USS Arleigh Burke Association
History Project

Interview of Andy Summers by Kenyon Hiser on March 26, 2024

Andy Summers
- USS Arleigh Burke
  - Design Integration Manager
  - Deputy Ship Design Manager
  - Ship Design Manager
- USS Zumwalt
  - Innovation Manager
  - Ship Design Manager

[Editor notes]

Highlights:

Kenyon
How did you become involved with Arleigh Burke?

Andy
I worked at NAVSEA right out of college. I went to Carnegie Mellon and then MIT for a Master's in Naval Architecture and Marine Engineering. I ended up in the early-stage ship design group at NAVSEA. There I did feasibility studies on all kinds of ships, destroyers, carriers, auxiliary ships, amphibious ships. I became part of destroyer frigate cruiser group. Prior to starting on Arleigh Burke, I did the CSGN, a strike cruiser with AEGIS. I did then the CGN42. They built three of the 38 class up to 41 and they were going to build a 42 with AEGIS. We did a whole preliminary design of that and I led that effort.

That ended and they looked at the CGN-42 versus the CG-47. At that time it was called the DDG-47, but it was basically the same AEGIS on a gas turbine ship versus a nuclear-powered ship. They did a cost study and the nuclear-powered ship cost more to build, more to operate, more to get rid of, more of everything. It was just more expensive. They decided to build gas turbine ships. That was of the end of the nuclear cruiser world.

I came back to NAVSEA and worked on some little projects and then we started up a new destroyer project. At that time, I think it was called DDX or DDGX.

Kenyon
What year sort of was that?

Andy
'79. I remember we did three basic ships. Captain Corky Graham was running it. He was a commander at the time, later became captain. He was running the office to do the designs and I was one of the engineers doing the design.

We had a ship design computer program model in NAVSEA 05D, which was the early stage group for designing destroyers. You would plug in a lot of what you wanted and it would come out with a ship. It would actually come out with a series of ships of different lengths and you'd pick which one you wanted based on a topside design length you needed or something or other that the program couldn't do.

We designed three ships. There was Ship One, Three A, which I did, and ship Five. Five was a big one. It was about 10,000 tons. Three A was mine and it was like 7,000 tons, 6,000, 7,000 tons. One was like a little frigate size It was 3,000 or 4,000 tons. Bigger than the FFG-7 but not much bigger.

Eventually we narrowed down on Ship Three A, which was mine. And then we started to do lots of tradeoffs for all kinds of things. This was 1980, maybe into the middle of '80. For instance, we looked at three gas turbines versus four. We looked at electric drives. We looked at crossover gear where you could run two shafts off three gas turbines. They actually have done that at times on other ships and it's painful but it can be done

Then I went off to Bath Iron Works. NAVSEA had a program that I actually helped start, which was send NAVSEA ship designers to a shipyard. My theory was people started at NAVSEA and went to work at the shipyards and never came back because it was nicer out there. They went to the SupShips or the shipyard. But very few people came from the shipyards to NAVSEA, so we didn't have a lot of shipbuilding experience. I said, "We need to take some of our young people, send them out to shipyards, and spend a year in the shipyard and see how a shipyard actually is built so that you could design the ship to be easier to build."

I went to Bath Iron Works for a year. This was 1980 to '81. We moved the whole family up to Maine. I worked in four different sections. The first one was Program Management, doing weight control and a hundred of other things, facilitating things. Then engineering. Then production planning, which is basically the heart of the building plan, if you really want to understand a shipyard, you have to understand production planning.

The question I had when I arrived at the shipyard was, "How does a person walking in the gate know what they're supposed to do that day?" There's like six million man-hours of work that goes into building an Arleigh Burke. (More early ships, less later ships). Everything is planned, and that's production planning. They get every job down to every piece of material so that the material arrives for the guy to do the welding, to put together the part, to put a number on it, to store it where it goes. That's production planning, and that's the center of the shipyard.

The last three months I spent out in the yard doing inspections on tanks, doing inspections on welding and machinery and moving things around and pipe problems, interferences, and fixing those. It was actually in the construction building and then on the ship on the ways and then the ship in the water getting ready for delivery. These were all FFG-7s at the time. So that was a lot of fun. It was great.

Kenyon
Bath built a number of those, right?

Andy
I was working on the FFG-8 which was just about delivered, and I think I got up to FFG-18. They were building them out at Todd in Seattle and Todd in L.A.

Then I came back and DDG-51 had tried all kinds of more innovative concepts. It was probably still called DDG-X or something at that time. I came back and they had done a lot of studies. They were looking at propulsion plants, different configurations for the deck house, all kinds of things. I ran some more studies at that point.

I actually picked the length of the ship at that point because when you ran the ship design program called DD-08, which designed destroyers, it would come out with every five or ten feet of length. And because the program couldn't understand how long the ship had to be for topside. Let me go back a step.

The requirement for DDG-51 was to be about three quarters of a CG-47 in performance and had to be a certain cost. It was going to be very tight on cost. NAVSEA wanted to design this ship right. The CG-47 Tico class had a lot of problems with the machinery, with systems. It was put together quickly, converting from the DD-963 class to the CG-47. We wanted to get that all right and design a class that really could be built right, which meant it was generally going to be bigger.

You think the DDG-51 looks a lot smaller than the CG-47, but it's not that much smaller because it's much wider and just big and heavy. It's all steel, steel superstructure where Tico was aluminum superstructure. We did all those studies. We looked at aluminum superstructure. The aluminum superstructure at that point was something that was looked highly down on because of the fire on USS Belknap. The Belknap hit the carrier when it was refueling and it poured lots of fuel down into the Belknap. They said the aluminum caught fire. Aluminum doesn't catch fire, but it melts. And a lot of it melted in the deckhouse.

They wanted a steel superstructure. For survivability and fire control and prevention. if you look at the length of the DDG-51, it's 466 feet on the water line. Now you could ask, why did you come up with a number like that? And there's a rule in NAVSEA. that you hit the ship with a hole 15% of the length of the water line hole. This comes from World War II data on torpedo hits and the resulting damage. If you multiply 466 times 15%, you get 69.9. If we put the bulkheads 70 feet apart, the water can't flood both the compartments on the ends. It'll either get two compartments or three compartments and not four. We wanted to maximize that. If I made it 467, I would have had to move all the bulkheads another foot or so. 466 was picked because of the 15% length of hit.

Kenyon
So why does 505 stick in my mind? That's length overall?

Andy
That's length overall. There's no real requirement on length overall. It's really the stern is sloped some. And you look back at old destroyers, they weren't always sloped, but we sloped them out. Generally, radar cross-section. We sloped the sides out and the stern out.

For the angle of the bow, we spent a lot of time in preliminary design on that bow. We had one guy that was a draftsman. We actually had draftsmen back in those days. He spent like two days drawing bows of the ship to make sure it looked good. He said, "Now it's just not right if I look at it." He could do it three-dimensional. This is all with pencils. This was no computer 3D. He said, "From this angle it doesn't look right." It's a fairly good rake on the bow of the Arleigh Burke. I think it is one of the beautiful design features of the ship.

Part of the bow angle is for the anchor. You need to be able to drop the anchor and not hit the sonar dome. Destroyers have a big sonar dome sticking out because of performance of the sonar. It's not because we wanted a bow bulb. Bow bulbs you have on a lot of ships and they're there to reduce resistance. But they do it at a certain speed. And at other speeds they sometimes add resistance. A destroyer really doesn't run at a single speed. It runs at very different speeds. A bow bulb just doesn't work on a destroyer. If you're an auxiliary ship and you're going to run at 18 or 20 knots all the time you put a bulb on and you'd size it just for that speed. You need that sonar dome

and it needs to stick out for sonar performance. You have to have the anchor drop and not hit the sonar because that's very expensive.

Kenyon
I'm sure that Peter Hsu and all the artists appreciate the effort to make that bow look artistically correct.

Andy
You're providing me another story, what makes a destroyer look fierce. We said you always want to stop the war before it starts. You want to have the destroyers appear on the horizon and people say we don't want to start a war. You know this is a fierce looking group. We brought in an artist, a marine artist. I don't remember his name. We said what makes a ship look fierce? He basically went back to the battleships. He said lots of things sticking out. I worked on the Zumwalt. There's nothing sticking out. He said lots of things sticking out like guns and little pointy things and radars. And then a nice big bow and a superstructure that is stepped back.

If you look at like the Ticonderoga class -- I tell people the first time I saw one in Florida when I was driving I saw it bow on. I said, what is that a container ship? And it turned out to be the Tico. And I knew a lot about Ticos at the time. But it's got that whole flat front and the Arleigh Burke has steps as much as we could do. It does look a lot better if you see it on the horizon. We tried to incorporate a lot of those features.

Kenyon
It looks like it's in motion even when it's not.

Andy
Yeah, it does. And it's supposed to. That was part of it. But the sleek back of the deckhouse tends to look like that. And so that was a big deal. This was a marine artist. He'd done all kinds of paintings that are in the White House, and many places.

Kenyon
That's a hidden requirement that never got to the TLR.

Andy
Yes you are absolutely right.

Kenyon
You just knew it had to be done.

Andy
Right. Now, by the way, TLR is a Top-Level Requirement. I had my own saying about those. We had a TLR that was very detailed. Admiral Meyer was in charge of the program early on. He later he left and he got fired over in my mind the DDG-51. He didn't like it. He liked his cruiser. He liked Ticos and he did not spend a lot of time on

DDG-51, and higher ups wanted the DDG-51 to be smaller. They didn't fire him but moved him down to what was called SEA 06. He was in charge of radars and electronics for all ships, which was a good job, but way below his capability. There were a lot of meetings with him, hundreds of them. What was then RCA and then became GE and then became Lockheed Martin in Moorestown.

Kenyon
I worked with Admiral Meyer much later in his career. It's an interesting point I have to examine sometime -- he did not like the destroyer, but yet his enduring legacy is the destroyer.

Andy
It is. And I went to the commissioning of the USS Admiral Meyer. I think it was that one. It was the one in Baltimore. And he was there. At the time he was getting quite old. He was in a wheelchair. And I introduced myself to him again as I had given him many presentations. And he said, "Ah, it's all your fault." It was what he told me.

Kenyon
It would not have been - he had passed away by the time his ship was commissioned.

Andy
Yeah, this was an earlier one. I forget what the name of it was, but yes.

Kenyon
His widow [Annamae] was threatening to bring him in a coffin to the commissioning if they did not get him buried at Arlington National before the commissioning, which caused them to speed up his burial.

Andy
Wow. I didn't know that. So anyway, he was quite a character and he would yell at you a lot. And he yelled at me many times.

I set the beam at 61 feet on the waterline and it's now 59. Why it went there is one of my other sea stories. They then took the whole design and they went to what we call the [Vice Admiral Robert S.] Salzer panel. This was basically a conservative group that said, "Okay, here's what you've got to do in the New Destroyer," because we had all kinds of new stuff. And they said, "We want tried and true equipment and systems."

That's when we went back to four gas turbines, just like the CG-47, like the DD-963. Almost identical. They flipped the two shafts on different sides, the long ones on one side and the other. And we flipped them and I can explain why. They threw out a bunch of things and squeezed the ship a little bit. It was always trying to keep it down to size of three-quarters of the cruiser. The biggest thing I would say that was three-quarters, is they have four illuminators, we have three. And that was the only thing on the whole ship that I could really say, "We got three-quarters of the cruiser."

We didn't have a hangar on the early ships. So let me just give you a side story. I have friends that worked in the early-stage feasibility study group at NAVSEA that worked for 30 years there and never had any of their designs built. We did lots of feasibility studies on all kinds of ships. And very few of them got built. Kit Ryan was my boss for a while at that time, early stage. He had his theory of black hole theory of ship design. In a black hole in space, if you get too close, light gets sucked in.

There are various black holes in shipbuilding and they're existing ships. For example the CG-47, if we tried to build an Arleigh Burke that was about the same size. Ingalls and Bath were building the CG-47s at the time, they would go to Congress and say, "Let's just build more of these. We got production under control. You're going to spend millions and millions on design, probably three or four hundred million. And why do that? We can just build these. Our people are trained." So, you couldn't build a new ship design.

That's why you don't see many new ships. The aircraft carriers—we haven't built a new design aircraft carrier in like fifty years now. The destroyers up until that point, they really hadn't designed a new one since the DD-963s, CG-47 was just a tweak of that. [Also DDG-993s.] The FFG-7s were new and it was very different than anything out there. It's very hard to get a new design built.

This is the black hole theory of ship design we used to call it. We tried to stay away on purpose from the CG because we knew we'd get canceled and just sucked into it if we didn't stay far away. The hangar was one of those things we said, "Every destroyer should have a hangar." It was one of the things we had to do to just stay away. The Salzer panel got us back and that's about when I came back from Bath, my year at Bath Iron Works, to NAVSEA and got back to being involved in the design.

Kenyon
Your ship Three A did not have a hangar?

Andy
Did not have a hangar.

The bigger one, the Five did. It basically looked a lot like the cruiser. But it had more HM&E things. We basically made it more survivable. One of the complaints about the CG is it's not as survivable. There's a lot of survivability features built into the Arleigh Burke. And those take up space and weight. They're big and heavy, more armor and things like that.

Kenyon
There's an apocryphal story that some of the crew had heard that that was one of the things that Lehman X'd out with his red pen was the hangar.

Andy
No, first of all, it was well before him.

I believe that was pretty close to the beginning. The idea was that there would be planes on the carriers. We would basically do battle group support. There's plenty of helicopters around. But they needed some time to refuel or just land if they're having a problem. We didn't really need a hangar. I know that wasn't great rationale, but that was some of the rationale.

Kenyon
You'd come back from Maine and they were starting to get real legs on this design in the early '80s.

Andy
Right. And we took out a bunch of weight. So, one, we kept making it shorter. And that was partly the 75 percent, trying to get it to look different than the CG, but also to save weight.

Length is great. Destroyers should be long and skinny. And the Arleigh Burke is short and fat. In fact, we used to call it the Arleigh Brick. We took out length. One of the things different on the ships is the deck house was too heavy which was driving up the beam as it is high on the ship. We were trying to figure out how to make it smaller. We did, what we call the flipped transverses. In the deck house, the AEGIS faces are installed on one deck and they stick up into the pilot house. On the Tico, they were two decks high. We saved a whole deck. And I wish I came up with that idea because I thought it was a neat idea, though I eventually tried to get rid of it. But it wasn't mine. I forget who did it. But it worked pretty well.

We turned over the transverses on some decks so that we could save a couple of inches here or there and make the whole ship height come down. When you get weight high, it drives the beam. Then the costs just start rising completely everywhere.

The other thing that I was very particular about is a ship is like a giant steel beam, a structural beam. It bends in the waves. You get a long wave; you get a crest in the bow and the stern and the middle drops down or you get a crest in the middle and the ends drop down. It's constantly bending. The superstructure, because it's far away from the center of the bend, sees a lot of that stress. If you have a long superstructure like the FFG-7s and DD-963s, you get cracks, especially aluminum, which doesn't do fatigue well.

Fatigue is you take a paperclip and it's real strong, but you bend it a lot and it finally breaks. That's fatigue. It will bend until it breaks. The deck houses were cracking on the aluminum deckhouse ships. We said, OK, we're going to do steel deck house, but it's still going to break up there if we make it long. So, we have two short deck houses.

Kenyon
You just cut the middle out of it.

Andy
Yes. And that was convenient because we put the harpoons there and that worked well for that. And the replenishment at sea is in the middle there. It gave us room to do that.

Kenyon
There's really not much up aft except the exhausts and a couple of radar rooms.

Andy
Right. Yes, there's lots of fan rooms basically. The aft end of the ship needs fresh air, and intake for that air should be high, thus it was from the aft superstructure. And the inside of the uptakes, the stacks, which is like a cathedral in there. I enjoyed that space.

The CIC was always in the deck house. It was near the pilot house because the C.O. would run back and forth between the pilot house and the CIC. We decided that the C.O. would stay in the CIC if there was anything exciting going on from a warfare standpoint. We moved it into the hull. That was a survivability feature. We needed the hull to keep getting bigger and bigger. The hull is from a weight standpoint is a lot heavier than the deck house, especially if the deck house is aluminum.

If you try to optimize the weight of a ship and you have aluminum for a deck house, the idea is to make the hull as small as possible and the deck house as big as possible. You can look at the FFG-7s and the DD-963s and you can see, wow, that's what happened. If the deck house becomes steel, you want to make the hull as big as possible and the deck house as small as possible. The DDG-51 is kind of an example of that. These are some of big shipbuilding drivers.

From 1981 on, I was part of DDG-51 until 1992 when I went off to England for a year.

Kenyon
This was as part of the NAVSEA design team, you were not in the program office?

Andy
Correct. I never was in the program office. I actually had a hat there once, but I was always NAVSEA 05, which is the engineering directorate. It actually was NAVSEA 03, I think at the time, but they later made it NAVSEA 05. And I was in that for my whole career. I started about '73 until I retired in December of 2011.

Kenyon
So that just really sort of tends into the next question -- what was your role?

Andy
During the early stage, I was a design integration manager, a DIM. And then I became a Deputy Ship Design Manager when the Ship Design Manager left, I became that position, we called it SDM. And then I became the Ship Design Manager in kind of early contract designs of 1984, '83, '84. I was in charge of the whole design. And then I stayed ship design management all the way through to the end, 1992, when I left.

Kenyon
So now you had a distributed design team, though. Some of this, was it all in NAVSEA? Some in New York, as I hear? Maybe some at the shipyard?

Andy
Let's start earlier where the design team was, because that's a fun story. Up until about 1982 or so, we were over in NAVSEA, Crystal City, NC2, fifth floor. We had a whole area. The battleship team were down at one end of the room. The CG-47 was down there as well. They were finishing up a lot of design. And the battleship guys were just finishing up because they brought back a couple of the battleships. My boss was involved in some of that.

Our plan was to turn over preliminary and contract design to the shipyard. We had a big source selection out in Rosslyn, which is across the river from Washington. We got everybody together and we looked at proposals from Bath, Ingalls, and Todd, there were only three. There might have been Newport News involved, too, but I think it was only those three. And this was like the '82, '83 timeframe. And we picked one. And because this is being recorded, I won't tell you which one we picked. But they didn't like who we picked.

I went off on vacation, this was around Christmas time. I was down in Florida. My grandmother had a condo and apartment in Miami Beach in a big apartment building. I was laying out at the pool and I got a phone call from my boss, at that time Commander Baskerville, later Captain. And he said, "Andy, what do you think about doing preliminary contract design in-house?"

We hadn't planned for this at all. I'm standing there in a bathing suit walking around the pool. I said, "Well, we could do it. We'd need some of the following things. We'd need a place where we could put maybe 100 people or so for a couple of years. And we'd need money and we'd need all kinds of things."

When I got back, they had decided to cancel that whole source election and decided to do it in-house. Somehow Baskerville got the purchasing people in NAVSEA to get office space, which was in Airport Plaza 1, across from the Hyatt Regency, which had a swimming pool full of stewardesses that laid out there. We could see from our windows. It was up on the 10th floor. I think it was 10th. Couldn't be 11th. We had the whole floor. We got that in like a month or two. It normally takes a year to get space allocated. We brought everybody together and we started the preliminary design.

We had a ship design; it was about 8,000 or 8,900 tons. It was 61 feet wide on the water line. It's now 59. We'll talk about that. And I had picked it 61. And it had four gas turbine generators. And it had a couple other little things that are no longer there. Anyway, Secretary Lehman –

Kenyon
Where did you find 100 good designers so fast? Were they government or contract?

Andy
I would say about at least half were government from all the different NAVSEA tech codes. We had machinery guys, electric, piping, auxiliaries, materials, combat systems, arrangements, structure, hull form, etc. At that time, Lieutenant Commander Mahoney's our machinery lead, later Captain Mahoney, he was on the Zumwalt with me. On Zumwalt He was the Program Manager. About half were contractors. I can't remember whether they were Lockheed Martin yet, but whoever they were, they were there. They made up RCA or GE, the same company. We had the shipyards were there. They had four or five people from each shipyard, Bath, Ingalls and Todd.

One of my only things where I got a gift from a shipyard guy, government guys aren't allowed to take gifts from contractors. At the end, when the Todd guy was leaving, he said, "I've got a gift for Andy Summers." And I said, "Oh, shit, this is the end of the world. I can't take gifts." We were allowed a $19 lunch with the government. He pulls out his ice scraper and hands it to me and says, "I don't need this anymore. I'm going back to L.A." So, I had his ice scraper.

Kenyon
But Todd didn't survive much after that because I was in there in '86 on the Vincennes PSA, and we were their last ship.

Andy
They became a repair yard and then they became nothing. The labor rate is tough, and that's one of the reasons Ingalls does very well is the labor rate is below Bath. Bath is tough, but in Maine there's almost nothing to do besides build ships. They're lucky in that way. Bath has a lot of very sophisticated people working there that could get a wonderful job almost anywhere else, but they work in Maine because they love Maine. And so that's their flaw that you're able to pay them a low salary, get a superstar to work, but they stay.

Kenyon
That's a hidden story - I had no idea that there was a voided ship selection early in the process.

Andy
Yes. Then Lehman got involved. Lehman was Secretary of the Navy and he had George Sawyer, who was Assistant Secretary of the Navy for Shipbuilding. George Sawyer had come from J.J. McMullen, which was a naval architecture firm that we used a lot over the years. He knew shipbuilding. He said, "We've got to get this ship smaller." Lehman wrote this letter to CNO that said, "Take out two feet of beam, take out one generator," so three generators. And it was—I can't remember what else, but that was most of it. CNO wrote back & said 4 generators. As you can see there are only 3 on USS Arleigh Burke.

Kenyon
Anchor windlass was one of them?

Andy
I don't think so, but maybe. And so CNO wrote back to SECNAV and said, "No." We helped write it for him. You asked me what's one of my biggest disappointments. My biggest disappointment was when you went from 61 feet down to 59, we had a clean ballast system at 61 feet. You never put water in a fuel tank. And we went to a compensated fuel to keep the ship stabile, which is in the DD-963s and the CG-47, and it's a decent fuel system, but it pollutes every single time you refuel, whether you're at shore or at sea, guaranteed. And I hated that.

I wrote a long point paper about how we were forced at 59 feet to go to a compensated fuel system, and that this was bad for the program, bad for the environment, bad for everybody. It didn't cost that much more for the two feet, but I lost. You should understand that 2 extra feet of beam is not very expensive, steel is cheap, pipes are longer and so is wiring, but these are relatively inexpensive. What SECNAV was most worried about is the navy filling up the ship with expensive electronics and weapons. Generally, the Navy adds things to the ship as long as they fit. So, by reducing the beam in constrained them.

Kenyon
MARPOL had not been enacted then. That might have been, that was later on.

[MARPOL Annex I – oil pollution, went in effect on Oct 2, 1983]

Andy
I don't remember that being an issue, compensated fuel can meet the requirements and Navies are generally exempt from MARPOL, although politically the Navy tries to meet those requirements. The requirements now talk about refuel without leaving a sheen on the water. In port they put the overflow of 'dirty water' into a barge that is then sent to an onshore oil water separator. Lots of cost!

Kenyon
The rules of the sea changed.

Andy
Yeah, they did change.

Kenyon
Interesting. I had not realized you had an uncompensated early system.

Andy
Yes, we did. Clean ballast was a big deal. I worked on a design at one point to add AEGIS to the DD-963 design. We were going to go to four generators and clean ballast. We proved that you couldn't do it on the DD-963 hull. They threw out that design, They threw out our design and said, "We're not going to do that. It won't work.

And they went to another group in NAVSEA that said, "You can do it, but we're going to make all these compromises." And that's what we ended up on, the CG-47. I did a study that said the CG-47 should never have happened. That was much earlier. Four years earlier.

Kenyon
George Sawyer is now sort of directing the design from SECNAV's office.

Andy
Right. CNO wrote back and said no, and SECNAV said yes. We ended up with three generators, and two feet reduced in beam, and a few other small things. And so that set us back. That was in preliminary design. We redesigned the ship again to meet that. And it reduced it down in weight, but it was still about 87 or 89 hundred tons.

Kenyon
To be sure, this is not where you then went in a computer program and said take out two feet. This is all by hand.

Andy
Right, this is not a computer program. This is all by hand. All new drawings, all the drawings were done by hand. We started computer drawings about this time, but they were always a backup to the hand drawings. Almost everything was done by hand. There was no such thing as 3D CAD. It was all 2D. And we were just starting to do a couple of pictures of 3D, but it wasn't doing very well. The computer guys were in one room on that tenth floor of Airport Plaza, and there were like three or four guys. And the rest of the big rooms were all draftsmen and engineers.

There were draftsmen doing the combat system, trying to figure out all the waveguide on the AEGIS, which was a big problem. There's a large number of waveguides to try to fit in, while keeping the structure adequate to support the vibration requirements of the electronics in the superstructure. We had that problem.

You asked at one point what was the biggest disappointment. My biggest disappointment is compensated fuel we had to put on that ship.

Kenyon
Interesting.

Andy
And you can see on the Zumwalt, which was my next ship, it's clean ballast.

So just staying with ballast, this is a little out of order. After the ship was built, it started polluting. There was a lot of money spent on redesign of the piping in the fuel talks and then retrofitting it in to distribute the fuel more consistently so it didn't mix with the water in the tanks. We made great strides, but it still pollutes.

Further on in design, in contract design, it was 8900 tons or 87. They said it's got to be 8500 tons or we can't sell it to Congress. One of the reasons this is called a destroyer instead of a cruiser is it sounds cheaper when they go to sell it to Congress. And that's a big, big deal for the Navy. [Admiral] Meyer always wanted cruisers and so -- but destroyer sounds cheaper even though it isn't. They said we can't sell it if it's over 8500 tons. We said, hey, we're in the middle of contract design. We've already designed the whole thing. We can't take out 3 or 4 hundred tons.

My comment, which was nasty, was 'ask a stupid question and we'll give you a stupid answer'. We took out 400 tons of fuel.

Kenyon
I remember that you had flanged off a couple fuel tanks and then after PSA you came back and just flanged it right back in.

Andy
In compensated fuel you pump in water or fuel from one end, you pump out water from the other end. We just connected the inlet and the outlet pipe in one or two tanks so that no fuel was in the tank. It would just run in pipe and out the pipe. They were bolted flanges so that we could unbolt it, unbolt that piece of pipe, throw it in the garbage and then put on a nice flange that made the fuel go in smoother.

But it still turned out that we were polluting, what was happening is the water and fuel was getting trapped behind all the stiffeners and so you get globs of fuel in the water as it went over the side. We went in and built models of the ship, of the tanks and redesigned a lot of the piping. During PSA you might remember a lot of piping went into the tanks so that the fuel didn't come out in one spot, it came out smoothly throughout and it didn't mix with the water. We didn't want the fuel in the water to get mixed up because then it would go out as fuel and water.

Kenyon
I don't remember the detail, I just remember early on refueling inport or at sea was a real pain in the rear end.

Andy
Right, so we made that a lot better but it never really solved it. The real problem is compensated fuel. When you mix fuel and water, even though they separate, the waters above the fuel below, they still get mixed up some and some of the fuel goes out when the water goes out.

Kenyon
We're sort of still in the early 80s trying to get to something you can put on contract, I think.

Andy
We had our ship and during contract design you write the contract; you write the specs basically. And the specs are somewhat logical in its organization. The contract is totally illogical. I don't know if you've ever read the contract but it is painful. It does have some technical things in the contract which was tough because I hated reading that contract language. We had what we call gen specs, general specifications at NAVSEA. They covered aircraft carriers, auxiliaries, destroyers, everything. You would go in in the beginning and you would type and say, "I want a destroyer that's going to be so many feet." And it would then trigger in those requirements. Let's say there's a requirement above 500 feet, you had to have for instance an extra life boat. It would throw out that requirement and it would give you a tailored spec based on your input. We got that and we had the CG-47 specs in front of us which were a mishmash from the DD-963 specs. And we then had reading sessions where we would go through each page of the spec with a group of about 40 or 50 people. And I've got a picture somewhere in my piles of pictures here.

Kenyon
Reading the spec?

Andy
Actually, there it is. Yep. There was the room and that's me and this is the room. These little signs up here, we had very little funny signs up on the wall that would say, sometimes they had Rule 10 and that was "Leave it out." You know, if somebody brought up a good idea, we just said we can't do it.

Kenyon
You didn't even have to say it, you just called the number.

Andy
Yes, you would just call it after a while. It's kind of like NCIS, they have rules. I actually read that spec from cover to cover three times as we went through reading sessions.

We had a preliminary and then we eventually had the final session. Each time we would mark up each page and we had typists type each day's work. Charlie Cinch was the spec guy and he had a whole team of women that typed it in. And because you know, you weren't working on like a word processor, they had a special word processor that they were using offsite. And each night they come in with this typed.

We would fight over every line because the tech codes always wanted to make it even better. And we would try to save costs and keep the weight under control because weight is a big deal on the ship in the early stages.

One of the lessons from the Ticonderoga was the ship design manager and the program office were very strong. And they would tell the weight guys, "Hey, this weight is wrong, it should be 50 tons instead of 80 tons." They would win over the weight group. Thus, the weight report was not right. The ship, when it delivered, was much heavier than it was supposed to be. And I said, "I will never tell the weight guys to change the weight of anything."

At one point the ship was too heavy, I had to get weight out of it. There's a lot of foundations under pumps, under gas turbines, under everything. The way they designed foundations in detail design, they aren't designed in detail, so in early design stages they're based on history. They're 12% of the weight of machinery or like that. In detail design, they'll look at the equipment, they'll design a foundation and they'll say, "Okay, I got quarter inch steel here and half inch steel, it's actually a 20-pound plate or 10-pound plate." Then they'll do their analysis and see whether it worked. If it worked, they'll say, "Good enough, go." But it could have worked with, instead of half inch steel, it could have worked with 3/8 inch. But they never go back.

I said, "Okay, how do I reduce the weight of foundations?" He said, "Well, you've got to change the specs or design." So, we required that at least one or two components in each foundation be at the maximum for structural strength Generally it was shock requirement that drove the stress in the components in the foundations. It was a shock requirement that was the largest load. It forced them to redesign the foundation.

It cost more for detail design, but we got a lighter weight. It actually paid off, because you almost never know what the real weight is of foundations, because it's almost impossible. The weight report is maybe 5,000 pages of every piece of structure and every nut and bolt on there. You've got to group it in the right group. It's years before you really know whether you were right or wrong. But we did that. We did a lot of things to reduce weight constantly.

Kenyon
One of the things I remember from the CG-47 class is I was told the amount of paper that the crew would carry on board was always mind-boggling to the ship designers.

Andy
Right. Well, on Zumwalt we tried to go zero paper on board, but we didn't accomplish that. We certainly didn't accomplish it on Arleigh Burke. But yes, there was a lot of paper in design. So, you have the specs, which is 500 or 600 pages of single-spaced typing, and then it refers to mil-specs, and you put all that in a room, it would take a whole house full of paper to show you all the requirements on that ship. Because it's hundreds of, it's thousands of mil-specs.

Did they ever tell you about MIL-FD-1111?

Kenyon
That number does not sound familiar.

Andy
Okay, well that's my favorite mil-spec. It's **M**ake **I**t **L**ike the e**F**fin' **D**rawing for **O**nce.

One, you do specs. Two, you do drawings of the ship. And three, they build it, and sometimes they don't build it to the drawings. And this happened a lot on the CGs. They would build it like the DD-963, even though the CG-47 was different. And then they'd get there and they'd say, "Okay, now we've got to make this work somehow." The workers just knew what they were doing. They didn't follow the drawings.

Kenyon
Well, on Vincennes, I remember they were still trying to track down the piping people at Pascagoula that thought they were still building Spruances and kept putting the Spruance piping in.

Andy
Yes, and there were a lot of problems with that. Now Bath was much, much better. But they also had their problems. And we'll talk about the problems of building. They almost stopped the DDG-51 in the middle of construction at one point because it was taking lots of manhours and they were going to lose a lot of money.

Kenyon
At some point you got to a contract design signing.

Andy
We signed the contract design, there's lots of pictures here of the contract signing. I showed you all with the admirals. And that's a big deal because it doesn't happen very often getting a new ship design all the way through design. Then we went out for another source election.

Kenyon
Admiral Burke was there at the contract design signing?

Andy
Yes. He was there. He came to the design site once or twice and walked around and so did Secretary Lehman, actually Secretary of the Navy. Sometimes I may confuse DD-21, the Zumwalt class, and the Arleigh Burke because I worked on them both.

You go through several Secretary of the Navies and several admirals and, you know, everything's changing all the time as you're going through this design. And then in 1979, you end up in '91, there's a lot of change in the bosses, with different objectives. Remember technology is changing at this time as well. That's certainly a problem for the designers, because some of us were consistent in the whole thing. There aren't many that stayed like I did through the whole thing.

I told people after this that it's not always healthy to watch the ship you designed built, to be there because you're fighting over the things that have been built and need to be fixed. You know that you screwed up and you couldn't blame it on somebody else, but you have to blame it on yourself. And it's said after a while you become a little nutty. So, it's not always healthy to stay that long. And I am an example!

We got the [contract design] signing, we went into a source selection. This source selection was across from Crystal City. There's a bunch of warehouses at the time. And we were in a big old warehouse. And it was Bath, Ingalls & Todd (Todd San Pedro, which is LA). We had three proposals.

In a source selection, once in a while, somebody doesn't like what the group decided on. You put a minority report.

I was in charge of the design team, thus we analyzed the ability of each bidder to do the detail design. We had like four or five guys that worked for me. We did design and then we'd pass it up to the Source Selection Evaluation Board, which I was on. We had like 10 or 12 people that would take all the different pieces (design, construction, management, etc.) in and we'd argue and change things. Then it would go up to the SSAC, Source Selection Advisory Committee, which would make the recommendation to the selection official, which was Assistant Secretary of the Navy. He would make the decision, the final decision.

Kenyon
So that source selection, they held it pretty high then?

Andy
Oh yeah, yes. And it actually completed and they actually went with what they decided. During that, you could write what was called a Minority Report. I don't know if you remember the movie Minority Report. I wrote a Minority Report that I didn't like the conclusion of one of the sections. I can't remember exactly which on DDG. I wrote several on the Zumwalt. But on that one, I was the only one that wrote one. And you have to explain why you don't think it's right and what your data is. It is daunting to write

a minority report where you say that all the 50 or so people got the wrong answer, The lawyers who reviewed everything didn't like minority reports as they thought they would invoke protests from losing bidders. I remember the Assistant Secretary of the Navy called me in and said, "Hey, this is good." Because he liked my decision, I can't say more because that could be source selection sensitive.

Kenyon
Understand, even all these years later.

Andy
We had maybe 50 or 60 people and it was very sensitive on what you did.

You asked what was some of my favorite things in my career? Being on a source election. It's a rare time in your career when fort wo or three months, you've got all the data you need in that room. And you can ask specific questions to the shipbuilders and they'll come back with more data, but not a lot. And you're going to make a decision and it's an important one. And you know it's going to happen. And it's rare, especially in early-stage design, when you know something's going to happen because you do hundreds of designs before they actually decide on one. I enjoyed all my source elections. I was on four or five of them over my career. They were all a lot of fun. Very intense, a lot of hours, weekends.

We were always working there and I remember that warehouse was hotter than heck in there. The air conditioning was lousy. But it was a lot of fun. We selected Bath Ironworks at that time.

Bath had Gibbs and Cox as their detail designers. Bath didn't have a big engineering group. They maybe had only about 30 engineers, thus they didn't have the capacity do the detail design so they hired Gibbs, which was in New York.

And just a side story, one of the first meetings we had, Bath talked about how they had contractually, Gibbs well under control. And I remember Capt. Brian Perkinson (our Program Manager), and Brian said, I don't believe those yokels from Maine could ever put it off to those, I can't remember what he used for New York lawyers, you know, and put it over on them. And about three six months later, Bath was complaining, this contract we can't afford it anymore. Gibbs and Cox have got us such that they are making too much money, they basically put in an inflation clause that was great for BIW at the time but turned out to be terrible and great for Gibbs & Cox.

Kenyon
So that's another misunderstanding. I always thought Gibbs and Cox worked for the government.

Andy
No, no. They worked for BIW. Later they did jobs for the government, but at this point they were working for BIW, we'll talk about detail design, that was a fun time too.

I want to take a step back for a second because there's a Ship Designer in our office, Phil Simms, who's passed away, but he was an early stage ship designer and he understood ship design better than anybody I've ever known. He had a theory that when the government has a lot of money, they build ships. When they don't have a lot of money, and you can look at various administrations like under Carter there wasn't much money for ship building because it was a peace dividend. It's a lot cheaper to design ships than it is to build ships. They do lots of studies. "Okay, I want to develop a cheaper navy, you know, and so we'll do a thousand studies." The answer is really we're not building ships, we're not spending the big money. Once they get money, they said, "Okay, what's on the shelf? Let's build it." That administration that puts money in the Navy wants to see results, designs are not results, delivered ships are results. You can look at the budgets and times for the navy and say, "Okay, are they building or are they designing lots of ships?" So, we would get very busy during certain times for the early-stage guys and not so busy later on when they were just building.

Kenyon
Some people think that the Arleigh Burke really was a government in-house design and in some ways it was.

Andy
Well, yes, we did the preliminary contract design, which is about 100, 150 sheets of drawings, some of them are like 10 sheets long or so. And a ship spec, which is about 500 pages or so. That's the kind of the end of contract design as far as the ship's concerned.

The detailed design, which we're going to get into up at Gibs and Cox, turns those specs and drawings into 350,000 sheets of drawings. Okay. Now, some of those sheets, of drawings are like electrical connections. You know, there's 128 pin connector that goes to these different things and this is the way you connect up every cable and they're basically computer printouts. But all these 350,000 sheets define every nut and bolt and structure and pipe for the shipbuilder. Just to be clear these do not include vendor drawings, So the shipyard drawings for the Gas turbine might be 3 or 4 sheets (electrical, piping, foundation connections), but the hundreds of sheets of General Electric drawings to build the gas turbine are not in this count.

There's always an interest of mine, how many real drawings are there? There are about 100,000 sheets that you or I would look at and say, "This is a drawing." Even though an electrical list of a computer printout is called a drawing and has a drawing number, I don’t think of that as a drawing.

There's a lot of things that come out of detailed design. There's a lot more people, 300 or 400, 500 people doing drawings, a lot of draftsmen, a lot of engineers. And this was in New York. I forget the address. It's like 33rd Street. It's right near Penn Station.

Kenyon
In New York City?

Andy
Oh, it's right in downtown. Every couple of weeks, we would take the train out of Washington. I would get it at BWI Airport, which is 45 minutes from my home, and take the 6 a.m. train. We would get up there and start work about 8 o'clock because we could walk from the station to Gibbs & Cox office in about ten minutes or less. Then we would go up and have meetings all day and leave there at like three or four in the afternoon and come back and get home around seven or eight o'clock. We did that at least every month for three or four years.

Kenyon
That would have been 85?

Andy
It would be like late summer of '85, maybe, or September, up to about three years or so before we started going more to Bath. We did Bath in between there sometimes, but most of it was New York. They had a lot of these drawings, so there would be guys doing a fire main drawing and then other guys doing a seawater service drawing and it would be a structural drawing and there would be arrangement drawings and there would be cable drawings. And they would all interfere with one another.

They were trying to route in the same place, so they would have what they call priority routing areas. They would say, "Okay, this area is for piping. This area is for ventilation. This area is for cables." But everybody would ignore that to some extent. You would have a pipe running through a cable. They had light tables. This is a drawing table that's 20 or 30 feet long that has a light underneath, it's glass top. You would make these drawings on plastic with a pencil and you would lay one on top of the other.

I was, I don't know, 37 years old and this little old lady would call me over and say, "Andy, come over here." And I said, "Yes, ma'am, yes, ma'am." And she said, "Look at this." And you're seeing like 10 drawings on top of one another on a light table. She said, "You see this pipe is running through the vent?" And I said, "Yes, ma'am." There's no way I could see that.

A pipe is a one line. It doesn't look like a pipe. It's just one line of the drawing. And it has a dimension. And I think the way pipes are dimensioned, it was from the deck up, so it was like six feet, eight inches to the middle of the pipe. Ventilation, I think, is from the deck up to the bottom of the vent. Cableway is from the top down to the middle of the cableway. And then there'll be another dimension that says the cableway is two feet

wide by one foot deep. There's no way you could look at this drawing and tell what interfered with what, it's all two dimensional, laid on top of each other, trying to get three dimensions. Somehow, and it seemed be a bunch of old ladies that did it, they found many interferences. We found a lot more in construction that had been missed in design. These were more expensive to fix.

Kenyon
It goes back to my theory, that it was all these people that knew how to do their job.

Andy
They knew how to do it.

And they got a lot of interferences, but then a lot of interferences come in construction.

On Zumwalt everything was 3D and the computer would tell you this pipe interferes with this and you fix it in design. There were very few interferences in construction, but on Arleigh Burke there were hundreds (and that's being kind).

We wanted a lot of 3D computer-aided design as part of detailed design. Gibbs and Cox design goes back to Gibbs who designed the SS United States and a lot of the World War II destroyers, frigates and other landing craft, everything. They were pretty old fashioned and they knew how to do it and they weren't going have any young guys from NAVSEA tell them how to do it. They were not a fan of computer-aided design, so they let the piping guys do computer-aided design.

Computer Vision was the company that we used their software. A friend of mine, Dan Billingsley, was the computer guy at NAVSEA and he said it takes three things to make computer work. One, you have to have trained people that know what they're doing. Two, you have to have software capable of doing the job. And three, you have to have management that really wants it to happen. And we didn't have any of those three.

They couldn't find people. Gibbs was hiring people off the street to do drawings. They couldn't hire draftsmen and designers fast enough to pull off this job of hundreds and hundreds of people. We hired, I used to say everybody on the East Coast, but it included Pascagoula and EB up in Connecticut and down in Newport News. Newport News Shipbuilding were laying off people, so we got a lot of engineers from them. We're doing different structural drawings and piping and electrical. We had everybody, and trying to put this together, detailed design at Gibbs in New York, was a nightmare, let me tell you. Trying to get the details designed.

Kenyon
Somehow it got together.

Andy
Somehow it got together creating these 350,000 sheets of drawings. We did some CAD work on the piping, but not a lot. The computer vision wasn't up to the task. It couldn't handle all the data. And the management certainly didn't like it and the trained operators didn't know it. We ended up doing by hand a lot of the piping systems. You've noticed that there's a lot of pipes on ships. On Zumwalt, my first thing I did was I wrote a whole presentation called "I Hate Pipe." It was trying to get all the pipe off the ship because it interferes with everything. It interferes with firefighting. It interferes, it's unsafe if it breaks, if it leaks, all kinds of things. It makes noise. It's expensive. There's just so many bad things. But we did get rid of a lot of pipes.

Kenyon
But then you find places like down by the MRG where there's a 360 degree loop of pipe. Why that extra weight just sitting right there instead of one 90 degree bend.

Andy
Because they probably couldn't see it. There was some designer that needed to get done with his day's work. He had a deadline and he was short on time and he hadn't gotten to that piece and he just drew a loop and said, "Okay, it's got to have a little loop so it can expand and contract." So, yes, there were some, I used to use the word "cockamamie " things.

Later on, I became the Innovation manager on Zumwalt and my wife has the best quote, "There's a fine line between innovative and cockamamie." And I often was on the cockamamie side of things. Anyway, so we made it through Gibbs. Bath complained about Gibbs. Bath didn't like Gibbs.

Kenyon
But Bath hired Gibbs.

Andy
They hired them because they had nobody else.

Okay. Ingalls hired somebody, but Ingalls had a bigger design team of their own. I don't remember who Ingalls did. But Todd hired McMullen in New York. They were in California and they had McMullen in New York. One of the things in the source selection we said, "It'll never work." My quote that I wrote was, "You can't do design over the phone." And, you know, they were three hours apart. There were 3,000 miles. Bath was bad enough in that they were like a two-hour flight away or they could drive down. But it was a nightmare for Todd.

Kenyon
At some point we get to where we're starting to build it in the shipyard.

Andy
The ideal first thing is you like to have all your drawings done before you start construction. The problem is the design is behind schedule and you need to start for the shipbuilder to be paid on the start construction milestone. Say you had all your structural drawings but you were behind on piping and you build a structure but the piping goes through the structure. You've got to put holes. Then you're putting in the holes late instead of in the easy part when it's a flat plate laying in the steel outfitting building. Everything gets a lot more expensive, more disruptive. You don't like welding and cutting on the ship after delicate things like wiring, electrical and electronics are installed. You'd like to just have bolting fitting on the ship.

The drawings were not ready. They would get drawings for each section of the ship. Bath starts building near the middle on the bottom and they work up and out towards the end. They would get drawings done as they could. But it'd be structural drawings first and then the other drawings and then they would impact the structural drawings. So, the DDG-51's construction was terrible. They were ripping out whole sections that had to be redone. They were way over cost.

Let me go back to competing. When the shipyards compete on how much to charge for detailed design and construction. The year I worked at BIW (paid by Navy), I sat in on one of these sessions to set the bid price. You go through all the sections at the shipyard and at Gibbs and Cox. You say, "How much is it going to cost, how many man-hours is it going to take to do this job?" And then you say, "What's it going to take to win?" And they're completely different numbers. So, let's say it took six million man-hours to build and they said, you know, "We're not going to win with six million man-hours. We've got to bid four and a half million." That is one of the flaws in competition. You start with a plan that is flawed from the beginning.

We know it's six million because our estimators at NAVSEA are pretty good. And I'll tell you how good. And Bath do it with six million man-hours, but they bid four and a half. So that's what we're evaluating in the source election and we're saying, you know, they're never going to make it for this. They're starting out kind of behind the curve when they're starting out on day one doing the detailed design. They're cutting out things. They know when it's not going to work that they're going to go over.

But NAVSEA knows it's going to go over. There's a whole costing group at NAVSEA and there's an independent cost group outside of NAVSEA that checks on all the different Air Force and Army and everybody cost estimates. The cost estimate for the ship from NAVSEA and the CAIG [Cost Assessment Improvement Group] it was called - was 1.1 billion for the lead ship. And I think we came out to 1.106, which is like a dream. That's a dream come true. Because a lot of people run over by 30 percent, 50 percent, 100 percent, on some of these Air Force programs and even Navy programs.

But that was the estimate, not the contract. Contract was much lower than that. We knew it was going to go over and Bath knew, they would, go over and so we talked about the reduction gear. Early on the reduction gear was being done by GE up in Massachusetts. GE Lynn was designing the reduction gear and they found out that some of the dimensions were wrong and they needed to change it. And that changed some of the machinery arrangements. There's a big cooler behind the generator, just forward of the generator I think on the aft engine room. And it needed a change because the reduction gear encroached into it.

So, we wrote an ECP, Engineering Change Proposal. We wrote a lot of ECPs. But, I said to the program office, I said, "Look, you know, we screwed up. We changed this reduction year." And the reduction year was GFE, Government Furnished Equipment. And so, it was change to the Gibbs and Cox designers. And we said, "Yes, this is going to screw them up some and it'll cost them, a couple of weeks' worth of work and maybe, two million dollars or five million dollars." Well, they said, "We're going to blame a lot of the setback on because we know these guys underbid. So, they gave them something like $50 million and several months delay to it. And I said, "Fine, you know, I'll accept that." But yes, we did that kind of stuff.

Kenyon
But on the reduction gear, just for a minute, my memory was you needed it lighter, you needed it quieter, you needed it to hold more horsepower, you needed a lighter foundation. So in other words, it wasn't just grabbing a DD-963 reduction gear.

Andy
Oh, it was a completely new reduction year. And we had Racer on it. I can talk about Racer for a second.

Kenyon
You can still see the Racer pinion. And there was a rumor that even the U.S. industry had lost that technology for those hardened ground gears and we had to bring it back from Germany. So it's not just a reduction gear you're going to go …

Andy
The GE/Lynn guys, it was unusual. They hadn't designed one in a while. The U.S. was having problems with all their reduction years on other programs. And even much later than that, they're still having problems on reduction gears on the LCSs, there were lots of reduction gear problems. And you remember there was a fire on DDG-51 on trials in the reduction gear brake that we fixed. But that was minor.

Kenyon
Brian covered the Racer. So, we've already got the Racer side story.

[see CAPT Brian Perkinson oral history – page 23]

Andy
But yes, the reduction year was completely new. Noise was a big driver. Noise was a big driver all over the ship. That was a big, big deal on Arleigh Burke. It involved a lot of things. We had a requirement in the specs for what we call resilient pipe hangers. You remember there were some pipe hangers, simple ones that were a steel rod which came down with a steel ring around the pipe. Any noise in the pipe would go directly into the structure. Then you had ones with two arms coming off and a big rubber piece and a big steel foundation for that so that the pipe could vibrate and the structure wouldn't see the noise. The spec required that almost all the pipe hangers where the pipe is filled with water that flows would have these pipe hangers. The ones with air in the pipe weren't a big deal, but the water carried a lot of noise.

We had quiet equipment. We had a pump that was really quiet. And then we had a resilient piping system with a couple of pieces of hose in there so that any noise that was in the pump didn't get into the pipe because the pipe would be attached to the structure, which would go into the sea. And then we said the pipe's going to make noise because of the water flowing through the pipe. We need to isolate that from the sea, basically from the structure.

We were in a meeting and the Bath guy said, "We're going to have like a thousand resilient pipe hangers." And I said, "No, you won't you don't have a thousand. There's probably like 200 of them." Randy Fortune was at that meeting and he said to me, "Andy, you're willing to live with 200 of them?" And I said, "Yes." And so, we just, right there in a meeting, we changed from a thousand to 200, and it probably was a thousand if you put everyone on, but it turned out 200 was adequate.

I then had to figure out which 200 I wanted. We grabbed all of the acoustics guys and they were out at Annapolis Lab. Annapolis Lab used to be the machinery guys at that time. They moved to Philly and out to Carderock lab, when they closed the Annapolis Lab. We got a guy that said, "Hey, the pipes closest to the water, the biggest pipes with the most flowing water or fluid in them." We made a priority list and Bath went through it and they put the resilient hangers in those spots, and it worked pretty well. We saved a lot of money there and a big fight, but there were a lot of those negotiations.

We negotiated almost every item on the ship. That was in detailed design, I think. Yes, it was probably in the middle of detailed design. I'm trying to think of other things in detailed design.

At one point, Bath was way over on cost, building the ship. They're building the ship now. They're doing lots of changes, ripping out things. I think they were ripping out 50% of whatever they put in, which is terrible. Mostly this was design was still catching up to construction, they built to an earlier version of the drawing, it changed so the pipe they put in was the wrong design. And now the lead ship is like 1.1 billion. By the time you get to the third or fourth fall ship, they're like 600 million, 650.

There's a lot of learning curve on a ship. If you want to read and understand what is a learning curve, because it took me a little while to figure this out. It came out with Curtiss Aircraft when they were competing against the Wright brothers. And Curtiss figured out the learning curve, whole theory of it, and that's why he won a lot of contracts. The idea is every time you double the number of units, you go down a certain percent of the manhours. If the learning curve is 85%, you go down to 85% of the man hours. And so they found that even in egg production from chickens, they had after like 100 billion eggs, they were still going down the learning curve. So, between 100 billion and 200 billion, they would pull down the others. Everybody thinks it levels off. It doesn't level up. It keeps going down. But the number of units has to double.

When you get to 10 ships, it's got to be until 20 ships. It looks like it's flat, but it's never really flat. Anyway, so the first ship was going terribly and Bath Ironworks was almost ready to say, "Let's hang it up." And the president of Bath, and I'm trying to remember, was Bill Haggett.

Anyway, he said, "We're going to make it work." And I guess somebody in the government said, "We're going to pay you for it." And who that was Brian would know that kind of thing. But they basically all of a sudden went full bore and they got it done and it was a success and it saved the day. But there was a time there where they almost stopped and said, "Let's forget it."

Kenyon
But they said, "It's almost like somebody whispered to everyone, 'Forget the contract, make it work.'"

Andy
Yes. For us it was a miracle.

Kenyon
And you see that all the way through the delivery test and trial.

Andy
They laid that on the president of BIW who said, "We're going to make it work." And if it is really him, he saved it the whole day. He saved the world at that point. But I don't know whether somebody else was whispering, you know, Secretary of Navy or somebody. But it was probably a big thing, but they got together and made it work. Because I don't know if you remember in the CG-38 class with Rickover, they stopped production at Newport News several times and said, "We're not building this CG-41," because Rickover was such a pain on the details and the shipyard could basically stop. So anyway, they built it. It all came together. It went on the ways.

Now they launch on the land level facility. It's very dull. Launching a ship, going down the ways, I was a nervous wreck. There were all kinds of things that could go wrong.

Kenyon
It's quite a spectacle getting out there, beating on the wedges, raising it up.

Andy
I went out at like four in the morning and I think that was a nice one. I did it on the FFG-7s where it was 15 below zero. And you're banging in the wedges with sledgehammers and these big poles. You're basically lifting on the DDG about 6,000 tons of structure that you're lifting. And you're lifting it by hand by driving in these wedges and getting it onto the actual grease.

Kenyon
But we even had the Admiral and Bobby out there that morning. I don't know if he swung a hammer, but he was there.

Andy
I swung a hammer and I drove in the wedges and it was a very proud moment. But there had been FFGs that had been launched up there where, every once in a while, they would have an access hole in the side of the ship underwater and they would cover it with cardboard. Then the painters would come in and they'd paint over the bottom and it would look like it was steel. Then they would launch and water would pour in. They had extra checks at BMW trying to make sure that there were no holes in the ship. There were all kinds of QA going on, but it was still a nervous wreck. There were ships that they launched at BMW that got away from them and almost hit the bridge. There were all kinds of accidents and bad things that happened.

In Seattle on the FFG-7s they had the Seattle SAG they called it, they launched without the engines in because they couldn't put that much weight on the ways. The ship would actually bend going down the ways because it sees a lot of stress. They had a big hole in the middle of it to put the engines in afterwards. So, the ships from Seattle were actually curved.

We launched and it was a success. We got it over to the dock and then continued the outfitting. And it was an exciting time going up there, but there were lots of changes, lots of ECPs on the GFE as well as lessons learned as you put things together. Then we went on, up to trials.

Kenyon
You mentioned trials, I mean the reduction gears were a big issue in alpha trials.

Andy
Right. Let's go back before that. They can't have the sonar dome on when they launch. There's a big notch there in the front and there's some big steel brackets sticking out from the hull to be able to lift that sonar dome on when they put it in the dry dock in Portland. The first thing we took it down to Portland and the engine room is moving port

to starboard about a foot. The whole ship is vibrating like it's going out of style. What the hell did we do wrong?

It turns out that once they cut off those two little lifting brackets, which were above the water and the notch for the sonar dome didn't really affect it that much, but these two things were above the water and when it was going fast, the wave was over that. They would cause a vibration in the hull and the whole hull was vibrating port to starboard, you know, back and forth. And you could feel it absolutely in the engine room. It was one of my worst days, you know, thinking, "Oh, what did we screw up?" Then they put the sonar dome on and then I think that was when Arleigh Burke came on board for a ride can't remember whether he was on the trip down to Portland.

Kenyon
He was onboard the very first time we got underway.

Andy
They put a special elevator in for him and he was up on the bridge most of the time and they took the ship down to the fueling station just south of Bath and they dropped him off there with a few other dignitaries. And then we went off and ended up in Portland and then they hauled it out. While he was aboard, I had a copy of the book “Admiral Arleigh Burke” by E.B. Potter. I went up to the Bridge and he signed it. I still have it. He wrote “To Andy with great appreciation for all he has done and is doing for our wonderful Navy. Arleigh Burke at sea under it.” It is one of my cherished possessions.

I'm not a great lover of heights, but I can deal with it, but they took me up to the top of the mast to look out. While the ship was on the dry dock. You could see half of Maine from there. You are way the heck up. That was not one of my favorite moments.

But we should talk about the mast some. That happened in detail design. If you look at the contract drawings, they all have a three-legged mast, kind of conventional, like the CG-47s. And much to my surprise, somebody at Gibbs came up with this mast design and said, "We can make it work and fit most of the antennas where you want them" Because the government specs had all those antennas and you were allowed to make a modification up to a certain number of inches. They made it almost work and I was pretty skeptical at first, but I got to love that mast and it's a big part of the ship. It really makes the Arleigh Burke look a lot better.

Kenyon
John Ingram covered that in his interview. He said that, you know, you can go to any port and you know where the Arleigh Burke is and it makes it look moving even when it is sitting on the pier.

[See Capt John Ingram oral history – page 11]

Andy
It's a big, big deal on the hull design. It's fantastic. And the fact that it's enclosed and safer, you can walk up inside it to the top, and instead of being outside with ropes and a safety harness on you, it's a lot safer and there's other advantages as well.

The mast is aluminum and the deck house is steel. There's a big joint where the aluminum meets the steel and we've spent a lot of time getting that right. There's some bimetallic material in there where you explosively bond aluminum to steel and you can do that and but it isn't that strong. You actually have a tri-metallic bond. It goes aluminum to some metal to steel. Then you can weld to both sides of it. And then there's some bolting for strength, with the trimetallic strip being there for EMI (electro-magnetic interference). Anyway, we got it to work and I haven't heard anything about it. My guess is it's still working. But you know, it may have gone bad after years. The mast is aluminum and there's not much aluminum on the DDG-51 and that's one of the pieces. But that's [the mast] fantastic. They did that at Gibbs in detail design. We finally approved it and we got together and said, "Yes, you can do it." So ECP, we tweaked it, they didn't get a lot of money but they got some.

Kenyon
Brian covered some of that in his interview and then Kristin said that was one of the first things she was working on up there at the shipyard.

[see CAPT Brian Perkinson oral history – page 9]

Andy
Who was the most unrecognized heroes? So very early, before preliminary design, we were still trying to figure out what this ship looked like and we were doing studies like it was going out of style. And at that time, the DD-963s and the CG-47 had the waste heat boilers on them. They had lots of steam. We did studies on waste heat boilers versus auxiliary boilers, donkey boilers, they call them, and all electric. And the donkey boiler came out as kind of the best.

Vice Admiral James H Webber was the vice chief of NAVSEA at the time. He came out at the meeting and said, we are not having steam on this ship. When all the studies showed that steam was pretty efficient, but he just considered all the other things that steam drives, which is extra piping, and lots of extra maintenance, and all kinds of problems. It isn't all about efficiency. So we don't have steam. I think that was one of the great decisions that he forced. And this was probably in the 1982 time frame. We used to have meetings with him monthly. And he would come in on Saturdays. We'd have 20 of us there on a Saturday. He'd be wearing a checkered shirt. And we're all dressed down and besides being a Saturday, it was an exciting time.

Kenyon
But the camel tried to stick his nose back into the tent with Racer.

Andy
Well, Racer was a weird steam. It was a self-contained steam. And what I liked about Racer, although I didn't love it, was that you could run both shafts on one gas turbine. Steam being the crossover. And Zumwalt, we finally did that with electric drive. But we couldn't do that any other way. We looked at electric cross connects for years on Arleigh Burkes. Putting a small generator on that Racer pinion and putting another generator on the other one and running 5,000 horsepower over from one to the other. Because you don't want to drag a shaft if you're worried about making noise. Then you run two gas turbines, you're eating fuel like it's going out of style. Gas turbines hate low power from a fuel standpoint.

Kenyon
What do you think was the biggest success in what you did for Arleigh Burke? What's the thing you're most proud of?

Andy
I'm proud of that we got a ship built. It's not easy, a new class. The Navy needs new classes. They shouldn't just keep building the same one, even though we built 100 of these. I'm not sure that's a great idea. I'm a fan of some diversity in the Navy. And that if there is a vulnerability to the Arleigh Burke class, it's the whole fleet of destroyers gets the vulnerability. It's nice to have different kinds of ships. You shouldn't build 100 of every one. You should build 20 or 30 and then start a new class. I was very excited that we got a new class, which is very difficult because there's a lot of up front costs. Hundreds of millions of dollars, probably billions now.

Kenyon
You've described a lot of challenges so far. Is there any one you would identify as the biggest challenge?

Andy
I think the detail design and construction without CAD was just a nightmare. That whole thing was a challenge to hire those people, train those people, get them to work on the same thing and then try to design something as complex as the Arleigh Burke and then get it built efficiently. It wasn't built efficiently on the lead ship. We didn't do very well. That was probably the biggest challenge overall, more than any of the early-stage design, those we could do.

Kenyon
What did you enjoy most?

Andy
I think some of the source selections were the most fun. Trials were fun, running all over the ship and seeing it work. Those are a lot of fun. I like to argue. You may actually have noticed.

Kenyon
I'm laughing because I'm thinking that for most anyone who's worked acquisition source selection is right below poking yourself in the eye with a pencil.

Andy
I love the interaction. I love those meetings with Randy Fortune where we argued all the time. In fact, I tell people I hated sitting at my desk and doing work. I love to be in meetings.

Once early on for Zumwalt, we brought in an expert from the auto industry about efficiencies. He had written several books and he talked about, the things you want are things that end in “ation”. You want survivability, abilities. You want lots of ‘ilities’. Things that end with ‘ing’ are things that cost you. And you want to minimize those, painting, welding, fitting etc. He called those the evil INGs. So anything with ING costs you. And he said the worst evil ING is meeting. And then Captain Syring, or Commander Syring at the time, I said Syr ING because he was our commander. He was a production manager. Anyway, but that was the joke. But yes, the evil INGs.

Kenyon
I could have used the ING thing back when I worked with the missile defense agency.

Andy
Tell him about evil INGs. He'd know about those.

Kenyon
How about most irritating or frustrating?

Andy
Well, the most irritating thing was that reducing the beam two feet and losing the non-compensated, or clean ballast system. That drove me wild for a while. I was just so disappointed. Most of the other things, the two anchors and one windlass, that was not a big deal. You could shift chains. I don't know if you've ever had to personally shift the chain, but that's not easy. Those chains are heavy. We made all those works. I would say the two feet of beam was the one.

A side story on that. So I helped with the Japanese Kongo class. They sent me over to Japan once for Brian Perkinson. I blame him for this. They wanted somebody to go over to there and kind of sell the design of the Arleigh Burke because they were going to design it and build their own, but then buy AEGIS. We're trying to do American sales. They said, "Andy, would you go?" And I'd say, "I'd love to go." Brian said, "You have to be back by Friday." I had pissed Brian off that week on another subject on frequency changers.

I went over on Sunday and it came back on Thursday. I went to work on Friday and then was sick for like three days. I had a great time in Japan and Tokyo at that time. Then I

went back for another trip. I told them like three or four things to do that I thought were wrong with Arleigh Burke. This is kind of your question.

I said, "It's too short." They said, "How much should we extend it?" I said, "About 40 feet." They did. They extended it 40 feet zero inches.

I said, "It needs to have two more feet of beam and it needs to have a clean ballast." It's two feet more beam and clean ballast. In fact, sometimes I joke, they're the only ones that ever listened to me.

I said, "The AEGIS faces, put those up, make it two decks high, put the pilot house up another deck." And because they had the two feet of beam, they could do that.

PMS 400 had a foreign military sales office and they were building the fourth Kongo class at IHI, in Tokyo, where the first three were built at MHI in Nagasaki. You've been to Ingalls and you've been to Bath. You can put Bath in Ingalls and you could never find it - it's giant. You could put Ingalls in MHI in Nagasaki and never find it. This is the biggest shipyard I've ever seen in the world. It's tremendous. But IHI in Tokyo makes Bath look gigantic. It's right in the middle of the city. They don't build any piping in IHI. It's all out to local vendors. Bath has a big pipe shop and many other shops. None of that. They don't build a single thing themselves and it all comes together.

PMS 400 foreign military sales was concerned that they'd have issues with the fourth ship because they were putting AEGIS on it. I went over to evaluate whether they could build the fourth ship.

I went down to MHI afterwards to understand how the design worked. And that's where I got lots of data. And I went out on a sea trial on the Kongo and they had the big bath tubs, the soaking tubs that the Japanese have. There's a bunch of those on the ship and they all take their shoes off when they go into CIC. A very, very interesting ship. Beautifully done.

Those were the things I told them, you know, wider, longer, and go up a deck with the three big things I changed in the design.

Kenyon
So that leads to a couple of other questions. The relationship between the program office, NAVSEA and the ship builder. You sort of have this division of who's doing what, who's making technical decisions, and how did you work with Brian and Randy? And you mentioned some of the Randy and Andy show.

Andy
Right, so we argued a lot, but I think he respected me. I certainly respected him. Randy was very smart. He was obnoxious, but so am I. And Randy had, and maybe Brian told

you this statement. He's had a statement. He said, "Never bring an engineer to a budget meeting. Under pressure, they tell the truth."

Kenyon
(laughing) - I think the list of people who hasn't argued with Randy might be short.

Andy
Yes. We got along well, because Randy was the only program office person at Airport Plaza when we did the preliminary and contract design. He was their rep, and then he stayed with the program all the way through till a bunch of ships I left after, partway through the second ship (DDG-52). And we met, we worked with Commander Roughhead and Captain Morgan, who were like absolute opposites. You know Morgan well. I don't know if you know Roughhead very well, but Roughhead is the nicest guy you've ever met. And he's so brilliant. And you want to do things for him. Even if he doesn't ask, you want to do things for him. And Morgan, you want to fight him at every step, but also brilliant.

One of the things I've lost big on Arleigh Burke - there's a requirement for navigation lights. You're supposed to have a forward navigation light that's over one third of the length of the ship from the other one to show that it's a big ship. And it's supposed to be, I think 10 meters above the longest continuous deck, which is the main deck on Burke.

Kenyon
And you put it on the bow sprit.

Andy
Yeah, I put it right up at the bow and it was 30 feet above the main deck or about 20 feet high on the 01-level weather deck. That was the requirement. The Arleigh Burke is low radar cross section, low noise, low everything. If you're another ship at night in peace time, you know, you can't see it well. Or you'll think it's a little ship and the lights the way they ended up, you'll think it's a little ship from the lights. You'll think it's a little tugboat or something like that, a fishing boat. You'll think it can maneuver in 50 feet. Well, Arleigh Burke can't maneuver in 50 feet. You might get in trouble.

My boss in '05 said, because Perkerson didn't want it. And Lockheed Martin said, it's will screw up AEGIS, which I don't think was true. There's a wire going up this pole (to light the bulb at the top, and the wire's at an angle. And so that way it doesn't screw up AEGIS. But the Commanding officer kind of guys don't like a light in front of their face. That was the biggest issue. But that's the law of the sea.

There's a Coast Guard guy in the Pentagon who was in charge of the Navy meeting all those requirements or not meeting and giving waivers. We went to talk to him and I sat down with him with a bunch of the others and he didn't buy it. He agreed with Perkerson and they said, "You got a waiver." So, the Arleigh Burkes definitely doesn't meet the rules of the road.

Kenyon
I remember that argument early on.

Andy
Right, and Morgan was pissed with me for doing it. And he yelled at me and said, "Andy, you don't know what you're doing." So, but yes, that was one of my other big losses. I had a bunch of losses, but that was one of them.

Kenyon
This was really the first ship that was after Falklands and had lots of these damage control. I remember survivability, damage control, and you haven't mentioned collective protection system, but there's a lot of this stuff that really came together in Arleigh Burke My first ship, I remember they had to come back and put steel beams in to hopefully stop the cables from falling in the aluminum superstructure. But you all had a chance to make a lot of these changes.

Andy
Yes. A lot of that came in and CPS (collective protection System), we had a lot of arguments on whether the engine rooms were part of it. We got it down to most of the ship is under CPS, but not all of it. We had full mock-ups of the stations where you come in and you undress and you get washed off. I remember going through those. The doors, so there was a big problem on the LHD, I think was a little ahead of Arleigh Burke. And they had a CPS system.

Kenyon
A partial system?

Andy
They had a partial system. The CPS pressurizes the ship that's protected, when you go from the pressurized space to the unpressured space there is a force of hundred pounds pushing the door open, But the problem was a guy would open the door. You generally open the door with your right hand, and your left hand could be carrying something. The door swings open and hits you in the face. It turned out to be a problem. There's a lot of pressure on that door. It's two inches of water pressure from CPS. If you add that over the whole square foot of the door, it's hundreds of pounds of force. That door will swing. We had to figure out how to stop it. In a way that was easy to use and inexpensive.

We had all kinds of designs. I had little mock-ups in my basement. I was building little models. We had a guy working for me that was a human factors kind of engineer. We basically ended up with the thing that looks like a barn door handle. It allows the door to open about an inch and then it hits a stop. Then the pressure is relieved. You can then hit it with your finger and it won't swing anymore unless the ship's rolling. It worked.

Bath design it, I gave them the requirements. They designed the actual handle and put it on all the doors. I think it's still there on all the ships. That was my door design.

CIC has got a passageway outboard of it. That's for survivability, on either side. Missiles come in and they'll explode right there that's called spaced armor. And the second bulkhead will stop a lot of the fragments.

Kenyon
You all moved a lot of stuff out of the superstructure down, radio central, radar rooms, CIC.

Andy
Remember we wanted to make the superstructure smaller because it was steel and it's got a big impact because it's up high. You want to make it smaller. The CIC moving down with survivability - 100%. Very early decision to move CIC down. They tried to put survivability on the Ticos and there's a little bit of extra aluminum around the CIC up there but it was pretty negligible. Arleigh Burke, the CIC is protected pretty well. We were very happy on that.

The rule in survivability is if you've got redundancy, separate things as far as possible. If you get a hit, it only knocks out half of it. And if it's not redundant, put it all in one place. The comm center, CIC, either one of those, you knock out, you're pretty bad off. And a lot of the AEGIS power supplies are all in that stack. It's a small area of the ship that you have to hit to really do damage to the combat system.

Kenyon
And that's the most protected area.

Andy
And that's the most protected and it's all together. Because we couldn't separate, we didn't have redundancy. And redundancy generally costs you money because you have to put two of them in instead of one. So better to co-locate it.

Kenyon
I recall actually there was a small alternate CIC early on and that went away. There were three consoles that went back in an aft room.

Andy
We did that on Zumwalt. But had to give it up on Burke.

Kenyon
Eventually that vanished from the design.

Andy
Yes, I can't remember when it vanished, but it did vanish, yes.

Kenyon
This was very different topic. And this is actually where I think I first encountered you. Arleigh Burke was the first ship designed after the new maritime pollution requirements. You've already mentioned the compensated fuel, but this is the first time we really had to deal with plastic waste and trash.

[MarPol Annex V Prevention of Pollution by Garbage from Ships (entered into force 31 December 1988) – complete ban on plastics.]

Andy
I'm trying to look around. I used to have a clock made of the plastic waste disks. You made those disks.

Kenyon
And I think I met you first around trying to contemplate whether or not this plastic melter was going to work.

Andy
Right, and that was all done here in Annapolis. The Annapolis lab that is no longer there was the center for all the pollution equipment. My son worked there one summer as a summer job. I'm trying to remember the guy's name, was just brilliant and was a great salesman. But first there was the trash compactor for the regular trash. And he said, "It's the only piece of machinery that the guy whose operating tries to break it, because if he breaks it, he doesn't have to do trash duty." So, he took a four by four and threw it in this machine and then slammed the door on it, trying to get it closed, and was kicking it with his feet and finally got the four by four into it. And then the machine, it was a titanium casting and it would just crunch that four by four into nothing. I said, "You cannot break this machine." And there's only like two buttons. You press them both at the same time. No matter what you do, you can't get it to screw up. They designed that.

Then they did the plastic waste processor. Then they had a shredder, which put in water and took paper and turned it out like mashed potatoes and would send it overboard. Not for security reasons, it wasn't the secret shredder, but it was just for paper waste. And then there was oil. We were trying to do oil treatments. We had oil water separators and we had lots of other equipment for environmental. We had a whole environmental trash room and it's still there, I think. I don't know what's in it now. Be interesting to know. I haven't looked in like 15 to 20 years.

Kenyon
The rules have not gotten easier.

Andy
Yeah. And most of it was working. We had some problems with some things, but we had trash chutes to go down and get the trash to the trash room. And we had lots of layouts in the room to try to make sure it was right.

Do you remember in the crews mess the ice machine with the little cubelets? It was a big thing. Sailors have to have lots of ice. In fact, food is very sacred to the Navy. Some people say it's what separates the Navy from the Army, that you get a real good hot meal. They take it very seriously. We had ice machines that were screwed up. We investigated all kinds of ice machines and we got these, they were called cubelets. They're little, they're 3/8 of an inch cubed size, but they freeze faster, you get it faster. We put those in. We had every item on the ship was fought over and discussed.

Kenyon
I want to go back to the trash room. I thought it was in the trash room; you taught me the three biggest lies in the Navy. You haven't mentioned those. “Rust proof, waterproof, and Sailor proof.” I've always attributed that to you.

Andy
I don't think that was me. I like it.

Kenyon
I've been saying for 32 years that Andy Summers taught me the three biggest lies in the Navy, rust proof, waterproof, and Sailor proof. Because it was that machine that you tried to make sailor proof.

Andy
I probably told you that he told us that it's the only machine on board that the people operating it try to break.

Kenyon
I remember when you come down to the ship, and it's the first time in my experience where somebody could actually tell you why something was the way it was on ship. That was a great part for us sailors aboard the ship to actually understand the why behind anything.

Andy
And I had been there from the very start, so I knew why the ship had its length and beam all the way down to every component.

Kenyon
The problem was is that the first person that would get you would always be the master chief boatswain mate. And we'd have to rescue you from him because I remember him dragging you around to fueling stations and all his other equipment.

Andy
Deep down inside, I'm a mechanical engineer and I love mechanical systems. I spent a lot of time on Zumwalt on them. Because we tried to revolutionize all that.

Kenyon
He dragged you to the fuel station, then he dragged you up and talked about every time about one anchor, one less versus two.

Andy
They got rid of the second anchor eventually.

Kenyon
I did not know that.

[Second anchor is deleted on Flight 3s]

Andy
To save more weight. I don't think it was cost because it's not very expensive, but they save weight. The chain is heavy. There are two chains.

Kenyon
I never did that wrangling expedition trying to move one over.

Andy
Each of those links is, I remember maybe 180 pounds. They're heavy.

Just one more anchor story. We were in design and the NAVSEA tech code did an analysis that said the anchors were too small. They have a current and a wind speed and the anchor weight comes from that. I looked at past ships, our anchors are bigger than CGN 38 class. There was a meeting with the higher ups and I sent them a poem by Shel Silverstein that has a line “my anchors too big for our ship” that my kids were reading. It shows a small boat with a giant anchor tipping it over in a cartoon next to the poem. In the meeting they saw it and bought my analysis that the present anchors were adequate and need not be bigger was good. We didn’t use the bigger anchors.

Kenyon
Are there any design firsts that we've forgotten to talk about?

Andy
Our direction was to have as few firsts as possible. They wanted reliability, proven equipment and designs. The survivability design has lots of firsts, but it's not risky. From a machinery standpoint, we were using the standard coolers, the standard frequency changers. Everything was pretty standard. Solid state frequency converters. You still had 400 hertz on the ship. We got rid of that later, but that was bad stuff. All those converters.

We had bleed air from the gas turbine.

Kenyon
You kept threatening to get rid of it. They were threatening to get rid of it at that time.

Andy
Yeah, we never did, never came close.

We had a choice of propellers and shafting when we were in contract design between 40,000 horsepower, which is what's on the DD-963s & CG-47s, and 50,000 that we wanted on Burke. And we always felt the speed requirement was really, we needed to make 31 knots just because of his nickname, 31 knot Burke.

Kenyon
But that [31 knots] was not a TLR requirement?

Andy
Not a requirement at all, never written down, no. It turned out the propeller hub, which is where all the meat is, is actually able to go to 50,000 horsepower on the DD-963s. The blades are not designed for it. The shafting isn't designed for it. We tried to push to go to 50,000 because it was cheap. It's basically a bunch of metal. They didn't want to do it. So, they said, let's make it part of the source selection. We'll get two proposals. We'll get a proposal from each of the shipbuilders and see the extra cost to do the 50,000. And the cost came out negligible that we expected. And we did do 50,000. They made that change to put that into the spec, which was good.

Kenyon
But not known is quietly GE, just keeps upgrading those engines. So that now what we call an LM2500, if you buy one today, probably is almost double the original horse power.

Andy
Now I haven't worked with an LM2500 since 1992 or so, because we were doing the European ones, Rolls Royce ones on Zumwalt.

Kenyon
You talk about reliability. Last year, I believe it was, they changed out one of the original LM2500's on the Arleigh Burke. 31 years, that LM2500 was still going and I believe there was one still remaining. There were some angsts over those LM2500's earlier, but...

Andy
Putting the rails and other support equipment in, we spent a lot of time making sure that the hot section of the gas turbines can go up the intakes and come out, and they're

supposed to be able to do it at a shipyard overseas in the Med in Italy. And they can, but it's not easy getting that hot section out. And that was a lot of effort.

Kenyon
What would you do different?

Andy
I would have made it longer and wider. Those are the two easiest ones.

Maybe higher, the two decks, the thing in the pilot house with the AEGIS sticking in, it's not bad. That actually worked out fine. But the beam with the fuel system, that I would change in a moment and making it longer.

I think it was in detailed design. NAVSEA had severe structural cracking of the CG-47s. Part of it was that the VLS had been installed with hard corners instead of big rounded corners. The ship is constantly bending fore and aft, like a big beam. After a while it fatigues and gets cracked. They were worried about the whole hull going. They put what we call the worst-case solution for a Naval architect - doubler plates on the outside of the CG-47. These are big three-quarter inch thick plates that are welded and bolted to the outside of the hull, fore and aft to keep the whole hull from cracking. Additionally, there were a bunch of changes made to VLS. We stuck a lot of those in, but in the early detailed design, we analyzed the ship and there were some problems back aft near the aft VLS that were going to be iffy.

PMS-400 wanted to do it because it was still in design - which of course is the cheapest way to do things by about a thousand times than back-fit anything. We beefed up the structure in the O-1 level in the main deck back near the aft VLS. That was another lesson learned from the Ticos. They were having all kinds of problems with beefing up and they couldn't take a lot of weight.

So, I could tell a little story that's off color you won't include

They had the TOTS program, which was Take Off Tons Sensibly. This was a big CG-47 program. They were right next to us on the fifth floor in NC-2 in crystal city… And so Randy Fortune decided to have a DDG-51 version of this.

So he called it [deleted]. So, and then he sent me an official Navy letter saying, "Andy, we've designated you head [deleted] or short [deleted] head."

I still have that letter.

We never actually had to take weight away top side. But they went to every component on the ship because they were way overweight.

We actually delivered right where we were supposed to, which is another amazing feat.

The fact that it cost what we said it was going to cost, the fact that it weighed what we said it would, the fact that it actually worked, is for the US Navy not easy on new ships.

You could see there's still problems, new carriers, LCSs and other ships, all kinds of problems. New classes are tough, really tough. And a lot of these guys that work the 25th ship and they're tweaking things; it's not that much risk. But when you're on the new ship, everything's a risk. Even the stuff that's simple, like four LM-2500s and two shafts, it's been around for 20 years at that point. It still was different. We had tweaked everything. Reduction years were different. The shafting was different. The stern tubes were different, everything.

Kenyon
I think that maybe there's something misunderstood too there. I mean, it worked, but we also had some kinks.

Andy
Well, we had a lot of work to do at PSA and they're still doing overhauls.

Kenyon
When we put the ship in the water, is not the point you measure it. You measure it when you're ready for OT (operational trials) - you've now actually been able to work some of those early kinks out of it. Because there were some kinks.

Andy
Right. By the way, talking about a kink, so it wasn't Alpha Bravo or Charlie Trial, but after delivery, we go on what we call CSSQT [Combat Systems Ship Qualification Trials]. I got to go on a couple of C-squats, which was really neat. They're down in the Caribbean and you're actually shooting missiles. We shot a harpoon at a boat that was remotely piloted and it comes back right away. We missed. This is the worst thing you can happen. You have a brand-new ship and you missed.

Well, it turns out it went in one door of the bridge and went out the other side. And they couldn't find the hole until it got in close. So, it actually hit perfectly. So that was one funny one.

The other sea story - DDG-51 was held back. You were on this trip with the carrier. It was supposed to deploy to Europe. And the carrier was held back because President Clinton was going down to the carrier to do some kind of ceremony. They held the carrier up and they needed one combatant to go with it. Arleigh Burke went over across the Atlantic. If you ever read the book, "The Perfect Storm," they talk about this perfect storm. They said there was a Halloween storm a year or two later that was almost as bad. That's when the Arleigh Burke and the carrier went across.

[See post on DDG51.org titled “Rough Seas.”]

We get messages from the carrier. I'm working on flight 2A at the time. Arleigh Burke had some of the tanks up forward destroyed. They lost some lifeboats. So, I'm saying, oh, this is a disaster. You know, I designed the ship wrong. It's not strong enough to handle the waves because it hit one heck of a storm.

Then I read about the carrier, the sponson was partly opened up and ripped off. And I said, we're okay. We fixed all that. We beefed up the stiffeners up in the bow. There were higher loads than any of our model tests or calculations had expected. Some of the stiffeners had rolled. What happens on the stiffeners, it doesn't break. It just rolls over to the side. Loss of the lifeboats are something that almost naturally happens if you get a strong storm, they get ripped off. And a few other things, but it wasn't much. We did a bunch of analysis. We beefed up some things in the follow-up ships.

The other thing that happened - one of the ships was over near Japan. It turned out if you slammed hard, the water went around the sonar dome and then hit the two sides of the ship with much more pressure than anybody had estimated. We tried to model test it; we couldn't get the numbers they were getting. So, we back calculated and said, if we wanted to break the steel like that, it had to be this pressure. We could never generate it in that lab, but we beefed up all the ships after that, right in that area, and made that a new requirement in the structural design loads.

Just a side note on ship structural design. Design is straightforward if you knew the loads, then different analysis techniques will tell you if the structure is adequate. The problem is the loads are difficult to determine, with mode tests or seaway analysis. This is always the weak link.

Kenyon
Did you have much interaction with Admiral Burke at all or just seeing him at the design review, occasional design designs?

Andy
I met him a couple of times on design, he signed my books. I don't think I've ever talked to him for more than two minutes or so. So no, the answer is no. I know that Perkinson went down a lot to meet him and talk to him, which I thought was wonderful, but I just was either too busy or too lazy to do it.

Kenyon
Any other leadership that we haven't talked about, Admiral Nyquist, Admiral Meinig, any of those that you have any observations on?

Andy
We had in the design team during contract design - Commander Baskerville and Captain Fee, who was one of the calmest guys ever. He had been a diver. We don't usually deal with a lot of divers, but we had one later in Zumwalt, Capt. Fee he had

helped clear the mines in the Suez Canal when they did that in the 1960s or 70s. And at one meeting, we were having the reading sessions and he got a call from someone and, it went away from whatever he expected. He took the phone; he threw it against the wall and everybody in the room stopped cause this guy never raised his voice. He was the, almost the perfect captain you'd want, just super solid guy. And this throwing the phone was just so unexpected, but that was the story with him, but he was great. I loved him.

Corky Graham is just awesome. You should definitely interview Corky Graham.

Kenyon
I've got his name on the list.

Andy
And he lived on a boat for a while so you can relate to him. I think when he was at Newport News, very early in his career. And then, likely several of the guys have passed away.

Kenyon
That's unfortunate we're doing this too late. Just one more question, we'll wrap it up for this session.

I know you think some things could have been done better, but it's pretty much an unqualified success. What's it like seeing something go from paper to then dealing with us obstreperous sailors that have to operate it and then looking back and seeing we're still building at 90 going to 100?

Andy
Well, you feel very proud and people think you're great, but I don't think I feel that great. There are a lot of other people that saved my ass in a number of areas and that's probably more why it's successful, but I did have a lot of impact so I feel good about that. As I told you before, staying with the design from beginning to end and knowing that anything that's wrong when you get to contract, get to detailed design and construction is partly your fault because I was there, is a little unnerving. You go a little nutty. It was good that I can remember why we initially did things, but it's hard. It's very few people that start, go from beginning to end. I consider myself very lucky that they left me in that one spot.

Kenyon
So, I used to call myself the Kevin Bacon of AEGIS BMD because you could blame any problem on me in less than six steps. So, you're the Kevin Bacon --

Andy
Yeah, it was like one step. You could blame it on me. I signed the specs, so I was one of two signatures on the specs. I signed the drawings, you know, so if there was somebody who was responsible, it was me. There's a lot of things went wrong. Every

ECP is basically something that went wrong as opposed to a real improvement. And there was a lot of money in that. On the other hand, we delivered what we said it would from the history of all the cost estimated groups. So that was great.

And I'm glad I had all that because going into Zumwalt, it was all about brand new, taking large risks. It was a very different philosophy. Everything that I learned on Arleigh Burke was valuable in Zumwalt where I was in charge of a lot of the design. We had the contractors do it, but I helped set the length and the beam and about a thousand other components in it. That's sad that that didn't get more ships built, but that's another thing, politics.

Kenyon
I would argue, if you look at, this is sort of off what we talked about. If you look between Arleigh Burke and Zumwalt, one's a Swiss army knife, one is a very specialized tool. And many times, it turns out the Swiss army knife is, even though it's not overly specialized for any one thing other than ASW maybe, that the generalization is what's kept it useful.

Andy
I agree a hundred percent. You know, we used to talk about building various ships for specific missions. In fact, when I was over in England, this is a big thing in Britain, they have ASW frigates, they have Air Warfare frigates. And I said, "It really doesn't work." Because if you have any vulnerability in a ship, they will exploit it. That's what the other guys do. And that's their job. And so, you have to be pretty good at everything.

The FFG-7 had the dilemma that it wasn't very good at anything, but that's another issue. I was always a proponent of destroyers and I was always a proponent that you had to do everything pretty well because if you didn't do something, they would exploit that. And you were immediately going to be gone.

Now the Zumwalt was trying to get near the coast, which is not where the Navy wants to play. You want to play out in the blue water and the deep water, and you don't want to be anywhere near the coast. And it's a very tough environment and it drives the requirements like crazy. And the stealth was big and it costs a lot of money. But we did it. But yes, so you need to be a jack of all trades or you will be destroyed.

Kenyon
Thank you, Andy.

Andy
Thank you.

Kenyon, you have asked me great questions, I said more than I ever expected to say. Also thank you for being part of the Burke's first crew. You were one of my friends. Learned a lot from you that I put into the ships I went on to work. Capt. Morgan was

lucky to have you. I had not interacted with Navy Sailors much. Just Engineering Duty officers on shore assignment, who were great.

But I was so impressed with all the crew members as I got to know them. Our ships need sailors like that.

