Engineering Ethics

Fourth Edition

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Prentice Hall
Upper Saddle River • Boston • Columbus • San Francisco • New York • Indianapolis
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Printer/Binder: *Edwards Brothers*
Cover Printer: *Lehigh-Phoenix*

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Library of Congress Cataloging-in-Publication Data

Fleddermann, Charles B. (Charles Byrns), 1956–
Engineering ethics / Charles B. Fleddermann. — 4th ed.
p. cm.
Includes bibliographical references and index.
ISBN-13: 978-0-13-214521-3 (alk. paper)
ISBN-10: 0-13-214521-9 (alk. paper)
1. Engineering ethics. I. Title.
TA157.F525 2012
174'.962—dc23

2011023371

10 9 8 7 6 5 4 3 2 1

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ISBN 10: 0-13-214521-9
ISBN 13: 978-0-13-214521-3

APPLICATION

CASES

The Disaster at Bhopal

On the night of December 2, 1984, a leak developed in a storage tank at a Union Carbide chemical plant in Bhopal, India. The tank contained 10,000 gallons of MIC, a highly toxic chemical used in the manufacture of pesticides, such as Sevin. The leak sent a toxic cloud of gas over the surrounding slums of Bhopal, resulting in the death of over 2,000 people, and injuries to over 200,000 more.

The leak was attributed to the accidental pouring of water into the tank. Water reacts very vigorously with MIC, causing heating of the liquid. In Bhopal, the mixing of water with MIC increased the temperature of the liquid in the tank to an estimated 400°F. The high temperature caused the MIC to vaporize, leading to a build-up of high pressure within the tank. When the internal pressure became high enough, a pressure-relief valve popped open, leaking MIC vapors into the air.

The water had probably been introduced into the tank accidentally. A utility station on the site contained two pipes side by side. One pipe carried nitrogen, which was used to pressurize the tank to allow the liquid MIC to be removed. The other pipe contained water. It appears that instead of connecting the nitrogen pipe, someone accidentally connected the water pipe to the MIC tank. The accident was precipitated when an estimated 240 gallons of water were injected into the MIC storage tank.

As with many of the disasters and accidents that we study in this book, there was not just one event that led to the disaster, but rather there were several factors that contributed to this accident. Any one of these factors alone probably wouldn't have led to the accident, but the combination of these factors made the accident almost inevitable and the consequences worse. A major factor in this accident was the curtailment of plant maintenance as part of a cost-cutting effort. The MIC storage tank had a refrigeration unit on it, which should have helped to keep the tank temperatures closer to normal, even with the water added, and might have prevented the vaporization of the liquid. However, this refrigeration unit had stopped working five months before the accident and hadn't yet been repaired.

The tank also was equipped with an alarm that should have alerted plant workers to the dangerous temperatures; this alarm was improperly set, so no warning was given. The plant was equipped with a flare tower. This is a device designed to burn vapors before they enter the atmosphere, and it would have been able to at least reduce, if not eliminate, the amount of MIC reaching the surrounding neighborhood. The flare tower was not functioning at the time of the accident. Finally, a scrubber that was used to neutralize toxic vapors was not activated until the vapor release was already in progress. Some investigators pointed out that the scrubber and flare systems were probably inadequate, even had they been functioning. However, had any of these systems been functioning at the time of the accident, the disaster could have at least been mitigated, if not completely averted. The fact that none of them were operating at the time ensured that once the water had been mistakenly added to the MIC tank, the ensuing reaction would proceed undetected until it was too late to prevent the accident.

It is unclear on whom the ultimate blame for this accident should be laid. The plant designers clearly did their job by anticipating problems that would occur and installing safety systems to prevent or mitigate potential accidents. The management of the plant seems obviously negligent. It is sometimes necessary for some safety features to be taken off-line for repair or maintenance. But to have all of the safety systems inoperative simultaneously is inexcusable. Union Carbide also seems

negligent in not preparing a plan for notifying and evacuating the surrounding population in the event of an accident. Such plans are standard in the United States and are often required by local ordinance.

Union Carbide was unable to say that such an accident was unforeseeable. Leaky valves in the MIC system had been a problem at the Bhopal plant on at least six occasions before the accident. One of these gas leaks involved a fatality. Moreover, Union Carbide had a plant in Institute, West Virginia, that also produced MIC. The experience in West Virginia was similar to that in Bhopal before the accident. There had been a total of 28 leaks of MIC over the previous five years, none leading to any serious problems. An internal Union Carbide memo from three months before the Bhopal accident warned of the potential for a runaway reaction in MIC storage tanks in West Virginia and called into question the adequacy of emergency plans at the plants. The memo concluded that "a real potential for a serious incident exists" [*US News and World Report*, Feb. 4, 1985, p. 12]. Apparently, these warnings had not been transmitted to the plant in India.

Ultimately, some share of the blame must be borne by the Indian government. Unlike in most Western nations, there was very little in the way of safety standards under which U.S. corporations must operate. In fact, third-world countries have often viewed pollution control and safety regulation as too expensive, and attempts by the industrialized nations to enforce Western-style safety and environmental regulations worldwide are regarded as attempts to keep the economies of developing countries backward [*Atlantic Monthly*, March 1987, p. 30]. In addition, the local government had no policy or zoning forbidding squatters and others from living so close to a plant where hazardous compounds are stored and used. The bulk of the blame goes to Union Carbide for failure to adequately train and supervise its Indian employees in the maintenance and safety procedures that are taken for granted in similar plants in the United States.

In the aftermath of the accident, lawsuits totaling over $250 billion were filed on behalf of the victims of the accident. Union Carbide committed itself to ensuring that the victims of the accident were compensated in a timely fashion. Union Carbide also helped set up job training and relocation programs for the victims of the accident. Ultimately, it has been estimated that approximately 10,000 of those injured in the accident will suffer some form of permanent damage [*Atlantic Monthly*, March 1987, p. 30].

KEY TERMS

Cost–benefit analysis
Duty ethics
Rights ethics
Utilitarianism
Virtue ethics

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