ALASKA STATE LEGISLATURE
HOUSE SPECIAL COMMITTEE ON ENERGY
April 4, 2017
10:19 a.m.

MEMBERS PRESENT

Representative Adam Wool, Chair
Representative Ivy Spohnholz, Vice Chair
Representative Dean Westlake
Representative DeLena Johnson
Representative Jennifer Johnston

MEMBERS ABSENT

Representative Matt Claman
Representative George Rauscher

COMMITTEE CALENDAR

PRESENTATION: HYBRID AIRSHIPS: Opening New Frontiers

- HEARD

PREVIOUS COMMITTEE ACTION

No previous action to record

WITNESS REGISTER

CRAIG JOHNSTON, Director
Business Strategy and Development
Lockheed Martin
Palmdale, CA
POSITION STATEMENT: Presented a PowerPoint on hybrid airships.

NICK MASTRODICASA
Office of Project Management & Permitting
Department of Natural Resources
Anchorage, Alaska
POSITION STATEMENT: Testified during the presentation on hybrid airships.

ACTION NARRATIVE

10:19:10 AM

CHAIR ADAM WOOL called the House Special Committee on Energy meeting to order at 10:19 a.m. Representatives Wool, Spohnholz, Johnston, and Westlake were present at the call to order. Representative Johnson arrived as the meeting was in progress.

Presentation: Hybrid Airships: Opening New Frontiers

10:19:29 AM

CHAIR WOOL announced that the only order of business would be a presentation on Hybrid Airships: Opening New Frontiers

10:19:59 AM

CRAIG JOHNSTON, Director, Business Strategy and Development, Lockheed Martin, shared some of his background and that of his employer, Lockheed Martin. He stated that the company was a conglomeration of many aerospace companies, was about 100 years old, and had about 100,000 employees in about 80 countries worldwide. He said that the company was primarily in the defense and military sectors, although they were increasing movement into civil and commercial sectors. He reported that he worked in the Skunk Works Division, which had been around for about 75 years. He said this division was mainly involved in aviation and was driven by urgent national needs, pointing to the introduction of the first jet fighter in 1943, the XP-80. He noted this long history of innovation and mentioned the development of the early spy planes, including the U-2 and the SR-71, as well as the stealth fighters. He highlighted some of the projects relative to energy, which were comparatively new to the company. He shared that this new business area was focused on five areas: energy management which involved complex systems engineering, energy storage and nuclear systems which focused on safety and controls, tidal and bio energy, and advanced energy means which included wind to power conversion. He spoke about the wind to power conversion which was put on the outside of buildings to generate energy in an aesthetic way. He reported on advanced technology for energy infrastructure inspections, with sensors to detect leakage in remote areas. He spoke about advanced plasma research to lock the power of fusion energy with compact fusion reactors.

10:25:03 AM

MR. JOHNSTON directed attention to the PowerPoint titled "Hybrid Airships: Opening New Frontiers." He spoke about slide 1, and

the branding of Lockheed Martin and Hybrid Enterprises in the commercial marketplace.

MR. JOHNSTON introduced slide 2, "Why Airships?" and shared two antique representations. He said that ships provided a very efficient way for carrying cargo because of the buoyancy, and they only needed a small amount of energy, often free wind energy, to move them. He stated that on the water the lift was free and the propulsion to push it forward was at a very low cost. He introduced the idea of using air, instead of water, for buoyancy by means of heated air, helium, or hydrogen, which was also a free lift. However, he pointed out that in the air there was less control, so some of the older renditions were challenged. He asked how to get the best of both modes, the ship and the air. He moved on to slide 3, "Airship Types," and listed the blimps, with no rigid structure and reliant on a lighter than air gas; the semi-rigid with a propulsion system which was dispersed; and the rigid airships which were massive with aluminum structures underneath and became more economical as they got larger. He shared the story of the Norge, a semi-rigid airship launched in the 1920s with the intention of flying over the North Pole, before making an eventful landing in the Arctic, being disassembled and never being flown again. He shared slide 4, "Concepts & Prototypes," which highlighted pictures of various airships as depicted on www.airship-association.org. He described the approach which capitalized on the power of the helicopter with lighter than air technology and the concept using mechanisms which controlled the buoyancy needed for up and down by compression of the lighter than air gas. He pointed out that this technology could be quite expensive.

MR. JOHNSTON, in response to Representative Johnson, said that the Norge was built for the U.S. Army through the contractor, Northrup Grumman. He explained that a company in the United Kingdom helped with the development of the airship.

MR. JOHNSTON returned to slide 5, a video, "What is Hybrid Lift?" He moved on to slide 6, "What is Hybrid Lift?" He said that one key element was buoyant lift, as provided by the helium gas; although the lift was free, a downside was that it was always on, and unable to be turned off. He said that the use of aerodynamics combined with lift allowed for forward operation, and not just flotation. He added that this also offered protection against any environmental conditions. He relayed that nominally about 20 percent of the lift was provided by the

aerodynamics, but if environmental conditions dictated, the angle of attack could be increased to provide more lift.

CHAIR WOOL asked if snow and ice were a huge concern.

MR. JOHNSTON explained that this was dependent on whether the airship was on the ground or in flight. He explained that, as a ship, it was designed with predictive capabilities to decide where was the safest place to be during an impending storm. He offered an example for a snow storm, and stated that the safest action, from an economic and safety standpoint, was to launch the airship and leave port. He said that the snow presented a bigger challenge on the ground than in-flight, as it was less likely for an accumulation of snow during flight. He explained that ice was a bit different, as for an airship the ice would create weight, even though it did not disrupt airflow.

REPRESENTATIVE WESTLAKE asked if the airships had a stall speed.

MR. JOHNSTON explained that, although a stall could be achieved, it was not in the normal sense for a fixed wing aircraft. He said that if there were an increase to the lift requirements that could not be met, ultimately, the airship would start to come down. He pointed out that a safety feature to this system was that "nothing happens very quickly." He compared this to a slowly descending parachute.

REPRESENTATIVE JOHNSTON asked if the airship pilots were studying the air currents, similar to fixed wing pilots.

MR. JOHNSTON, in response, addressed slide 7, "Our Hybrid Airship," and said that the direct lift from the propulsion system was also important. He reported that the LMH-1, which would be the first airship they would build, had four propulsion systems attached to the outside of the airship. As this was a non-rigid structure, the inside pressure was used to provide a stiff enough surface for attachment of the propulsion systems. He explained that the propulsion system supported both forward flight and the flight control system. He noted that the pilot only needed to give verbal commands to the flight control system for the airship to maneuver. He pointed out that the flight control system would also account for air currents in planning for the "most economic pathway" to its destination.

REPRESENTATIVE JOHNSTON asked if the on-board weather prediction and route planning used satellite imaging.

MR. JOHNSTON replied that it did, noting that it had the ability for very detailed, real time worldwide weather.

MR. JOHNSTON returned attention to slide 7, and spoke about the aircushion landing system, which was based on hover craft technology. He explained that it only took a small amount of pressure over a very small area to levitate on a cushion of air and move over almost any ground feature without touching.

REPRESENTATIVE JOHNSTON asked if the aero dynamic was still in play during the hover action.

MR. JOHNSTON explained that once in contact with the ground the aero dynamics were a very small component as there was a very low speed. He said that the decision to unload brought the airship into contact with the ground using suction, which created the friction necessary to keep the airship from moving.

REPRESENTATIVE WESTLAKE asked about anchoring.

MR. JOHNSTON replied that a typical operation for a tanker would be the use of on-board auxiliary tanks, which allowed for the most economic flight. He said that the weight had to be managed to ensure maintenance for a state of heaviness. He explained that fuel could be off loaded, and water could be pumped on board to balance the weight for ballast. He pointed out that there could be a weekly fuel run to land bound villages.

10:47:47 AM

MR. JOHNSTON reviewed slide 8, "LMH-1 Interior Layout," and reported that the cargo bay at the back end of the airship was 10 feet by 10 feet by 60 feet, which was slightly larger than an overland tractor trailer, and was capable of 20 metric tons of cargo, about 47,000 pounds. He directed attention to the ballast and cargo fuel saddle tanks which allowed for extra fuel or water for ballast. He explained that there was not a penalty for cargo in the back and people in the front, so that passengers would be at no cost. He shared that the Federal Aviation Administration (FAA) required 2 pilots, although the system was capable of full autonomy, and there were 8 business class seats, although there could be accommodation for 19 passengers. He noted that beyond 19 passengers, the FAA required additional safety features.

MR. JOHNSTON, in response to Representative Westlake, said the airship was a hybrid, with a new type of FAA certification. He

noted that they were working with the FAA for new pilot rules because of the degree of autonomy in modern systems.

CHAIR WOOL asked whether the requirement for two pilots was a large cost component, and if the airship were pilotless, would they still carry passengers.

MR. JOHNSTON replied that this would remain to be seen, as the primary concern of the FAA was safety of the people on board and on the ground. He questioned whether the public was ready to fly with no pilot.

REPRESENTATIVE JOHNSON asked if airspace changes were necessary.

MR. JOHNSTON said that, in general, this worked within the existing system. He pointed out that, as this was an unpressurized system, the maximum altitude was 10,000 feet even though the normal operating altitude was between 1500 - 2500 feet above ground level. He stated that most hybrid airship ports would stay away from airports and would be near airspace controlled by "the operations of these relatively slow things."

10:53:36 AM

MR. JOHNSTON shared slide 9, "Operations," a video which highlighted the business end of the hybrid airship.

MR. JOHNSTON, in response to Representative Johnston, said that the airship was non-rigid, and that the lightweight fabric was similar to Kevlar. He explained that the material was impervious to hydrogen and was strong and lightweight to allow it to be pressurized without a lot of pressure. He said that the design took the load of the gondola and suspended it through curtains hanging inside the airship, and that everything else was on the outside of the airship. He said that the concept had been around for quite a while. He directed attention to the P-791, slide 10, which was the smallest airship able to demonstrate all the requisite technologies, including the tri-lobe hull design, the digital flight control, the fully automated flight control system, and the air cushion landing system. Even though it was 120 feet long, it was not designed to carry cargo.

MR. JOHNSTON directed attention to the LMH-3, a massive airship capable of carrying a million pounds of cargo. He explained that the concept of a large container ship in the air, the size of the Rose Bowl, was "just a bridge too far" as a place to

start. He explained that the smallest size airship that made economic sense was the LMH-1, which could handle a truck. He said that this would make sense in remote areas without dedicated infrastructure, areas that would otherwise use a heavy lift helicopter. He noted that this was a much lower cost option, comparable to other forms of transportation in remote areas. He pointed out that the next step to a 400-foot-long airship with a larger payload was challenged with a need for a new manufacturing infrastructure.

MR. JOHNSTON, in response to Representative Westlake, replied that downdrafts were not a significant factor as much of the lift was on continually.

MR. JOHNSTON shared the video on slide 11, "Demonstrator Flight," and reported that with reduced payloads, the airship could perform vertical operations similar to a hot-air balloon.

MR. JOHNSTON, in response to Chair Wool, said that the larger thrusters and the aerodynamics, which allowed for a reduction in drag to surface area, made for a faster airship.

11:02:45 AM

MR. JOHNSTON introduced slide 12, "Getting to Market," and explained that the difficulty for fruition "entailed a fairly sophisticated value stream." He said that innovation and revolution happened when everyone recognized they had a piece of the value stream that made good sense. He shared that oil and gas, mining, logistics providers, transportation providers, and financiers were all receptive to the idea of year-round access without infrastructure and at low cost. However, they all wanted to see the elements in place.

MR. JOHNSTON reported on slide 13, "Offshore Operations Support," stating that the airship had the inherent ability to operate at greater ranges with greater payloads, and with safer transit. He acknowledged that challenges arose when flying close to the actual operations of the offshore oil rigs. He said that the ideal would be for a heliport on the surface of the water, although there was not a perfect solution.

MR. JOHNSTON directed attention to slide 14, "Oil & Gas Support," and shared that the airship worked well in the exploration phase as its low speed was excellent for surveillance and aerial surveying. It also had the ability to carry sensitive equipment because of the inherent low vibration

environment of a large soft structure with low power generating noise. He lauded its use for emergency services. He reported that the airship could move smaller oil rigs much more affordably, and that pipeline construction support was available. He said that the airship was excellent for spill response as well as transport and resupply.

MR. JOHNSTON, in response to Representative Johnston, said that the airship communications could be a Wi-Fi node with its radio frequency or it could be similar to a cell tower.

MR. JOHNSTON pointed to slide 15, "Hybrid Operations Case Study," and said that economics and an affordable solution were the driver. Compared to helicopters, he declared that airships had twice the range, with four times the payload, at 70 percent less operating cost.

MR. JOHNSTON addressed slide 16, "The 'Roadless' Mine." and reported that a memorandum of agreement for $850 million over ten years had been signed with a mining company in Northeastern Canada to move all of their concentrate by airship, twenty tons at a time. He said that they were also reviewing the possibility of carrying large wind turbine blades for a wind farm.

MR. JOHNSTON shared slide 17, "Arctic Operations," which reviewed data comparing airship transportation with use of existing roads and showed a 25 percent reduction in costs.

MR. JOHNSTON presented slide 18, "Hybrid Case Study," a significant test case operation in Papua New Guinea. He said that the transportation infrastructure costs could mitigate and enable other things. He declared that the airship budget projected a 98 percent reduction in the infrastructure cost. Moving on to slide 19, "Hybrid Case Study," he reported that the small hybrid airship reduced the costs by 72 percent.

MR. JOHNSTON discussed slide 20, "Operational Safety," and noted that everything with a hybrid airship could move slowly, with the ability to almost stop and "loiter without having to commit." He pointed out that the three engines in the system allowed for the loss of an engine at a remote site while maintaining the ability to fly.

MR. JOHNSTON stated that safety and sustainability were the two big pieces, slide 21, "Hybrid Airship Sustainability." He compared helicopter and fixed wing airplane fuel usage with the

airship, noting that the airship used one third to one tenth of the fuel. He compared the aircraft takeoff noise factor, which affected both remote areas for wildlife and urban areas and stated that the airship could be muffled to be almost silent. He reported that the airship noise was about 60 dB, similar to a restaurant, whereas an aircraft was about eight times that loud with three times the emissions of an airship.

11:20:18 AM

MR. JOHNSTON concluded with slide 22, "Summary," and stated that the airship was ideally suited for remote operations, as it was designed for unimproved surfaces. He added that the airship was very environmentally friendly, that it was driven by affordability, and that it would enable projects previously thought to be inaccessible. He reported that they were projected to close several deals and be in Alaska by 2019.

REPRESENTATIVE JOHNSTON asked if outside temperature had any effect on the airship.

MR. JOHNSTON explained that density goes up when the temperature goes down, and that the design was for the standard aviation specifications, minus 40 degrees, Fahrenheit or Celsius, as that was the crossover point, and up to 120 degrees Fahrenheit. He shared that there was design work on hangars for the remote operations, although most airplanes were designed to be outside.

REPRESENTATIVE JOHNSTON asked if the engines detached easily.

MR. JOHNSTON replied that the propulsion systems were designed for replacement en masse. He said that there was a reciprocating piston engine and an angle gear box that ran the propeller, with the release of only a few attachments to allow for the entire thruster system to be taken off and replaced.

REPRESENTATIVE JOHNSTON asked if diesel fuel was affected by low temperatures.

MR. JOHNSTON stated that, as the airship was always on, the environmental systems were always working. He added that there was anti-icing on the critical parts. He pointed out that the environment was more desert like in many remote areas, with not a lot of moisture.

REPRESENTATIVE WESTLAKE asked about the expected service life due to ultraviolet light in an environment with long days.

MR. JOHNSTON stated that there was a 15-year service life guarantee on the envelope, which was then replaced.

CHAIR WOOL asked if there was a risk of losing helium pressure, either through normal operation or attack.

MR. JOHNSTON explained that airships were almost invulnerable to small arms fire because there was very low pressure over large areas. He suggested that there could be a slow loss of helium lift and an increased need of fuel for lift. He pointed out that air would flow in faster than helium would flow out. He stated that the most important thing was to protect the pilot. He shared that an autonomous vehicle, "spider," was used to crawl around the envelope, find small holes and fix them, and that the military was very interested in this technology.

CHAIR WOOL asked about water transfer in low temperatures.

MR. JOHNSTON explained that they had conceived of heated water trucks and water systems for these cold, remote areas, and that the airship would have the capability to keep the water heated.

MR. JOHNSTON, in response to Chair Wool, said that 20 tons of fuel was quite a bit, which he estimated as about 5,000 gallons.

CHAIR WOOL questioned whether this was the most economical mode.

REPRESENTATIVE WESTLAKE said that there were remote villages that did not have a large enough storage capacity, and that this proposed delivery system was much more economical.

CHAIR WOOL mused that this could be in Alaska in the near future.

MR. JOHNSTON stated that the airship would be certified for fuel cargo and would also be allowed to carry passengers.

MR. JOHNSTON, in response, said that people would ride for free and be designated as non-revenue passengers. He expressed the desire that the FAA would review the safety record and determine the potential for operation as an airline with passengers.

11:33:44 AM

NICK MASTRODICASA, Office of Project Management & Permitting, Department of Natural Resources, said that he would only be repeating testimony by Mr. Johnston. [indisc]

REPRESENTATIVE JOHNSON asked about transporting the airship.

MR. JOHNSTON said that the envelope was part of the structure, so that the airship, once inflated, was never purposefully deflated until the envelope replacement. The system was capable of going all the way around the world, and it was capable of ferrying under its own power.

CHAIR WOOL asked if there was any competition at this same stage of development.

MR. JOHNSTON opined that Lockheed Martin was in the lead. The most visible competition was in the United Kingdom, which had a surveillance airship not intended to be a cargo airship. He characterized that technology as being equivalent to the Lockheed Martin technology of 10 years prior. He said that reliability was foremost. He stated that there was a challenge for the adoption of new technology as it did not always mean an operator would want to change the way it did business.

REPRESENTATIVE JOHNSON asked if the military was involved in the development of large-scale transport.

MR. JOHNSTON explained that Lockheed Martin was a defense contractor and had started with the Department of Defense. He relayed that the 20-ton size airship did not carry a significantly tactical payload, although the 100-ton size would carry be much more suitable. He spoke about the "fort to foxhole" concept, whereby all the necessary transshipments and port bottlenecks could be bypassed. He highlighted that the airships could also manage civil, humanitarian, and medical operations, especially when ports and airports were not functional.

11:43:27 AM

ADJOURNMENT

There being no further business before the committee, the House Special Committee on Energy meeting was adjourned at 11: 43 a.m.