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11 and Relator Dr. Nira Schwartz

12  
13 **UNITED STATES DISTRICT COURT**  
14 **CENTRAL DISTRICT OF CALIFORNIA**

15  
16 UNITED STATES OF AMERICA EX REL  
NIRA SCHWARTZ, )  
17 )  
Plaintiff, )  
18 vs. )  
19 TRW, INC., an Ohio corporation, and )  
BOEING N. AMERICA INC., a Delaware )  
20 corporation, )  
21 Defendants. )

CASE NO. CV 96-3065 CM (RMCx)

**FOURTH AMENDED COMPLAINT  
FOR:**

1. **VIOLATION OF THE FALSE  
CLAIMS ACT, 31 U.S.C.  
§§3729(a)(1), (a)(2) and (c);**
2. **EMPLOYMENT RETALIATION  
IN VIOLATION OF THE FALSE  
CLAIMS ACT, 31 U.S.C.  
§3730(h); and**
3. **WRONGFUL TERMINATION IN  
VIOLATION OF PUBLIC  
POLICY**

**DEMAND FOR JURY TRIAL**

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1 This is an action by relator Dr. Nira Schwartz (“Schwartz”), in the name of the  
2 United States Government (the “Government”), to recover penalties and damages arising from  
3 fraud on a vast scale perpetrated by defendants TRW, Inc. (“TRW”) and Boeing North America,  
4 Inc. (“Boeing”) in connection with the efforts of the U.S. Army’s Space and Strategic Defense  
5 Command to develop a Ground Based Interceptor (“GBI”) for possible deployment by the  
6 United States’ National Missile Defense (“NMD”) program. The claims asserted herein include  
7 counts under the False Claims Act, 31 U.S.C. §§ 3727 et seq. They also include a count by  
8 Schwartz as plaintiff under California state law for wrongful termination in violation of public  
9 policy.

10  
11 **I.**

12 **JURISDICTION AND VENUE**

13 1. This Court has jurisdiction of this action pursuant to 28 U.S.C. § 1345  
14 and 31 U.S.C. § 3732(a). This Court also has supplemental jurisdiction over Schwartz’s related  
15 California state law claim for wrongful termination in violation of public policy pursuant to 28  
16 U.S.C. § 1367.

17 2. Venue is proper in the Central District of California under 31 U.S.C. §  
18 3732(a) and 28 U.S.C. §§ 1391(b), (c). A substantial part of the acts or omissions alleged  
19 herein occurred within the Central District of California. Moreover, defendants TRW and  
20 Boeing transact business in this District.

21 3. Plaintiff and relator Schwartz demands trial by jury.

22 **II.**

23 **PRELIMINARY STATEMENT**

24 4. The events underlying this case arise out of the roles of TRW and Boeing  
25 in the NMD program. The NMD program is intended to develop a system to protect the United  
26 States from a limited attack of ballistic missiles containing weapons of mass destruction. The  
27 NMD program is premised on developing a “kill vehicle” that can locate, intercept and destroy  
28 an incoming warhead.

1           5.       The task of the kill vehicle intercepting a warhead is tantamount to  
2 hitting a bullet with a bullet. To intercept successfully, the kill vehicle must also differentiate  
3 between an actual warhead and decoys designed to draw the kill vehicle to the wrong target.  
4 Experts on missile technology, including at the U.S. Central Intelligence Agency, have  
5 concluded that a potential adversary's use of decoys is inevitable because effective decoys  
6 require much less sophisticated engineering than that necessary for an intercontinental ballistic  
7 missile.

8           6.       Boeing was a prime contractor in the NMD program during the times  
9 relevant to this action. TRW's role in the NMD program included purportedly developing  
10 technology for the kill vehicle to distinguish warheads from decoys. TRW, and Boeing as the  
11 prime contractor to whom TRW reported, have claimed to the Government that the TRW  
12 discrimination technology is effective. In fact, however, TRW's technology has always failed  
13 fundamentally.

14           7.       Despite actual knowledge of the failure of TRW's technology, or in  
15 reckless disregard of that failure, TRW and Boeing have made multiple false claims to the  
16 Government regarding the efficacy of TRW's discrimination technology. TRW and Boeing  
17 have also engaged in a campaign to cover up the severe scientific and technical flaws in the  
18 TRW technology. The claims of TRW and Boeing defy scientific principles and contradict  
19 extensive test data TRW collected, but systematically failed to disclose to the Government.  
20 Schwartz is informed and believes that this misconduct has occurred since at least as early as  
21 1994 and continues to the present day.

22           8.       The TRW-Boeing kill vehicle prototype purportedly attempts to  
23 discriminate between a target warhead and any decoys deployed with it based on  
24 "characteristic" or "systematic" differences in the relative intensity, including its fluctuation  
25 over time, of certain wavelengths (i.e., "colors") of infrared light emitted by the warhead and  
26 decoys. The premise of the system, however, is false, because neither the intensity nor the  
27 variation in the intensity of the infrared light from space objects, such as a warhead or a decoy,  
28 is a fixed and unique "characteristic" of such an object that could be used to determine what

1 kind of object it is. Without such unique differences, there is no basis on which to discriminate  
2 between warheads and decoys.

3 9. Moreover, relative to the difficulty of developing intercontinental  
4 ballistic missiles in the first place, it is simple to modify or construct decoys and warheads to  
5 mimic each other, or to look indistinguishably different from each other, thereby making it  
6 impossible for the kill vehicle's infrared sensors to gather meaningful data to distinguish  
7 between warheads and decoys. It would thus be highly likely that if an emerging missile state  
8 such as North Korea were to develop intercontinental ballistic missile capability, it would easily  
9 develop decoys.

10 10. In short, TRW's technology purports to discern characteristic signals for  
11 warheads versus decoys in numerous threat scenarios required by contract with the Government,  
12 where such signals cannot be discerned. TRW and Boeing falsely claimed to be able to extract  
13 meaningful information from meaningless data.

14 11. In their effort to conceal the fundamental problems with their  
15 discrimination system, TRW and Boeing (1) falsified data, (2) misrepresented the effectiveness  
16 of the system, and (3) recklessly disregarded well-established standards of engineering and  
17 scientific methods. In at least two instances, TRW knowingly falsified data.

18 a. In April 1996, TRW generated several reports on one of its  
19 computer programs, referred to as the "Kalman Filter." These reports were based on  
20 manipulated and falsified data regarding the results of tests of the program's ability to identify a  
21 warhead in a simulated attack. Actual test results showed that the probability of a correct  
22 identification by TRW's Kalman Filter program was significantly less than fifty percent. In  
23 some cases the program failed so totally that it could not even make up its mind to select which  
24 object was a warhead versus which were decoys. By contrast, Schwartz is informed and  
25 believes, and on that basis alleges, that TRW falsely reported to the Government, with  
26 knowledge of the falsity of its claims, that the probability of a correct identification was greater  
27 than 85 percent.

28 b. A second example of TRW falsifying data involves a series of

1 misrepresentations by TRW dating to 1994 and explicitly documented in 1995. TRW has  
2 regularly stated to the Government that its “BEST” computer algorithm(s) are fully autonomous  
3 and, before the kill vehicle is launched, select the “best” infrared signal features to insert in the  
4 kill vehicle’s computer profile of the threat objects it will encounter in an actual engagement.  
5 This technical approach makes it impossible for the kill vehicle to change the signal features it  
6 uses during an actual engagement. Nevertheless, this is precisely what TRW and Boeing did in  
7 fraudulent analysis of data from the first actual flight test of the system. Internal TRW  
8 documents – never released to the Government – demonstrate that the “BEST” system has never  
9 worked and that there is absolutely no evidence to suggest that it ever could. Indeed, none of  
10 the analyses of actual flight-test data were undertaken using the BEST algorithm. Instead, after  
11 the fact, TRW and Boeing staff hand-selected the purported signal features to be analyzed by  
12 the discrimination system. Despite the absence of data to support their claims, TRW and  
13 Boeing falsely represented to the Government on numerous occasions that discrimination can be  
14 conducted autonomously by the kill vehicle using TRW’s technology.

15           12.     The severe flaws in the TRW system have been concealed through a  
16 concerted effort by TRW and Boeing to limit the data that they disclosed to the Government.  
17 TRW and Boeing have systematically avoided disclosing to the Government the extensive data  
18 generated by TRW that expose the serious flaws in the discrimination system. Instead, they  
19 cherry-picked a few, highly contrived instances in which the system purportedly met  
20 contractually required standards (although even in the cherry-picked examples, the truth is that  
21 the system failed). Examples of this “cherry-picking” abound and include the following:

22                   a.     First, from among the hundreds of tests TRW conducted, TRW  
23 and Boeing systematically selected a few instances in which TRW’s discrimination system  
24 achieved a high probability of correctly identifying a warhead. TRW and Boeing fraudulently  
25 failed to disclose the great majority of tests demonstrating that the system performed far below  
26 this standard.

27                   b.     Second, TRW and Boeing never informed the Government of  
28 data showing serious instabilities in TRW’s discrimination system that cause catastrophic

1 failures under non-exceptional conditions. They also failed to report that the system was highly  
2 sensitive to small unexpected and unpredictable variations in the appearance of warheads and  
3 decoys when missile launch conditions varied even slightly from what the kill vehicle (or  
4 ground simulator) had been programmed to expect. TRW had extensive data demonstrating  
5 that, far from being “robust,” its discrimination system was crippled by even minor deviations  
6 from predicted parameters for a given missile type. Despite this, TRW and Boeing claimed that  
7 the system functioned under a wide range of conditions, even where accurate data about a given  
8 missile type are lacking.

9                   c.       It was only after Schwartz brought these problems to light through  
10 the instant action that any information was provided to the Government about these system  
11 failures. However, the information that was made available after Schwartz exposed these  
12 problems was substantially incomplete, and was formulated to hide its significance. Schwartz is  
13 informed and believes, and on that basis alleges, that from at least 1994 to the present day,  
14 TRW and Boeing have withheld and continue to withhold important data in their possession  
15 demonstrating that the TRW discrimination system does not and could not meet the  
16 performance standards claimed by TRW and Boeing in their statements to the Government.

17                   13.     In seeking to protect their government contracts, TRW and Boeing  
18 recklessly disregarded established standards of engineering and science. TRW and Boeing  
19 systematically omitted essential tests, ignored critical data, and improperly manipulated data to  
20 create the illusion that the TRW discrimination system performed at the levels claimed by TRW  
21 and Boeing in statements to the Government to support requests by TRW and Boeing for  
22 payment under their contracts with the Government. These practices were used falsely to  
23 legitimize performance claims by TRW and Boeing regarding the TRW system. These  
24 practices were also used to conceal from the Government the fundamental flaws of the TRW  
25 discrimination system. These practices violated canonical principles of objective, verifiable  
26 scientific methods and constituted a fraud against the Government.

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1 **III.**

2 **THE PARTIES**

3 14. Schwartz is an engineer with a combined specialty in physics,  
4 mathematics, and electronics. Schwartz obtained a doctorate from the University of Tel Aviv in  
5 1979. Schwartz was employed by TRW from September 1995 until late February 1996 in the  
6 Space and Technology Division of TRW's Space and Electronics Group in Redondo Beach,  
7 California. While at TRW, Schwartz was a Senior Staff Engineer involved in testing and  
8 analyzing the algorithms, computer programs, technologies, mathematical and physical  
9 concepts, and signal phenomenology being researched and developed by TRW for the NMD  
10 program. Schwartz brings this action on behalf of herself individually and on behalf of the  
11 United States of America pursuant to the provisions of 31 U.S.C. § 3730(b)(1).

12 15. Schwartz is informed and believes, and on that basis alleges, each of the  
13 following matters throughout this paragraph: defendant Boeing is a Delaware corporation. In or  
14 about August 1996, Boeing acquired Rockwell International Corporation ("Rockwell"). For  
15 purposes of this action, Boeing is the successor in interest to Rockwell for any liability on the  
16 part of Rockwell relating to the events alleged below that occurred prior to the effective date of  
17 Boeing's acquisition of Rockwell. After that acquisition, Boeing is liable for its own conduct as  
18 alleged below. Unless specified otherwise, hereafter references to Boeing include Rockwell  
19 where Boeing is its successor in interest.

20 16. Schwartz is informed and believes, and on that basis alleges, each of the  
21 following matters throughout this paragraph: As the successor in interest to Rockwell, Boeing  
22 became a prime contractor and system integrator responsible for development of a U.S. National  
23 Missile Defense system. Until October 1999, Boeing and TRW were contracted by the  
24 Government (contract number DASG60-90-C-0165) (the "Boeing Contract") to develop the  
25 "exoatmospheric kill vehicle" and its flight test system. The original contractor for the  
26 exoatmospheric kill vehicle had been the aerospace and defense divisions of Rockwell. The  
27 agents for Boeing are located at 12214 South Lakewood Blvd., Downey, California 90242, and  
28 2201 Seal Beach Boulevard, WSB37, P.O. Box 2515, Seal Beach, California 90740-1515.



1 might acquire such missile technology in the future; an accidental, unauthorized, or erroneous  
2 attack by Russia; or an attack by China. This mission places a very high requirement on defense  
3 effectiveness -- much higher than the requirement on offense effectiveness. Failure of the  
4 defense system to intercept even one missile warhead armed with such lethal weapons could  
5 lead to large numbers of deaths, whereas an offense that largely failed could still inflict severe  
6 damage upon the United States.

7           21.     The Ballistic Missile Defense Organization (“BMDO”) manages, directs,  
8 and executes the NMD program for the Department of Defense.

9           22.     BMDO traces its roots to the Strategic Defense Initiative (SDI) program  
10 that President Ronald Reagan started in 1983. Until 1989 the mission of the NMD program was  
11 to enhance deterrence of a first strike by the Soviet Union, by deploying a defense of thousands  
12 of interceptors. This mission has now gone through four major program changes, to its current  
13 status, with a protection role against a small number of threats. Over \$56 billion dollars has  
14 been spent by the United States on missile defense since 1983, with no system currently  
15 scheduled for deployment. A central reason for these poor results are the steep technical  
16 challenges posed by relatively simple “countermeasures” that can be taken to defeat an NMD  
17 system.

18           23.     The current NMD system includes a Ground Based Interceptor (“GBI”),  
19 which BMDO characterizes as the “weapon” of the system. The GBI mission is to strike high-  
20 speed ballistic missile warheads in the mid-course of the exoatmospheric phase of their  
21 trajectories and destroy them by force of impact.

22           24.     As detailed further below, Boeing and TRW were involved in developing  
23 a GBI system. That system is intended to use a ground-based interceptor missile to launch an  
24 Exoatmospheric Kill Vehicle (“EKV” or “kill vehicle”) designed to seek out and destroy an  
25 enemy missile’s warhead-bearing “reentry vehicle” by colliding with it outside the Earth’s  
26 atmosphere. The system design requires that incoming “threat clouds,” composed of warheads,  
27 missile debris, decoys, and other accompanying space objects, be tracked using ground-based  
28 radar and satellite-based infrared sensors (i.e., sensors that detect low-energy light emitted from

1 the warhead) to direct the kill vehicle to an area in space in which to intercept the threat cloud.  
2 As it approaches the interception point, the “kill vehicle” is supposed to use its onboard sensors  
3 and computer to identify the warhead reentry vehicle and to maneuver to collide with and  
4 destroy it.

5           25.     The NMD interceptor missile will consist of an EKV mounted on top of a  
6 booster rocket, which will be based in an underground silo. The booster rocket will transport  
7 the EKV outside of the Earth’s atmosphere before releasing it. The EKV design includes an  
8 infrared sensor, a source of propulsion for maneuvering, a communications system, and a  
9 computer-based guidance system. The EKV relies on the infrared-light sensor to identify the  
10 warhead among decoy(s) and other objects deployed by an enemy missile. Because infrared  
11 light is emitted naturally by all objects, including the Earth and its atmosphere, the infrared  
12 sensor limits the minimum altitude (estimated to be greater than 100 kilometers) above which  
13 the discrimination system can effectively operate.

14           26.     The TRW-Boeing design for the NMD system called for it to carry out  
15 the following operations:

16                   a.     First, ground- and space-based sensors detect a missile launch and  
17 transmit this information to the Ballistic Missile Defense Command Center in Colorado  
18 Springs. Radar stations confirm the launch to determine if the missile is a threat to the U.S.

19                   b.     Second, once the enemy missile’s booster rocket completes its  
20 burn cycle, the NMD system identifies the warhead(s) and any other objects accompanying it  
21 (such as missile debris or decoys), begins to track these objects, and calculates their trajectories.  
22 The radar stations provide the interceptor with in-flight target updates.

23                   c.     Third, just prior to launching the interceptor, the NMD analysts  
24 must identify the missile type (referred to as “threat typing”) and download data (the “Mission  
25 Data Load”) into the interceptor computer. These data correspond to certain “features” of the  
26 infrared signal emitted by the target warhead reentry vehicle and potential decoys. These signal  
27 features, in essence, tell the kill vehicle what each object should look like. The kill vehicle’s  
28 computer performs the task of attempting to identify correctly each warhead and decoy by

1 matching the observed signal features from each object it is tracking with the predicted signal  
2 features in the Mission Data Load.

3 d. Fourth, the NMD system launches an interceptor missile towards  
4 the predicted intercept point for each target (or, if several potential targets are close together, for  
5 each cluster of targets). Once the interceptor missile is sufficiently close to the target warhead  
6 and decoy(s), it releases the EKV.

7 e. Fifth, at about sixty seconds (or approximately 400 kilometers) to  
8 intercept, the kill vehicle is required to detect the warhead and any decoys with its own sensors,  
9 properly distinguish and identify the target warhead reentry vehicle, and maneuver to hit the  
10 target warhead directly.

11 27. Prior to launching the interceptor, the NMD analysts must identify the  
12 missile type (referred to as “threat typing”) and download data (the “Mission Data Load”) into  
13 the EKV computer. These data correspond to certain “features” of the infrared signal emitted  
14 by the target warhead reentry vehicle and potential decoys. These features are used by the  
15 EKV’s computer system to discriminate between the target warhead and any decoys traveling  
16 with it.

17 28. The number of attacking missiles will have a significant impact on the  
18 operational effectiveness of the NMD system. Also important are the “countermeasures” an  
19 attacker can use to confuse, overwhelm, or otherwise defeat the NMD system. All of the  
20 countries that have deployed long-range ballistic missiles (Britain, China, France, Russia, and  
21 the United States) have developed, produced and, in some cases, deployed such  
22 countermeasures for their missiles. The 1999 National Intelligence Estimate on the ballistic  
23 missile threat to the United States – a document prepared by the U.S. intelligence community –  
24 stated that such countermeasures would be available to emerging missile states.

25 29. Many effective countermeasures require a much lower level of  
26 technology than that required to build a long-range ballistic missile (or a nuclear weapon) and  
27 utilize basic physical principles and well-understood technologies. Any country capable of  
28 building a long-range ballistic missile would have the scientific and technical expertise to

1 exploit technologies available to construct effective countermeasures.

2           30. An attacker using nuclear weapons could, for example, overwhelm the  
3 system by using “balloon decoys,” by deploying its nuclear warhead inside a balloon and  
4 releasing numerous empty balloons along with it. Alternatively, an attacker could cover a  
5 nuclear warhead with a cooled shroud, which would prevent the EKV’s sensor from detecting  
6 or properly identifying the warhead and therefore from homing on the warhead for interception.  
7 There are many variations on these and other tactics.

8           31. The system developed by TRW and Boeing has been tested under  
9 conditions in which a warhead was accompanied by one to nine decoys to determine whether  
10 the EKV could distinguish between decoys and a mock nuclear warhead. These tests are  
11 discussed in greater detail below. This feature of the system – discriminating between a  
12 warhead and accompanying decoys – is the subject of the false representations and material  
13 nondisclosures by TRW and Boeing to the Government in this case.

14 **B. The Boeing-TRW NMD Contracts**

15           32. In 1990, Boeing’s predecessor in interest, Rockwell, was awarded a  
16 contract as prime contractor for development related to the EKV and Ground Based Interceptor,  
17 contract number DASG60-90-C-0165 (previously identified above as the Boeing Contract).  
18 Boeing was one of three prime contractors awarded such a contract; the other two were Martin  
19 Marietta Corporation and Raytheon (as successor in interest to the original prime contractor,  
20 Hughes Electronics Corporation, which Raytheon acquired in 1997).

21           33. From 1990 to 1994, the three contractors were in competition  
22 simultaneously to develop EKV technology. A “down-select” would eliminate one of the three  
23 in 1994, and the other two would then compete to obtain the final, sole contract for developing  
24 the EKV. In 1994, Martin Marietta Corporation was eliminated from the competition.

25           34. After the Integrated Flight Test-3 (“IFT-3”) in October 1999 and  
26 Schwartz’s exposure of the numerous faults with TRW’s discrimination system, as described in  
27 greater detail below, the TRW technology was dropped and Raytheon was selected as the  
28 contractor to develop the EKV’s discrimination system. Although the TRW Contract for the

1 EKV was terminated on April 5, 1999, Boeing retained TRW to continue development of the  
2 Baseline Algorithms as part of a “hot standby” (*i.e.*, backup) technology to the Raytheon  
3 system. That is, the Baseline Algorithms were to remain as a potential replacement for the  
4 Raytheon discrimination system if the latter were to fail. TRW continued work under a separate  
5 contract to develop the command-and-control system for the NMD program.

6           35.     Originally, in 1990, the Boeing Contract was for the Ground Based  
7 Interceptor Experimental (“GBI-X”) program. Schwartz is informed and believes, and on that  
8 basis alleges, that since 1990, the Boeing Contract has been modified numerous times. Unless  
9 specified otherwise, the term Boeing Contract as used herein means and refers to the original  
10 Boeing Contract and any modifications in effect at the time of the particular event described  
11 below.

12           36.     The scope of work for the Boeing Contract is described in the document  
13 SW-K08-90 (the “Boeing Statement of Work”). Schwartz is informed and believes, and on that  
14 basis alleges, that the Boeing Statement of Work has also undergone numerous modifications  
15 since 1990. Unless specified otherwise, the term Boeing Statement of Work as used herein  
16 means and refers to the original Boeing Statement of Work and any modifications in effect at  
17 the time of the particular event described below.

18           37.     In 1990, TRW was awarded a subcontract from Boeing (Rockwell) for  
19 development of certain systems related to the GBI-X program in support of the Boeing  
20 Contract. This subcontract was identified above as the TRW Contract. Schwartz is informed  
21 and believes, and on that basis alleges, that since 1990, the TRW Contract has been modified  
22 numerous times. Unless specified otherwise, the term TRW Contract as used herein means and  
23 refers to the original TRW Contract and any modifications in effect at the time of the particular  
24 event described below.

25           38.     The TRW purchase order for work pursuant to the TRW Contract is  
26 number M 1 M8XXK-48583 1M (as identified above, the “TRW Purchase Order”). Schwartz is  
27 informed and believes, and on that basis alleges, that since 1990, the TRW Purchase Order has  
28 been modified numerous times. Unless specified otherwise, the term TRW Purchase Order as

1 used herein means and refers to the original TRW Purchase Order and any modifications in  
2 effect at the time of the particular event described below.

3           39. In January 1991, an "Interim Statement of Work" was issued which  
4 described the systems to be developed by TRW pursuant to the TRW Purchase Order in support  
5 of the GBI-X program for Rockwell. These systems included "Seeker Tracking/ Data  
6 Fusion/Discrimination Algorithm and Software Development" as described in the statement of  
7 work, document number SW-MO72383 (the "TRW Statement of Work"). Schwartz is informed  
8 and believes, and on that basis alleges, that the TRW Statement of Work has also undergone  
9 numerous modifications since 1991. Unless specified otherwise, the term TRW Statement of  
10 Work as used herein means and refers to the original TRW Statement of Work and any  
11 modifications in effect at the time of the particular event described below.

12           40. TRW's role in the Boeing NMD program pursuant to the TRW Contract  
13 was to develop and deliver operational data processing software for the on-board functions of  
14 tracking, data fusion and discrimination by discrimination concepts, algorithms, and systems  
15 design for the flight test of the operational ground based interceptor, including threat analysis  
16 and modeling, statistical performance evaluation and simulation. The TRW end product  
17 software was to be incorporated into the on-board data processing software for the Boeing EKV  
18 system.

19           41. The Government has contracted with TRW for System Engineering and  
20 Integration support for the BMD Deployment Readiness Program. TRW is identified as the  
21 "System Engineer" as that term is used in the Boeing Contract.

22           42. As "System Engineer," TRW was responsible for independently  
23 reviewing the development of the technology for the EKV. At the same time, TRW was also  
24 working as a subcontractor to develop one of the key technologies. TRW and Boeing were  
25 explicitly obligated to abide by conflict of interest provisions in the Boeing Contract.

26           43. The technical requirements for the Boeing Contract are set forth in the  
27 Technical Requirements Document ("TRD"). Schwartz is informed and believes, and on that  
28 basis alleges, that the TRD has also undergone numerous modifications since 1990. Unless

1 specified otherwise, the term TRD as used herein means and refers to the original TRD and any  
2 modifications in effect at the time of the particular event described below, including without  
3 limitation a revision of the TRD dated September 28, 1993.

4           44.     Unclassified public sources, including the February 24, 1997 edition of  
5 Aviation Week and Space Technology at 54, establish a level the TRW discrimination  
6 technology minimally must meet: “NMD designers ‘expect roughly an 85% probability of kill  
7 from a single shot.’” Necessarily, the probability of the discrimination technology functioning  
8 properly must be at least as high as the compound probability of all the aspects of the  
9 interceptor collectively working properly. Thus, the minimum performance required of the  
10 discrimination is a probability of at least 85%.

11           45.     Paragraphs 2.0, 2.1, and 2.2 of the TRW Statement of Work specifies that  
12 TRW must comply with the TRD for the Boeing Contract. TRW was obligated to comply with  
13 all requirements imposed on Boeing pursuant to the Boeing Contract for warhead and decoy  
14 discrimination by the EKV. TRW was also required to comply with the provisions of the  
15 Boeing Statement of Work and the TRW Statement of Work.

16           46.     The TRD specifies the range of threat conditions under which the  
17 Ground-Based Interceptor design must provide a “robust” defense. The “design-to” threat cases  
18 are defined in Table 2.0-1 in accordance with Appendix 2 of the TRD. The TRD refers to these  
19 design-to cases as the “near-term threat scenarios.”

20           47.     Thirteen (13) specific threat scenarios are defined in the TRD. These  
21 scenarios describe specific missile threat-types, attack conditions, and aim points for the  
22 warheads. A central element of these scenarios is a description of the countermeasures  
23 associated with each warhead reentry vehicle, including the reentry vehicle characteristics, the  
24 number and types of decoys, and descriptions of other objects in a threat cloud.

25           48.     The TRD places specific bounds for a range of conditions, such as a  
26 range of temperatures, that are considered “normal” and over which the system must be able to  
27 function. The TRD also requires the system design to be able to handle each of the thirteen  
28 scenarios under “off-normal” conditions, for example the temperature or motion of the warhead

1 are outside the range expected.

2           49.     The TRD also requires that, in addition to these thirteen scenarios, the  
3 Ground-Based Interceptor must be designed to defend against a generic missile system where  
4 prior data about the attacking missile are not available. There is a substantial likelihood that  
5 little or no such prior data will be available in the event of a real threat.

6     **C.     The Critical Element of the Boeing NMD System: Discriminating Between**  
7           **Incoming Warheads and Decoys**

8           50.     While the technical challenges of the NMD system are not limited to the  
9 process of discriminating between an incoming warhead and a decoy(s), it has proved to be one  
10 of the most technically difficult – and critical – elements of the system. “Discrimination” is  
11 premised on identifying detectable and measurable characteristics of the target warhead upon  
12 which to distinguish it from accompanying decoys.

13           51.     In theory, three basic characteristics can be used to distinguish a target  
14 warhead from a decoy: (1) its size; (2) its shape; and (3) its temperature. In different ways,  
15 each of these characteristics influences the “infrared” (low-energy, long-wavelength) light  
16 emitted by a warhead. This infrared light can be detected by a specialized sensor. All objects  
17 naturally emit a range of wavelengths/energies of infrared light. The overall intensity of an  
18 object’s infrared emissions as viewed by a single observer/sensor are affected by its size and its  
19 temperature: (1) the larger an object is, the brighter it appears; (2) the hotter an object is, the  
20 brighter it appears and the higher in energy (shorter in wavelength) are its infrared emissions.  
21 The infrared signal from the warhead changes with temperature of the warhead reentry vehicle,  
22 which in turn depends on the conditions of the launch – including whether the reentry vehicle is  
23 heated or cooled – as well as with the type of material from which the reentry vehicle is  
24 constructed. In addition, the infrared signal from either a warhead or a decoy can be very  
25 substantially altered by painting or coating it with well-known special materials.

26           52.     For a single observer, such as the infrared sensor mounted on the EKV,  
27 the intensity of the infrared emissions it sees will vary as a space object’s visible surface area  
28 changes--only emissions from exposed surfaces of a warhead reentry vehicle or decoy are

1 observable. In addition, the infrared signal from an object can be expected to contain a  
2 substantial amount of infrared energy reflected from the Earth below, and from the sun if the  
3 object is not in the Earth's shadow. Accordingly, both the intensity of a warhead's infrared  
4 signal and the variation of that intensity over time as viewed by an observer are affected by its  
5 motion (i.e., whether it is tumbling, wobbling on its major axis, or spinning); temperature;  
6 materials construction (coatings will alter an object's infrared emissions); size; shape (for  
7 example, a sphere appears the same from any angle, whereas a cone has a very different  
8 appearance depending on whether it is viewed head-on or from the side), and the position of the  
9 Earth, sun, and spatial orientation of the target relative to the observer.

10           53.     The EKV uses an infrared sensor to observe (1) the intensity, (2) the  
11 variation in the range of intensities, and (3) the rate of change in intensity of infrared emissions  
12 from an incoming warhead and decoy(s). The sensor used by the EKV to detect infrared light  
13 emitted by a warhead or decoy(s) is extremely sensitive and must be super-cooled to eliminate  
14 thermal noise from the detector assembly itself that would interfere with the system. It also  
15 would be "blinded" at lower altitudes where the natural infrared emissions from the Earth and  
16 its atmosphere are too intense. The Mission Data Load also must be carefully calibrated to  
17 account for the position of the sun and the Earth relative to the sensor and the threat cloud.

18           54.     Prior to being launched, the EKV must be programmed with data (the  
19 Mission Data Load) that are assumed to predict the characteristics of the infrared signals from  
20 target warheads and possible decoys. The Mission Data Load is chosen based on analysts'  
21 predictions of the type of warhead to be intercepted ("threat typing") and the conditions of the  
22 attack that are determined soon after the missile launch is detected. Each type of missile has  
23 corresponding Mission Data Loads, which are constructed using available intelligence  
24 information and computer simulations. The fidelity of the simulated data to that collected by  
25 the EKV's sensor is highly sensitive to the specific size, shape, construction materials,  
26 deployment dynamics (motion), and temperature of the warhead reentry vehicle and decoys.  
27 For each threat type, multiple Mission Data Loads are available to account for different  
28 conditions under which a missile is launched. Schwartz is informed and believes, and on that

1 basis alleges, that the decision on which of these Mission Data Loads to use (a single missile  
2 type may have 150 Mission Data Loads) to account for different launch conditions is made just  
3 prior to the launch of the EKV.

4           55.     The Mission Data Load is used by the data processing system on board  
5 the EKV to predict and compare the infrared signal features from warheads and decoys  
6 observed by the EKV's sensor. Using elaborate mathematical algorithms, the EKV attempts to  
7 pick out the warhead from the complex of tracked objects by choosing the object that has signal  
8 characteristics which most closely match those predicted by the Mission Data Load for the  
9 warhead. The NMD system succeeds or fails based on, among other factors, the accuracy of the  
10 Mission Data Load and thus the ability of the NMD analysts to identify accurately the missile  
11 type and the physical characteristics of its warhead reentry vehicle(s). Even small errors in  
12 estimates of a warhead's temperature, for example, drastically reduce the reliability of the  
13 discrimination process.

14           56.     Part of constructing the Mission Data Load involves selecting which  
15 signal features to use. The Baseline Algorithms and Kalman Filter were developed to operate  
16 pre-flight with TRW's "BEST" algorithm, which supposedly preselected the "best" signal  
17 features for the Mission Data Load that will be matched against observed threats by the EKV  
18 during engagements. The BEST algorithm is purportedly able to determine which features of  
19 the signals from a group of threat objects can most reliably be used for matching and  
20 distinguishing between warheads, decoys, and other possible targets observed by the EKV  
21 during an engagement. The BEST algorithm, however, was not part of the EKV's onboard  
22 software. It was designed to be used on the ground prior to engagements against missile threats  
23 and in combination with a signal simulation program called OPTISIG. It would thus not be  
24 possible for the EKV to change the signal features selected by the BEST algorithm in real-time  
25 during an engagement.

26           57.     During the last sixty seconds prior to intercept, when the EKV is within  
27 400 kilometers of the target, the EKV seeks to identify the target warhead. At that point, the  
28 EKV is controlled exclusively by the processing of information that it receives from its onboard

1 infrared sensor. The discrimination method described above dictates whether the EKV hits and  
2 disables the warhead, or mis-guesses and fails. The discrimination method is thus critical to the  
3 effective operation of the system.

4           58.     TRW and Boeing were responsible for developing the equipment and  
5 computer programs used to generate the simulated data and to analyze the infrared-signal data  
6 from the EKV's sensor. As detailed further below, to receive payment, directly or indirectly,  
7 from the Government pursuant to the Boeing Contract, the TRW Contract, and the TRW  
8 Purchase Order, TRW and Boeing made fraudulent misrepresentations and omissions to the  
9 Government about the capabilities and robustness of the discrimination technology, and  
10 falsified and withheld crucial data.

11 **D.     TRW's Purported Technology for Extracting Information from a Target**  
12 **Warhead's Infrared Signal and Discriminating Between A Warhead and Decoys.**

13           59.     The infrared sensor used by the EKV views space-objects, such as  
14 warheads and decoys, as points of infrared light. There are three basic characteristics of this  
15 light that can be measured: (1) its intensity, that is how bright it appears at a given distance; (2)  
16 its wavelength, which corresponds to how much energy is released in a fixed quantity of light  
17 (shorter wavelengths of light being more energetic per unit of light emitted); and (3) the  
18 variation in its intensity over time (i.e., does the light emitted have a fixed intensity or does it  
19 have a characteristic cyclical variation and, if so, is the time for this cycle very short or quite  
20 long and what is the magnitude of these fluctuations).

21           60.     The TRW system does not measure all wavelengths of infrared radiation  
22 emitted from the objects it views. Instead, the TRW system uses two specific wavelengths of  
23 infrared light to be measured by the EKV's sensor.

24           61.     These wavelengths were chosen by Boeing, the sensor designer, because  
25 they supposedly would provide information about a potential target object's temperature.

26           62.     The TRW system purports to assemble a time-sequence of the signal  
27 from each object at the two wavelengths and purportedly uses this information to determine  
28 certain statistical properties of each time sequence. These properties include the time-averaged

I intensity and the magnitude of any fluctuations in intensity. This information is then analyzed  
2 in real-time using mathematical algorithms. The signal “features” obtained for each tracked  
3 object from this analysis are iteratively “matched” against the expected features for each object  
4 in the Mission Data Load to identify the warhead among the space-objects being tracked. At the  
5 point defined by the EKV’s capacity to maneuver successfully to intercept alternate likely  
6 targets, the discrimination algorithm purportedly conducts a final match against the Mission  
7 Data Load, identifies the warhead, and sends relevant data to the Boeing Navigation and  
8 Control System (for example, the target line-of-sight rate) for guidance of the EKV to collide  
9 with the object determined to be the warhead.

10           63. TRW developed two separate sets of algorithms, the “Baseline  
II Algorithms” and the “Kalman Filter,” that were to be the heart of the discrimination process  
12 used by the EKV. Development of the Baseline Algorithms began in 1990 and was purportedly  
13 completed by 1994.

14           64. In 1995, development of the Baseline Algorithms was suspended because  
15 of continuing difficulties in demonstrating that warhead reentry vehicles have characteristic  
16 features in the intensity of their infrared emissions on which to apply the Baseline  
17 discrimination method. After more than a year hiatus, TRW returned to the Baseline  
18 Algorithms in 1996 when it ran into technical obstacles (discussed below) with the Kalman  
19 Filter.

20           65. Schwartz is informed and believes, and on that basis alleges, that work on  
21 the Kalman Filter began in or about 1993 and extended into 1996. Ultimately it was  
22 abandoned.

23           66. In explaining its abandonment of the Kalman Filter approach, TRW  
24 claimed that memory limitations and computer speed of the EKV’s computer precluded its use  
25 in scheduled and possible future flight tests. This explanation was false. The truth was that  
26 TRW’s ground-simulation testing of the Kalman Filter had already demonstrated that it did not  
27 meet the Government’s technical requirements.

28           67. The two mathematical methods operate pursuant to the same principles

1 but differ with respect to how they utilize the input signal data. TRW's Baseline Algorithms  
2 purport to analyze two basic quantities: (1) the intensity and (2) the magnitude of the  
3 fluctuations in the intensity of the infrared emissions from space objects. The Kalman Filter  
4 purports to analyze the rate of change in the infrared intensity fluctuations, supposedly to  
5 identify a characteristic frequency of these fluctuations for an object in addition to analyzing the  
6 two quantities measured by the Baseline Algorithms.

7           68. TRW tailored the form of these quantities (referred to as "features") for  
8 each warhead type supposedly to maximize the effectiveness of the system. For example,  
9 features used for one threat type might be the fluctuations in intensity of both infrared  
10 wavelengths, whereas only one wavelength might be used for another threat type.

11           69. The Kalman Filter always relies -- supposedly -- on identifying a  
12 characteristic frequency for the variation in an object's infrared signal as a feature in the  
13 discrimination process.

14           70. These features also are used to generate the simulated data for the  
15 Mission Data Loads, which must be sufficiently "characteristic" of each warhead reentry vehicle  
16 and decoy to permit effective discrimination.

17           71. The appearances of space objects in a threat cloud change as the EKV  
18 approaches them. Almost invariably, the EKV changes its mind and selects different space  
19 objects over time as the most likely candidate to be the warhead, as first one and then another  
20 potential target object exhibits features that most closely match those of the target warhead  
21 profiled in the Mission Data Load.

22           72. Supposedly, the mathematical methods used by TRW are designed to  
23 generate feature values for the target warhead that converge towards the selected Mission Data  
24 Load values. In reality, no such convergence occurs. In simulated tests and using actual flight  
25 test data, the TRW technology regularly failed to select the correct target. It sometimes failed to  
26 select any target at all.

27           73. TRW's discrimination approach operates on the premise that the  
28 information supporting the Mission Data Load (i.e., threat type, warhead and decoy(s)

1 temperature, motion (tumbling, spinning), materials, shape, and size) are accurate and that the  
2 feature values for the warhead reentry vehicle will be distinct and identifiable relative to those  
3 of the decoys-that is decoys have not been constructed so that their infrared signals closely  
4 mimic those of the warhead. The reliability of the system is strongly dependent on the accuracy  
5 of the information about the expected appearance of all the objects that will be encountered by  
6 the EKV, including accurate prior knowledge of which reentry vehicle will be used to carry the  
7 warhead. If the data on the expected appearance of the objects are faulty, the system will not  
8 reliably identify the warhead.

9 **E. TRW's Testing and Development of the Baseline Algorithms and Kalman Filter**

10 74. TRW tested the discrimination performance of the Baseline Algorithms  
11 and Kalman Filter using data from computer simulations (the "OPTISIG" program) and flight  
12 tests, such as the MSX flight tests, the Delta 181 flight tests, and later the Integrated Flight Test-  
13 1A.

14 75. Simulated data were based on the 13 near-term missile threat scenarios  
15 provided in the TRD for the Boeing contract, and the basic parameters for each scenario (i.e.,  
16 warhead reentry vehicle and decoy temperature, motion, and construction) were varied.

17 76. For the flight tests, the Army provided (after the flights) detailed  
18 information on the temperature and dynamics of the warhead reentry vehicle and decoys for the  
19 purpose of evaluating the performance of the EKV's sensor and discrimination system.

20 77. For the flight tests, TRW and Boeing incorporated the data provided by  
21 the Army, after the fact, into the underlying discrimination calculations to artificially construct  
22 the discrimination system around the conditions of each flight test. TRW and Boeing  
23 retroactively tailored the discrimination system to the particular conditions of each experiment.

24 78. In order to test the discrimination system's degree of "robustness," TRW  
25 examined performance levels using varying levels of threat typing information. TRW  
26 performed a comprehensive series of studies by running what it referred to as an "exhaustive"  
27 set of statistical simulations covering all combinations of typing information, methods of  
28 constructing the threat typing classifier database, threat scenarios, and warhead reentry vehicle

1 variants. Concurrent with these studies, TRW conducted a fine-tuning iteration of the  
2 requirements balancing process.

3           79. As early as 1992, TRW determined that without direct information on the  
4 physical characteristics of each missile threat type, factoring in the probability of incorrectly  
5 selecting the Mission Data Load parameters substantially reduced its own estimates of the  
6 discrimination system's predicted performance. TRW found that unless it had access to  
7 detailed and accurate threat information, its system performed no better than making random  
8 guesses. Schwartz is informed and believes, and on that basis alleges, that TRW failed to notify  
9 the Government about these negative results.

10           80. TRW's testing of the Baseline Algorithms regularly produced results in  
11 which the system failed to select the warhead. TRW tried to readjust the parameters of the  
12 Baseline Algorithms (there were about 60) to improve its performance. However, after the  
13 system was re-calibrated based on the results from one test run, the system failed to select the  
14 warhead when the test conditions were altered even slightly (i.e., by as little as ten percent).

15           81. The Baseline Algorithms also failed catastrophically when spikes, gaps,  
16 or dips were introduced into the infrared signal data. Spikes, gaps, and dips are common under  
17 real-world conditions.

18           82. TRW's test results showed that the Baseline Algorithms could not  
19 discriminate between a warhead and decoy(s), except for a very few highly contrived scenarios  
20 not representative of real-world conditions or the near-term scenarios required by the Technical  
21 Requirements Document.

22           83. TRW's testing of the Kalman Filter regularly produced results in which  
23 the system alternated randomly between selecting the warhead and decoys that were being  
24 monitored, without fixing on a single object as the warhead. In evaluating the output of the  
25 Kalman Filter, TRW found that it did not "converge" on a specific feature value but instead  
26 oscillated between values, converged to a value other than that for the warhead, or converged to  
27 a value that was determined by the signal's "noise" level or signal spikes, dips, or gaps.

28           84. TRW's results showed that the Kalman Filter could not discriminate

1 between a warhead and decoy(s), except for a very few highly contrived scenarios not  
2 representative of real-world conditions or the near-term scenarios required by the Technical  
3 Requirements Document.

4           85.     The Baseline Algorithms and the Kalman Filter were purportedly  
5 operated in conjunction with TRW's "BEST" algorithm. The BEST algorithm is used on the  
6 ground prior to the EKV flight, and supposedly selects the best signal features for identifying  
7 space objects tracked by the EKV's sensor in flight tests or for ground simulations using the  
8 OPTISIG program.

9           86.     During the tests described above, TRW discovered that the BEST  
10 algorithm was highly sensitive to minor variations from the conditions under which empirical  
11 (i.e., experimentally based) parameters used to construct it were derived. Even slight deviations  
12 from these conditions caused the BEST algorithm to fail. TRW was never able to identify  
13 empirical parameters that permitted the BEST program to operate successfully under new  
14 conditions; it could only operate on a case-by-case basis in which the test conditions were  
15 predetermined.

16           87.     The failure of the BEST program was demonstrated by TRW's and  
17 Boeing's decision to hand-select (after the fact) the "best" signal features for use in the analysis  
18 of flight-test data taken from the first Integrated Flight Test ("IFT- 1A") of the TRW-Boeing  
19 infrared sensor system in July 1997. Hand-selection of features by human operators after the  
20 fact cannot be a part of the EKV performance in an actual deployment against a real threat. The  
21 system must discriminate in real-time, not in retrospect. Moreover, the EKV must perform  
22 autonomously.

23           88.     During the IFT-1 A, the features extracted by the BEST algorithm on the  
24 ground did not match the features extracted in real-time by the EKV in flight. This mismatch  
25 further demonstrates the failure of the BEST algorithm.

26           89.     Schwartz is informed and believes, and on that basis alleges, that TRW  
27 and Boeing continued to rely on hand selection of signal features until TRW was removed from  
28 the project in 1999.

1 IV.

2 THE PHYSICAL AND TECHNICAL FAULTS OF THE TRW-BOEING  
3 DISCRIMINATION SYSTEM FIRST DISCLOSED TO THE GOVERNMENT BY DR.  
4 SCHWARTZ

5 A. Dr. Schwartz's Work on the TRW-Boeing Discrimination Technology

6 90. Schwartz was employed by TRW from September 1995 until late  
7 February 1996 in the Space and Technology Division of TRW's Space and Electronics Group in  
8 Redondo Beach, California.

9 91. Schwartz was responsible for analyzing many aspects of the TRW  
10 discrimination technology, including (1) the sensitivity of its performance to different threat  
11 types and Mission Data Load parameters; (2) the physical causes of an object's infrared signal;  
12 (3) the impact of an object's temperature on its infrared signal; (4) discrimination concepts  
13 analysis; (5) discrimination feasibility and performance studies; (6) review of TRW test plans,  
14 procedures, and validation; and (7) assessment of the EKV's infrared sensor.

15 92. As part of her work at TRW, Schwartz reviewed most, if not all, of the  
16 TRW-Boeing test results and performance reports concerning the Baseline Algorithms and the  
17 Kalman Filter that were both for internal use and provided to the Government over the years  
18 1993 to 1996.

19 93. Schwartz recorded her findings in test files, computer files, and weekly  
20 and daily Quick Mail reports she sent to TRW colleagues. Schwartz prepared numerous  
21 reports, including the following: (1) discrimination performance reports based on simulated and  
22 flight test data; (2) discrimination concept performance and validation reports; (3) feature  
23 analysis performance and validation reports based on simulated and flight-test data; (4) flight  
24 test analysis and validation reports on the MSX and Delta 18 1 missions; and (5) reports on  
25 threat typing analyses.

26 94. Schwartz's analyses of the Kalman Filter and Baseline Algorithms were  
27 supported by extensive computer-based testing that Schwartz conducted with the assistance of  
28 other employees at TRW, including Robert D. Hughes, Department Head; Ray Maddalone,

1 Project Manager; Wally Beitzel, Chief Engineer; Hank Crowder, Senior Staff Engineer; John T.  
2 Tang, Senior Staff Engineer; Clifford E. Freiler, Senior Staff Engineer; and Scott A. Cook, Staff  
3 Engineer.

4 95. During the period December 1995 through February 1996, Schwartz  
5 informed her superiors, Clifford E. Freiler, Scott A. Cook, Robert Hughes, Ray Maddalone,  
6 Walter Beitzel and Henry Crowder, of the fundamental problems with the TRW discrimination  
7 system.

8 96. Wally Beitzel, Robert D. Hughes, Crowder, Ray Maddalone, John Tang  
9 and Scott Cook acknowledged that the test results and analyses performed by Schwartz and  
10 other TRW employees demonstrated that the Kalman Filter and Baseline Algorithms contained  
11 numerous fundamental flaws. They also acknowledged that the results reported to the  
12 Government that the discrimination system met contractual specifications were false.

13 97. When Schwartz explained her test results to Clifford E. Freiler, Scott A.  
14 Cook, Robert D. Hughes, Wally Beitzel, Hank Crowder, and Ray Maddalone and urged them to  
15 inform the Government and Boeing about the deficiencies in the discrimination system, they  
16 refused.

17 98. Schwartz is informed and believes, and on that basis alleges, that TRW  
18 personnel refused to inform the Government and Boeing about the deficiencies in the  
19 discrimination system for the following reasons:

20 (a) TRW was in competition with Hughes Electronics Corporation and  
21 would lose its contract if it reported the problems with the Kalman Filter and Baseline  
22 Algorithms to Boeing and the Government;

23 (b) It was too late in the development of the project to correct the  
24 defective Kalman Filter and Baseline Algorithms;

25 (c) TRW would not volunteer information about the fundamental defects  
26 in the Kalman Filter and Baseline Algorithms to the Government and Boeing and would only  
27 supply it if they made specific inquiries;

28 (d) Boeing had been informed that the performance of the Kalman Filter

1 and Baseline Algorithms met contractual specifications and TRW could not admit that its  
2 statements to Boeing were false; and

3 (e) Boeing had earlier rejected the Kalman Filter and requested that  
4 TRW use a fast Fourier transform algorithm, but TRW had convinced Boeing that abandoning  
5 the Kalman Filter and admitting TRW made a mistake would cause TRW-Boeing team to lose  
6 the contract to Hughes Electronics Corporation.

7 99. When Schwartz informed her superior Robert D. Hughes in January 1996  
8 that the Kalman Filter and Baseline Algorithms were defective, Mr. Hughes instructed her not  
9 to tell anyone and specifically directed her not to inform or contact the Government. TRW  
10 elected to disregard the fundamental problems with the discrimination system that had been  
11 identified by Schwartz and its own extensive testing. At a TRW staff meeting held on February  
12 26, 1996, TRW decided not to inform the Government about the fundamental flaws in the  
13 Baseline Algorithms and Kalman Filter or the system's failure to meet the standards established  
14 in the Technical Requirements Document incorporated into the TRW Contract.

15 100. On February 27, 1996, TRW summarily suspended Schwartz from  
16 employment and prevented Schwartz from accessing the tests she and other TRW employees  
17 had conducted on the Kalman Filter and Baseline Algorithms. Schwartz was also precluded  
18 from disclosing her findings to the Government and Boeing. In retaliation against Schwartz's  
19 efforts to disclose the fundamental defects in TRW's discrimination system, TRW terminated  
20 her employment.

21 **B. The Severe Technical Flaws in the Discrimination System.**

22 101. The TRW system critically depends on accurate information regarding  
23 the materials, shape, size, motion, and temperature of a warhead and any accompanying decoys  
24 for a given missile type ("threat typing"). In TRW's system, this information is used to  
25 construct the Mission Data Load, against which data collected by the EKV's infrared sensor are  
26 compared to identify the warhead.

27 102. The Phase-One Engineering Team (POET) conducted an "Independent  
28 Review of TRW Discrimination Techniques" in 1998. POET concluded that sufficient

1 information on many of the threat types included in the TRD of the Boeing Contract cannot be  
2 obtained.

3           103. Without information about an enemy missile and its countermeasures,  
4 construction of an accurate Mission Data Load is highly improbable. Without an accurate  
5 Mission Data Load, no mathematical methods for discrimination can be useful, regardless of  
6 sophistication. This informational deficit precludes the discrimination system from functioning  
7 effectively; without it, the system cannot work. Both TRW and Boeing understood this early on  
8 but failed to inform the Government that their system could not overcome such informational  
9 deficits. Instead, they repeatedly claimed that the system was “robust” with respect to  
10 uncertainties about the nature of the missile threat, meaning that the system would perform  
11 effectively when confronted with poorly defined threats.

12           104. The TRW discrimination system is particularly vulnerable to minor  
13 modifications (heating or cooling; specialized coating materials; altered motion) to a warhead  
14 reentry vehicle or decoy that substantially alter its observed infrared emissions. The system can  
15 also be overwhelmed by deploying warheads with decoys having infrared emissions that closely  
16 resemble those of the warhead reentry vehicle – an approach that involves simple technologies.  
17 Alternatively, the TRW discrimination system could be defeated by making all of the objects,  
18 warheads and decoys, appear unpredictably different to the EKV by heating or cooling them or  
19 coating them with common substances that alter their infrared emissions.

20           105. The problems with the TRW discrimination system are not limited to  
21 severe information gaps and simple countermeasures. Physical principles preclude the Baseline  
22 Algorithms and Kalman Filter from meeting the standards required by the Boeing Contract,  
23 the TRW Contract, or the TRD. The variation in intensity of light emissions from a warhead or  
24 decoy is affected by its motion (i.e., precession, spinning, tumbling) relative to an observer.  
25 The intensity of infrared emissions a sensor detects is affected by the surface area of the object  
26 that is visible; except for a perfectly uniform sphere, this changes as the object’s orientation  
27 changes relative to the sensor (e.g., as the object spins or tumbles). The premise of the TRW  
28 discrimination system is that each warhead type and decoy has a unique motion (imparted by its

1 deployment mechanism), shape, and construction that – purportedly – causes their observed  
2 infrared emissions to fluctuate with a “characteristic” frequency and intensity. (The Kalman  
3 Filter and the Baseline Algorithms both measure the average infrared signal intensity and the  
4 magnitude of its variation. The Kalman Filter also analyzes the rate (frequency) of the  
5 fluctuations in the infrared emissions from a warhead and any decoys deployed with it.) It is  
6 unrealistic to assume that each warhead type or decoy is deployed with a uniform motion having  
7 a characteristic rate.

8           106. Even if the warhead or decoy did have such a rate, a moving observer  
9 would nevertheless perceive varying frequency and magnitude of the fluctuations in the  
10 warhead or decoy’s infrared emissions. These fluctuations are caused by the motion of the  
11 object. Their frequency and range of variation are sensitive to the angle from which the  
12 warhead is viewed. Consequently, as the EKV approaches a warhead or decoy – and their  
13 relative orientation changes – the fluctuations and average value of each object’s infrared signal  
14 change from the perspective of the EKV’s sensor.

15           107. Thus, as TRW and Boeing were well aware, the principle upon which the  
16 Kalman Filter and Baseline Algorithms purportedly were based – *i.e.*, that the infrared signal  
17 from a warhead or decoy has such fixed “characteristic features” – is patently false because such  
18 features of an object’s infrared signal will not, and cannot be, static given the dynamic  
19 conditions under which the discrimination system must operate.

20 **C. TRW and Boeing Withheld Data From the Government Demonstrating the Severe**  
21 **Technical Flaws in the Discrimination System**

22           108. In testing its system, TRW determined that resolution of a characteristic  
23 frequency in a warhead’s or decoy’s infrared signal is further complicated by “harmonic  
24 frequencies” in an object’s infrared signal, which simply refers to signal fluctuations that are  
25 multiples of an object’s base frequency (e.g., for a base frequency of 100 hertz, the harmonics  
26 are 200 hertz, 300 hertz, etc.). Any warhead or decoy that has sharp edges or an abrupt change  
27 of surface materials generates infrared signals that contain harmonic frequencies. The Kalman  
28 Filter cannot resolve these harmonic frequencies and instead jumps between them without ever

1 being able to resolve one as being the characteristic frequency. In a great majority of the tests  
2 conducted by TRW, the Kalman Filter failed completely when harmonic frequencies were  
3 included in simulated tests. Harmonic signals would almost always be present in real world  
4 situations. Thus, the Kalman Filter never could have functioned effectively for this reason as  
5 well.

6           109. TRW also found in its testing that the limited range of the EKV's sensor  
7 creates serious problems. This constraint restricts the time over which data can be collected.  
8 The limited sensitivity of the infrared sensor creates gaps – periods when the signal cannot be  
9 resolved – in an object's infrared signal. The sensor's sensitivity is of particular importance  
10 when the EKV is distant from the warhead and decoys (approximately sixty to forty-five  
11 seconds before intercept) because this is when an object's infrared signal is weakest. Further,  
12 the "noise" in this early signal is amplified when the data are scaled to compensate for the  
13 increase in the signal that occurs as the EKV approaches the warhead and decoys. This re-  
14 scaling creates unavoidably large "spikes" and "dips" in the signal – observed in real and  
15 simulated data – during the period of sixty to forty-five seconds before intercept.

16           110. These data "gaps," as TRW discovered, cause sudden changes in the  
17 averaged infrared signal data analyzed by the Kalman Filter and Baseline Algorithms. The  
18 sudden changes in turn confused the discrimination system by creating erroneous fluctuations in  
19 the infrared signal that obscured the "real" fluctuations caused by an object's actual physical  
20 characteristics. During the period of these data gaps, an object's infrared signal is not consistent  
21 either in time variability or in measured intensity. Unless the discrimination system can  
22 accurately "fill" these gaps, the infrared signal cannot be relied on for discrimination until the  
23 EKV is very close (within approximately forty-five seconds) of the warhead and decoys. This is  
24 a critical constraint because effective targeting and kill-vehicle maneuvering require that the  
25 TRW discrimination system operate starting at about sixty seconds prior to interception.

26           111. Additional gaps in an object's infrared signal are introduced if the EKV's  
27 sensor cannot view simultaneously all of the objects it is tracking because they are spread out in  
28 space. Under these circumstances, the sensor's telescope must switch back and forth between



1 Force Base in California, transported a suite of ten test objects, which included eight decoys,  
2 one mock reentry vehicle (warhead) and a rocket upper-stage (the Mission Service Launch  
3 System, or MSLS), to deploy the decoys and mock warhead. The launch of the target cluster  
4 occurred twenty-one minutes before a payload launch vehicle lifted off from Kwajalein Missile  
5 Range in the Republic of the Marshall Islands with the TRW-Boeing sensor system. The sensor  
6 package acquired, tracked, and flew past the cluster of ten test objects, collecting an extensive  
7 amount of data on the objects that were analyzed using the Baseline Algorithms and Kalman  
8 Filter. No attempt was made to collide with the mock warhead during the IFT-1 A mission.

9           115. The conditions of the test were precisely arranged to optimize the  
10 chances that the TRW discrimination system would correctly identify the mock warhead:

11                   a. All of the parameters associated with the warhead and decoys  
12 (temperature, shape, size, motion, materials) were known precisely – meaning that the  
13 calculations for the Mission Data Load were based on uncharacteristically and unrealistically  
14 accurate data.

15                   b. These parameters were chosen to maximize the likelihood of the  
16 TRW system correctly identifying the warhead (e.g., the motion of the warhead was very simple  
17 and the “decoys” did not closely mimic the warhead).

18                   c. The time of the interception was set so that the sun would heat the  
19 warhead and decoys, thereby increasing their infrared signal and minimizing data-gap problems.  
20 The fly-by was specifically arranged to occur under ideal conditions, such that, barring  
21 unforeseen complications, the system would work. As such, the IFT-1 A mission represented an  
22 undemanding test of the system’s basic principles for discrimination.

23           116. One unanticipated problem did arise during the IFT-1 A mission. A  
24 balloon decoy did not fully inflate, which, ironically, made it appear to the EKV’s sensor almost  
25 identical to the warhead. Rather than acknowledging that its system could not perform  
26 discrimination between the warhead and the partially inflated balloon, TRW circumvented the  
27 problem by omitting the data pertaining to the partially inflated balloon from its analysis. TRW  
28 did so without first informing the Government. This omission is just one instance, in a long

1 chain, of fraudulent manipulation of the IFT-1 A data designed to maintain the appearance that  
2 the discrimination system is viable.

3           117. The data obtained during the fly-by also confirmed the technical and  
4 physical limitations of the system outlined above. First, the data showed no discernible time-  
5 fluctuating feature (“characteristic frequency”) in the infrared signal that was unique to either  
6 the mock warhead or the decoys. Second, neither the intensity of the warhead’s infrared signal  
7 nor its range of fluctuation consistently distinguished the warhead from the decoys. Instead, the  
8 analysis of the IFT-1A data revealed that the TRW system randomly shifted back and forth  
9 between the warhead and decoys in seeking to identify the warhead. Both of these results were  
10 predictable because these features of the infrared signal from the warhead and decoys change as  
11 the vantage point of the EKV’s sensor changes, and the orientation of the EKV’s sensor relative  
12 to the objects it is tracking unavoidably shifts as they approach each other.

13           118. TRW’s discrimination system was also unable to contend with interfering  
14 infrared signals from sources other than the warhead and decoys. Spikes in the signal caused by  
15 random atmospheric interference and reflections off of the warhead and decoys led to  
16 substantial deviations between the idealized simulated data and those collected by the EKV’s  
17 sensor, making accurate discrimination impossible. Consequently, rather than demonstrating  
18 the viability of the TRW-Boeing system, the IFT-1A mission confirmed the systemic flaws  
19 Schwartz reported to her superiors at TRW in 1995 and disclosed to the Government for the  
20 first time in April 1996, following her abrupt termination by TRW.

21           119. TRW produced a 45-Day Report (published on August 13, 1997) that  
22 analyzed the results of the IFT-1 A mission and the application of the Baseline Algorithms to the  
23 data it generated. The 45-Day Report employed a gap-filling algorithm to compensate for  
24 segments of unavoidably low signal and signal spikes (discussed above) in the simulated data  
25 used to construct the Mission Data Load for the IFT-1 A test. Incorporating this algorithm,  
26 TRW determined that the Baseline Algorithms had only a sixty percent chance of correctly  
27 identifying the warhead under the conditions of the IFT-1A test.

28           120. TRW, however, falsely represented to the Government that, had an

1 interception been attempted, the Baseline Algorithms would have correctly identified the  
2 warhead because it did not assign a higher probability of being the target to any other object in  
3 the threat cloud. TRW, however, cannot claim that its discrimination system would, in fact,  
4 have correctly identified the warhead; the only accurate claim is that it had a sixty-percent  
5 chance of doing so – far below that required under the TRD.

6           121. TRW's 45-Day Report was followed by a Boeing 60-Day Report  
7 (released on August 22, 1997) analyzing the performance of the EKV's infrared sensor. The  
8 60-Day Report found that the infrared sensor operated well within specifications. In addition, in  
9 April 1998 Boeing published an Addendum to its 60-Day Report that reanalyzed the data from  
10 the IFT- 1 A mission.

11           122. In the Addendum, Boeing fraudulently manipulated the IFT-1 A data and  
12 the discrimination system itself in several critical ways. First, Boeing engaged in an *exposte*  
13 modification of the Mission Data Load to ensure that it “matched” the IFT-1 A data. Boeing, for  
14 example, hand-selected signal features (different from TRW's) and, contrary to the operation of  
15 the system, spliced two sets of signal features together when a single set did not produce the  
16 desired result.

17           123. Second, where Boeing was unable to fit the Mission Data Load to  
18 specific segment of experimental data, it omitted the experimental data altogether from its  
19 analysis.

20           124. Boeing, for example, removed the first 31 seconds of data because of  
21 poor signal and large signal spikes. Boeing justified this action by claiming that the EKV's  
22 sensor was not functioning properly over this period and that warhead discrimination does not  
23 occur more than fifteen seconds prior to interception. These claims were false: (1) the Boeing  
24 60-Day Report found that the sensor had no problems; and (2) the design of Boeing's EKV  
25 requires that discrimination begin at least sixty seconds prior to interception. The removal of  
26 this 31 seconds of data was completely artificial, and was based on a claim Boeing knew to be  
27 false. In a real situation, the discrimination system would have to begin processing sensor  
28 tracking data early to classify all possible target objects before they pass from its field of view

1 and to provide the EKV with enough time to maneuver towards the object it selects as the most  
2 probable target.

3           125. Third, without any valid rationale, Boeing removed approximately the  
4 last thirteen to sixteen seconds of the IFT-1 A data because one of the decoys was actually  
5 designated by TRW's system as the warhead during this segment.

6           126. It was only through such fraudulent manipulation of simulated and flight-  
7 test data and through reconstructing Mission Data Loads that Boeing was able to "fix" the  
8 results of the Baseline Algorithms to meet the performance requirements set by the  
9 Government.

## 10 11 **VI.**

### 12 **THE DEFENDANTS' FALSE CLAIMS TO THE GOVERNMENT**

13           127. TRW and Boeing knowingly and deliberately submitted to the  
14 Government false proposals, false performance reports, false assessment reports, false test  
15 plans, procedures, and reports, and invoices based on false claims. Schwartz is informed and  
16 believes, and on that basis alleges, that Boeing and TRW have been paid substantial sums by the  
17 Government over the period 1992- 1999 in connection with the Boeing Contract, the TRW  
18 Contract and the TRW Purchase Order.

19           128. The Boeing employees involved in knowingly presenting false statements  
20 to the Government include, but are not limited to, Peter Chu, Robert Duffy, Daniel Garwich, C.  
21 Lee, Michael F. Madden, Len McAfee, David Pearson, John Ripley, and Linda Taylor. The  
22 TRW employees involved in knowingly presenting false statements to the Government include,  
23 but are not limited to, Wallace Beitzel, Scott Cook, Henry Crowter, C. Frieler, Robert Hughes,  
24 Ray Maddalone, and Jay Mitchell.

25           129. The statements enumerated below were presented in writing (e.g., the  
26 1993 and 1995 Threat Typing Sensitivity Study Reports; March 1995 and April 1996 reports on  
27 the Kalman Filter) and orally (e.g., the TRW and Boeing in October 1995) to the Government at  
28 the Defendants' principal places, which are provided above in the section listing the parties to

1 this action. In particular, since the time of the project down-select in 1994, TRW and Boeing  
2 have falsely claimed that the performance of the Baseline Algorithms met all contractual  
3 requirements. Some of these written reports and statements were made to or produced for the  
4 Government during the period from January 1993 until January 1996. A few additional reports  
5 (e.g., TRW's briefing entitled "GBI Discrimination Performance (U)" on November 18, 1996;  
6 TRW's April 1996 Kalman Filter Performance Report) and data were generated in the period  
7 from February 1996 until October 1999. Schwartz is informed and believes, and on that basis  
8 alleges, that there have been additional such statements made by TRW and Boeing to the  
9 Government, both in writing and orally.

10           130. Schwartz is informed and believes, and on that basis alleges, that when  
11 Boeing presented reports regarding the Boeing Contract to the Government, in most or all cases,  
12 TRW was the principal author of any portions pertaining to its discrimination technology.

13           131. TRW's reports to the Government falsely claimed that the system was in  
14 conformance with the TRD and Boeing's specifications that the discrimination system have,  
15 according to an unclassified Boeing document, a greater than a ninety-four percent probability  
16 of correctly selecting the warhead. TRW knowingly and falsely reported to the Government  
17 that the Baseline Algorithms and Kalman Filter could accurately discriminate between a  
18 warhead and decoys deployed with it. TRW falsely represented to the Government that the  
19 Kalman Filter could be used for discrimination when, for example, its tests showed that over  
20 85% of the time the technology failed to perform. Defendants falsely represented the  
21 probability for successful discrimination by fraudulently ignoring and withholding from the  
22 Government the majority of the data they had collected indicating that the system performed far  
23 below the standards required under the Boeing Contract, the TRW Contract and the TRD..

24           132. TRW and Boeing knowingly submitted false performance reports  
25 claiming that the EKV's discrimination system was fully "autonomous" (i.e., functioned in a  
26 "closed-loop, object-level" mode) with respect to selecting the right signal features, as required  
27 by the TRD and paragraph 4.0 of the TRW Statement of Work. This statement is directly  
28 contradicted by extensive data and testing of the "BEST" algorithm TRW developed to select

1 the optimal signal features. It is also refuted by the fact that TRW and Boeing never used the  
2 BEST algorithm in analyzing flight test data, but instead hand-selected features after the fact.  
3 Moreover, TRW and Boeing did not even choose the same features in their respective analyses;  
4 each used different signal features and different Mission Data Load values. Contrary to TRW's  
5 and Boeing's claims, no systematic method exists to select the "best" signal features that would  
6 enable the EKV to operate autonomously.

7           133. TRW and Boeing falsely asserted that the discrimination system complies  
8 with paragraph 3.1.1 of the TRW Statement of Work, the TRD, and Boeing specifications.  
9 TRW falsely stated that its discrimination technology is largely immune to fluctuations in  
10 Mission Data Load parameters and minimally sensitive to the level of threat typing information  
11 available. As TRW data show, the discrimination system is highly sensitive to changes or  
12 inaccuracies in the Mission Data Load parameters. Even minor perturbations (i.e., about ten  
13 percent) in the Mission Data Load parameters, for example, degraded the probability of accurate  
14 discrimination to less than 20% of the value TRW reported to the Government. TRW and  
15 Boeing concealed from the Government the high sensitivity of the discrimination system to  
16 differences/inaccuracies in the Mission Data Load parameters. TRW and Boeing withheld this  
17 information to stave off the crippling effect it would have on the NMD program, because  
18 accurate information on target missiles is rarely, if ever, available – meaning that under real-  
19 world conditions in which information is limited and uncertain, the system could not operate.

20           134. TRW and Boeing falsely asserted that validation of TRW's  
21 discrimination algorithms against phenomenology data acquired from experimental programs,  
22 such as Delta 18 1 and ERIS FTV, were in compliance with paragraph 3.1.1. of the TRW  
23 Statement of Work, the TRD, and specifications in the Boeing Contract.

24           135. TRW and Boeing falsely asserted that the discrimination system could  
25 identify a warhead among two widely spaced clusters of decoys as required in paragraph 1 .O of  
26 the TRW Statement of Work, the TRD, and specifications of the Boeing Contract. Selection  
27 between two clusters is impossible using the TRW-Boeing system because it cannot begin the  
28 discrimination process until less than 45 seconds prior to intercept, which does not afford the

1 system adequate time to discriminate between two clusters of objects and maneuver to intercept  
2 the warhead.

3           136. In their analysis of the IFT-1 A mission data, TRW and Boeing falsely  
4 asserted that the discrimination system designates an object as the warhead if it retained the  
5 highest importance value for 2 seconds or more, and selects the target warhead only in the final  
6 15 seconds prior to interception – despite the requirement that at least 60 seconds of  
7 discrimination time be available. Without any valid rationale, TRW also removed  
8 approximately the last thirteen to sixteen seconds of IFT-1 A data because one of the decoys was  
9 designated by its system as the warhead during this final segment. TRW and Boeing  
10 fraudulently manipulated the IFT-1 A data and the Mission Data Load to make it appear that the  
11 discrimination system successfully identified the warhead and to protect their contracts with the  
12 Government.

13           137. An unclassified document entitled “Independent Review of TRW  
14 Discrimination Techniques Final Report”, generated by Phase One Engineering Team  
15 (“POET”) in the course purportedly of assessing TRW’s technology, reflects results claimed by  
16 TRW of the performance of its Baseline Algorithms on IFT-1A data. As reflected in the POET  
17 report, TRW claimed performance of approximately 99% probability to assign the target. These  
18 claimed results are false.

19           138. TRW and Boeing falsely represented that there is rarely substantial  
20 overlap between the Mission Data Load for a warhead and that for a decoy when they had  
21 extensive data contradicting this claim.

22           139. TRW, for example, improperly incorporated data, such as gaps in the  
23 IFT-1 A data, into the Mission Data Load for the IFT-1 A mission that were not, and could not  
24 have been, available prior to the test flight. In other words, when the test data did not match the  
25 Mission Data Load used to discriminate between the warhead and decoys in the IFT-1 A  
26 mission, TRW and Boeing retroactively fit the Mission Data Load to the experimental data.

27           140. In December 1997, TRW acknowledged that the Mission Data Load had  
28 been manipulated in the 45-Day and 60-Day Reports and promised to provide the Government





1 part in Section VI of this Complaint, and were further based upon false records containing such  
2 false statements.

3 152. Defendants TRW and Boeing knowingly presented, or caused to be  
4 presented, to the United States Government for payment or approval, false or fraudulent claims,  
5 these claims being the above described requests for payment, and statements and certifications  
6 submitted to obtain such payments; each instance being in violation of 31 U.S.C. § 3729(a)(1).

7 153. Defendants TRW and Boeing knowingly made or used, or caused to be  
8 made or used, false records or statements to have false or fraudulent claims paid or approved by  
9 the United States Government, such records and statements being further described in Section V  
10 of this Complaint; each instance being in violation of 31 U.S.C. § 3729(a)(1).

11 154. As a result of the conduct of the Defendants corporations, as described in  
12 this Complaint, the United States suffered actual damages.

13 THIRD CLAIM FOR RELIEF

14 **(False Claims Act, Against TRW, for Violation of 31 U.S.C. § 3730(h))**

15 155. Schwartz realleges and incorporates by reference the allegations  
16 contained in paragraphs 1 through 143 of this Complaint as if set forth here in full.

17 156. Schwartz was employed by TRW from September 1995 through late  
18 February 1996.

19 157. Schwartz performed all labor and services required of her except to the  
20 extent that such performance was excused or made impossible due to the actions of TRW.

21 158. As alleged above, Schwartz brought serious questions regarding the  
22 failings of TRW's discrimination technology to the attention of her superiors. She presented  
23 test results demonstrating that the technology did not work. She raised issues casting doubt that  
24 the technology could ever work. She urged TRW to convey this information to Boeing and the  
25 Government.

26 159. On February 27, 1996, TRW responded to Schwartz not by doing as she  
27 requested, but instead by terminating Schwartz's employment without cause and without prior  
28 notice.





1 permitted by law; and punitive damages in an amount to be determined at trial.

2 5. For all costs and expenses of this civil action, with interest thereon.

3 6. For such other and further relief as the Court deems just and equitable.

4 7. In addition, Schwartz, acting on her own behalf, demands and seeks that  
5 an award be made in her favor as follows:

6 8. For twenty-five percent (25%) of the proceeds collected by the  
7 Government, if the United States proceeds with this action; or for thirty percent (30%) of such  
8 proceeds if the Government does not proceed with this action.

9 9. For all reasonable expenses incurred by Schwartz in relation to this  
10 proceeding, plus all reasonable attorneys' fees and costs.

11 10. For such other and further relief to which Schwartz may be entitled.

12 Respectfully submitted,

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14 Dated: January 5, 2001

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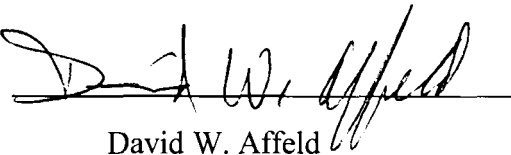
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LAW OFFICES OF DAVID W. AFFELD, A.P.C.  
GUY SAPERSTEIN  
NATURAL RESOURCES DEFENSE COUNCIL

  
David W. Affeld

Attorneys for Plaintiff and Relator Nira Schwartz

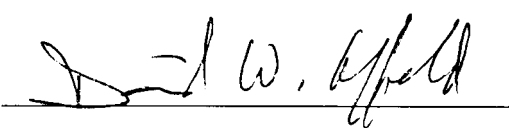
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**DEMAND FOR JURY TRIAL**

Pursuant to Fed. R. Civ. P. 38(b) and Local Rule 3.4.10.1, plaintiff and relator Dr. Nira Schwartz demands trial by jury.

Dated: January 5, 2001

LAW OFFICES OF DAVID W. AFFELD, A.P.C.  
GUY SAPERSTEIN  
NATURAL RESOURCES DEFENSE COUNCIL



David W. Affeld

Attorneys for Plaintiff and Relator Dr. Nira Schwartz

1 PROOF OF SERVICE

2 STATE OF CALIFORNIA )  
3 ) ss.  
4 COUNTY OF LOS ANGELES )

5 I, the undersigned, certify and declare that I am over the age of 18 years,  
6 employed in the County of Los Angeles, California, and am not a party to the within action; my  
7 business address is 333 South Grand Avenue, 37th Floor, Los Angeles, California 90071-1599.  
8 On January 5, 2001, I served the foregoing document described as **FOURTH AMENDED  
9 COMPLAINT FOR: 1. VIOLATION OF THE FALSE CLAIMS ACT, 31 U.S.C.  
10 §§3729(a)(1), (a)(2) and (c); 2. EMPLOYMENT RETALIATION IN VIOLATION OF  
11 THE FALSE CLAIMS ACT, 31 U.S.C. §3730(h); and 3. WRONGFUL TERMINATION  
12 IN VIOLATION OF PUBLIC POLICY** on the interested parties in this action by placing a  
13 true copy thereof enclosed in a sealed envelope addressed as follows:

14 **SEE ATTACHED SERVICE LIST**

15 **XXXX** BY MAIL - I deposited such envelope in the mail at Los Angeles, California.  
16 The envelope was mailed with postage thereon fully prepaid.

17 **XXXXX** I am "readily familiar" with the firm's practice of collection and  
18 processing correspondence for mailing. Under that practice, it would be  
19 deposited with the U.S. Postal Service on that same day with postage thereon  
20 fully prepaid at Los Angeles, California in the ordinary course of business. I am  
21 aware that on motion of the party served, service is presumed invalid if postal  
22 cancellation date or postage meter date is more than one day after date of deposit  
23 for mailing in affidavit.

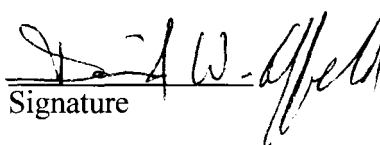
24 (BY FACSIMILE) At 1:00, p.m., I sent the foregoing document by facsimile  
25 transmission from The Law Offices of David W. Affeld, A.P.C., facsimile  
26 machine telephone number 213-229-0085, to counsel identified above at  
27 facsimile machine number **See Attached Service List**. The transmission was  
28 reported as complete and without error.

(BY PERSONAL SERVICE) I cause to be delivered such envelope by hand to  
the offices of the addressee.

29 **XXXXX** I declare under penalty of perjury under the laws of the United States of America  
30 that the foregoing is true and correct.

31 Executed on January 5, 2001 at Los Angeles, California.

32 David W. Affeld  
33 Type or Print Name

34   
35 Signature

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