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3. Thanks again for all your help.

James W. Vaught, Jr.

JAMES U. VAUGHT, JR., Capt, USAF
Graduate Student

3 Atch
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THE EMERGENCE OF THE NUCLEAR INDUSTRY AND ASSOCIATED CRIME

James W. Vaught, Jr.
B.S., California State University, Long Beach, 1983

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the requirements for the degree of

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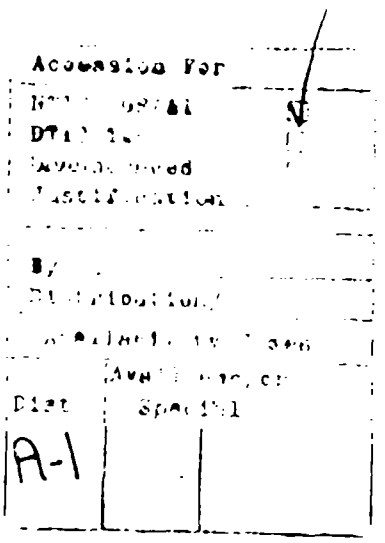

CALIFORNIA STATE UNIVERSITY, SACRAMENTO

SUMMER
1991

THE EMERGENCE OF THE NUCLEAR INDUSTRY

AND ASSOCIATED CRIME

A Thesis

by

James W. Vaught, Jr.

Approved by:

Thomas R. Phelps, Committee Chair

James M. Poland, Second Reader

Date: 31 July 1991

Student: James W. Vaught, Jr.

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Thomas R. Phelps, Graduate Coordinator

31 July 1991
Date

Department of Criminal Justice

Abstract

of

THE EMERGENCE OF THE NUCLEAR INDUSTRY

AND ASSOCIATED CRIME

by

James W. Vaught, Jr.

Statement of the Problem

Nuclear energy, in weapons production and electrical power generation, is a technology that has endured public scrutiny since the late 1940s. Societal acceptance of this industry has been affected by controversy in the following areas: health effects of exposure to radiation, possible consequences resulting from accidents, and nuclear non-proliferation.

The literature review begins in Chapter 2 by examining the changing public perceptions of nuclear energy over the last forty years. Support for the ideals and practices of the industry has often wavered, due to media representation of incidents, accidents, and potential catastrophic events.

The second part of the chapter highlights the crimes associated with nuclear energy in a chronological order of concern by nuclear industry security specialists. Research has found certain types of crime to be more prevalent during particular eras than others. Crimes instigated by spies,

peace activists, terrorists, and the insider (employee) are reviewed, with an emphasis on insider crime.

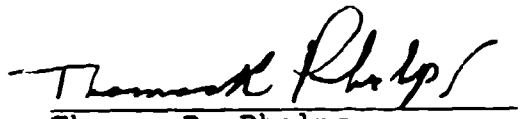
In recent years, nuclear security officials have spent considerable time and resources in attempting to neutralize the effects of insider crime. Chapter 3 examines programs in human reliability developed by the U.S. Air Force and the Nuclear Regulatory Commission. Their program goals mirror each other, as they seek to employ individuals with the "highest standards possible" to work with nuclear materials. Their methods in achieving those goals, however, are slightly varied, with strengths and weaknesses exhibited in each program.

Sources of Data

The data utilized in this study were mainly obtained from the scholarly journals of behavioral and social science literature. Technical journals, in nuclear facility operations, were also used. In order to achieve a well-rounded study, these journals covered a wide range of philosophical background, from liberal to conservative. Regulations in personnel reliability were obtained from the U.S. Air Force and Nuclear Regulatory Commission. Personal interviews were conducted with peace activists and personnel from the Nuclear Regulatory Commission.

Conclusions Reached

The controversies associated with nuclear energy are sure to continue in nuclear weaponry and nuclear powered electrical generation. As the world political climate continues to change, public perceptions of the need for weapons of mass destruction are likely to change as well. As energy needs increase, the benefits of nuclear power will continue to be compared to the availability and environmental impact of fossile fuels. Battles on such issues will be fought and won according to media presentation of the issues. The important question to be answered is what impact these battles will have on workers within the nuclear industry and possible insider crime.

 , Committee Chair
Thomas R. Phelps

DEDICATION

To my lovely wife, Julie, whose support in all my endeavors over the last fourteen years has been my motivation to succeed professionally and academically. One couldn't ask for a better companion.

This thesis is also dedicated to my first Air Force supervisor, Senior Master Sergeant Robert C. Hornbeck, who saw potential in a young airman and whose encouragement led to further education and a commissioning in the Air Force.

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CHAPTER 1

Introduction

Nuclear energy is one of the most beneficial, yet lethal, forms of power known to man. Relatively new, in technologies experienced by society, the concepts of fission have only been practically applied since the mid-1940s in weaponry and the early 1950s in electrical power generation. Debates over safety have raged for more than three decades, among representatives of various scientific disciplines and the public. Topics have included: acceptable radiation exposure limits, health effects of radiation exposure, nuclear non-proliferation and the possible consequences resulting from accidents in the industry.

Such a wide range of interests is made possible from the refinement of Uranium, a material which is abundantly mined in seventeen countries scattered across all seven continents. The number of different industries working with nuclear materials results in varied and more complex nuclear questions seeking resolution. A single activist's bumper sticker, declaring, "No Nukes," may be referring to any, or all of the following:

a. Refining/enrichment of Uranium and Plutonium

b. Nuclear weapons planning, production, and storage

c. Nuclear fueled electrical power generation

d. Transportation and disposal of spent fuel/obsolete weapons.

In our society, these industries employ countless individuals, with a technology that indirectly affects most people living in the United States.

Statement of the Problem

Under optimum conditions and barring the holocaust of a nuclear war, most of the public will never be aware of negative aspects of overexposure to radiation. Unfortunately, there are situations that have hindered this scenario from becoming a reality. A major contributor to date has been human error, spanning all of the previously mentioned industries. Another area of concern has been the threat and reality of crimes committed against these industries. These crimes include, but are not limited to the following: theft, sabotage, extortion, and vandalism.

Purpose of the Study

In order to maintain the integrity of the nuclear power industry, it is important to understand and reduce the negative factors associated with nuclear power. This study will concentrate on crimes committed against the industry, but will not focus on the issues of reducing human error within the nuclear industry itself. By learning more about the motivations, capabilities, and methods of the nuclear criminal, it will be possible for criminology to better understand this new form of deviance. In turn, the nuclear power industry will be better able to formulate security

measures in the protection of this potentially destructive resource which is under their control.

Need for the Study

As will be examined, the nuclear power industry has not had a perfect "track record" of safety and security. The resultant accidents and incidents have created an uncertainty among the public which has retarded the growth of the industry. Over the last thirty years, perceived and actual vulnerabilities have changed dramatically. Effective security procedures should concentrate on planning needs for both the current threat and future threats to the industry.

Among one of the more important topics of concern will be that of the "insider" criminal and potential damage to the industry and the larger society. While this facet of nuclear crime hasn't been ignored, efforts to combat effects have lagged well behind those designed to counter overt threats of terrorism. By focusing on potential problems, nuclear energy management, as well as industrial security officials, will be able to make more effective use of available time and resources.

Scope and Limitations of the Study

Most of this study will examine the nuclear industry discussing problems common to civilian and military usages. The two main areas selected for study are the following: civilian nuclear power plants and U.S. Air Force nuclear weapons programs. The Air Force was selected from the other

three branches of service because of the numbers of nuclear weapons possessed in the ballistic missile and strategic bomber areas. Additionally, a few areas in civilian production and disposal will also be covered to highlight problems that affect the industry as a whole.

There are many lesser uses for nuclear materials, such as for medical treatments and industrial research, that will not be dealt with in this study, because amounts of radiological material used are small and crime is not as threatening to the public.

Whether wearing a military uniform, or working for a local utility company, nuclear industry personnel are equally susceptible to human error and failure. Civilian, or military, nuclear facility management has the equal task of identifying both the motivators and detractors of effective employee performance. Finally, security efforts in both arenas should be found to parallel each other in effectively safeguarding hazardous materials from employee deviance.

Any limitations to this study would be in the form of classified aspects of physical security peculiar to various locations. Civilian nuclear power plants classify information relating to numbers of on-site security personnel and descriptions of site characteristics not observable from outside the boundary fences of the installation. On the military side, numbers of nuclear weapons at a given base and specific area vulnerabilities are topics which cannot be

included in an unclassified document. These particular areas of classification should not affect the overall theme of the study, which will be ensuring the effectiveness of the human element in safeguarding nuclear materials from behavior which can be defined as crimes committed by the nuclear criminal

Methodology

The information for this study will be gathered from a variety of scholarly journals, military experience and regulations, the Nuclear Regulatory Commission, and the U.S. Code of Federal Regulations.

From the journals as a source, every effort will be made to cover the entire spectrum of philosophical background, from conservative to liberal, as perceived when discussing the nuclear power industry. This will be helpful in identifying and reducing the impact of bias found at either end of the scale, when discussing and reviewing the literature dealing with a controversial industry in American Society.

Military regulations and the U.S. Code of Federal Regulations (Title 10) will reflect the most current practices in safeguarding the nuclear weapons and power industry. Information obtained from these sources is a matter of public record and easily obtainable.

Finally, the Nuclear Regulatory Commission, District V, has provided an extensive amount of background material for this study. Their public affairs office is quite responsive to inquiries of any citizen or group. Their information

provides the important balance between civilian and military nuclear security programs.

Definition of Terms

Clarification of the following terms will be helpful in understanding the orientation of this study:

Civilian Nuclear Power Facility - An electrical generating plant that uses radioactive fuel as the means of generating steam to produce energy. Even though plants are confined to specific locales, other functions necessary to maintain operations may be geographically separated and require transport of hazardous material through the public domain.

Military Nuclear Weapons Industry - The development, transportation, and storage of nuclear weapons for national defense.

Access - Opportunity to covertly tamper with, steal, or vandalize dangerous materials. Also, the ability to manipulate controls and commit unauthorized acts undetected. While some of these acts might not directly involve nuclear material itself, safeguards such as back-up systems and alarms can be affected.

Insider - Any one of several crafts necessary to run and maintain a facility within the nuclear power industry. Civilian examples span an entire range of occupations, such as: engineers, controllers, utility company supervisors/foremen, maintenance personnel, plumbers,

painters, security personnel, and truck drivers. The military examples are limited to: engineers, weapons systems operators, and security personnel.

Media - Not restricted to television, newspapers, and magazines. Also includes information imparted by scholarly journals, unclassified reports from regulatory agencies, and opposing viewpoints from Peace and Anti-Nuclear organization publications.

Organization of the Study

In a review of the available literature, Chapter 2 will begin by examining the emergence of the nuclear power industry in America. Fluctuations in the public's perception of the industry will be reviewed, beginning with the late 1940s and continuing to the present. Media representation of accidents and incidents and how it has influenced public opinion on nuclear issues will also be critically reviewed in this section.

The second part of the chapter will highlight, in an historical perspective, the emergence of a criminal element associated with the nuclear power industry. Four subsections will discuss implications of spying, terrorism, peace groups, and the insider criminal.

Chapter 3 will focus on the insider criminal, as well as what preventative measures are currently being undertaken by the Nuclear Regulatory Commission and the Air Force to protect plants, installations, and hazardous materials. Key to this

chapter will be the essential elements of the Nuclear Regulatory Commission's Human Reliability Program and the U.S. Air Force's Personnel Reliability Program. Both deal with personal behavioral standards for individuals who work directly with and in support of nuclear materials.

In Chapter 4, the summary will review the major obstacles to effective security within the nuclear industry since its beginning. The conclusion will identify and analyze present-day problems of insider crime, as well as the effectiveness of programs currently being implemented in the field of human reliability. Finally, recommendations for future safeguards against insider crime will be presented.

CHAPTER 2

Literature Review

Locations, People, and Attitudes

The "Trinity Site" in New Mexico is where the first atomic device was exploded at 5:29:45 a.m. on July 16, 1945. The bomb was the result of the U.S. government's code named "Manhattan Project's" three-year effort to build such a device. A sense of urgency was created by an effort to beat the Germans, who were also working toward the completion of an atomic bomb, according to intelligence reports.[1]

Three principal facilities were constructed in the United States to develop the bomb. At Oak Ridge, Tennessee, huge processing plants were built to separate Uranium 235 from its more common form, Uranium 238. Hanford, Washington, became the home for nuclear reactors that enriched plutonium. Finally, a laboratory at Los Alamos, New Mexico, was established to design and build the bomb.

At all three primary locations and several lesser ones in Canada and England, top scientists of the day worked in earnest on the project. The plants in Tennessee and Washington sprang up overnight and employed thousands of workers, first in tent cities, later in simple housing. Very few of them knew what the end result would be to their days, weeks, and months of labor. Morale was high because of the many jobs created where there previously had been none.[2]

Even though immortals such as Einstein and Fermi had theorized the early principles of nuclear fission, it was Robert J. Oppenheimer who was credited with being the driving force behind building a workable bomb by the end of WW II.[3]

After the first tests and wartime uses of nuclear devices, the United States government and military realized just how much they still didn't know about the potential of nuclear weaponry. Shortly after the end of the war, the Joint Chiefs of Staff ordered a task force to find a suitable location for further testing of nuclear weapons. Upon advice from this task force, the U.S. government settled on Bikini Atoll in the Marshall Islands. The U.S. military governor of the atoll spearheaded the moving of the inhabitants to different islands, giving as a reason "the welfare of all men." The islanders were promised they would be moved back to Bikini when it was safe to do so.[4] They were briefly moved back in 1967; however, later Atomic Energy Commission testing revealed the island to be uninhabitable for another 100 years.

Another testing site was also established at Eniwetok Atoll, in the fall of 1946. Over the next ten years, a total of 66 tests were conducted at both atolls.[5] There were no recorded protests among the islanders, because they were a simple and trusting people whose culture allowed them to be relocated easily and without protest.

In 1949, it was felt that a land-based testing site in the continental United States was necessary to keep up with

the Soviet Union, who had detonated an atomic device of its own during that year. Five different sites were studied and the Las Vegas/Tonopah Bombing and Gunnery Range was finally selected.[6] Since 1951, except for a three-year moratorium on testing with the Soviet Union, literally hundreds of nuclear tests have been conducted at the site. After 1963, all tests have occurred underground.

The public, in general, seemed supportive of the testing and stockpiling of nuclear weapons in the 1950s. It was especially popular in Las Vegas, probably because of all the business it brought into the area. Any dangers of harm from nuclear fallout were quickly dismissed by the Atomic Energy Commission (AEC), even though debates raged between different groups of scientists. The press gave little coverage to any scientist dissenting with the AEC and the testing program.[7]

There were a few public problems, however, during the early testing era. In 1953, an errant wind pattern sprinkled radioactive fallout over the populace at St. George, Utah. In another incident, 3,600 grazing sheep were killed in Nevada by fallout.[8] There were small-scale protests that took the form of sit-ins at missile bases and a few occasions of activists trying to sail into the Marshall Islands' testing zones. On a slightly larger scale, the national Committee for a Sane Nuclear Policy was founded in 1957 and claimed over 25,000 members within a year.

Still, everything considered, the people of the nation and Las Vegas greatly supported the nuclear weapons program. Popular Las Vegas Strip postcards of the day pictured mushroom clouds in the background. In 1955, and for $75.00, women could get an "atomic hairdo" at the Flamingo Hotel. Not surprisingly, the "atomic cocktail" was the biggest seller in bars along the strip.[9]

In 1957, commercial nuclear power was introduced into the United States through the Shippingport, Pennsylvania nuclear steam-electric prototype plant, a joint venture of the Atomic Energy Commission and the Duquesne Light Company.[10] The technology which was used followed that which had previously been developed for U.S. Navy nuclear propulsion units.

It was also in the late 1950s that other, more bizarre uses for nuclear energy were being studied. One of the more famous of these notions was "Project Chariot," a plan to dredge a deep water harbor in Alaska by means of nuclear explosions. This idea was conceived in 1957 at the Atomic Energy Commission's Lawrence Radiation Laboratory in Livermore, California. It was only one of the many ideas advanced by Edward Teller, director of the lab.[11]

Project Chariot's basic goal was to create a deep water harbor on Alaska's north shore, allowing for increased shipping to export vast coal reserves. For several months the plans proceeded nicely, gaining support among the majority of Alaska residents for the increased revenue it would bring to

individuals and the state. All problems encountered in the planning stages were given a hasty solution, or ignored--until that of the Eskimos of Point Hope. They, like the Bikini Islanders, were non-white, lacked political power, and were not uniformly proficient in the English language.[12] They might have been viewed to be just as easy to manipulate and deceive as were the Bikini and Eniwetok Islanders.

The problem that Teller and others failed to anticipate was the support these Alaska natives would receive from around the United States. It was known that Point Hope was the oldest continuously occupied settlement in North America. This historical fact, together with growing public concern about radiological contamination, led to the closure of Project Chariot.

Some of Edward Teller's other ideas continued to raise concern about peacetime use of nuclear energy. In 1958, he proposed closing the Strait of Gibralter by means of a nuclear detonation. The Mediterranean Sea would rise, freshen, and be used to irrigate the Sahara Desert. On another occasion, he proposed exploding a device on the moon in order to determine the possible effects of this action.[13]

In 1960 and 1961, nuclear powered electrical generating plants, in Dresden, Illinois, and Yankee Rowe, Massachusetts, came on line.[14] A total of five more plants were made operational in the 1960s, forty more in the 1970s, and forty-nine others in the 1980s. As of December 31, 1989, there were

122 nuclear power reactor electrical generating units in operation or under construction in the United States.[15] With only a few exceptions, nuclear powered electrical generating started in the northeastern states and moved south and west. Today, the greatest concentration of nuclear power plants will be found in the northeast states.

Radiation Controversy

An important question is whether government agencies such as the Atomic Energy Commission and the Nuclear Regulatory Commission (NRC) deliberately mounted a campaign of propaganda to lessen public reaction to the dangers of radiation. Systematic research suggests the answer is yes, because many NRC pamphlets produced today still underemphasize risks associated with nuclear energy. Their policies over the last 45 years have stated that a few risks don't outweigh the progress we have experienced in the use of nuclear energy.

The real problem with nuclear health hazards is the almost impossible task of assessing the exact sources of illnesses. Diseases such as cancer develop slowly and many times aren't detected for several years. There are also countless cancer-causing agents in our society. However, some families living close to nuclear complexes have developed higher rates of cancer than those living elsewhere. This is typified by families living in eastern Washington State, close to the Hanford Nuclear Reservation. Of those, some 60 percent of extended family members suffer from some type of thyroid

disease or cancer.[16] That's quite a bit higher than the national average.

In defense of some of the information imparted during the early nuclear testing program, researchers of the day couldn't fully know the long-term effects associated with exposure to radiation.

Even today, medical personnel and scientists are at odds as to what constitutes an acceptable level of exposure to radiation.[17] J. Samuel Walker reports the following in The Journal of the American Medical Association, August 4, 1989:

> ...scientific uncertainty has prevailed since the earliest efforts to set safety guidelines. Data for radiation limits has been chronically insufficient, inconclusive, or contradictory. More important, issues that involve the use of radiation sources have not been strictly scientific matters; they necessarily required policy assessments and priority judgements. Different individuals and groups are likely to take different positions in the future regarding the seemingly timeless question of what constitutes an acceptable exposure to radiation.[18]

Certainly, inconclusive data in this area suggests the need for more comprehensive studies; however, there are several methodological problems identified by Robert Alvarez, who is an expert on health and environmental programs at the U.S. Department of Energy. The first problem relates to the mishandling of several epidemiologic studies by the Department of Energy. The results of one investigation revealed, "...that over forty cabinets filled with medical records of Oak Ridge workers and families were incinerated after being set aside by a previous contractor for future study."[19]

Another problem is the Department of Energy conflict of interest which includes their responsibility for the manufacture of nuclear weapons, as well as their mandatory role in monitoring the health-related problems of both employees and those residing close to the weapons complexes. Energy Secretary James Watkins shifted responsibility for some of these health studies to the Department of Health and Human Services in 1991, in an effort to reduce this conflict of interest.[20]

Finally, it has only been in the last year that the Department of Energy has allowed greater access to employee medical records by independent researchers. This new "openness" may finally answer the questions of long-term exposure to radiation and links to cancer, which remain controversial at this time.

Incidents and Accidents

The earliest reported military accident involving a nuclear weapon occurred on February 13, 1950. A B-36, off the coast of British Columbia, had to jettison a nuclear weapon due to engine and icing problems.[21] Several of the subsequent accidents mirrored this type in which the weapons were not armed and no nuclear detonation took place. Only the high-explosive portions of the bombs inadvertently detonated, allowing the military to keep most of the accidents classified secret for many years.

The U.S. military wasn't always able to keep incidents secret and radiological contamination sometimes resulted from such accidents. The following three incidents illustrate:

> Jan. 17, 1966 / B-52 / KC-135 / Palomares, Spain
> Two aircraft collided during refueling operations. The B-52 carried four nuclear weapons, of which only two were recovered (1 on land / 1 at sea). On land, only the high-explosive material detonated, but radioactive material was released. Approximately 1400 tons of contaminated soil and vegetation were removed and transported to the U.S. for storage at an approved site.[22]

> Jan. 21, 1968 / B-52 / Thule, Greenland
> The aircraft crashed and burned seven miles southwest of the runway. Six of the seven crewmen survived. Four nuclear weapons burned in the fire and some contamination occurred. Over 237,000 cubic feet of contaminated snow, ice, water, and aircraft parts were taken to the U.S. for storage. The Danish government monitored clean-up operations.[23]

> Sep. 19, 1980 / Titan II ICBM / Damascus, Arkansas
> An Air Force Technician dropped a socket wrench, striking the missile and causing a leak from a pressurized fuel tank. About 8 and 1/2 hours after the initial puncture, fuel vapors within the silo ignited, killing one and injuring twenty-one others. There was no reported radioactive contamination.[24]

The problems associated with early nuclear testing and weapons transportation were small compared to the problems of today in the areas of safety and disposal. Two major nuclear materials complexes, which are typical of locations nationwide, are located in Hanford, Washington, and Rocky Flats, Colorado. Both geographical areas have experienced numerous problems in relation to radiological contamination.

Hanford has been the chief storage facility of spent nuclear material from weapons production and nuclear electrical power generation for over forty years. Forty-six

million gallons of high-level radioactive liquid wastes are included among the millions of tons of inactive solid and liquid waste materials stored at Hanford. Some 66 holding tanks have been described by inspectors as "leakers" or "possible leakers." Over the years, 200 billion gallons of low-level radioactive water have been dumped into open pits. The Columbia River, nine miles away, has been polluted by a radioactive tritium plume since 1963.[25] In 1989, the estimated cost to clean up Hanford's radioactive and mixed toxic wastes was over $57 billion, or more than four times the entire annual budget of the Energy Department.[26]

In June of 1989, the Rocky Flats Nuclear Munitions Plant, 16 miles northeast of Denver, was raided. The perpetrators were not the protestors that had been observed at the plant throughout its 38-year history, but a veritable army of FBI agents. The FBI was reacting largely to information provided by an employee who was convinced that he had been terminated for voicing safety concerns to his supervisors.[27] The FBI found in their investigation that numerous fires had occurred in recent years which had released unknown amounts of radioactive elements into the atmosphere.[28] None of these industrial accidents had been reported to authorities, as mandated by law.

Research on nuclear accidents and incidents would be incomplete without discussion of the serious problems at the Three Mile Island and Chernobyl nuclear powered electrical

generating plants. The accident at Three Mile Island (TMI), Pennsylvania, commenced on March 28, 1979, at 4:00 a.m. This industrial "accident" was really a series of misreadings and controller errors that resulted during two different work shifts at the plant. The possible consequences of the exposed nuclear core were serious enough; however, a timing factor created a worse scenario. In early March of that year, "...the York, Pennsylvania *Record*, a daily newspaper, ran a four part series citing unsafe conditions at Three Mile Island's Unit 2."[29] Additionally, a movie about an accident at a nuclear power plant, *The China Syndrome*, was being released and shown throughout the United States.

A report prepared by a special inquiry group, appointed by the Nuclear Regulatory Commission, highlighted additional factors which created this large media event. Among them were the following:

> 1. The recent growth in public controversy over the environmental impact of nuclear power generation.
> 2. TMI was in easy reach of the New York and Washington media centers which guaranteed immediate and massive attention from the wire services, networks, news magazines, and all the large daily newspapers, as well as the U.S. bureaus of most of the foreign media.
> 3. TMI was equally accessible to cities like Philadelphia, Chicago, and Boston, homes of big daily newspapers whose readers also live within the shadow of nearby nuclear power plants.[30]

All these factors influenced public perception of the safety and reliability of nuclear power plants. The Commission added, "The cumulative effects...sensitized many readers and watchers, as well as reporters, editors, and

commentators, to the implications of a nuclear accident and the possibility of a core melt is a thesis almost beyond argument."[31]

The April 1986 nuclear accident at the Chernobyl nuclear power plant in the Soviet Union received the most media attention of any such disaster because it involved "the largest release of radioactivity ever recorded in one technological disaster."[32] Nearly 400 million people worldwide (mainly in the northern hemisphere) were exposed to varying levels of fallout. Many people continue to experience renewed anxiety and doubt about nuclear power because of the Chernobyl disaster.[33] No longer can dissenters of nuclear programs be labeled as "commies," as they were in the early 1960s. Such accidents provide greater legitimacy to the concerns voiced by the critics of nuclear power.

Public Attitudes

The accidents at TMI and Chernobyl only solidified changes in attitude that had been taking place since the mid to late 1960s. Most of the opposition was localized to areas in which nuclear power plant planning and construction had occurred. The first plant construction to be challenged was the Ravenswood plant, to be built by Consolidated Edison Company outside of New York City. The opposition included David Lilienthal, former Chairman of the Atomic Energy Commission. He remarked, "I would not dream of living in Queens, if the Ravenswood plant is built."[34] Plans for plant

construction at Bodega Bay and Malibu in California were also canceled, following a strong growth of opposition. Opponents cited environmental impact factors as well as earthquake dangers in reactor safety problems when identifying opposition arguments.[35]

Beginning in 1969, a large number of anti-nuclear books and articles were found in the growing body of literature. Books included: Sheldon Novick's The Careless Atom (1969)[36] and Richard Curtis' and Elizabeth Hogan's Perils of the Peaceful Atom published in the same year.[37] Among the popular magazine articles was Wallace Cloud's "Is The Atomic Industry Risking Your Life" (1965)[38] and his "The Nuclear Threat Inside America" (1970).[39] These, and other related articles, enhanced the controversy over the effects of radiation. The American public, however, remained fairly complacent about the issue.

The accident at Chernobyl resulted in several studies which attempted to measure effects of such disasters on beliefs, attitudes, and responses of the public. Opinion polls were conducted in almost every major western country. In summary, those for and against nuclear power showed a marked increase in opposition immediately following the Chernobyl incident; however, most of these same people reverted back to their original views within one year.

From the study of 13 different polls from several countries, during the years 1976-1987, a few important

conclusions clarify public attitudes. First is that the biggest shift in public opinion on nuclear energy issues coincides with the emergence of major nuclear accidents. Second, these changes are seen to be only temporary in nature. Finally, the long-term trend in public opinion has been found to be a growing opposition to nuclear energy.[40]

One of the more scientific studies was able to observe such attitude changes over time. The study was conducted in the Netherlands, only two months prior to the Chernobyl accident. The survey instrument sought to determine public perception of the risks and benefits of nuclear power using 3,300 Dutch citizens as respondents. From a 78.3% response rate came 2,439 usable questionnaires. One month after the accident, 206 randomly chosen individuals received face-to-face interviews. From this sample, 154 individuals were willing to be interviewed once again within six months.[41]

The questions were based on nuclear power production in the Netherlands, where the type of nuclear plant design was considered to be "safer" than the one at Chernobyl. Even so, the opinion polls exhibited the same responses as before. Additionally, those who were initially opposed to nuclear power retained their original beliefs, while almost one-half of those initially in favor of nuclear power modified their viewpoints.

Public opinion polls measure only the belief component of an attitude which, when taken alone, may be unrelated to

overall attitude and behavior on an issue.[42] More important to the study of behavioral change was the study conducted in 1982 by Gerald Gardner, which sought to measure individual actions as influenced by personal beliefs.

A sample of 367 was drawn from the Schenectady, New York, and Hartford, Connecticut areas. Respondents included: 71 environmentalists, 66 college students, 76 blue collar workers, 80 business people, and 68 technologists (employed by a local power company heavily involved in nuclear power generation).[43]

A questionnaire was administered that included topics such as: acceptability of risks, trust in risk-management and related institutions, risks vs. benefits, subjective fatality estimates, sources of information, and self-reported actions. Respondents were asked if they had taken part in any of the following types of actions for, or against, nuclear power in the previous year:

1. Corresponding with a member of the media, person in government, a company, or corporation.
2. Joining, or contributing to, an organization devoted to a special cause.
3. Voting for, or against, a public official because of their stand on one issue.
4. Taking part in a lawsuit.
5. Signing or circulating petitions.
6. Going to public hearings.
7. Taking part in demonstrations or boycotts.[44]

If any of the aforementioned actions were engaged in within the previous year, they were asked if that particular action was related to, or directed against, any of the 17 nuclear technologies mentioned in the questionnaire.

Respondents were requested to describe the nature and goal of that action if it had occurred.[45] Environmentalists, college students, and blue collar workers were found to have taken far more actions against nuclear technology than the business people and technologists (nuclear workers), who were found to have taken far more actions which reflected a support for nuclear technology. A few respondents, in the environmentalist category, actually supported nuclear power because of the problems of pollution with fossil fuels.

The assessment of public attitudes concerning nuclear power is as difficult today as it has ever been, because of the complexity of the issues involved in such research.

To attempt to keep up with the changing issues in nuclear power, the media has resorted to several different types of interpretive "packages" over the years. This was aimed at changing audience opinion in response to the mood of the country itself, as created by experiences unique to diverse time periods in our culture. The following packages are condensed from the Gamson and Modigliani study:

> Progress Package - Frames the society's commitment to technological development and economic growth. Accidents can be conquered by adaptability, technological innovation, economic expansion, practicality, and expediency. This was the dominant package from the 50s into the 70s.
>
> Energy Independence Package - This package drew pronuclear meaning from the Arab oil embargo of 1973. Independence on nationally available resources was interpreted as the "cornerstone" of our freedom.

> Soft Paths Package - First of the mid-1970s antinuclear movement's packages. This was the child of environmentalists who promoted "splitting wood, not atoms."
>
> Public Accountability Package - Identified nuclear corporations as self-serving, profit-making endeavors which minimized accountability and control by the public.
>
> Not Cost Effective Package - Nuclear power is a "lemon," a bottomless pit to keep throwing money into.
>
> Runaway Package - While an antinuclear flavor is evident, the main message is, "It's here, so grin and bear it."[46]

The issues related to the use of nuclear power and weaponry are as complex and varied as the population receiving the messages. Complicating the matter further is the tendency of a community to forget a crisis incident soon after it has been resolved, or deny that the problem ever existed because large segments of the public did not experience the event in a personal way.

Public education in nuclear issues has progressed, as evidenced by a 1973 letter to the AEC by a fifth-grade school teacher who wrote, "I am teaching my class <u>all about</u> nuclear energy. Please send me a picture of an atomic bomb--and some mushroom clouds if you have them."[47]

Historical Perspective of Nuclear

Industry Criminal Elements

Spying

Had it not been for a defector working as a Soviet Embassy clerk in Canada, on September 5, 1945, the world may

not have found out until much later about the tangled web of espionage that spanned from North America to Europe.[48] As it turned out, the principal in the case was a German-born, English naturalized citizen. Klaus Fuchs worked as a scientist at Los Alamos, New Mexico, during World War II. Although not a Hitler sympathizer, Fuchs was a communist and passed atomic secrets to the Russians (our wartime ally). When eventually tried in England, Fuchs received a nine-year prison term. He was released in 1959 to East German authorities, where he worked as the Deputy Director of the Institute of Nuclear Physics until his death in 1988.[49]

Others who assisted Fuchs along the way were not as fortunate. Perhaps the most famous were Julius and Ethel Rosenberg. Julius was accused of giving information to the Russians, passed to him by his brother-in-law, who obtained it from Fuchs. Ethel Rosenberg was accused of retyping some of the handwritten notes for her husband. Although they were admitted communist sympathizers, they denied ever giving information to the Russians. The Rosenbergs were executed at Sing Sing Prison on June 19, 1953.[50]

The main intermediary between Fuchs and the Rosenbergs was Ethel's brother, David Greenglass. During the first part of the war, Greenglass was a member of the U.S. Army working at Los Alamos. In exchange for testimony against his sister and brother-in-law, he was sentenced to fifteen years in prison. Greenglass ultimately completed less than one-third

of his sentence and was reunited with his wife upon his release from prison. They changed their names, and as late as 1979 both claimed to be in good health.[51]

Another spy, an alleged associate of the Rosenberg team, was Martin Sobell, who was convicted and sentenced to thirty years in prison. He was confined for five years at Alcatraz and was later transferred to Atlanta Penitentiary. Released in the mid-1960s, Sobell still proclaimed his innocence and that of Julius and Ethel Rosenberg.[52]

There were many other individuals who played a lesser role in nuclear espionage during the period of development for the atomic bomb. Several scientists working and residing in Canada received prison sentences ranging from two to five years. Other convicted spies in the United States were given five- to fifteen-year prison terms. Total damage to national security is difficult to measure with accuracy. Most researchers agree that the information passed to the Soviets served to accelerate their nuclear weapons program by only one or two years.

In most areas concerning nuclear weaponry, classification of sensitive material remains just as important today as ever. It is worth noting, however, that opposing nations continue to engage in a very dangerous "game." The popular press reported, "Among the experts at an August 1989 symposium on nuclear explosive detonation sponsored by U.S. weapons labs, were three scientists from an Iraqi nuclear weapons lab.

Officials then estimated Iraq could develop a bomb in less than a year."[53]

Terrorism

Over the last fifteen years, experts on terrorism seem to have changed their views on the potential for nuclear weapons/material theft and threat by terrorists. Several studies, prior to 1975, indicated that a terrorist group would have the capability to use a nuclear weapon before the end of that decade. Fortunately, this assumption proved false. A 1988 RAND study highlighted the following several possible reasons why this did not occur:

> First, most terrorist organizations are not particularly innovative. Innovation referring to choice of targets and tactics used. Although radical in politics, they are conservative in operations. Second, the risks associated with stealing and handling nuclear material would be tremendous, and few terrorists are knowledgeable in the technical expertise required. Lastly, such mass destruction would cause public revulsion, alienating potential sympathizers.[54]

There have been several terrorist attacks against nuclear power plants worldwide, even though there has never been an overt terrorist theft of a nuclear weapon. It appears the terrorist goal in most of these incidents was to disrupt operations and to create media attention in an attempt to change public opinion. The goal was not to cause explosions or nuclear contamination resulting from the terrorist incident. The country with the most anti-nuclear terrorist activity has been Spain, with a total of 32 incidents between 1973 and 1985. Most of these attacks consisted of the

facility bombings and shooting of utility company personnel by the ETA, a Basque separatist terrorist organization. Property damage to one Spanish utility company alone was over $10 million.

The United States has been much more fortunate during the same time period, with only five incidents of much lesser magnitude as shown:

> May 12, 1976. Two bombs were exploded in the headquarters of the Central Maine Power Company, Augusta, Maine. An organization calling itself the Fred Hampton Unit of the People's Forces (Fred Hampton was a Black Panther killed in a 1969 police raid) promised a continuation of the bombings unless the expansion of nuclear power plants was halted. There were no injuries.
>
> October 10, 1977. At the Trojan Nuclear Power Plant, Columbia, Oregon, a bomb was detonated next to the visitor's center. The Environmental Assault Unit of the New World Liberation Front claimed responsibility.
>
> March 28, 1978. A guard at the Callaway, Missouri nuclear power plant received a bomb threat from a female claiming membership in the Symbionese Liberation Army and castigating utility company personnel. A search failed to disclose any devices.
>
> October 17, 1979. Indian Point, Con Edison Company. A series of bomb threats at the Indian Point nuclear complex were determined to be a hoax after the imposed deadline came and went without incident. A caller claiming to be a member of the Puerto Rican terrorist group FALN demanded $500,000 he never received.
>
> November 28, 1978. Indian Point reactors, New York. Six weeks after the previous incident, a similarly threatening note was received, signed by the Youth For Anti-Nuclear Power and FALN. It also stated "something would happen" if Indian Point didn't shut down.[56]

The Peace (anti-nuclear) Movement

As previously mentioned, the beginnings of the anti-nuclear movement occurred in the 1950s. Efforts by individuals sailing into the Marshall Islands, or penetrating the Nevada test site to protest a nuclear testing policy, were limited in number and the proponents were poorly organized. It is important to remember that during that era, an anti-government (anti-nuclear) stance was not very popular because nuclear power was new and unknown to most citizens. People with opposing views on nuclear energy were easily labeled "communists" or "crackpots," and the government did not have any interests in correcting these misconceptions.

The two anti-nuclear groups which have pioneered this social movement are the SANE and Freeze movements which merged in the late 1970s. The combined group claimed over 200,000 members nationwide by the mid-1980s.[58] Additionally, in 1981 there were at least 50 college peace groups, most having a strong anti-nuclear sentiment. The 1970s and early 1980s saw the rise of many more of the national groups testing nuclear choices. The following identify by name so of the organizations currently in existence:

National Anti-Nuclear/Peace Groups

SANE/Freeze	Grandmothers for Peace
Physicians for Social Responsibility	Spacewatch
Union of Concerned Scientists	Friends of the Earth
Council for a Livable World	Common Cause
National Resources Defense Council	Greenpeace
Citizens Against Nuclear War	Plowshares
American Peace Test	

Groups Formed by Women

Mothers Embracing Nuclear Disarmament	Peace Links
Women's Action for Nuclear Disarmament	Women Strike or Peace
Women for a Meaningful Summit	Grandmothers or Peace

There are many reasons why a person can choose to become an activist in the anti-nuclear movement. The following conclusions are from a 1989 RAND Corporation study researched by Richard A. Bitzinger, entitled "Philosophic Roots of the Western Antinuclear Movement."

> Pacifism - One of the strongest motivations behind the anti-nuclear movement. Predates anti-nuclear ideals by hundreds of years. To pacifists, nuclear weapons represent the most extreme manifestation of the unnaturalness, stupidity, and indignity of war.
>
> Moralism - Those with a moral aversion to nuclear weapons are not always anti-war. They are basically opposed to the mass destruction and long-lasting effects of the use of nuclear weapons.
>
> Politics - A political "football" over the last twenty years, communist parties in the United States and Western Europe have been quite active in the peace and anti-nuclear movements. Seemingly one-sided, they relate, "Capitalist nuclear forces are evil, while communist nuclear forces are defensive and peace oriented."
>
> Feminism - A "key" component of the anti-nuclear movement. Dr. Helen Caldicott (co-founder of Physicians For Social Responsibility) claims the nuclear arms race is, in part, the result of the biological, hormonal, and psychosexual makeup of men. Author of the book Missile Envy, she relates, "Women seemed more attuned to world survival issues and love of children. Not equal in politics, they remain equal as potential victims."
>
> Anti-Establishmentism - Criticizes the division of the world into two "camps" after WW II--each dominated by mutually distrusting and hostile superpowers. The influence of anti-establishmentism can be seen in some of the anti-nuclear organizations themselves. Most prefer a decentralized, grassroots management style.

> Anti-Nuclearism - Characterized by the overriding fear of nuclear war. In many organizations of today, "survivalism" is the common theme.[59]

Several protest tactics are used by contemporary anti-nuclear groups. These include: lawful symbolic demonstrations, acts of civil disobedience such as blockades and trespassing, and governmental lobbying. Protest groups consistently utilize individualized, specific tactics to achieve their goals. For example, the SANE/Freeze movement employs lobbying and the political process to inform local legislators of their goals. Grandmothers For Peace, another non-violent peace group, prefers to achieve media attention by being arrested and jailed for offenses such as trespassing, in order to highlight their causes.[60]

Marches and demonstrations seem to draw the largest crowds supporting nuclear disarmament. The number of participants at individual events has shown a dramatic increase between the years of 1980 and 1987, when rallies were attracting from 200 to 50,000 supporters.[61] Celebrity involvement is often evident at the larger gatherings. Some of the prominent figures who have been involved are the following: Madonna, Paul Newman, Barbra Streisand, Kenny Loggins, and Martin Sheen. Some celebrities have been arrested for trespassing at a nuclear test site; for example, Daniel Ellsberg, Casey Kasem, and Teri Garr, for their non-violent protest actions at Mercury, Nevada.[62]

Other professionals, such as Benjamin Spock, have lent their support to anti-nuclear groups. Dr. Spock continues to support the movement today--some thirty years since he appeared in a full-page anti-nuclear advertisement in the New York Times.[63]

Many Americans have devoted their lives to the causes of the anti-nuclear movement. Typical of them are the following two individuals profiled:

Jessie Cocks is the co-founder of the American Peace Test. At 43 years of age, she has been fighting violence all of her adult life. At 19, she married an alcoholic who beat her; at 27, she organized and ran a center for battered women in Chester, Pennsylvania. It has only been natural that she would find work in anti-nuclear activism deeply rewarding because of her commitment to non-violence. After a 1985 arrest at a Nevada test site, she said, "When you're right there where they test nuclear weapons, you're right in the belly of the beast."[64]

Bruce Gagnon became the chief organizer for the Florida Coalition for Peace and Justice in 1983. He was raised in an Air Force family, served as vice-chairman of the Young Republican Club in his county, and enlisted in the Air Force in 1971. While stationed at Travis Air Force Base, California, he was exposed to numerous airmen who supported an anti-war philosophy. He came into contact with them because Travis was an airlift base for Viet Nam during that time

period. After his discharge from the Air Force, Bruce Gagnon entered the national spotlight because of his efforts in opposing Project Galileo, which he concluded could result in a plutonium accident caused by a malfunction during a space shot.[65]

The future of anti-nuclear activity will probably be similar to that of the past three decades. The ranks within the peace movement will grow when potentially dangerous projects, such as Project Galileo and Project Chariot, are proposed. The same will occur if there are additional, more serious accidents such as those experienced at Three Mile Island and Chernobyl. Membership in anti-nuclear and social justice organizations will increase beyond present numbers, if media attention resulting from serious nuclear accidents continues in the future.

Insider Crime

Insider criminals pose a dual threat, since they can engage in theft of nuclear materials, or sabotage of a facility.[66] The insider is one of the most dangerous and elusive of criminals, because it is difficult to identify and guard against them. They may be young or old; a short-term or long-term employee.[67] They may have a combination of motives, or merely one. Some of the possible motives are the following: financial gain, intimate relationships, disgruntlement, disillusionment, misplaced altruism, or changed ideological allegiances.[68] The insider can work

alone, or align himself or herself with outside organizations such as criminals, protest groups, or terrorists.

Several types of damaging actions can occur as a result of insider involvement. These include, but aren't limited to: theft, sabotage, kidnapping or violence against other employees, disclosure of classified information, or faking a diversion.[69] In worldwide histories of crimes against nuclear facilities, it is uncertain how many crimes were committed by help from insiders, but their assistance was suspected in many of them. The following are examples of insider crime identified in this country during the past ten years:

> Two employees of a commercial nuclear power plant, who had both previously served on U.S. Navy nuclear powered vessels, vandalized fuel at the facility. Their Navy experiences had caused them to believe that security and other plant safeguards were inadequate. To call attention to the situation, they vandalized the fuel and called a press conference.[70]
>
> A maintenance employee set fire to an auxiliary building located about 100 feet from the main reactor.[71]
>
> Someone shut a valve to the high-head safety injection pumps, a crucial part of the emergency core cooling system.
>
> Diesel generators used for back-up power had been tampered with, causing them not to start during testing.[72]
>
> At another nuclear power plant, emergency diesel generators were also found tampered with, despite increased security from an incident of suspected sabotage the previous week.
>
> The general manager of a nuclear facility received an extortion letter containing a sample of uranium dioxide powder. With other information, it was found that two five-gallon containers of the

> substance were missing. The letter demanded $100,000, or else the materials would be dispersed in a large city. Ultimately, an employee of a subcontractor was arrested and sentenced to fifteen years in prison.
>
> Two plant operator trainees entered the fuel storage building, which was locked and alarmed (both had access). Sixty-two of sixty-four new fuel assemblies were damaged.[73]

In a "Safeguards Summary Events List" (Revision 16), published by the Nuclear Regulatory Commission in 1990, all irregular incidents associated with nuclear power plants in the United States are listed from 1957 to December 1989.[74] The number of incidents, by type of event in each category, has been tabulated by the Nuclear Regulatory Commission. The results follow: Bomb-related Events, Sect. A, devices found/ or explosions, (9); Bomb-related Events, Sect. B, hoaxes, (389); Intrusions, (51); Missing/Stolen Uranium-235, various types of equipment, (63); Missing/Stolen, Transportation Related, (30); Tampering/Vandalism, (125); Arson, (23); Firearms related, possessions/drive-by shootings, (230); Alcohol/Drugs, employees/contractors, (158); and Miscellaneous Offenses, (159).

Heavy insider involvement will be found in all the areas above, except for the intrusion category. The nuclear power industry is increasingly concerned about both the threat and reality of insider crime, because it is costing them millions of dollars and the theft and sabotage potential makes the future of nuclear power look increasingly unattractive to the

public.[75] The subject of insider control and enforcement is sure to be a priority for the future.

Notes

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CHAPTER 3

Safeguarding Against the Insider Criminal

This chapter will highlight programs in personnel reliability, instituted by the United States Nuclear Regulatory Commission and the United States Air Force. Although the goals of both programs, which are to prevent insider crime, are essentially the same, analyzing the methods used in achieving these expectations will be useful in identifying similar as well as individual strengths and weaknesses.

The United States Nuclear Regulatory Commission (NRC)

The NRC's purpose is "to assure that civilian uses of nuclear materials and facilities are conducted in a manner consistent with public health and safety, environmental quality, national security, and anti-trust laws."[1] This statement of purpose encompasses the entire spectrum of safety and security, ranging from nuclear power plant operations to medical and industrial uses of nuclear material.

The NRC is a regulatory agency only, responsible for implementing policy and enforcement of rules, accomplished by on-site inspections of licensees. The NRC employs about 3,195 people at the headquarters location and its five regional offices.[2] Each individual licensee, such as a public utility, is accountable to the NRC for any violations of imposed regulations. The Nuclear Regulatory Commission assigns

resident inspectors to nuclear power plants which are in operation or under construction. These inspectors are augmented by specialists, such as radiological and security inspectors, who are based at one of the five regional offices. Both resident inspectors and specialists conduct unannounced inspections at NRC-licensed facilities. Violations of rules can result in penalties up to $200,000 per violation, or modification, suspension or revocation of the license.[3]

The guidelines in human reliability, established by the NRC, revolve around an access authorization program for individuals requiring unescorted access to protected and vital areas at nuclear power plants. The program's objective is "a high assurance that personnel granted unescorted access to protected and vital areas of nuclear power plants are trustworthy and reliable and do not pose a threat to commit radiological sabotage."[4]

The access authorization program consists of the following three elements: the background investigation, a psychological assessment, and behavioral observation. The first two facets, the background investigation and the psychological assessment, were designed to identify past actions, or characteristics that may question a person's reliability or trustworthiness. Behavior observation was designed to detect an individual's changes within the job environment which, if left unattended, could lead to deviant

acts detrimental to safety and security. It was proposed by the NRC in August 1984 and finalized in August 1989.[5]

During the five-year interim between proposal and finalization, there were mostly positive, but also many dissenting, comments from industry work groups, including: The Nuclear Management and Resources Council, the Edison Electric Institute, and later, the Atomic Industrial Forum.[6] The following will illustrate some of the negative comments received and the NRC's responses to the proposed background investigation, psychological assessment, and behavioral observation:

The background investigation is divided into sub-areas which encompass employment history, educational history, criminal history, military service, character and reputation, and credit check. There were specific comments relevant to each area.

Employment history - Some commenters reported that no matter how much energy is expended, information is unobtainable because the previous employer will not release it, is out of business, or failed to maintain records. Especially in relation to employee terminations, the work history is frequently sealed and cannot be retrieved, even with permission of the former employee. Former employers are also fearful of litigation by previous employees. Another commenter believed that the information, when available, was too subjective and served no useful purpose. The NRC found

employment history to be a useful input to the total investigative process.[7]

Educational history - Most commenters related that it was an unnecessary burden to retrieve transcripts from all educational institutions, especially in jobs that didn't require a minimum education level, as in the case of unskilled labor. It was also felt that only educational achievement which appeared relevant to work performed on the job was necessary in a background report. The NRC maintained that a review of the previous five years of educational study was essential when establishing whether other kinds of false statements had been obtained when reviewing employee backgrounds.[8]

Criminal history - One commenter requested that contractors and vendors be allowed use of the FBI criminal history check procedure, as were the different utility company licensees. The NRC noted this was not possible because such authority is derived from Public Law 99-339. Another commenter related that criminal history checks made with state and local authorities were often more detailed than information received from the FBI. The NRC did not preclude the use of these checks, but they were not mandated, either.[9]

Military service - Many commenters felt that verification of a veteran's discharge certificate, the DD 214, should be sufficient when determining military status, rather than requiring a proposed verification of duty from the National

Personnel Records Center. The Nuclear Regulatory Commission maintained the DD 214 was relatively easy and the National Personnel Records Center check [illegible].[10]

Character and reputation - Some commenters believed phrases such as "susceptibility to coercion," and "any other conduct relating to an applicant's trustworthiness or reliability," have unlimited interpretation and, as such, are not useful in evaluating character. The NRC did not agree.[11]

Credit check - Comments were made that credit, or lack of credit, should not be a factor in granting unescorted access to nuclear facilities, and that such information was seldom beneficial when determining individual reliability. Other comments were related to where a "line" would be drawn in determining a poor credit risk; and even if such risk could be determined, it would seem impossible to know if such a person would be subject to coercion. The NRC concluded that the credit check was an important factor which offered a higher degree of assurance of employee trustworthiness desired in the prevention of radiological sabotage.[12]

Psychological assessment - The majority of commenters found this to be an important factor in the evaluative process. A few, such as the National Institute of Mental Health, noted that this type of testing had questionable predictive value. Although the NRC agreed, reference was made to the other two parts of the screening process (background

check/behavioral observation) which comprised the total predictive package.

As to a testing instrument, one commenter stated that a particular psychological test should be specified, and recommended it should be the Minnesota Multiphasic Personality Inventory. The NRC did not wish to limit the types and numbers of psychological tests used when evaluating applicants. Another psychologist recommended using a variety of tests and a second professional opinion when assessing the test results. The NRC believed that, while these may be valid points, it would be impractical to require multiple effort in psychological testing and additional assessments of the results. Furthermore, the behavioral observation program would provide ongoing assurances of stability which the agency deemed to be sufficient.[13]

Behavioral observation - Only one commenter strongly objected to the behavioral observation program, stating that it could easily be subjected to abuse, making amateur psychologists out of supervisors or assigning the task to others with no background or training in psychology. Several other comments indicated that only supervisors should be observers, but that they must be provided with proper training which was updated regularly. The NRC believed that supervisor training, when provided according to agency guidelines, was adequate. Furthermore, the agency concluded that final decisions concerning access authority should remain with

higher management in conjunction with review by a qualified psychologist or psychiatrist.[14]

The 10 Series of the Code of Federal Regulations prescribes the entire range of rules, regulations, and guidelines pertaining to nuclear power. Regulation specified in Part 10:10 determines that the eligibility for access authorization and/or employee clearance shall relate, but not be limited to the following, where an individual:

> 1. Committed, attempted to commit, aided, or abetted another in any act of sabotage, espionage, treason, sedition, or terrorism.
>
> 2. Publicly or privately advocated actions that may be inimical to the interests of the United States, or publicly or privately advocated the use of force or violence to overthrow the government or alter the government by unconstitutional means.
>
> 3. Knowingly established or continued a sympathetic association with a saboteur, spy, traitor, seditionist, anarchist, terrorist, or revolutionist, or espionage agent or other secret agent or representative of a foreign nation whose interests may be inimical to the interests of the United States.
>
> 4. Joined or engaged in any activity knowingly in sympathy with or in support of any foreign or domestic organization, association, movement, or group, which unlawfully advocates or practices the commission of acts of force or violence to prevent others from exercising their rights under the Constitution of the United States.
>
> 5. Deliberately misrepresented, falsified, or omitted relevant and material facts from or in a security questionnaire, a personal qualification statement, or a personnel security interview.
>
> 6. Willfully violated or disregarded security regulations or was grossly negligent with respect thereto to a degree which could endanger the common defense and security; or by intention disclosed

restricted data or national security information to any person not authorized to receive it.

7. Has any illness or mental condition which in the opinion of competent medical authority may cause significant defect in judgment or reliability of the individual.

8. Has been convicted of crimes indicating habitual criminal tendencies.

9. Has been convicted of a crime or has a background, where the facts, circumstances, or conduct are of a nature indicating poor judgment, unreliability, or untrustworthiness.

10. Is a user of alcohol habitually to excess, or has been such without adequate evidence of rehabilitation.

11. Has been, or is, a user of a drug such as amphetamines, barbiturates, narcotics, etc., except as prescribed by a physician, without adequate evidence of rehabilitation.

12. Refused, without satisfactory explanation, to answer questions before a congressional committee, Federal or state court, or Federal administrative body including the NRC regarding charges relevant to the individual's eligibility for access authorization and/or employment clearance.

13. Engaged in any other conduct or is subject to any other circumstances which tend to show that the individual is not reliable or trustworthy, or which furnishes reason to believe that the individual may be subject to coercion, influence, or pressures which may cause the individual to act contrary to the national interest.[15]

After employment and access authorization have been determined, the NRC's process for determining continued reliability is termed, "Fitness For Duty Programs." These programs are the responsibility of each individual licensee, who must model them after Part 26 of 10 Code of Federal

Regulations. General performance objectives in fitness-for-duty programs must:

> a. Provide reasonable assurance that nuclear power plant personnel will perform their tasks in a reliable and trustworthy manner and are not under the influence of any substance, legal or illegal, or mentally or physically impaired from any cause, which in any way affects their ability to safely and competently perform their duties.
>
> b. Provide reasonable measures for the early detection of persons who are not fit to perform activities within the scope of this Part; and
>
> c. Have a goal of achieving a drug free workplace and a workplace free of the effects of such substances.[16]

Almost entirely contained within Part 26 are procedures for operating a random drug testing program, as well as providing confirmation procedures for assuring positive results. There is very little language that relates to specifics in determining kinds of behavior resulting from personal problems other than drug and alcohol abuse. In 26:22 it states that, "Supervisors and escorts must be trained in behavioral observation techniques for detecting degradation in performance, impairment, or changes in employee behavior."[17] Appropriate corrective action will include referral to an employee assistance program.

U.S. Air Force's Personnel Reliability Program

Information for this section has been obtained exclusively from U.S. Air Force Regulation 35-99, the Nuclear

Weapons Personnel Reliability Program (PRP). The stated program goals are:

> Establish the requirements and responsibilities for screening, selecting, and continuously evaluating all personnel who control, handle, control the launch of, or control entry to nuclear weapons or nuclear weapons systems. It provides for the selection and retention of personnel who are emotionally stable and have demonstrated good judgment and professional competence. It also provides guidance for the removal of all individuals of questionable reliability.[18]

The Air Force regulation is the governing body for establishing requirements under PRP. Major commands, such as the Strategic Air Command, United States Air Forces in Europe, and Pacific Air Force, can supplement the basic regulation by adding more stringent requirements, but they can't detract from it. The same is true of individual base supplements within those commands.

There are many different levels of inspection for compliance at the base level. The top two inspections are the Nuclear Surity Inspection, completed by Air Force Headquarters, and the Defense Nuclear Surity Inspection, performed by nuclear inspectors from all four branches of the service. A major inspection is conducted every eighteen months to two years. During these inspections, all facets of a base nuclear weapons program is inspected, including strict compliance with PRP directives.

There are many different Air Force missions and weapons systems with many bases having absolutely no responsibility for nuclear weapons. For installations which do, however, the

personnel screening is initiated when a person is identified for a permanent change of station to a location with a nuclear weapons mission. The previous duty assignment could be basic military training, a technical school, or another base within the Air Force.

The reliability screening process begins with a check of one's medical and personnel records. Investigations are completed with a specific focus on the particular job that will be performed by the candidate. Projected duty functions are divided into two different PRP positions, critical and controlled.

A critical PRP position is one in which a person will be working in close proximity to nuclear weapons and in which he or she has gained a technical knowledge relating to launch, release, or detonation functions. This also includes the following command elements: missile launch control officers, nuclear capable aircraft commanders, and general officers with deployment authority. These individuals must have a background investigation completed before certification.

A controlled PRP position applies to such jobs as security personnel and aircrew members, whose assignment requires proximity to nuclear weapons systems, but does not require technical knowledge, or ability to launch, release, or detonate the weapons system.[17] These individuals must have a favorable National Agency Check, Entrance National Agency

Check, or higher investigation completed before final certification.

As prescribed in AF 35-99, the commander of each individual unit has the final responsibility for the reliability program in his or her unit. Assistance is received, however, from individuals responsible for the following base level functions:

-The Consolidated Base Personnel Office: Reviews preenlistment documents and reports all potential PRP disqualifying information to member's commander. Monitors unit compliance in completing certification requirements. Monitors personnel actions on individuals that have been decertified. Provides liaison, coordinates, and disseminates information with other units and staff agencies.

-Director of Base Medical Services: Evaluates member's health records as necessary. Notifies unit commander when the member's reliability may be impaired because of illness, injury, or medical, dental, or psychiatric treatment.

-Individual and Supervisor: Individuals assigned to PRP duties have the responsibility to monitor their own reliability. They should be aware that certain problems, concerns, and circumstances may reduce work effectiveness. Individuals must advise supervisors of all factors that could have an adverse impact on performance and safety. Supervisors have the responsibility to monitor the reliability of

subordinates and notify their commander of all potentially disqualifying information.[19]

As previously mentioned, the unit commander has the uppermost responsibility in managing the Personnel Reliability Program. He or she makes the final determination if someone is to be allowed to be certified, or decertified, under PRP. The commander must arrive at a "best judgment" of individual reliability. This requires input from supervisors, medical personnel, security police, and the base personnel office.[21] Initial certification by the commander must be based on a personal interview and a review of events in the individual's past history. These events might include:

> 1. Dependability in accepting responsibility.
> 2. Carrying out duties effectively and in an approved manner.
> 3. Flexibility in adjusting to changes in the work environment.
> 4. Good social adjustment and emotional stability.
> 5. Ability to use good judgement in meeting adverse or emergency situations.[22]

For personnel who have been in the military for at least one previous assignment, this type of information can be obtained from personnel records, performance reports, letters of reprimand contained in an unfavorable information file, and inquiries made to the previous commanding officer.

After certification, continued reliability is best judged by daily observation of one's work performance by peers and the immediate supervisor. Sources of information which are

available to the commander on a daily basis include the following:

> 1. Medical notification of illness, injury, or treatment that could affect duty performance.
> 2. The unfavorable information file.
> 3. Being the subject or suspect in an Office of Special Investigations or security police report.
> 4. Observations of coworkers.
> 5. Comments by the individual, or his or her dependents.[23]

If there are perceived problems in personality and behavior factors that may affect reliability, that creates commander doubt, a medical evaluation is appropriate.

If problems with an individual's reliability do arise, there are several courses of action available to a commander. The following are the three basic categories used when removing someone from PRP duties:

Suspension - May be initiated by the member, a supervisor, or the commander for a period not exceeding 45 days. The reasons can include any of the following: taking of medication for illness, investigation into alleged wrongdoing, or for personal problems.

Temporary Decertification - Initiated by the commander when additional time is needed to complete evaluation, or a situation is serious enough to warrant formal action. The time period for temporary decertification should not exceed 180 days, although an extension can be granted.

Permanent Decertification - This is formal action taken by a commander, and it often requires additional personnel

actions (such as retraining, reclassification, or separation from service).[24]

In comparing the human reliability programs of the NRC and the Air Force, much of the wording of regulations and goals are very similar. Both programs deal with the selection of only the most qualified individuals who exhibit outstanding standards in reliability and trustworthiness. Both organizations, however, are realists and understand that human reliability can be minimized by numerous internal and external psychological factors. To combat this effect, the Nuclear Regulatory Commission and the Air Force have implemented programs which provide for observation, identification, and correction of unacceptable behavior committed by employees.

A question of major importance is this: "Can troubled individuals be identified before they become involved in an act which might be detrimental to public health and safety?" Several of the following Air Force experiences will highlight some potential problem areas, within the Personnel Reliability Program, that weren't immediately rectified because of problems associated with the system, or with individuals.

-An Airman was decertified, then discharged for marijuana use. Over the course of the investigation, it was learned that this individual had fraudulently enlisted by not disclosing that she had failed an alcohol rehabilitation program prior to enlistment. The background check had not found this fact.

-An individual on PRP was treated by mental health personnel for marital problems. It was discovered that the person had made suicidal gestures, as a teenager, and had received over two years of psychiatric treatment. This information had not been revealed during the background investigation.

-A Staff Sergeant, with almost ten years under PRP, was experiencing marital problems. While on duty as a flight security controller, where he was directing response forces within a Minuteman missile field, he demanded to be returned home in order to check up on his wife. When he was told this couldn't be accomplished, he aimed his own M-16 rifle at his head and exclaimed, "What do I have do to, shoot myself in the head to go home?" After psychological counselling the following week, he returned to work under PRP.

-An Airman was found to be over $23,000 in debt from credit cards and bad checks. During the six months of his spending episode, he was working in support of nuclear weapons.

-An Airman under PRP was caught after an on-duty theft of a base exchange concessionaire. Further investigation revealed many thefts over a several-month period.

-A nuclear missile launch control officer in North Dakota was supplementing his income by committing bank robberies during his off-duty time. After several robberies, he was

identified and arrested because of the highly shined military shoes that he wore during the robberies.[25]

The previous examples illustrate the difficulty associated with determining whether individual reliability can be determined by day-to-day observations. Even in the military, where commanders and first sergeants are charged with knowing their personnel's whereabouts and habits whether off duty or on duty, predicting deviant behavior remains as difficult a task as is noted when attempting to study causation in criminology.

The main issue, from a management, command, or psychological perspective, is how to determine what form of behavior is acceptable and how wide is the range of tolerated behavior. This leads to the problem of how to staff all necessary posts on a daily basis when human reliability regulations are rigidly enforced. As in security duties, one AF regulation dictates the number of personnel needed to adequately protect nuclear weapons or facilities, while AF 35-99 states, "...members with personal problems should be temporarily suspended from PRP duties."[26]

The process of selecting and training qualified personnel is extensive and costly to an agency. Job satisfaction is as important in maintaining reliability as is personal problem identification. Many of the work assignments associated with nuclear power and weaponry are very repetitive and uninteresting. Security workers, reactor controllers, and

launch control officers often find themselves in reactive modes, waiting for a potential crisis situation. These factors, when combined with a high-stress occupation, can lead to serious problems associated with ensuring worker reliability in the nuclear power industry.

Notes

[1] U.S. Nuclear Regulatory Commission, Fact Sheet (Washington: GPO, 1990): 1.

[2] Ibid.

[3] Ibid., 7.

[4] U.S. Federal Register, Rules and Regulations 56, no. 00 (Washington: GPO, 1991): 18997.

[5] Ibid., 18999.

[6] Ibid., 18997.

[7] Ibid., 18999.

[8] Ibid.

[9] Ibid.

[10] Ibid., 19000.

[11] Ibid.

[12] Ibid.

[13] Ibid., 19002.

[14] Ibid., 19003.

[15] U.S. Code of Federal Regulations, Title 10, Energy (Washington: GPO, 1991): 258.

[16] Ibid., 351.

[17] Ibid.

[18] U.S. Air Force Regulation 35-99, Nuclear Weapons Personnel Reliability Program (Washington: Headquarters, U.S. Air Force, 1987): 1.

[19] Ibid., 17.

[20] Ibid., 7.

[21] Ibid., 9.

[22] Ibid.

[23] Ibid., 10.

[24] Ibid., 41.

[25] Erich Spranger, interview with author, 15 May 1991.

[26] U.S. Air Force Regulation 35-99, op. cit., 40.

CHAPTER 4

Summary, Conclusions, Recommendations

Summary

In an industry established less than fifty years ago, there have been myriad problems affecting public perception and security in nuclear weaponry and power. The Hiroshima and Nagasaki bombings brought a level of mass destruction previously unknown in modern civilization, but nuclear weapon proponents have suggested that this action brought an earlier end to World War II. The beginning of the nuclear weapons testing era was viewed as an important stage in the development of more efficient weapons. Then, beginning in the early 1960s, the earlier pattern of public acceptance began to erode. Scientists, as well as the nation, became more informed about the negative health effects of long-term exposure to radiological fallout. Public fear escalated because Soviet weapons capabilities seemed to be matching, or exceeding, the United States' nuclear weapons arena. Today, with the perceived disintegration of the "Iron Curtain," many Americans still oppose the fact that nuclear weaponry seems infinitely more powerful and plentiful than ever before.

Perceptions of nuclear-generated electrical power have been a little more equally divided among the American public. From the beginning, nuclear energy was proclaimed to be less expensive, cleaner burning, and safe. Even so, there were two groups of skeptics. Some scientists and engineers disagreed

with the safety aspects of containment and disposal. Other members of the public, through lack of understanding, equated nuclear power with nuclear weaponry. Currently, public acceptance of issues in nuclear power is a two-edged sword. On the one side, there is public realization that increased power demands are needed to maintain a routine lifestyle. Pro-nuclear energy arguments include the fact that fossil fuels are becoming harder to obtain, and their continued use promotes immeasurable harm to the environment. On the other side, there are the negative images of Three Mile Island, Chernobyl, and other potentially catastrophic nuclear accidents which are portrayed to the public in a negative manner by the media.

Any history of crimes committed against the nuclear industry reveals an interesting evolution in which certain forms of crime have been replaced by others, although not totally so. As with any new technology, spying was the crime of choice in the 1940s to early 1950s. The motives for these crimes might have been monetary gain or more complex ideological allegiances which prompted the resultant deviant behavior.

As more was known about the hazards of nuclear development, peace and anti-nuclear activists formed organizations which aimed to disrupt nuclear tests and halt progress in this new area of scientific knowledge. Many opposition groups remain active today; however, their current

methods of protesting do not outwardly pose a threat to the public from acts which might disrupt facility operations and cause radiological contamination.

The increase in international terrorism in the 1970s caused nuclear security planners to prepare their industry for a "worst possible scenario," directed against specific nations, facilities, or individuals within the industry. Experts in terrorism were certain that a terrorist organization might steal enough fissionable material to build a nuclear bomb. The possible threat of an entire country being held hostage had a chilling effect on the nuclear power industry, which quickly mobilized to develop the effective security procedures and systems being used today.

Even the most effective physical security systems available cannot protect the nuclear industry from the threat of insider crime. Security systems are able to be neutralized or bypassed because a working knowledge of systems and components is readily available to interested persons. Insider crime is sure to be the main focus of security managers into the next century.

Conclusion

There have been few major crimes directed against nuclear power facilities in the United States. Losses have been slight when compared to the millions of dollars the nuclear industry has lost in other countries, such as Spain. Security in the United States is obviously adequate and serves as a

deterrent against all but the most minor forms of insider crime. Criminal incidents involving vandalism, arson, and sabotage have steadily increased in civilian nuclear power plants in this country during the past fifteen years.[1] Fortunately, actual damage to facilities has been minimal and public confidence in existing security procedures remains high at this time.

This has not created a false sense of confidence among security planners. Efforts to create a viable, pro-active approach to the problem of insider crime is proceeding with the same success that was noted in the antiterrorism work of the 1970s and 1980s.[2] The U.S. Air Force and Nuclear Regulatory Commission programs in dealing with human reliability are effective, but improvements are still being sought by the industry. The U.S. Department of Energy is aware of these needs and has enlisted the help of organizations such as the RAND Corporation, a highly respected think-tank, to study the problems and possible solutions associated with the aforementioned issues.

The RAND Corporation studies and reports on insider crime offer valuable insight into the complex motivations and methods used by the insider criminal. Most of the empirical work produced by RAND has resulted from the study of insider crime distributed among many different types of occupations. The end result has been an increased understanding of the methods and motivations behind the insider criminal.

Other pro-active efforts which attempt to minimize insider crime include computer-generated evaluations of nuclear facility physical security effectiveness, which have been conducted since the early 1980s. Recently, several of the more effective programs, developed for the Defense Nuclear Agency, have defined the insider criminal as a potential adversary.[3] The Nuclear Regulatory Commission has also contracted with the U.S. Army to provide "live" intruder and insider scenarios in exercises conducted at nuclear power plants.[4]

Although this country has avoided serious damage to a nuclear facility as a result of insider crime, the potential for danger remains present. More sobering is the possibility that the insider might team up with a professional criminal element or terrorist group and commit a crime with disastrous consequences to a nuclear facility. This combination of criminals would certainly utilize the opportunity, technical knowledge, and desire necessary to make the term "worst case scenario" into a fearful and destructive reality.

Recommendations

This section is best divided into the following four sub-sections: pre-certification investigations, mental health evaluations, observing daily duty performance, and areas requiring further study.

Pre-certification Investigations - The NRC and the Air Force do not mandate local agency checks, but doing so could

serve as a valuable supplement to FBI investigative inquiries and the National Agency Check. More effort should be made in validating application references provided, as well as those applicant acquaintances discovered in the course of a background investigation. The Air Force, Office of Special Investigations, used to personally interview all individuals referred as references; however, that is no longer the policy. These interviews should become an integral part of the background investigation, because they are more reliable than records reviews alone.

Mental Health Evaluations - The NRC has successfully prescribed psychological testing in an effort to provide findings useful to the licensee access authorization programs. Most of the licensees continue to use the Minnesota Multiphasic Personality Inventory (MMPI), although the use of other psychological tests is not discouraged. Phil McKee, Chief, Reactor Safeguards Branch, Nuclear Regulatory Commission, reports that, "The MMPI is still the primary vehicle used by licensees for psychological testing. Particular types of psychological testing, as opposed to others, are not regulated...There is also no current provision for the NRC to inspect testing procedures or how the results are handled."[5]

The Air Force does not presently identify a specific battery of psychological tests to be administered to those who will be working within the Personal Reliability Program.

Prior to certification, an Air Force member may merely be subjected to a brief interview, conducted by an unlicensed administrative assistant in a mental health department. Questions such as, "Do you like it here?" and "What do you think about your job?" are alone not questions which adequately contribute to a valid psychological profile.

It is recommended that the NRC include two or three standardized psychological tests among the licensees. Furthermore, results should be reviewed by a second licensed psychologist working with the NRC.

The Air Force should implement psychological testing for Personnel Reliability Program applicants. The current psychological testing program remains reactionary in nature and unacceptable when compared to the risks involved. One Air Force psychologist has remarked, "If we catch anyone in the initial screening process, it is by luck only. It really doesn't happen very often."[6]

Finally, when psychological testing is uniformly employed by both these agencies, it is important to adopt procedures requiring periodic re-testing, followed by a second opinion conducted by a licensed psychologist or psychiatrist.

Observing Daily Duty Performance - The major problem facing Air Force commanders and supervisory personnel within both these organizations continues to be the ambiguous wording found in regulations concerning reliability. Generalized, faulty interpretations emanate from phrases such as, "Provide

reasonable assurance that nuclear power plant personnel will perform tasks in a reliable and trustworthy manner...and are not physically or mentally impaired from any cause,"[7] and "Individuals must advise supervisors of all factors...that could have an impact on their performance and safety."[8]

There are currently no valid guidelines for use when identifying personal problems and referring employees for mental health services. It is correct to state that treatment programs are available in a referral basis, but it is the responsibility of the supervisor to determine the presence of employee stress, such as marital problems or emotional problems affecting performance. It is known that many supervisors feel a more pressing need to maintain fully staffed positions on duty rosters, rather than to adequately identify the personal problems of subordinates.

In the Air Force, PRP is the final decision of the commander. This policy, while satisfactory, should be restructured by improving the procedures which focus on suspending and temporarily decertifying someone under PRP. Most commanders value the input received from organizations such as the base medical facility, social actions (social services), and personnel departments. However, others are unable to utilize relevant information from such diverse sources. Regulations should provide for the review of all suspensions and temporary decertifications by the base, or wing commander. These individuals usually have twenty years

or more of service and find it easier to ..e counsel and referral sources to meet the best interests of the Air Force.

A second opinion would also enhance and validate a mental health or psychiatric determination which has already been made by a mental health professional. In the Air Force, base level psychological and psychiatric determinations should always be reviewed by mental health personnel at either of the next two higher levels of command within the Air Force. For civilian nuclear power plant licensees, a second professional opinion would serve the best interests of the employee, plant security, and public safety.

Areas Requiring Further Study - If the public could be assured that no future incidents or accidents would occur within the nuclear power industry, nuclear energy might eventually be held in much higher regard than it is at present. This does not mean that the industry should falsely claim that a "fail-safe" system is possible.

An important issue requiring further research is one which explores the impact of public opinion on workers within the nuclear power industry. Studies should be undertaken which attempt to validate related studies that conclude that negative publicity can change attitudes and beliefs, and thereby change behavior.

An experimental research design could utilize the random selection of a control and an experimental group from outside the nuclear power career field. This would prevent expected

findings from degrading the security of any nuclear plant or complex. Membership in the two groups should as closely as possible resemble the crafts and knowledge existing within the field of nuclear power generation.

The hypothesis should relate to: "Workers in the nuclear power industry being more likely to engage in insider crime if exposed to increased amounts of the negative aspects of their profession, through different types of media."

The independent variable would relate to the experimental group being saturated with classroom instruction dealing with all hazards associated with nuclear power, weapons production, and hazardous waste disposal. The training should be designed to promote the negative aspects of these areas just as if a serious accident or incident was drawing national media attention.

The dependent variable would be the possible changes in attitudes and actions between the experimental and control groups. A pre-test and post-test, separated by six months of experimental group instruction, would be developed around the one used by Gardner, et al. Specifically, the primary measure would be self-reported actions toward nuclear power. Additionally, the testing should involve a modified Hostility and Aggression Scale (Green and Santori, 1969). This scale would "reflect a wide range of values concerning social behavior."[9]

Although changes in belief and attitude do not automatically create changes in behavior, the experimental group should show a definite increase in personal actions taken against nuclear power.

If nuclear security managers can continue seeking to understand the motives of the insider criminal, then alternate means for reducing the likelihood of such actions will become increasingly clear. To accomplish this, great strides will have to be made in industrial and organizational psychology. Future employee "re-bluing" programs may be needed to augment in-depth supervisory interviews and off-duty involvement with employees. Hopefully, there will be increased team cohesion, resulting in more job satisfaction and a lower rate of insider crime against the nuclear facility.

Notes

[1] U.S. Nuclear Regulatory Commission, Safeguards Summary Events List, Revision 16 (Washington: GPO, 1990): Figure 1.

[2] Doug Schuster, interview with author, 20 June 1991.

[3] R & D Associates, Current Methods For Evaluation of Physical Security System Effectiveness (Arlington: R & D Associates, 1981): 7.

[4] Schuster, loc. cit.

[5] Phil McKee, telephone interview with author, 16 July 1991.

[6] Howard Roe, interview with author, 16 June 1991.

[7] U.S. Code of Federal Regulations, title 10 Energy (Washington: GPO, 1991): 350.

[8] U.S. Air Force, AF Regulation 35-99, Nuclear Weapons Reliability Program (Washington: Headquarters US Air Force, 1987): 7.

[9] Stanley L. Broadsky and H. O'Neal Smitherman, eds., Handbook of Scales for Research in Crime and Delinquency (New York: Plenum Press, 1983): 355.

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