

# CONTROLLING TECHNOLOGY

---

## Ethics and the Responsible Engineer

Second Edition

**STEPHEN H. UNGER**

School of Engineering and Applied Science  
Columbia University  
New York, New York

Engin  
TA  
157  
.453  
1994



A Wiley-Interscience Publication

**JOHN WILEY & SONS, INC.**

New York • Chichester • Brisbane • Toronto • Singapore

In short, concerns over money and corporate health induced the managements of the two companies to overrule judgments expressed by their engineers that the DC-10 had design flaws that endangered human life. The engineers pressed the matter through normal channels within the two companies—Applegate was by no means the only one to urge remedial action. Indeed it reached top management levels. There is in this case no indication of a serious dispute over the technical issues—how could there be after the 1970 and 1972 incidents! But when their professional judgments on this matter involving public safety were contravened by managers on non-technical grounds, neither Applegate nor any of his colleagues took the matter any further. Nor did any of them, as far as is known, withdraw from the project.

Before criticizing them too harshly for what, according to engineering ethics codes, might be considered unethical behavior, one must consider the likely penalties in terms of career and economic damage that would have befallen any of them who had taken further action. What was required was heroic behavior and, unfortunately for the 346 mangled victims of the Paris crash and their surviving families and friends, the heroism displayed in one form by Bryce McCormick was not matched by any of the Convair or McDonnell Douglas engineers in their own realm. However, as is illustrated in the succeeding sections and chapters, the ranks of the engineering profession are by no means devoid of heroes.

### 2.3 THE BART CASE

The following account of the Bay Area Rapid Transit (BART) case originally appeared in the September 1973 Newsletter of the IEEE Committee on Social Implications of Technology (CSIT) and was subsequently reprinted in several other places.

There has been an upsurge of discussion recently about the status of engineering as a profession, the obligations of the engineer toward the public, and the relationship of the engineer to his employer. Some very important facets of these questions are illuminated by the fate of three engineers employed by Bay Area Rapid Transit (BART).

A few words about the structure of BART will be useful as a background. (The recent series by Gordon Friedlander (2) constitutes an excellent description of the overall project.) BART is a fast (80 mi/h top speed) modern rail transit system, with 34 stations and 75 miles of track, serving the counties of San Francisco, Alameda, and Contra Costa. Ownership and control are vested in the Bay Area Rapid Transit District (BARTD),

created by public statute in 1957 and governed by a 12-person Board of Directors, four from each county. It is financed by public funds.

Construction began about 1963 and the overall cost is now estimated at about  $1.5 \times 10^9$  dollars (1). Partial revenue service commenced, between Oakland and Fremont, on September 11, 1972, almost three years behind schedule (1).

A consortium of three engineering firms, referred to as Parsons, Brinkerhoff-Tudor-Bechtel (PBTB), was retained by BART to direct and engineer the construction of the system. They in turn contracted out various phases of the operation to other firms. In particular Westinghouse Electric Corporation, on the basis of competitive bidding, was awarded (in 1967) a \$26 million contract to design, install, and operationally qualify the Automated Train Control (ATC) System (1).

BART itself has an engineering staff whose functions include system maintenance and operation, surveillance and status checking of construction, approval of design changes, and general investigation of problem situations.

The following account is based on a collection of over 40 documents including letters, memos, newspaper articles, and reports, ranging in length from a few paragraphs to over 100 pages. These were acquired principally through correspondence. Because it was not feasible to interview the participants (even by phone), certain details have not been clarified. However, these are not important enough to affect the overall picture that emerges. The same is true for a few pieces of information that were given to the writer in confidence; these only serve to reinforce the impressions created by other information.

## THE EVENTS

Holger Hjortsvang, a systems engineer in the BART Maintenance Section since 1966, and a senior member of IEEE, was involved with the ATC system. He became, over a period of years, increasingly concerned with the way the development of this system was progressing. He felt that BART had no internal structure adequate to monitor this phase of the project, relying instead on PBTB, who were also not set up to oversee this task (3). In part as a result of his having been sent to work for ten months with the Westinghouse Computer Systems group responsible for ATC, Hjortsvang had grave doubts about the success of this phase of the project (4,5). He expressed these concerns to his superiors both orally and in a series of five written memorandums dating back as far as April 1969 (7). In one of these reports criticizing the ATC system, he predicted a mean time between failures (each stopping a train) of three and a half hours

when the system was in full operation (4,5). There was no significant response from his management.

Max Blankenzee, a programmer analyst working with Hjortsvang since 1971, had a similar experience. His memos to his superiors criticizing various aspects of the ATC development drew only vague verbal responses and warnings not to become a "troublemaker" (5,7).

Meanwhile, in BART's Construction Section, Robert Bruder, an electrical engineer monitoring various phases of the project since 1969, was growing increasingly disturbed about the "unprofessional" manner in which the installation and testing of control and communications equipment was being supervised by both BART and PBTB, as well as the obviously unrealistic opening dates being released to the public. His management was also not responsive to his expressed concerns (6).

Toward the end of 1971 the three engineers decided that in the public interest they must take steps to have their concerns dealt with seriously. Accordingly they made contact with Daniel Helix, a member of the BART Board of Directors, told him about the problems they were encountering, and gave him some written material. Mr. Helix expressed interest and was persuaded that action was needed. He conferred with two other board members and gave copies of a report on the subject to the entire board and the top management of BART (4-7).

The next step (and the elapsed time here is not clear) was the release to the press by Mr. Helix of the news of the controversy (7-9). This was followed by a public meeting on February 24 (or February 25) of the BART board at which presentations were made by Edward Burfine, a consulting engineer engaged by either Helix or the three engineers (possibly both— another unclear point) to present the criticisms of the handling of the ATC development, and by representatives of PBTB and Westinghouse in defense of their approach (4,7). The board voted ten to two (one source said eight to two) in support of BART's management, in effect rejecting the criticisms.

Apparently the identities of the three who initiated the controversy had not been made public, and BART's management now proceeded to identify them (6,9). On March 3, Hjortsvang, Blankenzee, and Bruder were given the options of resigning or being fired. Upon refusing to resign, they were summarily dismissed with no written reasons being given (5-7,9).

On February 23 (just prior to the public meeting of the board) Bruder, a member of the California Society of Professional Engineers, telephoned CSPE President William F. Jones, outlined the situation as it then stood, and asked for support. Mr. Jones immediately contacted the Diablo Chapter of CSPE (to which Bruder belonged) and, along with the leaders of

that chapter, initiated a thorough study of the situation. Subsequent to the discharge of the three engineers, Jones (on March 13) attempted to reach B. R. Stokes, BART's general manager. (All accounts attribute the firings to Stokes' initiative.) Jones was never able to reach Stokes. He did speak to Chief Engineer David Hammond, who expressed surprise that CSPE should be interested in the situation. BART's top management declined to meet with CSPE (112).

Requests by the fired engineers for hearings on their case, or even for written statements of the charges justifying their dismissals, met with no response, and in fact BART has refused to issue any explanation to anyone (6,7, 9-12). (Of three letters of inquiry I wrote to various BART manager—including Stokes—who were involved in the case, only one reply has been received. This was a refusal by Blankensee's supervisor to provide any explanation, on the grounds of pending legal action (13).)

A full investigation of the firings, the conduct of the three engineers, and the substance of their concerns about the BART project was then undertaken by CSPE. President Jones stated (10) that he and other CSPE members (Gilbert A. Verdugo, state director Diablo Chapter CSPE, and Roy W. Anderson, chairman of CSPE's Transportation Safety Committee, also played major roles) involved in the case were "convinced that the three engineers acted in the best interest of the public welfare in disclosing to the BART Board of Directors problems regarding train control, systems management, and contractual procedures. "He also stated that "a large volume of most distressing information on the employment practices of BART, and on its apparent disregard for public safety, has been gathered."

On June 19, 1972, a report of CSPE's findings authored by Roy Anderson and entitled "The BART Inquiry" was submitted to the California State Senate. At about the same time, the Diablo Chapter of CSPE circulated a public petition calling for a wide-ranging investigation of BART by the state legislature (a number of specific charges were made, but the case of the fired engineers, and employment practices in general were not mentioned) (9). CSPE also took some tentative steps toward a court action on behalf of the fired three, but never did follow through on this (9).

The state legislature did investigate, producing what is known as the Post Report (1). It acknowledges the CSPE report as its starting point. Several instances of mismanagement of the project are pointed out, although no mention is made of employment practices or of the three men whose initial warnings led directly to the Legislature's investigation. The Post Report (1), a further study by a special panel of distinguished engineers (14), and several other independent studies all confirmed, in general outline, the concerns expressed by Bruder, Hjortsvang, and Blankensee.

A great deal of information pointing to poor engineering design was uncovered.

A more dramatic confirmation occurred on October 2, 1972, when a BART train overran the station at Fremont as a result of an ATC failure and several passengers were injured (2). This occurred just three weeks after the initiation of partial revenue service.

At this writing, the BART ATC is still under a cloud, with the trains being controlled ultimately in the traditional manner (2). The three engineers are now suing BART for damages totalling \$885,000. They charge breach of contract and deprivation of constitutional rights. Blankenzee also charged that BART officials intervened on several occasions to discourage prospective employers from hiring him on the grounds that he was a "troublemaker" (15).

### COMMENTS AND CONCLUSIONS

The code of ethics of the NSPE states that the engineer "will regard his duty to the public welfare as paramount" and that "he will notify the proper authority of any observed conditions which endanger public safety and health." The Employment Guidelines approved by many engineering societies, including IEEE, and published in the May 1973 issue of *Spectrum* are also highly relevant.<sup>1</sup> The facts related above indicate that Hjortsvang, Blankenzee, and Bruder acted in a manner fully consistent with the letter and spirit of this code and guidelines, a conclusion also attested to by the CSPE. There is no indication that they did anything in this situation that could reasonably be called improper. When they felt it necessary to depart from normal administrative channels, they addressed themselves to the BART Board of Directors, an action difficult to interpret as irresponsible. (An interesting sidelight on the cautious approach of at least one of the three was provided by reporter Justin Roberts of the Contra Costa Times (16). He stated that he met Robert Bruder some months prior to the firings, and having heard, from other sources, of trouble in BART, "attempted to pump him." "He politely but firmly

<sup>1</sup>Objective #3: The responsibility of the professional employee to safeguard the public interest must be recognized and shared by the professional employee and employer alike.

Terms of employment #2: The professional employee should have due regard for the safety, life, and health of the public and fellow employees in all work for which he/she is responsible. Where the technical adequacy of a process or product is involved, he/she should protect the public and his/her employer withholding approval of plans that do not meet accepted professional standards and by presenting clearly the consequences to be expected if his/her professional judgment is not followed.

rebuffed my efforts." Only after the matter became public knowledge, did Bruder speak to the press.)

Dr. Willard H. Wattenburg, a consultant who looked into the matter, referred to Holger Hjortsvang as "one very honest engineer" who was "ruthlessly sacrificed."

Nevertheless, having performed an obvious public service in the highest tradition of engineering, the considerable personal sacrifices of Blankensee, Bruder, and Hjortsvang have been largely ignored in the reports that subsequently validated their claims. Only the CSPE showed any concern for them, and this group was apparently unable to take effective action on their behalf.

Unfortunately, the BART case is not a unique example of employed engineers being forced to choose between compromising their ethics or seriously jeopardizing their careers. It is imperative that the engineering profession develop institutional means for eliminating such dilemmas. The working Group on Ethics of IEEE CSIT is now exploring proposals toward this end and a progress report will appear in a future issue of CSIT Newsletter.

### ACKNOWLEDGMENT

The author's efforts to gather material on this subject were significantly facilitated by the cooperation of Messrs. Gordon Friedlander (IEEE Spectrum), Gilbert Verdugo (CSPE), and Justin Roberts (Contra Costa Times).

### SOURCES AND REFERENCES

- (1) A. A. Post, "Investigation of the operation of the Bay Area Rapid Transit District with particular reference to safety and contract administration," California State Legislature, Nov. 9, 1972.
- (2) G. Friedlander, Series of five articles on BART, IEEE Spectrum, Sept. 1972, Oct. 1972, Nov. 1972, Mar. 1973, Apr. 1973.
- (3) H. Hjortsvang, "BART System Engineering," memorandum to Director Daniel Helix, Nov. 18, 1971.
- (4) ———, Memorandum to CSPE attorney, Mar. 7, 1972.
- (5) J. Roberts, News article, Contra Costa Times, Mar. 7, 1972, p. 1.
- (6) R. Bruder, Letter to author, June 10, 1973.
- (7) R. Vogt, News article, Contra Costa Times, Mar. 8, 1972.
- (8) H. Hjortsvang, Letter to author, June 26, 1973.
- (9) "BART in Perspective," Editorial, California Professional Engineer, pp. 4-6, Mar.-Apr. 1973.
- (10) W. F. Jones, "The BART Affair," a printed document of the CSPE, undated, received from Mr. Verdugo.

- (11) "CSPE Action to Protect Engineering Employees," a typed CSPE document, undated, received from Mr. Verdugo.
- (12) R. W. Anderson and G. A. Verdugo, "The BART Inquiry," (Not the report to the Senate referred to later), a typed CSPE draft, received from Mr. Verdugo.
- (13) E. F. Wargin, BART Superintendent of Maintenance Engineering, Letter to author, June 14, 1973.
- (14) B. Oliver, C. Lovell, and W. Brobeck, "Report on Safety of the Bay Area Rapid Transit Automatic Control System," prepared for the State of California Senate Public Utilities and Corporations Committee, Jan. 31, 1973.
- (15) J. Roberts, News article, Contra Costa Times, May 20, 1973, p. 1.
- (16) J. Roberts, Letter to author, May 25, 1973.
- (17) W. Wattenburg, Letter to author, May 16, 1973.

Some fascinating insights into the quality of the engineering of BART's automatic train control system can be found in the letter (see Appendix A.3.1) by Bernard Oliver, a distinguished engineer and former president of the Institute of Electrical and Electronics Engineers (IEEE), who served on a three-member panel of experts commissioned by the California State Senate to review the system. After the expenditure of additional millions of dollars, the BART system now provides very good service, though maintenance remains a problem.

Following the appearance of the above article, the BART case was discussed intensively within the IEEE. In March of 1974, a two-part resolution was passed by CSIT, which called on IEEE's board of directors (BOD) to set up machinery to support engineers whose acts in conformity with ethical principles may have placed them in jeopardy and, in the interim, to intervene on behalf of the three BART engineers. The BART issue was also considered by the Ethics and Employment Practices Committee (EEPC) of the IEEE U.S. Activities Committee. A subcommittee appointed to consider the matter reviewed the file on which the CSIT article was based. As a result of this review, the EEPC endorsed the CSIT position.

The Executive Committee of the BOD responded by appointing its own subcommittee to consider the matter. This eventually led to the IEEE's filing an amicus curiae brief (see Appendix A.3.2) on behalf of the three engineers in their civil suit against BART. The brief deals not with the facts of the case but with the broad ethical principles involved. The court was urged to rule that an engineer's employment contract includes an implied term that he or she will protect the public safety and that discharging an engineer for adherence to this term should constitute a breach of contract by the employer.

Shortly after the filing of this brief on January 9, 1975, BART offered the



three engineers an out-of-court settlement (reported to be \$75,000). A combination of financial hardship and uncertainty as to the outcome of a trial, the latter compounded by a weakness in their case (the engineers had falsely denied to management that they were the instigators of Helix's intervention), induced the three to accept the settlement. An unfortunate consequence is that the opportunity to establish a legal precedent based on the IEEE brief was thereby forfeited. The principle involved was however taken further in the Grace Pierce case decided in 1980 (see Section 6.4).

Subsequent action by the IEEE related to the matter of general support in such cases is discussed in Section 5.3. Suffice it to say here that, in addition to the direct benefits that accrued to the public as a result of the alarm sounded by Hjortsvang, Bruder, and Blankensee, their action significantly advanced the cause of engineering ethics within the IEEE and other engineering societies. In 1978 they jointly received the first IEEE CSIT Award for Outstanding Service in the Public Interest, consisting of a certificate and \$750 for each.

## 2.4 COMPUTERS AND POLICE CARS

The New York City Police Department has had in operation since the mid-1970s an on-line computerized police car dispatching system called SPRINT. A dispatcher, upon receiving a telephoned request for police assistance, enters the address to a computer via a remote terminal, and the computer responds within seconds by displaying the street coordinates and the location of the nearest patrol car. By cutting the response time to emergency calls, perhaps by a few minutes, for each of hundreds of calls per day, SPRINT may be presumed to have saved lives and to have improved police efficiency. As of 1977, the system had been operating successfully for several years.

At that time, a project was well under way to install another computer system to aid law enforcement. This system, called PROMIS, was to provide New York City prosecutors with on-line information, again via remote terminals, pertaining to ongoing cases—names and addresses of witnesses, hearing dates, and the like. This project was being managed by the Criminal Justice Coordinating Council (CJCC), or Circle Project, a committee of high-level city officials including the deputy mayor for criminal justice, the police commissioner, and, as chairman, Manhattan District Attorney Robert Morgenthau.

The committee employed a computer specialist as project director and early in 1977 engaged Virginia Edgerton, an experienced systems analyst, as senior information scientist to work under his supervision. Both were

## A.3 BART CASE DOCUMENTS

### A.3.1 Oliver Letter\*

Hewlett-Packard Company  
1501 Page Mill Road  
Palo Alto, California 94304

12 March 1973

Bernard M. Oliver  
Vice-President  
Research and Development

Dear Sy:

You may have heard that I was a member of the recent Senate Panel charged with the evaluation of the safety aspects of the BART Automatic Train Control System. A copy of our report is attached. I must ask you to be forgiving of its poor organization and typographical errors. Our time schedule did not permit polishing the prose.

I am pleased that many of our recommendations are being carried out. I am also disturbed that one in particular is apparently being ignored by Westinghouse. I refer to recommendation 5A.

The Fremont accident was caused by a partial short circuit that developed across the crystal in the 27 mph speed command oscillator in car 143 causing it to generate a 70 mph command. These oscillators employ a non-inverting emitter coupled amplifier with feedback via the crystal from the second collector to the base of the first transistor, which is connected to ground by an anti-resonant LC circuit. When the crystal developed a resistive shunt the circuit oscillated at the LC resonant frequency.

Although the crystals are now being X-rayed to detect improper mounting in their cans, this step alone will not ensure safe operation. The crystal could be shunted by metallic whisker growth after a few months or years. Leakage paths could develop on the PC board. It is simply poor practice, in a circuit where frequency shift can be danger-

\*Reprinted with permission from California State Senator Alfred E. Alquist.

ous, to have a second resonant system that can determine the frequency if the crystal fails. Our recommendation would remove this hazard.

I find it difficult to understand how a company like Westinghouse, with so much at stake, would balk at such a relatively inexpensive fix. I would think simple pride would compel those in charge to correct a hazard that already produced one accident.

There are other aspects of the train control system that suggest that the design did not enjoy the attention of your top people. In some instances it is not clear whether the fault was in the specifications or in their interpretation, but the result was the same: BART did not get the best system modern technology could provide for the price that was bid. In view of the growing interest in public transit systems and the critical role of BART in future decisions by other communities, it is lamentable that the BART system is not a more shining example of modern system design.

Let me cite you a few examples:

1. *Multiplex System.* There are about 10,000 printed circuit boards in the BART system that would not be there if individual cable pairs had been run to the wayside stations. Most of these will fail over the next 20 years. Cable pairs would not, and are not that expensive.

2. *Car borne speed command circuitry.* This is unbelievably and unnecessarily complicated. Much of it is fail safe but the reliability still suffers from the complexity. It would have been far simpler to have used a speed code in which the number of ones in the code group was a direct measure of the speed (except that all ones would be interpreted as zero speed as would all zeros). All the crystal oscillators would be eliminated along with many other back-up circuits.

3. *Speed profiles.* These should have been flexible so the protection length behind a train could be extended under poor rail adhesion conditions. This would permit a performance mode in which only the accelerations were reduced, rather than the top speed, thus giving greater throughput in slippery weather. At some extra complication the entire profiling could be switched to allow automatic operation in reverse runs.

4. *Data degradation.* It seems ridiculous to transmit occupancy by zone (a group of adjacent blocks) back to the central control rather

than oc  
increas  
system  
when B  
play will  
as adjac  
the ope

5. Co  
made o  
function  
under s  
whole a  
comput  
tage. In  
job cou  
just not

6. Tr  
shunt r  
regulati  
ic jerk l  
comple  
comper  
part of  
anothe

I menti  
future s  
design.

Sy, I h  
recepti  
then to  
the me

Best pr

(signed  
B. M. C

than occupancy by block, since this could have been done at no increase in cost. The crude display presently given of the state of the system handicaps both the central computer and the operators. If and when BART reaches its planned full scale operation, the whole display will be lit up red and the location of trains will be further confused as adjacent zones become occupied. Why not give the computers and the operators a decent picture?

5. *Computer phobia.* As mentioned in the report, very little use is made of the computer as a back up system. It could be better at this function than all the central control operators put together, except under some unforeseeable situation. I get the impression that this whole aspect of the system was designed by a group that feared computers rather than one that knew how to use them to full advantage. Incidentally, I would venture the opinion that the whole control job could be done by a much smaller computer. The data rates are just not very great.

6. *Traction system.* Although series motors are commonly used, shunt motors offer several important advantages such as better speed regulation, simplified switching to regenerative braking, and automatic jerk limitation at the end of dynamic braking. A great deal of the complexity in the propulsion system circuitry arises out of having to compensate for the inherent characteristics of the wrong motor. This part of the system is rather a mess. One non-linear servo loop after another all interacting. Patches on patches department.

I mention all these points not merely to carp, but in the hope that future systems may enjoy a more integrated, simplified and elegant design.

Sy, I hope to see you at the IEEE convention, at the President's reception if nowhere else. Perhaps you may have had a chance by then to discuss these observations and we can chat about them. In the meantime,

Best personal regards,

(signed)  
B. M. Oliver

Dr. Seymour W. Herwald  
Vice President, Westinghouse Electric Co.  
Corporate Engineering, Gateway 3  
Pittsburgh, Pennsylvania 15222

bcc: Senator Alquist  
Steve Larson  
Clarence Lovell  
Bill Brobeck  
Len Cutler  
Dave Cochran

**A.3.2**

(Filed c  
Alamec  
case of  
and ter

**I. Sta**

This bri  
ings, it  
concer  
employ

The In.  
largest  
the es  
ernmer  
field.

This br  
of the  
ethics  
ularly i  
Court's  
materi

**II. Su**

This C  
law, ar

Within

\*IEEE, i  
ethical c  
\*\*IEEE t  
to offer  
!Reprint  
IEEE Co

### A.3.2 IEEE BART Case Brief<sup>1</sup>

(Filed on Jan. 9, 1975 in Superior Court of California for the County of Alameda by Attorneys Frank Cummings and Jill Cummings in the case of Hjortsvang vs. San Francisco Bay Area Rapid Transit District and ten Does)

#### I. Statement

This brief is filed as amicus curiae because, on the basis of the pleadings, it is clear that rulings in this case will involve important questions concerning the proper ethics of an engineer in the employ of a public employer.

The Institute of Electrical and Electronics Engineers (IEEE) is the largest engineering society in the nation and has a direct concern with the establishment, maintenance, and recognition (including governmental and judicial recognition) of ethics within the engineering field.

This brief is submitted with two limited aims: first, to inform this Court of the existence and terms of established standards and codes of ethics for engineers, in the employment context generally and particularly in the context of public employment;\* and, second, to seek the Court's recognition that such standards and codes are relevant and material to this case for the reasons discussed below\*\*

#### II. Summary of Argument

This Court is expected to rule, as the trial proceeds, on questions of law, and this amicus curiae brief is addressed solely to those rulings.

Within that framework, we urge this Court to rule:

\*IEEE, moreover, is familiar with and can supply expert evidence concerning the ethical codes of engineers.

\*\*IEEE takes no position on the merits and the claims, as IEEE has no direct evidence to offer as to what the claimants did, what defendants did, or why.

<sup>1</sup>Reprinted by permission from *Technology and Society*, No. 12, Dec. 1975, published by the IEEE Committee on Social Implications of Technology.

1. *As to Admissibility of Evidence:* That evidence of professional ethics of engineers, as outlined herein and as further developed by the parties, is relevant, material, and admissible;

2. *As to Any Motions for Judgment:* That, in consideration of any motion to dismiss or for judgment by this Court, the Court should rule that an engineer is obligated to protect the public safety, that every contract of employment of an engineer contains within it an implied term to the effect that such engineer will protect the public safety, and that a discharge of an engineer solely or in substantial part because he acted to protect the public safety is a breach of such implied term; and

3. *As to Jury Instructions:* In any charge to the jury herein, this Court should instruct the jury that if it finds, based upon the evidence, that an engineer has been discharged solely or in substantial part because of his bona fide efforts to conform to recognized ethics of his profession involving his duty to protect the public safety, then such discharge was in breach of an implied term of his contract of employment.

We base this position upon the cases, statutes and ethical codes discussed below.

**Point I**

*Professional Ethics Are Material and Relevant*

California judicially recognizes that an employee may not be arbitrarily discharged where the discharge would be inconsistent with the public good, even if his employment contract is terminable at will. In *Petermann v. International Brotherhood of Teamsters*, 174 Cal. App. 2d (1959), it was held that an employer may not discharge an employee because the employee refuses to commit perjury. The public has too great a stake in the integrity of the judicial process to permit such a discharge.<sup>1</sup>

In *Petermann*, the District Court of Appeal for the Second District noted that the contract of employment did not provide for any fixed period of duration and that such a relationship is generally terminable at will, "for any reason whatsoever." But it also noted that such a right of discharge "may be limited by statute" or "by considerations of public policy." The Court then said at page 188:

By "p  
citize  
publi

The Co  
against  
ally unl  
a unsp  
plovee  
encour  
this st  
above  
188,18  
reverse

When  
ethics  
code c  
charge  
incons  
must b  
Califor  
the pu  
State's  
tions c  
makes  
sures  
ously e  
ment.

The sa  
censin  
cal en  
6730 s  
proper  
cense  
revoke  
not a

What  
mined  
are in

By “public policy” is intended that principle of law which holds that no citizen can lawfully do that which has a tendency to be injurious to the public or against the public order. . . . [emphasis by the Court]

The Court then noted that, because the State has a declared policy against perjury, “the civil law, too, must deny the employer his generally unlimited right to discharge a employee whose employment is for a unspecified duration, when the reason for the dismissal is the employee’s refusal to commit perjury.” The Court said that “the law must encourage and not discourage truthful testimony. The public policy of this state requires that every impediment, however remote to the above objective, must be struck down when encountered.” *Id.* at 188,189. The lower court having dismissed, the Court of Appeals reversed.

When questions of public safety are at stake, an engineer’s code of ethics stands in the same position as the laws against perjury. If a code of ethics properly requires the protection of the public, a discharge because a employee insisted on following that code would be inconsistent with the public good. Thus compliance with such a code must be deemed an *implied term* of the employment contract.<sup>2</sup>

California statutes clearly recognize a engineer’s obligation to protect the public. California Government Code, Section 835 waives the State’s sovereign immunity and makes a public entity liable for conditions dangerous to the public. Section 840.2(b) of the same Code makes a public *employee* liable if he falls to take adequate measures to protect the public from such conditions. That section obviously encompasses any and all engineers engaged in public employment.

The same recognition is reflected in California statutes governing licensing<sup>3</sup> of professional engineers, including electrical and mechanical engineers. California Business and Professional Code Section 6730 states that the purpose of that Code is “to safeguard life, health, property and public welfare.” And Section 6775 provides that a licensed engineer may be disciplined—indeed his registration may be revoked—for “*negligence, incompetency* in his practice,” or if he “has not a *good character.*”

What is “*negligent,*” under ordinary common law principles, is determined by the scope of the negligent person’s duties, and those duties are in part determined by what is generally recognized to be ethical.



*“Incompetency in his practice”* involves failure to adhere to generally accepted standards of conduct and must be taken to include ethical standards, if those standards are widely publicized and generally recognized. And, most important, the notion of *“good character,”* particularly in a professional sense, certainly involves adherence to generally accepted ethical standards, and particularly standards of professional ethics.

California law, then, mandates adherence to ethical and moral standards. Engineers have adopted (see Point II below) proper ethical codes to complement statutory codes. We urge this Court on the *Petermann* principle to recognize (1) that an engineer has an overriding duty to protect the public, and (2) that California law, including statutes and case law, supports the drafting of ethical codes, makes the terms of generally accepted professional ethics relevant and material in a case such as this, and effects a legally enforceable incorporation of such codes into engineering contracts of public employment, insofar as such codes are widely acknowledged to be necessary for the protection of the public.

## **Point II**

### *Engineering Professional Codes Require Protection of the Public*

1. *A Common Thread: The Duty to Protect the Public.* The various professional engineering societies have, for many years, adopted and published codes of professional ethics. Such codes contain at least one common thread—that the engineer owes an overriding duty to protect the public safety.

For example, the *Canons of Ethics for Engineers* was prepared and adopted by the Engineers’ Council for Professional Development (ECPD) in 1946.<sup>4</sup> These canons were then adopted by the Board of Directors of the National Society of Professional Engineers (NSPE) in October 1946, and were published in NSPE’s Journal, *The American Engineer*, in its November 1947 issue.

Section 4 of these Canons provided:

He [the engineer] will have due regard for the safety of life and health of public employees who may be affected by the work for which he is responsible.

This code has an even longer history, having been discussed initially in the May 1935 issue of *The American Engineer*, although the code

was formally adopted in 1946, in a form differing little from the present code.<sup>5</sup>

NSPE's own code of ethics (distinct from ECPD's) was adopted in 1964 and published in the September 1964 issue of *The American Engineer*.<sup>6</sup> This code provided, in Section 2:

Section 2—The Engineer will have proper regard for the safety, health, and welfare of the public in the performance of his professional duties. If his engineering judgment is overruled by nontechnical authority, he will clearly point out the consequences. He will notify the proper authority of any observed conditions which endanger public safety and health.

- a. He will regard his duty to the public welfare as paramount.
- b. He shall seek opportunities to be of constructive service in civic affairs and work for the advancement of the safety, health and well-being of his community.
- c. He will not complete, sign, or seal plans and/or specifications that are not of a design safe to the public health and welfare and in conformity with accepted engineering standards. If the client or employer insists on such unprofessional conduct, he shall notify the proper authorities and withdraw from further service on the project.

We emphasize in this regard the code's injunction to the engineer that he must "notify the proper authority" of anything he observes which may "endanger public safety." We think it fair to say that the ultimate proper authority in the case of public employment is the public itself.

ECPD, meanwhile, adopted revised canons in September 1963, which stated, in the very opening paragraph:

- 1.1—The Engineer will have proper regard for the safety, health and welfare of the public in the performance of his professional duties.

These canons were adopted by a variety of professional engineering societies. The American Society of Mechanical Engineers, whose membership now totals close to 70,000, ratified these canons in 1963, and they were published in ASME's magazine, *Mechanical Engineering*.

The same principles are carried forward to the current day. For example, a set of "Guidelines to Professional Employment of Engineers and Scientists" published by the IEEE Board of Directors in its national

monthly magazine, *Spectrum*, in April 1973, contains the following paragraph:

The professional employee should have due regard for the safety, life, and health of the public and fellow employees in all work for which he/she is responsible. Where the technical adequacy of a process or product is involved, he/she should protect the public and his/her employer by withholding approval of plans that do not meet accepted professional standards and by presenting clearly the consequences to be expected if his/her professional judgment is not followed.

2. *General Acceptance and Publication of the Common Thread.* Because the cited codes have been widely circulated and generally endorsed, it seems eminently reasonable to conclude that every engineer is aware of his obligation to the public. The guidelines published by IEEE, for example, have also been endorsed by over twenty societies<sup>8</sup>.

Even before the engineer's obligation to serve the public was fully codified in writing, moreover, there was an historical recognition of that obligation, discussed in professional journals.<sup>9</sup>

### **Conclusion**

Based upon the foregoing, we submit and we urge this Court to acknowledge that an engineer has an overriding obligation to protect the public.

Specifically, we urge this Court:

- (1) To rule that evidence of professional ethics is relevant, material and admissible in this case; and
- (2) To rule, as to any motions for judgment or any jury instructions, that an engineer is obligated to protect the public safety, that an engineer's contract of employment includes as a matter of law, an implied term that such engineer will protect the public safety, and that a discharge of an engineer solely or in substantial part because he acted to protect the public safety constitutes a breach of such implied term.

### **NOTE**

1. New
2. principles  
er. The  
public  
change  
the "e  
duties  
is clear
3. I  
eties  
neerir  
licens  
partic  
on the  
situation
4. engin  
the Al  
Institu  
Engin  
leum  
of Agri  
Amer  
Mech  
neers  
Autor  
the N
5. 1935  
engin  
the p
6. 62,000  
1,000  
70,000
7. Instit

## NOTES

1. See also *Slochower v. Board of Higher Education of the City of New York*, 350 U.S. 551 (1956).

2. This court may, but need not, decide the extent to which the principles of this case would be applicable in the case of a private employer. The complaint in this case alleges that a public employer discharged public employees because those employees informed the public of a danger to the public safety. In a very real sense, the public at large was the "employer" of the plaintiffs herein; whatever may be the limits of the duties of public disclosure by the engineer in private employment, there is clearly a higher duty in the case of public employment.

3. Not all members of IEEE or other professional engineering societies are (nor are they all required to be) licensed to practice engineering in their home states. The ethical standards covering both licensed engineers and other engineers are the same, and this is particularly true where both types of engineers are working together on the same project, as was the case, we understand, in the BART situation.

4. ECPD is an organization founded by a group of professional engineering societies, whose participants and affiliates now include the American Institute of Aeronautics and Astronautics, the American Institute of Chemical Engineers, the American Institute of Industrial Engineers, the American Institute of Mining, Metallurgical and Petroleum Engineers, the American Nuclear Society, the American Society of Agricultural Engineers, the American Society of Civil Engineers, the American Society for Engineering Education, the American Society of Mechanical Engineers, the Institute of Electrical and Electronics Engineers, National Council of Engineering Examiners, the Society of Automotive Engineers, National Institute of Ceramic Engineers, and the National Society of Professional Engineers.

5. The ethical proposal originally published by NSPE in the May 1935 issue of *The American Engineer* included the following: "The engineer shall at all times and under all conditions seek to promote the public welfare by safeguarding life, health and property."

6. NSPE, when it published its code in 1964, had a membership of 62,038 engineers, and its journal was circulated, in addition, to over 1,000 libraries and institutions. Its membership today is approximately 70,000 engineers.

7. A much earlier code, adopted and published by the American Institute of Electrical Engineers (IEEE's predecessor) in 1912 pro-

vided: "An engineer should consider it his duty to make every effort to remedy dangerous defects in apparatus or structures or dangerous conditions of operation, and should bring these to the attention of his client or employer" The "employer," in a case such as this, is first the public entity and ultimately the California general public which is the entity's own employer. IEEE supplemented the 1912 code in 1974 by a new code which includes the following: "Engineers shall, Fulfilling their responsibilities to the community: (1) protect the safety, health and welfare of the public and speak out against abuses in these areas affecting the public interest. . . ."

8. The endorsing societies include: American Association of Cost Engineers, American Institute of Aeronautics and Astronautics, American Institute of Chemical Engineers, American Institute of Chemists, American Institute of Industrial Engineers, American Institute of Professional Geologists, American Nuclear Society, American Society of Agricultural Engineers, American Society of Engineering Education, American Society of Civil Engineers, American Society of Mechanical Engineers, American Society of Quality Control, Data Processing Management Association, Engineering Societies of New England, Inc., Engineers' Council for Professional Development, Engineers Joint Council, Institute of Electrical and Electronics Engineers, Instrument Society of America, Institute of Traffic Engineers, National Association of Corrosion Engineers, National Institute of Ceramic Engineers, National Society of Professional Engineers, Society for Technical Communications, Society for Experimental Stress Analysis, Society of Fire Protection Engineers, Society of Women Engineers, Technical Association of the Pulp & Paper Industry.

9. The code of ethics of the NSPE, for example, was discussed initially in the May 1935, issue of *The American Engineer* although that code was first formally adopted in 1946 (in a form differing little from the present code.)

A.4

A.4.

Prof  
A C

1. I

On I  
tion  
man  
havi  
said  
dati  
polic  
sup  
profThe  
add  
The  
Esk  
Cor  
tectHe  
Ms.  
swe  
sub  
Kas  
we  
circ  
the  
ing1A c  
ton)  
offic  
Stul  
\*Re  
by t