



**Oral History Interview Transcript**

**Interview Control Number: 6-C7 Mustard**

**Interviewee: Robert G. Mustard**

**Interviewers: Tony Thatcher and Pat Barnhouse**

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## **Transcription of Interview Number 6-C7 Mustard**

**Robert G. Mustard**

**Interviewed 13 June, 2006**

**By Tony Thatcher and Pat Barnhouse**

This is a CANDIB Oral History Project interview with Bob Mustard that was recorded in Ottawa on Tuesday the 13<sup>th</sup> of June, 2006. The interviewers are Tony Thatcher and Pat Barnhouse. We have signed the copyright release for this interview.

The subject of this interview is the development of several anti-submarine warfare equipments during the latter 1970s and their involvement with Canadian industry. The particular equipments are the active sonars, the [AN/] SQS-505 and the [AN/] SQS-510, the underwater telephone, sonobuoys and the advanced signal processor, the ASP, and CANTASS, the Canadian Towed Array Sonar System. Also, the events leading up to the purchase of the ASWDS, the Anti-submarine Warfare Data System from Holland, for the [DDH] 280 class during the late 1960s, is described.

Bob Mustard had an extensive career with the Canadian Navy and Department of National Defence and the Department of Supply and Services (DSS), now known as the Public Works and Government Services Canada, as well as industry. Bob was directly involved with these projects and their development in industry during his time in the government. I will now ask Bob to introduce himself and describe his career as it relates to these projects.

MUSTARD: My name is Bob Mustard I'm a retired Commander in the Canadian Navy. The relevant background for this is that when I was at sea I was a weapons officer on several ships, and between 1973 and 1976 I was on exchange with the Royal Navy where I did ASW related projects – mostly with submarines. When I came back to Canada in 1976, between 1976 and 1980, I was in DMCS 3, which was the underwater section in DMCS [Directorate of Maritime Combat Systems, National Defence Headquarters] and that's where most of these projects took place. I was the Deputy Section head and for a period of time I was the only naval officer besides the Commander in the section, and I was a very busy boy running about 12 different projects. When I arrived in DMCS 3 we were just in the early stages of getting approval to go ahead with the CANTASS Towed Array Sonar System and the Advanced Signal Processor. Between Chief of Research and Development and DMCS 3 we produced a paper "*Sonar the Way Ahead*" which was approved by the Chief of Research and Development, by the Chief of Engineering and Maintenance [and] Chief of Maritime Doctrine and Operations, which essentially gave us approval to go ahead and do a number of developments.

At that time the SQS-505 sonar was the active sonar for the hull-mounted sonars and for the VDS. We were then looking forward to develop a 510, we replace underwater telephones and we were intending to use the advanced signal processor as the basis of some of these systems. Of course one that is dear and near to my heart I was the first project manager was the CANTASS which is the Canadian Towed Array Sonar System. Also at around this time the DND decided to designate certain industries in Canada as Centres of Technical Excellence. For the purpose of this discussion, Westinghouse was the Centre of Technical Excellence for active

sonars and Computing Devices Canada were designated as the Centre of Technical Excellence for passive sonars. The 505 sonar was essentially in service and not a big problem and the big developments were the CANTASS and advanced signal processor. Through the Chief of Research and Development a company in Toronto called ESE was developing an advanced signal processor which was ahead of anything else available on the street and it would be the basis of CANTASS for sure and the new active sonar that we wanted, which was the SQS-510.

I will talk now about the sonars the SQS-510. For a period of a year or a year and a half we were under discussions with Westinghouse to see if they were interested or if they would go ahead on the SQS-510 development but to make a long story short they weren't willing to take any risk at all. Wanted us to pay for all of their gained expertise and the bottom line was that they really didn't want to use the advanced signal processor and therefore eventually the SQS-510 development was given to Computing Devices Canada.

The CANTASS system was Canada's pride and joy at the time and we were trying to build a better system than was available in the United States of America. With the tremendous help from all the DREs [Defence Research Establishments] in Canada, we took on the development of the Towed Array Sonar System and the main contractor was Computing Devices Canada. Other people were involved in the array which happened with Hermes in Halifax [who] got to do the array but basically Computing Devices Canada [were the prime contractor]. I would like to make a comment here on the length of time it takes to go from an idea to finally getting it into service. A naval officer could have spent his whole career, if he started on day one of the CANTASS before we had a production model at sea. Which is ridiculous in my opinion.

INTERVIEWER (THATCHER): Bob I'd like to ask you a question about the Westinghouse involvement. How did the company accept the decision that they lost the 505 [actually 510] and how was the transition to CDC accomplished?

MUSTARD: The Westinghouse gracefully accepted the transition because at that time the frigate program [CPF] was coming on. Since the frigates could be fitted with a VDS and a hull mounted they had lots of work to do with the SQS-505. As a matter of fact they had to redesign probably a third of it because the electronic devices used in the system no longer existed from the original design many years before and so it required a huge amount of redesign: practically all the cards in the system were redesigned. So Westinghouse was kept very happy moving along with the work for the frigate.

As a very humorous aside I happened to be working for Sperry Paramax [the combat systems subcontractor to Saint John Shipbuilding for the CPF program] when we were negotiating for the 505 sonar. There seemed to be some difficulty with funding so the first day in I said "how would you like to deliver us six sonar sets (which were worth in the order of 10 million or so [each]), and we won't pay you anything for the first four years because we have a cash flow problem. So you go away and tell me what that will cost us." So they said "right"- back to the hotel. They came in the next morning "Here is the number." "Well it is not quite so bad as I told you the day before. I've been told we won't pay you anything for two years. Would you go and redo the numbers?" "Right"- back to the hotel. The third day they come in, [I] said "Well now we are down to 'I won't pay you anything for a year'". "OK we will redo the numbers." They come in Thursday morning and [I] said "Well we will pay you as you go. So redo the numbers now." "Right". Friday morning they come in and [I] said "How would you like it if I give you three million dollars if you just give me a form that is signed and says you've done some work

you've started?" "We think we can live with that." So the actual contract with Westinghouse was they sent in a claim on the first day and they got three million dollars. The cash flow available to the program changed daily. The guy said to me, after he got three million dollars upfront, "Gee, can I come back again next week? Maybe you will give me all ten million upfront." But it never happened. Westinghouse lived through it and supported the 505.

Since CDC were required for the CANTASS to give us a proposal that used the new advanced signal processor and we wanted the new advanced signal processor in the 510 they would have preferred to use their own, but that was CDC, and we told them that we would not accept any proposal from them unless the first bid was for use of the ASP and they finally saw the light and said "yes we will do that." That is how Canadian Computing Device became 510 sonar [contractor].

Now the other companies that were involved in the sonar, C-Tech, Fleet, Fathom – still did the normal things either handling gear, bodies, single element transducers but the sonar itself and the processing was all done by Computing Devices Canada.

INTERVIEWER (THATCHER): Bob, it sounded as if the transfer from Westinghouse to CDC of the 505 technology would seem to be sort of neutral to Canadian industry. Was that how it turned out?

MUSTARD: Well it was neutral in the sense that work that was at Westinghouse was now going to CDC. However, in the long term Westinghouse Canada is essentially out of the active sonar business and it was now in the hands of Computing Devices which are now General Dynamics.

INTERVIEWER (THATCHER): Just another question. I guess we should just establish where these companies are would be of interest I think, geographically. Could you describe where Westinghouse's manufacturing plant was?

MUSTARD: Westinghouse was in Hamilton, Ontario. Computing Devices Canada was in Bells Corners, [Ontario] which now has a name on the front called General Dynamics. Fleet and Fathom are now taken over and there is one company and it is Indal. So time marches on. Canada's industry gets smaller and smaller or bigger and bigger however you think about it. C-Tech is still there. In fact C-Tech was used for part of the sonar system that was put on the maritime coastal defence vessel. Leave it at that for the moment.

INTERVIEWER (BARNHOUSE): This concerns the advanced signal processor. The original design was contracted out to a company known as ESE who was then bought up by Motorola. I was wondering if in fact there were any delays engendered in the project during this transition from one company to another.

MUSTARD: To the best of my knowledge there was no delay engendered by the buy out by Motorola, in fact you could say it may have solved a problem because several times the ESE company people were mortgaging their houses and we were giving them projects to keep them going. The one that probably caused the most delay, if it was a delay, was that at this period 64K memory chips were the "coming thing" or the "big thing" and we decided to design it to use 64K chips. Lo and behold, when we came to buy them we'd found out that IBM had gone into the market and bought all the 64K chips and we now had to redesign it to use 16K chips. But the original company ESE as an interesting side note, they built one of the first digital computer systems in Canada which now resides in the Science and Technology Museum in

Ottawa. As a matter of fact they built four of them. Three of them were bought by the government and at that time nobody could figure out what to do with all that power. So they had a very great track record of being on the forefront of things. Maybe they had a few problems on how to run a business and it was through the good graces of CRAD [Chief of Research and Development] and others that they kept going. So the advent of Motorola was probably a blessing, from what I know of it anyway.

Further to my introduction between '81 and '85, amongst other things, I was the ASW Manager for Paramax which were responsible for the combat systems for the frigate. How the government helps industry..... the government persuading Paramax to buy the sonobuoy processing system allowed CDC to make sales in Australia and England of this system. Before that when they were not selling this system to Canada they weren't having much success because the answer to the questions was – well if you can't sell it to Canada why do you think we'd want to buy it. But once we started buying the systems these other people were very happy to come on board and be part of the big buy.

INTERVIEWER (THATCHER): Did CDC follow on from that? Was this sort of a real push for them and has their success continued, do you know?

MUSTARD: I really don't know because CDC recently has been bought out by General Dynamics. They also got into the communication systems and they got into the display systems for the ships. My last ten years of working life I was on the MCDV [program] so I have no idea what happened to CDC.

INTERVIEWER (THATCHER): Turning to sonobuoys, I understand that Canada had two sources of supply for sonobuoys and I was wondering if you could expand on that.

MUSTARD: Yes, before I arrived in Headquarters in DMCS 3 it had been determined that as a strategic move that there must be at all times at least two sonobuoy manufacturers in Canada. So to this end we used Hermes in Halifax or Dartmouth and Spartan in London, Ontario. To split up the work Hermes basically did passive sonobuoys and Spartan did active sonobuoys. Through Canadian Commercial Corporation the Canadian Government arranged that basically Hermes would be the third supplier of passive sonobuoys for the US Navy so that kept their plant running. Although every two years or so it required some creative ideas to put more contracts in Hermes to either increase the stock pile or to do something like that to keep them going because although from a strategic point of view you needed two sonobuoy manufactures from an actual usage point of view we could not keep them both going 'pedal to the metal' the full time. There was a lot of work done by DND to keep the companies alive. Later on in the towed array program after Canada had bought one array from Gould, they [Hermes] were in the business of making arrays for the CANTASS system.

INTERVIEWER (THATCHER): This is Hermes?

MUSTARD: Hermes yes. Actually I guess we helped them a bit because we took the Gould Array and doubled its length so we doubled the number of hydrophones which is what they were doing.

INTERVIEWER (THATCHER): We will turn to the Canadian Towed Array System (CANTASS) now. Bob can you describe how we started into that and the sort of situation that you found yourself in when you were there?

MUSTARD: Towed arrays and the interest in towed arrays started before '76 and was certainly carried out in the labs on the west coast – DREP. When we did the *Sonar: the Way Ahead* one of the things we wanted was a towed array system for the frigates and retrofit to other ships, if and when possible. In fact there was a statement made by one admiral that without a towed array we should not build the frigates. I would like to say that although we had IEPs which are International Exchange Programs with the United States on their array systems, I'm rather proud of the fact that it was actually a made in Canada solution. A lot of the work was done by each and everyone of the defence research establishments in Canada, from coast to coast everyone was involved. When we were doing the CANTASS the lead lab was DREA, that is in Halifax, but all contributed. A major part of all of this towed array was use of the advanced signal processor because that was going to be the shining light in this program. We used a Canadian company to develop it, [CANTASS], Computing Devices, although there were a few other companies [who] provided bits and pieces. The question is 'why CANTASS'? Well, we had many discussions whether we were building a tactical or a strategic towed array. So we said lets call it neither. Let's call it the Canadian Towed Array Sonar System and if people were mad because it was strategic towed array we'd tell them it was tactical and if they were mad because it was tactical we'd tell them it was strategic. It worked very well. Frank Payne [CRAD's sonar expert] and I came up with that and we were very proud of ourselves.

INTERVIEWER (THATCHER): Can you elaborate on the role that CDC played in the development of the CANTASS?

MUSTARD: In the early developments CDC were given a number of study contracts to the limit of contracts in those days before we got the final go ahead. There was a lot of research and development done by them as well as the labs. Then when the contract was let they were basically the prime contractor for the towed array and they were the systems integrator and they did the software and the relevant hardware like including displays, boxes and they used the advanced signal processor from ESE. They used an array from Hermes. I believe the handling gear was from Haley but I'd have to check on that now but it was a made in Canada project. To emphasize again on what we did earlier, we had a large amount of information from the Americans because we had an IEP on the SQR-18 and an IEP on the SQR-19 which was the follow on version to the 18 and their latest array. The biggest change we made was we doubled the active size of the array that doubled its length. We also used the signal processor the ASP which was a floating point versus a fixed point IBM that the Americans were using.

INTERVIEWER (THATCHER): On balance do you think that we acquired more information from the US regarding towed array technology or did we also provide them with a fair amount of assistance?

MUSTARD: I think in the spirit of an IEP, I think it was a very good two way transfer in both benefited from it and to the best of my knowledge when we first put the CANTASS to sea and put it in exercises, we beat everybody else that was there with a towed array. So we did quite well. I think it was one of the developments that Canada did very well. The only problem will be as things change, will it be the same as the towed side scan sonar for the MCDVs, a number of orphans.

INTERVIEWER (THATCHER): Was CDC able to sell any systems overseas?

MUSTARD: I don't know because unfortunately that system is classified to the 'burn before

reading' stage because you have to have a lot of information on the targets. That is part of the information of the noise signatures of the things you are trying to find. That is closely guarded and that is what you aren't supposed to know. Don't know don't tell. If I told you, I'd have to shoot you.

INTERVIEWER (THATCHER): Can you tell us the circumstances surrounding the sale of the SQS-510 sonar to Portugal?

MUSTARD: The circumstances were that it was under the NATO auspices. We were required to provide something to Portugal on the ship side. One of the things that was suggested was the SQS 510 sonar, which was done and which they were very happy with. The irony was that this all happened at the same time we were getting equipment ready to put on the frigate program. We were not allowed to put the 510 on the frigate program because it wasn't off the shelf and in service. The real irony is that the latest and greatest hull mounted sonar that we developed got on a Portuguese ship that was being paid for by every country but Portugal before it got on the Canadian ships.

INTERVIEWER (THATCHER): This is the Bob Mustard interview tape. End of side one.

SIDE ONE ENDS

SIDE TWO

INTERVIEWER (THATCHER): Previously you mentioned Fleet and Fathom industries can you describe their involvement in the sonar activity?

MUSTARD: Once Canada started building it's own sonars with the advent of the 504 505 Fleet and Fathom were the people that supplies the bodies, the domes, the handling gear, the cages for the single element transducers, the mechanical lifting devices, so all the electromechanical parts for the sonars is what they provided to the government.

INTERVIEWER (THATCHER): There seemed to be quite a close relationship between the sonar industries and government and the navy and the research side of it, was that indeed the case? Would you like to elaborate on that?

MUSTARD: To the best of my knowledge is was one of the better relationships between industry and the government and in that I'm including the Chief of Research and Development in Ottawa, all the labs and certainly DMCS 3 over the years. I won't say we never had contractual problems or disagreements on technical things but having said that, it was one of the smoother running relationships that I'm aware of. [After the approval of *Sonar: the Way Ahead* a meeting was arranged with all the industrial players in Canada who would normally participate in sonar development and production. This gave industry a window on what was expected to happen in the next ten years.]

INTERVIEWER (THATCHER): Turning to the underwater telephone, what part did France play in the purchase of underwater telephones for CPF?

MUSTARD: Well it was not only the underwater telephones for the CPF, the underwater telephones in the late 70s, it was determined that we needed 40 or 50 new underwater telephones for the fleet. The old ones were wearing out and didn't have the capabilities they should have. The Industry Trade and Commerce, or whatever it was known [as] at that time had a contract with a company, small garage type workshop company, to build a linear amplifier

and we were quite interested in using that company as the basis for a new underwater telephone but unfortunately when we came to talk to the guy, there was a notice on the door and people were taking stuff out the back doors. The problem was that the person didn't have enough money to carry on and I guess some of us weren't clever enough at that time knowing how to get him more money since we weren't the guys that were at contract with him. Because there was a requirement for new underwater telephones for the fleet we basically did our normal thing and there wasn't one off the shelf in Canada and the one that best met our requirements was with France. So lucky France got the contract.

INTERVIEWER (THATCHER): Were there any other countries that had the same underwater telephone?

MUSTARD: Well France did, they used it themselves. After my smart remarks earlier that they certainly did use it themselves and were capable of showing us how it did work. They used that or versions of that telephone on their submarines and their surface fleet. We were quite happy with it. To the best of my knowledge there were really no problems with that telephone.

INTERVIEWER (THATCHER): Usually there are industrial offsets and that sort of thing to come to Canada do you know if there any for this or was it just.....?

MUSTARD: I don't remember.

INTERVIEWER (THATCHER): Turning to another system, could you tell us what you know about the ASWDS the Anti-Submarine Warfare Data System that we purchased from Holland?

MUSTARD: In order for me to do this I have to tell you that between 1969 and 1973 I was working in DMCS 9 on the command and control system [CCS] 280. It is also relevant that in 1968 I spent a year on the Aerospace Systems course in Winnipeg learning about why airplanes fly and don't fly and why they crash and why a helicopter you never want to go in because it is an accident looking for a place to happen. Having said that, when I was in DMCS 9 we were looking to put in a command and control system 280, a Litton System, for our AIO [Action Information Organization] System. We had decided that this was going to be a Litton System, that wasn't a problem and we were going merrily ahead with that. Being what we thought was very clever, we looked well ahead and said 'well, we need to do something like this for the sonar systems'. So we built a sonar converter that would take the sonar data and convert it into our little ones and zeroes that we needed for the CCS 280. Anyway when the project came up for what was called the ASW Data System, a number of people bid, one of them being H.S.A and one of them being Litton because they were doing the same type of thing-integration of data for us in the CCS 280; we already had the converter. Somewhere along the line when the evaluations were being made it was told to add two or three million dollars to everybody's bid but the one from Holland, and when you then re-evaluate, lo and behold, Holland won. This was quite interesting, like, why would someone want us to do that?

Well when I was on the aerospace systems course I was at a company in the United States and we did several tours around the world visiting aircraft industries and one of the guys talked about oh he remembers doing the study for the Canadian military on what new fighter airplane should be purchased at this certain time and listing [them]. This is at the time we purchased the F-5 from Northrup. Well apparently Northrup didn't make the short list on anybody's list however, Northrup was one and to the best of my knowledge the only one, that would allow its airplane to be built in Canada under licence. So Canada bought the F-5 which became the CF-5.

So apparently we thought it was such a good deal that because we had the MOUs with the Dutch we thought we could probably sell them the airplane. Well my understanding is that we changed the mainplanes [wings], we changed the engine, to make a long story short we lost our shirts. So come the time of the ASWDS, although we may have lost our shirts the Dutch said "Ah yes but you owe us. We bought airplanes from you so you should buy something from us." Lo and behold ASWDS was bought from Holland. Since I was responsible for the integration of the command and control system with all the other systems on the ship it made life very interesting because it was a 24-bit data system, different voltage levels than the CCS 280 which was a 32-bit system. You must remember in those days it wasn't standard one and half volts for a one. There were systems that were 24 volts for one minus 5 volts was zero etc.... made life very interesting. It is an interesting aside of how we had the ASWDS system. Of course very good we used it for the IREs and the 280s and it became an orphan as well.

INTERVIEWER (THATCHER): Must explain that H.S.A is Hollandse Signaal Apparaten in Hengelo, Holland.

MUSTARD: Now owned by Thales via Thomson anyway....

INTERVIEWER (THATCHER): Regarding ASWDS can you describe the approach to software development that was used at this time?

MUSTARD: Yes we were new at the game. This was the first time we really had to try and figure out how we were going to do software development and at this time the command and control system 280 decided that naval personnel would do the operational software while the ASW side of the house decided that it would use the contractor to develop the operational software of course, under the guidance of DND. Interestingly enough both of these systems were unique, replaced later by things that were run by standardized computer systems across the line. Although on the frigate a lot of the software was developed by industry, the support of the software has now evolved into happening in house within DND.

INTERVIEWER (THATCHER): The various equipments you have spoken about certainly Canadian Industry would seem to have been at the forefront of ASW technology. Could you give your opinion on how Canadian industry stood up?

MUSTARD: Well in the area we are talking it seems to me that Canadian industry and I have to emphasise here a large input from the Chief of Research and Development and the defence research establishments and DND itself, I think we more than met the requirements we were given to meet and we did not have to take a backseat to anybody in this particular world. However, the question becomes is this the stuff we need to go ahead? We are now changing to problems in the littoral areas of the world and certainly in things like the Canadian Towed Array Sonar System probably not relevant to that area. But at the time we more than met, we exceeded the requirements we were given and in my opinion we did a grand job. I don't think Canadian industry or the military has to be ashamed of anything they developed in this period of time.

INTERVIEWER (THATCHER): By those comments I interpret from that that you were mentioning that the towed array system was really a deep water system and the threat that came after that is actually in the shallower areas and that that system isn't compatible with the.....

MUSTARD: Well there certainly a new threat that people became aware of or an old threat that

has taken prominence now which is in the littoral systems. However, there are still a large number of diesel electric submarines in the world that are a real bugger to find and maybe there still is places that we could use things like CANTASS and active sonars etc..... So I don't want to take over from the operations and requirements people what their job is, but I do believe that the things we developed in this period of time were as good and as better than anybody else had.

INTERVIEWER (THATCHER): Bob I know that you have been involved in a number of situations over the years in your projects I was wondering if you like to recount an anecdote that encompasses some part of what we have been talking about?

MUSTARD: At one time in my life I went to all kinds of international meetings, whether it was NATO or AUSCANZUKUS or all kinds of funny meetings. One day we went to a meeting in Washington. The subject was ASW and when you went to Washington the US Navy had a habit of changing everybody they sent to the meetings so you didn't know who they were although we knew who the people were from every other country. You were either the advisor or the head delegate. Anyway we were in this meeting and this American captain comes in and sits down. None of us knew him and since it was on ASW if you don't have 5 acronyms per sentence you are not even trying so after about 10 or 12 minutes the guy put his hand up and stops the meeting and says "is this the ADC 1234 meeting?" We said "no." He said "thank God!" closed his book and left. Never saw him again he was obviously in the wrong meeting and he was figuring 'why am I as a four ring captain can't understand a damn word they are saying'?

Another incident that happened later on is as I said earlier; I was on exchange in England for three years and later on in life I was over there for a towed array meeting. I met a lot of people I had interfaced with while I'd been in England so somebody asked me about the SHINPAD system that Canada was addressing. I told him all about it and then I said "and unfortunately while we were doing this I tried to get SHINSHITS as part of one of the systems. Because we were now going to black water, grey water looking after trash so I figured SHINSHITS would be 'Ships Integrated Sanitation Handling Including Trash System'. One of the gentlemen I knew over there said "Oh Robert, I love it. Do you mind if I use it?" I said "No." So I'm sure it is all around the RN at least.

INTERVIEWER (THATCHER): Well thank you very, very much Bob for your insight into some of our ASW technical history and certainly some of the stories surrounding it. Thank you very much again.

This is the end of the interview tape one side two.

TRANSCRIPTION ENDS