

2nd CARGO AIRSHIPS FOR NORHERN OPERATIONS WORKSHOP, ANCHORAGE, ALASKA

*"The road is long,
supplies are costly,
seasons are short,
Fortune is fickle."*

*Alaska Mining Record, Juneau, 1895.
Highlighted by Senator Lesil McGuire, Alaska Senate*

Introduction

In 2011 the State of Alaska and NASA's Ames Research Center co-organised a cargo airship workshop at the University of Alaska Anchorage. It focused on operational considerations and requirements of heavy-lift cargo airships. Practical approaches to developing and deploying airship systems for commercial transport of goods and materials were discussed.

Airship experts described the possibilities heavy lift airship transport offers, and the challenges of developing practical and cost effective airship systems. An introduction to the basics of airship technologies, regulatory issues, weather issues, the likely capabilities and limitations of heavy lift airships and the current to near-term technology readiness of these aircraft were also presented.

The 2011 workshop was succeeded by the 2nd Cargo Airships for Northern Operations Workshop, held in Anchorage, Alaska during the period 21-23 August 2012.

Researchers from NASA Ames Research Center provided insights into the new technologies that form the solid engineering basis for modern cargo airship systems. Speakers from the mining, oil, and gas industries described their transportation challenges and how they plan to exploit cargo airships in support of their businesses. Local Alaskan air freight firms explained how cargo airships could complement existing air transport fleets by providing additional capability and expand air shipping services. Leading developers of airships provided design and operational details on new cargo airships currently being developed for commercial service. Representatives from the financial community presented options available for what has often been the missing element of airship development and operations, funding

Keynote Speakers

Two keynote speakers were present.

The Honourable Mead Treadwell, Lieutenant Governor of the state of Alaska gave the first keynote address.

He stressed that the focus of the conference was the business of using hybrid airships to transport cargo in Alaska. He advised that Alaska is a ready made market for airship technology.

He also stated that it was exciting to see modern airship milestones such as the:

- LEMV flight
- Proposed World Airship Race

Alaska has a record of adopting, promoting and developing new technology. Moreover, Alaska will offer a ready made market as soon as airships are shown to work. The technology must meet market demands.

Alaska has a population of about 720,000. 85% of communities accommodating one third of the population are not connected by roads. However, there is an urgent need to provide cost effective freight and communications in the State.

The second keynote speaker was Senator Lesil McGuire a Republican member of the Alaska Senate.

Senator McGuire focused on funding issues aimed at helping developing airships for use in Alaska. Four schemes were covered:

- **Emerging Energy Technology Fund** - to receive grants from the fund, the benefiting project must be for the research, development, or demonstration of a new energy or conservation technology or for the improvement of an existing technology, with the reasonable expectation the technology will be commercially viable within 5 years. Senator McGuire advised that air cargo airship systems could be part of the scheme.
- **Tax Credits** – could be offered to provide indirect support for airship developments through tax credits by including airship transportation in transportation carbon credit programs.
- **Low Interest Loans** – offers opportunities for private enterprise to borrow money from Alaska at a low interest rate.
- **Public Private Partnerships** - are contractual arrangements between private partners and public sponsors that facilitate private infrastructure investment.

Senator McGuire stressed that one objective of cargo airship operations was to reduce the amount of energy used in Alaska.

Summary of 1st Cargo Airship Workshop

1. The workshop's theme was to:

- Find a practical approach to satisfy the Benefits of transporting large and heavy supplies together with fuel, equipment, building material and goods.
 - Bring together the government and industrial experts in an airship technology environment.
 - Explore the possibilities that cargo airships offer and the challenge of developing practical, cost effective heavy lift airships.
2. Airships must demonstrate cost effectiveness, taking into account the impact of distance and remoteness associated with disasters and emergencies in Alaska.
 3. Airships need to provide regular resupply to remote communities in place of shipping annual stockpiles of using expensive ice roads.
 4. Airships will lead to the retirement of old, high fuel consuming aircraft.
 5. Modern technology offers airships that do not require infrastructures or ground support.
 6. Twenty metric tons represents a good initial baseline of payload capability. The heaviest piece of oil drilling equipment weighs 11,000 lbs.
 7. The State of Alaska needs to engage with airship developers to ensure that airships support the needs of Alaskan citizens.
 8. Only a successful demonstration of a viable airship will provide assurance public and private investors that airships can operate safely and cost effectively.
 9. Government help may be available where airships are included in transportation carbon credit programs.
 10. Economic assessment of cargo airship operations in Alaska shows potential increases in jobs, State revenues, business profits. In addition, in remote areas environmental protection and quality of life will improve.

Current Transport

Salient features given under this heading were presented by the Director of the Alaska University Transportation Centre. While his presentation was made towards the end of the Workshop I felt it useful to include the information in the early part of this report; basically it outlines thinking behind the need for cargo airships.

Currently the Alaska's transport needs are serviced by:

- **Barges** - carry 1,000 tons plus of cargo. They require navigable waters. The

operating window is limited to the summer months. Barges travel at a speed of about 10 knots.

- **Cargo Aircraft** - the aviation infrastructure expanded instead of most roads. The aircraft, mainly with a capacity of 8 to 10 seats, operate all the year round. However, destinations are limited by airport availability. Maximum load capacity of aircraft is about 10 tons, although a small number of C130 aircraft flown by Lender air cargo can carry greater loads. About 10% of jobs in Alaska are in aviation.
- **Helicopters** - can only cover relatively short distances. Load capacity is between 10 and 18 tons.
- **Ice Roads**- are frozen, human-made structures on the surface of bays, rivers, lakes, or seas in the far north. Trucks operate on these roads carrying construction equipment and gravel to service oil and gas exploration needs. They can carry loads of up to 100 tons. However, the operating season is limited to 2 to 3 months. Global warming has reduced this window; it used to be about 200 days per year. Permitting requirements for this form of transport are very costly.

Modern technology offer airships that do not require road, rail or port infrastructures. They can transport loads without being limited by the environment or seasons.

However, market penetration has been inhibited by past perceptions, particularly with respect to safety. What were previous areas of concern have been rendered less problematic by modern airship technology.

- **Safety** – technological progress has overcome past concerns.
- **Infrastructure** – requirements and cost are minimal.
- **Demand** – airships can meet requirements that no alternative form of transport can address.
- **Speed** - speed of response of an airship is important
- **Weather** – views expressed were that weather will only adversely impact on operations for about 10% of the time.

Presentations

Topics presented are summarised below.

❖ **United Nations World Food Program (WFP) – Airship Niche Market Applications**

WFP logistics:

- Sea – 30 ships at sea on any one day. In 2011 1600 shipments carried 2.5 million tonnes to 70 ports.
- Land – 4,000 trucks are on the road every day. \$ million tonnes of cargo carried in

2011.

- Air – 60 aircraft are airborne every day.
- WFP needs airlifts and air drops.

WFP views that 3 airship market niches exist:

1. Aerial survey and light cargo.
2. Medium sized cargo (20 to 50 metric tons) for regional use where road access is poor.
3. Large sized cargo (300 to 500 metric tons) for intercontinental use.

❖ **Large Airships – Risk Factors and Critical Design Elements** – Dr J Melton from NASA Ames Research Center highlighted some of the critical design elements and risk factors that airship designers must deal with. He stated that there is a need to develop airship engineering culture at US universities.

He highlighted 3 areas of risk:

- Economic Environment
- Engineering
- Northern Operations.

The Northern Operations Risks are given below:

- Extended empty backhaul/ferry flight.
- Environmental sensitivities.
- Remote wilderness.
- Extended darkness.
- Extreme weather conditions.
- Northern temperature range.
- Terrain.
- Challenge of testing in relevant conditions and environment.
- Fuel, spares and technician availability.
- Over 80% of community not connected by road.

❖ **Weather Modelling** – Dr A Sarma gave a presentation of a weather modelling tool for cargo airship flights in Alaska. His presentation covered:

Weather hazards to airship operation

- Hazard mitigation
- Weather over complex terrain - Prediction
 - Route planning and optimization - Severe weather avoidance and finding

favourable winds.

Dr Sarma demonstrated outputs from a very sophisticated modelling tool that allowed simulation of route optimisation using a Monte Carlo analysis approach.

- ❖ **Simulation Tools for Airship Design and Operations** – NASA Ames gave a presentation of Airship modelling and simulation capabilities.



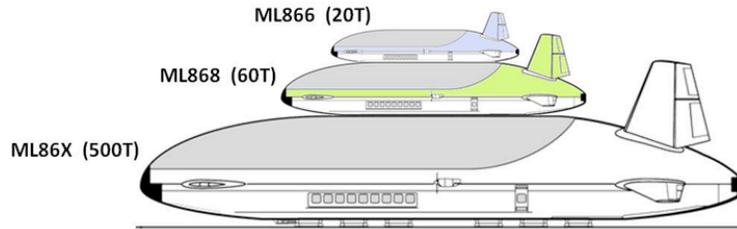
- ❖ **Airship Venture Deployment to Anchorage 2013** - Francis Govers, Special Missions Manager for Airship Adventures, said his company has planned a tentative route to fly its 246-foot helium-filled Zeppelin airship to Alaska next June and will decide by the end of the year if it lines up industry partners. Cruise ship companies and documentary makers are possibilities for joint ventures.

- ❖ **Airship Presentations**

- **First Helium Airship Designed and Built in Canada** – Barry Prentice described the 80-foot blimp built by Buoyant Aircraft Systems International (BASI) and non-profit research institute, ISO Polar, to study airship technology for its suitability for transport to challenging Northern Canada locations. He advised that Canada has almost no history of airship operations or manufacture. He was critical of the incompetence of the policy branch responsible for airworthiness regulations and certification. He views that the incompetence has inhibited progress for 10 years. He drew attention to CAR 542.7

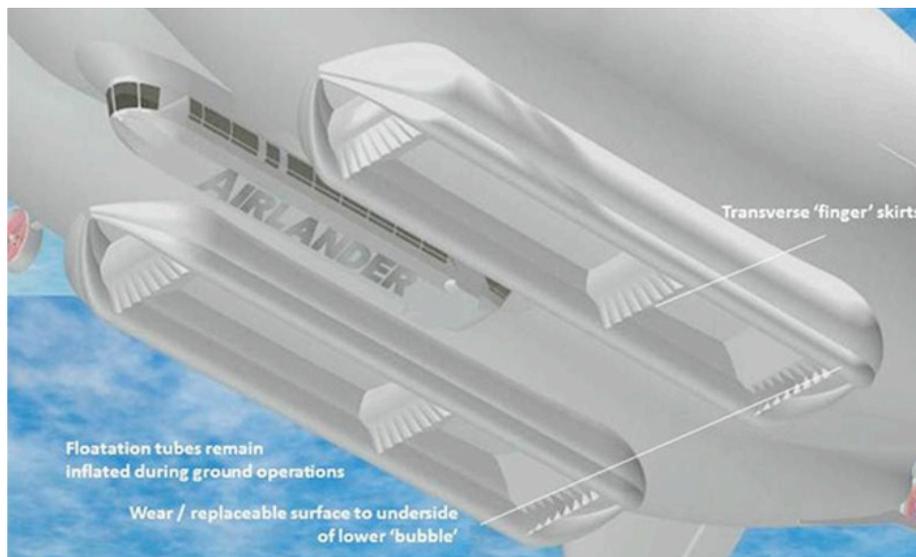
which states: “Hydrogen is not an acceptable lifting gas in airships”.

- **Aeroscraft** – gave a presentation and status of plans for deployment of hybrid cargo airships in Alaska and Canada.



	Aeroscraft ML866	Aeroscraft ML868	Aeroscraft ML86X
Length (ft)	310	500	787
Span (ft)	142	160	184
Max Payload (tons)	20	60	500
Range at Max Payload (nm)	1,000	3,100	5,300
Max Speed (kts)	120	120	120
Cruise Speed (kts)	100	100	100
Max Altitude	12,000	12,000	12,000
Vertical Takeoff and Landing at Max Payload	Yes	Yes	Yes
Onshore/Offshore Direct -to-Site Delivery	Yes	Yes	Yes

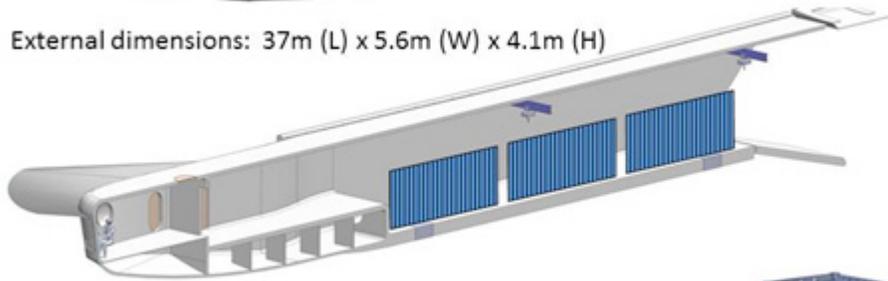
- **HAV “Airlander”** – Hardy Gielser, HAV’s Business Development Director, gave a presentation on HAV’s Airlander.



He stressed HAV’s product strategy: “Minimum disruption to the planet while giving maximum opportunity for people”.



External dimensions: 37m (L) x 5.6m (W) x 4.1m (H)

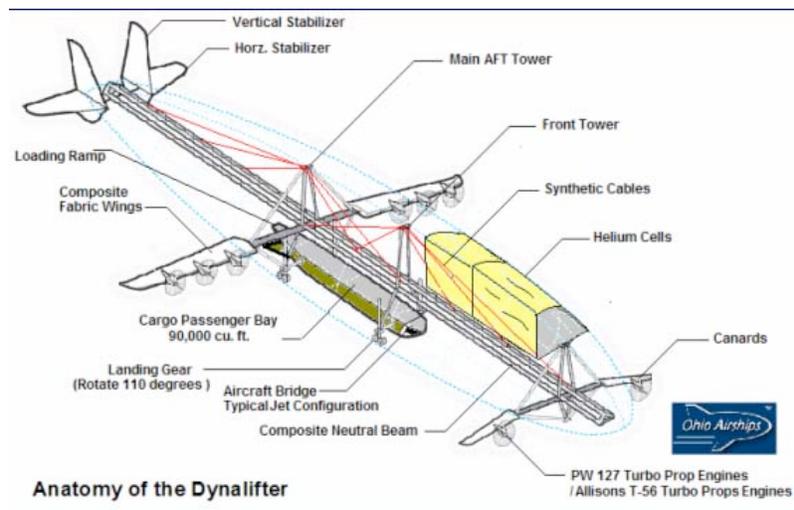


Holds 6 x 20 ft. ISO containers (3 x 2)

- **Lockheed Martin Skytug** – the SkyTug is a scaled-up version of the Skunks' P-791 demonstrator, flown in 2006, and looks a lot like the hybrid air vehicle Lockheed offered for the US Army's LEMV programme.

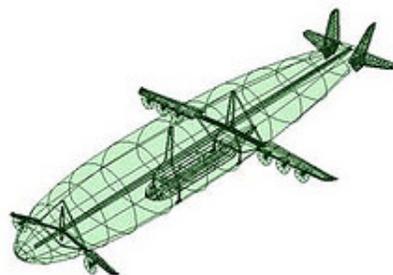


- **Varialift** – Alan Handley presented his Varialift concept. The Varialift section prototype testing was completed in November 2011 when the test flight was successfully conducted and the unit lifted off the ground under full control using its variable buoyancy units.
- **Dynalifter** – requires a runway for take-off and landing. Consequently its application for the vast majority of applications in Alaska has to be questioned.



Concept

- **Not Lighter-Than-Air (NOT ABLIMP)**
- **Aerodynamics provides about half of total lift**
- **Takeoff and land like an aircraft: wheels on a runway**
- **Hull is integrated with wing for dynamic lift generating**
- **Patented structure allows aircraft and airship integration**
- **Huge Cargo Bay/ Large Useful Gross Weight Capability**
- **Patented Structure Allows Concentrated Loading of Cargo**
- **Short Takeoff and Landing Capability**
- **All Weather Ruggedness**
- **Long Range/ Persistent Loitering**
- **5 X the speed of a surface ship**



- **Augur “Atlant”** – Michael Talsnikov gave a presentation on status of plans to deploy cargo airships in Russia. He highlighted the lack of roads in Siberia compared to European Russia (European Russ 56 m per m², West Siberia 0.42m per km², East Siberia 0.32 m per km²). He highlighted winter weather conditions in Siberia – wind-speed 60 knots, Snow fall 40 inches per day, temperature down as far as -55⁰C. The presentation included a hybrid airship design with a rigid skin. Questions were asked about the impact of hail and ice on the skin. The company also highlighted potential economic and supply issues affecting helium highlighting

exploring the use of phlegmatized hydrogen – phlegmatizing additives in hydrogen can suppress explosions in a closed volume [1].

❖ **Integrating Maintenance into Airship Design** – basically I gave the same presentation that I gave in Kent. However, I modified it to include ideas and examples of how a \$ per flying hour maintenance cost target (I used the publicly published Skycat 20 figure of \$995 per FH) can be broken down into sub system and component targets together with associated labour and material cost ratios. I also showed how to develop maintenance man-hour per flying hour figures. I also suggested that NASA might want to establish Cost Estimating Relationships (CERs) for airship maintenance costs; the first such CERs were developed in about 1936, the latest in about 1970. I also drew attention to the status of that the Air Transport Association's ATA 100 system chapter breakdown with respect to airships. While it includes areas of airship systems I view that it does not effectively cover all those areas needed. My presentation was the only one that attempted to portray development of economic issues involved in cargo airship operations.

❖ **Commercial Heavy Lift Air Transport in Alaska** – this was a pragmatic but very interesting presentation by the Schedule Services Sales Manager of Lynden Air cargo, a company operating C 130 aircraft. The issues and problems experienced were very well described (e.g. air - freighting a whale, loading a crate with one inch to spare either side with respect to the aircraft's loading area, landing on very rough airstrips, landing on frozen lakes). The presentation more than shored what was expected of a cargo airship.

❖ **Cargo Airships – A Business Case** – NASA commissioned a study on the cargo airship market potential. Salient features are given below.

- **Why airships?** - faster point to point, energy efficient, low impact on the environment, versatile (minimal infrastructure required). Airships do not require road, rail, port infrastructure. They can remove restrictions on location of facilities. They are not limited by the environment or seasons and can move goods from factory to community in an uninterrupted trip. Fuel costs are 35 to 50% of current cargo aircraft costs. Cargo airship delivery 1 – 3 days, ocean delivery time 6 to 8 weeks.
- **Market potential** – inhibited by past perceptions. What were previous concerns about airships have been rendered less problematic by modern airship technology. Market potentials are:
 - **Near term (by 2012 +)** – 25 ton payload for access to remote areas. Business opportunity \$250 million to \$1.5 billion
 - **Mid term (2015 +)** – 100 tonne payload. Business opportunity \$1.5 billion to \$3 billion.
 - **Long Term (2020 +)** – 500 ton payload. Business opportunity \$3 billion to \$5 billion

billion.

❖ **Heavy Lift Airships in Support of Mining Operations** – the presentation outlined the potential for heavy lift airships in mining operations. Applications of airships in different phases of mining operations are summarised below:

- **Exploration** – magnetic survey, aerial photography, aerial survey, drilling support, environmental studies, core sample transport.
- **Production** – transport out of concentrate and waste products, transport in of food, chemicals, processing equipment, parts and maintenance requirements.
- **Closure** – transport equipment out, transport chemicals in, environmental monitoring.

Operations will include carrying hazardous cargos (e.g. explosives, chemicals).

❖ **A Day in Alaska** – this was very informative. The speaker described typical activities in the daily lives of engineers and technicians working in the remote areas of Alaska. Cold, wet, windy, dark – all understate the environment. “By the way you won't even get bunks for your crew, since most of the activities are compressed to a few months in the summer”. Getting spares for your airship – carrying them with you. Maintenance technicians – carry them with you. This reinforced the idea of on board maintenance capabilities. I view that the requirement will need careful analysis and may well affect design issues. An airship, like a conventional aircraft will have a Master Minimum Equipment List (MMEL); it defines the Go/ No Go items covering the clearance of the vessel to fly. The list may demand a considerable number of on board spares. Redundancy in design may well accommodate some areas. Both have cost implications. Also maintenance disciplines (such as propulsion, avionics, structures, electrical) will certainly influence the number of maintenance personnel that have to be carried on a flight.

❖ **Financing Cargo Airship Development and Operations** – this presentation described the nature of project financing, issues facing investors and lenders together with criteria used to evaluate financial requests.

❖ **Financing for Deployment of Airships in Alaska** - this presentation covered funding options and approached for cargo airship development, deployment and support infrastructure requirements. It added meat to the information given by Senator McGuire.

Panel Discussion

Four questions were asked of panel members made up of Alaskan experts in the field of

aerospace and transportation.

Question 1 – what would you see as the principal opportunities for cargo operations in the State of Alaska.

Response:

- ❖ Alaska relies in many areas on air transport with heavy reliance on air taxis (8 to 10 seat aircraft).
- ❖ The cost of energy and fuel inhibits the communities. There is a need to lower the cost of living in these communities.
- ❖ Opportunities to service the communities.
- ❖ Ice roads are expensive from an operational point of view. In addition, ice roads used to be available for 200 days in a year; availability is now far less because of global warming.
- ❖ Exploration of off shore oil and gas opportunities.
- ❖ Off road transport is expensive and hard to get around. The land is covered in areas bounded by National parks. There is resistance to building roads. Consequently other means of transport are required that are alternative to barges and aircraft.
- ❖ Fuel is stocked in the communities on an annual basis. Consequently there is only a narrow window in which to buy fuel. The fickle nature of oils markets is not beneficial to the acquisition process. All year opportunity of fuel delivery would greatly improve matters.

Question 2 – If a cargo airship demonstration was set up in Alaska what sort of capabilities would airships have to show?

Response:

- ❖ Coping with the weather. Vast extremes of weather conditions are experienced. Icing is a critical factor.
- ❖ Speed of response of an airship is important.
- ❖ Demonstration that airship operations are cost effective.
- ❖ Effective competition with existing transport systems.
- ❖ Show existing customers that airships work; competitors will buy into airships if they do.

Question 3 – What are the main issues holding back deployment of cargo airships in Alaska?

Response:

- ❖ An effective business plan. The customer need exists. What is difficult is bridging the financial issues involved; that is how to finance the project to make it affordable.

Question 4 – What specific actions have to be taken and by whom to get airships operating?

Response:

- ❖ Financing – Alaska State, Financial institutions, manufacturers, operators.
- ❖ Investment in facilities.

Lieutenant General Craig Campbell, Alaska National Guard (Ret'd) and Lieutenant Governor Alaska (Ret'd) and now CEO Alaska Aerospace Corporation further advised that with the thawing of ice in the Arctic's North West Passage border security and territorial protection has become an important issue. The situation could lead to the US Coastguard using airships for security surveillance. He further advised that with 30,000 miles of coastline, Alaska has more coastline than the rest of the states combined.

Closing Presentation

Salient features of the closing presentation are given below:

- ❖ Alaska is ready for cargo Airship operations.
- ❖ Users need to define use cases and requirements balancing utilisation and cost.
- ❖ Designers need to define design and operating parameters to satisfy customer requirements.
- ❖ Operators need regulations and standards.
- ❖ NASA needs to explore what is needed in the way of propulsion systems.
- ❖ NASA needs to design the airspace environment to incorporate airships.
- ❖ Runway independent operations are needed.
- ❖ Where are prizes to motivate airship development?

Proposed World Airship Race - Don Harstell gave an informal presentation on the race during a coffee break. He told us about the race and outlined some of the provisional route.

Start point - Greenwich then onto Berlin, Rome, Egypt (landing at the pyramids) the Dubai, India, Sri Lanka, Indonesia, Malaysia, Vietnam, China (at the Great Wall) then across the Pacific to Hawaii and the either Anchorage of San Francisco and then across the USA, over the Atlantic and ending at Versailles. Race duration - 180 days. Don Harstell was in Anchorage to discuss the option of the route coming through Alaska.

The World Air League will fund and position certain support equipment; operators would also be responsible for certain aspects of their own support needs.

Don Harstell also said that the first race would be limited to existing vessels. Another one three years later would be aimed at new technology airships.

The Airship world at the conference, including NASA, seeks a competition and made those views known well before Don Harstell gave his informal presentation. Also during the closing presentation given by NASA the need for a competition was stressed but without any reference to the World Air League.

Issues Not Addressed Effectively

One very important issue stressed in the first Workshop held in 2011 was the need to demonstrate that airships can operate safely and cost effectively. This message was repeated in the second workshop. However, in the 2nd Workshop I view that presentations by airship manufacturers lacked effective technical and economic information (Acquisition, Operating, Maintenance and Support Costs) with respect to these issues. Very little economic information was presented.

Ice and snow offer major operating difficulties that will affect safety. The icing and snow load issues were raised several times by delegates, but not satisfactorily addressed by airship manufactures attending the workshop. Also the impact of hail and ice on lightweight monocoque structures was not addressed effectively. All the airship manufactures concentrated on marketing presentations that lacked sufficient information to address technical and commercial matters.

Another issue that prompted discussion were the question marks hanging over Airship Airworthiness and Certification Regulations. The FAA does not have airship certification regulations; it does have the 'Airship Design Criteria (ADC)' [2]. Canadian Aviation Regulations (CARs) address airships in Airworthiness Manual Chapter 541. CARs refer to the ADC; chapter 541 covers the following:

- **Subchapter A**
 - 541.1- Applicability
 - 541.3 - Definitions
 - 541.5 - Airship Standards

- 541.7 - Lifting Gas
- 541.9 - Reserved
- 541.11 - Reserved
- 541.13 - Markings and Placards - Fuel and Oil Filler Openings
- 541.15 - Reserved

The last change to 541.1 appears to be dated 2005.

FAA representatives at the Workshop stated that we should not sit back and wait for the certification document to be updated. The FAA and airship manufacturers would have to work together to document requirements. One delegate thought that using certification regulations for experimental aircraft would be acceptable; the FAA firmly squashed this approach. However, the FAA and Transport Canada are considering developing joint certification regulations.

Finally, two different cargo airship designs were presented by manufacturers; hybrid airships with a flexible envelope and a hybrid airship with a rigid skin. Surprisingly nobody sought a discussion on the pros and cons of each approach, with focus on operating in the aggressive Alaskan weather conditions.

Conclusions

- ❖ Overall the workshop was excellent. The views, expectations and concerns about cargo airship operations were effectively aired and well discussed.
- ❖ There is an urgent need to provide cost effective freight and communications in the State of Alaska. Alaska is a ready-made market for airship technology. However, airship manufacturers need to demonstrate that airships can operate safely and cost effectively.
- ❖ Markets exist for cargo airships with payload capacities of 20 to 25, 100 and 300 to 500 metric tons in the short, mid and long terms.
- ❖ The State of Alaska needs to see more than just proof of concept models but cargo airships giving full demonstrations of capability, safety and cost effectiveness.
- ❖ Issues of the impact of ice and snow on airship operations need more assertive action.
- ❖ On board maintenance issues need analyzing.
- ❖ Cargo airship certification regulations need assertive action.
- ❖ Manufacturers were advised of opportunities to help fund airship programmes.
- ❖ Alaska presents very aggressive weather conditions. Doubtless different views exist regarding the robustness and suitability of flexible envelope airships and rigid skin vessels in such conditions. Has any associated research been carried out?

The panel session effectively highlights most of the broad issues involved in developing cargo airship operations in Alaska. Financing manufacture, acquisition and operations seems to be a major issue facing the airship community players.

Rob Knotts
28 August 2012

References:

[1] VE Fortov et al, "Physics of Extreme States of Matter", Institute of Problems of Chemical Physics, Russian Academy of Sciences, 2011.

[2] Ron Hochstetler "Airship Insurance, Regulations, and Other Legalities", August 24, 2011, <http://event.arc.nasa.gov/airships/sites/default/files/pdf/RonHochstetler.pdf>