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Authorized Reprint

# Michigan DOC Runs BETA Test of New Remote Transdermal Alcohol Monitoring System

by Steve Bock\*

Problem drinkers consistently comprise a disproportionate share of community corrections caseloads, making effective, long-term, remote alcohol monitoring a pervasive and expensive problem. In February 2002, Alcohol Monitoring Systems (AMS), manufacturer of the new SCRAM™ (Secure Continuous Remote Alcohol Monitor™) System, asked the Michigan Department of Corrections (MDOC) to participate in a product testing program for SCRAM prior to making it commercially available. From July until December of this past year, the MDOC engaged in a comprehensive BETA test of the SCRAM System.

The MDOC started using electronic monitoring in the early 1990s. We operate our own in-house monitoring center with 24-hour staffing, central monitoring computer systems, and a telecommunications system. This system handles calling traffic from field units and officers, sends alert notifications to field officers, and supports remote terminal access. On any given day in 2002, the MDOC monitored well over 2,000 offenders under state control and provided monitoring services on several hundred additional participants from county community corrections agencies. In addition to continuous RF home monitoring, we also have remote alcohol testing equipment and generate random test calls to the homes of nearly 200 offenders enrolled in our system at any given time. We have an extensive history of testing new products, conducting evaluation studies, and participating in formal BETA programs to test their use and effectiveness, including various types of monitoring systems. We have conducted pilot programs using Global Position Systems for offender tracking, KIOSK check-in systems with automated fee collection and accounting, and voice verification systems for checking compliance with schedules that include more than

one location.

AMS approached the MDOC because of our extensive use and testing of monitoring technologies, our understanding of the responsibilities involved in the BETA test process, and our emphasis on testing not only the products, but also their impact on offender behavior and the overall supervision program. The MDOC sees BETA testing as an opportunity to see what is coming to the industry in terms of technological innovations and to get hands-on experience integrating these programs into our own system.

The Alcohol Monitoring Systems BETA test program is among the most formal in which the MDOC has participated. AMS defined a specific BETA test plan that established the agenda for MDOC participation. This plan included testing of their own product training and set-up; ease of installation of the product on offenders; product accuracy, reliability, and durability in the field for an extended period of time; and testing an agency's ability to use and to integrate the data management portion of the system into an existing alcohol monitoring program. It required trial usage by MDOC officers, installation on offenders already participating in some other form of alcohol monitoring, and testing and integration of the system's monitoring and call center features with the MDOC's own call center. The MDOC welcomed AMS' more formal process since it allowed us to fully assess our up front commitment to being a BETA test partner and relieved us of having to develop testing protocols to ensure we would thoroughly test the product and achieve the maximum benefits.

## Transdermal Testing

SCRAM is the first product to incorporate technology that uses the science of transdermal alcohol testing to determine a person's blood alcohol concentration (BAC). SCRAM measures Insensible Perspiration, which is the constant, unnoticeable excretion of sweat through the skin. The average person will emit approximately one liter of

Insensible Perspiration each day. SCRAM measures the ethanol gas in this Insensible Perspiration, which is a predictable result of alcohol consumption, to determine an individual's BAC, or with SCRAM, a person's Transdermal Alcohol Concentration (TAC).

## About the SCRAM System

According to AMS, the SCRAM System was designed for application in a long-term alcohol monitoring program. The system includes an ankle-worn bracelet and home-installed modem unit, like a home arrest system. It automates the process of collecting, storing, and transmitting subject alcohol concentration information. The ankle-worn bracelet (SCRAM Bracelet), see diagram, samples blood alcohol levels at least once an hour and uses the home-installed modem unit (SCRAM Modem) to send that data to a secure website (SCRAM Network) for data storage and web-based access by the agency or the alcohol treatment provider.

**Diagram 1: SCRAM Bracelet**



**Alcohol Testing.** Whereas most RF home monitoring bracelets require only one component (the transmitter) to be attached to the ankle or wrist, the SCRAM Bracelet attaches two components. The first component contains the alcohol testing sensors that determine the transdermal alcohol content (TAC). The second component contains tamper detection, test results and other data storage technology to send data and communicate with the home-installed modem device, and system control and processing technologies. There are two types of tamper

*See BETA, next page*

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detection. Similar to RF home monitoring bracelets, the first type ensures the bracelet remains secured to the subject's ankle. The second type detects attempts to interfere with the alcohol testing process. Agencies can program the unit to test for alcohol once or twice an hour; however, when it detects a tamper or positive alcohol test, the SCRAM Bracelet increases the number of alcohol tests to once every 20 minutes until it no longer detects the tamper or alcohol test results are no longer positive.

**Reporting Test Results.** After the bracelet is installed on an offender and synchronized with the SCRAM Modem, the offender installs the modem in his or her home. The system requires that subjects be within 25 feet of the modem at a pre-scheduled time each day for the data uploads. If a scheduled reporting time is missed, the system generates a Missed Modem Call alert 20 minutes after the scheduled report time.

### The BETA Program

As of November 11, 2002, the MDOC had the SCRAM System installed on five officers and 19 offenders in Washtenaw, Kent, and Berrien counties. These jurisdictions represent a range of sizes and socioeconomic profiles, including Michigan's second-largest city (Grand Rapids), a mid-sized city (Ann Arbor), and the small- to mid-sized cities of Benton Harbor and St. Joe.

The AMS agenda for the 150-day SCRAM BETA Program was divided into three distinct phases:

**Phase I—On-Site Training.** AMS Customer Support staff began our BETA program with on-site training. The training took place in two, half-day sessions with a total of five officers and supervisors from the three counties participating in the testing program, as well as two program managers from the MDOC Electronic Monitoring Center. Day One training covered installation of the SCRAM Bracelets and SCRAM Modems, as well as training on the SCRAM Network software. Units were placed on participating officers, who wore the bracelet overnight and to a training-sponsored "social event" designed to demonstrate the system. A Breathalyzer™ was used at

various points during that event in order to test the breath alcohol concentration of each participant as a point of validation and comparison.

Day Two training resumed with an evaluation of the positive drinking events and any alerts generated overnight, then continued with an emphasis on the SCRAM Network, including alert management, alert resolution, and the interpretation of the data and graphs.

**Phase 2—Medium-Term Officer Testing.** The second phase of the BETA program had officers wearing the SCRAM Bracelet and participating in daily tests of the full system. This phase was designed to continue testing and identifying positive readings or tamper alerts, as well as to identify any training deficiencies in the system prior to installing units on actual offenders. A total of seven members of the MDOC wore bracelets for varying periods of time during the first two weeks of this phase. We simultaneously began the process of identifying offenders appropriate for participation in the BETA program and obtaining the necessary

level of judicial approval necessary to progress to the next phase.

### Phase 3—Installations on Offenders.

The third phase included the installation of the SCRAM Bracelets and SCRAM Modems on actual offenders for extended periods of time. For the purposes of the BETA program, AMS sent a representative to each of the counties for initial set up and to ensure the effectiveness of the initial training module.

### Offender Selection and Participation.

Offender selection was done separately in each of the three counties participating in the program. All of our BETA program participants were volunteers. AMS objectives included a preference for subjects with variations in height, weight, age, and gender. Appropriate candidates were offered incentives to participate in the program. Beyond these objectives, each supervising officer made the selection based on their own individual criteria for appropriate candidates. See Table 1.

We required the offenders to sign a Program Participant Agreement form that

See BETA, next page

**Table 1- Participating Offenders**

This chart contains a breakdown of the participating offenders in each county, including gender, age, and size.

	Date On	Date Off*	Gender/Age/Size
<b>Washtenaw</b>			
Offender A	8/6/2002	9/2/2002	Female, 24, 5'3", 115 lbs
Offender B	8/7/2002	9/5/2002	Female, 35, 5'7", 165 lbs
Offender C	8/20/2002	10/1/2002	Male, 25, 6'0", 200 lbs
Offender D	9/6/2002		Male, 33, 6'2", 177 lbs
Offender E	9/30/2002	10/15/2002	Male, 21, 5'9", 155 lbs
Offender F	10/25/2002		Male, 25, 6'0", 170 lbs
Offender G	10/28/2002		Male, UA, 6'0", 150 lbs
Offender H	11/08/2002		Male, 27, 5'9", 140 lbs
<b>Kent County</b>			
Offender I	8/7/2002	8/23/2002	Male, 26, 6'5", 205 lbs
Offender J	8/7/2002		Female, 5'8", 155 lbs
Offender K	9/6/2002		Male, 31, 5'10", 190 lbs
Offender L	8/7/2002		Male, 33, 5'9", 145 lbs
Offender M	8/7/2002	9/11/2002	Male, 29, 5'8", 158 lbs
Offender N	8/19/2002	10/14/2002	Male, 42, 5'11", 185 lbs
Offender O	9/9/2002		Male, 39, 5'5", 170 lbs
Offender P	11/4/2002		Male, 27, 5'7", 170 lbs
<b>Berrien County</b>			
Offender Q	8/8/2002	8/31/2002	Male, 44, 6'0", 182 lbs
Offender R	8/8/2002	9/8/2002	Male, 31, 5'8", 130 lbs
Offender S	8/19/2002	9/9/2002	Male, 46, 6'5", 200 lbs

\* Offenders with no "Date Off" date were still wearing the SCRAM Bracelet as of 11/12/02.

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was provided by AMS. The agreement outlines any restrictions while subjects are participating in the program (such as limiting the use of products such as perfume that contain alcohol) and the offender's individual reporting schedule for transmission of data from the bracelet to the modem. Since the SCRAM System is a completely new product paradigm a new agreement was required, so part of the BETA program included evaluation of the AMS provided agreement.

### SCRAM Results—What Worked and What Did Not

The good news about what worked is that the product performed well in areas of concern to authorities involved with the community release of individuals with alcohol consumption restrictions. Namely, the BETA test results indicate that the product is able to detect circumvention of alcohol test sampling, reliably ensures that test samples are from those of the intended test subjects, and detects drinking episodes around the clock regardless of a subject's

schedule or location.

The good news about what did not work is that AMS made the necessary product modifications during the test period that resolved the only product-related issue identified during the test and enabled us to continue testing with the modified product. Other issues identified during the test had workable solutions that MDOC implemented on the program management side.

Things that worked included:

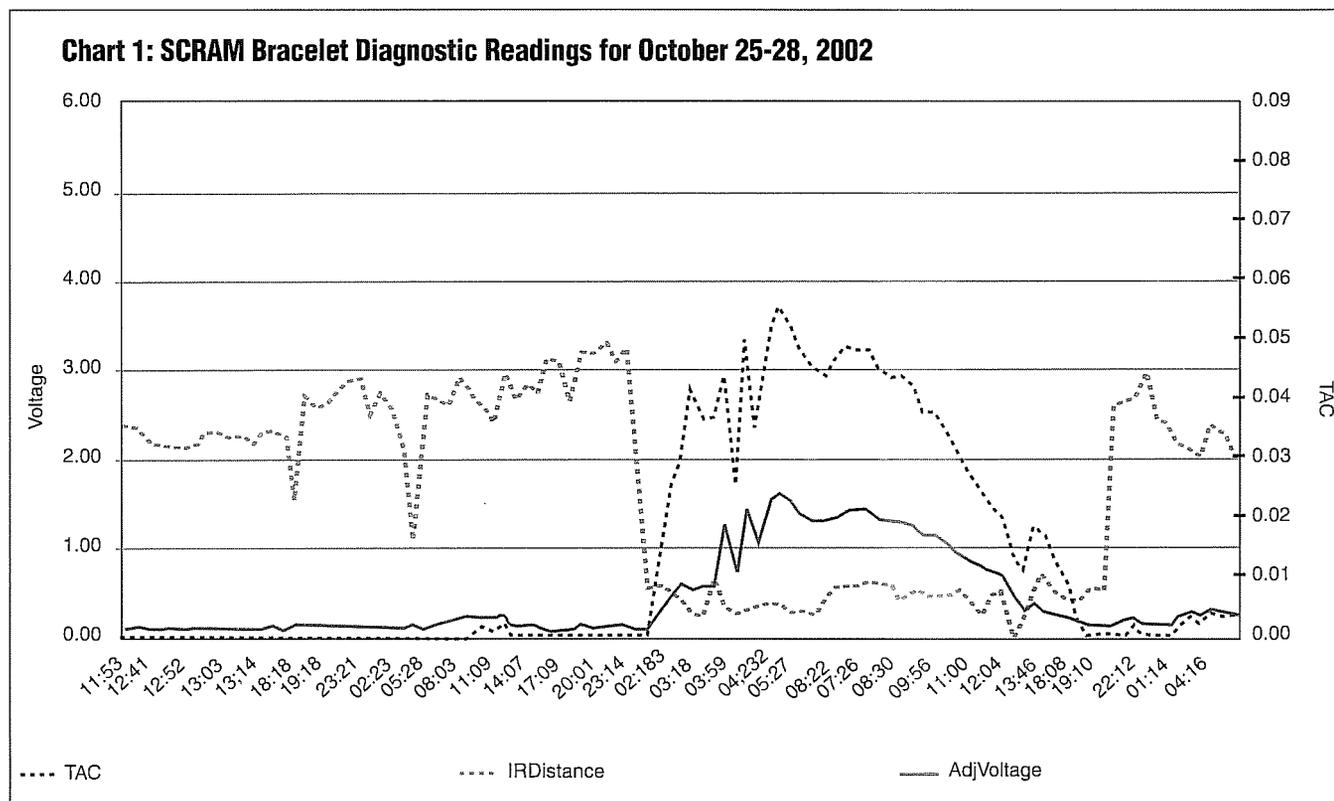
- **Product Training.** The AMS two-day training program was unusual in that it was exceptionally structured and detailed. This was necessary because this is a completely new technology and application, and integration into an existing system had a number of unknowns for the MDOC. The training program, including the training-sponsored "social event," resulted in instant respect for the alcohol monitoring capabilities of the product. Wearing the unit, feeling it sample, and then tracking the validity of the testing with the Breathalyzer built our confidence and comfort level for going into Phase 3 of the BETA test—installation on offenders.

Training on managing the alerts—via the SCRAM Network—was a longer-term initiative, and that learning curve will be different for each agency as they determine how the system will integrate with their own monitoring center functions.

- **Accuracy of Readings.** The SCRAM System clearly meets its primary objective of accurately measuring alcohol consumption. Once there is detection of a positive drinking event, the system automatically begins sampling every 20 minutes until alcohol is no longer detected. This feature ensures not only that we can determine the Transdermal Alcohol Concentration (TAC) by the results of the test, but also that we can accurately measure the burn-off rate of the alcohol, a second means of determining the subject's peak TAC.

Throughout the AMS sponsored social event—including in the training module for the BETA test—officers submitted to breath analysis, and those results were compared to SCRAM TAC results the following morning. The TAC to breath

See *BETA*, next page



Sample of diagnostic readings as reported by SCRAM System. See Chart 1, page 7 for interpretation of results.

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analysis comparisons were accurate, illustrating that not only did SCRAM detect that drinking events, but accurately calculated alcohol consumption, as well.

• **Ability to Detect Tamperers and Drinking Events.** The system has performed exceptionally well in terms of detecting tamperers and drinking events. Within the first week of installation on offenders, one subject applied perfume, in violation of the offender contract, but then immediately contacted her PO to report the violation. The system detected the alcohol as reported. In another case, a clear alcohol consumption event was detected, together with a tamper alert. When confronted with the SCRAM System reports and graphs, the offender admitted to alcohol consumption and to placing an obstruction between and the bracelet and his leg.

### Issues Resolved With Program Management

**Comfort and Wearability.** The SCRAM Bracelet is bigger than many ankle monitoring bracelets, and officers and offenders alike remarked that it took two to three days to get used to wearing the unit. A proper fit is essential in the installation, because a fit that is too loose will get accurate readings but will probably result in chaffing and discomfort. One officer initially requested a looser fit of the unit and experienced significant discomfort. Once that unit was adjusted to a different fit, the comfort issue diminished significantly. Overall, the units are unobtrusive and easily covered by slacks and appearance is not an issue.

**Data Transmission.** The upload of data from the bracelet to the modem was a process that required some modification during the BETA cycle. While the actual bracelet to modem data transfer only takes about ten seconds, we initially experienced a number of unsuccessful data transfers. No data was ever lost, but a number of Communication Alerts and re-tries were generated.

While the SCRAM Bracelet communicates with the home installed modem using radio frequency signals, similar to RF home monitoring equipment, one of the key differences is that RF home monitoring

equipment communicates a small amount of data in very short bursts while the SCRAM Bracelet sends a short stream of test data to the modem via radio frequency. We all know that RF communications are subject to interference—as RF home monitoring units wait for a series of missed RF signals before concluding that the transmitter is not in range. Even though it takes less than a minute for the SCRAM Bracelet to send its data to the modem, it isn't always successful due to RF interference. The bracelet keeps re-sending until the data is successfully re-

ported. So while the data might be communicated in less than a minute, offenders were asked to stay within reporting range for additional time to allow for retransmissions.

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ported. So while the data might be communicated in less than a minute, offenders were asked to stay within reporting range for additional time to allow for retransmissions.

The MDOC originally recommended that offenders be in proximity of the modem for 15 minutes. However, we initially experienced a number of Missed Communication alerts. To compensate, we simply modified the time interval recommended to remain in range of the modem, as well as the pre-programmed schedules for download. Offenders are now asked to be within range of the modem for 30 minutes (rather than the original recommendation of 15 minutes) to ensure that all the data is uploaded. Because this is a rather lengthy period of time, some offenders aren't completing this cycle. We feel the duration is long, and that although the process happens in a shorter period of time, the 30-minute window ensures a full data transfer. We have also scheduled the upload for sleep times (when a phone jack is available in the bedroom) or for times that it might be more feasible for a subject to be in one place for 30 minutes, such as while watching the evening news or cooking and eating dinner. This solution has again significantly minimized the problems with the upload cycle.

This modification to the testing interval will be addressed in the training module so

that officers are aware of the issue and well-

versed in the options available to ensure successful data transmissions.

**Integration Into Existing Programs.** With the product and program issues resolved early in the BETA process, MDOC is taking full advantage of the BETA test opportunity to evaluate how use of this product should be managed from our monitoring center operations. For the purposes of the BETA test, AMS is performing our monitoring center function by monitoring the results each day, reporting

them to the appropriate probation officer, and working with us on positive readings, Tamper Alerts, and Equipment Alerts. To understand how we will need to modify the role of our own monitoring center management and response processes, selected MDOC monitoring center staff are looking at alerts on a daily basis, entering notes, and familiarizing themselves with the AMS software. This will help enable us to write meaningful procedures for when we begin responding to alerts without AMS assistance. AMS released a revised version of their SCRAM Network software in November 2002 that refined what gets reported as alerts. This should make the program more user-friendly and helpful to the supervising agents.

**Battery Replacement.** The SCRAM Bracelet battery requires replacement every 60 days. The bracelet will generate alerts when the batteries need to be replaced, with an approximate seven-day warning period. The batteries are replaced at the probation office, and this function is being incorporated into regular visits. The battery changes can be done fairly quickly and without removing the unit from the leg. Every time a subject reports, the agent will be inspecting the unit to check for visible signs of tampering, and it only takes a little extra time to change the battery. This is very similar to

*BETA, from page 5*

how we deal with battery replacement in current RF units, which are now done every 12 months, and the alcohol units currently used by MDOC, which require recalibration every six months. Thus, integrating this function into our program has created no additional demand for meetings with offenders.

### Issues Resolved With Product Modification

**Durability.** Strap durability was the only product design issue identified during the testing cycle. Many of the problems detected in the straps resulted from intentional tampering by the offenders, such as twisting the strap excessively or trying to remove it from the ankle by twisting and pushing with the opposite foot. AMS did not anticipate the intensity of offender manipulation in their initial product design, and modifications were necessary to strengthen it. The strap houses electronic circuitry for the two sides of the bracelet to communicate. When the offenders stretched the strap beyond its technical strength specifications, the circuits began shorting out over a period of a few weeks. AMS engineers strengthened the straps significantly throughout the BETA cycle, making the product more rugged. AMS was able to identify the durability issue as one of intentional tampering, which is expected with this product. The new version of the bracelet was subjected to testing that simulated a year's worth of abuse. So far, we have stopped seeing premature failures of this type. We also addressed this through program management, and sample offender contracts provided to us with the AMS training materials for the BETAs were modified to include penalties for this type of tampering.

### Conclusions

**Officer Feedback.** Officer enthusiasm has been high with this BETA test, although the MDOC has found that to be the case with some of the other pilots they have conducted. For this BETA test, the agents were volunteers, which probably contributed to their continual acceptance and enthusiasm for the product throughout the extended BETA cycle. Overall, these agents genuinely felt that this technology has significant merit, is easier to use, and has benefits over other

equipment in the market.

**Offender Feedback.** For the purposes of the BETA Test Program, offenders were also required to complete a short questionnaire regarding their experience with the SCRAM Bracelet and SCRAM Modem. They were asked whether the bracelet is easy to wear and allows for performance of their daily activities, as well as the ease of use of the equipment. Offenders were also asked to comment on whether the SCRAM System acts as a deterrent to their consumption of alcohol and whether it is a preferred testing method. Overall, response from offenders was very positive, calling the system a fast-acting deterrent and a preferred method of testing because of the freedom to maintain work and family schedules. We even had offenders requesting to participate in the BETA program for these reasons.

**MDOC.** The MDOC will focus next on evaluating the revised version of the SCRAM Network software, which was released in November 2002, and on determining the role that Electronic Monitoring Center (EMC) staff would play in a SCRAM program. There may be some functions that the EMC staff, operating in a 24/7 call center, can do more efficiently, thus reducing agent workload. At this time there are no plans for a long-term evaluation of the SCRAM System.

From an end user's perspective, participation in BETA testing has many benefits, especially if it is a true BETA test. The obvious benefits include early exposure to new technology and an opportunity to assess the product's strengths and weaknesses in your own environment, under "real life" conditions. This can play a significant role in determining how supervision of offenders will occur in the future and what alternatives or enhancements fit in with your agency's mission/objectives. During true BETA testing, the product is still under development and it is much easier to make changes and improvements at this point rather than after it has gone into production. The vendor is more receptive to honest feedback and more willing to make necessary changes. In addition, it presents the end user with the opportunity to develop relationships with key technical and administrative personnel of the vendor that can have long-range benefits in resolving

problems and making improvements to the product over time. I also feel that the interaction provides both the vendor and the end user with the opportunity to gain a better understanding of each other's vision for the product and where future development might go.

Of course, as the testing agency, there is a responsibility on our end to provide the vendor with a test that will be meaningful to them. That means being an active participant in planning the test, providing staff participants that understand that this is testing and to not expect the product to work perfectly and be no work. If the test involves real offenders, the test must be structured in such a way to enhance the chances that feedback from those offenders will be honest. That is asking a lot, but by minimizing the offender's risk in being honest in their responses, it can be accomplished.

In this particular BETA test, these elements worked well. A remote alcohol monitoring system that requires minimal offender participation, collects samples on a continuous basis, regardless of the offender's location, and with virtual certainty about whom the sample was being collected from would be a welcome addition to the monitoring toolkit. AMS staff and MDOC staff worked well together, resulting in several improvements to the initial product, particularly the strap. As a potential end user, we have been able to obtain confidence in the product's ability to measure alcohol consumption and how the total package (hardware and software) works. ■

# Detection of Attempts to Circumvent SCRAM: Sampling of Transdermal Alcohol Concentration

by Royce McDonald\*

## Introduction

As part of the MDOC BETA test process, Alcohol Monitoring Systems (AMS) provided the Michigan Department of Corrections (MDOC) with a report that explained the readings and alerts generated from a Secure Continuous Remote Alcohol Monitor (SCRAM) Bracelet while being worn by an offender that attempted to circumvent its ability to measure concentrations of alcohol.

## Readings Reported and Alerts Generated

Distance Sensor Voltage and Transdermal Alcohol Concentration readings for the period under analysis appear in a graph below (See Chart 1). From October 25, 2002, to the first positive alcohol reading there were 36 hours of monitoring that indicated abstinence from alcohol consumption. After this initial period the following Alerts were reported:

- Distance Alert: October 26, 2002 at 10:39 p.m.
- Positive Alert: October 27, 2002 at 2:59 a.m.
- Distance Alert: October 27, 2002 at 8:11 p.m.

The first Distance Alert occurs when there is a drop in the SCRAM Bracelet's distance sensor voltage. The second Distance Alert occurs when the distance sensor voltage returns to its previous levels. The voltage readings are consistently lower between these two alerts and indicate the period of time during which a foreign object appears to have been placed between the SCRAM Bracelet and the subject's ankle.

A Positive Alert is generated at the first indication of alcohol above 0.025% Transdermal Alcohol Concentration (TAC). The SCRAM Bracelet communicated its readings at 2:59 a.m. on October 27, 2002, when it came within the proximity of the SCRAM Modem. This communication included six positive readings; the first one of which occurred earlier that same day.

Chart 1 shows the Distance Sensor Voltage and Transdermal Alcohol Concentration readings for the offender's SCRAM Bracelet from 11:53 a.m. on October 25, 2002 through 4:16 a.m. on October 28, 2002. It clearly shows the "bracketing" by the Distance Voltage readings of what appears to be a drinking event.

The first positive TAC reading occurred at 2:16 a.m. on October 27, 2002. The peak TAC reading was received at 4:44 a.m. on October 27, 2002. Alcohol was read transdermally above 0.02% until 12:04 p.m. October 27, 2002. The burn-off represents a typical "Blood Alcohol Curve."

## Report Results

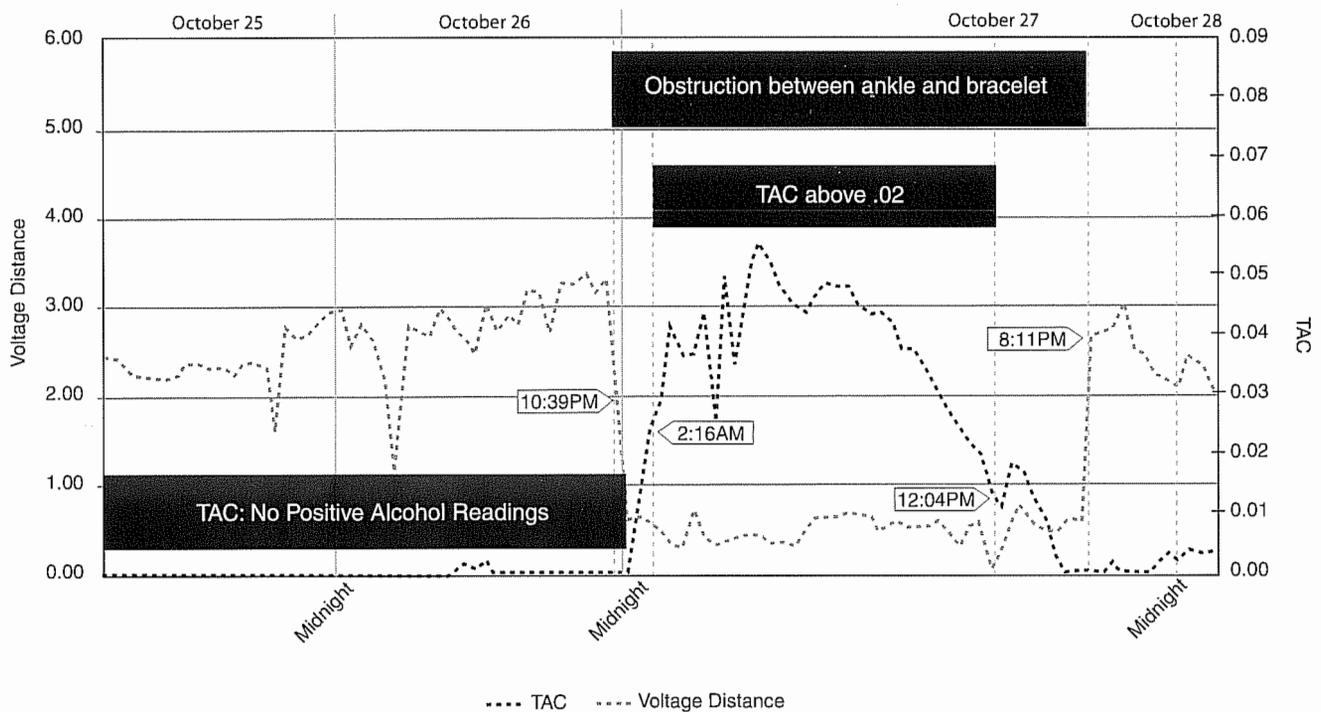
The report concluded:

1. Offender placed a foreign object between the SCRAM Bracelet on October 26 at 10:39 p.m. and removed it October 27 at 8:11 p.m.
2. Alcohol was consumed. Due to the presence of an interfering object the readings are in most likelihood reported lower than the actual alcohol concentration.

See CIRCUMVENT, next page

\*Royce McDonald is technical support manager at Alcohol Monitoring Systems; www.alcoholmonitoring.com.

**Chart 1: Interpretation of SCRAM Bracelet Readings for October 25-28, 2002**



*CIRCUMVENT, from page 7*

The AMS Technical Support Manager's report and SCRAM reports and graphs were provided to the probation officer.

The officer presented this report to the offender, who promptly admitted to both the drinking event and the tamper. According to the subject, he placed both a dress sock and an athletic sock between his ankle and the

SCRAM Bracelet and then consumed vodka. The SCRAM System correctly identified both the tamper and the consumption of alcohol.

An important item to note is that the SCRAM Bracelet continues to read positive Transdermal Alcohol Concentrations even though an object was placed between the bracelet and the ankle. AMS has used many common household items to try and create

interference of the readings. Playing cards, wax paper, stockings, and Saran Wrap are just a few of the foreign objects that have been tested. With these objects placed between the SCRAM Bracelet and the leg the peak TAC readings were diminished; however, all of these items still allowed for alcohol to be detected. The actual TAC readings without any foreign objects would read significantly higher. ■