Dr. Robert V. Gates – Podcast 2
1970 - 2007

Introduction	MUSIC 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.
Gates	The computers. when did the first, I guess, fully electronic computers as we know it, that moved away from the old tape-reel system and the punch cards, when did they come in and how did they improve the computational ability?
Gates	Well, what had happened on the boats, like I said, the first ones, they were fairly crude shipboard computers and we had a lot of punch cards. You had to pick the right punch cards, and based on a lot of computation done back at Dahlgren to model those trajectories and to compute those coefficients, those equations, that represented lots and lots of work at Dahlgren on the, I guess, probably the NORC and then the Stretch, a big IBM computer in the sixties. We very quickly, though, moved from the cards to move to tape systems on the submarine; first, paper tape and then Mylar tape and, later on, with magnetic tapes. And when we started making some big changes for Poseidon in the sixties and into the seventies, the really big changes in some sense were made with C-4, Trident I, where we had a much more capable computer by the standards of the day, not today's, by any stretch, but a much more capable computer, and we had gotten much more innovative with our mathematical algorithms. We had found ways to do fairly accurate and very fust trajectory models on the submarines. We were moving a lot of targeting data and other things by magnetic tape. As we get into the late eighties and started looking at putting commercial stuff on the submarine, one of the first changes that we made was you actually could deliver quite a lot more stuff by the kind of hard drive you'd see in, for example,

	a laptop. You could have magnetic media that was basically a hard drive that you can move back and forth through the submarine.
Rife	Become portable.
Gates	Yes, and we moved from there to things like optical disk and things like that. So we've got, these days, much more moving things electronically as well. So on the boat we've gone from hundreds of thousands of computer cards to things now like optical disks and messages, and we can do a whole lot more that way. At Dahlgren, when I first got here, we were working on the Stretch, which was a big IBM computer, 7090, I think, and one of the first things I did when I got here is, we were switching everything over to a CDC 6700. When I came over to K Department for a training assignment, when I went back to T, I was the computer expert, which I am not, but I helped them convert all their programs to the CDC 6700, because I actually knew how to spell it, I guess. more than anything else. But we went through the 6700, a guy named Dave Baker and I, who shared an office in the seventies, we were among the first people who started using an old G.E. teletype, and the programs that we wrote, we would write them so you could basical1y-you could get on the teletype and execute the program basically like submitting a card deck on the teletype. It still wasn't like a terminal. And you could submit the job that way and you could sit there and run-we were doing guidance analysis and system accuracy work. So we'd sit there and run bunches of programs by just resubmitting the decks through the teletype, and we'd get a little bit of output so that we could see that it worked, but you still had to go down and pick up the paper output. As the seventies went on, we saw that happening more and more, people running it that way, and late seventies into the eighties, finally getting PCs. So even though we got a Cray or two for some of the big detail work we were doing with targeting and stuff like that, it very quickly became apparent, as the seventies and eighties went on, that the way to do it was not those big mainframes anymore. So we do a lot of work with PCs and, back in the seventies and eighties, Vaxes and Suns and Silicon Graphics. So we use much more distributed kinds of systems, and you do a lot more right in your office, working either on your own computer or through the network in the building.
Rife	What types of computers do you use now, or in the last five or six years? Still Crays, or has it moved on to something else?
Gates	The Crays are still around, and there's probably still some stuff being done on the Cray, but the Cray always was mostly being supported by the SLBM work and a lot of the top secret targeting work. There was a Cray that was dedicated just for that. A lot of what's being done, the software development work, we've got Suns and things like that as servers, and people work on a workstation in their own office. You can actually get back to some of the fire control labs right

	from your own offices in Building 1200 and 1560, so it's been much, much more the servers, like Suns and some Silicon Graphics here and there, with workstations, is how we do most of the development these days. You've got to have a PC to do e-mail and a lot of that other kind of stuff, but a lot of the actual software development work is done on workstations hooked up to servers.
Rife	So the computers you're using are probably the same ones we use at the office.
Gates	Probably.
Rife	I want to move away from maybe the technology aspect of the department and maybe talk about the broader relationship with the military. How does the department coordinate with the military, and what's its relationship to the military?
Gates	Well, it's been a little strange, because you go back and you look, a lot of departments on base have a department position, that is, the 01, the military assistant. I cannot remember having a K Department 01, although Ed Veazey, who's a retired Navy captain who lives in King George, says he was the 0I when he was at White Oak in the seventies. He may well have been. I wasn't doing much at the department level in those days, so you can convince me of most anything. But what we've actually done, the programs like SLBM and Tomahawk, too, have always had more junior military officers, usually at the lieutenant, lieutenant commander level, who have been part of the program. We have a lieutenant commander in Tomahawk who's here now. We've got a lieutenant in SLBM, and she just replaced the previous lieutenant who was here. In the past, we would have lieutenant commanders either from the fleet or occasionally from JSTPS, who would be here. So we would get a very direct link back into the military through the military people who were part of the program. Because we actually develop operational software, we have also made a practice of hiring retired military, especially the fire control techs who served on SLBMs. So they come . . . They come back and they've done a lot of the personal face-to-face liaison. They go to crew debriefings and they go out with the newsletters we send and things like that. So they are very directly involved in tying us into the current operating forces. It's become fairly clear, you can go hire mathematicians and physicists who can develop software, but actually speaking to the guys on the boats is a special language. It really pays off, so we've actually done it. We've hired a bunch of the fire control techs, and one of their main jobs, besides bringing some reality to us in terms of how we develop things, they also do a lot of the liaison with the fleet.

	One of the things is that, too, working with SP, a lot of the leadership of SP is military and we work very closely with them. We work closely with the people in the air room at U.S. STRATCOM, and we have a detachment out in Omaha, so we have people who work with those who are the actual military planners, who work with those folks very closely. So we're tied in with not so much at the department level as we are at the programmatic level. I talked mostly about SLBM because I spent twenty-five years with SLBM and still think of myself that way, I guess, but Tomahawk has a very close relationship with NAVAIR, and we spent a lot of time both in Tomahawk and SLBM, testing on shipboard. So we're very closely tied right into the environment. But I think the department level is probably a little different than some of the other departments, where we don't have the department-level military officer particularly.
Rife	Because one of the themes that we're exploring for the book is the relationship between the military and scientific end of operations. In the early days, with Thompson, he being the sole chief physicist and having one or two assistants, generally, the relationship was good. But during World War II, when Dahlgren expanded significantly, there was a significant eruption between the scientific and military personnel. At the end of World War II, the scientific personnel on base sort of became predominant in driving the research. How has that developed? Is the military relatively easy to get along with in terms of defining what the research agenda is and how you accomplish it?
Gates	I think a lot of the folks we work with, especially at the sponsor, are EDOs. Some of them have spent their time in the fleet before becoming EDOs. Some of them have pretty much been on that track from the beginning. So with those folks, it's pretty easy to talk because they have some extent-sometimes to a great extent, like Admira1 Nanos, with a Ph.D. in physics, have a really good technical background. So you can have the technical discussions, and they have just as many good ideas probably, because they're Navy, they maybe tend to be more closely linked to what the Navy needs than maybe scientists always do. But they're a good way to link because they have good ideas, they understand technica1 things, they can have technica1 discussions, but they also tend to be linked into what the fleet's needs are. We probably say this too strongly some days, but I think K Department, because we actually develop software-we don't pay somebody to develop; we actually write the code and design it and everything else for SLBM and a lot of the Tomahawk stuff- that we have a very strong relationship with the user of that stuff, and we make a very conscious effort to tie ourselves in to the user. And also one of the jobs we do on both programs is a lot of-they have different names for them, but in SLBM they're called trouble and failure reports. When they're using our stuff out in the fleet and it doesn't work like they expected it to work or they see something they don't understand, they send back all these TFRs. Whether they come back for SLBM or the Tomahawk equivalent comes back, we get to look at them.

	We're sort of a clearinghouse for SLBM, and a lot of them will come in to us and we farm them out to wherever they rea1ly go. But there's a subset of them that come back to us and we look at what they're doing with our stuff, and sometimes what they're trying to do with it and, after some discussion with them, when you start from trying to see what were trying to do with it, what were they thinking, go, "Oh, this is what they need it to do." And we do the fleet debriefs, we do the fleet interaction. Tomahawk gets fleet folks up here to sit at the consoles as they're developing displays and things to make sure that it's going to meet their needs. So I think, basically, it's very easy with the EDOs because they have the technical background and they have their own views on things. You can have technical discussions. As you move up that chain to some of the branch heads and higher at SP, they get to be just as politically sensitive and attuned as any top-level civilian, and they're very interested in budget and acquisition issues. So they bring the same kind of a different view, too, that you get talking to a department head here or a division head here as opposed to a technical person. But I think from that point of view, we get good ideas talking to the fleet very directly, with the fire control techs, with the weapons officers, with the targeteers in the air room. We get very direct interaction, very good feedback as to what it is the Navy needs our stuff to do as opposed to what we think. One thing that we've always done that I thought was a pretty neat idea, and I got to write the one back in D-5, I guess, the first one for D-5, is that we do a document with SP at the beginning of each of these new programs. We sort of refer to it as our contract with SP. We don't really have a contract with SP, but it's a technical document that describes what the software is going to do, what features it's going to have, what kind of things it has to live up to in terms of accuracy and computational speed. That's something that we developed with SP. It's developed over a period of time with some interaction with the users and other people, so when we start a new program, we get our contract with SP. That's something that was developed very interactively based on knowing from the previous system what folks were trying to do with it, looking at some of the needs and so on. I think it's very good because we do tend to be much more technical even than the EDOs, but we're very closely linked with them and they bring some really good ideas, technical ideas, as well as the linkage back to the military usage.
Rife	Do you initiate any ideas that are, likewise, taken out to the fleet for consideration?
Gates	Well, we've done a number of them. I think I mentioned earlier the tactical control system. That was an idea we basically started here. We sold it to NAVAIR and they were very quickly onboard with it, too, so they helped us push it along. But you can go back. There are some things we did with air, with

	SLBM, with Tomahawk. Some of the things we're doing with the tactical Tomahawk, with the mission planner for the new tactical Tomahawk, there's some technical ideas we came up with, that is, you push them back up towards the sponsor, that they either see that there's a need for it or, when the time comes, they know that there's somebody who knows how to do it. I've done a lot of stuff over the years with SP, going back to the late seventies and early eighties, even looking back into the mid-seventies. As a matter fact, we were doing the improved accuracy program with SP. They were trying to figure out how you would meet the requirements that you were going to have for Trident I, C-4. Basically, C-4 wasn't to improve accuracy, exactly. You were going to shoot a missile further than Poseidon went and you wanted to maintain the same accuracy, which in a sense is improving accuracy. So there was a lot of work going on in the seventies looking at new concepts for modeling gravity, doing computation, guidance, all sorts of things, that not just us, but everybody who worked with SP, was part of this process, saying what kinds of things are we going to put into the system to maintain accuracy when we increase range. When we moved on, a lot of those things wound up rolling into what we went to with Trident II, D-5. We wanted to essentially maintain the range and greatly improve the accuracy so that a lot of the stuff we looked at through the seventies and beyond, there were a lot of concepts we came up with here, and Draper did, and other folks, and Lockheed. Lots of folks came up with a lot of those concepts, actually very quickly became part of C-4 and then D-5. We also looked at a bunch of things with SP. I was part of a study that SP did. I led the Dahlgren part, looking at how to put terminal sensors on reentry bodies, which is a way of getting a lot better accuracy. So we've looked at a bunch of things over the years and even decided the time wasn't right to do them. The technology, for one reason or another, didn't support doing it. There was a big computational job on a submarine that we probably could have done, but it would have been a real challenge back in 1980 or '81 to have done it. So we've done a lot of stuff in support of SP. We've put in study proposals down here, and the department uses some of the discretionary money. We looked at some things back in the eighties. I was on the department group that actually reviewed technology things, and we got funding for a work looking at how to use fractals to represent surface maps that Tomahawk might be able to use. So we've done a lot of stuff, both on Dahlgren's money and on other kinds of the Navy's money with ONR. Back in the old days, SP also had enough discretionary money that you could do work that supported them, looking at future concepts and things. And we've done a bunch of that over the years, and there are a number of examples going back to the guidance algorithm for Poseidons. You could call out things that we've actually done that have found their way into one system or another, some of which we started, some of which

	came out of a group effort with other people and we picked up our piece of it, figured out how to do our piece of it. But that's been one of the really good things about working on programs like SLBM over the years. If what I've seen of Tomahawk-I've been over here almost two years as division head. I don't really consider myself a Tomahawk person. K-70 is where the Tomahawk stuff is, and in K-05, the program office, but I judge that a lot of the stuff we've done is working very much the same way here with that. When we get good ideas, we've found ways of getting them sold and getting them into systems. And we've got ways of getting new ideas into consideration, which we're doing right now still with some of the Tomahawk things.
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