NATIONAL MUSEUM OF THE UNITED STATES AIR FORCE

Wings & Things Guest Lecture Series

Secret World of Space Reconnaissance

Learn about the Gambit 1 KH-7, Gambit 3 KH-8 and Hexagon KH-9 reconnaissance satellites during this presentation by CIA officers Dr. Robert A. McDonald and Dr. James D. Outzen.

Dr. Robert A. McDonald: Obviously the people in Dayton like to know secrets and that's what we're going to do today is share some secrets about how the NRO came to be formed and the association with the United States Air Force. I'll talk about that and then take a look at the Gambit and Hexagon programs as a case study in the partnership between the Air Force and the National Reconnaissance Office and Dr. Outzen will do that.

I have a couple questions for the audience first. How many of you have worked in the Gambit and Hexagon programs? Anybody here, great, great. And I would say to all of you "congratulations on a marvelous set of programs that you were part of and that made a very critical contribution to national security and as I think everybody in the room knows the work of your fellow audience members contributed to making the Cold War stay cold and for us winning the Cold War so really congratulations for the contributions that those of you have made." Let me ask the rest of you before tonight how many of you were very familiar with the National Reconnaissance Office or the NRO?

So you're into secrets already because the NRO has been a very, very, secret organization until 1992 and I'll talk about that in a few moments. But as Doug said, this is really a very historic time since January when this exhibit opened up with the Gambit and Hexagon artifacts. What you have here when this was opened on the 21st of January, actually is the largest collection, the largest assemblage of National Reconnaissance artifacts ever put together, declassified and made public and you're a part of this historic first wave of people who are seeing these artifacts in a public venue within a context of a marvelous story.

And several of you picked up copies of the compendium that Dr. Outzen put together and in that you'll find formally classified documents, but just recently declassified as a part of this event. So you're looking at top secret and secret material lined out, you've got the secrets in your lap in those books.

But this is a very historic event here and we're really pleased that the museum has done such a marvelous job, and very quick job, of putting these artifacts on display. The exhibit was opened within 6 months of the Director of the NRO declassifying the programs, and declassifying the artifacts, and that's probably a record in this kind of a

collection being put together in an exhibit. So you have a marvelous opportunity here to get great insight into a lot of things that were very, very secret for a very long time.

As I alluded to before the National Reconnaissance Office for its first 30 years was in the dark it was hidden in the shadows. It was often called the “Black Air Force” versus the White Air Force that was in the open in the sunlight. How many of you have heard about 4C1000? Ah, some of the veterans. That was the only way we referred to the National Reconnaissance Office before in 1992. 4C1000 is the room number in the Pentagon where the Director of the NRO had his office. The name NRO, National Reconnaissance Office, was so classified that even the stationary after the name National Reconnaissance Office had in brackets secret Talon [keyhole]. We couldn’t even say the name National Reconnaissance Office we said “oh! I'm going over to 4C1000.” and we knew. We didn't talk about satellite reconnaissance for a very long time that was classified the mere fact of, even within classified channels, we would typically say, “oh! We’re going to get some overhead,” with a kind of the wink of the eye. Well in 1992 things changed dramatically and the darkness disappeared and you suddenly had the National Reconnaissance Office.

[Laughter]

Thank you, so I might as well go all the way. Notice the trouble with the intelligence community when you try to become unclassified there is always something dragging around and pulling you around.

Male Voice in Audience: There are always strings attached.

McDonald: Absolutely, always strings attached. Well talking about strings attached the CIA in the Air Force were very closely entwined together. Actually the first Director of the National Reconnaissance Office were co-directors, one from the CIA, and one from the United States Air Force- not one director. Richard Bissell and Under Secretary Charyk were the first co-directors. The Air Force served for a long time as kind of also a cover for the NRO because it was buried in 4C1000 in the Secretary of the Air Force or the Under Secretary of the Air Force's office, but the relationship between the Air Force and the CIA organizationally extended in several dimensions. The first and foremost of course was in launch.

The NRO satellites, the Air Force is the organization that launched those satellites starting from the early Corona, and this is actually the last of the launches that the NRO did during its 50th anniversary year so for the entire life of the NRO Air Force has been a very critical partner in getting the satellites where they belonged. Another area that the Air Force organizationally has partnered with the NRO has been in the recovery of the film return systems and Dr. Outzen will talk a little later about how capsules of film were ejected from orbit and recovered by airplanes run by the Air Force and then the film ship back to Rochester, to Eastman Kodak, who did the initial processing. Eastman Kodak made duplicate negatives and duplicate positives and shipped out the duplicate positives to the various intelligence organizations that had to look at the imagery immediately and in generally that would be places like CIA's National Photographic Interpretation Center.

And then the rest of the film would go to another Air Force component at Westover Air Force Base and that organization which was the Air Force Special Processing Facility made additional from the duplicate negative made additional duplicate positives and ship them out to the rest of the intelligence community and military community to do additional what was called second phase and third phase exploitation in other words the scientific and technical intelligence community would get their film from Westover Air Force Base.

So this was an Air Force partnership Air Force organization. This organization not only processed the film, but they also looked at the quality of the film they made sure that the film met the proper standards and they identified the level of the quality of the film very, very important for future mission planning. Another area that the Air Force played a key role was providing people, and these people are not in uniform and I selected this picture in particular to make a point, and that is that this is a reunion of the people in the Corona, Corona was the first photo satellite reconnaissance program which initially operated in 1960 and here in 2002 they're coming together as a team. There was a lot of teamwork and those of you who worked in these programs would probably agree with me that wherever you were working in the program you were as a team collaboratively working and it created bonds that extended beyond the tours of people. There are informal reunions that take place with alumni not only from corporate, but also in the military Air Force components, NRO components, CIA components they just come together Kodak people, Lockheed people all of those who were involved they continue to come together, a very important theme in the way things happened in the early days of National Reconnaissance.

How did the NRO come to be formed? Well it actually started as a result of two major successes that the Air Force and the CIA had. There was this designer Kelly Johnson who was working at Lockheed and many of you have heard the name Kelly Johnson. He sent a proposal to the Pentagon and it went to Under Secretary Charyk, he looked at it, and had a colleague over in the CIA, Richard Bissell, and sends it over there and they were pretty interested in it. It somehow got over through the White House advisors, it got the attention of the President Eisenhower and the next thing you know Eisenhower had approved a program that ended up in the U-2 and a lot of success in that. There was a partnership between the CIA and the Air Force that worked so well when the idea for moving forward with the satellite reconnaissance program and there had been a series of studies in the 40s and in the early 50s, but it became urgent that these airplanes whether they were high-altitude or whether they were the RB-47s were really at risk and it was necessary to look for satellite reconnaissance and the White House said "look such a great success with the U-2 let's put the Air Force and the CIA together again," which they did and the rest of the story was the result of the Corona that operated from 1960 to 1972, which was instrumental in making the case that there really was no missile gap.

Those of you who either remember your history or remember your newspaper reports, in the early days of the Cold War the Soviets had led many to believe that they had this tremendous missile capability that was going to threaten the United States, we had been

through World War II we knew what the atomic weapons were like, we knew their bombers had range and certainly their missiles would have range into United States.

So, missile gap the Corona said no, the intelligence said there was not a missile gap, they debunked that. So great success with two programs importance of satellite reconnaissance becoming more apparent, the next thing we know there is a decision to bring all of the nation's national reconnaissance, satellite reconnaissance, activities together in one organization since everything worked so well with the NRO with the CIA and the Air Force we ended up having an NRO formed with agreement between the leadership at the CIA and the leadership at the Pentagon and the decision was made let's create this office the National Reconnaissance Office, but it was a streamline office in the beginning small staff at the Pentagon 4C1000 and it became organized into what we now call the alphabetic programs, and the Air Force took care of program A, the CIA took care of program B, there was a program C that the Navy took care of and there was a program D that took care of the National Reconnaissance Airborne assets, which were basically the U-2 and the A-12, also known in another form as the SR-71.

So you had these four programs, there were the autonomous program directors, all kind of working as a confederation reporting to the Director of the NRO who was the generally the Under Secretary of the Air Force, or the Secretary of the Air Force or an assistant to the Secretary the Air Force overtime the way it was structured. The Director of the NRO was always a civilian appointed by the Secretary of Defense and the Deputy Director was always an intelligence officer appointed by the Director of Central Intelligence now the director of national intelligence. So a partnership, but the NRO is a strange organization it doesn't have anybody working for it, it doesn't have a personnel system, it really borrows from organizations, it has people detailed from the Air Force, from the CIA, from the Navy, small in numbers from the Army, but the people belong organizationally to their parent organization, but they work in the National Reconnaissance Office. People made a lot of sacrifices who over the years worked in the NRO.

There were military officers who said it was more gratifying to work on a satellite reconnaissance program than to take all of the assignments that I would need to get promoted to Colonel or General, I want to stay where I am. And so you had people from CIA and the Air Force essentially having a whole career in the "Black Air Force," working for 4C1000 and making marvelous contributions. So, as I said it was a U-2 program Kelly Johnson's idea that's of course Gary Powers the success of the U-2 the success of Corona that resulted in the creation of this formally secret organization. And now I'll turn it over to Dr. Outzen who will kind of give you a case study analysis of the Gambit and Hexagon, and you'll see a little bit more of how the CIA and the Air Force kind of work together, and also you see about of how these programs really had a significant impact on our national security. And again it's great to have people in the audience who contributed to the national reconnaissance program and I would encourage you -- the others of you, to catch some of those people at the end and see if they can share some stories with you.

Dr. James D. Outzen: Well I'm not taking anything off let me just start by saying that, which is probably a good thing for us all, but Dr. McDonald and I were delighted when we receive the invitation to come out here and the talk a little bit about things that really haven't been discussed in the public previously. Important things, national reconnaissance systems, and I think it's been a privilege that we've enjoyed over the last two and a half years and working on the declassification of these systems.

This evening what I hope to be able to do is talk a little bit about the Gambit and Hexagon systems and really the Air Force's involvement in photo reconnaissance as a case study of how the Air Force took a leadership role in developing capabilities that fundamentally changed the way that we understood the Cold War, understood the resources of the Soviet Union and other adversaries in the Cold War, and then had better direction on how to more effectively and efficiently use our resources. And I want to talk about three challenges, one the larger challenge which was to develop very complicated systems put them in the harsh environment of space to take pictures from tens of thousands of feet above, us that's challenge one how do you just make the systems work. Challenge two is how do you launch large objects into space reliably on a consistent basis and then challenge three would be how do you get the images after you take them in space. So those are the three challenges I want to focus in terms of a case study of how the Air Force rose to the occasion in meeting these challenges. And then finally I want to just share with you some imagery that hasn't been released in public previously for the most part, to talk about the contributions of these particular systems.

Now as a historian I have to start someplace in the historical story and I want to start in the aftermath of World War II. Really that's where the Air Force's involvement traces back to. It was interesting walking around the museum today and seeing various displays of General Hap Arnold and his contributions to the United States Air Force. Probably one of the most significant contributions any individual made to the development is a photo reconnaissance resulted in this 1946 report.

We can trace the genealogy so to speak of photo reconnaissance back to 1946 in the aftermath of World War II. RAND Corporation, which in that year was established by the Douglas Aircraft Company at the request of General Arnold, to think about how to use new technology to fend off emerging adversaries a think tank which was a concept that the British had developed few years earlier Arnold believe that we needed to have a think tank to think about how to leverage emerging technology. Their very first report, the RAND Corporation, is this report its titled "Preliminary Design of an Experimental World Circling Spaceship," and it's really this report that we trace the history of satellite reconnaissance back to. The other element that I want to just quickly take you back in time to is I think it was President Eisenhower that described the attitude best in the aftermath of World War II "no more Pearl Harbors," we didn't want surprises again, we wanted to understand what our adversaries were doing.

So two things came together emerging technology and this concern that we defend the country from surprise attacks. What I've chosen to do tonight to kind of illustrate this story I'm going to show you this evening images, photographs, graphics that we have

never released to the public before. They've been recently declassified in about two months we're going to publish these, but I thought tonight we'd just use these images to tell the story about the Air Force's involvement.

So let me start with the first photo reconnaissance system that the Air Force was involved in. Eventually it became known as SAMOS. Its genealogy goes back to really 1954 when the RAND Corporation followed up with a preliminary report called "Project Feedback," which refined this concept of using an earth circling spaceship, which became known as a satellite, to take pictures from space and understand what our adversaries were doing. The original program was called "Weapon System 117L" later renamed SENTRY and finally named SAMOS in the late 1950s. The concept here was let's take pictures from space and there are two basic ways that we want to explore in trying to take the pictures. One would be - oops, go to the next one here. Oh! I'm sorry I'm going backwards. here we go. One approach would be to actually take pictures on film in space and then do what the Air Force called at the time read-it-out there would be a system on space that would read the exposed film and then send a signal back with the image on it so film read-out system was the first option. The second option was a film return system this is the film read-out system the E2 camera system. The other option was a film return system or it was kind of like a big camera in space take pictures, put it on film, and then somehow get the film back to the earth develop the film and understand what pictures were.

The program struggled in its early years and there is good reason for this its, brand-new technology the Air Force was doing something that nobody had attempted to do successfully before, and that was take pictures from space. And anytime you try to develop new technology there is lots of unknowns, there is lots of risk, there is lots of opportunity if you succeed in order to solve very challenging problems. Dr. McDonald talked a little bit about the next system, which is Corona. Here a couple of illustrations of the Corona system.

Corona became the very first successful photo reconnaissance system and there are some reasons for why it worked. It was a very small team, very dedicated individuals who brought great strength to solving this problem of how to take pictures from space. It took expertise from the Air Force and from the Central Intelligence Agency. It leveraged opportunities to expedite development of the system, if the CIA had authorities, and they have special authorities to procure things quickly and efficiently they would use those authorities. If they needed a strength or resource, such as launch from the Air Force, they would utilize those resources. And it became a real demonstration of cooperation in developing a successful photo reconnaissance system. The system was designed really to last for two years with the hope that we would have successor systems in the SAMOS. This was a film return systems so the pictures were to be taken on orbit, deorbited and developed back on earth. The hope was that SAMOS will come online and carry out a film readout system which would get the pictures back more efficiently and more quickly.

Well, SAMOS ran into a lot of difficulties and by 1963 Dr. Joseph Charyk then Director of the NRO, cancelled the program. There were very multiple reasons for failings

sometimes there were launch reasons, integration reasons, camera system reasons, but again it was an emerging technology with a lot of risk. Corona itself faced very much a losing record in its first set of launches. Of the first 13 attempts at launch, all 13 failed, that we now a day say “you know we probably wouldn’t make it pass one or two launches,” but the world’s change quite a bit. But on the 14th launch, which was actually labeled Discoverer Our Corona 13 there was one launch that failed so early it was an even numbered so a little confusing sometimes, but on the 13th launch we actually had a successful recovery of the Corona bucket. Now the Air Force was very astute, I think another really important lesson learned here, because there have been so many failures in a row there was a lot of pressure to cancel the program and to redirect resources elsewhere to solve this problem of photo reconnaissance.

The Air Force upon retrieving the bucket, as we called it the film return vehicle, immediately took it to Washington DC, immediately went to the office of the President and gave the President at the time system it was just --- its an experimental launch somebody had actually put an American flag in it and carry film our camera system, gave the President the flag that had gone into space and the President - we have a very famous picture that we’ve disseminated very widely - that shows President Eisenhower with the bucket and with the flag. Now why that’s important is the President is now able to reinforce his support and Eisenhower support was pivotal for continuing this program. So it gave him some cover to continue support in the Corona program. That’s the early involvement of the Air Force.

I’m going to talk tonight a little bit more about Gambit and Hexagon because these are the most recently declassified system. As Dr. McDonald mentioned we recently celebrated our 50th anniversary, Dr. McDonald was in charge of that commemoration and that celebration, and a major component of that was to declassify two photo reconnaissance systems that serve the nation for nearly a quarter century from start to finish.

The first is the Gambit system. This is an early graphic that was developed in the mid 1980s by Kodak. Kodak developed the camera for the Gambit system. They’d worked on the SAMOS system had failed to develop a successful camera, but came back with Gambit. Gambit was developed to meet this challenge of getting a photography from space and its primary purpose was to take highly detailed images. We’ve declassified the fact that the satellites took images that had a resolution as we say “a better than 2 feet.” and what that means is from 100 to 120 or sometimes 150 miles in outer space will have a camera that will look down and we’ll be able to see an object that is 2 feet in size and we would be able to identify details of that particular object, or in the case of the Gambit, better than 2 feet. It’s really a very successful undertaking that occurs here. This is the very first generation Gambit. There were two primary generations the first generation carried what was called the KH-7 camera system. There were some very important innovations that were included in this particular camera system. The first is when we look at the camera itself the focal length of the lens, you know think sometimes about the maybe the old 35 millimeter cameras that you carry around and you’d have like a telephone lenses scale on or whatever, so maybe 6 inches, 8 inches something like this.

This carried a 77-inch long lens, so you know we're talking 2 meters basically a very, very long lens with an aperture and an opening of about 20 inches, so it's a huge lens to put into space. And how to figure that out and point it back down was a major innovation with the KH-7. There was another challenge that was met - have this little film loop up here - you think that isn't a very significant development, but one of the primary reasons that SAMOS and even Corona had its early failures is this problem of how do you put film into space and space is a very cold, harsh, uninviting environment how do you make film that is durable enough that it can feed through this system very, very quickly go through the camera go into this recovery vehicle and withstand the stresses that are put on the film or the film looper becomes a primary innovation here that helps the system work. We follow on here with a second generation of Gambit which was called Gambit-cubed early on, it had some additional innovations that were included in it.

One of the primary innovations back here, I don't have an illustration of it in this particular image, but it had a [Indiscernible] that allowed the entire front-end of the camera system to go back and forth in order to take high resolution imagery. You see an introduction the KH-8 it was called block 2, the second set of KH-8, of having two film return buckets. The purpose of having these buckets in place its better to have two than one. You can carry twice as much film, twice as much time on orbit and twice the capability to understand what our adversaries are doing and several other renovations were included in the KH-8 system. Again, this is a recently declassified image. I put it up here, it's an interesting collage, but I wanted to just mentioned briefly what this represents to me. It looks busy and complicated, that when you think about it, it represents a successful partnership.

There were multiple corporations that came together in order to make these systems work. Kodak developed as I said earlier the camera system. GE contributed the orbital control mechanisms and the film recovery bucket for Gambit. We have Martin Corporation providing the boosters for part of the Gambit systems. Lockheed is the integrator, the companies that's putting all of this together. TRW is working on software development. So, when you sit back and you think about all of the players that were involved in this, and each of them working on a particular sub challenge to developing a system that would work in space, and having an Air Force staff that is capable of understanding the engineering challenges giving the guidance direction and hopefully understanding of how to make all these work using slide rulers, punch cards, hand-drawn engineering designs and as you encounter a failure on orbit hundreds of miles out or over 100 miles out, these were real challenges in very difficult times. I think the fact that it worked at all is a remarkable feat to the credit of the Air Force.

Just a couple of other things I wanted to talk about. I thought I'd share these pictures because what I think they represent here is a real new innovation these high days that were developed as they were called to stand up a satellite be able to integrate all the components together. This represents the cutting edge of technology in 1960, and always behind the development of technology are people. There are people that sacrificed their time, their energy, time with family was probably the most significant sacrifice that you see in order to have what I think this picture represents which is a breakthrough in new

material sciences, engineering designs, overcoming environmental issues in space in order to make a reliable systems.

The next picture here I wanted to share is just to talk about another issue here. You build a satellite in a facility, you don't launch from the facility you have to move it, you have to get it out they're big. When the rockets go off, people notice, so hard to keep that secret. So how do you do that, how do you meet that challenge of putting into space one of our most important intelligence collection systems without people finding out? Well this picture kind of represents that we have up here. A KH-8 where we're transporting it and in fact if you go back into the museum if you haven't had a chance when you look at the KH-8 display there is a trolley there its very similar, but we would cover them, we would fly them about, try to keep them disguised. Obviously once we got them onto their launch pad people could see that we were launching things, but there were always cover stories for what we were doing in space and each of these systems had a particular cover story.

I think one of the most interesting of all the cover stories that I read about or studied or seen documentation on is with the early Gambit system and the genius idea the Air Force program manager had was to hide Gambit out in the open. All right, to make it so obvious the people would say "they couldn't be doing it because they do it secretly," and he called it the null approach that if there is a perception that nothing is there that's the best cover of all. So the approach was basically this we'll make it look like it's the SAMOS satellite which large portions of that had been discussed out in the open. We'll do it, we'll purchase items along with the SAMOS program, but we won't call them Gambit so the launch vehicles, the Agena control vehicle, the design of the camera system, all of those things were purchased in conjunction with an overt or open-satellite system, hiding the system out in open this null approach to security it was really a very remarkable approach. I share that with you because it really demonstrates the genius that goes hand to thinking about every single individual problem and challenge or sub problem and challenge that comes along with meeting this larger challenge of putting a large system into space and making it work consistently and reliably.

There were multiple great ideas that would converge in order to make these systems successful. The next system I want to talk about in a little greater detail is Hexagon. Where to begin with Hexagon? Well, kind at the beginning I guess whereas Gambit was developed to Kofi Annan and look at an object that's you know, relatively smaller, get down and gain details of relatively small objects. But Hexagon was designed to really take the place of Corona in a sense and of Gambit to a lesser extent it was to be a hybrid system. Now what I mean by take the place of Corona, Corona would take pictures of very broad areas and by having these very broad area images, American Intelligence analysts were able to identify changes that had occurred in terms of additional missile silos, additional ships being built, additional facilities in the Soviet Union. It was an incredible capability that came in and as Bob indicated, the very first intelligence issue I saw was this missile gap concern. Hexagon was supposed to be developed to do that more effectively, do it more consistently, do it for a longer period of time with more capacity. Gambit on the other hand again was taking high-resolution and the hope was you could get a high-resolution broad-area coverage and have the best of both worlds.

Well this was a concept that was not new by the time Hexagon was under development. The Air Force had tried a couple of approaches to make this work using Gambit in a slightly different way the idea was maybe if you fly Gambit out at a higher --- at a much higher orbit, do a mode Gambit as it was known, maybe that would solve the problem. It didn't prove as effective as we needed. Perhaps Corona's camera system could be improved. The Corona camera system had already gone through 6 different improvements by the time it reached the end of its lifespan in 1972, so it seemed like we needed to have a new system, and Hexagon became the answer. But it came with controversy. It originally was a CIA concept and you look at the early history CIA was saying "no, no we're not going to improve Corona its not going to work, we're not going to improve Gambit or fly it higher in a dual-mode that's not going to work. We need an entirely new system." We have in this very dramatic period of time the Director of the National Reconnaissance Office at complete odds with the Director of Central Intelligence over this particular program.

My colleague at the CIA, the Chief Historian there, has studied this issue very extensively and as we compared notes on McChone, who was the Director of the CIA at the time, and look at the original documentation there was intense tension between him and McMillan, who was Director of the NRO. So this was a highly controversial project for some really important reasons. When you look at it to try and get a sense of scale here - oops, go back here and here we have the equipment the little wheels down here, individual, and then you look at this very large satellite that's been developed here. Well up to this point we had launched much smaller satellites so just getting the thing on orbit was a huge challenge. Previously the most return buckets we had you know I'll go to the next picture here because it gives a belly view of it, instead of two buckets you have four. Corona carried about 33,000 linear feet of film, the KH-8 a second-generation Gambit carried just over 12,000 feet of linear feet of film. Hexagon was designed to carry 60 linear miles of film, all right.

The original Corona was on orbit for about a day, the KH-7 first-generation Gambit system was on orbit usually about a week or so sometimes a little bit longer. The longest that the KH-8 system was on orbit was about half a year. The KH-9, or Hexagon system as it was known, was on orbit for 270 days it as long as point because it had more capability it was a more dynamic system. So how did we get to this point of this logger heads of the CIA and Air Force to this beautiful, gold bucketed - to me, I mean this is just a work of art and to be able to come here and see it I wish I live closer you know just everyday maybe before work come by and admire it. So you're lucky people if you live here in the area in my opinion. How did we get -- how did the Air Force work this out? Well in good fashion, the country's interest were put before organizational concerns.

Over a period of time there was an agreement that Corona would need to be replaced and that the CIA and the Air Force would need to come together and develop this system. They divided the work up, the CIA working primarily on the camera system, the Air Force working on launch issues, integration issues and other kinds of issues and it became a highly successful program move forward and contributed very significantly to helping the United States win the Cold War.

Another little feature of the KH-9, or the Hexagon system, is this mapping camera, and you have this camera in your museum - this is it. The mapping camera is important because it allowed the United States to gain imagery that could be used for making maps and maps were important for war planning and understanding how to once if we had a war the lay of the land and how to deploy resources and what are our battle issues, what our adversaries will likely to do so its very important in that sense. It gave us geodetic information, point locations for the first time, we're all so use to GPS and Google, Google maps or Yahoo maps or even just maps you're getting your mapping book nowadays. Back in the 1960s and 70s having that level of detail just didn't exist, but probably as important as anything else it was an innovation that could be incorporated and could piggyback on this highly successful system and demonstrate flexibility in solving a range of problems to more efficiently and effectively use the significant dollars that were being invested in these particular systems.

I'm going to just kind of wrap up here and spend less time talking about launch, and then film recovery I'll talk a little bit about that, because I think they are interesting for a couple of just really important reasons. Me, again trying to set the stage for the environment that existed when we were solving these problems. So there is a new graphic that, well its an old graphic, that were releasing for the first and I love it because it tells a great story a nice progression here of launch capability overtime. How many of you remember the Sputnik launch all right a good portion of you. Could I just have one of you tell me what you remember about it, a volunteer, okay a first launch? [multiple speakers] All right, yeah I'll use a laser pointer here. Yeah, everybody is looking at it and they're thinking what the Soviets have made it to space for the first time and did you see us as winning or losing at that point out there. There was a real concern that "yeah we were losing the race to space," a very legitimate concern and I think that was the public concern. Inside government the concern was even more compelling I think the historical record demonstrates and that's if the Soviets were the first to get to space and they have nuclear weapons they're probably going to be the first to get a nuclear weapon to the United States.

This became really, I think at least within government circles, the single most compelling reason for having these systems that we just talked about starting with SAMOS, Corona the Gambit systems, and Hexagon was to understand what the Soviets were capable of doing. So you see this nice progression of launch that occurs and then I think with that understanding the vehicles themselves just serve as a great example of how the progression unfolds. SAMOS, being launched on a Atlas Agena combination. Corona, on a Thor-Agena combination, which you actually have that combination here in the museum as well. I'd inadvertently didn't put in the Atlas Agena for the KH-7, I just have KH-8 launches here on the Titan 3Bs, but again these phenomenal developments in launch. And then finally Hexagon on Titan 3D system getting closer to what we now call heavy launch where there are solid fuel boosters that are placed on the rockets so that were finally able to large objects into space. And so a huge challenge those of you that remember Sputnik probably remember watching our launches explode on the launch pad right, and waiting for one to finally be successful, took until 1958 before that occurred, but there was that early concern that you see failure after failure after failure.

Well again, the Air Force was primarily responsible for this - if I go back a little bit - this remarkable progression that occurs here from the early systems up to this conceptual system beyond the Saturn launch. I just thought that was a nice graphic and these are good pictures to illustrate that success.

The final challenge I want to talk about briefly tonight is the film recovery challenge and I'll make it very brief. If you get film into space, you know it's easy to get film out of your camera, and take it and get it developed back when we used to do that and we don't do that anymore, but it's very difficult to take pictures get it from space and develop at back on the earth. It was a very significant accomplishment again that occurred here. Basically, for all of the film return systems they essentially have the same approach. There was always a film return vehicle in all of the systems used, or at least through KH-8 developed by GE, that bucket would detach, it would spin up, it would be a mechanism of retro rocket fire to bring it back down it would despin, there would be an emmiter that would come out eventually a parachute which will fully deploy the little or the large heap shell will come off we would then have a main chute deployment.

At the same time as this was all occurring this, later we'll go back to a plane, this graphic doesn't represented which would identify roughly where the bucket was going to come down and then in a grid pattern there were several air recovery crews that we're looking for and if we fell in the grid the air recovery crew will come by they use these little hooks on the end of wires here. I thought about bringing the hook, but I was afraid the security people at the airport would not like it. Usually when I do these presentations I bring it, its not that long it has four prongs on it, its just a little small hook like that. There were two of them hanging out the end of an airplane to capture the parachute and that was that's how the system work.

It was designed to have two passes, so if you didn't catch it on the first pass you could come back and try it again. Let's just say that there were some third pass catches by the Air Force were necessary, not often, but again they rise to the occasion. Again, it's people, I put this picture and this is a picture of the test squadron in Hawaii that was responsible for the midair retrievals. They have a successful retrieval here very symbolic to them a very significant accomplishment in fact it was so significant. Does anybody remember the tour after the first discover as it was called the overt name, of these gentlemen going through the United States appearing like the tonight show and things like that did you ever see that. Well, became a very popular tour for the recovery crews that did this successfully. Here is a early bucket this is the number 12 launch for discover again it wasn't successfully recovered, but here is the first bucket that's retrieved which is the 13th numbered bucket that comes back.

Just a couple of things to recognize here like everything else there was an evolution that occurs. Out in the front of the museum is a C119, it is the first plane to capture an object that return from space in air. The interesting thing about it is the Air Force and the people that were carrying out the operation didn't even know they caught the bucket until they had actually caught it reeled it in and the reason why is they weren't supposed to have the bucket in their zone that they were responsible for. So they had to maintain radio silence

while this other crew was going off and looking for the bucket. So they catch it, they reel it in, and finally they say, “hey, we got it, there is really no reason anymore to have the other crew out looking.” They went from that level of working out difficulties and challenges to the end of the programs. It was rare, very rare that the Air Force crews missed a bucket. They practice a lot and they became very, very successful in carrying those out.

Again, just another perspective you can see the wires and just very, very difficult. If you caught the parachute too low it would pull the plane down and that happened once, and the crew had to actually they had a strong cutter mechanism that would cut through the cable to pull it in, you don't want to be flying in a plane and having a large parachute on the backend of it. So there were challenges like that that we’ve overcome, but here the individuals, I put this one up because you can see they're looking out the back of an airplane holding onto a cable here that’s going to catch that parachute there on the background. I think this symbolizes the risk that individuals took in order to make this system work, probably as best as any picture I’ve run across in doing my research. And then finally you know sweet success here, to be able to look out the back of the airplane and this is what -- what it was all about to be able to pull this in get the film to where it need to be and get it developed. Just another shot again with the trailing another sign of success here you can see they were able to collapse the parachute rather than capturing it too high or too low.

And then finally like everything else bigger is always better, and this is a Hexagon capture, because it’s a bigger parachute and a larger film return bucket there and an entirely new aircraft C-130, which you have two off from what I understand here is the museum.

Finally, tonight I want talk about the contributions of the systems. This is a picture of the Soviet airfield taken by Corona don’t want airfield. Corona helped solve this problem this question of what were the strategic nuclear capabilities when it came to ICBM development of the Soviet Union. You put that question to rest, and it was an important one, because by having a clear understanding of what Soviet capabilities looked like that meant we could invest money in things like Gambit and Hexagon to get even better information to solve tough intelligence problems. We had a sense of what was occurring on the ground when it came to nuclear weapons and air capabilities - and I put this up it symbolizes I think strategic bombing capabilities strategic bombers. This is an image from KH-7, first generation Gambit, of a Chinese nuclear test facility, and again it was about understanding the nuclear threat. What we’re at our adversaries in the Soviet Union, China and associated states up to, how much progress were they making? What did their test results look like when they put a nuclear test in place? KH-7 really helped us solve those questions. I put this one up, we have only 8, KH-8 images that we released, and that maybe all we release for a while because of the resolution of the system, its a phenomenal system.

But I put this out because it helped us understand not only sea based deployments, but more importantly, a broader based of how do you develop weapon systems, different

platforms for waging the Cold War. That's a fundamental question that it answered. And in conclusion I wanted to use Hexagon imagery tonight to really kind of talk about today. My point here is this, if it took us 12 years to develop these kind of capabilities, from the first successful Corona launch to the first successful Hexagon launch, we've been using imagery now for over 50 years. We have phenomenal capabilities today and they help us with not only military and intelligence kinds of issues, but I put this mapping camera image up because I think it helps you think about environmental issues or perhaps humanitarian issues or human rights issues and also the kinds of things in addition to our national security issues that the systems help us with today.

And then finally, probably for me a little bit of an emotional image here, and this was taken years ago, the Twin Towers, but from the panoramic camera on the KH-9, but I think it symbolizes a devotion and a dedication over years which have evolved into current capabilities that help us fight the battles of today. We use these systems for terrorism, we use these systems to deal with the multiple threats that emerging from non-state actors and those that would do us harm. And its because of people that served in the United States Air Force, and in the Central Intelligence Agency, in General Electric Corporation, and Kodak, Perkin Elmer who developed the an ITECH developed the Hexagon camera system. Lockheed, Martin, Lockheed Martin when the combined sacrifices were made, brainpower was brought to the air, and I think the characteristics of human ingenuity devotion dedication and loyalty are really represented by these systems.

So my hope in talking to you tonight was again to use some recently declassified images to help you understand a little bit more about the systems, but more than anything else how the Air Force in partnership with other individuals was able to rise and meet an important challenge in establishing a fundamental capability for winning the Cold war and establishing a fundamental foundation for meeting the intelligence and security challenges of today. So I thank you for your attention.

[END]