Dr. Robert V. Gates – Podcast 1
1970 - 2007

Introduction	<u>MUSIC</u> Welcome to the Dahlgren Centennial Celebration – A Century of Innovation. We hope that this and our many other products, events and offerings will showcase what Dahlgren has accomplished during its last 100 years. Throughout our history, we've interviewed some of the most prominent minds, leaders and innovators that worked here, and we're opening up the vault to share them with you this year. Today we are honored to listen to the story of Dr. Robert V. Gates, whose significant work at Dahlgren spanned from 1970 to 2007. His podcast will focus on his contributions to Submarine Launched Ballistic Missile Program and the work environment at Dahlgren in the 1990s.
Rife	This is Jamie Rife and I'm interviewing Rob Gates. Today is June 4, 2003. Rob, just starting off, can you tell me about your background and your career and how you came to be at Dahlgren?
Gates	I graduated from the Virginia Military Institute with a bachelor 1s degree in physics in 1967, and went to work at the Reentry Systems Division at General Electric in Philadelphia. When I got laid off in 1970, I came to Dahlgren and started on June 15, 1970, in the old T Department, where they did testing. I was hired as an aero engineer, and I went on the JPD Program and spent two six-month assignments doing testing in T. I came to K Department on one of my training assignments, and decided K was where I belonged. It was a lot like what I had been doing at G.E. The environment was a lot the same. It was working on the strategic systems like I had been doing at G.E. My last training assignment was in SLBM in K Department in March of 1971-and I came in March and stayed for the next twenty-five years or so until I went over to be on corporate staff. In the meantime, I did technical things, worked on guidance and real-time computing systems for Trident I, and Trident II, I was a branch head. Eventually I was on division staff doing future systems work and doing studies in the Pentagon with SSP in the late eighties and nineties. And was part of the group of two of us from Dahlgren, one from SP, and one from what was then G.E. Ordnance Systems in Pittsfield, that planned the fire control system upgrade program that started in '89 or 190 and is finishing up the first go-through right now, with replacing shipboard systems with COTS as opposed to the specialized computers and things we had always developed for shipboard systems for Trident and before. Like I said, I worked on C-4 test flights as a test flight coordinator and was a

	branch head in other things. In 1996, I was on K-40 staff doing one thing and another and working at the department level a lot, and got asked to go over and be on corporate staff. I was on Tom Clare1s staff when he was the ED and I was the director of Strategic Planning for the Dahlgren Division and the head of the corporate staff I did that for about three and a half years with Tom Clare and the first year so that Tom Pendergraft was the ED. I'd gone over for a year and, one way and another, re-upped a couple of times and stayed for three and a half. I got back to K Department January of 2000, as deputy department head of the Strategic and Strike Systems Department, and did that for about a year and a half, and Sheila Young, the department head, asked me to come over to K-60 and be the division head of the Strike Systems Planning Division. So I've been at Dahlgren, in another week or so, for thirty-three years. And one thing that has been really attractive to me over the years is the opportunities that they've provided to continuing education. They helped me finish a master's degree in engineering science at Penn State that I had started at G.E. Helped me to get a master's degree in political science from Virginia Tech, and go to the Navy War College, and have helped me almost finish a Ph.D. in public administration at Virginia Tech. And most of those courses, except for the ones I did in G.E., most of them have been paid for by Dahlgren, and back in the old days, some of them were actually done on the clock, although these days, you do them on your own time.
Rife	What's your current position and what are your responsibilities?
Gates	I'm the division head of the Strike Systems Planning Division, K-60, in the Strategic and Strike Systems Department. K Department is widely viewed as being the department where Tomahawk is done and SLBM is done. I'm fond of saying we're the division that's not Tomahawk and it's not SLBM, but that's not, strictly speaking, true. One of the three branches does simulation work and analysis for Tomahawk. The other two branches we've had, we've done various things in mission planning technology and unmanned systems. We developed and prototyped and tested the tactical control system that NAVAIR has got in acquisition now with Raytheon. When it moved into the acquisition process, we sort of went from twenty work years or so down to a couple. That's hard to take some days, but I've convinced myself and convinced other people around here, that's the way it's supposed to work, that as a Navy laboratory, we're supposed to develop concepts and ideas and prototype them and prove them, and when they go into acquisition, we obviously aren't going to build many of them. So we've moved on to doing some other kinds of unmanned systems that ties back with the mission planning work that we were doing also. We've gotten into a somewhat new line of work for us in the past year or so. We're doing verification, validation, and accreditation of software, which builds on the work

	we've done for the carrier program and some of the other things we're working for, the Missile Defense Agency and for JWAC on doing some VV&A. So, we've got, like I said, the one branch that does Tomahawk work and two other branches that we're trying to stake out a couple of things that we're going to become expert in, and if I had to say what they were right offhand, I'd say unmanned systems and software VV&A, and still doing some mission planning technology kind of work.
Rife	Unmanned systems-that's UAVs, drones?
Gates	It started out as doing the tactical control system, which was a single control system that you could use with software inserts to control any unmanned aerial vehicles, and we've actually flown several different kinds and shown you can do it with one ground station. UAV manufacturers like to sell ground stations a1ong with selling the vehicles, but if you're going to have a couple or three different kinds of unmanned systems, you rea1ly can't afford the space on a ship or the manpower to have two or three different stations with a couple of consoles each, with each of them dedicated to a particular unmanned system. We started doing UAVs. We've also done it with unmanned surface craft. Panama City has the robo-ski, and we've demonstrated it with that. They also have the surface crawler, and we've demonstrated it with that. So what we're doing now, we've sort of taken the "aerial" out of the technology name, so we're really focusing on unmanned systems. And working with Panama City, that means we get to do the surface craft, underwater stuff, and working with G Department on some things that might actually be armed.
Rife	You know, that's really interesting, because it seems like Dahlgren's come full circle, because one of the first projects that was undertaken here in the 1920s was pilotless aircraft, and that's what brought in Dr. Norden. They were a1so playing around with technology at the time for surface craft also, and they'd take them out on the Potomac and guide them around, or try to guide them around, using gyroscopic automatic pilot technology. Then at the time, in the late twenties, the Bureau of Ordnance just lost interest in it. They didn't necessarily kill it all, but it was just left hanging, and then World War II intervened. So I guess there's a lineage from 1920 through what's happening today.
Gates	Well, one thing that's interesting, Doug Devant wrote an article for the Bullet, I think, a couple three months ago on unmanned systems, and he sent it over to us, among other places, to look at it for technical accuracy. As we started looking into it, I've got the copy of the green Dahlgren book that was done in the late seventies, and there's an article in there and a picture of Norden, and I think it's mislabeled. The picture says he's standing next to a plane with his bombsight. It's actually the plane with . . .

	With the automatic pilot. I mean, if you look at the picture, it's obviously in the wrong place to be a bombsight. And I've seen that same picture labeled properly other places. So we actually found some references to that and saw some of the pictures, and I had recently wrote a paper that Doug Devant put in the Bullet on Norden bombsight. I got a visitor one day down in the lobby, a man who retired from here in the eighties, I guess, was down in the lobby, Carlton Middlebrook, and he had a booklet-I'm not 100 percent sure. I think it's his nephew wrote . . .
Rife	Charles' life.
Gates	On his father, Charles Candy Middlebrook. It's a little kind of a booklet. So he said his sister said he had to bring that to me, so he did, and I guess he and his sister are both in their eighties or something by now, but he brought me the booklet and I was reading that just recently. It said that Charles Candy Middlebrook was probably the first civilian at Dahlgren. He came here as a Navy chief when he was at the Brooklyn Navy Yard and Norden sent him down here. He got out of the Navy after World War I and was probably the first civilian here, and he worked on all those things with Norden. So talking about some of the testing and whatnot, that was a pretty interesting personal kind of history.
Rife	That book's actually in the Library of Congress. We found it and copied it. A little booklet. Yes, he was a chief electrician's mate, as it turns out.
Gates	Yes, and when he retired in the early fifties, it was as an instrument maker or something, when he retired. One of the things it said in there in one of the notes, is the fact that getting information to write that booklet in the late eighties, it was almost as hard then to get information about the bombsight as it was in the thirties and forties, but this time it wasn't that it was classified; most of it had been destroyed in the fifties because it was easier to just destroy it than it was to declassify it.
Rife	Yes, that's right. The Navy was really the worst of the services. Instead of just allocating resources to reviewing and separating possibly historically significant documents, they just trashed them. So we've run into that problem before.
Gates	Yes, well one of the things that came from that is, I started with my Ph.D. dissertation in public administration, I was really focusing it on something I thought I knew something about, the Navy Laboratories, but I picked a time in 1966, when DNL was established as sort of my focal point for my dissertation, and while I knew something about the years I've been here, I've gone back and I've learned an awful lot about the laboratories in general, back in the sixties, and being kind of curious by nature, I found myself wandering down all sorts of side paths, so I've read all sorts of things now and I've accumulated books about all the Navy Labs and all of that sort of stuff, most of which is not going to make

	it into my dissertation at all, but it's some of the sidetracks I've gone down. So I've become very interested in the history of the Navy laboratories. I've often wondered why I became a physicist because I really, really like history as much as physics, probably. And now the stuff I'm doing with my dissertation and just a general interest, I'm combining both of them in a strange sort of way.
Rife	Well, that's good. It's given you a breadth that you don't normally see with the typical engineer.
Gates	And one thing we've discovered, I volunteered to be part of a group that's looking at putting a display in the museum in Fredericksburg, so I'm one of the people on that group looking at doing that. And some of the people who are on that group have been here probably since the early eighties and some of have said, as they started thinking about this, and I said, "I didn't even realize anything about Dahlgren." I didn't know anything about what happened before I came here or what it was like or what Dahlgren has done. I think just being on the committee has been very informative for some people. I actually got interested in that three or four years ago when the dissertation stuff started. But it really is the case with scientists and engineers. They're much more interested in technology. They can probably tell you technical things that have happened that relate to what they've done over the years, but have no particular interest in the history of Dahlgren.
Rife	Since we're on the topic of history, what do you know about the specific history of Strategic and Strike Systems Department? From where did it derive and why was it organized and how has it developed?
Gates	But basically, when the Navy decided to get into the SLBM business in the mid-fifties, some of the folks from here, the technical director at the time, Dr. Lyddane, and Dave Brown and some others, went up to SP with a proposal in about 1956, because we had the computing power. We had done a number of things with ballistics over the years. We had also had the Navy Space Surveillance System going on. There was a number of things we had done with the earth model in geodesy. So they sort of felt in some way that we were very specially qualified to help SP in some of these areas, and basically went up and made an unsolicited proposal in, I think, 1956, give or take a little bit. It didn't actually lead to much. If you go back and read some of the SP history, like Sapolsky, the people who were setting up the Special Project Office at the time, had no particular desire to involve the Navy Laboratories. They had a feeling that the Navy Laboratories, working for whatever bureau they were part of at the time-and then we were in the Bureau of Ordnance, and by 1959, the Bureau of Weapons-that they had a feeling that we were much more responsive to the bureau we were part of, technically, personnel-wise, everything else, and they couldn't depend on the laboratories as much as they depended on a

contractor, who they contracted to and paid.

So if you go back and look at what they set up at the time, there were not very many Navy Laboratories involved. You go back and look at Sapolsky. We don't even show up on the org charts, although we've been part of it from the very beginning. Well, what happened is, we wound up doing some consulting kind of a work for about a year and then they actually gave us a contract in about 1958 or so, that actually got us to develop some of the guidance stuff we had been looking at and got us looking at how to do the fire control and targeting problem, and that's really been the focus of what we've done from that point forward, all the way from Polaris A-I through all the versions of Polaris A-1, A-2, A-3, Poseidon C3, Trident C-4, D-5. So that started in 1958 or '59 when we got that piece of work to do, and that's what we've done ever since.

And that's been the real focus of what Dahlgren has done in the strategic systems, and it started as a group in the computational laboratory, because that's where the computers were. The current Building 1200 was built in about 1964, and the department moved there then. Like I said, I came in 1970, and then began working in SLBM in 1971. It was right about the time that Poseidon was being flight-tested and before IOC, so I actually never worked on Poseidon, but I got thrown in right at very beginning on the future studies and the future guidance studies that became part of Trident I, C-4. So I got involved from the very beginning on some of the guidance things that didn't actually get implemented and tested for another five or six years, when they started building C-4 Trident I. But we've basically been in that job ever since, working with SP.

We also, for a good number of years, worked with-there was a part of SP that looked at targeting studies and targeting analysis and targeting requirements. So we actually wound up doing a lot of studies with them. And because we deliver targeting models for the Navy to what's now U.S. STRATCOM, what was then Joint Strategic Target Planning Staff-JSTPS-we've worked with them a lot over the years. We worked with offices in OPNAV, doing targeting studies as they were setting requirements for future systems and doing targeting analysis. We worked with them a lot over the years.

So we've gotten into that kind of stuff, but our bread and butter has always been the fire control and targeting models, and that's what it is still today. The team that SP put together in the late fifties has stayed together pretty much. We started working-I wrote an article for the Tech Digest a number of years ago, and one of the things that you had to do was put a key to what all the name changes were, because we started in the late fifties, we were still the Navy Proving Ground, shortly to become the NWL, and G.E. Ordnance Systems was G.E. Ordnance Systems, and they've gone through about four name changes.
Now they're General Dynamics, and we've gone through about four or five names changes. And the same thing with Lockheed, who did the missile. So

	when you start telling the story, you need a key to all the name changes, but it's basically the same people have been together and we've been working for SP-23 the whole time, and the old G.E. Ordnance Systems and Naval Proving Grounds are still the team doing the hardware and the software for the shipboard fire control systems.
Rife	What kind of mathematics are involved in that?
Gates	Well, at the beginning, the really interesting part was that even though Polaris' range was twelve or fifteen hundred miles, which doesn't sound like much by today's standards. It was a lot then. I've gone back and read some of the history of the intermediate-range missiles, the Thors and things like that, and there was some real issues with the missile on how you got a missile--especially one you could put on a ship; it couldn't be liquid fuel-how you could get a missile on a ship that would go that far. The real issue that really involved Dahlgren a lot was, it's not like sitting in a silo. A silo, you survey it, you know where it is once and for all . . .
Rife	And it's well away from the launch control facility. You're not in close proximity.
Gates	And it's in proximity to the launch facility. It's also in proximity to the people who develop the software. If you have problems, you can get to it regularly, to fix problems. But from the targeting and fire control problem, it's in a fixed place, it doesn't move. You can spend all the time you want surveying locations, surveying gravity, doing whatever, so when the target changes, you at least have a fix on one end of the problem. You know where you are and you know how fast you're going, which is just the rotation of the Earth. When you're on a submarine, where you don't know where you're going to launch from-well, you can control the speed and the depth to whatever you want it to be, but you don't know where you're going to be when you go to shoot-that you have to be able to compute some of the things on the submarine, and back in the sixties, on a computer, that was extremely limited computationally, and because you wanted to be able to do the computation required in a limited amount of time. When you wanted to launch a missile, you wanted to be able to do it in a relatively few minutes. You didn't want to wait days to do a computational solution, which wouldn't have been right anyway because you would have moved some more. So we actually went through a process with Polaris. Polaris, when you go back and look at even what's now out in the public domain, I guess for the time it was fairly accurate, but it was not particularly accurate compared to today's standards, because you could not-well, one, you have to locate the target

	accurately and you can do that somewhat, but you also have to be able to compute the data to send into the guidance system on the missile to compute as you're flying, to fly you towards the point in space that will get you-once you cut the motors off. that will get you to the target. And you have to compensate for the details of gravity and the reentry atmosphere and all that sort of stuff. So our biggest contribution in Polaris was target onset, which always used to be referred to as Kentucky windage, from the old Kentucky long rifle shooting days. You sort of figure out where to aim so the thing hit where you wanted it to hit. So we would have to do some calculations on what the reentry effects were going to be of the atmosphere, what the gravitational effects were. Guidance systems use basically a round Earth, and we had to compensate for everything above a round Earth model, and you had to do that based on where you were launching from and where you were firing to. So the first submarine that went to sea, the George Washington, on the first patrol we did this very crudely. It had a couple hundred thousand computer cards, and basically that would give you the coefficients for a very simple equation to compute the target offsets. Our biggest contribution in Poseidon was making the argument that you couldn't solve the guidance problem on the missile and the shipboard fire control problem as two separate problems. You needed to think of them together and develop a guidance algorithm that supported you doing the computations you could do on the submarine. So the guidance algorithm that we came up with for Poseidon was one that got accepted and it got put into the guidance by MIT Instrumentation Lab, now Charles Stark Draper Laboratory. But it was based on some work we did, some proposals we made and studies that we did. Then that led us to develop a much better fire control solution because the guidance that you were doing was-you viewed the whole thing as a system. So the biggest contributions we made at the beginning were with the Earth model and the ballistics kinds of computations you had to do.
Conclusion	Thank you for listening to this week's Dahlgren Centennial Podcast, and hopefully you have learned another interesting aspect of what our people accomplish for the Navy and for our nation. We will continue sharing how Dahlgren is a one-of-a-kind location where innovation is heralded as the hallmark of each individual. PAUSE Thank you for celebrating this century of innovation with us at Dahlgren. MUSIC