

Project Boresight

Original text By William Reed with W. Craig Reed

Objective - The following account of Project Boresight has been paraphrased by the web master and also shortened considerably from the original account found in a web document at Tripod.com. The intent is to highlight some technical characteristics of Project Boresight and how it affected the Soviet submarine crisis and the Cuban missile crisis of October 1962.

In November, 1960, the monitoring station at a USAF base in Karamursel, Turkey started noticing that all HF transmissions from Soviet submarines had ceased. The primary function at Karamursel was to monitor, by means of massive antenna arrays, any electronic emissions from the Soviet Union as well as any transmissions from Soviet fleet units, surface or subsurface. In spite of searching frequencies used by the submarines for the last 30 years, there was no luck in intercepting any further transmissions. The mystery deepened but all those who were in charge agreed that the Soviet subs had to be communicating with their Fleet H.Q. in some manner.

Historically the subs had always been required to check in at least once daily. If they were in foreign waters that could expand to four times a day. There were a lot of Russian subs on patrol therefore there should have been an abundance of signals to monitor.

A small corner of the Karamursel station housed an American Naval Security Group (NSG) detachment. One day, the Chief-in-Charge, William Reed of intercept operations section, theorized that the Soviets might have started to use "burst" transmissions. It was a technique that the Germans started to use towards the end of WWII. Back then Morse Code was compressed and sent out in bursts of a few seconds or less. It was a successful technique which eluded the standard direction finding techniques of the day. Even by 1960 there was no equipment that could provide a bearing on a burst transmission and even if it was possible, the contents would have been encrypted.

By Christmas 1960, however, the "lost" Soviet submarines had been found and quite by accident. William Reed had been hearing a "scratchy" sound for some time on various monitored circuits, but had passed it over as some kind of an anomaly.... a spurious emission. It sounded like a burst static but not quite. Then, one day, he made a sonograph-enlarged picture of another signal that happened to have one of these scratchy sounds almost on top of it.

Years earlier at Skaggs Island California, NSG was primarily tasked to record and analyze Soviet radio transmissions. Everything was encrypted, so the trick was to break the code in order to read the traffic. The device used in the process was a sonograph machine. It utilized a large drum around on which a photographic type of paper was hand wound by the operator for each signal to be analyzed. On playback of a recorded signal, the structure of the signal was imprinted and enlarged for inspection by the analyst. That work required 20/20 vision and a tremendous amount of patience. Once a signal code was broken, someone had to figure out from the baud formations their equivalent letters in the Russian Cyrillic alphabet. This initial decode was sent

to the National Security Agency. NSA engineers were then able to construct machines that could read these messages in the same manner as the Soviet machines.

When NSA began to read Soviet traffic in volume, they passed on relevant excerpts to military or political end users. Good information could not be obtained forever as the Soviets changed signal codes frequently. When the codes changed, it was back to the drawing board to start all over again.

Reed indicates “It was the sonograph machine that enabled us to locate and analyze the “scratchy” signal. I spread it out and took a closer look. I’ll be damned! It had bauds! Tiny bauds; the most compressed signal that I had ever encountered. It was a man-made signal and it obviously was not one of ours. It was a burst signal, and it had to be a Russian sub. It just had to be!

We fired the recording directly to the National Security Agency, and they were ecstatic! NSA put their best analysts on it and instructed us to concentrate on obtaining as many recordings of this new signal as possible. And suddenly we (and other Naval Security Group intercept stations) began to find them all over the spectrum. Scratchy signals were music to our ears ... now that we knew what to listen for. As we obtained better recordings, I measured them carefully and deduced that the signal had a “trigger” heading, probably meant to activate a Soviet recording device. The trigger was a series of bauds at 345 characters per second, followed by a series of bauds at 142 cps. Next came the obvious text of the message. NSA confirmed our suspicions in short order. The subs were back! They had, of course, been there all the time.”

“We had found the Soviet burst signal, but now the question was, “What can we do about it?” Even before NSA put their best code experts and computers to work trying to break the text, I knew that it was unbreakable. If we could read the text of a position report, we would obviously know the exact location of the submarine. Our only hope, I realized, was to devise a means to locate the transmitters by direction finders. With existing technology, that was impossible. A new concept was required.”

The reason why spies get on and off the air as quickly as possible is due to the time that it takes time to get a bearing on any transmission. One direction finder will only provide the bearing from which the signal is emanating. It does not tell the operator how far away the transmitter is. Three direction finders zeroing in on the signal will give a *triangulation*, and the approximate location of the transmitter. A number of direction finders will give a *multiangulation* and a much closer location of the transmitter. But the typical burst signal was on the air for less than a second. That was okay for the operator at a Soviet receiving station, since his triggering device would automatically turn on his recorder. Once recorded, the operator had all the time in the world to feed the signal into a decoding machine which contained the key to translate the coded bauds into Cyrillic alphabet and thence to Russian plain language. NSG could (and did) build a triggering device to record the signal, but that left them with nothing more than an unbreakable code.

Since existing direction finders didn't have time to get a live bearing, the only hope was to devise a means of obtaining a bearing “after the fact” from a recorded signal. That had never been done

before and no one in NSG thought it would be possible. But NSA engineers did exactly that. They started a crash program on a par (almost) with the Manhattan Project of WWII (ie to build an atomic bomb). Within months after intercepting the first Soviet burst signal, NSG had stations set up and operating to detect, record and direction-find Soviet submarines. At first this was limited to areas of primary strategic importance, but soon expanded to cover every body of water in the world where Soviet subs operated.

In common with most great discoveries, the concept was, in retrospect, basically simple: it consisted of constructing huge circular antenna fields in areas around the world which would be able to receive transmissions from critical bodies of water in which Soviet submarines normally operated. These antennae called Wullenweber arrays were connected to large banks of receivers, tuned to narrow bandwidths which overlapped and covered the entire spectrum that the submarines might conceivably use. When a receiver encountered a trigger on a burst signal, a wide (two inch) sixty-inch-per-second recorder switched on immediately and recorded the signal, along with a marker, indicating the time to the millisecond that the signal was intercepted. Since the antenna field was circular, and divided into segments every few feet, it was also possible to determine, tangentially, the general direction from which that signal had been received. When combined with two or more other intercepts which provided a triangulation or multiangulation indicating the general direction from which the signal had emanated, one was able to determine, after the fact, the approximate location of the submarine.

Later, NSG had obtained ample space at their site locations to construct separate antenna fields for both intercept stations and direction-finding stations. This allowed the luxury of comparing notes between the two to obtain even more precise evaluations of direction. Ample space on site was a prime consideration since, besides the large antenna fields, the space required for the reception and recording equipment required a large building and had to be fully air conditioned, since the receivers in those days still used vacuum tubes which generated considerable heat. Land area sufficient for construction of a base, with housing and other facilities for the operational personnel, had to be taken into account. Large power plants and ancillary units had to be installed. The project was immense in scope, and was classified Top Secret. That codeword, which designated the entire program, was BORESIGHT. The BORESIGHT project which has just described is now as outdated as the Model-T Ford. It did however, play a critical role in the outcome of the Cuban Missile Crisis in 1962.

In 1961, BORESIGHT was in its evolutionary stage. NSG had to train operators at outlying stations on what to look for, and how to analyze the signals when they received them. No one could mail them a correspondence course and of course, nothing could be described by telephone or over the radio. The tapes containing examples of burst signals had to be hand carried. That meant by armed courier, with the tape in a briefcase attached to his wrist by lock and chain. In other words, that meant people like Reed and others who knew the signal first hand would have to train operators in the field. During the next period, Reed circled the globe many times helping to install BORESIGHT stations and training personnel. In early 1962, Reed was notified that he had been selected for a commission in the United States Navy.

National Security Agency, Fort Meade, Maryland 1962-1965

Upon reporting in at NSA, Reed was assigned a minor desk in Section A22, the Soviet Submarine or, effectively now, the BORESIGHT section. As the only man in the section with any actual BORESIGHT field operational experience, he encountered a great deal of confusion and misunderstanding about what the equipment could and couldn't do. He brought in other field experienced personnel, and eventually worked them into a competent BORESIGHT Control Headquarters.

In September 1962, American U-2 over-flights finally confirmed what had been suspected: the Soviets were installing missiles in Cuba. That's all the American public ever heard about. It has never been officially acknowledged, but there was also a Russian Submarine Crisis going on simultaneously. Intelligence had received evidence of Soviet submarine pen construction in Cienfuegos, Cuba. Soviet submarines with potential long range missile launching capabilities, stationed that close to U.S. shores, with the resultant increased ability to range up and down US coasts, posed a much greater threat than medium range fixed missiles in Cuba. That danger had to be eliminated at all costs. NSG were told to maximize efforts to locate the position of every Soviet submarine possible. They did so and started to get hit after hit.

In late October 1962, NSG obtained BORESIGHT fixes, and later visual sightings, of four Soviet Foxtrot-class attack boats converging on Cuba. It was suspected more were on the way. That's when Reed's boss, Commander McPherson, who was Chief of Section A22 (Soviet Submarine Section) at the NSA, was called to the White House. The president and his inner circle had previously been briefed on BORESIGHT, but in light of these new developments they wanted an up-to-date confirmation of just how good it was and a technical explanation of precisely how it worked. Should the U.S. decide to blockade Cuba, a Wolf Pack of near-silent Foxtrot submarines carrying nuclear-tipped torpedoes could spell disaster unless the US could find them.

Commander McPherson was a sharp, competent, naval officer, but he only knew BORESIGHT second hand, mostly from Reed. In fact, both men had worked up his presentation jointly. Operationally he was on solid ground, but he was a bit intimidated by some of the technical aspects. As a result he invited Reed to accompany him to the President's office. The briefing was actually held in the "little" White House, or annex, off to the right side of the White House proper.

Commander McPherson gave a very good presentation, but as the briefing progressed and the questions became more technical and precise, Reed was called upon frequently to amplify. He had brought along charts and graphs which had been previously prepared for use in a BORESIGHT manual. Most of the questions came from the panel of technical experts assembled from various agencies of the Defense Department.

President Kennedy asked very few questions. He appeared to be very tired. Secretary of Defense Robert McNamara, seemed to be pretty much in charge ... at least at the beginning of the briefing. But as the briefing progressed he looked like he was falling asleep; head down, almost on his chest. When the presentation concluded, McNamara's head came up. The first question (or rather review) came from him. He said, "Now let me see if I understand this ..." and proceeded with the most precise and comprehensive explanation of BORESIGHT that Reed ever heard. He

had memorized just about everything that NSG had presented in a two-hour briefing. He had the ability to make even bauds and bits and radio-wave-propagation theory sound interesting.

There was a key question which had to be answered and everyone wanted the President Kennedy to understand. What did a BORESIGHT position report translate to in terms of precise target location? Was it 100 yards, or 500 yards, or five miles? It could mean a big difference to ASW weapons. If this came down to a shooting war, could the US take out one or two of the subs moving in Cuban waters, or all of them, if needed, with one concentrated strike?

The main point made during the presentation was the limited number of BORESIGHT stations installed and operating. NSG would be lucky to get a simple triangulation fix. That would put any fix in the right ballpark, but it would not guarantee the precise location of the target. Once in the ballpark, it was up to naval forces to locate the target. Given more locations, a multiangulation fix could be provided, thus improving the accuracy of the initial fix.

The Cuban Missile Crisis:

William Reed and his son also compiled a precise day-to-day account of U.S. Naval operations during the Cuban Missile Crisis, including the vital role that BORESIGHT played in bringing that operation to a successful conclusion. In the details of those day-to-day operations of the U.S. Naval ASW forces, they pointed out time and again how the ships of the US ASW forces were directed to the precise locations of various Soviet submarines. The subs had made the mistake of raising their antennae and sending off position reports by burst transmission but BORESIGHT nailed them.

There was no militant exchange involving Soviet submarines, because by this time Khrushchev was having second thoughts. His Fleet Commander, Admiral Gorshkov, continued to assure him that the Foxtrots, operating on battery power, were invisible. They could not be detected by the Americans! But Khrushchev was receiving reports hourly from his submarine commanders contradicting this assurance. His "invisible" Foxtrots were being prosecuted around the clock by U.S. ASW forces to the point that they were often forced to surface under threat of depth-charge attack. Khrushchev began to realize that he could no longer back up his threat to "sink the American naval vessels" should they try to effect a quarantine of Cuba. On the contrary, his Foxtrots were in imminent danger of being sunk! The deciding factor in this exchange was, of course, BORESIGHT.

At 10:30 AM on October 27, 1962, Secretary of State Dean Rusk turned to McNamara and spoke words that would make history, "We're eyeball to eyeball and I think the other fellow just blinked." All Soviet ships headed toward the quarantine line had stopped or turned toward the Soviet Union. The Essex received her next orders: do not fire, allow the Soviet ships every opportunity to turn around!

So what made Khrushchev blink? Volumes have been written trying to answer that question.. Khrushchev was finally convinced that Kennedy was serious about going to war over Cuba and that was the most plausible reason as to why he backed down. Khrushchev risked losing

everything in Cuba plus a nuclear strike on his own country. (Comprehensive accounts of the Cuban missile crises can be found by Googling that subject).

Following the Cuban Missile Crisis, BORESIGHT quickly became the hottest program at the National Security Agency. It had the full backing of SECDEF McNamara. He insisted upon a crash program. America wanted to install BORESIGHT in every corner of the globe! He pressed American allies for the use of choice locations in which to install the large antenna fields required, plus a secure operating environment.

The remainder of 1962 and all of 1963 was a period of system refinement and expansion. Major installations included: Adak, Alaska; Kamiseya, Japan; Guam; Pearl Harbor; Port Lyautey, North Africa; Edzell, Scotland; Cheltenham, England; Recife, Brazil; Winter Harbor, Maine. These were backed up by a number of secondary sites which were constantly expanding. In Canada, by 1970, Wullenweber systems (AN/FRD-10) became operational at Masset, BC. and Gander, Nfld. The AN/FRD-13 Pusher system, the smaller version of the FRD-10, was installed in Alert, Nunavut; Inuvik, NWT; Leitrim Ontario and Bermuda in 1979.

By 1964, BORESIGHT had been designated the number two U.S. military priority, second only to the development of U.S. Polaris ballistic-missile nuclear submarines. It remained so closely guarded a secret for the next twenty years or so, that nobody ever questioned publicly what effect this program might have had in the crucial final-day talks between President Kennedy and Soviet Premier Khrushchev. How could they have? If there had been so much as a rumor of BORESIGHT, the NSA, the CIA, and even the President of the United States would have sworn under oath that no such program had ever existed.

Canadian SIGINT personnel also played a role in the Cuban Missile crisis and the Soviet submarine crisis. This extract from the book "History of Canadian Signals Intelligence and Direction Finding" provides some details.

"One of the prime reasons Khrushchev was ready to capitulate to Kennedy was based on the successes of the Atlantic HFDF Net, specifically with a project known as BORESIGHT, especially the wideband capabilities of these sites. In the exchanges between Khrushchev and Kennedy, Khrushchev threatened Kennedy with the information that the Soviets had nuclear submarines sitting on the bottom of the Atlantic from Florida to Halifax. These were armed with nuclear missiles targeted against major and critical sites such as Norfolk, Boston, Cape Canaveral, New York and Halifax amongst others.

Because the Soviets had been using super burst transmissions, they were obviously convinced that those transmissions could not be DF'd or fixed. Kennedy had been well briefed and was prepared for just such an eventuality and was willing, under these severe circumstances, to take the chance of blowing the cover of wideband direction finding successes. He advised Khrushchev that he was well aware of the disposition of Soviet submarines and then proceeded to provide him where they were located by latitude and longitude. He also advised him how often they reported and that they were all targeted with US Polaris missiles. Kennedy also indicated his military were quite aware of the location of the five diesel electric Foxtrot submarines en route to Cuba and the Cuban submarine facility under construction at Cienfuegos,

Cuba. He further informed Khrushchev, that in an instant of time, the first target of US forces would be the destruction of the Soviet submarines, both nuclear and diesel electric. The complete scenario then changed and Khrushchev backed down and commenced to negotiate a deal on the de-installation of US missiles in Turkey.

The Supplementary Radio System (SRS), as it was known at that time, and especially its Atlantic DF/Intercept stations located at Gloucester, Ont, Frobisher Bay, NWT, Coverdale, NB and Gander, Nfld. can take well deserved credit in the contribution they made in support of Kennedy's stance. Canadians can always be proud of our SRS operators for their contribution to this major event in history. They never received so much as a congratulatory message from their Canadian military masters. Recognition did however, come from such US Naval authorities as CNO, CINCLANT and CINCPAC."

Contributors and References:

- 1) Boresight by William Reed found at <http://dool-1.tripod.com/days79.htm>
- 2) History of Canadian Signals Intelligence and Direction Finding by George Fraser and Lynn Wortman . Published by Nanlyn (2005).

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