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THE USE OF CANINES FOR EXPLOSIVES DETECTION IN THE PERSONNEL ACCESS CONTROL FUNCTION AT A NUCLEAR FACILITY

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In order to put this report in perspective, let me first provide a short background on Allied-General Nuclear Services and the Barnwell, South Carolina facility. Allied-General Nuclear Services is a partnership of Allied Chemical Corporation and General Atomic Company. General Atomic Company is, itself, a partnership of Gulf Oil Corporation and Scallop Nuclear, a wholly-owned subsidiary of the Royal Dutch Shell group.

The Allied-General Nuclear Services partnership, "AGNS" as I will refer to it, was initially formed in early 1971. Its purpose was to construct and operate a 1500 metric ton plant for reprocessing spent nuclear fuel from light-water reactors owned by the electrical generating utilities. The first two facilities of the plant were completed and undergoing initial checkout in 1977. In April of that year, the Administration, because of its concerns regarding plutonium weapons proliferation, announced an indefinite deferral of commercial spent fuel reprocessing in the United States. Rather than close the Barnwell plant, thus eliminating the option of near-term reprocessing in this country, the Congress appropriated funds to utilize the facility as a research and development center. In January of this year, AGNS entered into a contractual arrangement with the Department of Energy to conduct research and development activities in the areas of spent fuel transportation, handling and storage, proliferation resistant technologies and advanced safeguards programs.

One of our areas of concern, of course, is the Physical Protection of a nuclear facility. This concern goes well beyond the mere protection of assets. It involves the protection of the facility against terrorist attack and against acts of sabotage. It also involves the protection of potential weapons material from theft, as well as covert diversion.

These threats, of course, are carried out by people. Therefore, a physical protection system for a nuclear facility must be directed toward protecting against malevolent acts by people. Part of such a protection system is the people-oriented control systems, i.e. personnel access control. Today I'm not going to discuss those aspects of a physical protection system that detect entry through other than normal entrances, but rather, I'm going to concentrate on that portion of the personnel access control passageway that involves the detection of (or search for) explosives.

However, before discussing explosives detection, let's review the purpose of a personnel access control passageway (or passageway). The essential functions of the personnel passageway are to assure that those personnel entering a nuclear facility are:

a. who they claim to be--positive identification
b. authorized to enter that particular area
c. do not have any materials in their possession that could be used to accomplish--in whole, or in part--any of the threats mentioned earlier.

As I mentioned earlier, it is this last item of assurance that I would like to concentrate on today. Our studies and investigations have revealed two things: First, the search for metal objects, such as weapons, or weapon parts and ammunition, can be conducted with a high probability of detection of such contraband items--and can be conducted in a reasonably expeditious manner. Likewise, those "substitute items" used to divert or smuggle materials can be revealed expeditiously and reliably using the same electronic metal detecting devices in concert with physical inspection techniques. For instance, a cigarette lighter would not pass through a metal detection unit. A physical inspection of this item would quickly reveal whether it was, in fact, a cigarette lighter or whether it had been modified to be a small vessel which could be used to divert small amounts of plutonium or other strategic special nuclear material.

The saboteur, however, presents a different and more difficult problem. Here, the materials used - explosives - are generally non-metallic and easily concealed. Short of a "pat-down" search of an individual, which has serious civil liberties implications in the private sector, one must rely on other means of detection. Traditionally, electron capture devices have been used with varying levels of success. None of these devices, however, provide a combination of a high probability of detection, low false alarm rates and, of equal importance, the expeditious processing of personnel through the search process. To date, investigations reveal that those electronic units that provide a high probability of detection also have a very high false alarm rate that slows the search process substantially. Conversely, those units which have a lower probability of detection simply cannot discover explosives at an acceptable frequency. The challenge then is to find a system that will provide a high probability of explosive detection with minimal time consuming false alarms. While I have no doubt that the electronic industry will ultimately respond, the current most effective "State of the Art" explosive detector appears to be the canine. Man's oldest and best friend will, I think, be able to provide the necessary interim mechanism to detect explosives in the personnel search application.

Of course, the canine's value in a physical protection program goes well beyond being used in the passageway explosive detection function. The canine can be used for area, building and vehicle searches for explosives. He can also be used as a partner for the security officer on patrol during alarm assessment responses, during unoccupied building searches, and during civil disorders. Throughout all of these functions, the canine constantly provides a psychological deterrant to the adversary, both insiders and outsiders.

The military services have used the canine, and trained them for others, in explosives detection. Explosive detecting canines are currently in service with the military, the FAA, FBI, Secret Service and other federal, state and local law-enforcement agencies. Most of those canines currently in service have been trained at the Military Working Dog Center at Lackland Air Force Base in San Antonio, Texas. We had the privilege, through the courtesy of the Defense Department, of visiting the center at Lackland last November. Several observations of the explosive detecting prowess of their dogs convinced us that they had real potential for our application. While we recognized that these animals were trained to a different environment, that is, moving in their search to a stationary explosive, rather than having the explosive come to them, we felt strongly that this training problem could be overcome. Additionally, the canine's ability to adapt to a confined environment had to be established. With the ability to detect varied explosive compounds with 100% accuracy at odor dilution levels of up to 10^{-9} and with 85% accuracy above that to 10^{-13}, we felt compelled to try.

And "try" we did. Under our DOE Contract, with the help of DOE's Office of Safeguards and Security and the outstanding cooperation of the Department of Defense and, most especially, the staff at Lackland, we conducted a preliminary evaluation of canines in the personnel search passageway at the Barnwell facility. We have somewhat jokingly stated that we're not sure whether these were experiments in explosive detection--or experiments in environmental adjustment. At any rate, the tests have confirmed our belief that the canine has real potential in this application and that, with added site specific training and environmental adjustments, we can unequivocally verify this.

The test ingredients in our preliminary evaluation were two canines with Air Force handlers and the Secure Access Passageway building at the Barnwell Plant. The first dog, "Dutch," was a four-year-old German Shephard from DOD's bio-breeding program.

"Dutch" is both patrol and explosive detection trained. He has been used primarily as a demonstration dog for the past two and one-half years. He was handled by M/Sgt. Harold Poll, an instructor supervisor at Lackland with sixteen years of dog handling experience. The second dog, "Ace," a fifteen-month-old bio-bred dog with only three weeks, or so, of explosive training prior to our evaluation, was handled by T/Sgt. Dan Hayter. Sgt. Hayter is an instructor at Lackland with ten years in the program. It should be additionally noted that "Ace" had not even had thorough obedience training before coming to Barnwell. The canines utilized were obviously on different ends of the experience spectrum. One, an old professional that went about his tasks with a mature and calm demeanor, and one, quite puppy-like, somewhat confused, but eager.

Our initial experiment involved the use of a utility closet in the passageway building. The closet was approximately four and one-half feet deep and about five and one-half feet wide with a standard three-foot door. This was the station to be occupied by the dog and handler. We installed a variable-speed blower in the back wall of the closet with its exhaust directed to the outside. We drilled a four-inch hole in the door and mounted a spread-steel screen on it so that the dog could not in any way come into contact with the subject. (Civil liberties court cases, as they apply to the private sector at least, almost mandate the separation of canines from search subjects who are not usually or normally intent on rule-breaking.) To the outside of the closet door, we attached a human-sized box-type affair with a door.

The search box had holes drilled in the top to allow air to flow down across the search subject. We also had less than an airtight seal at the floor level to allow air to flow up from the foot area and through the hole in the closet door which was at about canine nose height.

The explosive samples used in the evaluations were:

1. Flex-X - Wrapped - 243.0 grams
2. Flex-X - Unwrapped - 234.0 grams
3. C-4 - Wrapped - 302.1 grams
4. C-4 - Unwrapped - 280.7 grams
5. TNT - 119.5 grams
6. Smokeless Powder - 534.4 grams
7. Detonation Cord--Military - 21.8 grams
8. Detonation Cord--Commercial - 10.4 grams
9. Fuse - 23.1 grams

To preclude, to the extent possible, cross contamination of explosive odors, all samples (with the exception of the Detonation Cord and Fuse which were in metal cans) were placed in zip-lock plastic bags, stored in discreet polyethylene bottles and handled with sample-dedicated plastic gloves.

After a day of orientation and acclimatization of dogs and handlers, we commenced the first tests in the closet. After a small number of samples, it was evident that this was definitely not the way to go. Everything went smoothly outside the closet, search subjects came and went--with and without explosive samples. Inside the closet, however, confusion, frustration and pandemonium prevailed. While we were accomplishing a better than 60% detection rate, false alarms were extremely high. Varying air velocities through a door port had no corrective result. The dogs were accutely confused and frustrated with the confinement of the closet. At one point, the dogs were alerting on the door port without regard to the presence of explosive odor. One dog received minor cuts from the electrical cabinets in the closet while chasing his reward ball. "Dutch's" handler put it well when he suggested, "Let's terminate this nonsense!" He was right. It was just too much of an adjustment for those dogs, trained as they were, to make--almost overnight.

In our opinion, the closet approach could be accomplished with a few significant, but easily accomplishable training adjustments. First, the dogs we utilized were trained to a "passive" type response. That is, they are taught to "sit." This makes a lot of sense when you are searching for bombs. Find it--but don't touch it! Drug detecting canines, on the other hand, are taught an "aggressive" rather than "passive" response. They actually try to tear the container apart to get at the drug. In a closet-type environment, the explosive dog should use an "aggressive response." This would provide an emotional outlet for the animal and provide a more easily discernable alarm than the "passive" response. Secondly, a different reward system should be utilized in the closet. The dogs we used received a hard rubber ball when they alerted accurately. They were allowed ten or fifteen seconds of playtime with the ball. This, we found does not work in a small closet. A morsel or tid-bit reward system would be more appropriate.

The point is that while the closet approach deviates drastically from the traditional explosive search mode, we believe that canines can be trained to adjust to and operate in confined areas. This type of training, however, might well diminish or even preclude the same animal's ability to work in a roving mode and thereby reduce its versatility.

Having experienced problems in the first test, and being under a severe time constraint, we decided to proceed on a path of compromise. We had four booths, somewhat resembling the traditional "out-house," constructed of plywood. Each booth was approximately four feet wide, three feet deep and seven feet high. Each had a solid plywood floor with three horizontal one-inch by six-inch vents in the backside located approximately two inches above the inside floor level. A drum-type blower was mounted on the top of each booth, along with variable blower speed controls. Air was blown down across the subject and out of the vents in the back of the booth. The four booths were placed side-by-side approximately five feet from a building wall to create an alleyway behind the booths where the dog and handler could work up and down the row of booths. Each booth was fitted with a single door for search station ingress and egress.

Again, using the samples mentioned earlier, one day was devoted to adjustment trials. Air flow rates in the booths and the number of passes required in each search sequence were both varied to roughly establish parameters. We noted that the unfinished plywood booths presented a lingering odor problem. Unfortunately, the time available for modifications did not permit the three or four days necessary to properly coat or finish the bare plywood booths. As an alternative, we developed air flushing times required to clear the booths after it was used by a person with a sample. The flushing times varied with the type of explosive and was primarily a function of quantity and relative vapor pressure of the sample. While we did not establish proof that the air flushing program eliminated the odor lingering problem, it substantially reduced the problem. During that initial day of tests using the booths, we processed 148 people and 31 samples. Even with varying air flows and flushing times, we had 23 of the 31 samples detected for a detection level of 74% and with only an 8% false alarm rate. We knew we were headed in the proper direction.

For the next three-day period, we tested in earnest. Booth search status air-flows were constant, the flushing time program between searches adhered to, sample integrity maintained per the system mentioned earlier and two passes by a canine constituted a search. Additionally, only one dog and handler worked each block of four subjects. The other team was required to remain outside the building. During periods of heavy activity, the search teams were changed every twenty minutes. During periods of light traffic, they remained on duty for a longer period of time. The results were very gratifying--and encouraging. Overall, we were able to achieve a 80.4% detection level with a 7.4% false alarm rate. The more experienced "Dutch" achieved an 89.3% detection level with a false alarm rate of 8.5%. (I'll speculate on the false alarm rate in a moment.) "Ace," the younger animal, detected at the 71.4% level with a surprisingly low false alarm rate of 6.2%. These levels and rates are based on 270 subjects searched, 56 of the subjects had explosive samples, randomly placed and selected, on their person, with 45 of the 56 samples detected. Interestingly enough, the 11 samples missed were of random varieties. All samples were placed on the search subject approximately two minutes before they were searched.

As the three days of testing progressed, we observed several interesting situations. The canines were working at an ever increasingly lower "threshold." That is to say that they were alerting on lower odor levels. The false alarm rate increased as time went on. We suspect that our booth air flushing program became inadequate as the dogs worked to more sensitive levels. We do know, however, that one false alarm was on a subject who had lifted a sample from his friend's pocket with only his thumb and forefinger in a playful gesture. This was reported to have happened in other cases, as well, which, in my mind, questions the validity of our 7.4% false alarm rate. During the last day of testing, we experienced some false alerts where the dogs alerted one booth early--always on the same side of the booth with the explosive. We noticed that the general building air-conditioning exhaust vent was in the ceiling at that end of the row of booths. Not only did we have an odor lingering problem, but we had an odor drift problem, as well. This became most acute as the dogs worked to the lower thresholds.

All-in-all we found this preliminary evaluation both confirming and excitingly interesting. It confirmed our feeling that, potentially, the canine has another contribution to add its impressive repertoire of abilities. The tests identified the training and environmental problems associated with the use of macrosmatic animals in this environment. There may be more problems discovered in our subsequent programs, but I feel we have identified the major ones this year. The encouraging thing is that the identified problems are solvable by fairly straightforward adjustments in the training and environmental areas. The Good Lord willing, and with the support of the Department of Energy and the United States Air Force, I sincerely hope I can return next year to inform you that canines in the personnel explosive search application achieved a better than 95% probability of detection, with a false alarm rate of less than 5% and an average per person search time of 20 seconds. I really have no doubt that it can and will be accomplished.