Barry Dillon and Joe Francis

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 have been here, and we're opening up the vault to share them with you this year. Today we are honored to listen to the stories of Barry Dillon and Joe Francis. Their podcast will cover the early history of Theater Warfare Systems, which was known as T Department in the early 2000s. Theater Warfare Systems particularly focused on interoperability missile defense and precision strike.
Rife	This is Jamie Rife, and I'm as the Theater Warfare Systems. I'm interviewing Barry Dillon and Joe Francis, and we're going to talk about the history of Theater Warfare Systems as well as management and current challenges from the 1980s and 1990s. My first question, gentlemen, is could both of you just briefly give me your background, your career and how you both came to Dahlgren?
Francis	Joe Francis: I came to Dahlgren in June 1964, as a physicist working in the HERO Division at the time, in the Research Branch. In about a year, they sent me back to graduate school to become an electrical engineer with a master's degree. I returned to Dahlgren, with a commitment to work at least ten years, and I've been at Dahlgren ever since in various departments, from the old engineering departments, then into the F Department. I've been in G Department; I've been in K Department. I've been in most departments, except N. In fact, I was in N, once upon a time, but not in the Aegis part. Back in the old days, under Paul Wessel. So I've been in most of the departments at Dahlgren.
Rife	How about you Barry?
Dillon	Most of my career – all but three years – have been in the naval aviation community. I started working in the science and technology for ASW and did that for about seven, eight years. Then moved into infrared sensors on joint programs. Then moved into the F-14 and became the deputy program manager for the F-14. Then was picked up, director of surveillance and avionics for all of naval aviation. Moved from that into the director of the Unmanned Aerial Vehicle Joint Project Office and deputy PEO for UAVs. Did that for about

	eight or nine years. Went down to Panama City for three years. Was a department head down there in the research and incorporated special ops and amphibious warfare domains into that. And then have been here since March of 2000.
Rife	What can you tell me about the history of T Department? From what did it derive? What were its origins and what was its original mission, and how has that evolved and what does it do today?
Francis	I don't know the exact date, but we used to have an A Department for warfare analysis which was created out of some key warfare analysis talent that was at GS-15 level on staff, plus some other branches that were in various divisions at the time. Anyway, A Department was created under Chris Calvertinas and that ran for two or three years and included modeling work, like Mars. Then Tom Pendergraff, who was head of F Department at the time, I think, was probably the first to realize that the nature of our work in the future was going to be at a higher level than developing individual systems. So he realized that we were going to be developing warfare-level systems and that we needed to create a department that would focus on that. So I believe he was the principal instigator for creating what we now call T Department, as distinct from the old T Department a long time ago, which was test. This T Department is very much theater-warfare-level system engineering kind of work and things that go with that. So I was in A Department at the time as the deputy department head under Chris Calvertinas, and A Department, it was decided, should be merged with F Department. Primarily, those two departments would then make up T Department, and that was approved by the board under Pendergraff's leadership. We brought together a whole bunch of GS-15s out of both these departments, sort of reallocated them to the various jobs, created new divisions. One innovative thing that we did was to match leading senior program manager positions, which is sort of area program managers, to individual divisions and the division heads. So we had partnerships between lead program managers on department staff, of which I was one of the original ones. Actually, I'm the only remaining one. And the individual divisions. So there was one for anti-air warfare matched with the anti-air warfare or the Maritime Defense Division, as we called it at the time, and there was one for warfare systems engineering kind of stuff, which had a slightly different name at the time, under Dick Whalen, and land attack, which I was leading at the time, and still am trying to. So we had this match of lead program managers and division heads, with responsibilities to support each other. The program managers were responsible to help the divisions; the division was responsible to help the program managers. It was a true partnership sort of

	arrangement. It was even written into our annual goals and objectives. But with the transitioning nature, programs and pieces of programs, all this is now changed, so all of the programmatic work I think we have now is under the individual division heads, with the exception of what I represent here on staff. Now the date for that I can't remember exactly. I think it was about early '98 or late '97 that we formed T. Department. But I can't remember being in A Department about eight months or so before we began transitioning. Then we sort of converted A Department into a division, and to a division of the new T, as part of that merging process before the transition was completed.
Rife	What are some of the major technical developments?
Dillon	Let me explain maybe where we are in the evolution over this six or seven years. When I got here in 2000, things like interoperability and battle groups and battle forces were just starting to become understood and known, and things like the missile defense activities that we're reading in the Washington Post, in order to defend this country as well as to apply them to the Navy and sea-based components, we're still in early phases at the moment. One of the things we've tried to do in this department is to take the five divisions and really focus them on the initiatives and the efforts of the Theater Warfare Systems, so our total mission is to be the United States Navy lead in addressing what the requirements, needs and what needs to be developed, and the systems engineering associated with that, to satisfy systems operation. Today, the foresight of the people to generate this department, I think, are very, very essential. We no longer concentrate, or just concentrate, on making a product and those type items. It's not even adequate or sufficient to make a ship totally interoperable amongst itself. It is essential that these ships be interoperable in a battle group configuration. It is essential that they go to a large area of operation, like a theater of operation, and they be able to work in a joint manner with coalition forces, and that they achieve all the dynamics, all the flexibility, all the interoperability that can be taken from that level of operation. That's required us to understand strategic systems and to overlay those and to be able to provide and sift, if you will, information and get it to the tactical users. It's required us to think net centric, and it's required us to think interoperability at very high levels, more than interfaces, to real engineering of interoperability. So in this department, our mission is to go lead a team of people, recognizing that maybe all the expertise isn't found in this department, but a lot of this expertise is found throughout Dahlgren Division, and to work programs not only vertically, but work programs more horizontally across all the assets of Dahlgren in order to satisfy and to meet these needs and to be able to deal with these issues and problems. So we take that very seriously in our goals and in what we have laid out. So we have four strategic goals that we've had in place here for the last three years. In my

	opinion, we've made steady and continued progress on them, and I think they've paid off. One is interoperability, particularly of the battle group, and the coalition levels and the joint levels. Another is missile defense, both self-defense of our ships, which our product lines are improving significantly compared to earlier years. Part that's just the progression of development, and I think our ability to address and design those and to wring them out has improved, as well as to be able to provide a sea-based element of missile defense. The other is precision strike, or land attack, which Joe has had a principal involvement in. We feel that being able to put the right weapons in the right place, precisely, minimizing collateral damage, and to be able to do that for a wide array of sensors and the hooking-up a wide array of sensors as well as weapons is very important. So we've been working strongly to understand how to do the mission planning and the fire control, and to be able to do those in a theater warfare-type basis. Our ships now can fire weapons that go anywhere from zero to in excess of 1,200 nautical miles and everything in between. How do you come up with the fire control to be able to manage all of that? And then developing these theater warfare systems and engineer requires us to be able to use the assets about Dahlgren and to bring about change in that. So we've had those strategic focuses, and as a result of that there's been a lot of spinoff. Today, this department is out of people; it is not out of money. We have too few people to do all the jobs that we've got, which is a good thing because it's got other problems, but it's not the usual problems of not having sufficient support or not having sufficient dollars. So we feel that we're very relevant to the needs of the Navy, very relevant to today's times because we work horizontal, we have a lot of flexibility in what we're doing, and we feel like we're at the cutting edge of the key programs. So the people that set up this department, think, had good vision in hindsight. We had very good vision in the way we structured and kind of molded that. I think we've been able to get into really the most prominent and the most important working areas of our Navy and to be able to support them and to have the technical ability to be able to offer some value.
Rife	What are some of the product lines that you send out to the fleet and elsewhere?
Dillon	A lot of people don't realize we do an awful lot of work on GPS in terms of the satellites, and we do that for the nation, not just our Navy. Its accuracy and its ability to remain accurate, certainly from the satellite orbits, is something—we have physicists and mathematicians that do that, and they work for all of the key agencies of the Department of Defense as well as the nation. We have a great and strong interface with NEMA in terms of precision location and digital maps. We are leading certainly Dahlgren and leading even NAVSEA with options for sea-based missile defense. We're very activity with Patriot, we're very active in the ground missile defense, those types of activities. So we do both the sensors as well as the signal processing to be able to make detections as well as the BMC – the battle management communications, command, and

	control –to be able to detect, engage, and target, and then, if necessary, hit and kill, and to be able to engage that on a global basis. We might make detections somewhere across the Pacific or the Atlantic Ocean. We need to cue the people here in CONUS of that happening, even if we're able to take out in proximity. So that's one product area. To be able to provide CC, cooperative engagement systems, to be able to provide –we do all the development of combat systems for non-Aegis. So we're very much into the combat system development and putting those in and improving them, and take that very seriously. We have a very serious effort in looking at battle groups and the engineering associated and the trades that need to be made to ensure those are up and operating in limited time and limited dollars, and we look at that on a battle-group-by-battle group basis and make engineering decisions on what's to be done and how to do it on a battle group by battle group. That's only taken place here in the last couple of years, but it's a big focus, a different focus that what was done before. Where you might look at a ship-by-ship basis, we're looking at it across the board on a battle group by battle group and interfacing with a lot of senior people in NAVSEA to pull that off. We do a lot of work in interoperability. We have the distributed engineering plant, which actually has fourteen different sites from around the country to include Air Force, Army, and a couple sites that are being stood up overseas to actually take existing actual hardware and play it simultaneously to prescribed scenarios and be able to deduce from that what a battle group's capabilities and limitations are going to be in a full interoperability engagement. We then go out and actually engage the fleet before they go on their deployments, and based on that, and it goes all the way from the senior chiefs to the senior commanding officer, then those are actually going to the Con Ops and they use that information then against the threat. They know what their capabilities are and they know what their limitations, and they evolve and develop their Con Ops. We do that for every battle group that gets deployed in the United States Navy now. We also do a lot of work on new concepts of net centric new ways of coupling and correlating and new ways of spreading information around, commonly referred to as TCN and CC, new ways of ensuring that we have all the advantages of early detection, situation awareness, queuing targeting so that we can make the proper decisions and do that as quick as necessary, but certainly in advance of any emerging threat. We have probably the strongest group of technical people able to produce sensors anywhere in the Navy. We have people that understand the technology of not only the spy radar, they understand the future development of radars and where that's going with multiphase digital techniques, they understand the signal processing, they understand the clutter environment, and we've made tremendous improvements and strides in capability by adjusting those and being able to perfect those. We now have radars that can do simultaneous detection of multiple targets in all sorts of different areas and be able to provide extensive ranges and extensive detections, which gives them a lot of flexibility. We also that for the electro-optic laser systems and a whole host of things.

	Then another product line we do is we do all assessments, all the analysis, and we even do kind of thought pieces, if you will, for senior levels of OSD, the Joint Chiefs of Staff, as well as the CNO and other places in the Navy, on what are some options and what some analyses. For example, the DD-21, the basis for the DD-21 was due to a cost-and-effective analysis. The work was performed by people here. The tradeoffs for the littoral combatant system, our analysis that's actually being done here. We're starting to do antisubmarine warfare studies for OSD, anticipating that being a new threat area as we operate more and more in the theater of operation. So all of this, our job, Joe's and mine, and the other people here, so look at all of that and figure out where the heading and the next direction of the theater of operation is. By the way, we also work strongly with the Air Force and very strongly with the Army in looking at all these, because they're an integral part of that operating community.
Rife	So essentially the mission is to predict the future.
Dillon	We try to predict it, we try to give options for the future, as we look ahead. Another way I would describe it, in simple terms, is we try to make sure that there's a system engineering or system construct, that all of that fits in and that it makes sense. It's kind of an architecture that if you come and you're able to do that, there's a place where it fits better, there's an interface which needs to be accommodated so that it has a home and that it contributes at those theater-of-operation levels, not just at a lower tactical level, and that it can be properly interfaced and integrated. You know, if you look back a couple of years, people kind of thought about that. If you look at things now, people mandate that you understand the systems and can articulate and put it in that perspective.
Rife	Does T Department initiate any of its own research, or do you only respond to requests from the fleet or from Air Force or from other services?
Dillon	People like Joe, people like Roger Harmon and Dr. Ebbens, a lot of people initiate not only new concepts, new ideas, but those two guys that I just mentioned, for example, actually develop Advanced Technology Concept Development, ATCDS, which is way of getting OSD dollars. We initiate a lot of work in the S&T community with respect to ONR and DARPA, and have several programs in there, as well as we work with other organizations to generate those development programs. So we do a substantial amount of early development as well as system engineering development to get things fielded and implemented.
Rife	Joe, since he's been around a lot longer, probably would know more about how this fits in to the greater scheme of Dahlgren's history and that one of the fundamental struggles that has gone on here since Dahlgren was founded in 1918 is a struggle between the fundamental research end in which the scientists generate what's being developed and the

	direction the research takes, and then the military's needs. The early part of World War II is actually clashed spectacularly, with Dr. Thompson –Dr. L.T.E Thompson – when they brought in some old-line gunnery officers to run the place and it caused a serious rift. The irony of it is that at the end of World War II, even though these old-line gun officers ran the place in 1945, the scientists were emerging as preeminent and they were setting a large part of the research agenda, so it seems like it culminates with T Department in that. How is the relationship with the military? Is it really close? Are there any problems?
Dillon	My observation is, we have very few military in this department, which I wish I could change. We're supposed to have military deputy, a captain. That would be very, very good because understanding that perspective, understanding the sense of urgency, and being able to get a better feel for what the user intends to do, or what changes they might have to go through to incorporate a different product line are all very, very important to include the elements more in the back end of the development, the training and the cycles there. But we have, I think, phenomenal rapport with the fleet. For example, LANTFLT Fleet, which also works as a combined forces command for the Pacific Fleet as well, for example, when we do these battle groups, we are actually performing that program and we are in compliance with the fleet instruction. They are the ones providing the guidance, they're asking for these products, and we interface directly with them on those capabilities and limitations. They drive the scenarios, they drive the compositions, certainly, of the battle groups, so our interface is very, very direct with the fleet and very good. I don't think they would deploy without understanding what those capabilities –they wouldn't want to deploy. They feel that would be very risky and unwise to do. New programs that are going to go in to Op Eval and various significant tests. More and more, they're coming here to get the pretest and get that worked out, knowing that we can test if very, very well. We can wring it out, and then when they go and deploy and actually get on a ship and go out to sea, they can pass the test. So we have done a much better job of making the land-based test true to what the users need and true to the environment that they ultimately put it in. My sense is, some of these things, like dealing with the theater of operations, dealing with five battle groups in the same body of water, some of those are so complex that they just want an organization to look at those, understand what the limitations are, and advise them technically what's going on so they can then address them from the military or user need. Those are the kind of things we do. We tend to send out a lot of advisories, a lot of hands-up, and then we also get involved into the actual fixes. When we make changes as a result of these tests, and we actually modify software and that, we engage them. They're a very active participant. They're call OAGs, Operational Advisory Groups. They actually chair those. So we're doing those fixes, we're making those changes on their behalf, for them, and then when we get those priorities, we know what those are, whatever the available dollars, then we do those top priorities and the others

	don't get done because we don't have unlimited resources to do those. So we take that very seriously. That's a good working relationship. Even in the cases of the analysis and those things, we work very, very closely with the folks, predominantly in those cases the OPNAV, a lot of kind of one on one, so I think it's really good, it's really healthy, and we take a lot of pride in those interfaces and nurturing those and keeping them just that way.
Rife	Today, you ask four different people what the Dahlgren Way is, you might get five different answers. The Dahlgren way derives from the 1920s with the arrival of Dr. L.T.E. Thompson as the first chief physicist at Dahlgren. He was a firm believer in fundamental or pure research in which scientists here at the facility would essentially inaugurate a project, then develop the concept, then take it out to the fleet, test it and prove it, and then bring it back and just generally follow it all the way through, from concept to service. He left Dahlgren in 1942 as a result of the problem with some of the old-line gunnery officers. He was having trouble getting his research implemented, as well as some of his ideas. So he left and went on to greater things. He actually ended up at China Lake and became the first technical director out there. But in the fifties, after had had left, there was a lull, and the researchers and the scientists here sort of moved away from that. They started responding primarily to fleet needs and the needs of the Navy and the government rather than initiating really anything on their own. That was just a reflection of the times. Later, with Barney Smith and Jim Colvard, in the late sixties and early seventies, who had worked under Thompson at China Lake, they brought the Dahlgren way back to Dahlgren. Since then, it's developed on its own. So I was wondering if you had any kind of comments on what you may feel is the Dahlgren way, or your perception of the Dahlgren way.
Francis	Beginning with 1964, my impression of the Dahlgren way was that it was a very much hands-on, do a competent engineering job for the Navy, and recognizing right in the beginning that our warfighters at sea are our customers, and if we get in trouble, it's usually because we're trying to do the right job for the warfighters, whether or not it's perceived as the right job everybody else. A strong commitment to doing the right thing for the Navy, I think, is part of the Dahlgren way, and a good, solid engineering approach, understanding your objectives, or doing the operational analysis work up front so that you really understand what the needs are, and translating that, through a competent system engineering approach, into design constructs and allocations of requirements, and build all the pieces, and ensure that you have the interfaces, and ensure that this stuff is going to operate properly for the warfighter and be a viable warfighting asset, not just a neasty, keensy, technology box. So I think Dahlgren has been appreciated by a lot of people over many years for actually delivering valuable products, or working closely with contractors who, in turn, will do the

	finishing, if you will, of the product engineering and the production for valuable products. I can even tell you, even though this place, this NSWC Dahlgren, is focused and has been focused on the surface Navy, the surface combatants, the gun-shooters and the missile-shooters and the antisubmarine guys and all that, two or three years ago, I got to go aboard the *Teddy Roosevelt* carrier and I was surprised – I looked at their big system diagram of all the systems they had –that there were four systems on that carrier that I had been responsible for at one time or another my career here, responsible for the development of, which surprised me, because we expect all of our stuff to go to surface combatants, and yet there were four systems on a carrier that really came from Dahlgren. And I would bet that no one on that ship knew that Dahlgren was the principle technical agent for creating that stuff, because they always recognized it as Texas Instruments stuff or Raytheon stuff or Lockheed stuff because that's the name that ends up on it. So I think in many cases we're a lot more valuable than even the warfighters realize. But I believe that relationship with the warfighters is probably stronger than most labs because of our strong focus on delivering things to them that work and working with them closely to make sure that things they have get improved or fixed. And the interoperability work is extremely important for the carrier battle groups and probably enhances our reputation with them a lot. We have historically suffered in our reputation with the fleet being less than is deserved because the products we work on, you know, it can ben ten years or five years before they actually get to the fleet, so that a lot of the stuff that we create and produce gets transitioned to other key players for in-service support and stuff, and we don't get the recognition for what we do. If we were fully recognized for everything that we did good for the Navy, our stock would probably go up about 1,000 percent. With respect to the Dahlgren story, there are other organization that have a reputation for creating prototypes and have a reputation for creating technology and have a reputation for doing analysis, but also have a reputation for not being able to produce, not being able to deliver. Dahlgren has a strong reputation for delivering real capabilities that are warfighting assets. That's because, when we come in here as a GS-7, or even a GS-5—we start with the sort of focus as the Dahlgren way. The other thing I would say is, it's really important to balance responding program managers in Washington to deliver, to develop those things for which orders have been created, and maybe concept work was even done by other people, other than Dahlgren, to respond to those and do the engineering development and get the products out the door. It's also important to balance that with the innovative work we to do to address the future, the creation of concepts, advancing of technology, the matching of future technologies with future concepts, and helping orchestrate a large warfare system kind of view, with the right kinds of interfaces so that the system of the future, with these new technologies, is going to operate much better than today, even though we make all these changes. In other words, be able to do these changes in a very carefully technically organized way.

	I realize, in writing your history, there have been times in our history when the researchers, if you will, the technologists, have been more in charge, other times when the engineers focused on getting the products out the door have been more in charge, and that's gone back and forth. But it's really important that we have a reasonable balance of both of those things, I think, to do the right job for the Navy.
Rife	It seems like Dahlgren's really come of age in the last twenty years. Outside influences and challenges. How has T Department dealt with governmental issues? I know, since it's a relatively new organization, that it came later, after the BRACs, but in some of our other interviews, with a couple of former commanding officers, they spoke of a technological and management chasm—not gap, but chasm—that's formed in the last ten years. Has T Department been affected by a preponderance of really high senior-level management types and lower-level engineering technical people, with nothing in the middle?
Dillon	It seems like the mid-thirties to mid-forties there's a gap in just about all our organization, where there was either insufficient hiring or the ability to attract really was just at an all-time low. We in this department have actually gone through the worst of the experiences already. About two years ago, we had a maximum number, the largest number of retirements, people that were beyond the fifty-five—most of them fifty-six, fifty-seven, fifty-eight—that chose to retire in pretty large numbers, and we've gone through that. We're retiring almost at half the rate that we were two years ago. We, in my opinion, got through that. I don't think we had too big of a problem doing that, but it was a struggle. It was hard. Fortunately, we've been able to get new people in. My sense is, the other departments here at Dahlgren, because they're not as senior, and because this really was a collection of more senior people that addressed these more challenging things when it was first conceived, they are going to go through that. So we're going to see Dahlgren, you know that process that we went through, others going through it or about to go through it. But it will happen, and you're starting to see that in a couple of the other departments already. Eventually, they all will. What we've done is, we've hired an exceptionally large number of people. We've hired over 250 here in the last three years, just in this department alone. So we've gone out of our way to do that. We've only set the levels high in terms of their qualifications. We've been hiring young folks out of college as well as journeyman, and been able to attract them. And world events helped, the economy helps, but the nature of what we do, I think, has attracted a lot people to this organization. So at the moment, we're at the largest we've ever been. We've actually grown. We're very blessed to have more than enough money to certainly pay all the salaries. We have the problem of too few people to do all the jobs. That's a fabulous situation to be in. My hope is that world events aren't going to change that a whole lot next year, but they could. We could things turning and changing. I think there's going to be a lot of traditional classical programs that are going to go by the way. People are tired of nurturing programs that have

	been around ten years. They're willing to start new and get later technology, or maybe do without them. They were good for ten years, but they may not have what they need now. So part of our job is recognizing those and providing options to decision makers so we end up with products that useful and meaningful. So we have through that, and I think that gap still exists somewhat, but we're bridging that. We've been doing the good recruiting. It is going to be a problem for Dahlgren. There's going to be a continued exodus here of senior people. And you just can't replace them. So we've gone on a campaign of indicating to everybody that secession planning is every individual's job; it's not somebody else's. It's not over there; it's not here. Each of us has to prepare our next in line. That's part of our job, part of our responsibilities. We've got to mentor; you have to mentor; you need to mentor. Then we're also taking great strides to ensure that our younger people are doing the right development in taking these courses. It's hard to do than it sounds, people to take care of themselves, people to plan their own future. It takes a lot of energy to get them to do that, but we're imposing on them, nonetheless, so that they can emerge and they can fill these gaps and we can do the best job we can with the people we have.
Rife	One of the running themes throughout Dahlgren's history is –well, it's actually two related themes, but they're intertwined. One is mathematics; the other is computers. And this goes all the way back really, to 1920, with the Norden bombsight in which, okay, they developed bombs, but developing the bombs and dropping them out of a biplane at 10,000 feet and actually hitting what you're aiming at are two entirely different things, and that led to the Norden bombsight, which is really a computer. Since then, mathematics has branched out throughout Dahlgren, first through ballistics and then later on, through bombing tables in World War II, which, in turn, led to the Exterior Ballistics Group, and that, in turn, brought in Howard Akin and computers. What types of mathematics and computational technology does T Department employ? What do you have to deal with?
Dillon	We have a special group over in T-10, again, looking at the GPS and all the guidance system and georotation atomic change, affect on gravitational pull, all related toward the fineness and the accuracy of GPS, as well as the hull elements, how that fits in, various targets, and all the targeteering associated there. So we actually have the oldest mathematician on base in T-10, still performing and still able to do that. So the mathematics are fundamental, and keeping those honed and being able to apply those are very fundamental, very essential. What I've seen is the ability here at Dahlgren to understand the key technologies, to be able to do the signal processing, which is more than just detecting, but actually understanding it, identifying it, registering it, tracking it, and then providing that to a solution set so that you're able to do something and react and take that into action. So we've always looked at systems in that context. So that's required a lot of disciple to work across that. And whether you're a computer scientist or an electrical engineer working some of the computer, or just a configuration management and trying to bring about discipline of the signal processing, all of that's very much woven in all our organization, and that's what brings it about and makes

	it operate with some confidence. The other part of this is getting a lot more complex is the ability to take responsibility for some of these products. I'd say another word for that is to be able to certify these products. In other words, we're willing to take on the role of bringing these out, testing them, checking them, and putting them into the operating regime that they're going to be placed in the real world, and we're willing to put our name on the line that says, "We'll certify that that's what we say it is and that this machine will work under these following conditions, and do that reliably and confidently." And we do that also with the mindset that represents the operating environment that it's going to be placed in, that the user will be satisfied with the capabilities of this system. That's something that industry sometimes doesn't have a feel or, in some cases, doesn't want the liability associated with that. Somebody has to do that. An eighteen-year old can't figure it out right? Or a senior officer, for that matter, has got other things going on. The last thing they need to do is to worry about whether their equipment is going to work, or how it works, or if it's going work, So we take that understanding of that system, from nuts to bolts, over its operating environment very, very seriously. So we're laying out processes to certify products, to certify combat systems on a ship and a battle group so that you can deal that with some certainty as to how its performing and operating.
Rife	The mathematical story is something I think a lot people –when they think of all these wonderful ship systems and missile systems and the cool weapons technology, they don't realize the mathematical complexities that are involved, and what it takes to sit down and—because in the old days, scientists had to sit down and just do calculus, pages and pages and pages of it in longhand, and with computers, it has it made it so much easier. What types of computers do you guys use? I just talked to Rob Gates up in Strike Systems and they've got, he told me, couple of Crays and essentially PCS. Is that . . .
Dillon	Well, I'll tell you what; today's computers that you can get at the supermarkets are unbelievable.
Rife	Two gigabyte.
Dillon	In fact, we had a special branch within T Department especially for just high-level computation, and we did assessment across the base. Today's computer are such that, with some minor exceptions, you can do all the work that previously required Crays. There are some high-end fluid dynamics, thermodynamics, those type of things, where you need a continuum over large, large volumes, and you need absolute precision because of breaking points or criticalities, and that requires special computers. In that regard, we're about to tap into the DOD assets and buy time off those. That has been decreasing, the need to do that, because of just availability of computers that are more than adequate to do those calculations for us.

	We are doing things like IV&V for missile defense, the trajectory, all the aspects, the detection, all the atmospherics, all the environmental, enormously complex simulations, stimulations, of both actual as well as the simulated design. So we're doing that more and more, where we understand the complexity, we develop Con Ops around that, and then we go to the users as to how to lay these out and actually engage them and use them. So we're about to do that more and more.
Rife	Are there any stories that need to be in this book, that need to be told, that we haven't covered? What would you like to say regarding T Department?
Francis	Wee, don't leave out the computer bug story. You probably have that one right? The first computer bug, a moth, we're talking.
Rife	Anything specific maybe in the last ten years? That's really where the dearth of materials is.
Dillon	I think understanding an entire battle group and being able to baseline that, consistently and persistently, so the fleet is able to develop and evolve its concept, is a change in the role of the laboratory and change in the expertise and the knowledge base that we can provide the fleet that really impacts their ability to be successful and safe. Get them all there and get them all back, and tie in all the threat and all that, to be able to that in facilities the lab downstairs. Do that repeatedly over and over. Right after 9/11, within three days we had two Aegis ships at Norfolk that they wanted to put in the Indian Ocean, anticipating further problems. They came to us and said, "Does it make a difference what battle group those two ships line themselves up with?" Because there were two battle groups in the operating area of the Indian Ocean. The answer is, yes, it does matter. What was validation to me was the fact that the people in OPNAV asked us for our advice and our technical input, knowing that these arrangements and when you add or take a ship off, it can affect the overall performance of the battle group. That was validation. The other is when we put five battle groups into the Indian Ocean here during the Iraqi, people said, "We've never done that before." We've done them individually. Now we've got five collectively. What are the problems and what are the issues associated with doing that? Well, we were able to lay them out, move them in different positions, align them based upon the threat and the geometry, but also provide them with advisories as to what the limitations of their overall effective capability would be in that operating area, because some of their gear is twenty, thirty, many years old, and it is limited. It's not as good as some of the others. It's essential that they know what those limitations are so they not get hurt, they not get killed. So we did quick assessments on that collective group and also went back with advisories as to how to use that. So I like to think we are integral to their success, and we are doing a better job of getting them the right information to ensure their success over time. I think

	the work that's going on in fire control systems, naval fire control systems, is just revolutionizing. We're going from a weapon launcher, a control system, and several bodies in charge and responsible for that. We're going to have an array of weapons we can launch through a variety of means, to a fire control will take care of all of them, and do that in a cohesive, organized fashion to include deconflicting airplanes, friendly and hostile, and the whole nine yards, to include hitting precisely where you want, to includes miles in excess of 1,200 miles from the ship. Very, very phenomenal capability. When we talk about operating the 112s, we talk about the new ships that they're thinking about. This is what they've got to have to be able to operating in those areas successfully, and in some cases to ensure that they're only hitting the intended targets and that there is no collateral damage in the supporting things. I believe that trend is going to change the way we operate our Army and ever our Marine Corps. We used to send everything over, put it on a four-wheeled vehicles, and then move it around and about the country. You don't have to do that today. You can shoot from the ship that got it there in the first place. That provides us a lot options, a lot more agile. We can still get to everything, we can still be in total and complete support of them. So I see surface warfare kind of changing significantly. Our national defense, to protect against ballistic missile defense, we are that close, in my opinion, to actually being able to solve those kinds of problems. There's probably nothing more complex. You think about Star Wars? It's nothing. It's nothing compared to what we're on the verge of doing and capable of doing, and I believe that it's the assets across Dahlgren, not just in this department, it's the assets across Dahlgren, that are absolutely imperative to that. I don't think they're found in *Toto*, and it's going to require all of that to go into solving that challenging problem and to be able to bring that about for the sea-based component. The sea-based component not only defeats the United States, it's also used as an element of national security to protect other countries from "whacking each other." It's tremendously important to how we do world affairs and do things on that level. So we've gone from just helping our Navy to, in my opinion, being a very fundamental and foundational organization that's necessary for the most cutting-edge programs we've got going in the Department of Defense. And not only can we provide the missile defense, we can ensure that it will work with coalition and the other services in whatever interoperability or method that they want. That, to me, represents a tremendous asset and capability that I think is uniquely Dahlgren. I can think of another story that goes back a ways, that I think represents that Dahlgren way. There's something called the Chemical Warfare Directional Director, CWDD, which Roger Harmon was the lead engineer on it at the time we did it, and it was in my branch, my Electronic Systems Branch, back when that branch was in N Department. The CWDD is a capability for detecting and realizing the disposition of various classes of chemical warfare clouds. It was conceived, engineered, and brought to IOC, Initial Operation Capability, in, I believe, eighteen months. Might even have been fifteen months. A very short period of time, ok? And the conception was here, the engineering was here, the carrying it through

	the process to get it to IOC was all out at Dahlgren. There's a lot of information on that we can up, I'm sure. Chemical warfare director. I think it's on every ship in the Navy that amounts to anything of course, including all the carriers.
Rife	Well, it's something we haven't found too much of. We've found an occasional press release or newspaper clipping about Dahlgren's role in chemical and biological defense, so anything you could add to that, about the history of it…
Francis	Well, that included the first forward-looking infrared receiver—FLIR—to my knowledge, that was put in the fleet, at least in the surface fleet. There might have been some on the carrier before then, but in the surface fleet, that included the first FLIR system as part of the chemical warfare directional director. It was also invaluable as a night-vision device, just to help you navigate when you're in close quarters at night and in heavy weather. But it's one of the little stories of the kinds of things we can do at Dahlgren, and do routinely, that often don't get as much recognition as they might.
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. Tune in next time to hear from Daniel Green, an early computer programmer for the Naval Ordnance Research Calculator. Thank you for celebrating this century of innovation with us at Dahlgren. <u>MUSIC</u>