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Contents

1 Introduction 5

2 FUSETRA Project 6

3 Workshop Results 7

3.1 Operational Aspects 7

3.1.1 Landing areas 7

3.1.2 Landing Procedures and wave characteristics 8

3.1.3 Operational experiences given by a test pilot 10

4 Regulatory Aspects 10

5 First results of FUSETRA scientific investigations 12

5.1 Analysis of conditions favourable for seaplane transport system development in Europe 12

5.2 Long term future opportunities for seaplanes operations 14

6 Break Through 16

1 Introduction

Beside scientific investigations the FUSETRA consortium committed to organize three workshops in various locations in Europe within the timeframe 2010 – 2011. It was the objective to gather information about seaplane/ amphibian operational experience, about new ideas in infrastructure and aircraft design, about the current permission transfer situation from local to EASA responsibility and to enlarge its network of stakeholders involved in the seaplane/ amphibian transport system. The first workshop took place in Biscarrosse on the occasion of the 13th international seaplane event in May 2010. The second workshop was organized on the occasion of Malta International Air show in Malta in September 2010. The third workshop was originally planned in the Baltic area, but it was decided to arrange it on the occasion of the AERO exhibition – the global show for general aviation – in Friedrichshafen Germany in April 2011. This decision was made for reaching a great variety of stakeholders and interested operators.

The following speeches have been given during the Friedrichshafen Workshop:

- Introduction to FUSETRA - Dr. Sträter (Coordinator of FUSETRA program)
- Analysis of conditions favourable for seaplane transport system development in Europe. Review of FUSETRA aircrafts characteristics. - Dr. Majka (University Rzeszow)
- Long term future opportunities for seaplane operation - Dr. Srmcek (University Glasgow)
- Operational conditions for seaplanes - Vadim Zdanevich, (Beriev Aircraft Company)
- Future Sea Drome (= floating airdrome; Requirements + Proposals) - G. Zietsch
- Operational experiences with various seaplanes - Paul Mulcahy (Certification and test pilot)
- Seaplane issues in the New Ops rules - Willy Sigl (EASA)

Participants from 9 European countries attended the Friedrichshafen workshop. This paper gives a summary of contents discussed by speakers and participants. All papers can be found on the FUSETRA website – www.fusetra.eu.

2 FUSETRA Project

The FUSETRA project and the FUSETRA partners were briefly introduced with given emphasis on the goals:

- Identification of the State of the Art of Seaplane/ Amphibian transport system
- Identification of strength and weaknesses of the European Seaplane / Amphibian transport system
- Demonstrate the needs and quantify the potential of seaplane traffic business development
- Propose recommendations for the introduction of new seaplane / amphibian transportation system to improve passenger's / customer's choice as well as better time and cost efficient travel and transport
- Roadmap for future improvement

Furthermore, the main topics within the FUSETRA scope to be dealt with were introduced again:

- Operational Aspect
- Aircraft Aspects
- Regulatory Aspects

FUSETRA aims at developing a culture of trust and understanding between the seaplane operators, and the different aviation and maritime authorities.

Within this workshop first results of investigations by the partner universities were presented.

3 Workshop Results

The following paragraphs present the results of the presentations held during the Friedrichshafen workshop and respective discussions among participants.

3.1 Operational Aspects

3.1.1 Landing areas

Seaplanes and Amphibians need landing areas suitable for a safe take off and landing. An ideal area can be found at the Beriev Seaport home base at the Black Sea near Gelendzik.

Mr. Zietsch - a shipbuilding engineer - gave a paper about historical and future oriented seaport designs considering the operational and economical requests of effective solutions. The development of Sea Drome infrastructure shows the adaption of the urban and geographical situation as well as sea (water) state, beach characteristics and other operational factors.

The English Bristol Company developed a submersible pontoon in the 1920th. The kind of mooring the pontoon generally results in a downwind fixing, so that a flying boat or floatplane can generally approach the pontoon upwind. Operated pneumatically the central cradle of the arrangement could be lifted up or lowered with changing buoyancy of the corner cylinders, which is equivalent to a minimalistic floating dock.

As another example a common Raft construction was presented located at a tidewater beach or quayside. The seaplanes are moored along the fender protected raft pontoon. Admittance to seaplanes is via the gangway exclusively. Approaching and departing of the seaplanes is executed by common rules. Comparatively simple in construction and easy to maintain this type of Sea Drome infrastructure is found all around and will hold its place in future developments, too.

A floating hangar built on a barge is another possibility which was quite often used in the past. The small seaplanes are towed to the ramp tail first.

Arrangements of a turn table solution especially suited for the handling of floatplanes and a so called “Mushroom” Ramp were also presented. On a Mushroom Ramp the Amphibian is standing feet dry after entering the ramp on its own wheels. The seaplane can turn on the ramp. This kind of arrangement is well suited to narrow water areas and congested waters.

At the start point for the Layout of a new Sea Drome one should remember that the seaplane operator is in charge and responsible for its own Sea Drome as well. In the same way as designing ordinary buildings and arrangements, the process starts with the layout of the base – the floating base in our respect. Today’s shipbuilding sub suppliers offer Modular Pontoon Elements, which can be arranged and close coupled in various shapes. To fulfil the requests of their customers in offshore work and high sea environments, these elements as well as the couplings and fixings are approved by the various Certifying Societies as Lloyd`s Register, ABS, GL or RINA. Modern layouts should be modular ones using such cost effective and certified Container Elements set up on a structured base floor with purposely arranged rooms and made out of fibre materials and “textile architecture” for avoiding sea water corrosion. Landing sites have to be equipped with reasonable facilities in the event of accidents. Guide lines on an acceptable level of rescue equipment and training have to be set up Europe wide. The necessary operational equipment may be stored in tender boats as well as fuel supply. Some types of boats should be part of the Sea Drome for cost saving reasons as well as for fulfilling the requests of safe operation.

Even visionary ideas were explained about energy generation and supply and cooperation with cruise liners by Mr. Zietsch.

3.1.2 Landing procedures and wave characteristics

Before landing, pilot must check the following:

- wind and sea condition;
- floating and fixed obstacles;
- if possible, define water depth, the presence of water banks and fish shoals; a combination of both may often be seen in clear weather, when the aircraft is passing at a low height over the area of future landing.

Worthy of mention is that in the area of water banks and fish shoals the water disturbance is inconsiderably higher than in the nearby area.

While evaluating the landing trajectory, one should be guided by the fact that the wind blows from the side of calm water surface. By the calm strip width one may estimate wind speed. Besides, wind direction is marked by wind routes (parallel white foam strips), if the wind is quite strong, but these factors should not be mixed with similar flow lines.

It is preferable to perform landing near some object, to assess aircraft height above water surface.

Visual height assessment above mirror surface is often misleading and wrong. With calm water it is preferable to through off the board a pair of foam buoys, while passing over at a low speed, to evaluate the height above water surface.

When it is possible to perform takeoff, a pilot must choose takeoff direction, critically assess tidal flow, sea state and check for an obstacle for the case of a refused takeoff.

A theoretical approach for defining the characteristics of waves including wave refraction and diffraction on isles and mole heads would be an ideal tool for a better and safer flight planning.

The deputy general designer of Beriev aircraft company Vadim V. Zdanevich - the most experienced seaplane producer and operator for the time being - introduced a new analytical method for analysing the wind generated disturbances and the influences on the characteristics of waves. A spectral method was used for finding sea disturbance parameters. At first the effects of wind generated disturbance spectrum to swell-type and mixed water type disturbance was investigated. Afterwards an algorithm was defined for calculating sea disturbance static characteristics using Spectral Analysis Method. This method could be a milestone for a better and safer flight planning and landing operation.

3.1.3 Operational experiences given by a test pilot

The CAA test pilot Paul Mulcahy gave an impressive paper about his experience flying various seaplanes of different types and sizes (from small to big). He does not only present the characteristics of at least 10 aircrafts including floatplanes like the Piper Super Cub, the Maule MX 7 and seaplanes like Catalina, Iren Dornier´s S-Ray, Twin Bee and the Beriev 200 ES-E. He additionally described the challenges in operating seaplanes on small lakes like Loch Earn and other Scottish lakes and gave recommendations to the participating pilots how to handle the different kind of aircrafts in different weather and local conditions. But special emphasis he gave on the new small two-seater of Iren Dornier – the S-Ray - and especially on the Beriev 200. The presence of the deputy chief designer of Beriev – Mr. Vadim V. Zdanevich – gave the audience the unique opportunity to share a technical and operational oriented insider discussions about the flight behaviour including strengths and weaknesses of one of the most modern and sophisticated seaplanes for the time being.

4 Regulatory Aspects

In all three workshops the participating operators and pilots complained about the diversity of authorities involved in the permission process for getting operation licenses and about insufficient specific rules.

In Europe the safety regulators and standardization teams have a responsibility to a group of different states often with different priorities, for the time being. As a result, many difficulties arise in Europe in the commercial operation of seaplanes both from an operational point of view and with the various authorities. In addition, the Joint Aviation Requirements, the regulatory requirements for commercial aviation operations in public transport, have not been established with wide input from seaplane operators.

The Joint Aviation Authority has been programmed around a number of independent states, all with differing criteria and it was difficult enough coordinating a common basis from which to manage commercial seaplane operations within Europe let alone trying to emulate or introduce regulations or methodology gained from states outside the European Union where there is a better understanding between operators and the regulators.

But with the EC decision that the “European Aviation Safety Agency (EASA)” shall take over the responsibility for European wide operation of commercial and non-commercial flights within the next 12 months a window of opportunity is

open to address the specific items of seaplane operation into the new rule making process. Therefore the audience appreciated the presence of Mr. Willy Sigl - the “Air Operations Officer” from EASA. He gave an overview about the running process of taking over the responsibility for operation from national authorities to EASA.

EASA is updating existing rules and implementing new rules according to market demands in a continuous process in order to:

- Establish and maintain a high uniform level of safety
- Align rules with ICAO SARPS and the content of existing rules as far as possible
- Promote performance based rulemaking
- Consider the proportionality of rules
- Provide flexibility to address diverse operational needs and circumstances
- Promote cost-efficiency in the certification and oversight processes

Some parts of the new rules are already drafted and published for gathering comments. End of this year a formal approval by the EC authorities is expected. Other parts are still in the working process.
Mr. Sigl checked the rules with respect to special chapters for seaplane operation. He found only two chapters addressing specific items for seaplane operation. He admitted that these chapters are of minor importance and there are more safety oriented chapters needed. He recognized that there is a need to intensify the dialogue with seaplane operators and producers for defining special rules for commercial and non-commercial flights of seaplanes which may not covered by existing rules for land based aircrafts. In an intensive discussion with the audience Mr. Sigl proposed to establish an interdisciplinary working group of EASA specialists and of experienced seaplane pilots and operators.
In the discussion it was highlighted that there are two main areas of needed actions beside others:

- The establishment of landing sites, their construction, dimensions, management and safety management system.
- The second greyest area is involved with licensing.

Operators intend to establish a European controlled and regulated system of approving or licensing seaplane operating bases acceptable for all commercial seaplane operations (as regular airfields). They should have an accepted method of classification when risk assessment is taken into consideration and

remove the need for an operator to negotiate with various authorities other than their own authority when extending operations within Europe.

The audience requested that FUSETRA shall take the initiative in nominating a group of specialists and being point of contact to EASA.

5 First results of FUSETRA scientific investigations

The universities of Munich, Glasgow and Rzeszow are partners in the FUSETRA program. The universities have the work share dealing with theoretical investigations in context with the analysis of the today's situation of the European seaplane transport system, including a SWOT (strength, weakness, opportunities, threat) analysis.

5.1 Analysis of conditions favourable for seaplane transport system development in Europe

The Department of Aircrafts and Aircraft Engines of Faculty of Mechanical Engineering and Aeronautics of the Rzeszow University of Technology investigated the intermodal potential accessibility of Europe.

The result shows that the accessibility is generally limited and especially poor in parts of Scandinavia, in the new EC countries and in parts of the Iberian Peninsula. Only the central European countries have an excellent multimodal accessibility with its industrial and populated areas (Northern France, Belgium, Dutch, Western Germany and South-East England) (see figure 1).

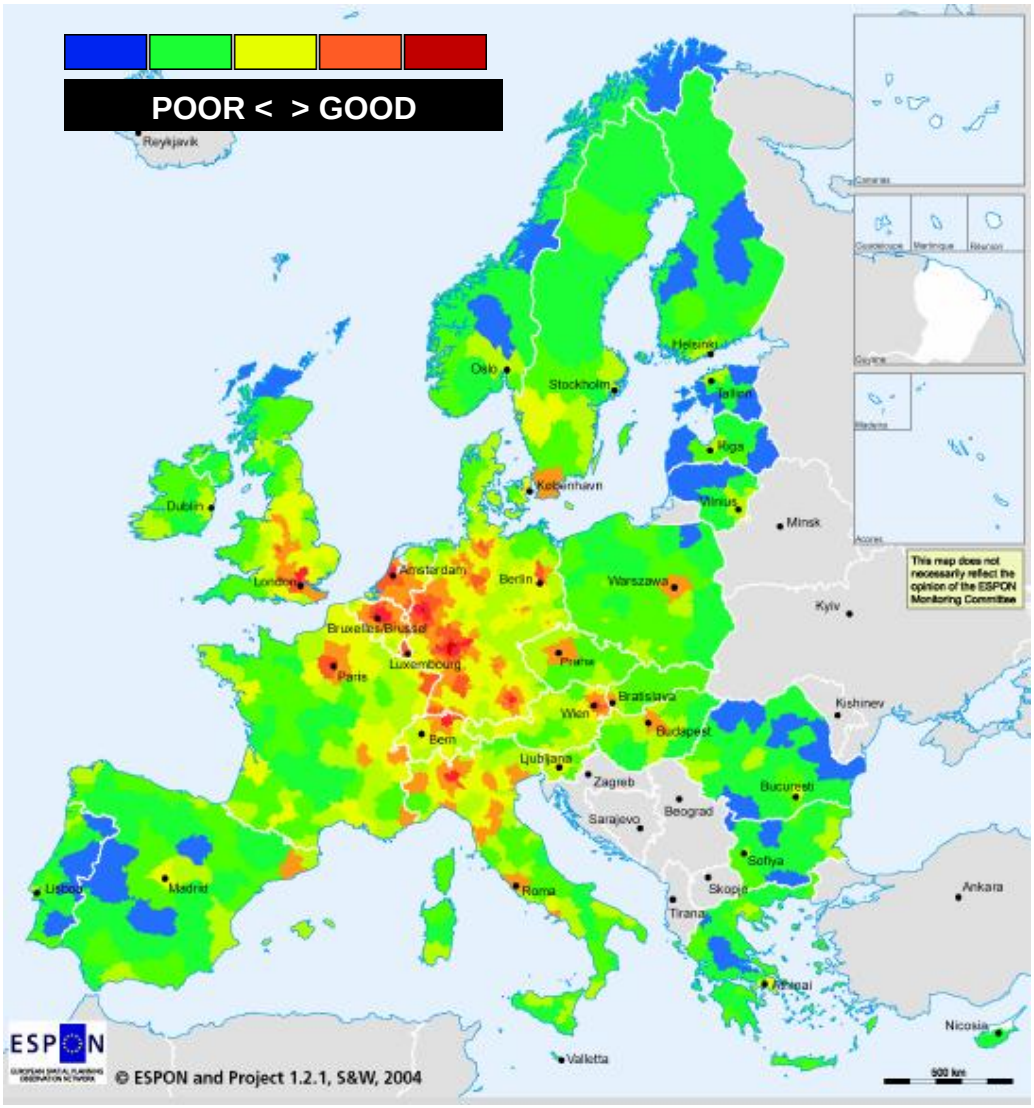

Figure 1: Multimodal potential accessibility in Europe

Looking into more detail to potential landing places for seaplane operation it was found that there are about 1400 potential seaports all over Europe but although in those areas where the accessibility is poor, for the time being. Seaplane operation may be an attractive traffic system for connecting these landscapes to international traffic or industrial or touristic centres. In short the following facts were found:

Europe is a special area with good features favouring the development of regional passenger air transportation system with using seaplanes:

- it has about 1,400 potential seaports (excluding lakes and smaller rivers),
- by optimising the catchment area of the potential seaports main seaports may be selected; there are many cities in the vicinity of the main

European seaports (not fewer than 10 cities with population greater than 50 000 within 50 km radius of each seaport) – passengers can freely choose the most suitable seaport,

- a lot of European population (potential passengers) live close to main seaports – approximately 100 000 inhabitants within 40 km radius of a seaport,
- 20% of European (26% of EU) citizens lives in catchment areas of seaports
- Number of tourist visiting regions lies in catchment areas of seaports (at least 130)

These are some preliminary results showing that seaplane operation may fill a traffic gap in various locations in Europe. Of course beside the seaport location the whole traffic system with the necessary network with road and rail connection has additionally to be investigated.

Based on the regional statistics Rzeszow University made some flight mission calculations and compared the need with aircrafts characteristics of existing and new seaplanes. Beside new flying boats and amphibians Rzeszow emphasised on modification of existing land-based aircrafts. For 8 single and 4 twin engine aircrafts mission calculation were accomplished and it is demonstrated that the mission needs could also be achieved by the modification of existing land based aircrafts. For finding the most effective aircraft the different aircrafts and missions were compared by calculating a relative transport efficiency factor, the direct operating cost (DOC) and a ticket price.

5.2 Long term future opportunities for seaplanes operations

The team of the Design and Structures Group of the University of Glasgow are involved in the analysis and investigation about strengths, weaknesses and opportunities of seaplane operation in Europe. The key word for introducing or widen a new transport system is “sustainability”. Sustainability depends on the wellbeing of the natural world as whole and the responsible use of natural resources.

The aeronautical community in EC (governments, industries, airports, flight control centres, etc.) have committed to a sustainable future in the EC approved strategic paper ACARE Vision 2020. Guidelines including requirements with fixed improvement figures till 2020 are:

- more affordable
- safer
- cleaner
- quieter

An important parameters are environmental impacts especially air and water pollution in case of seaplane operation. Here controversial statements and public opinion can be found. Contrary to public opinion American studies came to the following result:

- Air quality: no impact
- Water quality: no impact
- Soil quality: no impact
- Wildlife: no impact
- Fisheries: no impact
- Hydrology: no impact

Noise	**dBA**	**Example**
Military jet	120+	
Jet ski	110	e.g. watersports on lake
Chainsaw	100-104	e.g. tree felling/forestry/logging
Grass Cutting	88-100	Golf courses
Tractors	95	e.g. general operations
All terrain vehicles	85	
Speedboat	65-95	e.g. watersports on lake
Seaplane	75	on take-off only @ 300m (20 sec)
Inside car – 30 mph	68-73	
Normal conversation	65	

Table 1: Noise levels

Table 1 shows a comparison of noise levels. Even in a take-off mode the aircraft noise is acceptable whereupon it should be considered that new

technologies are available even today for reducing the noise level of future seaplanes considerably.

Comparing with ACARE Vision 2020 the following strength of seaplane operation can be achieved:

- point to point connections
- connections to very difficult to reach places
- safe and efficient surveillance in otherwise inaccessible destinations
- sightseeing tours/tourism
- Safety: ability to conduct rescue operations over large bodies of water

As future opportunities for seaplane operation including aircrafts and infrastructure on a long term the Glasgow team mentioned:

- Investments in new technology and materials
- Avionics systems (lighten the burdens on the pilot, help making correct decisions and reduce human error, night flight)
- New seaplanes/amphibians advance design
- Larger seaplanes with better range and less affected by weather conditions
- Efficient, safe, comfortable infrastructures (seaports, docking facilities, accessibility…)

Market and mission investigations show that there is a need for more effective aircrafts. As the team from Rzeszow the Glasgow engineers made proposals for better aircrafts and proposed beside new design ideas modifications of land based aircrafts into sea based, as well.

6 Break Through

Although the investigations are not yet terminated an important result was achieved within the third workshop. Thanks to the presence of Mr. Sigl from EASA a progress was achieved for solving the nearly daily problems of permissions and certifications. EASA agreed that there is need for action and proposed to form an interdisciplinary working group.