SECURITY STUDIES PROGRAM
Massachusetts Institute of Technology

Attachment C
Letter to John Podesta
White House Chief of Staff

# Collected and Annotated Defense Criminal Investigation Service Documents Associated With the Investigation of Tampering With the Scientific and Technical Data and Analysis from the IFT-1A National Missile Defense Experiment


Material Annotated by T. A. Postol
Professor of Science, Technology and National Security Policy
Massachusetts Institute of Technology



Summary of the Contents of these Documents

The annotated documents contained herein are letters from the Defense Criminal Investigation Service to Keith Englander, Deputy Director of System Integration for the Ballistic Missile Defense Organization (BMDO). These letters document that high-level management of the BMDO were alerted to tampering with test data that was designed to hide test results. These test results indicated that the National Missile Defense's Exoatmospheric Kill Vehicle (EKV) could have serious problems selecting lethal warheads when they are accompanied by quite simple decoying objects like light balloons. Pages 7 of 11, 10, of 11, and 11 of 11 contain boxed areas of text that are triple starred to indicate their importance. The triple starred box on page 7 identifies text that first needs to be decoded by careful reading. Decoding leads to the conclusion that when objects are not deployed as intended (that is, they are not deployed "nominally"), they will exhibit motions that with very high probability drastically degrade the EKV's ability to pick out the lethal target from a complex of simple light balloon decoys. Stated differently, the EKV's will have a severely degraded ability to classify the targets observed by its homing sensor– thus leading to a breakdown in the EKV' s discrimination capability and a massive defeat of the National Missile Defense.

Further decoding of the paragraph also reveals that an object that was not deployed nominally had to be removed from the IFT-1A data set because the baseline algorithm (BLA) could not deal with it. Since this target was never put back in the data set during subsequent analyses, it appears that it was removed because it was indistinguishable from the mock warhead – thus proving that the basic discrimination technique that will be used by the US National Missile Defense is subject to massive failure.

DEPARTMENT OF DEFENSE INSPECTOR GENERAL
DEFENSE CRIMINAL INVESTIGATIVE SERVICE
WESTERN FIELD OFFICE
26722 Plaza St., Suite 130
Mission Viejo, CA 92691-6300

March 25, 1998

Mr. Keith Englander,

This correspondence has been generated, per your conversations with Special Agent (SA) Sam Reed during March 1998, which highlight additional concerns about the **misrepresentations/ noncompliance with the Technical Reqirement Document** (TRD) by TRW regarding their discrimination technology. The following is provided for your information:

1. In September 1995, Dr. Schwartz was hired by TRW as a Senior Staff Engineer. Her duties were to review various technologies within the Strategic & Launch Systems Technology Department and reported directly to the department manager Robert Hughes. One of the areas she reviewed was the discrimination technology of the Exoatmospheric Kill Vehicle (EKV) program which was using the Kalman Filter(KF). Dr. Schwartz tested the KF and disclosed to her supervisors that it had severe defects and their discrimination technology could not meet the contract requirements. Dr. Schwartz was directed to and came up with a discrimination technology that met contract requirements but it was not used by TRW for whatever the reason.

2. In April 1996, TRW provided a classified document to the government called the (U) Kalman Filter Performance. In this report TRW states, on page 11, that (U) "KF features add to current set of GBI features, resulting in a more **robust discrimination** algorithm construct," and the (U) "Extended KF (EKF) is used to handle nonlinear model cases." It also states on page 13 of this report that a (U)"Tuned EKF is tested with 1000 EFT objects in the BEST simulation to compute a probability of correct target identification". (U)"Results demonstrate that the EKF can extract features of interest in a timely manner to allow for early target identification".

3. During the latter part of September 1996, the KF was removed from TRW's discrimination technology. TRW stated the KF was only an enhancement to their discrimination and they removed it because it took up to much processing space, and they could meet contract requirements without it. Prior to the announcement, on the removal the KF, TRW had provided no previous information on any problems with the KF/EKF to Rockwell or the government.

4. During the week of March 10, 1997, Dr. Schwartz, DOJ Attorney Dennis Egan, and myself made a trip to the GBI office in Huntsville, Alabama. The purpose of this trip was to get testing done on TRW's Discrimination technology, to include testing on the KF. Prior to the trip at least two conference calls were held with GBI representatives to discuss possible testing on both TRW's baseline discrimination technology and the KF. It was conveyed by GBI representatives that there was no reason to test the KF as it had been removed by TRW and was no longer a part of the discrimination process. It was during this March meeting that we were first informed by NRC that they had already tested the KF and their results paralleled those of Dr. Schwartz. It was apparent from this information that the GBI representatives were not aware of the NRC testing of the KF, or their test results. The NRC test report on the KF was published on November 14, 1996.



9. TRW's GFA attempts to fill-in missing data points in the EKV sensor signal output. They accomplish this by using values from the OPTISIG library. However, the intended program inadvertently had zero values for the data points. This resulted in the "anomalistic" behavior of the signal outputs analyzed by NRC during their testing of TRW's discrimination technology, wherein every signature had an unexplained dip. Additionally, TRW artificially chopped the amplitude of the sensor signal output which results in arbitrarily forcing the signal mean to a predetermined value. This resulted from the sensor output noise level being to high for the baseline discrimination algorithm to process. It has been shown by TRW that the GFA works by manipulating data which gives you an artificial result. TRW showed this in their correction to the 60 Day Status Report by changing the location of the center of the ellipses, changing the shape of the ellipses, and by changing two of the features. This allowed an artificial improvement in the Probability of Assigned Target (PAT). The PAT should be solely dependent on the actual measurement of data from the signature(s), versus creating a signature(s) with gaps of missing data and filling in this data artificially to increase the value of the calculated PAT. **This GFA process is done outside the scope of statistical scientific methods.**

10. TRW performs Ranking by using a Bayesian Classifier in order to determine the degree that a detected object belongs to a specific group ( the RV in particular). The Mahalanobis distance , is calculated for each detected object as a relative measure of the likelihood of belonging to the RV group. These calculations lack the need for scaling/normalization of values, and violate the symmetry laws of .Physics and the laws of Probability.

In conclusion, it is our belief, based on the information provided herein, that TRW's discrimination technology cannot, or has ever, performed within the TRD requirements. This only leads us to believe that the PAT percentage figure reported in both the 45 and 60 day reports, for the IFT1-A flight test, were **invalid** and **well below** the contract requirements.

We are requesting that the Ballistic Missile Defense Organization undertake additional testing regarding TRW's discrimination technology. If approved, we suggest that a government controlled facility be employed to do the testing. We feel the additional testing will provide unbiased results and can only strengthen the EKV program.

I want to thank you for your interest and consideration in this matter. I look forward to hearing from you in the near future. If you have any questions please contact SA Reed, or myself, at the number listed below.

(714) 643-4191

Thank You,

Robert A. Young
Group Manager



5. While in Huntsville in December 1997, during the NRC presentation, it was stated several times by NRC representatives that the P-Select could only be equal to or less than the Probability of Identification (PID). In the Sensor Flight Test Final (60 Day Report), page 127 first paragraph, the PID is much less than the P-Select test results and requirements provided on page 11 of the Nichols Research Corporation (NRC) test report dated December 2, 1997. This is a clear indication that the Technical Requirement Document (TRD) specifications for the Single Shot Probability to Kill (SSPK) can never be met as the PID starts with a percentage that is equal to but not greater than the SSPK. This means if we start with a PID percentage that is only equal to the SSPK requirement, and the Mission Data Load (MDL) in the Kill Vehicle (KV) deviates in any way from what the sensor observes, which is expected in any real life or test flight situation, then the TRW discrimination technology will completely collapse.

We were also informed during this meeting, by GBI representatives, that our intelligence community provides us with updated information on the capabilities of our adversaries every two to six months. This data is used in developing the pre-flight dynamics which is part of the MDL. The primary inputs to building the MDL are the files containing predicted signatures for the targets. Additionally, if there is no prior knowledge of the object dynamics and other parameters/variables, then the discrimination capabilities would be reduced drastically. The General Concept of TRWs discrimination technology is wrong.

6. Prior to the IFT-1A flight test in June 1997, TRW was provided with the specific pre-flight dynamics that identified the set of features for the selected decoys and Reentry Vehicle (RV) being used for the flight test scenario. This data was part of the MDL (PID) that TRW loaded in their discrimination software programs before the flight. During the flight test if there is any deviation from the MDL, even if the deviation is within the TRD requirements, the Probability of Selecting (P-Select) the RV is degraded drastically because the features extracted during the flight do not match the MDL. The method used by TRW to select the RV is not done in a statistical manner but depends primarily on what is loaded in the MDL. The TRD lists multiple scenarios for each of our adversaries with numerous possibilities per scenario. To incorporate the probability of selecting the correct MDL for an adversary with only ten (10) different scenarios would reduce the SSPK by at least a factor of ten times smaller than defined in the TRD.

7. After the IFT-1A flight test TRW produced a 45 and 60 day status report both of which contained charts/grafts that were wrong regarding the Probability of Assigned Target (PAT). TRW has admitted that these charts/grafts were wrong and gave a presentation, in December 1997, that allegedly corrected the PAT. TRW stated during this presentation they had used the wrong Mission Data Load (MDL), MDL#4, vise MDL#5, which gave them the wrong PAT results. TRW provided no hand-outs nor did they validate the contents of their presentation. It was also during this TRW presentation that a senior GBI representative requested that TRW produce an errata sheet to correct their mistakes. To our knowledge there has been no errata sheet, as requested by GBI, produced by TRW to correct the two status reports.

8. There are other areas of the TRW discrimination technology that should be of **serious concern.** These areas deal with the **"Gap Filling Algorithm"** (GFA) for the signatures, and the **"Ranking"** of the RV. It was stated by both NRC and GBI representatives, during our December 1997 trip to Huntsville, that they do not understand how TRW's GFA for the signatures works, and that TRW has never explained or validated this process.

Intelligence on foreign countermeasure capabilities is updated every 2 to 6 months and added to the *Technical Requirements Document*, known as the TRD. This data includes critical information on the motion of targets, and it is essential for creating predicted signatures for targets. If the data or the signatures predicted from the data are unavailable or inaccurate, discrimination capabilities will be drastically reduced.

This also indicates that the defense system will have a serious dependency on timely and accurate intelligence data. In addition, it will be very difficult, and probably not feasible, for the defense system to modify its performance characteristics on such a very short time-scale.

These problems are not limited to the TRW technology. If the detailed signatures of objects are not known, or if they are different from what is expected, the Exoatmospheric Kill Vehicle will have drastically reduced discrimination.

Even in the case of the IFT-1A flyby experiment, where all the target characteristics were fully known, both warheads and decoys could not be reliably identified from the observed infrared signals.

DEPARTMENT OF DEFENSE INSPECTOR GENERAL
DEFENSE CRIMINAL INVESTIGATIVE SERVICE
WESTERN FIELD OFFICE
26722 Plaza St., Suite 130
Mission Viejo, CA 92691-6300

April 10, 1998

Mr. Keith Englander,

I am providing this correspondence regarding our conference call on March 26, 1998. During our telephone conversation we discussed several areas of concern regarding the Kalman Filter (KF), the 45 and 60 status reports, provided to you via the correspondence dated December 22, 1997, and the NRC test results of TRW's discrimination technology regarding the unexplained anomalous spikes which appeared on every target signature. The TRW KF report dated April 1996, the NRC tests results of the KF dated November 14, 1996, and NRC test results of TRW's discrimination technology dated December 2, 1997, can be provided to you by the GBI office in Huntsville, Alabama, as we discussed. A cover sheet identifying each of these documents is provided as enclosures (1), (2), and (3), respectively, as you requested. Additionally, the legal document we discussed relative to the decision of the Administrative Law Judge for unemployment compensation between Dr. Schwartz and TRW's General Counsel, is enclosure (4). I am also providing seven E-mail transmissions, enclosure (5), generated by Dr. Schwartz, while employed at TRW, which support her allegations regarding problems with the KF.

BMDO Senior Management was informed of potentially serious problems with the discrimination capabilities of the Exoatmospheric Kill Vehicle (EKV).

As discussed in *Attachment B,* the infrared signals from all the targets closely approximated signals that can be modeled in terms of a sum of randomly distributed spikes of different time duration and intensity. These signals contained no features that were unique to either the warhead or the decoys.

Thus, for all practical purposes, there was no information in any of the signals that could be used to identify warheads and decoys.

I was disappointed in Mr.Boster's comment regarding my correspondence dated December 22, 1997, that "even if I had received it I would not have read it". That comment suggests, at a minimum, a disdain for our investigation. As you know, our organization is quite concerned because of what we have learned throughout this investigation. Our preliminary findings are not based simply on allegations from Dr. Schwartz, but have been supported through other credible sources. A good example is the KF. We learned very early that the KF did not work. Our findings in this regard not only established the trustworthiness of our various sources, but also that TRW was willing to repeatedly falsify documents submitted to the United States on this program.

Comment of BMDO Senior Management revealing disinterest in addressing potentially very serious technical problems called to their attention

As I related to you previously, during my meeting with Boster while in Huntsville on December 3, 1997, he stated that the Nichols Research Corporation (NRC) did an acceptable job testing TRW's discrimination technology and that my investigation seemed to be a "witch-hunt". Also, the comment by NRC during the December 3, 1997, meeting stating they have a lot to lose as the Technical Representative for the Ground Base Interceptor (GBI) office if TRW's discrimination technology did not work, was a significant indicator of bias testing and the definite need for additional testing by a disinterested party.

Additional statements indicating a negligent attitude toward potentially very serious technical problems called to their attention

As I have stated before, I feel that additional testing can only help the Exoatmospheric Kill Vehicle program. This is evidenced by a document generated by TRW, enclosure (6), wherein they try to explain the anomalous spikes found in every target signature which was surfaced from the testing by NRC. There have been several serious areas of concern that have been brought to the attention of TRW through the efforts of Dr. Schwartz. I believe if these questionable areas had not been identified that the government, nor possibly anyone else, would be aware of them today.



In closing, you stated during our conversation that your intentions were to possibly have TRW give a presentation on their discrimination technology with full validation. This is an excellent idea but I would like to discuss the matter with you for other possible considerations. I look forwarding to talking with you in the near future.

Sincerely,

Samuel W. Reed, Jr.
Special Agent, DCIS

Enclosures

DEPARTMENT OF DEFENSE INSPECTOR GENERAL
DEFENSE CRIMINAL INVESTIGATIVE SERVICE
WESTERN FIELD OFFICE
26722 PLAZA ST., SUITE 130
MISSION VIEJO, CA 92691-6300

August 6, 1998

To: Mr. Keith Englander,
Director, BMDO/JNI

From: Samuel W. Reed, Jr.
Special Agent DCIS

Subject: Response to TRW's (U) POET Review of EKV Discrimination Algorithms dated July 21-22, 1998

The presentation by TRW for the POET Team on July 21 & 22, 1998, was unique and revealing. We have examined the document provided by TRW during their presentation. Our evaluation of the TRW document is provided in attachment (1). I am also providing an NRC document, attachment (2), dated March 5, 1998, initially obtained from GBI during TRW's presentation, which identifies several questionable areas of TRW's discrimination technology. We feel there are some very distinct areas in our evaluation, with examples and illustrations, that clarify why TRW's discrimination technology is incapable, and does not meet the EKV contract requirements. A copy of this correspondence has been provided to Dr. Frank Handler for distribution to the POET Team.

Criminal Investigative Service finds further confirmation that there are serious problems with the post-flight analysis of the IFT-1A National Missile Defense flyby experiment

My concern in talking with members of the POET Team is they have been overwhelmed with a voluminous amount of material to review in a short period of time. I hope they have been able to immerse themselves in this very complex and difficult area to understand/analyze. It is requested that an extension of time be considered for the POET Team in order for them to do an accurate and complete assessment.

In my last correspondence to you, dated August 3, 1998, I referred to an individual who is willing to come forward and meet face to face with the POET Team concerning problem areas with TRW's discrimination technology. I hope this can be arranged in the near future? I await your response on the matter.

In conclusion, I request that this correspondence, and the one containing the "Contradictions" dated June 29, 1998, not be disseminated outside your office or members of the POET Team. I want to thank you for your time and interest in this matter. I look forward to hearing from you in the near future. If you have any questions please contact me at this number, (949) 643-4191.

Attachments:

Sincerely,

Samuel W. Reed, Jr.
Special Agent, DCIS

DEFENSE CRIMINAL INVESTIGATIVE SERVICE
WESTERN FIELD OFFICE
26722 PLAZA ST., SUITE 130
MISSION VIEJO, CA 92691-6300

September 1, 1998

Mr. Keith Englander,

This correspondence identifies the inadequacies of TRW's discrimination technology. The information relied upon in this report was taken directly from TRW's own reports (45 day, 60 day, Addendum 1, July 21/22, 1998), their assumptions, and their own mathematical equations for computing likelihood. A hard copy printout provides the process used to calculate the results, which is also on diskette. This will enable you to review and validate every step. The results you will see are all entirely supported and completely derived from TRW's data, which clearly demonstrates scientifically that their discrimination technology does not, can not, and will not meet the TRD/contract requirements.

The Defense Criminal Investigative Service (DCIS) independently confirms that scientifically unsound data analysis procedures have been used to make false technical claims about the post-flight results of the IFT-1A National Missile Defense flyby experiment. The DCIS provides BMDO with a detailed re-analysis of the post-flight data set from the IFT-1A flyby. The analysis shows that claims made that the EKV will have a high capability to discriminate warheads from decoys are not supported by the post-flight data analysis.

First, we would like to comment about a specific term used by TRW referred to as the "Walking Vector". We have searched everywhere, and the concept of the "Walking Vector" used by TRW is undefined. There is nothing to our knowledge in any statistical literature on "Stochastic Convergence" that matches the TRW notion of a "Walking Vector". This is an ill-defined concept. We would appreciate any comments and input from you.

The enclosure to this correspondence is a thirteen-page report with four attachments. The Statistical Hypotheses for testing the Probability 'P' that a sample from class "0" is more likely to come from class "0" than any of the samples from other classes, is given in pages 1 through 6 of this report. The discrimination algorithm robustness is computed by introducing changes to the ellipses within the range that TRW introduced in their numerous reports. The robustness is displayed on pages 7 & 8 by the differences between P1 and P2. The mathematical equations for 'P', for the negative log likelihood and three-sigma confidence bound, were "computer analyzed " in two cases: (1) The TRW non-standard likelihood approaches and (2) The Standard definition of likelihood approaches. The comparison performance is provided in the "Monte Carlo Sampling Results" (MCSR) on page seven of the report. The MCSR identifies the ellipses, displayed in attachment (1), by their page number from the TRW report dated July 21/22, 1998. The results on page seven, from the MCSR, are staggering but scientifically supported using only TRW's own data as generated by their Baseline Algorithm for discrimination.

Criminal Investigative Service points out that the techniques used to analyze the post-flight IFT-1A data were scientifically unsound.

From the results of the statistical hypotheses testing and validation of TRW's discrimination technology it is absolutely clear and scientifically based that they do not have a statistically sound method of achieving the robust results as published in their numerous reports.

Subsequent analysis reveals that the probability of identifying the correct target is still very low, even when scientifically sound data analysis procedures are applied to the data.

This result indicates that the physical data from IFT-1A sensor flyby does not contain unique information that makes it possible to discriminate between the decoys and the warhead.

The 'Computer Analysis' subroutines are listed on pages 11 & 12 of this report and are provided in attachment (4). The operating software code, along with the RM/Fortran



compiler and linker, are on the diskette marked attachment (5). This is an operational tool the POET Team can use for evaluating the probability performance of TRW's discrimination technology.

A tremendous amount of effort was required to produce and validate enclosure (1). This report was done in the most simplistic, clear, and concise way to hopefully eliminate any confusion that can so easily occur in the discrimination area. We conclude, based on the data contained in this report, which was derived entirely from the information provided in TRW's reports, that there is absolute irrefutable proof that TRW's discrimination technology does not work. We know that this is the strongest statement that can be made regarding our position relative to TRW's discrimination technology. We invite the POET Team to thoroughly review this report, make their own calculations, and ask them to either validate our findings or refute them scientifically.

Defense Criminal Investigative Service (DCIS) invites the Ballistic Missile Defense Organizations's internal analysis team, the Phase One Engineering Team (POET), to validate the DCIS findings.

The subsequent report of the POET, while very badly written and organized, presents findings that are in basic agreement with those of the DCIS.

In conclusion, we are aware that the POET Team is finalizing their report regarding TRW's discrimination technology. Our report clearly demonstrates and scientifically proves the inadequacies and misrepresentations by TRW concerning their discrimination technology. We are anxious to meet with the POET Team to discuss these findings and answer any questions they may have. Our TRW source, along with Dr. Schwartz and other engineering personnel will be pleased to discuss the findings at anytime via conference call, prior to our next meeting with the POET Team. This report will be disseminated to the POET Team in order to save time and expedite matters. We ask that this correspondence not be disseminated, or its information disclosed, outside your office or members of the POET Team. I look forward to hearing from you in the near future. If you have any questions please contact me at (949) 643-4191.

Sincerely,

Samuel W. Reed, Jr.
Special Agent, DCIS

DEPARTMENT OF DEFENSE INSPECTOR GENERAL
DEFENSE CRIMINAL INVESTIGATIVE SERVICE
WESTERN FIELD OFFICE
26722 Plaza St., Suite 130
Mission Viejo, CA 92691-6300

September 24, 1998

Mr. Keith Englander,

In our last correspondence dated September 1, 1998, we provided what we feel is absolute irrefutable scientific proof that TRW's discrimination technology does not, can not, and will not work, and falls far-short of meeting the TRD/contract requirements. We only used the data reported by TRW, which primarily focuses on the IFT-1A 45-day, 60-day, Addendum 1, and July 21/22, 1998, reports. We also provided you with enlarged copies of the TRW ellipses, which is the final product of TRW's Baseline Algorithm (BLA) for discrimination. The means to validate our calculations was provided both in hardcopy an on diskette and we invited the POET Team to do their own calculations to verify our report. Our report showed the use of one set of two features and provided two Monte Carlo Sampling Results tables which disclosed significantly lower results than reported by TRW.

I would like to draw your attention to our August 6, 1998 report, specifically attachment (2) of that report, which is a document generated by the Nichols Research Corporation (NRC), dated March 5, 1998. That NRC document highlights numerous areas of concern by NRC regarding the BNA Sensor Flight Test Final (60-Day) Report. On page four of the NRC document under "Summary" #25 it states-"the conclusion they are trying to make is not supported by the data shown. **This point cannot in fact be demonstrated by a single mission, one realization out of potentially thousands of realizations. Putting it a different way, this might simply be a lucky draw out of the realm of statistical possibilities.** Examination of many, many missions and a wide variety of stressing conditions using either real or simulated flight test data can only support the statement made here" (see page 1 fourth bullet of this report). Also, please review #27 of the NRC report, which states "There were significant differences between the 45 and 60 day reports results. What happened in between? Some discussion of this would have been appropriate. Did they use different models? Different smoothing? Different filtering? Different data? Different sensor characterizations"? NRC appears to be somewhat puzzled or confused on how TRW came up with the results they reported in their 60-day report.

Enclosure (1) to this correspondence is a fifteen-page report with four attachments. The report shows the use of two sets of two features (four features) with the same significantly lower results than reported by TRW. Again, everything is provided in hardcopy and on diskette so the POET Team can validate every step of the process. We invite the POET Team to calculate the probability of correct discrimination using the IFT-1A flight data and TRW's mathematical equations for computing Likelihood, and compare the results to the PAT figures published by TRW in their July 21/22, 1998, report (see page 184 of that report).



Again, our report is not based on opinions, approximations, or estimations. It is based entirely on scientific fact using standard mathematical equations clearly established throughout the scientific community. We ask that the POET Team review our report using a scientific approach to disprove any of our findings.

In conclusion, we are looking forward to meeting with the POET Team members during the week of October 5, 1998. If there are any questions from the members we ask that they be forwarded ahead of time so we can prepare a response. This report will be disseminated directly to the POET Team in order to save time. We ask that this correspondence not be disseminated outside your office or members of the POET Team. If you have any questions please contact me at (949) 643-4191.

Thank you for your support and patience in this matter.

Sincerely,

Samuel W. Reed, Jr.
Special Agent, DCIS

NOTE

Defense Criminal Investigative Service (DCIS) letter pointing out additional discrepancies in technical reports about the results of post-flight data analysis of the IFT-1A flyby.

This includes a report by Nichol's Research Laboratory that early conclusions about the ability of the EKV to discriminate between decoys and warheads are not supported by the data collected during the IFT-1A flyby.

It is also pointed out that two post-flight data analysis reports issued 45 and 60 days after the flyby have wildly different results that are not explained in the documents.

DEPARTMENT OF DEFENSE INSPECTOR GENERAL
DEFENSE CRIMINAL INVESTIGATIVE SERVICE
WESTERN FIELD OFFICE
26722 PLAZA ST., SUITE 130
MISSION VIEJO, CA 92691-6300

February 01, 1999

Mr. Keith Englander,

In our last correspondence we provided what we feel is absolute irrefutable scientific proof that TRW's discrimination technology does not, cannot, and will not work, and falls far-short of meeting the TRD/contract requirements. After reviewing the POET draft report we feel even stronger about that statement. We have just received the final version of the POET report, but have not had time to review it in detail.

I would like to start by highlighting a few areas of the four-page "Executive Summary" from the POET draft report which are **extremely supportive** in exposing the serious flaws in the TRW discrimination technology. These statements fully corroborate our findings and reiterate what we have been saying for over two years.

Starting with the first paragraph of the "Executive Summary" (page iii), last sentence, it states *"Target discrimination and selection must be done with or without handover information about the target from the rest of the NMD system." The second paragraph, first sentence, states "TRW has developed an onboard autonomous discrimination architecture and a set of algorithms for the Boeing EKV."*

The first indented paragraph on page iii, **#1, states** *"Overall, the Baseline Algorithm(s) (BLA) are well designed and work properly, with only some refinement or redesign required to increased robustness of the overall discrimination functions."* We feel this statement is misleading and incomplete, and contradictory of later material in the report. The indented paragraph #4, page iv, states *"The performance of the discrimination architecture may be fragile. Training data sets that closely match actual threats are crucial to the performance of the multimodal Bayesian quadratic classifier (MBQC) for the fine (i.e., precision) discrimination function. Performance may degrade significantly if incorrect prior knowledge regarding target signatures is used in the classifier database. The target signatures are heavily influenced by threat type, target characteristics, sensor-to-target geometry, and engagement timeline. Therefore, unexpected targets in the threat may challenge the performance of the MBQC. It would be desirable to expand the current discrimination architecture to make it more robust by including, for example, real-time adaptation capability and certain threat-type-based system-level discrimination."*

We definitely agree with the above statement which totally supports and corroborates what we have been saying, and contradicts indented paragraph #1 which states *"Overall the BLA are well designed and work properly,* **etc"** along with the statement that TRW's discrimination architecture is autonomous. The Technical Requirements Document (TRD) requires that the discrimination technology be capable of operating with or without



knowledge of threat types. The POET **clearly** indicates that TRW's discrimination BLA **is not robust**, and it is crucial that the training data sets closely match actual threats for the fine discrimination function.

The POET's statement of *"Overall, the BLA(s) are well designed and work properly"* would be accurate if stated that **TRW's BLA's are well designed and work properly if and only if the training data sets, loaded in the Mission Data Load (MDL), closely match the actual threats for the fine discrimination function. We have always contended that prior knowledge can improve algorithm performance to a certain extent but it is critical that a discrimination algorithm perform independently, to the maximum possible extent, with limited or no prior knowledge. A discrimination algorithm has to be capable of adjusting to unpredictable and unknown target objects from classes that are not expected. It has to be capable of adjusting to the situations in which an object from an expected object class is missing.** The TRD specifically states that "Included in the scenarios are accidental and unauthorized launches by the Commonwealth of Independent States (CIS, formerly the Soviet Union) and China, and limited strikes by China and the Rest of World (ROW) countries" (page A-2). Also, the BLA must perform when an object from an expected object class does not perform nominally. TRW's discrimination algorithms have never been able to function in this situation. **Their algorithms are heavily dependent on prior knowledge, or they adjust their discrimination results by using Post Flight data in order to show acceptable results. It is scientifically impermissible to use unknowable information to correct experimental results after the fact.**

On page v of the Executive Summary, the last sentence on the page states *"If targets are deployed nominally in IFT-3, it is the POET team's assessment that the TRW BLA will successfully select the MRV as the intercept target, even for the most stressing target suite."* It also states in the body of the same paragraph *"The most stressing target suite for EKV discrimination contains the same ten targets as those deployed in IFT-1A."* This contention seems questionable because TRW requested the removal of one of the objects from the target suite for the IFT-3. This information surfaced at the July 21 & 22, 1998, meeting with TRW at the Aerospace Corporation. The reason for the removal of the object was that its off-nominal deployment caused TRW's BLA significant problems. This confirms the POET's statement *"The performance of the discrimination architecture may be fragile."*

On page vi of the Executive Summary, third paragraph, it states *"One of the most important criticisms raised by DCIS is that during the IFT-1A postmission analyses TRW unjustifiably shifted the preflight feature distribution ellipses between the 45-day report and the 60-day report in order to increase the BLA's discrimination performance. As previously noted, TRW's explanation that an improperly constituted GFA caused the discrepancies appears to be correct."* In TRW's report titled "(U) POET Review Of EKV Discrimination Algorithms" dated July 21 & 22,1998, they state **"The primary differences**

NOTE

Defense Criminal Investigative Service (DCIS) letter summarizing the findings of its investigation of the various reports associated with the post-flight data analysis of the IFT-1A flyby.

The letter speaks for itself.

* * *

Flight test data for the partially inflated balloon removed from the post-flight data analysis of the National Missile Defense flyby experiment IFT-1A. Note POET caveate that *"if targets are deployed nominally"* then discrimination will be possible.

**The target was not deployed nominally, and as a result it was indistinguishable from the mock warhead!**

3

**between the 45 and 60-Day MDL was in the settings for the available track length." "Gap Filling did not affect the measured signatures because of the start time of 1752 for the hand-tracked object reports. Features are calculated from the measured signatures and compared with the MDL." The explanation by TRW that an improperly constituted GFA caused the discrepancies referring to the shifting of the ellipses between the 45 and 60-Day reports is totally incorrect (pages 156 and 173 refer). The real difference between the discrimination performance result (PAT) provided by TRW in the 45-Day Report, compared to the 60-Day PAT, was the shortening of available flight data track length to 16 seconds for the 60-Day, versus 47 seconds used for the 45-Day Report. Additionally, it appears the training of the OSC code by TRW with the actual IFT-1A flight data, was used to generate the 60-Day MDL.**

The very high PAT provided in the 60-Day Report is a direct result of the extremely close match between the OSC code trained with IFT-1A flight test data and the IFT-1A flight test data results. It is certainly clear that the IFT-3 actual results will not be available as a training set until the flight test has been completed.

In our March 25, 1998, report we provided our views regarding the Gap Filling Algorithm (GAP) and the serious adverse of using this consequence algorithm. We related that both NRC and GBI representatives informed us, during our December 1997 trip to Huntsville, that they do not understand how TRW's GFA for the signatures works and that TRW has never explained or validated the method. We explain that TRW's GFA attempts to fill in missing data points in the EKV sensor signal output by using values from the OPTISIG library. However, the intended program inadvertently used zero values for the data points. This resulted in the "anomalistic" behavior of the signal outputs analyzed by NRC during their testing of TRW's discrimination technology, wherein every signature had an unexplained dip. Additionally, TRW artificially chopped the amplitude of the sensor signal output which results in arbitrarily forcing the signal mean to a predetermined value. This resulted from the sensor output noise level being too high for the baseline discrimination algorithm to process. It has been shown by TRW that the GFA manipulates data in such a way to give artificial results. TRW showed this in their correction to the 60-Day Status Report by changing the location of the center of the ellipses, changing the shape of the ellipses, and by changing two of the features. This allowed an artificial improvement in the Probability of assigned Target (PAT). **The PAT should be solely dependent on the actual measurement of data from the real signature(s), versus creating a signature(s) with gaps of missing data and filling in this data artificially to increase the value of the calculated PAT.** This GFA process is done outside of accepted statistical scientific methods. Prior to the down-select TRW stated they were not going to use the GFA for the IFT-3 which is also stated in the POET's report. This can only raise the question of how would TRW handle any gaps in the actual IFT-3 signatures.

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On page vi the POET states ***"Another important issue concerns the "improper" concept of ranking probability used by TRW for selecting an intercept target. It is clear to the POET team that all points raised concerning this issue were based on misunderstanding of Bayes rule and misinterpretation of TRW's approach."*** Our understanding of TRW's ranking scheme is that it selects the object with the highest probability of belonging to the RV class given the object's extracted feature vector. This is the case even though it is possible that the particular object selected may have a higher posterior probability of belonging to another class. It can also be the case, that another object with lower PAT than the highest-ranking object could actually have the largest probability of being the RV among the classes. The table below is a simple illustration of this possibility:

| OBJECT | OBJECT CLASSES | | |
|---|---|---|---|
| | RV | MB | LB |
| 1 | 0.40 | 0.60 | 0.00 |
| 2 | 0.39 | 0.305 | 0.305 |

We do not misunderstand Bayes rule. We apply it differently than TRW does in its MBQC. Rather than assuming that each tracked object surely belongs to one of five different classes with a given prior hypothesis probability per object class, we assume the equally likely prior hypotheses that one of the tracked objects is surely the RV. In addition we view the set of extracted independent feature vectors as comprising the compound posterior event.

Given our hypothesis and event structure, our Monte Carlo analysis (1000 samples) yielded an estimated probability of correct RV selection that is within a few percentage points of the POET's. The Confusion Matrix, displayed on page 18 of the POET draft report, shows their probability of correct RV selection. The POET results and ours are consistent and mutually supportive. The difference between the two is well within the Monte Carlo sampling error.

The last paragraph, page vi, of the Executive Summary the POET states ***"It is a legitimate concern that the robustness of the BLA's discrimination function could be compromised by the assumption that threat-typing information would be available for use in the MDL database and that target characteristics, motion parameters, and engagement geometry would be known for a given threat system. Reliable prior knowledge on many of the threat types included in the TRD cannot be obtained. The POET study did not evaluate to what extent the BLA may be used to meet the general requirements described in the TRD beyond the ability to determine which object among a threat cloud is lethal (given that the threat type is known). However, the POET team's concerns regarding the potential lack of robustness of the current BLA have been indicated earlier. The POET team also***

***recognizes that the concept of threat typing can have significant impact on EKV discrimination performance and that such impact should be examined carefully in the context of overall NMD architecture design and threat assessment. Within the EKV scenario setting it may be important to structure the discrimination architecture to take advantage of threat-typing information while at the same time reducing potential risk."*** We agree with the sense of this paragraph even more strongly than as stated by the POET.

In reviewing the POET report we noted that part of the report focused on the Kalman Filter (KF) performance. We reviewed the Statement of Work (SOW) generated by Dr. Frank Handler for the POET but did not see anything about the KF. **Our concern is when did this become part of the SOW? Why weren't we notified? Why didn't we get a copy of the new SOW?** and **Why didn't we get a chance to provide some input?** In reviewing the reference list for the POET report we noted that the "I-SETAC ANALYSIS OF ROCKWELL KALMAN FILTER FEATURE EXTRACTION CONCEPT (U)" dated November 14, 1996 was not identified. The Nichols Research Corporation (NRC), which is the technical advisor to the Ground Base Interceptor (GBI) Office in Huntsville, Alabama authored this report. We feel that before the POET made any comments regarding the KF they should have had all immediately available reports concerning the matter.

From reviewing the POET draft report, the TRD requirements, and all the other accumulated relevant documents we will summarize a number of points on why the TRW BLA is not, nor has it ever been basically sound or capable of meeting the contract requirements:

(1). Almost all features are only descriptive statistics which wash out any intrinsic physics and spectral information contained in the intensity signatures. Moreover, the features are not functionally independent.

(2). The features, for all object classes, are assumed to be constant over time; they are not. Feature time variability is artificially compensated by lumping it into the apriori feature error covariance matrices. Lumping feature time varying effects into these covariance matrices creates large regions of overlap in the feature spaces of different object classes. These overlap regions grow as mission elapsed time increases because of the secular trends in the features. Such trends, reflected in the extracted features, are highly likely to cause one detected object's extracted feature vector to wander close to the center of the apriori error ellipse family for a different object class. Depending on the actual engagements object-by-object materials, temperatures, aspect angle temporal variation, etc. the RV's extracted feature vector will, with uncomfortably high probability, travel out of the apriori likely RV class region into the likely region of another object class; conversely the extracted feature vector for another object class is likely to "walk" close to the RV apriori feature vector mean. We can predict with some certainty that such confusion will grow overtime as more object-by-object data is accumulated. This is exactly what a sound



algorithm should not do. A sound algorithm should be able to select the RV with greater and greater confidence as the object-by object data spans increase.

(3). TRW's BLA, while computing a feature extraction error covariance matrix for each tracked object, does not use this matrix in its Baysean Likelihood calculations. This omission is both statistically incorrect and computationally inefficient. We can only speculate that the required use of this matrix as a summand was left out because to include it would generate larger total error overlap and selection performance degradation.

(4). The strictly recursive feature extraction approach is questionable. Recursive computations have appreciable startup transient times and preclude the exploitation of spectral methods, which require a batch of data over an appropriate time span. Batch estimation is more appropriate than recursive estimation for truly time invariant parameters.

(5). With one exception the total feature set has nothing to do with the underlying physics, thermodynamics and mechanics.

(6). To paraphrase one of the POET's main finding's, apriori threat identification data will not always be available. Even if accurate missile typing data is transmitted from surveillance assets to the GBI via the BMC 3 element, there is no assurance whatsoever that the corresponding MDL would faithfully represent the set of objects, RV and decoys, carried by the missile's PBV, nor all likely variations in the actual object-by-object composition, temperature distribution, deployment geometry, rotational dynamics properties, etc.

(7). Given (1) to (6) one can expect that the BLA performance will be exquisitely sensitive to feature extraction start times, data spans, non-nominal object deployments, irradiance data gaps, dips, and spikes of whatever origin. Such dips and spikes can arise from particle and gamma ray events, sensor electronic anomalies, or actual rapidly time varying aspect angles as well as the individual objects projected area, shape, and body element material composition changes.

(8). As for robustness, we assert that the BLA is, instead, extremely fragile. This contention is borne out in both the POET's and our results as shown in the table on page 66 of the draft report titled "Independent Review of TRW Discrimination Techniques", 7-8 December 1998, by Dr. Ming Tsai et al (page 67 of the POET final report refers).

(9). It is clear from our reading and analysis of the documentation cited in the POET's bibliography that TRW heavily censored the IFT-1A signature data, deleting approximately the first 20 seconds and the last 11 seconds to go from poor results in its 45-Day Report, to excellent results in its 60-Day Report Addendum. Removal of the last 11 seconds is especially critical because we have evidence to believe that in this interval of time the RV's PAT fell dramatically and dropped below another object's rising PAT.

Additionally, TRW generated the MDL used for the 60-Day Report analysis by training the OSC code with the detailed knowledge from IFT-1A flight data since that information was used in constructing the MDL. The very high PAT achieved in the 60-Day Report is a direct result of this close match and has nothing to do with the GFA. **Such after-the-fact censoring is impermissible as any kind of empirical evidence that the BLA meets TRD specified near term discrimination performance requirements.**

(10). We also suspect that early data was censored to hide the difficulty the BLA was having with real signature spikes, not Boeing/GBI sensor-induced spikes. **These signature spikes were actually induced by object attitude motion as verified by the Airborne Sensor Testbed (AST) data.** In addition the use of impermissible after the fact knowledge by TRW to switch features in mid-data stream was also noted, and previously reported to the POET.

(11). **TRW's BLA cannot be well designed if it is lacking a critical component such as an effective Gap Filling Algorithm.**

Putting together all these instances of impermissible use of after-the-fact knowledge, early data censoring to remove difficult data, late data censoring to make sure that the RV was selected, and a missing key algorithm, can only cast grave suspicion about the ineffectiveness and fragility of TRW's BLA's capability to meet contract requirements.

There is no crime in producing a failed algorithm during a Research and Development project. That's all part of the acceptable risk in order to eliminate the non-viable approaches. The crime is in producing a failed algorithm and knowingly covering up its failure.

In conclusion, we are looking forward to meeting with you and the POET this week. I request that this correspondence not be disseminated outside your office or members of the POET. I want to thank for your time and interest in this matter.

Sincerely,

Samuel W. Reed, Jr.
Group Manager, DCIS

DEPARTMENT OF DEFENSE INSPECTOR GENERAL
DEFENSE CRIMINAL INVESTIGATIVE SERVICE
WESTERN FIELD OFFICE
26722 PLAZA ST., SUITE 130
MISSION VIEJO, CA 92691-6300

9610701Z-18-JUN-96-50LA-E0QT March 15, 1999

**TRW CORPORATION**
Redondo Beach, CA

RECEIPT OF ARMY CORRESPONDENCE: On March 8, 1999, Department of Justice (DOJ) Attorney Dennis Egan faxed reporting agent a copy of a letter from the Department of the Army, United States Army Legal Services Agency, Arlington, VA. The letter is addressed to Mr. Michael F. Hertz, head of the Commercial Litigation Branch, Civil Division, DOJ Washington, D.C. The letter is dated February 26, 1999, and recommends against DOJ intervening in this case. One of the reasons for not intervening was based upon conversations with the investigators handling the case. This statement has no factual basis as reporting agent is the only investigator assigned to the case, and has not spoken with any Army representative regarding not intervening in the case.

***

**Army misrepresents Defense Criminal Investigation Service findings to the Department of Justice**

Attachment
1. Army Letter dated February 26,1999.

Prepared by SA Samuel W. Reed, SO-Western Field Office
APPR: SWR/PRW

DEPARTMENT OF DEFENSE INSPECTOR GENERAL
DEFENSE CRIMINAL INVESTIGATIVE SERVICE
WESTERN FIELD OFFICE
26722 PLAZA ST., SUITE 130
MISSION VIEJO, CA 92691-6300

August 11, 1999

Mr. Keith Englander,

I am sending this correspondence to provide you with our response to the Phase One Engineering Team (POET) answers to our questions. These questions were presented to the POET during their briefing on February 3, 1999, at the Aerospace Corporation. We still feel that the questioned discrimination technology does not work and we only hope the truth will prevail in the near future.

On March 11, 1999, I received a fax from you that contained the POET answers to our questions. Our response to the POET answers reflects several areas of concern. I feel we have already presented information that clearly demonstrates TRW's Baseline Algorithm (BLA) for discrimination has never worked unless TRW modified their algorithm to fit the scenario after the fact. The POET report was the basis for BMDO to accept that TRW's BLA for discrimination meets the contract requirements. We do not accept this because if you read the final POET report you will find a number of serious contradictions within the report. We quoted these contradictions in our last correspondence to you dated February 1, 1999. Again, the POET never proved that DCIS was wrong in the DCIS analysis of TRW's discrimination technology. Following are just some of the POET statements taken directly from their final report that support our analysis:

(1). "*The performance of the discrimination architecture may be fragile*".

(2). "*It would be desirable to expand the current discrimination architecture to make it more robust*".

(3). "*However, the POET team's concerns regarding the potential lack of robustness of the current BLA have been indicated earlier*".

(4). "*It is a legitimate concern that the robustness of the BLA's discrimination function could be compromised by the assumption that threat-typing information would be available for use in the MDL database and that target characteristics, motion parameters, and engagement geometry would be known for a given threat system. Reliable prior knowledge on many of the threat types included in the TRD cannot be obtained*".

(5). "*The POET team also recognizes that the concept of threat typing can have significant impact on EKV discrimination performance and that such impact should be examined carefully in the context of overall NMD architecture design and threat assessment. Within the EKV scenario setting it may be important to structure the discrimination architecture to take advantage of threat-typing information while at the same time reducing potential risk*".

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(6). "*Overall, the Baseline Algorithm(s) (BLA) are well designed and work properly, with only some refinement or redesign required to increase robustness of the overall discrimination functions*". The underlined portion of this statement is never detailed within the POET report. It would seem that in order to do *only some refinement or redesign* of the BLA would cause a domino effect on the entire algorithm. The DCIS team also pointed out that the BLA is missing such key algorithms as "**Gap Filling**" and an "**Automated Method to Determine Data Span**".

The six quotes above were taken directly from the POET final report. These are only some of the statements which support our allegations that TRW's discrimination technology does not work or meet the contract requirements.

Throughout the course of this investigation I have tried to keep an objective overview of both sides regarding the questioned discrimination algorithm. I know it seems that the appropriate steps were taken when a POET reviewed the technology, but I am only more convinced after their results that the technology does not work. It seems as though no one is actually reading the entire report(s) but only skimming the contents before reaching a conclusion. There are other engineers who have been working on this discrimination technology, besides Dr. Schwartz, for several years and can certify that it does not work. If you would like to meet a respected senior engineer with forty years of experience in the aerospace industry, who worked on the questioned technology at TRW, and who has reviewed both the Schwartz and POET report(s) please notify me as soon as possible. If you cannot meet with this person we could do the initial contact by telephone.

In conclusion, this is the tenth report I have provided to you regarding the questioned discrimination technology. I look forward to hearing from you in the near future. I request that this correspondence not be disseminated outside your office, and only to those who have a need to know. I want to thank you for your sincere interest in this most important and critical area.

Sincerely,

Samuel W. Reed, Jr.
Group Manager, DCIS

Enclosure

***

Defense Criminal Investigative Service points out that the Phase One Engineering Team (POET) Report essentially *confirms the serious problems with EKV discrimination* exposed from the post-flight analysis of the telemetry data from the IFT-1A National Missile Defense flyby experiment.

*The POET findings appear to be intentionally constructed to obfuscate this fundamental finding.*

It is clear from this and the accompanying correspondence that BMDO management chose to ignore serious warnings from the Defense investigative Service even after the BMDO's own internal team verified the concerns.