result in a positive impact on the environment through less fluid being used (+).

IA 4.5.4 Social

No impact expected.

IA 4.5.5 Regulatory

Either an amendment to, or clarification of OR.GEN.205 & 210.

Otherwise, the impact is neutral.

IA 4.6 Summary of Impacts

- Safety (+).
- Economic (+).
- Environmental (+).
- Social (0).
- Regulatory (0).

Overall a positive long-term impact (+).

IA 4.7 Impacted Stakeholder Groups

EASA, operators, and some third-party ground-handling organisations acting as a communication hub for ramp operations.

IA 5 Ad-hoc Regulations for Air Operations

IA 5.1 Recommendations

IA 5.1.1 Recommendation CHKLST

EASA to require operators to provide flight crew with a checklist system that specifically addresses aspects of de-icing / anti-icing.

IA 5.1.2 Recommendation OPMAN

EASA to review and expand the required contents of the operator's de-icing / anti-icing policy and programme that shall form part of the Operations Manual.

IA 5.1.3 Recommendation CONTRAIN

EASA to require the inclusion of an operator's de-icing / anti-icing programme and procedures within the operator's conversion course ground training.

IA 5.1.4 Recommendation DIFTRAIN

EASA to require the inclusion of applicable elements of an operator's de-icing / anti-icing programme, and any new knowledge, within the operator's differences and familiarisation training requirements.

IA 5.2 References to Options presented in the Interim Report

OPTIONS REGAO applies to all four Recommendations.

REGAO7, REGA10, REGAO8 & REGAO9 apply to each of the above respectively.

IA 5.3 Situation

IA 5.3.1 Checklist

One area of risk and inconsistency uncovered by this Study is both poor decision-making and the technical and procedural knowledge of flight crew. De-icing / anti-icing can be a demanding operation; when undertaken in a pressurised operational environment and traffic situation (as it frequently is) decision-making and access to

technical knowledge can be hampered. Providing a set of pilots' notes in a checklist, or in diagrammatic style (in line with HF principles) will greatly enhance decision-making. Such "notes" / "checklist" should be designed to meet each operator's own needs and may also be aircraft type-specific, and perhaps covering de-icing / anti-icing methods, Holdover Times (HoTs), meteorological information, contract arrangements, communication procedures, local rules / differences, etc. Both EU OPS 1.210(b) and OR.OPS.100.GEN(e) require operators to establish a check-list system to be used by crew members to ensure that the operating procedures in the OM are followed. Recommendation CHKLST would appear to "fit" within this requirement, yet such aide-memoirs for use by flight crew are rare.

> **Note:** *As a side, but related issue, EASA may wish to investigate the need for an in-flight checklist for flight crews to use whenever stiff or frozen flying control systems are encountered and the suspected cause is frozen re-hydrated fluid residues.*

IA 5.3.2 Operations Manual

Appendix 1 to EU OPS 1.1045 (A 8) and AMC5 OR.OPS.015.MLR contain a list of 5 specific subjects concerning fluid types which must be described within the OM. Limiting the relevant contents of the OM to these few elements detracts from other critical aspects of the programme. Furthermore, OPS.GEN.600 and its AMC omit "relevant parts" of the OM from the list of documents to be carried on all aircraft, unlike OPS 1.130. The omission of certain information may hinder pilots' decision-making during winter operations. Providing more guidance on the contents of the OM, specific to de-icing / anti-icing, will increase the harmonisation amongst operators of how this information is presented. Amendment to the contents of the OM can be coordinated with any development of a new AMC, and may include information on the following:

- the operator's communication and coordination procedures (for de-icing / anti-icing);
- the anti-icing code;
- inspection and checking procedures;
- re-assessment of HoT in changing conditions;
- affect of frozen contamination on flying control surfaces;
- affect of re-hydrated fluid residues on flying control surfaces;

- the Operators management programme for reducing / eliminating fluid residues (e.g. desired frequency of using of two-step procedures); and

- details of the operator's standard contract for de-icing / anti-icing service provision at all destinations.

IA 5.3.3 Pilot Training

The Study has uncovered that the lack of pilot knowledge is a frequent occurrence in reported incidents. Under the existing regulations there is a risk that pilots may operate during winter conditions without having undertaken any instruction in the operator's de-icing / anti-icing procedures. Currently, de-icing / anti-icing instruction is only included in the operator's recurrent training programme (EU OPS 1.965) and is not included in the operator's conversion course (Appendix 1 to EU OPS 1.945). The same situation will arise under AMC OR.OPS.135.FC.

It may also be possible, under existing regulations, for pilots to be unaware of the need for a variation in de-icing / anti-icing procedures (perhaps, any ground-handling activities) when operating a new variant (of the same type) or type (of the same class) of aircraft. Currently de-icing / anti-icing differences and new knowledge are not included in the operator's differences and familiarisation training requirements (EU OPS 1.950); this situation also exists in GM OR.OPS.040.FC.

IA 5.4 Pathways to Improving Current Operators' Regulations

It would be more practical and efficient to amend future proposed Implementing Rules for Air Operations rather than amend EU OPS.

Recommendation OPMAN may include the need for an aide-memoir / checklist to be included within the OM; this may fulfil Recommendation CHKLST, however, there must be a requirement for the information to be carried on board each aircraft (OPS.GEN.600).

If OR.OPS.040.FC (Differences and Familiarisation Training) were deemed "generally" sufficient to cover "any" procedural changes, then some guidance may still be required to include ground-handling activities and not just operation of the aircraft.

IA 5.5 Impact Assessment

All four of these Recommendations are grouped together because of the nature of their implementation – i.e. minor amendments to the future EASA Rules for Air Operations – and therefore, may be included in the same Impact Assessment.

In particular, concerning CONTRAIN and DIFTRAIN, the Study collected no evidence that operators do not actually include de-icing / anti-icing within their conversion, and differences and familiarisation training courses: and it is likely that most operators do. However, it is a loophole that needs closing.

Therefore, this Impact Assessment concentrates mostly on Recommendations CHKLST and OPMAN.

For those operators that do not actually include de-icing / anti-icing within their conversion, and differences and familiarisation training courses, there may be additional requirements, at a cost, for extra training. However, as appropriate training courses already exist within recurrent training programmes, the economic impact will be slight to none.

IA 5.5.1 Safety

Lack of pilot knowledge and access to knowledge which aids decision-making during de-icing / anti-icing operations are frequent contributing factors to accidents and incidents. Increasing the training opportunities and requiring the carriage (on board every aircraft) of information and / or appropriate checklists / guidance information will help reduce these risks. Furthermore, a well-designed checklist which meets the operator's requirements can act as an effective safety net in a pressured environment.

The impact on safety from the adoption of these Recommendations is therefore likely to be positive (+).

IA 5.5.2 Economic

EASA would need to provide resources to facilitate the amendment of Implementing Rules for Air Operations and to undertake the necessary consultation process. These four amendments could be addressed by one person. Revising the required contents of the OM and providing guidance for operators on the design / contents of a checklist would be the main tasks. Combined these may take a facilitator 15 man-days, and also involve input, via e-mail, from active NAAs, possibly another 15 man-days: in total EUR 26 100.

The development of checklists, and changes to the OM will require effort from operators. Depending on the guidance provided by EASA this effort will vary. However, by consulting with other airlines (through Associations) this work can be reduced considerably, with the added advantage of increased harmonisation. Needless to say, the work may require 5 man-days per operator, which across Europe will total – EUR 1 305 000.

NAAs would need to "accept" changes to operators OMs, and in the near future possibly "approve" these new elements, in order to maintain the validity of an Operator's AOC. This process already exists, and allowances could be made to "phase" these acceptances / approvals over a suitable period, to coincide with other changes and routine inspections. Thereby, the economic impact for NAAs is likely to be none: however, in the worst case, changes to each operator's OM may require one man 2 hours to accept or approve, which overall totals EUR 87 000.

Any positive economic impact would be as a consequence of the reduced number of incidents and possibly accidents. The amount is not currently possible to estimate accurately – not until Recommendations DATA 1 to 5 are implemented.

The overall economic impact is therefore an initial one-off cost to Industry of EUR 1 418 100 (-), but with a long-term positive outlook.

IA 5.5.3 Environmental

No impact expected.

IA 5.5.4 Social

No impact expected.

IA 5.5.5 Regulatory

Forthcoming Implementing Rules for Air Operations, including Organisation Requirements will need amending, and the changes consulted upon.

CHKLST: OPS 1.210(b) and OR.OPS.100.GEN(e)

OPMAN: Appendix 1 to EU OPS 1.1045 (A 8), AMC5 OR.OPS.015.MLR and OPS.GEN.600. This Recommendation would also facilitate elements of OPAMC.

CONTRAIN: EU OPS 1.965, Appendix 1 to EU OPS 1.945 and AMC OR.OPS.135.FC.

DIFTRAIN: EU OPS 1.950 and GM OR.OPS.040.FC.

Closing the loophole that permits pilots' conversion and differences training courses to omit de-icing / anti-icing will have a positive impact on the regulations.

IA 5.6 Summary of Impacts

- Safety (+).
- Economic (-).
- Environmental (0).
- Social (0).
- Regulatory (+).

Despite the moderate investment required, for no discernable financial gain, the long-term benefits from the expected improvement in safety result in an overall total positive long-term impact (+).

IA 5.7 Impacted Stakeholder Groups

EASA, NAAs and operators.

IA 6 Operational Communication

IA 6.1 Recommendation

IA 6.1.1 Recommendation COMM

EASA facilitate an International programme, involving Industry and Regulators, to standardise communication elements, their use, meaning, and methods of delivery.

IA 6.2 References to Options presented in the Interim Report

OPTIONS COMM 1 to 7 inclusive.

IA 6.3 Situation

The Interim Report[22] to this Study concluded that there were seven areas of highest risk towards which resources should be directed. Three of these seven areas were: communication, coordination, and inspections / checks.

Captains are reliant on external parties for information concerning contamination, the need to de-ice and the results of de-icing and anti-icing applications. Additionally they are equally dependent for information concerning de-icing / anti-icing operations, such as position and movement of vehicles and personnel, fluid types used, the need to reconfigure flying surfaces etc. These messages are delivered in person, or via VHF voice, or on message boards, or sometimes by a “thumbs-up”, and often through a third-party. Such third-parties are often remotely sited, away from the operatives in their vehicles and the pilots in the aeroplane, and must therefore relay any messages between these two. This essentially isolates the two “experts” (pilot and de-icing operative) from one another. Often, for contractual reasons, the post-treatment check is conducted by another organisation; in these cases, the same communication criteria ought to apply.

[22] Attachment A to Interim Report: Summary and Analysis of Available Safety Data.

One of the crucial communication elements is information to allow a captain to calculate the prevailing HoT; this is achieved by the passing of an “anti-icing code”. There is no internationally accepted, or implemented, standard of message content or delivery. Like most details of an operator’s de-icing / anti-icing programme, the Code is recommended best-practice, and is described in ICAO Doc 9640, JAA ACJ OPS, AEA and SAE Recommendations, as well as EASA SIN 2008 – 29[23]. As such, the meaning of the Code is open to interpretation, and this Study has discovered that the understanding attributed to the Code varies considerably. Some service providers issue the Code only to confirm that the service requested has been provided and not necessarily that a post-treatment check has been conducted *and* no contamination found. Some operators always believe (assume) that the issue of the Code implies that the aircraft is now clean of contamination. Another aspect for confusion is the connection (or not) of the issuing of the Code and the communication to the flight crew that all de-icing / anti-icing personnel and vehicles are “clear” of the aircraft; and furthermore, confusing this with a communication that the aircraft is clear to taxi.

It is usual, within Air Operations, that safety critical messages (e.g. ATC clearances, load data, passenger safety briefing) are standardised to avoid ambiguity and misinterpretation. Such communication is also conducted by suitably trained and qualified personnel. The methods / mechanism for communicating safety critical messages are also usually prescribed (e.g. voice, or by approved forms). All three of these elements allow the aircraft Captain to challenge, question and qualify with an external party, who in turn can provide expert answers. None of these elements are prescribed for de-icing / anti-icing.

IA 6.4 Pathways to Improving Communication during De-icing / anti-icing Operations

The development of internationally standardised messages for de-icing / anti-icing operations would ideally need ICAO (FAA also), SAE, IATA and AEA agreement, and indeed assistance. This would be a necessarily long process, but the results would be more universally acceptable. However, if EASA could reach an agreement with AEA the process would be quicker, uptake within Europe would be close to universal,

[23] EASA Safety Information Notice 2008 – 29, April 2008.

and the other Industry and Regulatory bodies are also likely to be willing to participate.

EASA has the opportunity to include (mandate) standardised messages, their purpose, meaning and content, through a revised AMC (OPAMC) and / or inclusion in the OM (OPMAN).

Consultation, led by EASA, would need to consider the following elements of communication:

- Clarification of the meaning and purpose of the anti-icing Code and its contents: furthermore, that no additional meaning or messages are implied.
- The need for a separate “aircraft clean / aircraft not clean” message following the post-treatment check.
- A specific, separate and standard “equipment and personnel clear of aircraft” message.
- The benefit of continuously available verbal contact between de-icing / anti-icing crew chief / operative and the flight deck.
- The need for critical messages (e.g. “aircraft clean”) to be delivered by a qualified person who is present at the operation and whether there is a need for this qualified person to provide his / her identity with either the Code, or the post treatment check results.
- The need to require operators to include these elements in their contracts with service providers.

IA 6.5 Impact Assessment

IA 6.5.1 Safety

There are no direct safety benefits or penalties that arise from facilitating a process, as Recommended here. However, if the process is successful, then the long-term safety impact is very positive (++).

For the purposes of this IA the safety impact is neutral (0).

IA 6.5.2 Economic

Whether facilitating an international forum or unilaterally leading a work programme with AEA, the resources and effort required are likely to be similar except the latter process will be quicker to complete. The Agency would need to plan and host several small meetings, but work would be shared with the Industry (e.g. AEA and ERA). It is estimated that the Agency would need to contribute 20 man-days, and it would be expected that an active Industry working group of 10 members would be required to contribute 120 days (chair – 30-days, and 9 members, 10-days each); which totals a cost of EUR 121 800 for 140 man-days.

If this process leads to changes to communication procedures, as described earlier, there will be a need for minor investment from operators to publicise any new communication procedures and messages, educate flight crews, and publish details in the appropriate manuals / checklists. This might amount to around 10 man-days per operator (EUR 2 610 000).

Overall, to implement this Recommendation, the economic impact is minimally negative (-). Depending on the outcome, the eventual one-off investment costs will be higher, however, there is great potential to reduce the risks associated with de-icing / anti-icing operations through better communication. For example, the avoidance of an aircraft colliding with a de-icing vehicle can produce savings well over EUR 100 000 in direct costs (damage repair) and even more in indirect costs (cancelled flight). Therefore the potential long-term economic impact is positive (+).

IA 6.5.3 Environmental

There is no environmental impact expected from implementing the Recommendation (0).

However, in the long-term, if changes are made, improved communication and reduced misunderstanding may result in more effective and efficient use of fluids, and also reduced inappropriate use of fluids. Therefore there is potential for a positive environmental impact (+).

IA 6.5.4 Social

No impact expected.

IA 6.5.5 Regulatory

Details of this Recommendation would impact upon, and be integral to, the results of Recommendations OPAMC and OPMAN. They may also impact upon Recommendation CHKLST.

There may be a necessary review and revision of all, or some of, the following:

OPS.GEN.100, AMC2 to OPS.GEN.100, and GM 1, 2 & 3 to OPS.GEN.100. Conditions for application and issue of AOC (OPS 1.175 and 1.185, and OR.OPS.015 & 025.AOC) will be affected if changes are incorporated within the OM.

EASA SIN 2008 – 29 paragraph 5 gives examples of the anti-icing code, and the need for an “all operations complete and equipment clear” communication.

In the long-term, liaison with ICAO to improve and re-issue Doc 9640 may be a preferred solution.

However, there is no immediate impact expected on other regulations from adopting this Recommendation (0).

IA 6.6 Summary of Impacts

- Safety (0) / (++) potential long-term.
- Economic (-) / (++) potential long-term.
- Environmental (0) / (+) potential long-term.
- Social (0).
- Regulatory (0).

Despite the moderate investment required to follow this Recommendation, the potential long-term benefits from the expected improvement in safety and reduction in economic losses result in an overall total positive impact (+).

IA 6.7 Impacted Stakeholder Groups

EASA, NAAs, operators and service providers.

IA 7 Regulatory Oversight of De-icing / anti-icing Operations

IA 7.1 Recommendations

IA 7.1.1 Recommendation OVERS

EASA to encourage all NAAs to establish and maintain a monitoring programme of de-icing / anti-icing service providers whose operations lie within their territory.

IA 7.2 References to Options presented in the Interim Report

OPTIONS EASAAR 1, 2 & 3.

IA 7.3 Situation

The Study revealed that few, if any, NAAs conduct direct oversight of any de-icing / anti-icing activities at their aerodromes. Where they do, it is not to any set programme or structure. Instead NAAs rely on their relationships with operators (and sometimes aerodromes), resulting in distant and superficial relationships with service providers. The “oversight” of de-icing / anti-icing occurs through operators’ Quality Assurance programmes, which together with operators’ OMs, are approved / accepted by NAAs. NAAs are not required to review and oversee how operators arrange contracts with service providers (AMC 2 AR.GEN.300). There is no systematic inspection (beyond what flight crews can observe/experience) of de-icing / anti-icing activities as they occur.

Proposed EASA Authority Requirement AR.GEN.305 requires NAAs to conduct oversight of non-certified bodies and personnel who are conducting activities on their territory: the oversight programmes and audit schedules shall be proportionate. Unless NAAs are required to specifically focus on de-icing / anti-icing, the current situation is unlikely to change.

A unified purpose for such programmes would encourage their development and use, and also to provide useful feedback which could then be compared between States.

IA 7.4 Pathways to Improving the Oversight of De-icing / anti-icing Operations

The proposed regulation AR.GEN.305 (Monitoring of activities) is clear in its intent; however, to focus NAAs' attention onto de-icing / anti-icing, EASA will need to either circulate specific guidance information and / or include it in an addition to AR.GEN.305, as GM or AMC. AMC3 to AR.GEN.305, as currently proposed, is not clear or appropriate for this Recommendation.

Rather than concentrate specifically on de-icing / anti-icing activities, focus could be spread to all activities conducted on / at an aerodrome by third-parties which directly affect the safety of aircraft operations (on the ground and / or in flight); many of which, like de-icing / anti-icing, are not included within NAA oversight programmes.

It may be appropriate for EASA and NAAs to develop and implement the necessary procedures for a Safety Assessment of Foreign Aircraft (SAFA) style process of inspections, thereby providing an opportunity to share resources, data and feedback of inspection results to the operators who use these services. Such inspections could include elements such as an aerodrome's "snow plan", de-icing operatives' qualifications, serviceability of vehicles and quality of fluids. Consideration would need to be given to the conduct of "live" inspections (from different vantage points – de-icing vehicles, de-icing coordination centre, flight operations, and flight deck), and also the conduct of off-season inspections / audits.

Reviewing and amending AMC 2 AR.GEN.300 (Continuing oversight OPS) to include an operator's arrangements for ground-handling (including de-icing / anti-icing) would increase awareness of the issue, and allow NAAs to inspect (and become familiar with) these arrangements.

This Recommendation is concerned only with aerodromes within EASA Member States and does not investigate the need, or mechanism, for conducting oversight of de-icing / anti-icing operations outside of EASA Member States.

A major point to consider here is that the Recommendation is not inferring that every service provider at every location is routinely and regularly audited and inspected. The monitoring programme can be tailored by NAAs to meet their specific needs, and it is expected that the number, breadth and depth of NAA audits and inspections will be sufficient to meet these needs.

IA 7.5 Impact Assessment

IA 7.5.1 Safety

Increasing NAA awareness, expertise and knowledge, through “real-time” and off-season oversight of de-icing / anti-icing activities should have a significant positive affect on safety (+).

IA 7.5.2 Economic

EASA and NAAs (i.e. those that wish to become involved in the development) will need to invest some resources to develop guidance for establishing and running an oversight programme and, if required, develop acceptable amendments to the Authority Requirements. For EASA, this is likely to involve a subject-matter-expert (SME) acting as facilitator; the process may take longer than one year and involve several meetings. The estimated cost to EASA could be 40 man-days – EUR 34 800, and for those NAAs involved (perhaps 10) 20 man-days each – therefore 200 days – EUR 174 000. The total establishment costs would be EUR 208 800.

NAAs will need to make provision for continuous annual running costs to fund inspectors, inspections, report writing and information analysis and sharing. The SAFA process currently returns (on average) one inspection per week per Member State[24]. Respondents to the Study, on average, incur about 70 days per annum where de-icing operations take place. As many of these are frost removal only, the number of days when anti-icing also occurs is much lower. For a similar rate of return as that achieved through SAFA, the oversight of de-icing / anti-icing activities would require, on average, each State conducting about 7 inspections. Naturally some States (Scandinavia) would conduct twice as many, whilst others (Mediterranean) may conduct none. It may also be desired to make inspections at *all* large commercial aerodromes in the Member States, and this would increase this rate considerably. Furthermore, “live” inspections would need to be made within a restricted time period, and often at short notice, perhaps necessitating more than one inspector per State. Probably an equal number of off-season inspections / audits would also be necessary. There is no reason to suppose that currently employed Operations Inspectors and Aerodrome Surveyors could not be used for this task, and therefore new employment is unlikely to be necessary. De-icing / anti-icing inspections could be combined with others for efficiency. Nevertheless, to service this

[24] http://www.easa.eu.int/approvals-and-standardisation/safety-assessment-of-foreign-aircraft-SAFA.php

rate of inspection would perhaps require 40 man-days per NAA per annum, every year – EUR 1 044 000.

Any positive economic effects are not quantifiable at this stage, however, if the programme assists NAAs in providing operators with more effective guidance and useful data; those operators will be able to adjust their service provision contracts to reduce risks.

However, in the immediate future, this Recommendation will cost EUR 208 800 to establish and EUR 1 044 000 in annual running costs (-).

IA 7.5.3 Environmental

No impact expected (0).

Although an oversight programme may result in some service providers removing less capable vehicles from service, and replace them with more efficient vehicles. There may therefore be a net decrease in the use of fluids in the long-term.

IA 7.5.4 Social

No impact expected (0).

Although there could be some job creation in some NAAs if their amended oversight programme requires more inspectors; however, as explained above, this is unlikely.

IA 7.5.5 Regulatory

Adoption of Recommendations COORD 1 & 3 would be necessary to facilitate the development of this Recommendation and its ongoing success; such expertise within EASA and NAAs would naturally grow as the “system” of oversight became more mature.

Inspections by NAAs could provide useful safety data which may satisfy some elements of Recommendations DATA 1, 4 & 5.

Implementation of a European-wide NAA oversight of de-icing / anti-icing activities could possibly be coordinated and integrated with Recommendation LOA (if adopted).

Other safety-critical “activities”, which also currently avoid direct oversight by NAAs, could be considered along with this Recommendation for improved efficiency and effectiveness.

Overall the impact from regulatory changes is positive (+).

IA 7.6 Summary of Impacts

- Safety (+).
- Economic (-) / (+) potential long-term.
- Environmental (0) / (+) potential long-term.
- Social (0).
- Regulatory (+).

Although not quantifiable at the moment, the overall impact from adopting Recommendation OVERS should be positive (+). Also the spin-off from NAAs gaining a greater insight into de-icing / anti-icing activities is very positive, in the long-term.

IA 7.7 Impacted Stakeholder Groups

EASA, NAAs, and service providers.

IA 8 Quality Assurance of De-icing / Anti-icing Service Providers

IA 8.1 Recommendations

IA 8.1.1 Recommendation LOA

EASA to investigate the possibility, and the potential for an LoA system of quality assurance of de-icing / anti-icing service providers.

IA 8.1.2 Recommendation VOLQCP

Industry to voluntarily develop, or adjust, a system whereby service providers can opt to be accredited through a recognised audit scheme based on acceptable standards.

IA 8.2 Reference to Options presented in the Interim Report

OPTIONS REGLOA & VOL.

IA 8.3 Situation

It is not rare that a service provider will be audited 20 times each year. The Study shows[25] that currently 34% of operators audit to IATA De-icing and Anti-icing Quality Control Pool (DAQCP) standards, 19% conduct audits to their own standards, and 16% to AEA (although DAQCP audits are also based on AEA standards). Whilst being audited by the DAQCP can reduce the auditing rate for some service providers, it is still common that operators who are members of the DAQCP also choose to conduct their own audits as well. Service providers find it difficult to meet operators' many different requirements for procedures, processes and levels of service: this detracts from a standardised system and is resource intensive.

[25] Interim Report – Data Summary and Analysis.

The average European operator will operate to many destinations[26]. For most of Europe's airlines, all their destinations will incur conditions that require de-icing (e.g. frost and cold-soaked wings), and a large proportion will require anti-icing as well. Not all airlines are members of IATA DAQCP, and not all destinations have been audited by the DAQCP. Thus, most operators have to conduct a multitude of audits each year, making it very difficult to ensure a consistent level of service, that meets their own specific needs.

Membership of the DAQCP is restricted to airlines. Service providers cannot "join" the DAQCP nor request to be audited to gain DAQCP "accreditation / qualification". There are about 50 member airlines[27] and audits are conducted at about 600 companies at more than 250 airports within Europe. The Study Team is unaware of any other quality control audit pool currently active within Europe.

EASA currently operates an audit pool system for providers of navigation databases, and avionics containing navigation databases, to assist Operators to fulfil their regulatory requirements. Very few organisations are involved and the Agency provides the auditors who conduct audits annually against a standard acceptable to EASA. Letters of Acceptance (LoA) are issued to organisations that successfully meet the necessary criteria: LoA1 to suppliers of databases, and LoA2 to those organisations who supply avionics containing navigation databases, that they themselves obtain from organisations awarded an LoA1. The system prevents the need for each organisation providing databases to be audited by each of its airline customers, many of whom may not have the expertise to do so effectively anyway. This Study[28] has drawn parallels between assuring the quality of navigation data and assuring the quality of de-icing / anti-icing services. No other audit pools are currently operating to assist operators meet any regulatory obligations and the DAQCP is not officially recognised by EASA (or any NAA) as a means of meeting regulatory compliance for operators.

[26] e.g. Alitalia Express – 28; Germanwings – 75; Ryanair – 145; SAS Regional companies – 156

[27] http://www.iata.org/whatwedo/Documents/Whatwedoandmembershipinfo.pdf

[28] Interim Report – Options for Change.

IA 8.4 Pathways to Creating Pooled Auditing

The option of EASA issuing LoAs to providers of de-icing / anti-icing would introduce different challenges from those of the LoA system currently in use for air navigation database suppliers.

Firstly, in the case of the existing LoA process, there are only a few air navigation database suppliers, and therefore the Agency's commitment of resources is limited. Secondly, if EASA did audit every de-icing / anti-icing service provider, this is duplicating a process that operators are obliged to do anyway, thereby creating. wasted effort. Additionally, there are also questions as to which standard the Agency would use to conduct their audits, unless Recommendations OPAPP and OPAMC were adopted.

The benefit of using an LoA process is that standard "conditions and guidance" can be established against which audits and inspections can take place. The IATA DAQCP provides a model where member airlines agree a common standard audit checklist (based on AEA Recommendations), and accept the audit results of shared audits within the pool of members. The auditors are provided by the pool members and are trained in accordance with the DAQCP's own accepted standards. In effect, any service provider passing a DAQCP audit is issued with an Industry seal of approval whilst not removing the ultimate responsibility from the operator. It could be conceivable that any organisation (like IATA) wishing to establish a de-icing / anti-icing quality control pool can be "approved" or "accepted" by EASA and issued with their own LoA (perhaps LoA1); this would then permit the pool's own qualified auditors to issue, on behalf of the Agency, LoAs (perhaps LoA2) to service providers who meet the necessary standards. Currently, the DAQCP is established from the perspective of its own airline membership, and this limits the number of destinations and service providers included in the scheme. An improvement to the scheme would be to allow service providers membership where they either pay for the privilege of being audited and thereby "accepted", or they pay a fee and contribute to the pool of auditors. The regulatory control would be established if EASA accepted that a shared audit from one of its "accepted" schemes fulfils operators' regulatory requirements for Quality Assurance and eases their obligation to conduct their own separate audits. Whereas if an operator wished to use the services of a provider who sat "outside" of any scheme and did not possess an LoA, they would have to demonstrate to their competent Authority that they could meet the same standards through their own contract provisions and quality programme. Such a system would minimise the use of

EASA's resources, whilst also allowing EASA to define criteria and standards to be adopted by, and through, the scheme.

An officially sanctioned audit pool scheme, as recommended, is likely to achieve a high level of acceptance and membership, thereby raising and harmonising standards significantly. This will be greatly enhanced if the scheme is also "open" for service providers to join directly and request qualification / accreditation. Such a mechanism would also greatly improve coverage of the existing voluntary DAQCP, as it is in the service providers' interests to reduce their audit burden.

Such a scheme could be funded through a service providers' joining fee, and the operators providing and training the auditors and conducting the audits.

IA 8.5 Impact Assessment

This IA is focused mostly on Recommendation LOA, as VOLQCP is outside the remit of EASA to arrange no matter how beneficial. However, if EASA approved the concept of operators sharing audits, then the arguments below would apply equally to VOLQCP.

IA 8.5.1 Safety

Developing a common acceptable standard, applicable to members of the scheme, will increase harmonisation, and reduce considerably the variations in procedures that service providers need to learn, resource, train to and comply with. Such a reduction will reduce the risks associated with the confusion that can arise and also the possibility of incorrect procedure selection.

It will be in the interest of operators to select only those providers who have been audited within the scheme, thereby encouraging more providers to "join", thus giving further movement towards a universal harmonisation and the raising of standards.

Adoption of Recommendation LOA would fulfil a substantial element of the Study's terms of reference – *to recommend the most effective way NAAs can regulate de-icing / anti-icing so that the safety of air operations is maximised and a level commercial playing field is maintained*.

Overall, the expected safety impact is very positive (++).

IA 8.5.2 Economic

The scheme would be funded mostly by Industry; however, the potential for both service providers and operators to make significant savings is high.

If 300 operators, each operating to 30 destinations, and holding de-icing / anti-icing contracts at 50% of those destinations, they would currently be expected to conduct 30 audits per year each (15 x 2), which equates to 9 000 audits. Each audit will involve 3 man-days on average at a cost of EUR 2 610 per audit. That is a cost to operators of EUR 23 490 000 every year. If only 1/3 of those providers were issued an LoA, the savings to operators would amount to EUR 7 830 000 per year.

Similarly, service providers would have their audit burden significantly reduced. These 9 000 audits will cost each service provider 1 ½ man-days each, giving a total of 13 500 man-days, costing – EUR 11 745 000. If 1/3 of operators were members of the QCP, this would result in savings to service providers of EUR 3 915 000 each year.

EASA would be required to develop (or adopt) guidance to those organisations wishing to establish a pooled auditing scheme and qualify for an LoA. Currently there is only one scheme (IATA DAQCP) in a position to “fulfil” this Recommendation, and EASA should be encouraged to liaise with IATA DAQCP to develop a suitable working model and to agree standards of de-icing / anti-icing activities as well as auditor training. This development phase could potentially take one year, and involve many small meetings with Industry and NAA experts: possibly 8 x 2-day meetings for 12 delegates, giving 192 man-days – EUR 167 040. The Agency would also be required to contribute perhaps a further 40 man-days to facilitate the work - EUR 34 800. Giving a total estimated establishment cost of EUR 201 840.

EASA’s annual obligation to issue LoAs to the pool organisations will involve one audit per organisation (currently 2 man-days EUR 1 740) and possibly 5 days of administration EUR 4 350; giving total running costs of EUR 6 090 per audit pool organisation.

Overall, the envisaged combined annual savings to Industry of EUR 11 745 000 far outweigh the set-up and annual running costs. The economic impact is extremely positive (++).

IA 8.5.3 Environmental

Reducing the number of audits conducted will also reduce the amount of fluid disposed preceding and following fluid quality checks. Furthermore, travel by auditors will also be greatly reduced. Neither of these is quantifiable, but overall it will be slightly positive (+).

IA 8.5.4 Social

Operators' and service providers' auditors are predominantly (if not totally) employees who are engaged in other roles, and their auditing activities are a small part of their responsibilities. Even Operators' full-time quality assurance employees will have many other activities to conduct as well as auditing of other areas of operational activities. Therefore, it is unlikely that reducing the number of audits to be performed, even by a substantial amount, will reduce employment levels.

Organisations wishing to establish and run quality control pools will require administrative and technical staff. Therefore, there is likely to be a net increase in employment, although the new positions created may be fewer than 10 for each different audit pool scheme.

Therefore, overall, the impact is negligible (0).

IA 8.5.5 Regulatory

Recommendation LOA can be coordinated with Recommendation OVERS, such that NAA responsibilities for oversight of "activities" within their territory may be partially met through a quality control pool. Refer to AR.GEN.305 and associated AMC.

Recommendation OPAMC may also involve inclusion of a de-icing / anti-icing quality control pool's standards and criteria into AMC and / or GM to OPS.GEN.100.

Existing Rules concerning operator's Quality Assurance programmes are contained in OPS 1.035; and the equivalent proposed EASA Regulation (compliance monitoring) is contained in AMC 1, 3 & 4 to OR.GEN.200.(a)(7).

GM to OR.GEN.205 may be the mechanism to "allow" effective out-sourcing of audits to a suitable audit pool organisation.

Overall the effect on regulations will be neutral (0).

IA 8.6 Summary of Impacts

- Safety (++).
- Economic (++).
- Environmental (+).
- Social (0).
- Regulatory (0).

The overall impact from adopting Recommendation LOA will be extremely positive (++). It meets one of the key requirements of this Study by itself, and the economic benefits accrued will more than adequately cover the costs of the other Recommendations.

IA 8.7 Impacted Stakeholder Groups

EASA, NAAs, operators and service providers.

IA 9 Responsibilities of Aerodromes

IA 9.1 Recommendations

IA 9.1.1 Recommendation ADRESP

EASA to clarify within future rules for European aerodromes, the minimum responsibilities aerodromes have towards de-icing / anti-icing facilities and infrastructure, and the facilitation of safe de-icing / anti-icing operations.

IA 9.2 References to Options presented in the Interim Report

OPTIONS REGSP3 , REGAD 1 to 6 inclusive, GHDAD 2 & 3.

IA 9.3 Situation

Some aerodrome management organisations also act as service providers of de-icing / anti-icing, often as a monopoly supplier. In this role, they are not regulated directly, but indirectly through regulations for air operations (operators).

Feedback during the Study[29] revealed that most stakeholder group representatives considered that as the expertise for de-icing / anti-icing sits with operators and service providers (although there are exceptions to both), that this arrangement should continue.

The Option to regulate service provision through making de-icing / anti-icing the sole responsibility of aerodromes was not supported, and considered to be counter-intuitive (see Final Report - Introduction).

However, aerodromes do have responsibilities[30] for facilitating the infrastructure as well as for the safety of activities conducted at the aerodrome; approximately 50% of respondent aerodromes do set their own standards and requirements on service providers with respect to procedures, vehicles, storage, and/or recycling. The

[29] SRB Report and Interviews.

[30] ICAO Annex 14 - Aerodromes I, aerodrome design and operations.

certification of an aerodrome by the appropriate Authority includes the acceptance / approval of the Airport Manual, which shall contain details of the de-icing / anti-icing facilities and services.

The interpretation of and compliance with Annex 14 varies between each EASA Member State, and sometimes within States (via local governments). Therefore, compliance with the Annex 14 requirements for de-icing / anti-icing facilities, services and location, differs widely throughout Europe because of each NAA's own unique interpretation. This variance between EASA Member States in the interpretation of SARPs is a natural consequence of the overall generic nature of ICAO Annexes and SARPs.

ICAO guidance[31] further complicates matters by including de-icing / anti-icing vehicles and fluid storage systems as part of the aerodrome facilities, whereas the Study revealed that the aerodrome only owned / managed these at 50% of locations, and these were mostly aerodrome respondents who also act as service providers.

Only 50% of respondent aerodromes collect and recycle used / spilt fluids; and only half of those have fixed infrastructure to achieve this. Similarly only 26% of de-icing / anti-icing operations are conducted at dedicated remote / centralised facilities, while 70% still occur at the gate and ramp area: indicating a low number of dedicated specifically designed facilities. However, operators have divided opinions about the preferred options – Ramp or Remote.

The available infrastructure and facilities can often limit the service offered to one-step de-icing / anti-icing only. Often, de-icing / anti-icing operations are confined to the ramp area in order to facilitate fluid collection, as well as provide space for multiple service providers to operate. Such arrangements do not always provide the shortest taxi distances for departing aircraft as recommended in Doc 9640.

Whilst it might seem likely that de-icing / anti-icing "areas" would be 100% managed by the aerodrome, this is only valid in 77% of locations. Other organisations will frequently share the ownership and management of de-icing / anti-icing facilities and infrastructure.

A majority of aerodromes are currently required to comply with ICAO SMS SARPs; these do infer that safety data should be collected and analysed concerning safety

[31] ICAO Document 9640 – Manual of Aircraft Ground De-Icing-Anti-Icing Operations 2nd Edition, 2000.

critical activities on the aerodrome. However, the Study has highlighted that aerodromes are not collecting such data from de-icing / anti-icing service providers.

Requirements for local noise abatement procedures (use of runways) can take priority over maintaining shorter taxi routes for departing aircraft, thereby threatening HoTs.

IA 9.4 Pathways to Clarifying Responsibilities of Aerodromes

EASA is currently undertaking the task of creating Implementing Rules for aerodromes, and following this process, the question of varied interpretation and application should be resolved. This would be a unique opportunity to examine whether aerodrome regulations can be used to encourage closer scrutiny and a greater involvement in de-icing / anti-icing operations by the aerodrome and whether this would be necessary. Any such increased involvement ought not to conflict with operators' programmes and contracts, nor interfere with any market access that may exist, but should enhance the whole process and facilitate more effective cooperation between stakeholders and also the co-ordination of operations. Any regulatory or voluntary mechanism that can encourage long-term planning and (appropriate) investment to improve the de-icing / anti-icing facilities and infrastructure should be considered.

Whilst interpreting ICAO Annex 14 requirements into EU Rules, the Agency should give consideration as to whether aerodromes have any responsibility for:

- setting pre-conditions for the issue of licenses to service providers (in conjunction with local authorities and Directive 96/67/EC[32]) concerning the facilities made available:
    - ensuring that the de-icing / anti-icing vehicles and fluid storage capacities (as part of the facilities), used by service providers, are sufficient and appropriate to meet the needs of the aerodrome winter traffic flow plan;

[32] Directive 96/97/EC on access to the ground-handling market at community airports, October 1996.

- ensuring that service providers' (procedures, vehicles, resources, fluid types available, communication systems, etc) are capable of meeting the needs of *their* operators and safety levels required;

– planning for two-step de-icing / anti-icing procedures (where space allows and operators so request) even though some operators may continue to choose the one-step procedure;

– providing a supporting case in favour of each de-icing / anti-icing area, with specific reference to how these chosen areas support the HoT :

- considering conflicts between safety and environmental noise protection in choice of active departure runway;

– actively promoting the recording, collection and analysis of safety data related to de-icing / anti-icing (or, all ground-handling activities):

- including third-parties within the aerodrome SMS; and

– facilitating the regular planning and operational meetings of all relevant stakeholders (at the Aerodrome) to discuss de-icing / anti-icing of aircraft operations and safety.

EASA should also consider the need for Member State NAAs to implement similar and proportionate requirements on those aerodromes that will fall outside of the scope of future EU rules, due to size, capacity and / or facilities[33].

IA 9.5 Impact Assessment

Acting upon this Recommendation would require EASA to absorb the above considerations into the drafting and consultation process for the adoption of EASA proposals for Rules for Aerodromes. This, in itself, will have minimal impact on the Agency's resources.

Therefore, the Impact Assessment below considers the materialisation of those "pathways" introduced in paragraph 9.4 above.

[33] As presented by EASA at the SRB as Option REGAD7.

IA 9.5.1 Safety

Giving aerodromes the responsibility to "set" certain conditions for service providers to meet (concerning their vehicles, fluid storage etc) will harmonise the technical capabilities amongst service providers at each location. This may involve an increase in safety where the standards required are set appropriately high to meet Industry best-practices. Furthermore, ensuring that Operators' needs can be met will also have a positive impact upon safety.

Requiring aerodromes to facilitate shorter taxi routes / times will reduce the risks of HoTs being exceeded.

The facilitation of the coordination and cooperation of all relevant stakeholders and the active encouragement of the collection and analysis of safety data will greatly assist matters (see Recommendations DATA 1 to 5). Analysis of such data would lead to focused mitigation measures being undertaken, thereby reducing future incidents and accidents.

Overall, the safety impact should be positive (+).

IA 9.5.2 Economic

Setting conditions, facilitating cooperation and data collection and exchange, and changing procedures to optimise HoTs will require aerodromes to liaise, consult and draft new procedures and specifications. Use of the existing documentation (AEA, SAE etc), together with operators' and service providers' participation will ensure that this process is inexpensive:

- 54% of aerodrome respondents indicated that they impose AEA and SAE equivalent standards, and the requirements for Airport Users Councils already exist within Directive 96/67/EC. Perhaps for the remaining 46% (276) of aerodromes to invest 30 man-days in the first year – EUR 7 203 600.

- Annual renegotiation and oversight will demand further ongoing effort; however, over 30% of respondent aerodromes already conduct audits on service providers' procedures, fluid storage, and vehicles. If the remaining 70% (420) of aerodromes introduced annual audits of service providers of which there are on average less than 1.3 per aerodrome, at 3 man-days per audit – EUR 1 425 060.

Planning to provide two-step procedures will involve great expense for those aerodromes which currently do not have the necessary space, facilities and / or infrastructure. Details of the expense involved in upgrading to two-step with Type I fluid are provided in the Final Report – Cost of De-icing / Anti-icing Service Provision. Unless this is mandated, then only those locations that have the space and facilities are likely to comply. Therefore, for the purposes of this IA the cost is neutral.

Any significant expense incurred by service providers is likely to be restricted to those providers who currently operate below acceptable Industry standards with vehicles and facilities that cannot meet operators' needs. Therefore, imposing equal standards for all service providers will ensure fair competition and equal investment. Service providers at 70% (420x1.3=546) of locations will be audited once a year by the Aerodrome, at 1 ½ man-days – EUR 712 530.

Involving third-parties within an aerodrome's SMS should have no negative economic impact (89% of aerodrome respondents claimed that this already happens). However, there is potential to make savings through reduced losses in the long-term; these cannot be quantified until more data is collected.

Overall, the economic impact for Industry will be EUR 9 341 190 (--).

IA 9.5.3 Environmental

If aerodromes are permitted to override local noise restrictions in order to maintain HoTs, then on those few occasions each year there will be increased noise for local residents. Although it is unlikely to be a "real" environmental impact, there may however, be some political impact at some locations.

The result of added scrutiny from aerodromes may encourage service providers to invest in newer equipment and vehicles; this should lead to reduced fluid loss, which is a positive impact on the environment. Overall though the impact will be neutral (0).

IA 9.5.4 Social

If some service providers are unable to provide de-icing / anti-icing services in response to necessary investment, then the other providers will take-up their contracts and jobs will be transferred, rather than lost.

Other service providers wishing to invest and raise their standards to meet new criteria may employ more staff. However, the expected social impact is neutral (0).

IA 9.5.5 Regulatory

The main impact will be on future EASA proposals for Rules for Aerodromes; this can be seen as a positive impact (+).

There is unlikely to be any impact on other regulations; however, consideration will need to be given to Directive 96/67/EC on Ground-Handling, and regulations for Air Operations concerning the minimum standards of service provision required to prevent any conflict.

Recommendations DATA 1, 3 & 4 will also be impacted, or need to be coordinated.

IA 9.6 Summary of Impacts

- Safety (+).
- Economic (--).
- Environmental (0).
- Social (0).
- Regulatory (+).

The overall impact from adopting Recommendation ADRESP will be neutral (0). Although the aerodromes may argue that they are funding a role that the operators should be undertaking. If other Recommendations, such as OPAPP and LOA are not adopted then the impact of this will be much more positive.

IA 9.7 Impacted Stakeholder Groups

Aerodromes and service providers.

IA 10 Directive 96/67/EC on Ground-Handling

IA 10.1 Recommendations

IA 10.1.1 Recommendation GHD1

EASA to approach the European Commission with proposals and supporting arguments to amend Directive 96/67/EC on Ground-Handling, by including de-icing / anti-icing in the list of services which States can limit (in accordance with Articles 6 and 7), and by extending the maximum licence period (to at least 10 years) for de-icing / anti-icing contracts where the number of providers is limited further still under an exemption (in accordance with Articles 9 and 11) due to safety, capacity or limited space.

IA 10.1.2 Recommendation GHD2

EASA to facilitate an Industry-wide voluntary agreed interpretation and implementation of Directive 96/67/EC on Ground-Handling, applied through a memorandum of understanding (or other such mechanism), concerning minimum criteria to be met by de-icing / anti-icing service providers in attaining their licences to operate, and use of AUCs.

IA 10.2 References to Options presented in the Interim Report

GHDAD 1, 2, 3 & 4; GHDSP 1 & 2; REGAD 3 & 4; and TRGSP.

IA 10.3 Situation

The scope and detail addressed by the Directive, together with the commercial reality of the ground-handling Industry, demand action to avoid inconsistent interpretation and application.

Directive 96/67/EC on ground-handling is designed to protect open competition in the provision of various ground-handling services throughout aerodromes within the Member States: this liberalisation includes de-icing / anti-icing. For some services (baggage, ramp, oil, fuel, and mail handling) Member States are permitted to limit the

number of suppliers to two (Article 6), but not de-icing / anti-icing. However, exemptions for other services, including de-icing / anti-icing, are permitted (Article 9) with certain conditions applying. Although at the present time, and for the past 10 years no tenders have been issued using an Article 9 exemption[34]. If such exemptions were granted they would apply (in the case of de-icing / anti-icing) for 3 years and contracts would be restricted to a maximum of 7 years (Article 11). In practice, limitations under Article 6 are common[35] (60% of aerodromes within EU-15 States); in these circumstances the contracts for services are also limited to a maximum of 7 years (Article 11).

A substantial proportion of de-icing / anti-icing services are provided by ground-handling companies which provide other services[36], including those services for which the number of authorised suppliers can be (and often are) limited (baggage, ramp, oil, fuel and mail handling). Single contracts for ground-handling are typically negotiated and issued for a raft of services. As such, ground-handling contracts are often restricted to 7 years or less, depending on local arrangements, and de-icing / anti-icing services can be included within these “umbrella” contract conditions. Effectively resulting in de-icing / anti-icing contracts of 7 years maximum (some States and aerodromes impose 5 year contract lengths). Real competition (from independent and dedicated companies) in providing de-icing / anti-icing services is limited due to the large investment required and unpredictable revenue; as explained in the Final Report – Cost of De-icing / Anti-icing Service Provision document.

The majority of de-icing / anti-icing operations are currently conducted on the ramp and at the gate[37] (74%) and therefore most aerodromes are unlikely to apply for any exemption to limit the number of de-icing / anti-icing service providers due to space or capacity. From the safety perspective it is usually preferable to conduct off-ramp operations as they protect HoTs by reducing taxi time, however, the need to collect fluid run-off “anchors” operations at many locations to the ramp area. However, off-ramp operations, typically, are restricted for space, and operating with too many service providers in a restricted space increases risk and slows down traffic flow

[34] Source European Commission .

[35] Study on the impact of Directive 96/67/EC on Ground-Handling Service 1996 – 2007, by Airport Research Centre, February 2009.

[36] Interim Report – Data Summary and Analysis, airsight GmbH, November 2010

[37] Interim Report – Data Summary and Analysis, airsight GmbH, November 2010

(reducing capacity). The situation currently exists at some aerodromes where no limit on the number of de-icing / anti-icing service providers exists (as per the Directive) but operations are conducted off-ramp. Multiple providers operating in restricted space reduce capacity, but also increase risk. As the trend in best practice is to move more towards off-ramp de-icing / anti-icing, these scenarios will increase in number, and assuming correct interpretation and application of the Directive there should be an increasing demand for exemptions to an open market for de-icing / anti-icing. As at 2007 a sizeable number of aerodromes were still not applying the Directive fully[38], resulting in non-liberalised markets.

Establishing a de-icing / anti-icing service requires a significant investment in vehicles. These vehicles typically have a life-span of 10 to 15 years, and are usually paid for via loan / lease arrangements. Restricting the potential to recoup this investment to only 7 years (in practice and if exemptions are issued) increases the annual operating costs, and increases the capital depreciation costs. In an Industry where profit margins can be slim or even negative, this is a disincentive for ground-handling organisations to offer de-icing / anti-icing services, thereby reducing competition contrary to the Directive's intent. De-icing / anti-icing services are mainly provided by companies that offer many other ground-handling services, and is viewed as "part of the package".

The Directive requires that aerodromes establish and facilitate Airport Users' Committees (AUC). There is no mandate as to the regularity of meeting, method of meeting and communication, or the subjects to be discussed. The Study has revealed that AUCs are not held consistently, and that their effectiveness is often limited. Some aerodromes convene the AUC prior to each winter season, to discuss the coordination of traffic during de-icing / anti-icing operations. It is rare that SMEs in aircraft de-icing / anti-icing procedures (from the operators, providers and aerodrome) meet to discuss matters specifically related to fluids, procedures, vehicles, communication, safety etc.

A few NAAs do claim to partially regulate de-icing / anti-icing service providers through this Directive, and also they retain the option to audit against these criteria. However, this is usually restricted to organisational and structural matters such as: financial capability and managerial experience (Article 14). There is some scope for

[38] Study on the impact of Directive 96/67/EC on Ground-Handling Service 1996 – 2007, by Airport Research Centre, February 2009.

also including procedures / manuals as being fit for purpose; and also operatives' personal vocational qualifications.

Vocational qualifications which aim to meet recommended Industry standards set by AEA have been developed in some States. However, approval of such qualifications is expected from the respective NAAs, independently of the Directive. Furthermore, the Study Team understand that such qualifications are not being made exclusive nor mandatory.

IA 10.4 Pathways to Harmonising Interpretation of Directive 96/67/EC on Ground-Handling

EASA has no direct path of influence over aerodromes or service providers through the Directive. Whilst some NAAs do / can prescribe certain limited requirements through the Directive, it was not developed with operators in mind.

Clarification through amending the Directive (GHD1) would be a lengthy process involving the EC, Council and EP, and the outcome would not be certain. Prior to this, EASA would be required to open consultation with the Industry to establish a common, acceptable interpretation. This preliminary step would also be required in fulfilment of Recommendation GHD2. Although it may be considered that an "agreed" interpretation may not be as consistently applied as a Directive, the current situation contradicts this view. However, an amendment would be necessary on two key issues – inclusion of de-icing / anti-icing on the list of services that can be limited under Article 6, and the extension of the maximum length of contract beyond 7 years for exemptions (Articles 9 and 11).

In adopting either of these Recommendations, EASA would be required to act as a facilitator and give consideration to at least the following four issues:

1. Extending the maximum length of contract for exemptions to at least 10 years in order to encourage investment amongst bidding suppliers and the migration towards more off-ramp operations.
2. The conditions to be met whereby the number of suppliers can be deliberately limited due to safety and space restrictions.
3. Which elements of a service provider's business (administrative specifications) would be open to scrutiny and approval / acceptance before granting a

licence. As a minimum, they would include: organisation, management experience, structure, financial capability, training, qualifications, manuals, procedures, and staffing levels. Furthermore, how this process should be applied.

4. How best to structure and schedule mandatory meetings of AUCs to specifically address de-icing / anti-icing operations.

Consideration as to what elements of infrastructure and facilities (technical specifications) need to be open to scrutiny and approval / acceptance before granting a licence, including: vehicles, storage facilities, environmental protection etc, may best be resolved through other regulatory pathways, as defined in other Recommendations (e.g. ADRESP) made in this Study. However, if these fail to resolve the issue of technical specifications appropriately, the Directive may provide a suitable means.

The same argument applies to the raising and harmonisation of training standards for de-icing / anti-icing operatives. If no other pathway is successful (i.e. through regulation of Operators) then consideration might be given to negotiating a Europe-wide vocational qualification standard, as suggested within the Interim Report (Option TRGSP).

It is recommended that GHD2 is used as the launch-pad for GHD1 in that the associated issues can be discussed and agreed during this stage before a need to amend the Directive is accepted.

IA 10.5 Impact Assessment

To adopt these two Recommendations, EASA will need to facilitate an open debate with Industry and sponsor any changes through the EC, Council and EP processes. This will involve the Agency investing resources spread over a long period.

The Impact Assessments below assume the adoption of the four issues highlighted in paragraph 10.4.

IA 10.5.1 Safety

Encouraging more de-icing / anti-icing contracts with longer terms will achieve greater levels of experience within the supplier organisation and create more effective relationships between the aerodrome and providers. It may also encourage

greater investment into modern de-icing / anti-icing vehicles, with greater capability. Where limitations on the number of suppliers is imposed due to safety, capacity or space, this may encourage more “specialist” suppliers to enter the market in competition with existing ground-handling organisations. These will all provide positive safety benefits. Service level agreements (as part of the contract) will ensure that longer contract lengths will not impact negatively on safety or service standard. However, shorter contract lengths are a disincentive to invest in new equipment which has a longer service life than the contract length; this may have a negative impact. Longer contract lengths will reduce the risk to the supplier from several years of low revenue streams due to above average climate and weather conditions.

Reducing the number of suppliers at locations where space is limited will reduce the risks involved with overcrowded manoeuvring areas and the rotation of service providers’ vehicles between operations. It may also reduce the pressure for service providers to reduce overheads by limiting their investment in vehicles, manpower and training.

Introducing a standard harmonised set of minimum administrative specifications should ensure that all service providers granted a licence to provide de-icing / anti-icing services will be adequately resourced and fit for purpose, thereby reducing the risk of unsuitable organisations acting as suppliers.

Mandatory meetings of the AUC that encourage cooperation and coordination between all relevant stakeholders at an aerodrome will facilitate both the effective sharing of safety data and the efficient mitigation of operational problems arising during de-icing / anti-icing operations.

Overall, the impact on safety is expected to be positive (+).

IA 10.5.2 Economic

If a service provider is uncertain about gaining a renewal of licence to operate at an aerodrome, their business model would be to repay the cost of equipment within the licence term (whether that is 5, 7 or 10 years) and pass these costs on to their customers within that same period. Therefore, encouraging the extension of contract lengths should result in service providers being better able to amortise the cost of their investments, reduce annual lease / loan repayments and reduce the cost to the customer. Using the Final Report – Cost Model the reduction on service providers’

annual repayments for each de-icing vehicle is over 15%[39]. Some service providers will already have 10 year loan arrangements and others will utilise some of their vehicles for perhaps 15 years. The larger organisations can also transfer equipment between different stations / aerodromes and this will allow them some flexibility on their repayment schedules. Therefore it is difficult to extrapolate these savings directly across all 780 assumed service provider stations and all their vehicles. However, if only half the number of service provider stations extended the loan period of only one of their vehicles the annual savings to Industry would be €3.44m. As the average vehicle fleet size is larger than this the economic savings can be very large (++) in the long term.

Reducing the number of suppliers may encourage providers to invest more in vehicles, manpower and training; in such cases the cost of service to operators may be slightly higher. With fewer providers the remaining providers would increase their revenue, without duplicating administration, some training, some storage and some vehicles. Any savings would offset any additional expenditure on extra vehicles. The cost impact of this will probably be neutral (0).

Requiring service providers to meet stricter administrative criteria during the licensing process may require those authorities granting the licences to invest more effort into the process. However, it is unlikely that this will make a significant difference to what is expected today, and this effort will be spaced 7 years apart. If the licensing process engaged an additional man-day per licence every 7 years, then this equates to on-going costs of EUR 96 942 per year (780 x 870 / 7) (-).

Aerodromes are obliged to hold meetings of the AUC under the existing Directive, and therefore no further significant costs should be incurred by holding one or two more dedicated meetings for appropriate SMEs.

For EASA to facilitate debate and agreement on these issues it would be expected that multiple meetings with stakeholders will be necessary over a period of 2 years maximum. This is likely to equate to 8 meetings for a facilitator and 10 delegates (160 man-days). Additional work may involve the Agency facilitator for 50 days, and each of the delegates 10 days each. In total 220 man-days – EUR 191 400.

Overall, the cost of adopting and maintaining these Recommendations are completely overshadowed by the potential economic and safety gains that are made

[39] 7 year repayment period for a €500,000 vehicle and a loan interest rate of 3.5% and 40% residual value equates to annual payments of €56.063. Whereas for 10 years and 30% residual value the annual repayments are €47.334.

possible (++). The economic gains are totally dependent on amendments being made to the Directive.

IA 10.5.3 Environmental

No impact expected.

IA 10.5.4 Social

If some service providers are unable meet any new licensing criteria, or are unable to bid for, or win, certain licences (due to their own organisational limitations), then the other providers will take-up their contracts and jobs will be transferred.

Where service providers are able to improve their cash-flow due to longer contract lengths, they may employ more staff.

Where contract periods are increased, job security will increase for employees.

Otherwise, in general there is no social impact expected (0).

IA 10.5.5 Regulatory

Those elements of these two Recommendations which address technical standards of facilities and infrastructure are possibly best dealt with through other regulatory pathways as identified in several other Recommendations made in this Report e.g. OPAPP, OPAMC and ADRESP.

The remaining Recommendations, if adopted, will have no other regulatory impact other than Member States' legal interpretation of Directive 96/67/EC.

Overall a neutral impact on regulations (0).

IA 10.6 Summary of Impacts

- Safety (+).
- Economic (++).
- Environmental (0).
- Social (0).
- Regulatory (0).

Provided changes can be made to the Directive concerning contract length, the overall impact from these Recommendations is very positive (++); failing this there are still safety gains to be made for little investment.

IA 10.7 Impacted Stakeholder Groups

EASA, NAAs (and possibly local government authorities) and service providers.

IA 11 Fluid Residues

IA 11.1 Recommendations

IA 11.1.1 Recommendation RESDATA

EASA, in collaboration with Member State NAAs and Industry, to pursue, in open debate, the need to agree a dataset, and method of collection, distribution and analysis of data, for ascertaining the existing levels of risk from residue formation.

IA 11.1.2 Recommendation FLUIDTEST

EASA should investigate the ways and means of increasing and improving the number and quality of fluid testing activities in line with its own and Industry's current concerns.

IA 11.2 References to Options presented in the Interim Report

OPTIONS RESDATA 1, 2 & 3, and FLUID 2 & 6.

IA 11.3 Situation

Following a significant number of serious incidents in the years 2005 and 2006, concern over the formation and effects of de-icing / anti-icing fluid residues became widespread throughout the Industry. This prompted the development and implementation of residue detection and removal procedures amongst the operators of the most affected aircraft. Since then, it appears that the number of incidents has reduced considerably.

In response to these incidents and demands from Industry for action, EASA released a Safety Information Notice (SIN) 2006 – 09, which was replaced by SIN 2008 – 29. These highlighted the need for operators to comply with the aircraft manufacturers' instructions for de-icing / anti-icing and also residue detection and removal procedures.

EASA then released A-NPA-2007-11[40] to obtain feedback on its own recommended options for action which had been assessed for impact. These recommendations included the need for type-certificate (TC) holders to publish and issue their procedures for de-icing / anti-icing; and, also the need for residue detection and removal procedures, and associated knowledge requirements, to be formalised. The former was addressed by EASA through a letter to TC Holders dated 14 April 2009; and the latter changes to Part M were introduced through EASA NPA 2009 – 09[41].

A-NPA-2007-11 also concluded that existing Industry fluid specifications and procedures (ISO and SAE) could be amended to better address the full range of properties required from de-icing / anti-icing fluids. In response, the Agency has committed itself to participate in relevant working groups of the SAE G-12 Committee.

Debates continue amongst the different stakeholder groups represented within the SAE G-12, concerning how residues are formed and re-hydrated, and the conditions that exacerbate or alleviate them. For example, the current belief amongst many operators is that increasing the use of Type I (to act as a "wash") in between applications of thickened fluids will reduce the formation of residues. However, others believe that the use of Type I in a two-step procedure may re-hydrate the residues, thereby placing them into an "active" state where they can freeze, restricting the movement of controls and surfaces, etc. Anecdotal evidence is plentiful, but the "science" is not yet conclusive, or comprehensive, and this is due to a lack of useful and comparable data. Data is lacking from both laboratory testing and also from operational conditions.

Some operators are collating their own data concerning the results of inspections for residues, and comparing the amounts of residue discovered against the preceding applications of different fluid types since the previous inspection and / or cleaning procedure. This may provide valuable evidence; however, this data is:

- not being universally recorded;
- not being shared;

[40] EASA A-NPA-2007-11, De-icing and Anti-icing fluids, July 2007: http://www.easa.eu.int/ws_prod/r/doc/NPA/A-NPA-2007-11.pdf

[41] EASA NPA 2009-09, De-icing and Anti-icing, September 2009: http://www.easa.eu.int/ws_prod/r/doc/NPA/NPA%202009-09.pdf

- based on subjective assessments of residue quantities; and
- lacks other important contributing factors such as meteorology and the types and quantities of contamination that have been “de-iced” from each aircraft.

Some operators declare that they are still unsure of their manufacturer’s “guidance”; however, the reduction of incidents of frozen and stiff controls and control surfaces does appear to be as a result of the introduction of inspection and cleaning procedures. There is no comparison of manufacturers’ recommended procedures and practices, and therefore there is no sharing of best-practices concerning frequency of two-step procedures compared with one-step, or of the most effective residue detection and cleaning methods.

Other on-going areas of concern within the Industry include the inter-reaction of aircraft de-icing / anti-icing fluids with runway fluids, for which data is sporadic and anecdotal.

It is clear that the collection, comparison and sharing of more data concerning residue formation and elimination will be of great benefit to the Industry, including EASA which will require reliable evidence to support any future regulatory changes.

IA 11.4 Pathways to Learning More about Residues

This debate may best be pursued through the SAE G-12 Committee, with perhaps four lines of intended progress:

- de-icing / anti-icing operational procedures that reduce the formation of residues;
- maintenance procedures which reduce and eliminate residues;
- other factors that contribute to the formation of residues (such as mixing with runway de-icing / anti-icing fluids; combinations of different fluid brands; local water sources and dilution percentages); and
- fluid properties that contribute to, or decrease, residue formation.

The first two lines of progress will require the collection of data from operators. For this an agreed data-set will be required, as well as sufficient numbers of participating operators. EASA has the choice of managing this process itself by communicating

and coordinating directly with operators (possibly through the airline associations); or the Agency has two other pathways to achieve this. EASA may consider requiring aircraft manufacturers to provide evidence that their proposed residue management procedures are effective, thereby placing the onus on manufacturers to collect operational data. Or, EASA may require NAAs to include within their State Safety Programmes a plan to reduce the risks associated with thickened fluid residues; this would necessitate them collecting and analysing data. This latter pathway would however lead to duplication and coordination. Whichever pathway is chosen, it is still preferable that coordinated action is taken using identical datasets.

The last two lines of progress will require laboratory resources and also an agreed experimental programme. The resources currently used are limited and it is unlikely that a coordinated set of experiments could be conducted on the scale required to fully understand all the variables that exist. However, to fulfil Recommendation FLUIDTEST it may be possible to utilise a combination of academic institutions and research grants (EU and National) throughout Member States such that a suitable programme can be completed within a reasonable timescale.

IA 11.5 Impact Assessment

The two Recommendations require EASA to investigate further the pathways towards a solution and to achieve an Industry consensus, through existing forums, on how to collect more meaningful operational and test data that can help mitigate against the risks from fluid residues. The IA is based on this task required of EASA, and not the end result, which remains unknown.

IA 11.5.1 Safety

There are two questions worth asking:

- *are the existing risks from fluid residues being adequately controlled, and*
- *are the existing SAE G-12 forums and Industry contributions adequately addressing potential future risks from fluid residues?*

In answer to the first question we may say *“possibly”*; however, we really do not know for certain in either case. Pursuing these Recommendations through the SAE would be the most efficient use of existing resources and experience, although there will be no immediate impact on safety (0). However, if useful residue data can be

successfully collected and analysed, the increase in knowledge should contribute towards an increase in safety by aiding future decision-making on operational and maintenance procedures as well as regulatory activities. Thus allowing existing, and possibly future risks to be reduced: therefore the long-term prospects are for a positive safety impact (+).

IA 11.5.2 Economic

EASA is already committed to engage with the SAE G-12 to investigate and promote amendments to specifications and procedures concerning fluid properties and applications. Introducing the pathways to progress shown in paragraph IA 11.4 above will not require any additional resource from the Agency. However, proposing an agenda, and then actively pursuing it will involve additional resource from the Agency. This would, perhaps, require an extra person to attend the annual SAE G-12 conference, and undertake the preparatory and subsequent work and networking. This is likely to be 7 days for the meetings and a further 20 in support work - EUR 23 490.

There is no immediate investment required concerning the discussion of coordinating tests, test facilities and test resources; this matter can be pursued together with the residue data issue. In the long-term, any test programme will require investment, which could be substantial. However, there will be different mechanisms within the EC, within Member States and also in the USA and Canada, to attain research grants, and therefore, the cost to the aviation Industry can be reduced, perhaps substantially.

Overall, in fulfilling these two immediate Recommendations the economic impact will be slightly negative (-).

IA 11.5.3 Environmental

No impact expected.

IA 11.5.4 Social

No Impact expected.

In the long-term, some jobs may be created to address a fluid testing programme.

IA 11.5.5 Regulatory

No impact expected, as this is a preliminary and voluntary set of Recommendations and Pathways designed to collect data upon which future regulatory changes may, or may not be made.

IA 11.6 Summary of Impacts

- Safety (0).
- Economic (-).
- Environmental (0).
- Social (0).
- Regulatory (0).

The long-term goal will bring positive safety benefits. The current overall and immediate impact from following these two Recommendations is slightly negative economically (-).

IA 11.7 Impacted Stakeholder Groups

EASA.

IA 12 Availability of Type I fluid

IA 12.1 Recommendations

IA 12.1.1 Recommendation WORKSHOP

EASA facilitate a workshop to discuss the possible need for, and the options available, to influence the availability of Type I fluid across Member State aerodromes.

IA 12.2 References to Options presented in the Interim Report

OPTIONS WRKSHP, REGAD 2, 3, 4 & 5, and FLUID 2, 3, 4, 5, 6 & 7.

IA 12.3 Situation

The discussion concerning the presumed benefits of using Type I fluid to reduce instances of residue re-hydration and freezing, as outlined in paragraph 11.3 above, also applies to this Recommendation. Does Type I fluid reduce the risks associated with residues from thickened fluids, and how much availability is required to reduce these risks to a reasonable level? Again, the science is not complete. For example, a an increased use of Type I as a first-step de-icer may result in (as recommended by AEA) the use of undiluted thickened fluids in the second step, as opposed to diluted mixes currently used in the one-step method. This may exacerbate the residue problems.

EASA A-NPA-2007-11 recommended that some mechanism is required to ensure that the range of de-icing / anti-icing fluids is made available at all appropriate locations: and the conclusions drawn following consultation included the need for EASA to find ways that *an appropriate range and stock of thickened and un-thickened fluids to anti-ice aircraft (i.e. each type of fluid should be available) is maintained and offered at each aerodrome receiving commercial air transport aircraft.*

The Study did not reveal any mechanism currently in use by any NAA which can act as an example of how to influence the availability of fluids at aerodromes within the Member States. Currently, Type I fluids are available at 54 % of aerodromes included in the Study. The selection of the types of fluid available and the related investment is generally based on a consensus of stakeholders' interests. Active airline requests, as well as the management and organisation of the de-icing / anti-icing services and the ownership of the storage facilities, are the main influencing factors for the responsibility of the decision.

The situation is complex and confusing. The Study revealed that, despite an average availability of Type I of 54%, some operators, due to their home location and route network, find it difficult to access Type I fluids. Within some States the availability is below 20%. Some service providers are willing to supply Type I fluids but have had no requests to do so from operators. Some operators have made successful requests for availability of Type I fluid, but their flight crew will request a one-step procedure with a thickened fluid. Whilst at other locations, the addition of Type I fluids will introduce a significant economic impact, due to space and infrastructure limitations.

There is no existing regulation that requires any operator to use any specific fluid types, other than those that qualify under the SAE AMS. Therefore, if aerodromes / service providers were somehow mandated to provide Type I fluid, there is no certainty that it will be requested by the operators.

Many operators still prefer the use of one-step applications because it suits the meteorological conditions, meets their operational requirements and / or they operate aircraft that have not been adversely affected by re-hydrated residues in the past.

IA 12.4 Pathways to Influence a Greater Availability of Type I Fluids

Any actions aimed at improving the availability of fluids at aerodromes are likely to require a greater consensus. The opening of a debate to discuss if there is still a need, and also the possible options, could be beneficial in attaining a high consensus for any changes.

Potential solutions to debate (as well as those OPTIONS presented at the SRB) include:

- Mandating that operators use Type I and two-step de-icing / anti-icing for all, or for a certain percentage of, operations that require de-icing. A risk assessment may help decide what percentage is acceptable to the Agency.

- Requiring aerodromes (through future EASA Implementing Rules for Aerodromes) to supply Type I fluid whenever an operator makes a pre-season request. Exemption criteria will also need discussing.

- Lobbying the EC (Recommendations GHD 1 & 2) for an amendment to, or canvassing a universal interpretation of, Directive 96/67/EC such that Type I fluid provision is a necessary criterion for service providers to attain their licence, at certain aerodromes. The conditions for selecting those aerodromes would need to be based on evidence from a risk assessment.

- If an LoA system is adopted (Recommendations LOA, VOLQCP), EASA could make it a condition of issuing an LoA to service providers at certain locations that they supply Type I fluid. The conditions for selecting those aerodromes would need to be based on evidence from a risk assessment.

- If EASA, in the long-term future, regulates service providers, then supplying Type I may become mandatory, again under certain conditions.

- For the conduct of a proper risk assessment, relevant data will be required, hence discussion of Recommendations RESDATA and FLUIDTEST (IA 11) will be worthwhile in this Workshop.

IA 12.5 Impact Assessment

This IA is based on the establishment and conduct of a Workshop to determine whether a greater availability of Type I fluid across the Member States is necessary or not. And if so, an acceptable way forward to progress the greater availability of Type I fluid.

In the long-term, if it is decided that provision of Type I fluids is made mandatory at some, or all, aerodromes, the economic impact will be very negative, due to the initial investment. Details of these costs can be found in the Final Report – Cost of De-icing / Anti-icing Service Provision and the accompanying Cost Model.

IA 12.5.1 Safety

There will be no safety impact from arranging a Workshop. However, the results of the Workshop may lead to a long-term reduction in risks associated with thickened fluid residues (0).

IA 12.5.2 Economic

The resources necessary for EASA to run a workshop, or workshops, would be around 28 man-days (2 people x [5 planning days + 3 contacting days + 2 prep and attend days + 2 report writing days]) – EUR 20 880. It would be expected that attendance will be high, unless numbers are capped, perhaps 50 delegates will attend (there were 70 attendees at the ERA Workshop in Basel in 2006): this will equate to 100 man-days – EUR 87 000.

EASA cannot host a meeting of this size utilising its own facilities, and therefore venue hire and refreshments will need to be considered; typically at a delegate rate of EUR 50 for the day, the additional cost will be EUR 2 500.

Subsequent work to draft a work programme (if required) will take a further 10 man-days - EUR 8 700.

In total the economic impact from adopting this Recommendation will be EUR 119 080 (-).

IA 12.5.3 Environmental

No impact expected.

IA 12.5.4 Social

No impact expected.

IA 12.5.5 Regulatory

No impact on regulations from implementing this Recommendation.

In the long-term, if Type I is mandated, then significant regulatory changes would be required before this could occur. This would predominantly involve future EASA Implementing Rules for Aerodromes; however, Directive 96/67/EC may also be used as a vehicle.

Requiring operators to use Type I would involve currently EU OPS 1.345, however, it is more likely (time-wise) and more practical to achieve this through future

Implementing Rules for Air Operations, specifically: OPS.GEN.100, AMC2 to OPS.GEN.100, and GM 1, 2 & 3 to OPS.GEN.100.

IA 12.6 Summary of Impacts

- Safety (0).
- Economic (-).
- Environmental (0).
- Social (0).
- Regulatory (0).

The immediate overall impact from running a Workshop is negligibly minor (0); however the long-term benefits could be substantial.

IA 12.7 Impacted Stakeholder Groups

EASA, NAAs, aircraft manufacturers, operators, aerodromes and service providers.

Also, fluid manufacturers and de-icing equipment manufacturers may wish to participate.

6 Summary of Impact Assessments

IA Code	IA	Recommendations	Overall Impact	Comments
IA 1	Liaison and coordination.	COORD 1, 2, 3 & 4	+	Overall a slight initial positive impact, However, the Recommendations are essential if a work programme to adopt other Recommendations is undertaken.
IA 2	Safety data.	DATA 1, 2, 3, 4 & 5	+	Overall an initial positive impact. However, the Recommendations are essential if a work programme to adopt other Recommendations is undertaken.
IA 3	Operators' approval and compliance.	OPAPP OPAMC	+	Positive long-term impact expected.
IA 4	Training of operators' operations dispatch staff.	OPDISP	+	Positive long-term impact expected.

IA 5	Ad-hoc regulations for air operations.	CHKLST OPMAN CONTRAIN DIFTRAIN	+	Despite the moderate investment required, for no discernable financial gain, the long-term benefits from the expected improvement in safety result in an overall total positive long-term impact
IA 6	Operational communications.	COMM	+	Despite the moderate investment required to follow this Recommendation, the potential long-term benefits from the expected improvement in safety and reduction in economic losses result in an overall total positive impact.
IA 7	Regulatory oversight of de-icing / anti-icing operations.	OVERS	+	Although not quantifiable, at the moment, the overall impact from adopting Recommendation OVERS should be positive (+). Also the spin-off from NAAs gaining a greater insight into de-icing / anti-icing activities is very positive, in the long-term.

IA 8	Quality assurance of de-icing / anti-icing service providers.	LOA VOLQCP	**++**	The overall impact from adopting Recommendation LOA will be extremely positive. It meets one of the key requirements of this Study on its own, and the economic benefits accrued will more than adequately cover the costs of the other Recommendations.
IA 9	Responsibilities of aerodromes.	ADRESP	**0**	The overall impact from adopting Recommendation ADRESP will be neutral. Although the aerodromes may argue that they are funding a role that the operators should be undertaking. If other Recommendations, such as OPAPP and LOA are not adopted then the impact of this will be much more positive.
IA 10	Directive 96/67/EC on ground-handling.	GHD 1 & 2	**0 / ++**	If contract lengths can be extended, the overall impact is very positive; failing this there are still safety gains to be made for little investment.

IA 11	Fluid residues.	RESDATA FLUIDTEST	**-**	The long-term goal will bring positive safety benefits. The current overall and immediate impact from following these two Recommendations is slightly negative economically.
IA 12	Availability of type I fluid.	WORKSHOP	**0**	The immediate overall impact from running a Workshop is negligibly minor (0); however the long-term benefits could be substantial.

7 Conclusions to the Impact Assessment

This IA lays out the 26 Recommendations into 12 different groups, each one is given a separate impact assessment for: safety, economic, environmental, social and regulatory. The last category concerns the effect on other existing or proposed regulations, and the connections with other Recommendations.

Overall, the projected impacts for the majority of these Recommendations are overwhelmingly positive. This is to be expected, because the Study has already eliminated many different Options originally presented in the Interim Report.

In estimating the economic impacts, several assumptions had to be made; these are explained and therefore it is relatively straightforward to revise these figures. In particular the daily rate (recommended by EASA) used for manpower of EUR 870 is likely to be much higher than the European average, and the allocation of man-days to the estimates does not consider that many of these personnel expect to be involved in these activities within their existing contracts and salary structure. This leads, in the Study Team's opinion, to inflated cost estimates, for example the estimated cost to Industry of running a Workshop for 50 delegates is EUR 119 080.

In terms of meeting the requirements to raise standards and improve safety all these Recommendations offer something positive, whether in the short or long-term. Ultimately, it is recommended that they be combined within a work programme to address the following (see Final Report – Introduction – Work Programme):

- Improving coordination between Industry and the NAAs: IA 1.
- Collecting more safety data and analysing the existing risks: IA 2.
- Ensuring regulations and guidance for air operations are comprehensive, unambiguous and practical: IA 3, 4, 5 & 6.
- Conducting oversight activities to ascertain whether regulations are being harmoniously and consistently applied across Europe: IA 7 & 8.
- Consider alternative regulatory means to support operators achieve acceptable service levels from their providers and to facilitate aerodromes and service providers in ensuring this: IA 10.
- Engaging with all stakeholders to ensure that more focused research is conducted, and data gathered, into fluid qualities and performance: IA 11 & 12.

The final element is recommended as the "next step" towards achieving the other aspect of this Study (investigating and recommendations concerning the availability of fluids).

To fulfil some of these Recommendations there will be some initial negative economic impact; e.g. setting up and running meetings, defining work plans, amending manuals, conducting additional training and gaining a wide consensus and feedback etc. EASA will need to provide some resources to every Recommendation, and operators and service providers will likely bear the main proportion of the costs in implementing a majority of the Recommendations. However, the potential savings to Industry from reduced risk leading to fewer incidents, accidents and losses, and also from more efficient application of fluids, are very considerable, and far outweigh any investments made initially.

With more efficient application of fluids there will be overall positive environmental benefits.

On balance, the social impact on employment is neutral.

In conclusion, the Study Team recommends that EASA addresses each element of the suggested work programme and all the proposed groupings of Recommendations presented here in the IA. To “do nothing” is not an option for the Agency, and we think the information presented within this Final Report will more than ably assist EASA establish a plan of action to positively improve the safety of future de-icing / anti-icing operations and as a consequence provide substantial economic gains for the Industry.

EASA.2009.OP 21

Study on the regulation of ground de-icing and anti-icing services in the EASA Member States

FINAL REPORT

Summary of Options to Recommendations

(see attached Spreadsheet)

EASA.2009.OP 21

Study on the regulation of ground de-icing and anti-icing services in the EASA Member States

FINAL REPORT

Cost of De-icing / Anti-icing Service Provision

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1 Introduction

This present document, part of the EASA.2009.OP 21 – Study on the regulation of ground de-icing and anti-icing services in the EASA Member States "Final Report", should be read for a better understanding ideally in conjunction with Final Report – Introduction document.

The cost of providing de-icing / anti-icing services at an aerodrome depends on numerous complex and interrelated factors, such as size of operations, maximum peak capacity, type and quantity of fluids provided, personnel structure, equipment requirements etc.

To provide a quantitative estimation of the cost of de-icing / anti-icing services, a generic cost model has been developed (Section 2). This cost model has been applied to different scenarios (aerodromes defined in Section 3), in order to assess first the annual cost of providing de-icing services (Section 4) and second the additional annual cost (and additional investment expenditure) to upgrade facilities and equipment to offer Type I fluid in addition to Type II and IV fluids (Section 5).

2 Cost model

The cost model, developed using Microsoft Excel 2003, is based on several assumptions to estimate quantitatively, amongst other indicators, the annual cost of de-icing service provision. An overview of the cost model spreadsheet is attached at the end of this report (Table 15 and Table 16).

The cost model variables can be modified by the user to adapt the model to a specific scenario.

Variables have been defined to assess the cost of service provision based on the size of operations. These variables have been divided between primary and secondary variables. Primary variables are the most impacting variables (e.g. number of de-icing operations per annum), while secondary variables are less relevant to the user (e.g. de-icing truck annual maintenance cost). In the cost model, primary variables are represented by "blue" cell backgrounds, and secondary variables are represented by "light blue" cell backgrounds.

The calculated values, or output variables, are represented by white cell background and may be underlined (representing a sub-total) or **bold** (total).

A cost range (minimum and maximum values) displayed by light green cell backgrounds, has been defined for several variables, to assist the user to set the variables. These cells have only an indicative value, and are not used in the calculation.

The costs comprise the following elements:

- Equipment cost
- Fluid cost
- Personnel cost
- Storage facilities cost
- Other facilities and equipment cost

The total cost of each category is expressed in terms of annual cost.

The model has been calibrated using publicly available information (public balance sheets of service providers and aerodromes), as well as information collected in the online questionnaires or during interviews. For confidentiality reasons, the information sources are not cited in this document.

3 Scenarios and main input parameters

As stipulated in the Inception Report, the aerodromes in this study are classified according to the following criteria:

- Small (100 000 to 0.5 million passengers p.a.)
- Medium (0.5 to 1 million passenger p.a.)
- Large (1 to 2 million passengers p.a.)
- Very Large (>2 million passengers p.a.)

In this document, an additional category (Largest) has been introduced to analyse the cost of de-icing services at the largest European aerodromes. Additionally, a number of movements per annum have been assigned qualitatively to each aerodrome category. Table 1 displays the sample aerodromes selected for the scenario, in terms of passengers, movements and weather zone. Each sample scenario corresponds to one of the aerodrome category defined above.

A scenario, per definition, corresponds to a set of input and output variables.

Aerodrome Size Classification	Small	Medium	Large	Very Large	Largest
Passenger	375000	750000	1500000	5000000	50000000
Movements	7500	15000	30000	80000	450000
Weather zone	Continental	Continental	Continental	Continental	Continental

Table 1: Scenarios

The number of de-icing / anti-icing operations, the average operation duration and the maximum de-icing capacity are the main cost factors, or main scenario variables. These quantitative figures, displayed in Table 2, have been defined for each scenario.

De-icing / anti-icing operations	Small	Medium	Large	Very Large	Largest
No. of de-icing / anti-icing operations	100	200	400	1065	6000
Average operation duration (in minutes, including turnaround additional time)	30	30	30	30	30
Maximum de-icing capacity (number of average procedure per hour)	2	2	3	8	40

Table 2: De-icing / anti-icing operation scenarios (main input parameters)

The number of de-icing operations mainly depends on the winter conditions, as well as the number of movements. The number of operations was set for each scenario to obtain a ratio of approximately 1.33 de-icing operations for 100 movements (1.33% of the annual number of movements, typical figure for aerodromes in the continental climate zone, as defined in the Interim Report). This ensures a better comparability of the results between the scenarios.

The maximum de-icing capacity (expressed as the number of de-icing / anti-icing operations per hour) directly influences the required number of de-icing trucks and operatives. The maximum de-icing capacity an aerodrome aims to provide is an indicator of the quality of service (in terms of delays).

The average duration of a de-icing / anti-icing procedure includes the turnaround time (moving the de-icing trucks to position, refilling, etc.). It must be noted that the operation duration time is from the perspective of the de-icing / anti-icing operatives and not from the pilots'.

4 Cost of providing de-icing / anti-icing services

4.1 Cost breakdown

4.1.1 Equipment cost

Equipment (de-icing trucks and related expenses, shown in Table 3) represents the main expenditure to provide de-icing / anti-icing services. For simplicity, the term “de-icing truck” is used to describe a truck, or trucks, necessary to perform both de-icing and anti-icing as necessary, unless otherwise stated. The equipment annual cost is equal to the sum of the:

- de-icing trucks annual acquisition cost
- de-icing annual maintenance cost
- de-icing annual insurance cost
- fuel annual cost

Equipment cost	Min	Max	Small	Medium	Large	Very Large	Largest
Number of de-icing trucks			2.00	2.00	3.00	8.00	40.00
Number of de-icing trucks per operation	1	4	2	2	2	2	2
De-icing truck acquisition cost (per truck)	250 000 €	700 000 €	350 000 €	350 000 €	500 000 €	500 000 €	500 000 €
De-icing truck acquisition cost			700 000 €	700 000 €	1 500 000 €	4 000 000 €	20 000 000 €
De-icing truck service time (in years)	8	15	10	10	10	10	10
Residual value (percentage of acquisition cost)	0%	50%	30%	30%	30%	30%	30%
De-icing trucks annual acquisition cost (per de-icing truck)			34 406 €	34 406 €	49 152 €	49 152 €	49 152 €
De-icing trucks annual acquisition cost			68 813 €	68 813 €	147 455 €	393 215 €	1 966 073 €
De-icing trucks maintenance annual cost (percentage of acquisition cost)	2.0%	5.0%	3.5%	3.5%	3.5%	3.5%	3.5%
De-icing trucks maintenance annual cost			24 500 €	24 500 €	52 500 €	140 000 €	700 000 €
De-icing trucks insurance annual cost (percentage of de-icing trucks annual cost)	3%	6%	5%	5%	5%	5%	5%
De-icing trucks insurance annual cost			3 441 €	3 441 €	7 373 €	19 661 €	98 304 €
Fuel price (per litre)	1.20 €	1.50 €	1.40 €	1.40 €	1.40 €	1.40 €	1.40 €
Fuel quantity (in litre, per operation)	10	25	20	20	20	20	20
Fuel annual cost			2 800 €	5 600 €	11 200 €	29 820 €	168 000 €
Total equipment annual cost			**99 553 €**	**102 353 €**	**218 528 €**	**582 695 €**	**2 932 377 €**

Table 3: Equipment cost

The number of de-icing trucks is dependent on the maximum de-icing capacity, the average operation duration and the number of de-icing trucks per operation. Providing a maximum capacity of 40 procedures per hour (peak), with an average number of two de-icing trucks per operation and a procedure duration of 30 minutes would require 40 de-icing trucks.

The de-icing trucks annual acquisition cost corresponds to the annuity required to amortise the de-icing trucks acquisition cost over a defined period (de-icing truck service time), taking into account depreciation (residual value) and interest rate.

The de-icing truck annual costs for maintenance, insurance and fuel are self explanatory.

4.1.2 Fluid cost

In the model, the annual cost for fluids (shown in Table 4) is divided into purchase and disposal costs.

Fluid cost	Min	Max	Small	Medium	Large	Very Large	Largest
Average quantity of fluids per procedure (in litre)	250	600	350	350	400	400	500
Fluid annual purchased quantity (in litre)			35000	70000	160000	426000	3000000
Cost of fluid purchase (all types mixed with water on average)	0.80 €	1.60 €	1.20 €	1.20 €	1.20 €	1.20 €	1.20 €
Cost of fluid disposal / recylcing (per litre)	0.00 €	0.50 €	0.25 €	0.25 €	0.25 €	0.25 €	0.25 €
Fluids annual purchase cost			42 000 €	84 000 €	192 000 €	511 200 €	3 600 000 €
Disposal annual cost			8 750 €	17 500 €	40 000 €	106 500 €	750 000 €
Total fluids annual cost			**50 750 €**	**101 500 €**	**232 000 €**	**617 700 €**	**4 350 000 €**

Table 4: Fluid cost

The model does not differentiate between fluid types (thickened and unthickened) and mixture. The quantity of fluid per year or per procedure, as well as the cost variables are defined as average figures. In addition, the possible cost related to fluid testing (e.g. laboratory equipment) can be included in the model in the fluid purchase price.

The annual quantity of fluids purchased depends on the average fluid quantity per operation, and the number of operations. It is possible to assume that the average fluid quantity is further dependent on the average aircraft size and weather conditions. In most cases, small aerodromes require less fluid per operation than large aerodromes, as the average aircraft size is smaller.

4.1.3 Personnel cost

In the cost model, the personnel annual cost (displayed in Table 5) comprises the cost of de-icing / anti-icing operatives and office staff members, as well as the training costs.

Personnel cost	Min	Max	Small	Medium	Large	Very Large	Largest
Working hours			8	8	8	8	8
Number of working days (for office staff)			215	215	215	215	215
De-icing office staff cost (hourly salary)	10 €	40 €	30 €	30 €	30 €	30 €	30 €
De-icing operative cost (hourly salary)	10 €	40 €	30 €	30 €	30 €	30 €	30 €
Number of operatives per de-icing trucks	1	2	2	2	2	2	2
Number of shifts	1	3	2.5	2.5	2.5	2.5	2.5
Number of operatives			12	12	18	48	240
Number of operatives per office staff	15.00	30.00	20.00	20.00	20.00	20.00	20.00
Number of office staff			0.60	0.60	0.90	2.40	12.00
Number of operative hours (without overhead / unused time)			200	400	800	2130	12000
Cost of providing capacity factor	1.5	2.5	2	2	2	2	2
Number of operative hours (with overhead / unused time)			400	800	1600	4260	24000
Personnel annual cost (operatives)			12 000 €	24 000 €	48 000 €	127 800 €	1 440 000 €
Personnel annual cost (office staff)			30 960 €	30 960 €	46 440 €	123 840 €	619 200 €
Initial or refresher training duration (including trainer in man-days)	2	5	3	3	3	3	3
Training annual cost			8 640 €	8 640 €	12 960 €	34 560 €	172 800 €
Total personnel annual cost			**51 600 €**	**63 600 €**	**107 400 €**	**286 200 €**	**2 232 000 €**

Table 5: Personnel Cost

In the model, operatives are paid by the hour, whilst office staff are considered as full-time employees, expressed in terms of “full-time equivalent” (FTE) per year (215 working days / year).

The operatives annual cost is primarily based on the number of operative hours per annum and operative hourly pay. The number of operative hours is further determined as a function of de-icing operations, manpower requirement per truck, and operation duration. To reflect the overhead costs of operatives (i.e. time spent not in de-icing operations, e.g. waiting, refilling, moving the trucks, etc.), a “cost of providing capacity factor” has been introduced. This factor, equal to two in the simulated scenarios (i.e. half of the operatives’ time is overhead time, not spent directly in the de-icing procedure itself), has been determined qualitatively.

The number of operatives is a function of the number of de-icing trucks, truck manning requirements and the number of shifts. The number of operatives is generally determined to ensure the full equipment (truck) utilisation during peak time. In the model, the number of operatives is equal to the number of trucks, multiplied by the number of operatives per truck and shift and an additional factor (1.2 in the scenarios) to reflect rest or absence. It must be noted that the number of operatives is not dependent on the number of operative hours.

The number of office staff is based on the ratio of operatives per office staff member. In the simulated scenarios, this ratio is set at one office staff member per 20 operatives (in FTEs).

The training cost is a function of the duration of training, the number of operatives and their hourly pay.

4.1.4 Storage facilities cost

The costs related to the storage facilities (shown in Table 6) comprise:

- storage annual acquisition cost
- maintenance annual cost
- rent annual cost

Storage facilities cost	Min	Max	Small	Medium	Large	Very Large	Largest
Storage / annual consumption factor (proportion of annual fluid quantity)	0.2	1	0.5	0.5	0.5	0.3	0.3
Storage capacity (in litre)			17500	35000	80000	127800	900000
Storage acquisition cost (per litre)	1.00 €	4.00 €	3.00 €	3.00 €	3.00 €	3.00 €	3.00 €
Storage acquisition cost			52 500 €	105 000 €	240 000 €	383 400 €	2 700 000 €
Unit life-time (in year)	0	20	15	15	15	15	15
Storage annual acquisition cost			1 574 €	3 148 €	7 195 €	11 494 €	80 947 €
Maintenance and cleaning (percentage of acquisition cost)	0%	15%	10%	10%	10%	10%	10%
Maintenance annual cost			5 250 €	10 500 €	24 000 €	38 340 €	270 000 €
Container height (in meter)	1	10	1	5	5	5	5
Space requirements (for storage facilities, in sq meter)			17.5	7	16	25.56	180
Rent annual cost (for storage facilities)			2 100 €	2 520 €	7 680 €	12 269 €	86 400 €
Total storage facilities annual cost			**8 924 €**	**16 168 €**	**38 875 €**	**62 103 €**	**437 347 €**

Table 6: Storage facilities cost

The storage annual acquisition cost (similar to the de-icing truck annual acquisition cost) corresponds to the annuity required to amortise the storage acquisition cost over a defined period (storage unit lifetime), taking into account depreciation (residual value is estimated to null) and interest rate. The storage acquisition cost depends on the storage capacity and an average storage cost per litre. The storage capacity is expressed as a function of the annual capacity, i.e. a value of 0.3 means that 30% of the annual fluid consumption can be stored.

The annual maintenance (and cleaning) cost is proportional to the storage acquisition cost.

The rent annual cost is a function of the space requirements (in square meter) and rent per square meter charged by the aerodrome.

The model does not directly take account of the number of storage facilities, which may influence the storage acquisition, maintenance and rent cost. However, the impact on the price of providing several storage facilities is taken into account by adapting the storage acquisition cost (per litre).

Small aerodromes requiring smaller quantities of pre-mixed fluids may purchase and store fluids in cubitainers to reduce the storage acquisition and maintenance cost.

4.1.5 Other facilities and equipment costs

In the cost model, other facilities and equipment costs (Table 7) include the rent for the office and facilities, as well as software (e.g. de-icing management coordination).

Other facilities and equipment	Min	Max	Small	Medium	Large	Very Large	Largest
Rent (per sq meter per month)	10 €	80 €	10 €	30 €	40 €	40 €	40 €
Space requirements (per de-icing truck, in sq meter)	20	40	30	30	30	30	30
Space requirements (for de-icing trucks, in sq meter)			50	50	75	200	1000
Rent annual cost (for de-icing trucks)			6 000 €	18 000 €	36 000 €	96 000 €	480 000 €
Space requirements (for operatives and office staff, per person, in sq meter)	2	10	5	5	5	5	5
Space requirements (for operatives and office staff, in sq meter)			27.00	27.00	40.50	108.00	540.00
Rent annual cost (for operatives and office staff)			3 240 €	9 720 €	19 440 €	51 840 €	259 200 €
Software annual cost (percentage of de-icing trucks acquisition)	0.0%	1.0%	0.0%	0.0%	0.5%	0.5%	0.5%
Software annual cost			0 €	0 €	7 500 €	20 000 €	100 000 €
Total other facilities and equipment cost			**9 240 €**	**27 720 €**	**62 940 €**	**167 840 €**	**839 200 €**

Table 7: Other facilities and equipment cost

The space rented by the service providers is required for de-icing trucks, as well as for offices and other facilities.

The rent annual cost for de-icing trucks is a function of the cost of a square meter charged by the aerodrome, the number of de-icing trucks, and the space requirement per de-icing truck.

The rent annual cost for the operatives and office staff is dependent on the number of staff within a shift (number of office staff, plus total number of operatives divided by the number of shifts), the space requirement per staff, and rent per square meter. The space requirement per staff member is low (compared to other industry space requirements), as the operatives spend most of their time away from the facilities.

The software cost is calculated as a percentage of the de-icing truck acquisition cost.

4.2 Cost breakdown analysis

Table 8 details the cost breakdown and subsequent total cost per annum for each scenario.

Cost breakdown	Small	Medium	Large	Very Large	Largest
Cost of equipment	99 553 €	102 353 €	218 528 €	582 695 €	2 932 377 €
Cost of fluid	50 750 €	101 500 €	232 000 €	617 700 €	4 350 000 €
Cost of personnel	51 600 €	63 600 €	107 400 €	286 200 €	2 232 000 €
Cost of storage facilities	8 924 €	16 168 €	38 875 €	62 103 €	437 347 €
Cost of other facilities and equipment	9 240 €	27 720 €	62 940 €	167 840 €	839 200 €
Total cost	**220 067 €**	**311 341 €**	**659 744 €**	**1 716 539 €**	**10 790 924 €**

Table 8: Cost breakdown

According to these simulated figures, the cost per annum to provide de-icing / anti-icing services amounts to between EUR 220 067 (small aerodromes) and EUR 10 790 924 (largest aerodromes). Fluids costs represent the major expenses (more than a third of the total expenses), followed by equipment and personnel.

In the simulated scenario for small aerodromes (low number of de-icing operations and two de-icing trucks), the equipment cost represents a higher than average portion of the total cost. The de-icing trucks in this scenario are under-utilised, as both are required to provide the defined target maximum hourly capacity. There are no economies of scale for small aerodromes.

Table 9 displays the average cost[1] breakdown per de-icing operation.

Cost breakdown per operation	Small	Medium	Large	Very Large	Largest
Cost of equipment per operation	996 €	512 €	546 €	547 €	489 €
Cost of fluid per operation	508 €	508 €	580 €	580 €	725 €
Cost of personnel per operation	516 €	318 €	269 €	269 €	372 €
Cost of storage facilities per operation	89 €	81 €	97 €	58 €	73 €
Cost of other facilities and equipment per operation	92 €	139 €	157 €	158 €	140 €
Total cost per operation	**2 201 €**	**1 557 €**	**1 649 €**	**1 612 €**	**1 798 €**

Table 9: Cost breakdown per operation

The resulting average cost per operation of the scenario ranges from EUR 1 557 (at medium aerodromes) to EUR 2 201 (at small aerodromes). These figures are displayed graphically in Figure 1.

[1] Average cost is equal to the sum of the cost per annum to provide de-icing / anti-icing services divided by the number of operations per annum.

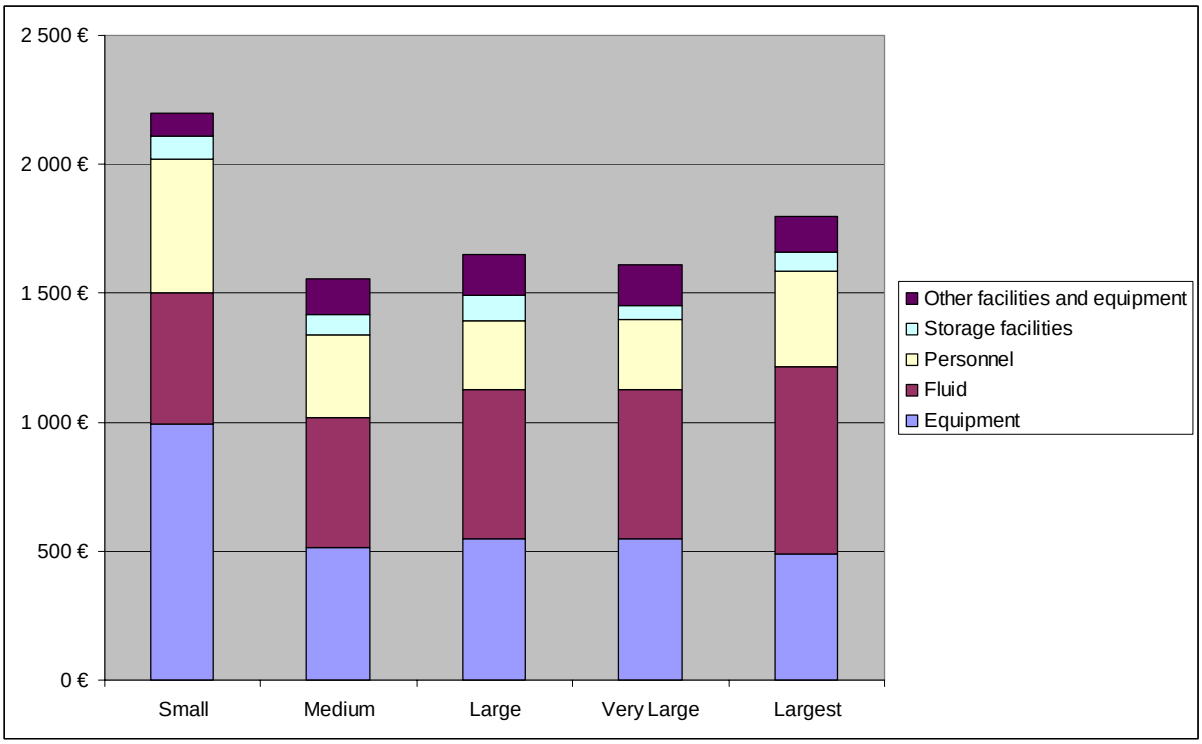

Figure 1: Cost breakdown per operation

The cost of de-icing service provision (Table 10) ranges between EUR 0.22 and EUR 0.59 per passenger (total annual number of passengers), or between EUR 20.76 and EUR 39.34 per movement (total annual number of movements).

Cost of service provision	Small	Medium	Large	Very Large	Largest
Cost of de-icing service provision per pax	0.59 €	0.42 €	0.44 €	0.34 €	0.22 €
Cost of de-icing service provision per movement	29.34 €	20.76 €	21.99 €	21.46 €	23.98 €

Table 10: Cost of de-icing service provision

4.3 Acquisition cost (summary)

The acquisition cost for equipment to provide adequate aircraft ground de-icing / anti-icing operations, at an aerodrome where this was not previously provided, are summarised in Table 11.

Acquisition cost (summary)	Small	Medium	Large	Very Large	Largest
Storage acquisition cost	52 500 €	105 000 €	240 000 €	383 400 €	2 700 000 €
De-icing truck acquisition cost	700 000 €	700 000 €	1 500 000 €	4 000 000 €	20 000 000 €
Total acquisition cost	**755 068 €**	**806 740 €**	**1 741 846 €**	**4 385 209 €**	**22 701 973 €**

Table 11: Acquisition cost

5 Cost of providing Type I fluids in addition to thickened fluids

5.1 Cost breakdown

The provision of Type I fluids and two step de-icing / anti-icing at aerodromes represents a major long-term financial commitment.

The cost of providing Type I fluid, in addition to Type II and IV, is driven by the storage and de-icing trucks upgrade cost (initial investment and additional annual cost). The cost model is based on the assumption (confirmed by industry experts) that the total annual cost of fluids itself remains unchanged. The total cost of fluids for providing one-step or two-step de-icing / anti-icing procedures is similar. This is because, whilst the cost of neat Type I fluid is higher than thickened fluids, it is more efficient as a de-icing fluid, and is also frequently used in a more diluted form than thickened fluids, thereby reducing the overall cost to similar levels.

The storage upgrade cost is dependent on the additional storage capacity required to store Type I fluid. In the simulated scenarios, we assumed that the small and medium aerodromes would have to double their storage capacity (100%), and that the larger aerodromes would have to increase their storage capacity by between 30% (very large and largest aerodromes) to 50% (large aerodromes). Small and medium aerodromes, making use of portable, self-contained cubitainers provided by the fluid manufacturers, may in real terms have no additional cost of storage.

Service providers operating with a single type of fluid (e.g. Type II) have, in most cases, trucks unequipped to perform two-step de-icing / anti-icing (i.e. with both type I for de-icing and thickened fluids for anti-icing). The costs associated with upgrading vehicles/systems to provide two-step procedures can vary considerable between minor to major and is dependent on their current equipment. In the cost model, the de-icing truck upgrade cost is equal to a given percentage of the de-icing truck acquisition price.

Table 12 below displays the upgrade cost (initial investment).

Upgrade cost (initial investment)	Min	Max	Small	Medium	Large	Very Large	Largest
Storage upgrade cost (percentage of storage quantity)	0%	100%	100%	100%	50%	30%	30%
Storage upgrade cost			52 500 €	105 000 €	120 000 €	115 020 €	810 000 €
De-icing truck upgrade cost (percentage of de-icing truck acquisition cost)	0%	100%	5%	5%	5%	5%	5%
De-icing truck upgrade cost (per truck)			17 500 €	17 500 €	25 000 €	25 000 €	25 000 €
De-icing truck upgrade cost			35 000 €	35 000 €	75 000 €	200 000 €	1 000 000 €
Total upgrade cost			**87 500 €**	**140 000 €**	**195 000 €**	**315 020 €**	**1 810 000 €**

Table 12: Upgrade cost (initial investment)

The upgrade annual cost is equivalent to the total additional annual cost required to provide Type I fluids in addition to thickened fluids. The upgrade annual cost comprises the annual cost generated by the additional storage capacity and de-icing trucks upgrade.

Upgrade annual cost	Small	Medium	Large	Very Large	Largest
Storage upgrade annual cost	8 924 €	16 168 €	19 438 €	18 631 €	131 204 €
De-icing truck upgrade annual cost (per truck)	2 419 €	2 419 €	3 455 €	3 455 €	3 455 €
De-icing truck upgrade annual cost	4 838 €	4 838 €	10 366 €	27 644 €	138 219 €
Total upgrade annual cost	**13 762 €**	**21 006 €**	**29 804 €**	**46 275 €**	**269 423 €**

Table 13: Upgrade annual cost

The storage upgrade annual cost is calculated similarly to Section 4.1.4, i.e. taking into account additional storage acquisition cost, maintenance cost and rent cost.

The de-icing truck upgrade annual cost is calculated similarly to Section 4.1.1, i.e. taking into account the increased price of the de-icing truck, resulting in higher annual acquisition, maintenance and insurance costs.

5.2 Cost breakdown analysis

The upgrade cost (per de-icing / anti-icing operation, passenger and movement) is summarised in Table 14.

Upgrade cost (per operation, pax and movement)	Small	Medium	Large	Very Large	Largest
Total upgrade-induced additional cost per operation	138 €	105 €	75 €	43 €	45 €
Total upgrade-induced additional cost per operation (percentage of increase)	6.25%	6.75%	4.52%	2.70%	2.50%
Additional cost of upgrade per pax	0.04 €	0.03 €	0.02 €	0.01 €	0.01 €
Additional cost of upgrade per movement	1.83 €	1.40 €	0.99 €	0.58 €	0.60 €

Table 14: Upgrade cost (per de-icing / anti-icing operation, passenger and movement)

The additional cost generated by upgrading ranges from EUR 43 (very large aerodromes) to EUR 138 (small aerodromes) per de-icing / anti-icing operation. The additional cost caused by upgrading is more important in the small aerodrome scenario, mainly due to the high additional storage cost. According to these figures, aerodromes which update their infrastructure and facilities to provide Type I in addition to a Type II or IV fluid would increase their service charges by between 2.50% (largest aerodrome) and 6.75% (small aerodrome).

6 Summary

The investment and annual costs associated with the provision of de-icing / anti-icing services are not negligible. The total investment expenditures to provide de-icing / anti-icing infrastructure and equipment at a “very large aerodrome” (5 000 000 passengers and 80 000 movements per annum) may amount to between four and six million Euros. The annual cost related to the provision of de-icing / anti-icing services (incl. the amortisation of the initial investment) in the previous example would amount on average to around 1 700 000 Euros per annum. Based on the assumption that the airside revenues (landing fees and ground handling charges) of such a very large airport amounts to 80 million Euros per annum, the annual cost for providing de-icing / anti-icing services would represents 2.12% of the airside revenues.

Regarding the cost composition, de-icing / anti-icing fluids represent the main expense, followed by de-icing trucks, and personnel.

The aerodrome operators and service providers may adapt to a certain extent their cost structure to the size of their de-icing / anti-icing operations; however, the main cost driver is the number of de-icing trucks necessary to provide the required de-icing capacity during peak hours and severe winter conditions. Though a reduction of the investment in de-icing equipment would reduce cost, it may have a strong negative impact on delay.

The cost of providing Type I fluid, in addition to Type II and IV, is determined by the storage and de-icing trucks upgrade cost (initial investment and additional annual cost). The additional investment required to provide Type I fluid in addition to Type II and IV may increase the cost of de-icing / anti-icing operations by between 2.50% to 6.75%.

In general, the investment per passenger (or movement) in de-icing / anti-icing services is much higher for small and medium aerodromes. These aerodromes have to invest a larger part of their revenues into de-icing operations, and may therefore be more affected in case the provision of Type I fluids were made mandatory.

The impact of the winter conditions variability on service providers’ financials (operating costs and revenue) potentially limits major investments. While a large part of the de-icing operating costs are “fixed” (e.g. equipment and facilities), the revenue is generally dependent on the winter condition. To illustrate this, in the very large aerodrome scenario, a reduction of 50% of the number of de-icing / anti-icing operations (532 operations, instead of 1065) would increase the cost per operation of the service provider by 51% (from EUR 1 612 to EUR 2 439).

Aerodrome Size Classification	Small	Medium	Large	Very Large	Largest
Passenger	375000	750000	1500000	5000000	50000000
Movements	7500	15000	30000	80000	450000
Weather zone	Continental	Continental	Continental	Continental	Continental

De-icing / anti-icing operations	Small	Medium	Large	Very Large	Largest
No. of de-icing / anti-icing operations	100	200	400	1065	6000
Average operation duration (in minutes, including turnaround additional time)	30	30	30	30	30
Maximum de-icing capacity (number of average procedure per hour)	2	2	3	8	40

Equipment cost	Small	Medium	Large	Very Large	Largest
Number of de-icing trucks	2.00	2.00	3.00	8.00	40.00
Number of de-icing trucks per operation	2	2	2	2	2
De-icing truck acquisition cost (per truck)	350 000 €	350 000 €	500 000 €	500 000 €	500 000 €
De-icing truck acquisition cost	700 000 €	700 000 €	1 500 000 €	4 000 000 €	20 000 000 €
De-icing truck service time (in years)	10	10	10	10	10
Residual value (percentage of acquisition cost)	30%	30%	30%	30%	30%
De-icing trucks annual acquisition cost (per de-icing truck)	34 406 €	34 406 €	49 152 €	49 152 €	49 152 €
De-icing trucks annual acquisition cost	68 813 €	68 813 €	147 455 €	393 215 €	1 966 073 €
De-icing trucks maintenance annual cost (percentage of acquisition cost)	3.5%	3.5%	3.5%	3.5%	3.5%
De-icing trucks maintenance annual cost	24 500 €	24 500 €	52 500 €	140 000 €	700 000 €
De-icing trucks insurance annual cost (percentage of de-icing trucks annual cost)	5%	5%	5%	5%	5%
De-icing trucks insurance annual cost	3 441 €	3 441 €	7 373 €	19 661 €	98 304 €
Fuel price (per litre)	1.40 €	1.40 €	1.40 €	1.40 €	1.40 €
Fuel quantity (in litre, per operation)	20	20	20	20	20
Fuel annual cost	2 800 €	5 600 €	11 200 €	29 820 €	168 000 €
Total equipment annual cost	**99 553 €**	**102 353 €**	**218 528 €**	**582 695 €**	**2 932 377 €**

Fluid cost	Small	Medium	Large	Very Large	Largest
Average quantity of fluids per procedure (in litre)	350	350	400	400	500
Fluid annual purchased quantity (in litre)	35000	70000	160000	426000	3000000
Cost of fluid purchase (all types mixed with water on average)	1.20 €	1.20 €	1.20 €	1.20 €	1.20 €
Cost of fluid disposal / recylcing (per litre)	0.25 €	0.25 €	0.25 €	0.25 €	0.25 €
Fluids annual purchase cost	42 000 €	84 000 €	192 000 €	511 200 €	3 600 000 €
Disposal annual cost	8 750 €	17 500 €	40 000 €	106 500 €	750 000 €
Total fluids annual cost	**50 750 €**	**101 500 €**	**232 000 €**	**617 700 €**	**4 350 000 €**

Personnel cost	Small	Medium	Large	Very Large	Largest
Working hours	8	8	8	8	8
Number of working days (for office staff)	215	215	215	215	215
De-icing office staff cost (hourly salary)	30 €	30 €	30 €	30 €	30 €
De-icing operative cost (hourly salary)	30 €	30 €	30 €	30 €	30 €
Number of operatives per de-icing trucks	2	2	2	2	2
Number of shifts	2.5	2.5	2.5	2.5	2.5
Number of operatives	12	12	18	48	240
Number of operatives per office staff	20.00	20.00	20.00	20.00	20.00
Number of office staff	0.60	0.60	0.90	2.40	12.00
Number of operative hours (without overhead / unused time)	200	400	800	2130	12000
Cost of providing capacity factor	2	2	2	2	2
Number of operative hours (with overhead / unused time)	400	800	1600	4260	24000
Personnel annual cost (operatives)	12 000 €	24 000 €	48 000 €	127 800 €	1 440 000 €
Personnel annual cost (office staff)	30 960 €	30 960 €	46 440 €	123 840 €	619 200 €
Initial or refresher training duration (including trainer in man-days)	3	3	3	3	3
Training annual cost	8 640 €	8 640 €	12 960 €	34 560 €	172 800 €
Total personnel annual cost	**51 600 €**	**63 600 €**	**107 400 €**	**286 200 €**	**2 232 000 €**

Table 15: Cost model and simulated scenarios (part 1)

Storage facilities cost	Small	Medium	Large	Very Large	Largest
Storage / annual consumption factor (proportion of annual fluid quantity)	0.5	0.5	0.5	0.3	0.3
Storage capacity (in litre)	17500	35000	80000	127800	900000
Storage acquisition cost (per litre)	3.00 €	3.00 €	3.00 €	3.00 €	3.00 €
Storage acquisition cost	52 500 €	105 000 €	240 000 €	383 400 €	2 700 000 €
Unit life-time (in year)	15	15	15	15	15
Storage annual acquisition cost	1 574 €	3 148 €	7 195 €	11 494 €	80 947 €
Maintenance and cleaning (percentage of acquisition cost)	10%	10%	10%	10%	10%
Maintenance annual cost	5 250 €	10 500 €	24 000 €	38 340 €	270 000 €
Container height (in meter)	1	5	5	5	5
Space requirements (for storage facilities, in sq meter)	17.5	7	16	25.56	180
Rent annual cost (for storage facilities)	2 100 €	2 520 €	7 680 €	12 269 €	86 400 €
Total storage facilities annual cost	**8 924 €**	**16 168 €**	**38 875 €**	**62 103 €**	**437 347 €**

Other facilities and equipment	Small	Medium	Large	Very Large	Largest
Rent (per sq meter per month)	10 €	30 €	40 €	40 €	40 €
Space requirements (per de-icing truck, in sq meter)	30	30	30	30	30
Space requirements (for de-icing trucks, in sq meter)	50	50	75	200	1000
Rent annual cost (for de-icing trucks)	6 000 €	18 000 €	36 000 €	96 000 €	480 000 €
Space requirements (for operatives and office staff, per person, in sq meter)	5	5	5	5	5
Space requirements (for operatives and office staff, in sq meter)	27.00	27.00	40.50	108.00	540.00
Rent annual cost (for operatives and office staff)	3 240 €	9 720 €	19 440 €	51 840 €	259 200 €
Software annual cost (percentage of de-icing trucks acquisition)	0.0%	0.0%	0.5%	0.5%	0.5%
Software annual cost	0 €	0 €	7 500 €	20 000 €	100 000 €
Total other facilities and equipment cost	**9 240 €**	**27 720 €**	**62 940 €**	**167 840 €**	**839 200 €**

Cost breakdown	Small	Medium	Large	Very Large	Largest
Cost of equipment	99 553 €	102 353 €	218 528 €	582 695 €	2 932 377 €
Cost of fluid	50 750 €	101 500 €	232 000 €	617 700 €	4 350 000 €
Cost of personnel	51 600 €	63 600 €	107 400 €	286 200 €	2 232 000 €
Cost of storage facilities	8 924 €	16 168 €	38 875 €	62 103 €	437 347 €
Cost of other facilities and equipment	9 240 €	27 720 €	62 940 €	167 840 €	839 200 €
Total cost	**220 067 €**	**311 341 €**	**659 744 €**	**1 716 539 €**	**10 790 924 €**

Cost breakdown per operation	Small	Medium	Large	Very Large	Largest
Cost of equipment per operation	996 €	512 €	546 €	547 €	489 €
Cost of fluid per operation	508 €	508 €	580 €	580 €	725 €
Cost of personnel per operation	516 €	318 €	269 €	269 €	372 €
Cost of storage facilities per operation	89 €	81 €	97 €	58 €	73 €
Cost of other facilities and equipment per operation	92 €	139 €	157 €	158 €	140 €
Total cost per operation	**2 201 €**	**1 557 €**	**1 649 €**	**1 612 €**	**1 798 €**

Acquisition cost (summary)	Small	Medium	Large	Very Large	Largest
Storage acquisition cost	52 500 €	105 000 €	240 000 €	383 400 €	2 700 000 €
De-icing truck acquisition cost	700 000 €	700 000 €	1 500 000 €	4 000 000 €	20 000 000 €
Total acquisition cost	**754 701 €**	**806 557 €**	**1 741 649 €**	**4 385 012 €**	**22 701 798 €**

Upgrade cost (initial investment)	Small	Medium	Large	Very Large	Largest
Storage upgrade cost (percentage of storage quantity)	100%	100%	50%	30%	30%
Storage upgrade cost	52 500 €	105 000 €	120 000 €	115 020 €	810 000 €
De-icing truck upgrade cost (percentage of de-icing truck acquisition cost)	5%	5%	5%	5%	5%
De-icing truck upgrade cost (per truck)	17 500 €	17 500 €	25 000 €	25 000 €	25 000 €
De-icing truck upgrade cost	35 000 €	35 000 €	75 000 €	200 000 €	1 000 000 €
Total upgrade cost	**87 500 €**	**140 000 €**	**195 000 €**	**315 020 €**	**1 810 000 €**

Upgrade annual cost	Small	Medium	Large	Very Large	Largest
Storage upgrade annual cost	8 924 €	16 168 €	19 438 €	18 631 €	131 204 €
De-icing truck upgrade annual cost (per truck)	2 419 €	2 419 €	3 455 €	3 455 €	3 455 €
De-icing truck upgrade annual cost	4 838 €	4 838 €	10 366 €	27 644 €	138 219 €
Total upgrade annual cost	**13 762 €**	**21 006 €**	**29 804 €**	**46 275 €**	**269 423 €**

Upgrade cost (per operation, pax and movement)	Small	Medium	Large	Very Large	Largest
Total upgrade-induced additional cost per operation	138 €	105 €	75 €	43 €	45 €
Total upgrade-induced additional cost per operation (percentage of increase)	6.25%	6.75%	4.52%	2.70%	2.50%
Additional cost of upgrade per pax	0.04 €	0.03 €	0.02 €	0.01 €	0.01 €
Additional cost of upgrade per movement	1.83 €	1.40 €	0.99 €	0.58 €	0.60 €

Cost of service provision	Small	Medium	Large	Very Large	Largest
Cost of de-icing service provision per pax	0.59 €	0.42 €	0.44 €	0.34 €	0.22 €
Cost of de-icing service provision per movement	29.34 €	20.76 €	21.99 €	21.46 €	23.98 €

Table 16: Cost model and simulated scenarios (part 2)

EASA.2009.OP 21

Study on the regulation of ground de-icing and anti-icing services in the EASA Member States

FINAL REPORT
Cost Model
(see attached Spreadsheet)

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