MORAL RESPONSIBILITY AND WHISTLEBLOWING IN THE NUCLEAR INDUSTRY: BROWNS FERRY AND THREE MILE ISLAND

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I. INTRODUCTION

On February 2, 1976 three engineers in General Electric Company's nuclear energy division resigned and made statements to the press and on TV declaring their concern for the effects on the public of technical flaws in the nuclear power program. The three engineers, Dale G. Bridenbaugh 44 years old, Richard B. Hubbard 38 years old, and Gregory C. Minor 38 years old, had each joined GE at the age of 22. Bridenbaugh was a manager in the area of performance evaluation and improvement, Hubbard in quality assurance, and Minor in advanced control and instrumentation.

On January 13, 1976, Robert D. Pollard, a nuclear safety engineer and project manager for the Nuclear Regulatory Commission, acting without knowledge of the decisions of the three GE engineers, had given notice of his resignation to be effective February 15. He had expressed his concerns about nuclear power plant safety in a CBS interview recorded on January 13, but not aired until February 8.

What led to these concerns and the four startling resignations which involved substantial personal sacrifice? The engineers cited a number of specific unresolved safety problems in commercial nuclear power plants. Prominent among them were hazards revealed by the Browns Ferry Plant fire on March 22, 1975. The fire, which started in the electrical control cables from the use of a candle to detect air leaks, burned uncontrolled for seven and a half hours. The two operating GE nuclear reactors were at full power when the fire began. One of them went dangerously out of control for several hours and was not stabilized until a few hours after the fire was put out. The reactor's sophisticated emergency safety devices failed totally. The unit was in the end controlled by some available equipment which was not part of the elaborate safety apparatus, and which emerged from the fire undamaged as a matter of random chance.

The accident was a case of common-mode failure. This occurs when a single event causes multiple failures of plant components or systems, a type of accident assumed to be highly unlikely, in fact, not "credible." Harry J. Green,

Superintendent of Browns Ferry, said after the fire, "We had lost redundant components that we didn't think you could lose." The record shows, however, that there was extensive official foreknowledge of safety deficiencies at Browns Ferry and that the very combination of problems responsible for the accident had been identified by federal safety authorities but left uncorrected.

The responsibility for designing and maintaining nuclear power plants and for assessing and guaranteeing the safety of their operation rests to an important degree with engineers, individually and collectively, in the industry and in the regulatory agency. Failures by engineers, at many different levels, to anticipate consequences, to establish safety criteria, to meet applicable criteria, and to respond to recognized situations of non-compliance led to the Browns Ferry fire.

We are left with the question of what made possible all these failures. How should we judge all those whose failures to act made the accident possible? Were these four engineers morally required to take a course of action such as they pursued in resigning and "going public"? Was it a professional obligation? Or did their actions exceed what was morally and/or professionally required of them? If so, how should we regard their actions--heroic, morally creditable, emulatable, foolhardy, or unnecessary?

All these questions have particular urgency if Dale Bridenbaugh was correct when he said in his letter of resignation, "In the past we have been able to learn from our technological mistakes. With nuclear power we cannot afford that luxury."

The narrative which follows consists of (A) a chronology of events and (B) a brief discussion of certain general matters including (1) the economic setting of the nuclear power industry, (2) the problems posed by increases in knowledge, especially of hazards and safety requirements, (3) the existence of a network of scientists and engineers heavily invested (emotionally and otherwise) in the nuclear power industry, (4) the problem of adequate quality control, (5) the status and function of the NRC and its ancestor the AEC, and (6) the problem of access by the public to information about nuclear power and its industrial development. The operations of the industry go on largely hidden from the public and to some extent from the NRC. The industry's cover is that divulging requested information would cost a company competitive business advantages. Ordinary citizens have been the consumers of nuclear energy (35-50% of energy use in Illinois is nuclear), and they have paid in tax dollars for the development of the nuclear industry without knowledge of the risks and costs.

II. CASE NARRATIVE

1954: The Atomic Energy Commission (AEC) begins to regulate the commercial nuclear power industry. The Commission has the dual roles of promoting and regulating commercial nuclear power plants. This situation is to lead to conflicts over maintaining development schedules and resolving known safety problems.

1958: Commercial nuclear power gets underway with the installation and start-up of the first large-scale commercial nuclear power plant, Commonwealth Edison's Dresden 1 near Chicago. Dale G. Bridenbaugh is the field engineer for that project.

The 1960's: Section III of the hallowed ASME codes, originally developed to protect the public from boiler explosions, is further developed for application to nuclear power plant components. However, these codes do not apply to some safety-related equipment. Present Nuclear Regulatory Commission (one of the two agencies into which AEC was split in 1975) requirements for equipment not covered by ASME codes are less stringent than those for ASME boiler code items.

1963: AEC's Division of Operational Safety warns that the combustibility of polyurethane foam constitutes a fire hazard. Nevertheless, this is the material later used in parts in Browns Ferry's electrical system.

1965: During the construction of the Peach Bottom plant, a serious electrical cable fire erupts. The fire is the first of a series over several years which involves major damage to important cable installations. These fires make plain the capacity of electrical cable fires to cause failure of important safety systems.

1966: Construction begins on the Browns Ferry Nuclear Power Plant near Decatur, Alabama. It is intended to be a model for future U.S. power production and is to supply electricity for about two million people. The plant is to be ten times the size of any plant already in operation. Indeed, it is to become one of the world's largest electrical generating facilities.

1967: Browns Ferry goes through a major Federal safety review and is granted a Federal construction permit.

1969: AEC adopts a vague design standard for electrical cables. The need for physical separation of cables is admitted, but there is a failure to specify how to achieve it. On July 3, F.U. Bower, an AEC inspector monitoring Browns Ferry, sends the AEC a memo in which he notes, among other items, the need for specific criteria for

cable separation. He points out the incongruity of requiring the spending of immense sums on specific safety systems in case of accident without providing equivalent criteria for the electrical cable installation.

1970: In January, after a five day inspection of Browns Ferry, five AEC inspectors report deficiency in quality control over cable separation, and other deficiencies as well. The AEC adopts an addition to its regulations to minimize the danger of fires. However, there are no specific provisions for achieving cable separation, that is, as to how much, which cables, the design of cable spreading rooms, and the like.

1971: Fire erupts at Indian Point 2, before the plant is in operation. The AEC, in its Review, concludes that there is an urgent need "to re-evaluate previously approved cable separation criteria for this facility and for other facilities." In October, three AEC inspectors, including F.U. Bower, warn about safety problems at Browns Ferry in their evaluation report.

1972: In January, the new head of Region II, Norman Mosely, sends a memo to AEC headquarters supporting Bower's report, and he puts as his first regulatory question, "What enforceable requirements exist for separation of redundant component instrumentation and wiring?" When Browns Ferry is under review by AEC's Committee On Reactor Safeguards, the Assistant Manager of Power for the TVA urges deferring safety improvements that would interfere with the schedule for start-up. In December, AEC safety reviewers criticize electrical cable separation at Browns Ferry, but they defer needed improvements to unit 3. They allow serious compromises with the safety of units 1 and 2.

1973: In June, Browns Ferry is issued a license by the AEC for commercial operation. In November, Manning Muntzing, AEC's Director of Regulation, speaks personally with Browns Ferry officials about serious deficiencies in their Quality Assurance program. The AEC regulatory position is that the company operating a nuclear power plant should be self-regulating. The detailed implementation is also left up to the companies. Quality Assurance programs are the companies' devices for implementing safety guidelines and for checking up on implementation.

However, Browns Ferry is extended a grace period of several years to upgrade its Quality Assurance program. Browns Ferry is allowed to operate during that interval without Quality Assurance programs considered essential to nuclear plant safety. Requiring Browns Ferry to meet new separation criteria for its electrical system would involve extensive rewiring and reconstruction of redundant systems. Such efforts would entail substantial expenditures and delays in going into operation.

1974: In March, Charles E. "Doc" Murphy supervises pre-operational testing a Browns Ferry. On August 1, Browns Ferry goes into full operation after Murphy sends a warning to AEC headquarters about the electrical cable installation of the plant. The warning is ignored. The AEC thus overlooks warnings since 1969 about dangers of electrical cable fires arising from poor control of combustible materials, inadequate fire prevention programs, and poor separation of redundant circuitry.

1975: On March 22, in the course of plant modification at Browns Ferry, a candle which is being used to detect air leaks ignites polyurethane foam. The foam is employed to plug leaks where electrical cables pass through the wall between the cable spreading room and the reactor building. The fire which erupts causes extensive damage to electrical power and control systems. This damage interferes with normal and standby cooling systems. The capability for monitoring the plant's status is also affected. It is a matter of random chance that unit 1 is brought under control. A potentially catastrophic radiation release is avoided "by sheer luck." Units 1 and 2 are put out of service for many months.

Coincidentally,over the course of the year, Dale Bridenbaugh has discussions with colleagues and his boss in which he talks about his concerns about safety in the nuclear power plant program.

1976: In February, Bridenbaugh, Hubbard, and Minor resign from their nuclear plant management positions at GE and Pollard resigns from his project management post at the Nuclear Regulatory Commission. They give as their reasons their concerns about known hazards of a serious nature which are left uncorrected.

B: Discussion

(1)

The Nuclear power industry is involved with a very complex product which is extremely expensive; indeed, its development has required billions of dollars of government expenditure as well as private resources. Solving the technical and safety problems which are gradually revealed requires additional huge expenditures. The very work of uncovering the problems is exceedingly costly in money and technical skills. Plant shutdown is also an extremely expensive proposition, involving hundreds of thousands of dollars per day. The momentum of heavy investment needed to initiate a nuclear power project suffices to carry it forward in a headlong way with continuing large expenditures to salvage the original investment. Furthermore, power plants, which can take a decade to build, must be large to

be economical. Though larger plants with their greater fuel loads and higher power present more dangers, the huge plants and giant plant constellations, such as at San Jose, California, employ large numbers of workers and bring in substantial tax revenues to the state and community. These advantages help to explain the reluctance of legislators and NRC officials to put any brakes on nuclear power development.

In addition, the risk of oil boycotts has tended to support nuclear power development. The pressures of international competition have played a similar role. There is intense effort to avoid large escalations of cost, including strategies for dealing with safety problems that avoid the costs of correcting them. Nevertheless, the costs are so high and the safety problems so persistent that there is growing evidence of retrenchment and retreat from nuclear power by large private utilities and big reactor producers.

The economic considerations come to distort the thinking of those engineers and others who make safety decisions in the industry and in the regulatory agency. The rush to retrieve investment and avoid more expense is so great that Bridenbaugh testified, "I am convinced that economic considerations cause us to have a cloudy view of the decisions that are made." Determinations about start-up or continuing operation are often made in a highly pressured atmosphere in which threatened economic losses from delay or shut-down loom large.

Our concern is to understand how the perceived economic pressures effect the thinking and decision making of those involved and to see what measures might insure that decision making incorporates technical and safety considerations. Are there devices for making engineers' decisions more independent of company loyalty and agency coziness? Can we find feasible ways of introducing balanced judgment and the opinions of a better informed public into the decision-making process?

(2)

An important feature of development in the nuclear industry lies in the possibility of succeeding generations of reactors' taking advantage of advances in technology, increased knowledge of hazards, and development of safeguards. Construction and operation are and have been carried forward on the basis of theoretical projections rather than empirical testing and large-scale mock-ups. It therefore happens that when plants go into operation, mock-ups are made, and testing is finally carried out, flaws and hazards are revealed in operating reactors. The problem arises of bringing already operating units into conformity with present standards. Since that task involves huge

expenditures in testing and highly expensive back-fitting of older or already operating units, there is great resistance to efforts to produce general conformity with current standards.

In general, the prospect of huge expenses making nuclear power less and less economical has slowed responses to known deficiencies and safety problems. This even applies to incorporating new data into units under construction, as at Browns Ferry. During the last four years of construction of that plant, officials made repeated stabs at showing the need for adequate electrical cable separation. In the end, TVA succeeded in deferring the inclusion of this safeguard and, thus, units 1 and 2 were vulnerable to the common-mode failure actually suffered in the fire of 1975. This "penny-wise, pound foolish" attitude, which F.U. Bower commented on in 1969, may not be uncommon.

What remedies can we find for this situation? How can we insure that decisions about whether to back-fit rely on technical and safety considerations and that the biases caused by economic and political pressures are minimized? Whose responsibility is it to consider whether empirical testing and production of mock-ups should precede construction? By now there is a considerable body of data indicating that serious problems show up in construction and operation which were not anticipated in the theoretical studies. Since the risks to the health, safety, and property of the public are so great, decisions about whether to "grandfather" (exempt older units from current standards) should at least be made systematically and according to clear criteria.

What channels could be developed to enable engineers with access to problem situations to bring their information and concerns to bear on the decision-making process? What about ordinary citizens living in ignorance of risks they might not choose? Bridenbaugh, Hubbard, Minor, and Pollard resigned partly out of frustration at being unable to impress the problems they were familiar with upon the consciousness of others in the industry, the regulatory agency, and the public. In January 1975 Pollard attempted to learn from his superiors and from the NRC Counsel if any such channels were available to him. This effort was not successful. He later said, "I would still be working at NRC if I had thought that the public in general was aware of all the problems." Bridenbaugh's testimony was similar: "I have one suggestion... that would be if a way could be developed whereby people in the industry who do have specific concerns could express those without having to quit to do it, that would be a very valuable thing to do."[1]

(3)

So far in our story we have identified the economic investment in nuclear power. There exists an economic community, so to speak,, of those with a hefty financial stake in nuclear development. There is another involved community (which has some overlap with the first group); this second group is known as the "nuclear fraternity." In the fraternity are very dedicated people, many of whom have spent most of their careers in the development and operation of nuclear power. Included are physicists such as Nobel-laureate Hans Bethe, a well known proponent of nuclear power, and academics such as Dr. Norman Rasmussen of MIT, who directed the highly controversial reliability study of nuclear plants.[2] Not so well known but very committed to the development of nuclear power are a few thousand physicists and engineers in positions in the industry, government (especially the regulatory agency), universities, and technological institutes.

The fraternity originated in the military, in the atomic and hydrogen bomb projects. Shrouded in military secrecy for a long time, it has bred close bonds of support and mutual protectiveness. An "old-boy network" has grown in which men move smoothly back and forth between agencies such as AEC, now NRC, and the large corporations which dominate the private nuclear domain, such as GE, Westinghouse, and Bechtel. For example, Robert Hollingsworth, the former general manager of the AEC, became a top official at Bechtel. Likewise, W. Kenneth Davis, a vice president of Bechtel, was formerly head of AEC's Reactor Development Division.

Members of the fraternity command respect through personal prestige, connection with high-status institutions such as MIT and Cal Tech, and through associations such as the American Physical Society and the American Nuclear Society. They may be assumed to be sincere in their support of commercial nuclear power development, and not necessarily motivated merely by personal or financial gain. Their investment derives, often enough, from career commitment and fascination with the prospects and problems of harnessing atomic power.

However, we should bear in mind that their careers and reputations are bound up with the nuclear power program. There is a tendency in the fraternity, as in other professions, to "rally round" to the extent of covering up (whether wittingly or not) flaws, errors, and problems. Those on the outside are kept in the dark. Members are inclined to underrate the powers of comprehension and the critical judgment of those outside. They prefer to believe that ordinary citizens, when apprised of problems, will react hysterically.

As a result of all these factors, momentous decisions, which affect all our lives, are made within a relatively closed circle. In such circumstances, it is not surprising that the efforts of knowledgeable and crusading outsiders are sometimes needed to correct the insulated judgment of those within the circle. (e.g. Ralph Nader vis-a-vis the auto industry).[3] Without adequate outside checks or channels for expressing dissenting judgments within the industry, the public is at the mercy of those with vested interests within the industry.

The consequences from cover-up and the delayed imposition of standards are potentially so catastrophic that engineers on the scene must seriously consider their personal responsibility for such harm. Charles E. "Doc" Murphy, the Federal official supervising pre-operational testing at Browns Ferry wrote the memo to AEC, shortly before the plant went into operation, warning of the electrical cable installation. Murphy had been discussing the problem with AEC officials since 1970. He has said that he did not expect a fast response but wanted to prod the AEC to develop adequate safety standards governing electrical cable installation. He received no response at all. Exactly a year after he wrote the memo, he was the first NRC official informed of the accident at Browns Ferry. He exclaimed, "Oh my God"!

Our concern is with methods for encouraging individual engineers to view their professional responsibilities more independently, to see themselves as more autonomous agents. Would portable insurance and pension benefits help protect engineers so that unusual moral courage would not be required to speak up or pay attention to warnings? Are there feasible schemes for the profession through its professional associations, to back up the engineer who reveals or responds to problems and thus to encourage responsible behavior?

(4)

There is a standard two-fold solution to the technical and safety problems of the nuclear industry and other industries--government regulation and Quality Assurance programs. This section will be addressed to Quality Assurance and the next section will explore government regulation.

NRC sets general regulations and standards for the company to follow but leaves detailed implementation up to the company. Checks on implementation are also carried out by the company; NRC inspectors check only about 1 or 2% of safety-related activities at a particular plant. Each plant is supposed to establish its own management system to assure

conformity with applicable safety requirements. This is the "operating quality assurance" program, and it is supposed to yield the unprecedented meticulous care required for safe nuclear plant operation.

Yet plant management at Browns Ferry was so unreceptive to Quality Assurance that even after the fire in July 1975, Norman Mosely, head of NRC's Region II (covering Alabama), said "NRC, quite candidly, is trying to ram quality control down TVA's throat." Recall that the AEC had issued Browns Ferry a license to operate allowing it to defer its Quality Assurance program in order to keep on schedule.

In theory, TVA safety reviews should have detected the fire hazards associated with the construction work going on. However, in violation of NRC requirements, TVA had no written procedures governing the work, no review of the work was carried out by the plant safety review committee, and there was no safety evaluation of the leak testing. In addition, no independent quality audits were carried out while work proceeded to determine if there was conformity with applicable requirements. As a result, management permitted an extensive unsupervised work program with unmonitored safety implications to go on in the electrical cable spreading room beneath the control room. In the latter room were the controls for the two operating units. This work project made use of an open flame and highly combustible polyurethane foam. There were numerous small fires before March 22, including two on March 20, one so large that dry chemicals were required to extinguish it. These fires were not properly reported, and no safety review of their significance was conducted. All these failures to write procedures, supervise, review, monitor, and report were failures of Quality Assurance.

How is it that professional engineers on the plant staff failed to insist upon a proper Quality Assurance program? Were the economic imperatives to keep on schedule such that it didn't occur to them? Were potential dissenters worried about being and appearing to be team players? Can we find devices for reminding professional engineers of responsibilities which may go beyond company interests? Can conscientious engineers produce a climate in which over-loyal company engineers may feel pressured to reflect upon their actions?

As we have seen, there are serious obstacles to genuine independence on the part of the regulatory agency. Two primary factors vitiate the independence of the agency. One is the promotional role which the regulatory agency has had from the outset. The splitting of the AEC early in 1975 into the Energy Research and Development Administration (ERDA) and the NRC ostensibly separated promotional from regulatory functions. However, this division has not

succeeded in insulating the regulatory function adequately from the pressures of cost and schedule, according to the testimony of former NRC manager Pollard.

The other factor is the interchange of personnel between the industry and the regulatory agency. Agency officials who anticipate lucrative jobs in the industry may not be prepared to make the technically based, independent safety decisions required by law when these decisions are unwelcome (i.e. are costly, cause delay) to the industry. This problem is a general one across many government regulatory agencies, and it results in part from the fact that roles in the industry and the regulatory agency require similar professional training. Hence, professionals in both domains are socialized to share similar outlooks.

Obviously, industry resists regulation, and the factors noted support that resistance. Nevertheless, there are examples of effective regulation. The American Society of Mechanical Engineers (ASME) codes were initially developed in 1911 to protect the public from boiler explosions in public facilities, such as office buildings. These codes command practically universal respect and are more strict than comparable NRC codes. For example, there is a disciplined program of third party inspection required by the ASME codes absent from the NRC Regulations for non-code safety-related items.

Another example of effective regulation comes from a private organization, Underwriters Laboratory, Inc. (UL) founded in 1894. Many household electrical appliances receive the third-party review required for listing by UL. NRC, by contrast, does not require independent third-party evaluation and product proof testing of the Class I safety-related electrical equipment which controls and protects a nuclear power plant. Electrical appliances such as a toaster or hair dryer receive more stringent safety checks than the electrical equipment which controls a nuclear power plant.

(6)

This brings us to our final concern: exclusiveness, restrictiveness, and secrecy in the industry versus the need for an informed public making responsible choices about life and death matters. With some exceptions, the NRC does not require plant owners to report field failures. There is an informal arrangement for such reporting, but this set-up permits excessive filtering and omission of data. The question of the scope of "trade secrets" in an industry with such potential for catastrophic accidents deserves investigation.

Consider this illustration of the problem. In the autumn of 1974, GE undertook a Nuclear Reactor Study of Boiling Water Reactors. The director of the study, Dr. Charles E. Reed, a vice-president of GE and former MIT faculty member, admitted before the Congressional Joint Committee on Atomic Energy that the study dealt with overall design considerations, plant components, test facilities, and management and organization. However, he said, "Although in the course of the Study Group's review nuclear safety aspects were considered, this study was not a safety review." On the grounds that the study report was a sensitive document "from a competitive standpoint," GE did not make the report available to the NRC. It merely conducted an in-house review which concluded that there were no reportable deficiencies not previously reported to NRC. Only after Bridenbaugh, Hubbard, and Minor, who had participated in the study, revealed its existence and its safety significance before the Joint Committee, was the report made available to the NRC. The study was not to be made public at all, however, and it was to be available to the Congressional Committee only via an NRC report after a review of the study by that agency. Reed repeatedly defended this secretiveness, saying that there was no new safety-related information in the report.

We have already encountered the relevant assumption operative in the industry: the public cannot comprehend the issues in nuclear plant safety, and if ordinary people were informed about the risks and costs, they would hysterically reject nuclear power altogether. The advantages in the alternative of public debate and informed public support of perhaps a modified schedule in nuclear power development are thus lost. Instead, the nuclear power community proceeds feeling embattled and estranged from the public and constantly on guard against the leakage of any negative data. They are deprived of the common sense, diversity of outlook, and cool judgment which might come from public discussion.

If nuclear power is an "unfinished engineering dream," a most promising way to a satisfactory completion is to enlarge the perspectives and sharpen the moral and professional consciousness of engineers in training and to raise the level of literacy of ordinary citizens about these momentous projects.*

III. CASE COMMENTARY

This case narrative actually contains two stories, the whistleblowing episode and a sequence of events leading up to the Browns Ferry nuclear plant accident. Both incidents merit careful study for their implications about the moral responsibilities of individuals in organizations. In the

interval since 1976, we have had considerable discussion and analysis of the practical and moral problems for individuals who seek to oppose organizational practices. Though some new laws have been passed and procedures adopted, we have not seen conditions in the workplace modified significantly during this period.[4]

In 1979, the general public became acutely aware of the nation's more costly nuclear plant accident at Three Mile Island (TMI). In contrast to the Browns Ferry fire, it received the full glare of media attention. In addition, we have the Report of the President's Commission on the Three Mile Island Accident so that we can assess decisions and actions in the Browns Ferry case with informed hindsight.[5] In the light of our subsequent experience and analysis, it is worth underscoring salient features of the instance of whistleblowing in the case narrative. It will also be useful to outline more sharply the pattern of conduct in the Browns Ferry sequence, a pattern repeated in the events of the Three Mile Island episode. We will then be prepared to make moral assessments of some of the actions of engineers.

A. Moral Issues in Whistleblowing

In spite of the fact that some companies and government agencies have instituted various versions of the "open door" policy for airing concerns, the personal costs remain high for employees who actively pursue problems of wrongdoing in their organizations. These employees set in motion a sequence of responses which generally prove to be profoundly upsetting to their expectations. Even the less naive employee who blows the whistle, that is, publicly exposes inside information, must be shaken by the intensity of the opposition she provokes, the sustained attention turned upon her personal as well as occupational affairs, and the seriousness of the threat or damage to her career.

At important junctures, society has relied upon whistleblowers to bring to light serious instances of waste, corruption, and risks to health and safety. Nevertheless, most of those who have dared to expose wrongdoing have paid high personal costs.[6] Perhaps we should not be surprised that associates who are adversely affected by the revelations of wrongdoing have used the options and resources available to them to discredit and retaliate against the whistleblowing "troublemakers." The prospect of such responses must be reckoned with by anyone aiming to bring to light what has been kept hidden within an organization. Moreover, the anticipation of bringing harm to oneself carries moral weight in deliberation, as does the expectation of harming any other person. To put the point in Kantian language, one counts oneself in the community of rational beings, all of whose members are to be treated as ends and not merely as means.[7]

There are other moral concerns to vex those who have evidence that significant, specific wrongdoing is concealed within their organizations and believe that exposure is needed to deal with it. The potential whistleblower faces quandaries about harming others, for the self-authorized act of exposure ranks as an accusation . However well-founded, it is very likely to violate relations of trust, damage morale, disrupt operations of the organization, and redound to the injury of some of its members. The whistleblowing itself is almost certain to cause harm to other individuals, some of whom are known to the whistleblower. Prospects of damage to the reputation or operations of the organization need to be considered inasmuch as such injuries cause harm to people.[8] Of course, the potential whistleblower may conclude that, on balance, the injuries are justified. He may judge that the harms will be greater if the wrongdoing is allowed to continue without exposure.

Harms to people count as <u>prima facie</u> moral considerations against blowing the whistle. We can liken this to the way injuries to an offender count morally against inflicting punishment. Punishment stands in need of justification precisely because it entails inflicting pain on human beings, for hard treatment is by definition a feature of punishment. Similarly, to blow the whistle is to bring an accusation. Even if the accused is an organization or an industry, the accusation must fall on individuals who are very likely to be harmed thereby. Hence, whistleblowing also stands in need of justification. However, to say that the harms caused by public accusation can never be justified would be to insist on blind compliance with organizational practices and to condone or allow the intolerable injuries to which those practices can lead.

In order to give due weight to the harm which the revelations may cause (sometimes to innocent parties), the potential whistleblower must consider carefully the grounds for exposure, the manner and methods by which perceived wrongdoing may be brought to light, and the chances of success. Even if whistleblowers justifiably assess a situation as serious enough to warrant running the risks to themselves and to work associates, the revelations may fail to reach an interested audience with the power to rectify the situation.[9] In "going public," whistleblowers may cause harm to themselves and others without producing the expected benefits. Their actions may then rank as impractical and unwarranted measures which lack moral justification to the extent that no moral gains weigh in against the harms. Nonetheless, even when the possibility of rectifying the situation is remote, an employee may be morally justified in blowing the whistle to "bear witness" or maintain personal integrity.

B. The Whistleblowing of the Nuclear Engineers

Judged by moral and practical standards and measured against other whistleblowers, the conduct of the four engineers highlighted in the case above is striking. They plainly and deliberately blew the whistle, going outside their organizations to make insiders' information public. Their conduct stands out in several other important respects: they resigned just before making their accusations; they managed to get their concerns before a receptive public; and they succeeded in devising career alternatives for themselves, continuing in professional roles related to nuclear plant safety.

In some of the other well-known instances of whistleblowing, the employees who were concerned about wrongdoing took actions which were more ambiguous than those of these nuclear engineers. The BART engineers for example, approached a member of the Board of Directors who made the information public. The engineers apparently did not regard that act as whistleblowing.[10] Virginia Edgerton, a computer specialist for New York City, became a whistleblower by going over the head of her superior to contact directly the Circle Committee which had hired her and her supervisor.[11]

In a narrow sense of the term, whistleblowing requires that exposure be made outside the organization. However, a broader sense includes jumping lines of authority to reveal information to the highest level with the organization.[12] Of course, whistleblowing might encompass any unauthorized revelation of a work-related secret. However, ordinary gossip and tattling generate no special interest regarding moral responsibility. The cases which have gained visibility and merited attention divide into two main types: those in which the whistleblower steps outside the organization to make disclosures and those in which an individual from lower down in the organization discloses wrongdoing to a chief officer or member of the board of directors, or an equivalent.

One reason to distinguish these two types is that in instances of the second type, individuals often do not see themselves as blowing the whistle, since they keep problems within the organization. In fact, they might argue that they take these actions to avoid "going public." Nevertheless, cases of the second type are justifiably ranked as "internal" whistleblowing because they often have been treated as such by the organization, with repercussions similar to those for employees who go outside. Furthermore, in some cases internal whistleblowing has directly precipitated public exposure. The reason for excluding less extreme internal breaches of lines of authority is that we want to distinguish the whistleblowing itself from pursuit of internal remedies to give those who may be accused a

chance to rectify matters. There is, then, a conceptual point to regarding whistleblowing as an extreme form of dissent or departure from organizational practices.

Disengagement is one straightforward way to deal with ruptures associated with whistleblowing. The practical awkwardness and moral strains of workplace dealings between the whistleblower and those who feel accused or betrayed are intertwined. For analytical purposes, we can note first some practical considerations. In resigning, the whistleblower acknowledges that it is almost impossible to maintain normal work relations with those who are in any way implicated in the exposed wrongdoing. Among the latter, the act of exposure is likely to arouse hostility and distrust. Withdrawal realistically recognizes that eventuality. In addition, it affords the whistleblower a certain measure of control over subsequent events, removing him from immediate vulnerability to an employer's retaliatory response.

Eliminating the necessity for normal relations may carry moral force, by showing respect for those accused. At the same time, resignation suggests that the whistleblower can no longer morally justify association with the organization's operations. The effect is to underscore the seriousness of the charges. Some would urge that an employee who considers wrongdoing in an organization serious enough to warrant exposure must conclude that the work environment is morally unsuitable for continued employment. To others it may seem morally fitting that the whistleblower resign and thereby acknowledge that you cannot "bite the hand that feeds you and insist on staying for future banquets."[13] All this is not to say that resignation is always required or recommended but to point out that it is a direct measure for reducing moral ambiguity and practical difficulties.

Some observers object that if an employee resigns first, he is not a whistleblower. However, there seems no reason to deny status as a whistleblower to an employee who resigns because of the intention to blow the whistle and promptly carries out the intention. Of course, the longer the delay, the less likely we shall be to rank the disclosure as the act of an insider calling a foul against his own team. One might argue that withdrawal compromises the whistleblower's effectiveness. That objection has to be considered on a case by case basis, for in some instances the reverse is true. Some point out that since resignation often requires sacrifices, engineers may justifiably complain that morality demands too much of them. This complaint has merit and underlines the need for reforms such as changes in insurance and pension arrangements to eliminate or reduce those costs and make it easier for employees to resign on moral grounds.

The whistleblower's circumstances need not inevitably necessitate resignation. However, considering the tendency of superiors in hierarchical organizations to fire or demote the employee who steps out of line, the option of resigning generally ought to be considered. In contemplating this hardship, an engineer, as any moral agent, must recognize that the demands of morality may come into conflict with self-interest. In resigning the whistleblower exercises some control over events and is therefore likely to suffer less than when he is fired.

All four engineers in this case decided to relinquish hard-earned positions of responsibility, and they made careful plans in order to make the most of their sacrifices. They were probably maximally effective in drawing media attention to their resignations and revelations; many people still recall their startling disclosures on CBS television and in the columns of the New York Times. To many readers and listeners they brought the first word of the serious fire at the Browns Ferry Plant in the preceding March (1975) and the first reports of uncorrected generic safety problems in the operation of nuclear power plants. Their resignations and disclosures precipitated hearings on their charges several weeks later before the Joint Committee on Atomic Energy of the U.S. Congress.

The record of those hearings makes plain that these engineers had prepared carefully and acted with appropriate moral and prudential foresight. They wanted to call attention to generic safety problems and thereby remedy what they considered the most serious deficiency: the public's ignorance of significant safety hazards in nuclear power plant operation. It was not until three years later, after the Three Mile Island accident, that the public could appreciate the problem Gregory Minor identified in his testimony in 1976 when he pointed out, "The control rooms do not look alike, and the simulator does not look like the control room."[14] Testimony at the hearings by a General Electric Company executive perhaps helps us gauge the success of the engineers in reaching an interested audience. His irritation at their "one-sided press conferences and sensational TV shows" suggests that their disclosures had a significant impact.[15]

Several factors in addition to the engineers' careful planning explain their practical success in communicating their ethical concerns. With the growth of the consumer and environmental movements, the public was becoming more skeptical about technological developments. In the post-Watergate period, members of the public probably were especially ready to listen to such disclosures. The credibility of the informants, however, was a very important factor. These engineers had good work records of long service in the nuclear field and had risen to supervisory

positions with considerable authority. They spoke from intimate knowledge and deep experience. Gregory Minor revealed that he had worked on the design of the control and safety systems for the Browns Ferry plant, and he said, "It was an accident I would previously have classified as 'incredible'." [16] Evidently these engineers had themselves previously shared some of the confident views about nuclear plant safety still held to in 1976 by many of the public.

One question raised by this instance of whistleblowing concerned its rarity for this industry. If the criticisms which these engineers came to express were well-founded, many asked, why was it that so few had spoken out? Part of the answer lies in the fact that blowing the whistle in the nuclear industry is likely to lead to the end of a career, not merely termination of a job. Demand for civilian nuclear engineers arises primarily within the nuclear power industry and the government regulatory agency. In view of the traditions of secrecy associated with commercial as well as military nuclear developments, potential dissenters would not have much hope of remaining within the fold once they had broken the silence.

These engineers showed unusual resourcefulness in devising subsequent careers to capitalize on their concerns and expertise as nuclear engineers. Their ingenuity in this regard is both morally and prudentially creditable. Bridenbaugh, Hubbard, and Minor formed a consulting firm which has done work for the State of Illinois. Pollard took a position, in which he is still visible, with the Union of Concerned Scientists, a public interest group. In contrast to the best known whistleblower, Ernest Fitzgerald, these engineers succeeded rather promptly in saving their careers and continuing their professional efforts to upgrade nuclear plant safety.

With all their forethought and preparation, the engineers did not escape the profoundly unsettling consequences alluded to at the outset. The role of informer, as we noted, presents a double face: betraying the trust of close associates in making an accusation and bringing hidden wrongdoing to light. Members of Congress who heard the engineers' testimony in the hearings showed limited appreciation of their safety concerns and regarded the engineers with suspicion, questioning whether they had made genuine sacrifices or had been paid off in some scheme. The congressmen were unwilling to take at face value the engineers' professed motivation, character, and conduct. At some junctures, the engineers were frustrated by the politicians' oversimplified paraphrases and other misunderstandings.[17] Speaking of this episode in an interview several years later, Gregory Minor said, "It was the closest I've ever come to experiencing a witch hunt."[18]

Moreover, the act of resigning and going public, as Hubbard described it several years later, did not produce immediate feelings of satisfaction. Hubbard recalled his nervousness on going to meet the reporters at the airport and the blinding sunshine which kept him from really seeing their faces. He recollected that as soon as he resigned, he telephoned a close work associate of many years to apologize for not telling him in advance. Immediately, he perceived the rupture his action had produced. His former colleague said, "You know, I never had a friend who threatened my job."[19]

C. Moral Justification of Whistleblowing

Our central question about the whistleblowing concerns its moral justification. The chief relevant factors to consider are (1) the extent to which the whistleblower has investigated the matter and used internal channels for dealing with the problems, (2) the adequacy of the whistleblower's evidence of wrongdoing, and (3) the seriousness and likelihood of the harms. The first point is worth stressing as a moral, and not merely practical issue.[20] The potential whistleblower is morally required as a matter of fairness to give those who may be accused an opportunity to rectify the situation. (This requirement may be waived if time is too short until serious damage occurs.) Only when reasonable efforts to resolve the problems internally have clearly failed, is the whistleblower justified in speaking out.

As the case narrative indicates, these four engineers tried repeatedly over an extended period to move their superiors to take corrective action. In frustration, they finally concluded that significant generic problems were dealt with by being identified rather than rectified and that the public's ignorance made this situation intolerable. The Browns Ferry accident seems to have served as a catalyst in precipitating the engineers' bold actions in resigning and publicizing nuclear plant safety problems. The soundness of their conclusion about failure to follow through on the part of the industry and the regulatory agency is born out by <u>The Report of the President's Commission on the Three Mile Island Accident</u>. It states, "The evidence indicates that labeling a problem as 'generic' may provide a convenient way of postponing decision on a difficult question." The Report also asserts,

> We find that there is a lack of 'closure' in the system--that is, important safety issues are frequently raised and may be studied to some degree of depth, but are

> not carried through to resolution; and the lessons learned from these studies do not reach those individuals and agencies that most need to know about them.[21]

The requirement of reasonable evidence has a prudential and moral point. It is, of course, wastefully disruptive to sound alarms without evidence. Follow-up investigation alone can involve delays and other economic costs. From a moral point of view, two chief considerations emerge. One obviously is that making an accusation without reasonable evidence may unjustifiably harm those who are accused. Only as a lucky guess will the charges be confirmed. For most situations, it is plainly unfair to use the whistleblowing itself as a means for obtaining evidence.

The second consideration has to do with an often suggested requirement that the whistleblower act in good faith.[22] To go public merely as an act of revenge, out of a grudge, to cover one's own failings, or to inflate one's own importance surely lacks moral justification. Often enough, however, a variety of motives combine to bring forth a person's actions. Indeed, it frequently appears that certain crucial actions are over-determined inasmuch as any one of a number of motives the agent had would have been sufficient. As regards whistleblowing, the requirement is that, whatever her other motives, the whistleblower acts out of concern about the problem to be exposed.

This demand for good faith translates very plausibly into the requirement that the whistleblower have evidence which is reasonable for those circumstances. The division of labor and other features of hierarchical organizations, as well as specific mechanisms of information control, may severely limit an employee's opportunities for obtaining evidence of suspected wrongdoing. Nevertheless, we properly require those who contemplate revealing organizational secrets to go to the trouble of acquiring evidence to which their positions and training give access. Failure to be through and resourceful in investigating suspected misconduct, insofar as time allows, undermines moral justification of the act of exposure.

In the long period during which the engineers' concerns evolved to the point at which they took decisive action, they gathered a large body of evidence of unresolved generic safety problems. From their positions within GE and the NRC, they could observe failings elsewhere in the industry, as well as in their own organizations. Their testimony at the congressional hearings presents their evidence and shows that the ripening of their concern was slowed by the recognition that they lacked a comprehensive perspective and might err because of fragmentary evidence.[23] Their efforts to overcome those limitations ultimately convinced them that

the fragmentation of knowledge was itself part of the configuration of safety problems. It is an unusual and noteworthy feature of this case that the revelations concerned patterns of action and inaction, not just a specific instance. Obviously, a proportionately greater task of gathering evidence burdens those who would expose generic problems.

One of the best indications we have of the adequacy of the evidence on which the engineers based their disclosures is that their revelations clearly anticipated the findings of the President's Commission which studied the TMI accident. The problem of human error which the engineers pinpointed and explained in their congressional testimony in 1976 was the major factor which the President's Commission cited in its 1979 Report on TMI.[24]

Perhaps most striking is the fact that these engineers had studied the institutional processes as well as the technical issues. They correctly identified deficiencies in the procedures of their organizations in addition to those in the technical systems. One can argue that the moral duty to investigate carefully before deciding to "go public" refers to organizational practices as well as to the wrongdoing. To be an effective moral agent in an organization, one has to become alert to organizational structures and practices and assess them in moral terms. Practically speaking, an understanding of the organization is essential to taking appropriate internal steps to rectify a perceived problem.

These engineers are impressive for observing the role of institutional pressures and procedures in allowing safety problems to persist and for insisting at the same time that individuals take responsibility for their own actions. These engineers were remarkable in resisting the temptation to take refuge in organizational practices, to see them as making responsible conduct impossible and as excusing failure to take action. In light of the serious accident three years later at TMI, we can safely say the nuclear engineers were concerned about significant harms which were likely to occur. To an outstanding degree, these nuclear engineers fulfilled the requirements for morally justified whistleblowing.

D. Failures at Browns Ferry and Three Mile Island

When we turn to the conduct of individuals highlighted in the case chronology and discussion, we see numerous instances of failure to carry a problem through to resolution. In 1969, AEC inspector Bower sent a written message to the AEC about the need for cable separation criteria, and in 1971 he warned again of safety problems at Browns Ferry. After the new head of Region IV supported

Consider this illustration of the problem. In the autumn of 1974, GE undertook a Nuclear Reactor Study of Boiling Water Reactors. The director of the study, Dr. Charles E. Reed, a vice-president of GE and former MIT faculty member, admitted before the Congressional Joint Committee on Atomic Energy that the study dealt with over-all design considerations, plant components, test facilities, and management and organization. However, he said, "Although in the course of the Study Group's review nuclear safety aspects were considered, this study was not a safety review." On the grounds that the study report was a sensitive document "from a competitive standpoint," GE did not make the report available to the NRC. It merely conducted an in-house review which concluded that there were no reportable deficiencies not previously reported to NRC. Only after Bridenbaugh, Hubbard, and Minor, who had participated in the study, revealed its existence and its safety significance before the Joint Committee, was the report made available to the NRC. The study was not to be made public at all, however, and it was to be available to the Congressional Committee only via an NRC report after a review of the study by that agency. Reed repeatedly defended this secretiveness, saying that there was no new safety-related information in the report.

We have already encountered the relevant assumption operative in the industry: the public cannot comprehend the issues in nuclear plant safety, and if ordinary people were informed about the risks and costs, they would hysterically reject nuclear power altogether. The advantages in the alternative of public debate and informed public support of perhaps a modified schedule in nuclear power development are thus lost. Instead, the nuclear power community proceeds feeling embattled and estranged from the public and constantly on guard against the leakage of any negative data. They are deprived of the common sense, diversity of outlook, and cool judgment which might come from public discussion.

If nuclear power is an "unfinished engineering dream," a most promising way to a satisfactory completion is to enlarge the perspectives and sharpen the moral and professional consciousness of engineers in training and to raise the level of literacy of ordinary citizens about these momentous projects.*

III. CASE COMMENTARY

This case narrative actually contains two stories, the whistleblowing episode and a sequence of events leading up to the Browns Ferry nuclear plant accident. Both incidents merit careful study for their implications about the moral responsibilities of individuals in organizations. In the

Bower's warning in 1972, the AEC allowed serious compromises with the two units. It is important to note that officials made this retreat almost two years in advance of putting the plant into operation. This sequence manifests the fragmentation and lack of coordination and follow-through which troubled the whistleblowers.

A similar picture impressed the President's Commission which studied the TMI accident. Their report notes, "Several earlier warnings that operators needed clear instructions for dealing with events like those during the TMI accident had been disregarded by Babcock and Wilcox and the NRC."[25] Bert Dunn, a senior engineer at Babcock and Wilcox (suppliers of the nuclear steam system at TMI) had appreciated the potentiality for a calamity in an incident at Toledo's Davis Besse plant in 1977. He realized that if the Davis Besse plant had been operating at full power, the incident would have been far more serious. More than a year before the TMI accident, which began with a similar incident, this engineer wrote an internal memo strongly urging his company to provide other utilities with instructions for dealing with such events. He did not see his advice acted upon by anyone either at Babcock and Wilcox or at the NRC, which had investigated the Davis Besse incident.[26]

The recent trial in a law suit brought by the TMI utility against Babcock and Wilcox revealed that at a meeting at TMI four months before the accident, the superintendent of the Davis Besse plant "told of a faulty relief valve that stuck open, allowing cooling water to escape." Testifying at the trial, Frank Fahland, a Babcock and Wilcox manager of systems engineering, "conceded that after this presentation there were no instructions from Babcock and Wilcox engineers not to rely on the pressurizer for water level."[27] It appears that to follow through with instructions Babcock and Wilcox engineers would not have had to take on powerful opposing interests, but rather to overcome inertia.

It is safe to conclude that engineers at Babcock and Wilcox and the NRC had evidence about the technical systems and organizational practices which would have justified their taking a more forceful stand on the implementation of instructions for operators. In view of the seriousness and likelihood of the harm anticipated, we may question whether whistleblowing was not merely permissible but morally obligatory. The conduct of individuals referred to in the Browns Ferry narrative gives rise to a related query: were they morally required to pursue their concerns to a resolution? The latter question raises the possibility of a range of firmer responses, short of whistleblowing, but stronger than dispatching a memo.

E. Organizational Practices and Options

The TMI and Browns Ferry stories, as well as others, suggest that the memo is an accepted device among engineers for alerting supervisors to serious problems and prodding them to take action. Often perceived as indicating stronger concern than a verbal warning, the memo has the further advantage of providing a record of the author's appreciation of the problem and effort to rectify matters. It allows the recipient time for a considered reaction. This option is attractive also because it usually poses little risk of retaliation to the writer. However, when they put others on notice, the memo writers apparently come to believe that solutions to the problems now properly rest with those others. Having transmitted their misgivings to superiors (or in some cases, designated government officials), the authors give the appearance of believing they have transferred responsibility for resolution. They seem to think they no longer bear any responsibility themselves for harm which may result if the problem remains unresolved.

Of course, those who have now been put on notice also have responsibility for risks and harms, but without absolving those under them who have sounded warnings. Consider a parent's giving over the responsibility for educating their children to teachers. Teachers now have responsibility for the outcome, but so do the parents. The parents now have to pay critical attention to what the teachers do. To fulfill their continuing responsibility, engineers must follow-up on the performance of those whom they have alerted to problems, at least to the extent of ascertaining what, if any, action has been taken and considering other options for themselves if a memo has had no effect. Since, on the basis of past experience, engineers often have reason to anticipate that their warnings will go unheeded, they have added reason to follow-up. In the Browns Ferry episode, Doc Murphy, the AEC official supervising pre-operational testing, acknowledged that he did not expect prompt action on the memo he dispatched about a year before the fire. He received no response at all and apparently did not react. This suggests that the routine (in some cases the ritual) of the memo is part of an atmosphere of so-called "pluralistic ignorance," a state in which "each bystander is led by the apparent lack of concern of the others to interpret the situation as less serious than he would if alone."[28]

Though this atmosphere helps to explain the pattern of delay and neglect in attending to identified deficiencies such as the lack of adequate cable separation, it does not excuse the failure to follow-through. Rather, members of organizations have a moral obligation to be alert to routines such as memo writing and to ascertain whether these practices foster immoral or irresponsible conduct.

Professional employees have a duty to resist or at least call attention to procedures they find are faulty.[29] They can also take the option of resigning. In circumstances in which failure to act can have predictably harmful consequences, particular persons who refrain from acting may bear responsibility for those outcomes. By virtue of their organizational positions and knowledge, a number of individuals may therefore bear responsibility for a particular outcome, even though the action or omission of no one of them was necessary or sufficient for that outcome. Since cooperative efforts or a series of actions and omissions were sufficient for the untoward outcome, all who contributed to the outcome are to varying degrees responsible.

F. Moral Judgments

For whistleblowing to be mandatory, further conditions beyond those which make whistleblowing permissible or morally justified have to be satisfied. Richard De George has proposed two such conditions to be added to those he specifies for morally permissible whistleblowing. He holds that whistleblowing is morally justified if (1) the firm will do serious and considerable harm to the public, (2) the concerned employee has reported the threat of harm to her supervisor, and (3) failing an effective response from the supervisor, the employee has exhausted all internal options within the firm. In contrast to the conditions set out above (section C), De George's conditions do not include a requirement of evidence reasonable for the employee's circumstances. Perhaps this is because he concentrates on the actions of informing one's supervisor and going through internal channels, actions for which the evidence requirement need not be so strong. There is no reason to anticipate causing significant injury when one alerts internal officials to a problem. However, when an employee contemplates public exposure, he must anticipate that this accusation will cause harm. To be justified in going public, he must have good reason to believe that his action will avert more serious harms.

The stronger the evidence of very serious threatening harm and the more reason to believe that going public will rectify matters, the stronger the obligation to blow the whistle. De George's further conditions which make whistleblowing mandatory are (4) the employee must have access to documented evidence that would convince a reasonable observer and (5) the employee must have good reason to believe that going public will bring about the necessary changes.[30] Under these conditions an employee may be required to blow the whistle at some cost to herself. Of course, the obligation is stronger where the cost is less.

Let us look again at the Three Mile Island incident. In view of the seriousness and specificity of their problems, the documentation they had, the feasibility of an obvious solution, and the credibility their roles afforded, Bert Dunn and others at Babcock and Wilcox and NRC had a duty to take stronger action. They should have considered whistleblowing as a last resort if all else failed. The requirement cannot be more stringent because whistleblowing so frequently imposes high personal costs on the whistleblower without bringing proper attention to the problem disclosed. (As recently as March of 1983, a senior engineer for Bechtel Corporation was suspended indefinitely with pay after complaining to Federal officials "that dangerous shortcuts were being taken in the cleanup of the crippled TMI nuclear plant."[31])

In the Browns Ferry episode, Fu.U. Bower, Doc Murphy, and a number of their colleagues, some of whom are identified, are morally blameworthy for failures to press for resolution and to correct procedures that permitted warnings to be ignored. That is, we can judge that, in the light of their task responsibilities and knowledge, they were at fault and morally reprehensible for not taking more care to avoid the damaging fire.[32] Prudentially speaking, we can fault professionals involved in large expenditures on redundant systems who allow persisting deficiencies which undermine redundancy.

From the outside, it is difficult to say what forms of pressure beyond the memo might have been exerted to good effect by engineers at Browns Ferry, Babcock and Wilcox, and the NRC. This is the very reason why the duty to scrutinize local routines falls upon professionals on the scene. The availability of options for responding to problems within particular cooperative arrangements counts as a critical feature of the environment for moral agents. Identifying and assessing such options should continually concern anyone in an organization who seeks to exercise the discretion characteristic of a professional. In fairness to the engineers blamed for failure to take stronger action, we should point out that their professional education generally neglects the organizational contexts of engineering work. Engineers take up their positions in these challenging settings without adequate preparation for the subtleties of organizational life and with little explicit forewarning of the complexities of moral responsibility in the workplace.

Even though participants in a cooperative scheme cannot function strictly autonomously and must accept routine constraints as well as legal limits to independent action, they can function as moral beings. They have a duty to become morally attuned to the conduct of others in the organizations, to the predictable consequences of common routines such as the memo, and to the outcomes of the

organization's operations. The events at Browns Ferry and TMI and the episode of whistleblowing by the four nuclear engineers make it evident that professionals have an obligation to scrutinize and revise schemes of cooperation in which they are involved. Whistleblowing emerges as an option or duty when these schemes have failed and serious harms are likely to result.

* The Introduction and Case Narrative are based on information derived from two primary sources:

1. Investigation of Charges Relating to Nuclear Reactor Safety, Hearings before the Joint Committee on Atomic Energy, Congress of the United States, Ninety Fourth Congress, Second Session, February 18, 23, and 24 and March 2 and 4, 1976, Volume 1: Hearings and Appendixes 1-11 and Volume 2: Appendixes 12-19.

2. Browns Ferry: The Regulation Failure by Daniel F. Ford, Henry W. Kendall, and Lawrence S. Tye (Cambridge Mass: Union of Concerned Scientists 1976).

NOTES

1. The NRC subsequently devised procedures in an attempt to fill this need. See A Survey of Policies and Procedures Applicable to the Expression of Differing Professional Opinions, Office of Management and Program Analysis, United States Nuclear Regulatory Commission.

2. WASH-1400 which is referred to as the Rasmussen Report is the best known reliability study. It was funded by the AEC-NRC and appeared first in draft form in August 1974. It describes the frequency to be expected for a loss of coolant accident. By now, the NRC has repudiated this study.

3. Ralph Nader, Unsafe at Any Speed (New York: Grossman Publishers, 1965).

4. For a full account of the current status of legal protections for whistleblowers, see Martin Malin's "Protecting the Whistleblower from Retaliatory Discharge," University of Michigan Journal of Law Reform, Vol. 16, No. 2, 1983. A summary of an earlier version delivered at the Second National Conference on Ethics in Engineering, Chicago, March 1982 appears in Perspectives, June 1982, a publication of the Center for the Study of Ethics in the Professions (CSEP) Illinois Institute of Technology,, Chicago, IL. A survey of company procedures for expression of employees' dissent appears in the summary of David Ewing's address in Report of the Workshops on Ethical Issues in Engineering, ed. V. Weil, published by CSEP under an NSF-NEH Grant, May, 1980, Chicago, pp. 32-34.

5. Report of the President's Commission on the Accident at Three Mile Island: The Need for Change: The Legacy of TMI (Washington DC: U.S. Government Printing Office, 1979). This is a very illuminating document.

6. For case histories and accounts of what befalls whistleblowers, see Rosemary Chalk and Frank Von Hippel, "Due Process for Dissenting Whistleblowers," Technology Review 81 (June-July, 1979) pp. 48-55; Alan S. Westin, Whistleblowing: Loyalty and Dissent in the Corporation (New York: McGraw-Hill, 1981); David Ewing, Freedom Inside the Organization (New York: Dutton, 1977); Ralph Nader, Peter Petkas, and Kate Blackwell, Whistleblowing (New York: Grossman, 1972).

7. Immanuel Kant, Foundation of the Metaphysic of Morals, translated and analyzed by H. J. Paton (New York: Harper and Row, 1964), p. 96.

8. It seems that if one regards the corporation as a moral being, then one has to regard harming that entity as prima facie a moral wrong. Recently some writers have defended the notion of the corporation as a moral agent. See for example Peter French, "Corporate Moral Agency" reprinted in Tom L. Beauchamp and Norman Bowie, eds., Ethical Theory and Business (Englewood Cliffs, N.J.: Prentice-Hall, 1979), pp. 175-186; Christopher Stone, Where The Law Ends (New York: Harper & Row, 1975), pp. 112-118. For an opposing view, see John Danley, "Corporate Moral Agency: The Case for Anthropological Bigotry," in Michael Bradie and Myles Brand, eds., Action and Responsibility (Bowling Green, OH: The Applied Philosophy Program, 1980), pp. 140-149.

9. Richard De George discusses success as a moral factor in Business Ethics 2nd Ed. (New York: Macmillian, 1986).

10. The most thorough and comprehensive account of the BART episode is found in Robert M. Anderson et. al., Divided Loyalties (West Lafayette, IN: Purdue Research Foundation, 1980).

11. Stephen Unger details this episode in his book Controlling Technology: Ethics and the Responsible Engineer (New York: Hole, Rinehart and Winston, 1982), pp. 18-19.

12. Deborah Johnson is a philosopher who rejects this broader sense.

13. Forest City Publishing Co., 58 Lab. Arb. (BNA) 773, 783 (1982) (McCoy Arb.), summarized in "Legal and Philosophical Viewpoints," Perspectives, Vol. 2, Nos. 1/2 (March/June, 1982), CSEP Publication, p. 2. Many labor arbitrators have taken this position in upholding discharges of employees for whistleblowing.

14. Investigation of Charges Relating to Nuclear Reactor Safety Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, 94th Congress 2nd Session, Feb. 18, 23, and 24 and March 2, and 4, 1976, Vol. 1, p. 56.

15. Ibid., pp. 173-174.

16. In a letter to the author dated June 1, 1979.

17. Investigation of Charges, p. 28.

18. Leslie J. Freeman, Nuclear Witnesses: Insiders Speak Out (New York: W. W. Norton & Co., 1981), p. 268.

19. Ibid., p. 291.

20. Richard De George amplifies this point in his discussion of his conditions for morally justified whistleblowing. Supra, footnote 9.

21. Report of the Commission, p. 11.

22. See for example Sissela Bok, "Whistleblowing and Professional Responsibility," New York University Education Quarterly, Vol. 11, Summer, 1980, pp. 3-6.

23. The evolution of the engineers' concerns is not described in the Case Narrative above but in Investigation of Charges, pp. 30 and 38.

24. Ibid., pp. 51-53; Report of the Commission, pp. 20 and 8-10.

25. Ibid., p. 28.

26. David Bird, "Atom Engineer Testifies His Guide Would Have Prevented Accident," New York Times, Jan. 20, 1983, Section 1, p. 16.

27. David Bird, "Atom Trial Told of Ohio Problem," New York Times, Jan. 19, 1983, Section 4, p. 24.

28. This phenomenon is discussed by John G. Simon, Charles W. Powers and Jon P. Gunnemann in an excerpt from The Ethical Investor: Universities and Corporate Responsibility (New Haven: Yale University Press, 1972) reprinted in Ethical Theory and Business, pp. 166-168. Simon et. al. mention empirical studies indicating that individuals' failures to respond to problems in social situations may have the further effect of suggesting to others who might have stepped forward that the situation is not so serious as they might have thought.

29. The view is impressively defended, with reference to cases of officials of government bureaucracies, by Dennis Thompson in "Moral Responsibility of Public officials: The Problem of Many Hands," Political Science Review, Vol. 74 (Dec., 1980), pp. 905-916.

30. Supra, Footnote 9.

31. New York Times, "Cleanup Complaint Made at Three Mile Island," March 24, 1983, p. 8.

32. Bernard Gert in The Moral Rules (New York: Harper and Row, 1973), pp. 121-125 argues that the rule "Do your duty," is included among the moral rules. The engineers referred to appear to have violated that rule.