

CATO INSTITUTE POLICY FORUM

OSPREY OR ALBATROSS:

SHOULD THE V-22 TILTROTOR AIRCRAFT FLY OR DIE?

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Moderator:

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Featuring:

Maj. Gen. Mike Ryan, U.S. Marine Corps (Ret.);

Philip Coyle, Former Director, Office of Test and Evaluation,

Department of Defense; and

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F.A. Hayek Auditorium

The Cato Institute

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## PROCEEDINGS

Jonathan Clarke:

Good afternoon. Welcome to this Cato forum on the V-22 Osprey aircraft. My name is Jonathan Clarke and I'm a scholar in foreign policy studies here at the Cato Institute. For anyone interested in military issues, these are exciting times. The administration is conducting a far-reaching review, which promises radical change in strategy for structure and weapon systems. The Osprey will take a central part in this review. Already the battle has been joined with congressional hearings parading the strongly held views on both sides. To guide us through these complex issues, we have a panel of distinguished experts today with deep knowledge of the technical, budgetary and overall strategic factors involved.

First, will be Ms. Lane Pierrot. Ms. Pierrot is a senior analyst for technical aircraft issues in the National Security division of the Congressional Budget Office ("CBO"). The division is responsible for responding to congressional requests for analyses of major defense issues. During her 17 years at CBO Ms. Pierrot has performed analyses in a variety of areas; including DOD's technical aircraft requirements and the balance and affordability of DOD's plans. Ms. Pierrot has been widely published on the technical issues in the defense area. Please join me in welcoming her.

Lane Pierrot:

Thank you. A speaker at a conference I attended recently quoted Senator Moynihan on the subject of facts and opinions. The senator who was engaged in the floor debate said, "Sir, you're entitled to your own opinions, but not to your own facts." I'm grateful to Cato and to Ivan Eland for hosting these forums where people with different and frequently conflicting opinions can discuss their perspectives with candor. Perhaps bringing them together and sitting them side by side as Cato regularly does here will help clear up some of the differences that are related simply to misunderstanding. At a minimum these Cato forums may make it obvious if we're all using our own facts. Ivan asked me to talk a little bit about the V-22's history and run through a few facts about the V-22 program as a preface for the other participants who will give you the meat of this discussion. He also asked that I discuss a couple of alternatives to V-22 plans that CBO included in a recent publication.

The V-22 is a tiltrotor aircraft that can transport up to 24 troops or 10,000 pounds of equipment from the docks of amphibious ships that transport marines to operations ashore. That amphibious assault mission is currently performed by CH-46 and CH-53 helicopters. The V-22 program

started in 1981 as a four-service program with the army as a lead. One thousand or more V-22s were to be bought at that time. By the end of the 1980s the army had dropped out of the program all together and the navy's and air force's planned purchases were quite modest. The marines, however, still expressed a need to buy large numbers of V-22s. About 550 planes in the late 1980s to replace it's aging fleet of CH-46 helicopters.

The first Bush administration tried to kill the V-22 program in 1990, expressing concerns about the V-22's cost, which had grown, and about whether the program was affordable in the face of declining defense budgets. But the Congress preserved the V-22 program. It added funding for developing the plane until DOD began requesting funds for it again. The V-22 entered production in 1997 and funds for about 30 aircraft were allocated to the program through fiscal year 2000.

The Marine Corps now plans to buy 360 V-22s for the amphibious assault mission. About two-thirds of the planes that it expected to buy in the 1980s. The V-22 will bring crucial advantages to the amphibious assault mission, according to the Marine Corps. One major advantage is speed. Tiltrotor planes can fly faster than conventional helicopters. The Marine Corps believes this added speed along with other design features will make the V-22 less vulnerable than conventional helicopters when flying over enemy terrain. The corps also expects that added speed will decrease the ship to shore transit time. That can make the ships of amphibious task forces less vulnerable to enemy ground fire as they can conduct operations from farther off shore, out of range of a variety of anti-ship missiles. Reduced transit time would also permit the Marine Corps amphibious forces to build up fire power ashore more quickly.

In a hostile environment, even modest differences in the availability of troops and equipment could spell the difference between success and failure. Recently the V-22 program appeared to be at risk again. In addition to those earlier concerns about affordability, concerns have also been raised about the planes operational effectiveness. Including its survivability and operational availability. Two crashes last year led to concerns about whether the V-22 had been adequately tested and was safe to fly. Concerns about the program reached such a level that an independent panel was assembled to look at it. That panel, which reported its findings to the Congress last week, suggested that the V-22 should be more fully tested before it begins operational use. The panel did not support program cancellations, agreeing with the Marine Corp that no other aircraft would fully meet that services requirements.

I hope my fellow panelists will discuss the issue relating to aircraft design, aircraft capability and the plane's performance and testing as they can teach us all a great deal about that subject. I will focus the rest of my remarks on cost, affordability and those alternatives that I mentioned. Most of DOD's

weapons grow in price from the original design estimates to production. The V-22 is no exception. V-22 development costs have more than doubled from a total of about \$3 billion in the early 1980s to more than \$8 billion today. All the costs, by the way, that I'm using are expressed in 2001 dollars so adjusted for inflation. Over the same period total V-22 procurement costs have risen much less precipitously, increasing from about 20 - 30 billion over that same time period. Cuts in planned quantities hold those total costs down. The V-22's unit procurement price has almost doubled, rising from about \$30 million per plane in a 1983 estimate to about \$60 million a piece in DOD's most recent estimate.

Some defense leaders have also expressed concerns about affordability -- whether defense budgets can pay for the V-22. The Marine Corps expects to acquire the Joint Strike Fighter "JSF" as a replacement for its Harrier at the same time it is purchasing the V-22. Annual spending for those two planes in last year's plans would have peaked at about \$5.7 billion. That sum is about four times the amount that was included for Marine Corps planes in the 2001 Clinton budget request. If no additional funds were added to DOD's budget, DOD would need to cut some other program or funding area to offset those costs. But a recent CBO analysis of defense budgets, which is by the way available at CBO's website at [www.CBO.gov](http://www.CBO.gov) (Ivan wanted me to bring copies, but I think you all can look it up on the web) suggests that there is no shortage of budget pressures from other sources, including the need to pay higher operating costs and support a greater pace of modernization to offset a decade of low procurement funding.

In CBO's budget options paper, also available on our website, we considered alternative procurement strategies for the Marine Corps amphibious assault mission. One alternative that we considered was aimed at making plans more affordable by cutting V-22 purchase in half over the 2006- 2011 period. When both V-22s and JSFs would be bought at the same time. That alternative would cut funding requirements over that period by more than half a billion a year. CBO also considered an alternative that would cancel the V-22 and purchase helicopters instead. Over the next five years annual savings under that option would average more than one billion. Even if new helicopters were purchased to offset most of the lift lost as a result of the V-22 cancellation, but that alternative would not meet the Marine Corps requirements for its medium assault mission. Actually, since speed is such an important factor to the corps no helicopter option would. It is nonetheless something to keep in mind should the V-22 be unable to successfully complete the next testing round that it seems very likely to undergo. Thank you.

Jonathan Clarke:

Our next speaker is Maj. Gen. Michael Ryan. Mike Ryan is now the executive vice president of Rolls Royce here in Washington, D.C. where he has responsibility for providing customer and executive service for all Rolls Royce's military programs in North America. More importantly for our purposes today, before joining Rolls Royce, General Ryan enjoyed a full career serving his nation as a United States marine. His last appointment in the corps was as a major general commanding the second marine aircraft wing, a force of over 400 fixed and rotary wing aircraft manned by over 14,000 marines and sailors. He also served as deputy commanding general, second marine expeditionary force and in that capacity had the opportunity to command the largest and most complex multinational—that is U.S. and U.K.—forceful entry exercise conducted since WWII. General Ryan is a highly experienced aviator; he has compiled over 3,300 flight hours in a variety of fighter, attack and helicopter models. The bulk of his time in the Harrier and the Harrier II VSTOL fighter aircraft models. Please join me in welcoming General Ryan.

Maj. Gen. Mike Ryan:

Well thank you very much, Jonathan, I appreciate it. My real, I guess, qualifications to be here today are questionable, but let me tell you what I think they are. When I left the Marine Corps three years ago, I was ship qualified and not only in the AV-8, but also in the CH-46 and the AH-1 Cobra. I've got night vision goggle time in all of the four types of helicopters that the Marine Corps operates, plus the UH-60. I did have an opportunity to fly the XV-15. I haven't flown the V-22, but I've flown the simulator several times. I've had many landings in the desert on night vision goggles, both fun and unfun. In 53s the largest helicopters, so some of the things that people discuss about the ability of V-22 to do certain things, I've got some perspective on that at any rate. But my friends told me last night that I was failing as a marine getting up here because I needed a haircut and unfortunately I didn't have time to get one this morning either. What I'd like to talk about a little bit about is the areas that I have some knowledge of and having been associated with the program for many, many years, I'd like to talk about the requirement a little bit, I'd like to talk about the successors that we've had and then I'd like to talk about the problems that we're having as well and then finally maybe mention the way forward.

It goes back to Tarawa (sp?), Iwo Jima, amphibious assault. Incredible casualties during WWII. We'd like that not to be the way that we do future operations. It goes back to in modern days to Mogadishu, trying to evacuate an embassy when in fact it was such a close thing that the people that were trying to hurt our citizens were coming over the wall as the helicopters arrived. So there are real good reasons based in past experience for decades of why the V-22 is so attractive to the Marine Corps and the capabilities are so attractive. I'd like to quote Mr. Coyle's executive summary when he said in the planning

and execution of missions these three improved characteristics of range, speed and payload can be interchanged and utilized in countless ways. Together they provide a major step ahead in tactical flexibility. What are the individual leaps ahead?

Well, to just try to put this in maybe a little bit different perspective, let's make some comparisons here. If a V-22 can cruise at 248 knots as it did in op/eval versus a normal helicopter of 110 or 120. We're talking about 100 percent improvement in speed. Relatively speaking does that mean that the F-22 should be able to go Mach 4, to have the same kind of leap ahead in performance capability that a V-22 does over a helicopter.

Payload -- A V-22 will carry 24 troops. Its major payload is troops, or its primary payload, I guess I should say, is troops, is 24 troops versus ten for most other medium lift type helicopters. That's 240 percent improvement. Does the C-17 carry 240 percent cargo than a C-141? And again, I'm not trying to be critical of other airplanes. I'm just trying to put a frame of reference around the enormous leap forward in capability that a V-22 represents over anything else that we've been able to look at.

Range -- Full combat load, 500 nautical miles. Probably the best other helicopter that is out there on the market is 230 miles. Again that's double.

Countless ways that Mr. Coyle hit the nail on the head. Let me give you a more practical thing on a day in day out basis. When we would fly a squadron of CH-46s from the east coast of the United States to 29 Palms, California to operate in a combined arms environment, it would take three to four days, it would take 12 stops and it would use up all the flight hours that the C&O utilization authorizes for that airplane for one whole month. And that's just to get them to California. With a V-22 you can do that in about six hours and 20 minutes if the winds are good without stopping at all. Six and a half hours rather than three to four days. That's just in a practical basis.

When we neo'd (sp?) noncombative evacuation Mogadishu embassy back in 1991, when the first SOS call went out it was on the second of January. It took until the fifth of January for the amphibious force to get close enough to launch 53-Echoes, and after they launched them they had to aerial refuel twice to get there. That wouldn't happen with a V-22.

From a perspective of more combat-associated operations, if you're sitting on a task force offshore and you're worried about going ashore against a defended area. One of the studies we did many, many years ago just kind of nailed these numbers. From 75 miles offshore, with a CH-46 you could threaten 980 square miles. With a V-22, instead of 980 square miles, it was 43,000 square miles. Put yourself in the position of the guy that has to defend those places. It's an incredible quantum leap over things.

There's a description that they have in one of the books that I have read on V-22. With one aerial refueling a V-22 in the middle of the Mediterranean can range from Paris to Iraq. The area of influence that that airplane is capable of providing to the Marine Corps and to an amphibious ready group is in the neighborhood of 27 times the area of California. I mean this is a huge capability, a huge capability. Not just for the Marine Corps, but for the nation. But let's say that you can't pick the area because there are times when you don't get to choose where you want to go ashore. Make yourself a marine rifleman. Under a CH-46, if you're coming ashore, one of the studies we did to get a regiment ashore, doesn't matter the numbers of airplanes. It's all apples to apples. If you're doing it with CH-46s it takes you 26 hours. If you're doing it with V-22s it takes you four and a half. Make yourself the guy sitting there for the other 22 hours waiting for help. It's a tough day, it's a tough day.

Lastly, self-deployability (sp?) -- When I was a CG of second wing we sent some airplanes to South America - 53-Echoes. We had to fly them into Cherry Pointe, you've got to take three days to take them apart, you've got to take a day to put them on the C-5s, you've got to take a day to fly them, you've got to take three days to put them back together again and at least a day to test fly them again. After it's all said and done you're talking about eight to ten days. You wouldn't do that with a V-22; you'd simply fly it. Unrefueled range with extra tanks in it is about 1,600 nautical miles. With one aerial refueling in Op/Eval-ling it went 2,300 and some odd miles. If you want to deploy to Europe, as an example, a CH-46 squadron it's going to take you 12 C-17s and 10 days or 9 days or 8 days or whatever it is. V-22s you need one C-17. Huge difference, not just for the Marine Corps, but for the nation when it needs to move forward and it needs to deploy. I could go on on this because there are a lot of advantages. Let's talk a little bit about the problems.

First of all, let's not be distracted about problems. With due respect to Mr. Coyle. The quote is "there were 22 waived major operational requirements." I'll tell you there's problems here. Real problems. He's right. For instance, R&M shortfalls. The R&M shortfalls on the airplane in Op/Eval are absolutely unacceptable. You cannot go forward and fight a viable force with those kinds of deficiencies. They are absolutely number one important. I have to tell you that there's another part of this range here too. Let's take the waived operational requirement (major operational requirement) of being able to do air combat maneuvering with the airplane. The Marine Corps has always been looked at as kind of the leader in the world, actually, in air combat maneuvering and helicopters. We don't do it any more with helicopters. It tears them apart. It's hard. It's really hard on them and besides which, when you come out with the numbers of missions that we have for those kinds of platforms, air combat maneuvering is so far down near the bottom of the list (it may be, in fact, at the bottom of the list). So when are we going to get to doing

air combat maneuvering testing in the V-22? When we've got the time and when it gets to be at the top of the priority list. It's not even close now.

How about a major operational requirement waived - excessive force required to disconnect the intercom? I mean, I have a hard time accepting that as a major operational requirement. Particularly since they immediately got the fix put together in the local squadron para loft (sp?). So all I'm saying is there are serious deficiencies here. There's serious problems here. We need to keep our eye on the ball over which ones we really need to go after and not get confused over things like 22. By the way, 22 sounds like a lot. I'm told the last two airplanes that went through a similar evolution had 59 and 72 operational waivers. So maybe 22 isn't so bad after all. I'm sure some of the 59 or 72 are similar type things that about what we're talking here.

Last thing I'd like to talk about is VRS. Is Vortex Ring State a problem? Yeah, it is. It's a problem any time you're flying a rotor craft, but let's once again put this in perspective. "When flown in compliance with NATOP's (sp?) warning limits and adequate training susceptibility to VRS is nill." Further testing is ongoing as I think everybody knows. "To date no uncommanded responses within the 800 foot per minute 40 knot NATOP's warning range." I don't know any airplanes that you can't get in trouble in. But so far the testing says that VRS doesn't come into play in a V-22 until you're in excess of 2,000 feet per minute rate of descent at less than 40 knots. I've done some auto-rotation practice in helicopters and I've got to tell you 2,000 feet per minute at less than 40 knots literally scares the hell out of me. I mean you are already out of control if you're in that kind of set of circumstances in a helicopter at almost no airspeed coming down in excess of 2,000 feet per minute is frightening. Especially if you're close to the ground.

A couple other points: Mr. Coyle brings a good point and he gives great credit to the program for bringing the new testing on VRS on their own -- to bringing it forward on their own. And it kind of makes you think, well, why didn't they do it earlier? Well, I don't know the answer to that but I can make a supposition. "This area is historically left unexamined in other military rotorcraft, which put in place restrictions that rely on information nonspecific to their particular aircraft. In other words, we don't test any other rotorcraft in VRS either. Why? Because we know you're not supposed to go there. It's not a friendly place. If you violate restrictions, the laws of aerodynamics and physics will bite you.

I did one quick check and since I'm not in uniform any longer I can't completely verify the number, but one of the fighters that we have - in the last 20 years, 49 of those aircraft have been lost due to out of control flight, flying outside the envelope, and yet we don't see that on the newspaper headlines. We see one out of control VRS problem with the V-22. So again, you're darn right it's a problem and we need to make sure that people stay away from it.

Every military aircraft has prohibited maneuvers. The AV8 has over 20 prohibited maneuvers. The F18, for instance, has prohibited maneuvers. So yeah, we need to have prohibited maneuvers in the V-22 also.

What about the way forward? And I'll close with this. I think the Blue Ribbon Panel, I have enormous respect for the members. I think they've probably got 90 percent of it right. I think there's a lot of work that needs to be done, but I also think the industry has an obligation to not take our eye off the ball. I think the department of the Navy recognizes that; they are putting together a senior executive level committee to make sure that we do keep our eye on the ball and that we have constant attention to this. Let's not lose sight of it again and find ourselves in a bad position. But at the end of the day the country needs a V-22 and I firmly believe that. So we need to fix it. This isn't rocket science, this isn't high technology, it's put your nose to the grindstone and one by one knock down the problem areas and I think we can do that. Thank you.

Jonathan Clarke:

Thank you General. Our next speaker is Mr. Philip Coyle who is a senior advisor at the Center for Defense Information. Prior to joining CDI, Mr. Coyle had two periods of service in government. From September 1994 to January 2001, Mr. Coyle was assistant secretary of defense and director of the Operational Test and Evaluation in the Department of Defense and is the longest serving director in the 17 year history of that office. In this capacity he was the principle advisor to the Secretary of Defense and Under Secretary of Defense for Acquisition, Technology and Logistics on test and evaluation in the DOD. In the Carter Administration Mr. Coyle served as principal deputy assistant secretary for defense programs in the Department of Energy. Before entering the administration and in between Mr. Coyle has some 30 years experience at the Lawrence Livermore National Laboratory in Livermore, California. He is the recipient of many awards; recently Aviation Week magazine named him as one of it's laurels. He has also received various awards inside the Department of Defense. Please join me in welcoming Mr. Coyle.

Philip Coyle:

Thank you very much. I appreciate being included in the program today. The V-22 program office has a tremendous amount of work to do. To be convinced of that, all you have to do is read the report of the Blue Ribbon Panel, which makes many, many recommendations for things that need to be done, but in addition to the things that the Blue Ribbon Panel has recommended there are other things that will need to be done as well. The V-22 was supposed to be cheaper and easier to maintain than the helicopters

that it is to replace, and so far it hasn't turned out that way. In addition, the reliability problems that the V-22 has had have manifested themselves also as safety problems. If you have reliability problems in your automobile that's not a good thing, but if it's in an aircraft flying, reliability problems can manifest themselves as safety problems; and in the case of the V-22 they have. Another safety area that Gen. Ryan has already talked about is Vortex Ring State. One of the things the program needs to do is finish the Vortex Ring State testing that they started at Pax River. They haven't been able to do that yet and that will define a safe operating area. Once that safe operating area has been defined then the Marine Corps will need to do operational testing to see if they can do the operational missions they want to do within those restrictions. Let's say that 800 feet per minute turns out to be the restriction. Gen. McCorkle (sp?) has already said, in press conferences in the Pentagon that are on tape, that the Marine Corps does not want to have to operate within the 800 foot per minute restriction, but wherever it turns out to be, the question will be, can they use the aircraft within the restrictions that become known?

Another big piece of work that has to be done is all of the various reliability problems (I've forgotten the exact number, but nearly 800 of them that came up during Op/Eval ) -- all of those reliability issues have to be fixed and once they're fixed there will still be things that will fail from time to time and so there will have to be another investigation of all of the software issues. One of the most telling comments in the Jag manual report on the December accidents is that the hydraulic failure alone would not have caused the accident. That's not to say that hydraulic failures in an aircraft are a good thing, but the point the Jag manual was trying to make was that there was a software programming error also, such that when the pilots did the correct thing with the flight controls, things that they had been trained to do and did do many times, it actually caused the aircraft to fall out of the sky faster than it would if they had done nothing at all. And so one of the things the contractor and the program office is going to have to do is it's going to have to go back and pull the string on all of these kinds of issues and look, okay when this emergency situation happens, when this fails, when that fails, when these other things fail; despite our best efforts to fix the hardware and electronics and hydraulic issues, is the software itself programmed properly to take the next steps as it was not in the case of the December accident.

After all of that I would think that the program would want to do a sustained reliability test to demonstrate that the fatal accident rate is not as high as it would appear to be from the accidents so far, which have occurred every 800 or 1,000 hours or so on average. So that would mean doing a test that was two or three times longer than that. Say 3,000 hours sustained reliability test. When you talk about the V-22 and testing, the biggest test that program faces right now is a test of confidence and the sustained reliability test would help reestablish confidence in the aircraft.

But in addition to things like this there are still some operational issues, which have never been addressed. For example, the V-22 is supposed to be able to operate with many other V-22s on amphibious ships, but that's never been tried in operational testing where you would have a dozen, let's say, V-22s on the same ship. Similarly the V-22 is supposed to be able to operate on and off amphibious ships in mixed fleets of aircraft with other helicopters, with other aircraft and that also has never been tried in operational testing. It's something the program just never got to and so that will need to be done also and that I don't believe is in the Blue Ribbon Panel report, but it's obviously something that would need to be done. So the program office has an awful lot of work to still to do and you'll be able to tell whether they're serious about it: if you hear that they think they can get it done in two or three months you'll know they're not serious about it. I think it's going to be more like two or three years. And so the biggest question in my mind is whether the program and the contractor have both the will and the resources to do all of this work. As the Blue Ribbon Panel notes, the Marine Corps doesn't even have the travel funds to support visiting the squadron and doing other things that they need to do and so whether they will have the wherewithal on all of the different ways that resources manifest themselves to do all of this work is, I think, one of the biggest questions facing the program. Thank you very much.

Jonathan Clarke:

Our next and last speaker is Mr. Ivan Eland. Ivan is Cato's director of defense policy studies. He has authored studies on terrorism, the proliferation of weapons of mass destruction and homeland defense, the military threats facing the United States and the cost of NATO expansion. He has testified on the military and financial aspects of NATO expansion to the Senate Foreign Relations Committee. Ivan is a graduate of Iowa State University and has an MBA and a PHD in national security policy from George Washington University. Please join me in welcoming Ivan Eland.

Ivan Eland:

Thank you Jonathan. As many senior officials during the Reagan, Bush and Clinton administrations did, I also believe that the Osprey should be cancelled. Many of these officials, including Dick Cheney as secretary of defense, tried to kill the program because of its exorbitant cost. I think the general accounting office has also echoed their concerns about the cost of the program. As Lane just mentioned the total development costs have more than doubled and the production costs have grown by 50 percent and the reason that was held at 50 percent only, was because the number of planes was reduced. So, all in all, the program has experienced a \$15 billion increase in cost and, of course, Lane also mentioned that Congress kept funding the program and one of the reasons for that is that the V-22 program has been

spread across more than 40 states for its subcontracts. So there's a lot of political support at the time, but I also think despite this political support there are major problems. Now, Phil Coyle has mentioned some of these problems and also the General mentioned some of the problems also: the reliability, and availability which has been in the news and also the Vortex Ring State. I won't go into that too much since that's already been covered. I think the mission capable rates are sometimes less than 20 percent compared with the 79 percent for the aging CH-46 that the V-22 is supposed to replace. Note that a possible alternative for the V-22, the Blackhawk, has an availability rate of 80 percent and the goal of the V-22 is 82 percent, I believe, but it's no where near that.

Now I think the Blue Ribbon Panel also spoke of continuing quality control problems in manufacturing, etc. and this panel said that it would take another one to two years to fix the program. Mr. Coyle said it may take two to three years. So one to two years may be optimistic.

But those are really not my primary concerns with the aircraft. These problems may be fixed. It will cost a lot of money on top of the money that we've already spent on the program, but I have two major problems: the first one is the actual need for the aircraft and the second one is the cost and I'll go a little bit more in detail in those.

During the 1980s, David Chu, the chief weapons evaluator at the Pentagon during the Reagan-Bush era told the marines that it did not make sense to buy the V-22 for the short range mission of shuttling marines from the ship to the shore. And Chu is quoted in a March 2000 article in the National Journal as saying "we have private discussions with the Marine Corps along the lines of look if you guys have got a different tactical idea here come forward with it." So instead of having a fighting doctrine and designing an aircraft to carry it out, the marines seemed to have altered their doctrine to accommodate this high tech aircraft. So instead of hitting the beach with all our forces the marines would deliver about one-third of their forces inland behind the enemy with the V-22. Now I sort of have a problem with that because the V-22 can carry only men and light weapons. Heavier weapons must be brought in by the CH-53, which turns out to be the weakest link in the process. Lightly armed marines may not survive until the heavy equipment gets there. That is they may be defeated piecemeal or they either have to do that or they have to link up with heavier forces. Now we've dropped lightly armed airborne forces by parachute behind enemy lines and it seems to have had a spotty record and I think that's why parachute assaults have been rare and, of course, this may be similar to that.

Now, of course, it may be even harder for the marines to link up with the forces than it would be the army linking up with parachutes because sometimes it difficult to get off the beach. Amphibious assaults are very risky

under any circumstances and, I think, they're made even more risky by the strategy of dropping people further inland. So perhaps the marines maybe should stick with the doctrine of landing their forces on the beach, although amphibious assaults are risky as I mentioned, this adds even more risk, the new concept. I do support the new amphibious assault vehicles and they already have the high speed air cushion ships so they can hold more of the coast at risk even without the V-22. If we eliminate the need to drop the forces in I think that helicopters become a much better option.

So that's the need for the aircraft and now I'll go into the cost. The number of aircraft purchases have dwindled to about 458. That's 360 for the marine corps and the rest for the air force and they navy. The program cost is \$40 billion. If you figure in the total cost, that's \$80 million per aircraft. Last year alone the aircraft costs increased by about seven percent from the expected amount. The real question, I think John Warner asked it in the hearings the other day, was... Well, actually he questioned whether the added capability in range and speed that we're getting is worth the high cost and risk. As Lane pointed out earlier, buying both the JSF and the Osprey at the same time would require a four-fold increase in the budget for marine aircraft. I don't think the Marine Corps can afford both of these aircraft and so it's going to have to make a decision about what it wants to do on that. Bush's advisors have complained that there are too many aircraft programs in the budget. We've got three fighters and the Osprey alone—if you count those four programs you're almost at \$400 billion combined, and if you count Comanche and maybe C-17s you've got even more aircraft in the budget.

I think the marines make the claim, and this a very convincing argument to most people, that marine lives will be lost if you don't get this aircraft. Well, the air force makes that [argument] about the F-22 and every service makes that argument about their plane, but you have to say well, what's the opportunity cost if you spend the money on this plane some lives may be lost if we don't buy something else that needs to be purchased.

My last point here is that the V-22 is a prime example of a failed defense acquisition system. The defense industry is still very socialist -- that is, government-owned shipyards, depots, arsenals, etc. It has a lot of industrial policy in it. The Pentagon protects certain companies and manages what it euphemistically calls competition as rampant politics, pork projects and refusal to close facilities and is about ready to sink in a morass of unnecessary over-regulation, and yet we continue to fund programs that have experienced cost growth like this. When you say this nobody evens bats an eye because that happens on every defense program, but I think the Bush administration wants to reform the defense department. The V-22 would be an excellent program to cancel. It would send a big message to the acquisition folks and Congress that we're not going to put up with these sorts of things anymore. What happens is the Pentagon puts too many weapon systems in the pipeline and then costs

grow and numbers dwindle and suddenly [we're] producing all these weapons in very low quantities.

What we need to do is give the system a wake-up call and the V-22 is an example of where this panel and everyone else, I think, has said that the program has been rushed. Now we're going back and fixing things at very high cost that should have been thoroughly tested in the first place and so I think the process has really failed. Now maybe it's no worse on this program than any other program, but it's nonetheless there and this program is in trouble because of that. There's political pressure in the system to get programs into the advance stages of R&D and production so they can be safe from political winds -- that is termination. The marines found out they didn't have the money to fix the programs because it wasn't in full production. They would have gotten more money then, but to get it in full production they had to have better availability of record on the aircraft, which, I think, led to the problem that we see now.

I think no matter what defense budget you're looking at or what level you think the defense budget should be we have too many weapons in the pipeline and we should prune some of these weapon systems and produce the rest of them at efficient rates and that's not happening now. We've seen the IOC date for the V-22 delayed by a decade. I mean these programs are just horrendous inefficiencies and yet we seem to give the bureaucracy more money. Now you say well what about the argument that there's \$12 billion sunk costs in the V-22 and if you kill the program that's all going to be wasted. Well, first of all, you may get a better value for your money on this particular program by continuing since you put all your resources into it, but what does that say to other program managers? It says well, no matter whether you're muddling through or not, the more money you spend the more money you have under the wire, the less likely it is that your program is going to be killed and I think that's a very bad message to send to people. And also a lot of the technology and the research and development programs are transferable down the road to other things anyway, I think. So I don't think it's necessarily all wasted.

Some of the alternative to the V-22 (Lane mentioned some of them, I think) are the army Black Hawk, the CH-53E. Both are cheaper aircraft. Also the possibility of the European EH-101 helicopter--it's \$30 million versus \$65 million procurement cost for the V-22. It's bigger than the V-22 so it can carry more troops (30 versus 24). It's already fully ready for marine operations. It has a 200 mile range. It's not as long as the V-22, but nonetheless may suffice for carrying troops to the beach. It takes up less space on the amphib deck than a V-22 (actually, in 1987 one Marine general advocated buying this aircraft instead of the V-22). The best alternative may be the Sikorsky S-92 helicopter, which is an enlarged Black Hawk equivalent. The aircraft will carry about the same number of people and the same amount of cargo as the Osprey. I'm very much for the military using commercial items when it can

because I think the military runs into a problem where if it doesn't start doing this, its technology is going to be out of date. In transportation aircraft you can use commercial aircraft and modify them for military purposes. Of course, in fighter aircraft and submarines it's more difficult to do and things like that, but in this particular case I think we could use a commercial alternative, and frankly, our military doesn't want to do that because our military is a "Cadillac" military. No military comes close in the world to what ours does and it has great expectations of having the detailed specifications it wants and I think in the long-term that is going to be a problem because the technology in the commercial sector is racing ahead of that in the military sector and if the Defense Department doesn't change the way it does business it's going to be in big trouble. In this area, I think, we could easily use a commercial system. If not the S-92 than some other vehicle.

I would terminate the V-22 because I don't think it's a good program in itself and also it's a prime example of the acquisition system gone awry. I think it's unneeded, it's costly, it's in need of redesign of some key components. It's likely to have schedule slippage in the future. And this would send a big signal to the Pentagon bureaucracy and to the Congress that George Bush is really serious about reforming the Defense Department. Thank you.

Jonathan Clarke:

I would like to thank our panel very much for, I think, a clear and incisive view of the issues on both sides. If I may identify a possible consensus -- it seems to me that there is a consensus that this aircraft does have some exciting capabilities, but it's also highly problematic. The issue really is whether the problems that it has are typical and fixable or whether they are atypical and somehow nonfixable and whether one should proceed, therefore, to termination of the program.

We have about 35 minutes now for questions, may I ask you to raise your hand and I will recognize you. Then wait for the microphone to come to you. Please identify yourself and your affiliation and please also say whether your question is addressed to an individual on the panel or to the whole panel.

Question & Answer:

My name is Dan Sagalyn. I'm with the News Hour with Jim Lehrer. I'd like to ask Gen. Ryan a question and then Mr. Coyle, if you could comment. The Blue Ribbon Panel also said the office of the V-22 should look at if it needs to be able to auto rotate. Something you guys haven't really talked about. My question to you sir is would you want to fly an aircraft where they drop that requirement and whose glide capabilities might be questionable.

Maj. Gen. Mike Ryan:

I think it's a good question, it really is and I think the answer is not complete yet, but when I first kind of stumbled on this after having been gone for some period of time, my first instinct was to say what's going on here? Why can't you auto rotate? Then I started thinking about the practice auto rotations I've done in a 53-Echo. Wow. Not a fun time. And then I also started thinking and I asked a few questions and I got some good answers and that is, there's a wing on this airplane. There's another envelope here that you can expand so start thinking about... You know people have this impression that you auto rotate and you come straight down out of the sky and that's not it. Far from it. There's a zero auto and then there's other autos and in many cases your best opportunity is to roll the airplane on at slow speeds, engine off, slow speeds, not do a zero hover auto rotation. Well, if you then start thinking about a wing on a V-22. In auto rotation you can look out the window and you're going to come down someplace in this circle. With a wing where you can glide you actually may be able to design some tactics and techniques that will allow you to have a better opportunity to survive rather than a worse opportunity to survive. I think they have done that. They have done some studies on it. They've done some simulation on it and it's very promising. I do think though, and Dr. Coyle can comment on it, but I think that's one area where they really do need to do some actual no kidding, hands on testing to really flesh that out because I think there's some real promise there.

Philip Coyle:

If you just talk about auto rotation per se I don't believe there will be much that the V-22 can do about that. I think it will simply be too dangerous to even try it in testing to do straight auto rotation. I agree with Gen. Ryan that there needs to be some testing of looking at using the wing. The problem they will have is the wing doesn't have a lot of lift in some positions and so it depends where you are when you have an emergency that gets you into this situation in the first place. But even with the wing in its best position the V-22 comes in very steeply and so when you talk about gliding it, it might not be the mental picture you have of that. It's quite steep, sort of like when the Space Shuttle comes down and so I agree with him that some more testing of that approach will be needed.

Maj. Gen. Mike Ryan:

Please keep in mind in order for that condition to exist both the engines have to be no longer operating.

[Unknown speaker:]

Could you explain what auto rotation is?

Maj. Gen. Mike Ryan:

Me? Well, if you want a harrier pilot's description of it. Auto rotation is this. If you lose your engine.. On a helicopter rotorcraft your wing is really the rotor and so what you have to do is give up altitude to maintain some airspeed and to keep the wing of your airplane flying is what it boils down to. And then as you get closer to the ground, what you have to do is you have to trade off that energy that you've maintained in your rotor to break your rate of descent and hopefully it all works out that all your energy is used up when you very nicely and softly hit the ground. But that is pretty problematic and the bigger the helicopter gets, the harder the issue becomes.

Bill Hoar, Periscope Military Database: General this is a question to you. You made mention of some of the fighter aircraft and you weren't all together sure of the numbers and without holding you to the specific numbers could you specify what aircraft you were talking about, and in line with that, somehow compare the V-22 with some of the other problems; I'm thinking specifically of safety. I've seen some figures for the Black Hawk of 20 crashes in the last nine years for example. Just as a way of comparing what the V-22 has accomplished.

Maj. Gen. Mike Ryan: I'll try. First of all I would prefer not telling you the aircraft type. The numbers are pretty good. It's 20 years and it's 49 airplanes lost out of out of control flight. I would ask that rather than me telling you the airplane, you know, you have resources much better than I and it might be useful to try to... My point on this was, why are we centering on this issue on the V-22 when so many other aircraft have similar things that they need to deal with. There are operational issues that everybody has to deal with. Any time you get a capability you're going to give something else up in an airplane. And there is no way, even with all the testing that Dr. Coyle and others want to do you're still not going to get to zero (100 percent) certainty on any of these issues. It's a matter of degree that we're talking about here. I think Dr. Coyle and I probably agree on an awful lot of things. We may disagree on just the degree of some of these things.

In terms of comparing V-22 against the others, you can't because it's in a developmental program. It was in a developmental program that was killed for three to four years so there have been some stumbling blocks along the way. Part of this whole issue around the V-22 is it's been a threatened program for so many years. People do funny things when it's a threatened program. You know you become insular, you start probably working through some problems in a different way than is maybe the best way, so I think that a lot of this is

being recognized now. I would say this that if you look at most developmental programs I don't think the V-22 has an atypical accident rate for a development program.

[Unknown speaker:] I might just comment, one thing that's different about the V-22 is it carries lots of troops. People have compared F-14 accidents with V-22 accidents and the difference of course is when an F-14 has a problem, the pilots eject and parachute out, and often survive. When a V-22 crashes you can lose a lot of troops as in the case of the April accident where all in all 19 people were killed.

Maj. Gen. Mike Ryan: Absolutely true and it's true of CH-53s and CH-46s and it's true of Black Hawks. Nobody likes to see people get killed and the more people die, the less people like to see that.

Rick Whittle, Dallas Morning News: I'd like to ask you Mr. Coyle if you would elaborate a little bit on your last comment and address the point Mr. Eland was making that the V-22 from his point of view is maybe the most egregious example of this defense acquisition system that's out of whack. If the V-22 had not been tested carrying 19 troops or actually 15 troops, and the flight crew had been killed, but not 19 people in that crash, would this program be in the crisis that it's in now. I mean is it a question of... Well I think you get the point.

Philip Coyle: Well, all in all, 30 people have been killed in V-22 crashes so far. Twenty-three in the last two crashes. So that's getting to be a fair number of people. To go to your question about acquisition: the V-22 program was under a tremendous amount of pressure—schedule pressure and budgetary pressure—and is pretty well documented now by a number of different reports—reports that my former office put out, the Defense Science Board and now the Blue Ribbon Panel. They cut corners because of those pressures and now they're going to have to work that should have been done before—work that I tried to outline in my remarks earlier.

Linda DeFrance, Aerospace Daily: Dr. Coyle this is for you. You outlined... Since you have worked in many, many test programs I kind of wanted you to line-up the V-22 as compared to some other programs. Is it common to have 22 waivers in Op/Eval, the 800 issues you said that surfaced during Op/Eval and then I know that during Congressional testimony before the Senate Armed Services Committee, the marines brought up that there were 170 hydraulic issues that came up during Op/Eval and in addition to that another one or two catastrophic failures that nobody seemed to know about. Is this common for a test program?

Philip Coyle: No it isn't. With respect to waivers, that's something that we have criticized. We think that the Navy should not use the waiver process they way they did in the case of the V-22. That's something that the Defense Science Board criticized separately from us. I certainly understand why waivers from minor things should be permissible going into Op/Eval, but to the degree that they were used here I think was excessive and the DSB said the same thing. With respect to hydraulic failures there were 170 during Op/Eval and my former office counted 39 of those as safety related because of their severity. We got that information by reviewing the maintenance action forms and looking at what the nature of the failure was. So for example, if there was an active leak we counted that as a safety related failure because fire or just losing the pressure in the hydraulic system. We also counted failures similar to the one that was part of the cause for the December crash, namely where there was rubbing. A wire bundle rubbed in the case of the December crash on the hydraulic line. Not all the way through, mind you, but rubbed the wall thin enough so that the 5,000 PSI inside burst the line. So we would count rubbed lines of that sort. If they were cosmetic we didn't count them in the 39, but if they were starting to do real damage to the wall we did. Those maintenance action forms are prepared for the program office and for the contractor so they know about them. They are not prepared for my former office, so there's no reason why my former office would know about them and the program office wouldn't.

Linda De France, Aerospace Daily: Is that amount of failures, is that similar to other test programs at that stage in development into an aircraft system?

Philip Coyle: I don't recall an Op/Eval where there were so many failures. Perhaps if we went back we could find an example where there were, but I don't recall on in the last six and half years.

Maj. Gen. Mike Ryan: Well, the only thing I would say is I agree the reliability and maintainability issues and the failures during Op/Eval are absolutely unacceptable and I think everybody agrees on that and they need to be fixed. That's at the heart of what the way forward needs to look at. However, testing... We go back to this degree issue. Let me give you an example: live fire testing on the V-22. Dr. Coyle and others have complimented the program. The requirement was to be survivable with 12.7 millimeter. They went to 14.5. They even tested it with 30 millimeter. All complimented and then comes the other shoe, but you didn't test it against missiles. It needs more testing. I mean, you can ask for more testing until the cows come home on an awful lot of things. These are just value judgments that people have to make about what is the time and cost, not just into the program, but into failing to get the airplane to the operator in an effective and timely fashion. And so that's why I go back and I say that many things Dr. Coyle and I

probably do agree on, but the degree of these things, I think. It really is. And if you lump all these things together you lose sight of the things that are really critical and the reliability and maintainability is absolutely centermost.

Christopher Earles, National Security Research: My question is for Gen. Ryan. I don't think anybody would argue with the increase in range and payload and speed that you laid out earlier. Those were all great improvements over the helos, but many of the marines that I work for and the retired marines I work with have expressed almost uniform concern about the ability to get a V-22 into a hot zone and out of a hot zone quickly. They cite two related problems: one being the time it takes to transition from horizontal to vertical flight, which increases your amount of time under fire, and then just the survivability of the aircraft itself. One of my co-workers in particular says with the 46 or 53 you can bring them in very fast. You can land them very hard either vertically or rolling landing. Throw the marines out the back or throw the civilians into the back and get back out. How would you compare the V-22 in that one specific category?

Maj. Gen. Mike Ryan: I'll give you two answers to that. One kind of, hopefully, intelligent; the other one kind of an emotional answer. The intelligent one would be this: Nobody wants to go into a hot zone. The idea is to avoid hot zones and so the V-22 gives you much more capability because of speed, range and pay load to avoid hot zones and get there with the combat power that you need because in the Marine Corps you're always starting at zero combat power and how fast you can build things up is very, very important.

Now I'll give you the other side. I was the CO of the first AV8B squadron and there were two AV8A Squadrons, good friends of mine because I had come from that airplane, down the street. We got one airplane and after about a week and a half I went down the street and talked to my counterparts in the AV-8 squadron and I said would you please tell your young captains to stop bad-mouthing the brand new airplane we've been waiting 10 years for. It carries twice as much, three times as far and is 10 times/20 times safer. By the way, they haven't even looked at the darn thing yet. There is an emotional attachment to what you've grown up with and what you've flown. You love the airplane that you fly. You resent something new coming along and taking it's place. That's reality, that is really true. Some of the comments that people make in that regard are very well meaning comments, they care about the issues, they recognize how well they did and how good their airplane was to them and they survived hot zones with it. But at the end of the day this is called progress. No offense, Ivan, but why can't the marines do it the way they did it in WWII? I'm sorry, I know a lot of those folks. I really don't want to do it the way we did it in WWII.

Don Ernsberger, Deputy Chief of Staff with Congressman Rohrabacher's office: My question for Maj. Gen. Ryan, but also for Mr. Coyle -- Maj. Gen. Ryan mentioned that the laws of aerodynamics can sometimes bite you (in your presentation) and one thing that we haven't talked about very much here at all is the fact that the gyroscopic resistance of tilting these gigantic rotors in this plane require three separate 5,000 PSI hydraulic lines and all of my studies show that the hydraulic lines, which seem to be very brittle and are always breaking, has been the single biggest problem. So is it in fact, the biggest single problem with this plane is that it tries to break the hydro-dynamic laws by trying to overcome this gyroscopic effect. So I'm interested in that particular problem of the hydraulics problem which seems to be the heart of most failures.

Maj. Gen. Mike Ryan: Boy, you got me I'm an English major. I'm not an engineer and I honestly can't answer your question on that. I just can't, sorry. I can hook you up with some folks that can though.

Philip Coyle: Well, if I could just comment a little bit. This aircraft has 5,000 PSI titanium hydraulic lines to save weight. The high pressure is to be able to use smaller diameter, which saves weight and the titanium on top of that saves weight. So that's how the program got into this particular design mode. You're correct there are a lot of big forces on this rotor, but the failures in the hydraulic system have not been because of the forces so much as because of rubbing and leaks and other kinds of things. Now 5,000 PSI systems in and of themselves are not all that common. Most aircraft use 2 - 3,000 PSI and there's jokes amongst the maintainers, you know with 5,000 PSI systems that if it's not leaking it's empty. But there are other aircraft that have used 5,000 PSI systems, but this one did it to save weight.

Maj. Gen. Mike Ryan: I would make one comment, although being an English major... But I was talking to Paul Schneider (sp?) this senior executive level committee that the DON is trying to establish with industry as well and one of the things that Paul mentioned to me was we need to do some trades here. And he specifically talked about smaller hydraulic lines to save weight, weight is always a problem in airplanes, but this airplane has such phenomenal performance that maybe we just lost sight of something here. That robustness maybe 300 lbs. was a number that somebody used, maybe an extra 300 lbs. isn't such a big deal here. And so I think you're going to get to those kinds of answers if we follow the way forward that the Blue Ribbon Panel has laid out.

[Unknown speaker/ possibly Coyle:] I might just add that the biggest problem that I think right now is the Blue Ribbon Panel has recommend that they redesign the nacelles. Those nacelles are absolutely chock-a-block full of

hardware and the Blue Ribbon Panel has said those have got to be redesigned and that's going to be a big job for the contractor.

Tony Capaccio, Bloomberg News: I want to follow-up on that from Gen. Ryan. Rolls Royce, I think, makes the engines in the V-22.

Maj. Gen. Mike Ryan: Yes, we do. By the way, we make the engine on the EH-101 too.

Tony Capaccio, Bloomberg News: I know, but the whole issue of the nacelle, the Blue Ribbon Panel during their public session explicitly pointed out that this was a major issue that needed to be dealt with to redesign. To what extent does Rolls Royce, Bell & Tech, and Boeing bear some kind of design problem responsibility here -- overestimating the tolerances that could be crammed into the Nacelles or poor design? What responsibilities do the companies have and how much of this should be fixed on their nickel?

Maj. Gen. Mike Ryan: Boy, that's interesting questions and tough questions and I'm probably not qualified to answer either of them. I would say from an engine perspective. The engine has been extraordinarily reliable. It also by the way is the same core engine that's on the C-130J and on the Global Hawk. It's been a good program for every... All those programs combined, they've all benefited by being a combined program, so to speak. The nacelles, I really can't comment on it because I don't have any knowledge about it. I would like to say that now that I have transitioned over into the civilian world, I've become a little more understanding about companies and money and frankly when I was in the Marine Corps as a senior officer, if you weren't going to talk to me about \$100 million I really wasn't interested. That's an overstatement, but you get the point. I'll tell you what, in industry, you're talking about \$200,000, you're talking about a lot of money and so there are very small margins in the defense business. The only thing that makes the defense business attractive in my mind, in my short period of time, is, the U.S. government is the best risk and revenue sharing partner that you can find. And if you take that away from defense industry, I don't know what the landscape will look like to be honest. So I think good people have to come to grip with those answers, but I would say in my view this is a shared success story and it's a shared tragedy so we all need to pitch in here.

Jonathan Clarke: Ivan, does risk and revenue sharing sound like socialism to you?

Ivan Eland: Yes, it does.

Maj. Gen. Mike Ryan: There are risk and revenue sharing partners in the civilian world, too, I might add. It's just that when the U.S. government is your risk and revenue sharing partner it is a very good risk and revenue sharing partner to have, so I didn't mean that was exclusive to the DOD.

Ivan Eland: So, we probably should raise the profit margins and do less risk and revenue sharing, I think.

Niels Sorrells, Congressional Quarterly: I wanted to ask Gen. Ryan about the Osprey's use. I'm specifically curious about your response to what Mr. Eland said about how the Osprey couldn't carry enough cargo and so you'd have marines out there with only light infantry.

Maj. Gen. Mike Ryan: I don't agree with that. The light weight Howitzer--155 Howitzer--that's being designed is 9,000 and some odd pounds. The V-22 has proven in Op/Eval that it can external 11,700 lbs. and so in fact compared to 46s or Black Hawks and several other medium lift type helicopters the ability to build up combat power with the V-22 is not just a factor of range, [?pate?] and speed, but is also a factor of that payload that it can carry. Look, tanks don't swim. You know, this is why the Marine Corps needs fixed wing airplanes. Amphibious operations or forced entry operations are a different nature other than line-up the armies across the line from each other and start the war after everybody's in place. It's a different business and some of the risks have to be appreciated and then you have to mitigate the risk. The V-22 hands down mitigates those risks better than anything that's out there by far.

[Philip Coyle I'd just like to comment about carrying troops. An issue that the V-22 hasn't resolved yet is how many troops with what equipment they really can carry. They're supposed to carry 24, but during Op/Eval the soldiers and marines made comments on the comments sheets that it was too crowded for that. The V-22 has special crash seats for the crew in the back and you're not supposed to put gear underneath those seats and that means there's a lot of gear and people on top of your legs and feet and the marines commented that they thought that that situation was unsafe and so that will have to be worked out as to what exact equipment can they carry, how many can they carry, without creating a situation where in combat, and the process of trying to get in and out the back, somebody gets hurt.

Maj. Gen. Mike Ryan: He's absolutely right. The spec called for 24 troops at 240 lbs. a piece. You know we've got a lot of small marines as well as big marines and that's a lot of gear that people want to carry. And they want to carry more and more gear and I understand that. I've been in the front of them and been in the back of them and got off of them in the places where it was not fun and this is a big issue for the troops. I would only say this, that the Marine

Corps operational use will make accommodations for this. There are tactical work-arounds to that particular issue.

Ivan Eland: I just wanted to make a comment about what it can carry. I think, you know compared to medium lift helicopters, it probably does well, but to bring in heavy equipment it really doesn't do what a CH-53 will. Also on this doctrinal issue, I'm not advocating going back to WWII. I think you'll have the new amphibious assault vehicle. You already have the landing craft air cushion, which dramatically increases your speed to the coast. So I don't think we need to go back to WWII on this, but I still have a problem with the doctrine as it's being promoted and has been promoted for several years, for quite a few years actually now. But it's really a question of I think this doctrine was developed to justify the plane rather than being a sound... to drop light troops behind enemy lines. I'm not sure that's a smart idea.

Maj. Gen. Mike Ryan: I'm sorry I just can't agree with that. He's said it twice now and, look, it implies that there's some nefarious reason why the Marine Corps wrote the requirement the way they wrote it and I was there and there isn't one. The reality is that no one imagined the capability that a V-22 could bring to the table, so nobody wrote a doctrine ahead of time expecting that you were going to get this kind of capability. Nobody expects a 100 to 400 percent improvement in tactical capability for pity's sake, but when the Marine Corps was told what the airplane would be able to do, they sat there with a big smile on their face and said holy cow, this opens up a whole new world of possibilities for us that we haven't even been able to dream of before this. So we've got to get the cart and the horse here in the right place and the right place is when the potential surfaced, the Marine Corps looked at it and optimized it.

Adam Hebert, Inside the Airforce: There's been a lot of discussion about the V-22's susceptibility to Vortex Ring State because that was a contributing factor in the December 2000 crash. I was wondering if Mr. Coyle and Gen. Ryan could comment on the V-22 susceptibility to VRS compared to other helicopters and whether or not you feel there is something unique to the V-22's design that's making it hard to get a handle on what exactly the flight envelope for this aircraft should be?

Philip Coyle: I think you misspoke there, you said VRS was the leading cause or something of the December crash. [It was an] April crash -- just in case somebody else picked up on that. One of the things that's different about the V-22 is the rotors are side by side. In other tandem rotor helicopters they're fore and aft, and when you're coming in at a steep descent the fuselage actually shields the aft rotor. So if the forward rotor goes into Vortex Ring State it causes the nose to drop, which is what you want to do to get out of it anyway because you get forward speed that way and you can get out of the

VRS situation. In the V-22 because the rotors are side by side, that causes you to lose lift first on one side or the other. You don't know which one it might be necessarily and so that puts you into a different attitude where the first thing that happens is the V-22 tilts over and then starts to go nose down as it did, not only in the April crash, but also in the tests they've done at high altitude at Pax River since, where they've been trying to identify where the safe flight envelope can be. So, part of it is the geometry is different and part of it is the Marine Corps does hope to be able to use this for very fast descents. Whether they'll be able to do that as I say remains to be seen. They've got to finish the developmental testing at Pax River first, which they haven't done and then they'll have to go out and do operational testing under those restrictions to see whether or not they can do the missions they want, the way they want, under those restrictions.

**Maj. Gen. Mike Ryan:** First of all, I agree substantively with everything that Dr. Coyle said, but I would put a different comment to it. Vortex Ring State was not the cause of the mishap in April. The cause of the mishap in April is because the aircrew flew the aircraft well outside (over 250 percent outside) the approved limits that were established for the airplane. If you do that, particularly if you do that close to the ground, you will suffer bad things happening to you. It's not like VRS was not known. This has been around for a long, long time. Last thing I'd say is this. You give to get. You give to get. I was an AV8-A pilot, then became an AV8-B pilot -- there's a restriction in the AV8-B that you're not allowed to push on the rudder above .8 mach. We never had a restriction like that in the AV8-A. You'd shove your feet all over the place all day long. Why? Because that can depart the airplane and give you Gs in excess of 10 Gs and can do serious damage to the engine after you relight it because it will probably have to be shut down, in a single engine airplane. Serious consequences. Do we like the fact that you've got to put your feet on the floor at .8 mach? No. But the airplane is so much more capable and so much more safer in the areas where you historically in the AV8-A where you got in trouble. Emotionally we may not want to put our feet on the floor, but intellectually everybody understands that this is goodness, not badness. So one of the things that comes along with having the rotors side by side is you get a rolling moment if you get into VRS. What's the answer? Don't get into VRS. As a pilot it's pretty simple. Don't spin. There's three conditions to spin: you've got to stall it and you've got to put yawl into it. Don't do those things and you won't spin.

**[Unknown Speaker]:** I would like to ask each of the four panelists, no matter what you think ought to be done on this program, what's your prediction about what the Pentagon and Congress will do? In the process, maybe you can comment on the Blue Ribbon Commission's report and whether you think the solution that they came up with is sort of the compromise that is going to be politically viable?

Lane Pierrot: I'm not sure I want to answer that one at all. Given the defense review that's going on I think it's very difficult to tell what's going to happen with any number of defense programs, so lacking an inside perspective I really have no idea. I do suspect that there will be a tendency to want to preserve the program, and I hope that there will also be a tendency to want to get through the development hurdles in a cautious sort of way. Bottom line though, is, I don't think that anybody knows what's going to happen with the program right now except maybe Secretary Rumsfeld.

Philip Coyle: I think that if the Marine Corps does a good job from here on out, does the kinds of things that I described earlier, finishes the Vortex Ring State testing, reviews all the software from the ground up, fixes the reliability problems, all of those things--Congress and the leadership in the Pentagon will support the program. If, on the other hand, they try to take short cuts again, I think it will be tantamount to causing the program to be cancelled. The Blue Ribbon Panel report I thought was quite a good job. Obviously, they did a lot of work and so it was fine as far as it went, but it did not include some things that have to be done still. For example, as I said, the Blue Ribbon Panel report was silent about the operational testing that still needs to be done where they operate multiple V-22s off the same ship or V-22s with other aircraft off the same ship. Those are two missions that for sure the marines are going to want to be able to do and they have not done those kinds of tests yet and they will need to. So the report is great as far as it goes, but there are other things that have to be done and it's whether the Marine Corps has the will and the resources to do all of those things, which I think is the biggest issue.

Ivan Eland: I'd just like to say I don't know what's going to happen to the program either and I think Lane is right about that--only Secretary Rumsfeld knows what's going to happen, and probably Congress, we'd have to add that too, since they seemed to reverse the Defense Department on this program before, and they may do it again. I think this program is now in trouble for not the right reasons. I think the crashes, the maintenance records, etc. certainly... they have to prove that this is a safe and reliable aircraft and they should be held to task on keeping... Well, not keeping accurate records, but not covering up any problems that exist. These types of things get in the press and I think that's why the program is in trouble. Also because Cheney wasn't too thrilled about it, at least when he was Secretary of Defense. On the other hand, it's very difficult to kill any weapon system because constituencies build up in states (in this case over 40 states).

Is the Panel's solution viable? I find it very disappointing because we just soldier with these programs, no matter how much the cost goes up or how many problems we have or how long they're delayed and I think their solution

may be the political out the program is looking for, unfortunately, from my perspective.

One other point on the doctrine. We were discussing that earlier. I know the General has one perspective, but I think David Chu has another perspective on how the doctrine was developed because he told the marines that they couldn't justify this expensive aircraft just ferrying people from the sea to shore, so I guess there's multiple perspectives on how this doctrine came about, but I'm still not sold on it.

**Maj. Gen. Mike Ryan:** You know anything I said about what's the future would be wishful thinking. You know I really don't know. But I do know this. I served two years in the Marine Corps as legislative affairs and I learned a few things about Congress. One, I learned they work incredibly hard and incredibly long hours for very little pay relative to the industrial world. Number two, they did that by in large because they love their country and they wanted to do the right thing despite what people may think about constituent issues and other things. And third, they take a very intelligent and long view of these issues. They've been there, done that. I have great faith that the Congress of the United States will do the right things for the right reasons. And if it turns out the way I wish for it to happen then they'll be V-22s all over the place.

**Jonathan Clarke:** I was delighted that General Ryan said he was an English major because as a classics major, I must say some of the discussion has been of VRS and 5,000 psi hydraulic lines has been a bit above my head, but I think that you'll agree with me that the panel has given a really very clear overview of the issues involved, and however this turns out we're all much better informed today. Please join me in thanking them.