ALASKA STATE LEGISLATURE
HOUSE TRANSPORTATION STANDING COMMITTEE
April 4, 2017
1:08 p.m.

MEMBERS PRESENT

Representative Adam Wool, Co-Chair
Representative Matt Claman
Representative Harriet Drummond
Representative Chuck Kopp
Representative Mark Neuman
Representative Colleen Sullivan-Leonard

MEMBERS ABSENT

Representative Louise Stutes, Co-Chair
Representative David Eastman (alternate)
Representative Gabrielle LeDoux (alternate)

COMMITTEE CALENDAR

PRESENTATION: HYBRID AIRSHIPS: OPENING NEW FRONTIERS BY SKUNK WORKS ~ A DIVISION OF LOCKHEED MARTIN

- HEARD

PREVIOUS COMMITTEE ACTION

No previous action to record

WITNESS REGISTER

CRAIG JOHNSTON, Business Director
Lockheed Martin Skunk Works
Palmdale, California
POSITION STATEMENT: Offered a PowerPoint presentation titled "Hybrid Airships: Opening New Frontiers".

ACTION NARRATIVE

1:08:02 PM

CO-CHAIR ADAM WOOL called the House Transportation Standing Committee meeting to order at 1:08 p.m. Representatives Wool, Drummond, Neuman, Sullivan-Leonard, and Claman were present at

the call to order. Representative Kopp arrived as the meeting was in progress.

PRESENTATION: HYBRID AIRSHIPS: Opening New Frontiers by Skunk Works, a Division of Lockheed Martin

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CO-CHAIR WOOL announced that the only order of business would be the presentation by Craig Johnston, entitled "HYBRID AIRSHIPS: Opening New Frontiers by Skunk Works, a Division of Lockheed Martin."

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CRAIG JOHNSTON, Business Director, Lockheed Martin Skunk Works, advised that the corporation is over 100 years old, and Skunk Works has almost 75 years' worth of history, primarily in aviation and innovation. It's landmark products include as follows: introduction of the first jet fighter toward the end of World War II; development of some of the early spy plane technology, such as the Lockheed U-2, ultra-high altitude reconnaissance aircraft "Dragon Lady" and the Lockheed SR-71 "Blackbird"; involvement in advances in combat capability represented by the Lockheed F-117 Stealth Fighter "Nighthawk"; design for the Lockheed Martin YF-22 and the X-35, frontline fighters of today's United States Air Force; and the Lockheed Martin F-35 of the United States Marine Corp, Navy, and Air Force. Traditionally, he said, Skunk Works has been motivated by solving tough problems for the nation primarily in the realm of the military. Of late, it expanded to look at civil and commercial missions and, for Skunk Works this is a bit of a "back to the future" because the last big commercial project was the Lockheed L-1011 TriStar, which ceased production in the 1980s. Skunk Works, he related, is moving back into the commercial world with the introduction of the hybrid airship.

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MR. JOHNSTON said that primarily, he would like to discuss these hybrid airships in the transportation realm as Lockheed Martin considers itself a transportation company first and foremost. Its roots originated in carrying people and cargo and, ultimately, moving into elements of the far reaches of the deep sea and deep space. The hybrid airship represents direct evolvement into the cargo market space, he said, and it has been a two-decade adventure.

MR. JOHNSTON turned to slide 1 and pointed out that both the Lockheed Martin and the Hybrid Enterprises logo appear because approximately 2.5 years ago Lockheed Martin decided that it was "good at doing things within the governmental sectors," but not so much in the commercial sector. Therefore, it brought onboard Hybrid Enterprises as a partner, with the entity selling the hybrid airships, he explained.

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MR. JOHNSTON turned to slide 2, "Why Airships?" and referred to the centuries known fact that the natural buoyancy of ships on the water allows a ship to hold cargo, and noted it was relatively inexpensive to push the ship through the water with sails. Except, he commented, ships are relegated to the water with inherent limitations as to where they can operate. The concept of an airship was introduced many years ago using buoyant gas to lift it in the air, and the challenge was making it operable enough to control it and take advantage of that fact. He suggested that when thinking of airships, to think ship first and air second because much of the operation has a stronger heritage to ships in terms of how it moves through the surface.

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MR. JOHNSTON turned to slide 3, "Airship Types" and explained that the airships in California are non-rigid airships, also known as blimps, and are filled with helium used to pressurize the envelope. Generally, he explained, they concentrate all the load into one single structure that is "hung below that one" so the compulsion system, pilot, and limited crews "all ride in there." Semi-rigid airships are a bit larger and distribute loads into other areas of the structure, he advised that the airship depicted on the slide is the "Norge Airship of the 1920s." Interesting, he noted, this airship has a bit of Alaska history, wherein it was an airship built by the Italians, flown out of Norway with the design mission to fly over the North Pole and drop flags to declare America as being "the first here." He said that he read this morning that there was controversy as to whose flag was the largest when they dropped it over the North Pole. That airship recovered into the Arctic Region in Alaska, it had a not so successful landing, and it was decided to just take it apart. There may be remnants of the Norge airship in some of Alaska's museums, he offered.

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CO-CHAIR WOOL noted that he read about an airship that carried airplanes during World War I and asked whether it would have been a rigid airship.

MR. JOHNSTON answered that originally, those were the "Graf Zeppelin" rigid airships that were large to enough to attach a piece of structure to it and tether the airplane. He said that they were used somewhat successful and were recovered on and off, but the utility ended up not being that high. Those were the large rigid airships of the 1920s and 1930s, he said.

MR. JOHNSTON, in response to Co-Chair Wool, agreed that they were the first aircraft carriers. He referred to the massive scale of those rigid airships and advised that the LZ 129 Hindenburg was of that class. He described that it was an aluminum structure covered with a fabric impregnated surface to hold the hydrogen in at that time, the vehicles were over 900 feet long, and he commented that airships have been in operation since the mid-1800s.

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MR. JOHNSTON turned to slide 4, "Concepts & Prototypes" and said there are concepts for "modern ways of going about it." He advised that with regard to the Boeing-USA and Piasecki-US concepts, Lockheed is trying to capitalize on putting together the best of a helicopter and an airship, using the helicopter for precision as to how to move things around, and the balloon to augment the lift and offset some of the weight, and it would be a precision hybrid airship that was part helicopter and part blimp. Except, he advised, the concept turned out to be the worst of both cases because it did not solve enough of the problem of what happens when trying to tie four large helicopters together and hang a large balloon above them.

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MR. JOHNSTON pointed to the Aeorscraft-USA and the Varialift-UK and advised that they are similar in concept because both are semi-rigid to rigid airships and employ the concept of how to control the buoyancy of the airship. He related that one of the benefits and challenges of an airship is that the lift cannot be turned off because when there is a lighter than air gas, such as helium, the lift cannot be turned off. Therefore, he said, both the Aeroscraft and the Varialift concepts employ a mechanism

whereby it tries to control the buoyancy by the compression and expansion of the helium gas, but it tends to be a fairly expensive way to think about operations. The RosAeros Systems-RU is a Russian concept and not a lot has been portrayed, but it does appear to bring on both rigid structures and some amount of air dynamic lift, and from that standpoint it would be called a hybrid airship concept. He opined that probably the most mature of the concepts and prototypes is the Hybrid Air Vehicles, out of the United Kingdom, originally designed as part of a United States Army contract for a surveillance platform designed to fly at 20,000 feet and stay there for a certain amount of time. The United States Army cancelled the concept and the contract. Hybrid vehicles in the United Kingdom have continued to move forward in terms of a platform that could be employed for future commercial use, whether it be cargo, surveillance, or sight-seeing activities.

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[MR. JOHNSTON played a video from 1:20 p.m. to 1:21 p.m.]

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MR. JOHNSTON turned to slides 5-6, "What is Hybrid Lift?" and advised that, importantly, with hybrid lift the big payoff is that 80 percent of it comes from the buoyant helium gas, which is as close as they can get to anti-gravity in terms of the ability to lift. That is where a lot of the economics come in, he said, and with economics come operational challenges addressed by the two other components of lift. The aerodynamic lift employed by the forward motion of the airship, and the wing-like shape of the airship by its tri-lobe hull. One of the challenges of lighter than air vehicles is that they are sensitive to weight changes. In the event there was an increase in weight, such as being rained on, it simply increases the angle of the wing of the body which makes up for the lift that otherwise would have been lost, with a component of efficient lift plus robust lift. The direct lift provided by the helicopter-like operation offers a lot of the controllability. The four propulsion systems have a great degree of thrust-vector capability and offer the ability to be highly maneuverable on the ground, in flight, and in the presence of wind. When all three of those are combined it is considered "a hybrid lift solution," he said.

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MR. JOHNSTON turned to slide 7, "Our Hybrid Airship" and advised that specific to the Lockheed Martin hybrid airship, the tri-lobed hull allows the ability to generate the aerodynamic lift. It also offers a mechanism to provide a structural mechanism with the ability to carry fairly significant loads, about 47,000 pounds of load off that envelope by distributing the load across the entire surface. There are four thrust vector and propulsion systems attached to the side of the vehicle, the envelope itself is non-rigid, and the rigidity comes simply from the helium gas that fills the envelope. Therefore, he pointed out, not only does the helium gas provide the buoyant lift gas, but it also provides the pressure gas that keeps the outer skin stiff allowing things to be attached to the outer skin. Significant to the capability, he said, is the capable Fly-By-Wire (FBW) flight control system. This FBW system makes it extremely easy to fly, and with the modern computers and modern flight control technology they can make all that a simple mechanism for the pilot operating the airship. The FBW system has two controls, one control "says how fast you want to go" from minus three knots to seventy knots, the computer determines the propulsion inputs needed, and the other stick "says go up/go down/turn to the left/turn to the right." He described it as very simple and ship-like in terms of how it is operated, and sophisticated in terms of the flight controls that are running behind the airship.

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CO-CHAIR WOOL surmised that to control it, a pilot is not required to have particular knowledge about each engine, what the engine is doing, and the angles of surfaces, and he asked the type of licensing necessary to fly the airship.

MR. JOHNSTON responded that Skunk Works will work with the FAA to have a "type certificate" in a hybrid airship, and he anticipates that initially Skunk Works will use the pilots it trained under the "initial cadre of pilots." Subsequent to that process, he said, it is anticipated that the typical airship pilot and command would have the similar experience as a pilot and command in a twin-engine piston powered aircraft. He described that it is not as sophisticated as the airliners because flying the airship is relatively straight-forward. Skunk Works has a requirement to work with the FAA for that training program and the training of the initial cadre of pilots, he offered.

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MR. JOHNSTON turned to slide 8, "LMH-1 Interior Layout" and noted that a significant feature, when it comes to the operability of hybrid airships, is the ability to adapt to the environment. One of the challenges of earlier airship operations was that they had no idea as to the weather over the horizon, and modern weather prediction and planning allows that to be an issue of the past. A common misperception is that airships are more sensitive to the environment than airplanes, such as wind, and cold. Except, he pointed out, airships have essentially the same weather limits as the fixed-wing fleet, and airships are certainly more robust than the current helicopter fleet. The onboard weather prediction and route planning is key in allowing for efficiency when looking for route structure because the airship flies the currents exactly as a sailing ship. After reviewing worldwide routes, the airship can count on up to a 15 knot increase in speed when flying with the wind as opposed to into the wind, he advised.

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REPRESENTATIVE NEUMAN asked whether temperature affects the lift, and whether the same quantity of gas is used at the equator as at the North Pole.

MR. JOHNSTON answered yes, if there had been a plan for operations in one spot only because the helium load could be optimized for that specific environment. However, he said, onboard is the Balane automatic system which automatically regulates the pressure of the helium gas with the goal to keep that pressure constant through temperature, through altitude, and through many such factors. He explained that as the airship moves up in altitude, the pressure is going down as the temperature changes, and there is a built-in Balane system which automatically takes care of that issue. For most operations, he said, they would just rely on the Balane, and there is the ability to slightly optimize the "helium load out" to make it more ideal for a specific location. In the end, he advised, "that is not a big swinger" in terms of ...

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REPRESENTATIVE NEUMAN asked whether there are any environments where airships will not work.

MR. JOHNSTON answered no. Although, he said, there are environments where they do not work well, such as Greenland with

extremely high winds all the time in one area, airships would probably not be seen in that region due more to the wind rather than the temperature. As it gets colder, the airships work better within the airship component because the components that occupy the airship are standard aircraft components and are generally certified by the FAA down to minus 40 Centigrade and Fahrenheit, he explained. Any electronic component can be frozen, he said, but they are standard aviation specifications for environment specifications.

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MR. JOHNSTON advised that other pieces include: the large cargo bay is 10 feet by 10 feet by 60 feet long; unpressurized; the airship generally operates below 10,000 feet; the payload bay is square; the ramp is at truck bed height; the tailgate is a soft structure in the back of the airship allowing it to carry outsized cargo, such as a large turbine wind blade out the back of the airship; and its cargo fuel and ballast tanks are located in the back to manage its weight on the ground.

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REPRESENTATIVE SULLIVAN-LEONARD requested a description of the tri-lobed hull, and whether it was specific to the front of the airship.

MR. JOHNSTON responded that the tri-lobed hull is throughout the entire structure, and a normal airship is purely round because all pressure vessels want to naturally go to round. In this case, he noted, there are two rounds, cut in half, and joined with the other part, which would be a third one in the middle. The reality is that with the round one in the center, as soon as a load is on it will straighten out. He explained that when looking inside the airship a person would see two half lobes and a lobe with straight lines which provides shape. Most importantly, he said, are those curtains that "we hang all that load on." The original hybrid lift had the three-lobed hull, "what normally would be circles," but Skunk Works intersected them together to form that which goes from the nose to the tail offering a bit of streamlining, but it also is a mechanism for hanging the payload.

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REPRESENTATIVE SULLIVAN-LEONARD related that, initially, she was thinking of the double-hulled ships that are required for the

transport of oil and gas, and whether that would be the same concept. Although, the airship appears more aerodynamic or structural in design, she offered.

MR. JOHNSTON responded that it was not there as a safety feature, three lobes have been put together for both aerodynamic and structural reasons.

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MR. JOHNSTON advised that in addition to the water ballasts used to manage the airships heaviness on the ground, it also has the cargo fuel tanks. He referred to the "cube-out" phenomenon challenge in typical fixed-wing transportation and explained that normally when hauling cargo by air, the cargo bay is filled with cargo before hitting the maximum weight because there is not the tendency to carry "really heavy stuff" in a fixed-wing aircraft. He related that not all cargo is heavy, but 10,000 pounds of groceries take up volume, such as cereal boxes. In this case, he said, to put the airship at maximum efficiency with 10,000 pounds of groceries, the company would load the cargo fuel tanks with 36,000 pounds of diesel fuel for remote areas. One of the things recognized in remote areas, he commented, is the need for fuel, and the airships can always fly full which, from a weight standpoint, drives economics. Importantly, he said, because Skunk Works is part of the certified system, fuel is not hazardous cargo and it flies people at the same time as the fuel. Skunk Works is working with the FAA in that its baseline configuration will be two pilots and eight passengers, with the ability to travel with up to 19 passengers, the FAA limit. He pointed out that the people essentially fly nonrevenue, at no cost, unlike most transportation opportunities because the airship is designed around the main cargo bay and the people are there basically flying for free. At this point the airship was not intended to be an airline, but eventually an operator could apply for an airline operating certificate.

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MR. JOHNSTON turned to slide 9, "Operations" and said the video was a full-scale mockup in Palmdale, California designed to represent a landing site in the Ambler region. He said when they bring people to the "Hybrid Experience" they say "Welcome to Alaska" as they tried to put it directly in its working environment.

[Video played 1:37:21 through 1:38:50.]

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CO-CHAIR WOOL referred to what was seen on the video wherein "they see the envelope there."

MR. JOHNSTON agreed.

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MR. JOHNSTON turned to slide 10, "Tech Demo to OPERATIONAL CAPABILITY" and noted that the vehicle at the top left, P-791 (2006), flew ten years ago as a sub-scale demonstrator to prove out the tri-lobed envelope design, digital flight control, full vectored thrust, air cushion landing system, and it over-performed so they made some design changes. Palmdale, California, he advised, is one of the windier places on earth and in terms of the operation they were able to prove the airship could operate routinely in 30 plus knots of wind, which exceeds most fixed-wing aircraft, and the airship system is designed for 40 knots of wind. He referred to the LMH-3 and advised that is where they started 20 years ago, the vehicle was capable of carrying 500 tons or 1 million pounds of cargo as a "through the air version" of a container ship, except the vehicle was approximately 700 feet long. There are no facilities today "to do that" and they backed away from that vision to what they believe is an irresistible initial market space in the remote cargo transport market. He suggested the committee consider that it carries payloads designed for overland trucks, Lockheed C-130 Hercules, or the Boeing 737 fleet. He said, "So that's the first vehicle that we intend to introduce to the marketspace," anticipating having the first flights in 2018. Skunk Works will perform a one-year FAA certification program during which it may conduct some environmental testing to prove it works in the environments in Alaska, he said. The airship would then be introduced into commercial services in 2019, and FAA certified under a whole new type of certificate with new criteria for hybrid airships.

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REPRESENTATIVE KOPP said that as far as air traffic controls, the airship would have the similar approach and take-off as a helicopter and asked where they would commercially operate.

MR. JOHNSTON answered that the basic concept is to avoid the traditional airport infrastructure with long runways, and fast-moving airplanes. The fundamental concept of operation, although it is compatible, is a landing area approximately 2,000 feet in length and approximately 800 feet in width, devoid of large trees due to the air cushion landing system. Most likely, he said, the most rigorous element to accommodate is how the buyer would operate their cargo operation and whether trucks were accessible. He stated that "vertical operations" would require a 500-foot helipad. He explained that [airships] have less vertical precision than helicopters.

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CO-CHAIR WOOL surmised that a frozen or unfrozen river in rural Alaska would be ideal.

MR. JOHNSTON agreed, and he clarified that a raging river would not be ideal, but the weight would certain work.

REPRESENTATIVE KOPP noted that there should be a commercially based area for resupplying away from an airport, and good road...

MR. JOHNSTON interjected that close to a railroad is ideal which is close to a road network because when bringing cargo from remote areas to the railhead there should be a quick mechanism to put it on the railroad or truck and transfer it to the next most efficient mechanism as quickly as possible. He related that a partner of Skunk Works is looking at setting something up in the Kenai Peninsula in terms of a remote location.

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REPRESENTATIVE KOPP said he knew that PRL Logistics had a commercial heliport there with a lot of logistical support for the oil companies.

MR. JOHNSTON said that he can publicly disclose that PRL Logistics is the logistics arm of the first announced interested buyer, Straight Line Aviation out of the United Kingdom, and they recently signed PRL Logistics on as a component of its logistic side.

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REPRESENTATIVE CLAMAN asked the range of the cost of a hybrid airship.

MR. JOHNSTON answered that the purchase price is $40 million, more expensive than used airplanes and cheaper than new airplanes. He commented that the competition, such as the Douglas DC-3s, has a market value of approximately zero. More importantly, he said, is the fact that it competes on the overall operating costs, and the price of the vehicle is a component. Detailed modeling has shown that when competing against used cargo aircraft, and rolling in the maintenance cost, operating cost, fuel cost, crew costs, all those other costs, and determining what it costs per ton mile to operate, he said that Skunk Works is competitive against almost all the existing "remote transportation needs."

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REPRESENTATIVE CLAMAN noted that there are practical limits as to the distance of transporting cargo. For example, he offered, 2,000 miles would be too far of a distance for the airship and that 200-300 miles becomes more reasonable.

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MR. JOHNSTON stated that Representative Claman was correct. The airship has economic ranges probably in the 300-600-mile range, and he explained that the range has to do with the throughput of cargo, how many flights, and how long the crew was onboard. He related that a customer flew the airship around the world, it could fly 22,000 miles without refueling, except it took him 28 days. The airship has a 1,400-nautical mile range and he suggested thinking of that primarily as a ferry range. He offered that if the airship was deployed from Alaska to an area in Canada it would be flown there "which probably would be a nonrevenue flight generally, "it would be a positioning of it." Travel slower and those sorts of ranges could be exceeded, which is typically in the 300-600-mile range. Skunk Works is working with the FAA on a new set of rules that makes it more ship-like in terms of how it is crewed, he said. Rather than having a pilot in command that can only sit in the seat for eight hours and cannot let him off, to switch over and have a captain onboard relaxing in the back with a duty officer. That is the model that was there in the early days of the airships because they were the same speed and flew for long periods, he said, and the FAA is willing to work with Skunk Works on the concept.

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REPRESENTATIVE CLAMAN surmised that it flies lower, so it is a different airspace than what the FAA currently regulates.

MR. JOHNSTON replied that it still can be regulated, but it generally economically flies at 1,500 to 2,500 feet above ground level (AGL) with the maximum height of approximately 10,000 feet. The lower the airship flies, the more efficient it is but the planning will be weather and obstacle dependent, he explained.

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REPRESENTATIVE DRUMMOND referred to Mr. Johnston's earlier testimony regarding diesel fuel in the tanks of the airship and asked whether there was a limitation other than size and weight on the other types of cargo, such as a tank of liquefied natural gas (LNG) or propane going to a remote village which would otherwise be difficult to reach.

MR. JOHNSTON answered that a plan is to certify the airship to carry the diesel fuel in the tanks, and because it is certified it would allow people and fuel at the same time. Skunk Works looked at the transport of LNG and noted that LNG is not well designed for airborne operations due to the "tare weight" being fairly high, and currently no one would conceive of flying LNG in an airplane. There is a market space that could transport LNG efficiently, and it would probably involve a slight modification to the transport mechanism. Whether or not the FAA would allow Skunk Works to do it as a non-hazardous operation is still to be determined, he explained, and that would basically mean that "you can't fly passengers and would have to take specific actions." He said that they do believe this could open a market that says, in addition to just heavy fuels "that you actually even be able to conceive of a -- of a pace that you could actually deliver LNG to remote areas where you start to unlock the sorts of things where you could provide a year-round access to that."

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REPRESENTATIVE DRUMMOND noted the upside is that a village is small, and it does not need a large LNG tank, and the whole goal is to replace diesel fueled operations with cleaner fuel.

MR. JOHNSTON added that LNG does not have the same shelf life of a heavy fuel and the airship could simply supply fuel once a week and top off the tanks. That is a potential, he commented, but it is not in the baseline thinking because no one is really trying to transport LNG by air.

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CO-CHAIR WOOL noted another fact for LNG as opposed to diesel is that there is no fear of it spilling on the ground whereas many tank farms in rural Alaska have a lot of necessary maintenance and rehabilitation. He referred to the largest LMH-3, which was 700 feet with 500-ton payload, noting that the Graf Zeppelin was 900 feet, and asked whether it had a huge payload and its primary use.

MR. JOHNSTON answered that the Graf Zeppelin was built for passenger carriage, and although it was 900 feet long, it had a payload capacity of approximately 10 tons, and due to technology, that is half of what Skunk Works is doing on its smaller airships. It had a rigid structure, the fabric that was dope covered so it was not a lightweight high strength fabric. In terms of the massiveness of an airship, the modern airship is smaller and "much, much, more capable" due to advancements in technology and materials ...

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CO-CHAIR WOOL interjected that even though the gas was half the weight, all the other stuff was heavier and was primarily like an ocean liner ...

MR. JOHNSTON interjected that it was an ocean liner and was never designed for cargo.

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MR. JOHNSTON turned to slide 11, "Demonstrator Flight (video)" and said the slide is the demonstrator Skunk Works built and flew in 2006. It was a ground operation and although it is a fairly large machine "you can see how nimble it is on the ground turning on itself," which is afforded by the propulsion system making it very snappy in its takeoff and flight characteristics. The airship is large with no sense of motion, it is like a bush plane in terms of the mode of operation, on a much larger scale.

MR. JOHNSTON, in response to Co-Chair Wool, advised that the airship is possibly "knocked around" in serious turbulence resulting in a bit of a ship-like swaying, but a person would be comfortable due to the large inertia.

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CO-CHAIR WOOL asked the weight of the LMH-1.

MR. JOHNSTON replied that weight is interesting when discussing airships because after removing helium from the airship it weighs approximately 60,000 pounds, when helium is inserted it becomes much lighter, and then if all the payload is removed it weighs less and will float away. He explained that "heaviness" is a measure of apparent weight and that a typical airship blimp has about 800 pounds of heaviness, yet if you put their airship on the scale under normal operations it would weigh approximately 20,000 pounds. There is a robustness ...

CO-CHAIR WOOL interjected that as far as being pushed around by the wind, how much mass would be involved.

MR. JOHNSTON answered that in-flight there would be little effect, and because the flight control system is trying to drive it 20 degrees, for example, it would perform whatever the flight control had to do to make certain it stayed on the command of the pilot's course.

1:57:29 PM

MR. JOHNSTON turned to slide 12, "Getting to Market" and advised that getting the airship to market comes down to understanding the value stream and making it clear across an entire value stream that this is good for everyone involved, including convincing the oil and gas and mining extraction side. He pointed out that questions for the user of transportation could include: what was needed to move "their stuff" into and out of their facilities; what mode; and how that mode would save money; whether it would de-risk their operation; and how it would lower those costs. Additionally, he said, the oil and gas and mining folks do not generally operate any of their own equipment and generally work through a logistics provider. For example, Pacific Rim Logistics (PRL) connects the hard job with someone willing to do the hard job, and convincing a logistic provider there is money in the airship. Ultimately, he said, the financiers, such as Lockheed Martin, said that before "I go do all the capital development it says okay, I'm going to develop

and field one of these systems, how do I know that somebody's actually going to use it or buy it." He related that by Skunk Works moving through that entire stream of value and locating everyone willing to sign up and agree, has been a relatively hard challenge over the last three years. The hard part of revolutionary technology is how to get everyone to sign on, he said.

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MR. JOHNSTON turned to slide 13, "Offshore Operations Support" and advised, in transportation there is the consideration of safety, and how the airship would support off-shore oil, with the range, payload, and costs advantages far superior to the helicopter fleets of today. Safety is a challenge, he said, and landing on the oil rig itself is not necessarily an ideal situation, and there is the problem of landing on the surface around the rig to transport the crew to the rig.

MR. JOHNSTON turned to slide 14, "Oil and Gas Support" and said the airship can support phases from exploration through development through production to emergency services. Skunk Works spoke with the oil companies about making their rigs small enough to fit 20 tons at one time, and the oil companies agreed if it made enough sense. He said that it is difficult to compete with pipeline transportation, and the interest is in spill response, transport, and resupply.

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MR. JOHNSTON turned to slide 15, "Hybrid Operations Case Study" and said that, ultimately, from an economic standpoint "we can push out" close to twice the range of the current fleets, four times the load, charge aggressive rates, and allow the operator to make money. When it comes down to the value in this, he said they offer an opportunity to open a tremendous new value proposition for all the players.

2:03:23 PM

MR. JOHNSTON turned to slide 16, "The 'Roadless' Mine" and noted that the largest rare earth mineral deposit, outside of China, is on the border of Quebec and Labrador in Northeast Canada, and the plan is to build a permanent road from the Strange Lake Project to the coast on the east side. He explained that they have worked for multiple years to obtain the environmental impacts reports and "we're having a challenge" closing the

business case on this. Straightline Aviation approached "them" about creating a roadless mine with the current plan to fly the rare earth mineral concentrate out of Strange Lake to Schefferville, put it on the railroad and ship it to further processing. He described this as the first adoption of a truly roadless mine, although, they may build temporary ice roads for some of the initial construction and infrastructure to provide wind energy. Significant to that value stream, he pointed out, is the fact that now there is a mining operation signed up and ready to spend $850 million, over a 10-year period, writing contracts allowing the logistics provider to buy services from the airline (indisc) shifts from Lockheed Martin "and the whole string closes through there."

2:04:57 PM

MR. JOHNSTON turned to slide 17, "Arctic Operations - Ice Road Replacement - Point Thomson" and referred to the slide that depicts the budget allocations for 2015-2016 for this specific operation involving trucks moving up the Dalton Highway, an ice road for the last mile from Deadhorse to Point Tomson and flying all the people from Anchorage to Point Tomson. He said that when only considering that last tactical mile, the small hybrid airship would result in a 25 percent reduction in the operating cost of that operation.

2:05:47 PM

MR. JOHNSTON turned to slide 18, "Hybrid Case Study" and emphasized the significance of a major project completed at Papua New Guinea performing LNG movement. Skunk Works was able to review in detail the costs involved in the manner they performed the project, and how those costs would have been impacted if "we'd done it a different way using airships." The total actual project cost was almost $1 billion, largely due to building the road and runway infrastructure to allow the cargo to move in on a large Russian antonov 124 vehicle. If they had had the 20-ton hybrid airship they would have been able to complete the same project, in terms of the infrastructure set up, for a 98 percent reduction. He said that those facts get people's attention, the challenge is that no large oil company is willing to bet a $1 billion plus development program on something that does not yet exist. Therefore, he noted, it is important to get the hybrid airship to market so the public will start to see that this will enable different projects.

MR. JOHNSTON noted that in a similar region "they are looking at transportation options" that currently represent barges moving up rivers. The problem being that, at times during the year those rivers are dry, unlike Alaska with its frozen rivers, and it has a tremendous risk of losing all transportation options. Therefore, "they look at ways" of de-risking those operations by bringing on alternate mechanisms of transporting people and materials, he said.

2:07:10 PM

MR. JOHNSTON turned to slide 19, "Hybrid Case Study" and said, in terms of the direct costs of transportation, when comparing the large Russian antonov 124 vehicle moving essentially the same cargo as a hybrid airship, the airship offers a 72 percent cost reduction.

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MR. JOHNSTON turned to slide 20, "Operational Safety" and reiterated that safety is a key component of any operation. Airships inherently travel at slow speeds and the beauty is that "if it really looks hairy and scary" in terms of the approach, it could pull back and wait because it can fly at zero speed at certain weight levels. He explained that the redundant systems refer not only to the electronics and avionics onboard, but also to the propulsion system because the airship is designed to "fly with engines out." Therefore, he pointed out, another asset is the ability to lose an engine and take off and return home with only three engines, plus the airship can operate off any surface when looking for emergency landing spots, whether it is a river, lake, or an open spot. There is also the fact, he said, that the airship was purpose designed for cargo and it keeps the potential sources of fire away from people through separation and inherent safety elements.

2:08:58 PM

MR. JOHNSTON turned to slide 21, "Hybrid Airship Sustainability" and reminded the committee that more and more of a worldwide issue is the sustainability of transportation solutions. Conservatively on the fuel side, he advised, the airship is one-fifth to one-tenth of the fuel required to carry the same payload via the airship compared to a helicopter. Even compared to the most efficient fixed-wing aircraft, [airships] require one-third to one-tenth the fuel. He related that more and more of an issue in both urban areas and remote areas is the noise

impact on the environment and animals. He explained that the baseline noise profile of a hybrid airship is approximately 60 decibel (db), which is a relatively low noise footprint compared to the current eight times that level. The emissions, the carbon footprint, goes almost hand-in-hand with fuel because when burning less fuel there is less production of a carbon footprint, which becomes a bigger and bigger issue as some nations drive toward reducing that carbon footprint.

2:10:35 PM

MR. JOHNSTON turned to slide 22, "Summary" and related that the hybrid airship was purpose built for remote operations; the ability to operate without building an infrastructure; environmentally friendly; ability to show the dramatic reduction in the cost of performing operations; and when the airships are introduced it will begin to enable different concepts. He related the airship can assist in humanitarian missions, such that a radiological group signed up and is trying to provide radiological services worldwide in rural areas, which is possible with an airship. Alaska, he stated, could see airships as early as 2019 because Skunk Works anticipates flying airships and starting the certification program in 2018. Skunk Works believes that Alaska is ideally suited for the operations that this vehicle was purposely built to solve, he said.

2:12:38 PM

CO-CHAIR WOOL commented that the Lower-48, with its access to roads and railways, probably is not a likely area to see a lot of hybrid airship cargo activity, but Alaska is likely by being remote and without those infrastructures. He said that it sounded like Skunk Works has customers and people interested, which is the part that interests him, noting that he had been reading about this for decades. He said that Mr. Johnston had testified that Alaska would see the airship next year and asked whether that was an accurate statement.

MR. JOHNSTON responded, "We believe so, we -- I'd like to say that it's done, but I can tell you that there is a lot of stuff going on in the background that is aligning all of those component pieces," and his company would not waste his time coming to Juneau to say, "Oh yeah, just -- just wait another year, just wait another year." Skunk Works is serious about this with a lot of serious players performing serious work in attempting to unlock this opportunity because it will truly open new frontiers in terms of transportation in Alaska and Canada in

remote areas, he stressed. Ultimately, Skunk Works believes that as it deploys the full family of these capabilities, to start in Alaska, he remarked.

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CO-CHAIR WOOL opined that the timing was fortunate because someone had mentioned it to him in passing, his office contacted Mr. Johnston, and now he was testifying, which is a testament to the fact that Skunk Works is serious about being in Alaska. Alaska has transportation needs and resources located in remote areas and "we'd love to combine those two things." He described that it will be exciting and see how it works at minus 40 degrees in Barrow or Fairbanks.

MR. JOHNSTON related that it was a privilege to address the committee.

2:16:01 PM

ADJOURNMENT

There being no further business before the committee, the House Transportation Standing Committee meeting was adjourned at 2:16 p.m.