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Fitness for Duty in the Nuclear Power Industry: A Review of Technical Issues

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Pacific Northwest Laboratory

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ABSTRACT

This report presents information gathered and analyzed in support of the United States Nuclear Regulatory Commission's (NRC's) efforts to develop a rule that will ensure that workers with unescorted access to protected areas in nuclear power plants are fit for duty. The primary potential fitness-for-duty concern addressed in the report is impairment caused by substance abuse, although other sources of impairment on the job are discussed.

The report examines the prevalence of fitness-for-duty problems and discusses the use and effects of illicit drugs, prescription drugs, over-the-counter preparations and alcohol. The ways in which fitness-for-duty concerns are being addressed in both public- and private-sector industries are reviewed, and a description is provided of fitness-for-duty practices in six organizations that, like the nuclear industry, are regulated and whose operations can affect public health and safety. Methods of ensuring fitness for duty in the nuclear industry are examined in detail. The report also addresses methods of evaluating the effectiveness of fitness-for-duty programs in the nuclear power industry.

EXECUTIVE SUMMARY

This report presents information gathered and analyzed to support the Nuclear Regulatory Commission (NRC) in its effort to develop a rule that will ensure that workers with unescorted access to protected areas in nuclear power plants are fit for duty. The primary threats to fitness for duty are drug and alcohol abuse. Emotional problems and job-related stress can also affect fitness for duty.

The NRC has been concerned with fitness-for-duty issues since the late 1970s. In 1982 the NRC required licensees to develop fitness-for-duty programs. To encourage licensees to develop individual programs, the NRC postponed implementation of a fitness-for-duty rule. Due to inconsistencies in licensees' individual standards and programs, however, on December 16, 1987, the NRC requested its staff to prepare a fitness-for-duty rule. The findings in this report suggest that such a fitness-for-duty rule should require properly implemented random, for-cause, and pre-employment drug screening. The findings also suggest that the rule should require licensees to establish employee assistance programs, maintain proper workplace security and access authorization programs, and ensure that supervisors receive adequate training on fitness-for-duty issues.

The need for fitness-for-duty programs in the nuclear power industry arises from reported incidents of substance abuse among nuclear industries and the research literature that suggests that substance abuse problems are widespread in the U.S. workforce. There are currently no data to suggest that these problems are any less severe in the U.S. nuclear power industry. Approximately 10% of the U.S. workforce has a drug- or alcohol-abuse problem; other estimates range as high as 23%. An additional 10% to 15% of the workforce is affected by a family member's substance abuse habit. A series of surveys of drug abuse in the workplace conducted by Schrier (1987) showed that private and public sector organizations reporting incidents of drug abuse increased from 36% in 1971 to 95% in 1986. Drug abuse costs the U.S. economy an estimated 120 billion dollars annually. Substances that are abused include marijuana, cocaine, opiates, phencyclidine, amphetamines, alcohol, prescription sedatives, and over-the-counter preparations that contain these substances in small amounts.

In addition to substance abuse, psychological disorders and job-related stress can impair performance on the job. Estimates of the proportion of workers affected by psychological disorders range from 5% to 25%. Job-related stress, which has been linked to many types of diseases, can also affect fitness for duty. These problems can lead to accidents, reduce productivity and increase absenteeism.

Many public- and private-sector organizations are in the process of developing fitness-for-duty programs. The Department of Defense subjects its civilian and military employees to the most extensive fitness-for-duty program currently in existence; all military employees on active duty are subject to mandatory random testing. Various branches of the Department of Transportation (e.g., the Federal Railway Administration) also require drug

testing. Private companies are adopting policies involving drug testing, assistance programs for employees with substance abuse problems, or both.

There are a number of alternative approaches to assuring fitness for duty in the nuclear power industry. These approaches include the following:

- No Additional Action - The NRC may choose to take no additional action regarding fitness for duty. The prevalence of drugs in the U.S. workplace and the potential danger resulting from drug abuse at a nuclear power plant indicate that this is not a suitable course of action.

- Random Drug Testing - Frequent random drug testing appears to be effective in detecting and deterring substance abuse. Data from the U.S. Armed Forces indicate that drug abuse decreases as test frequency increases.

- Pre-Employment Screening - Job applicants can be tested prior to hiring. Although this approach may keep drug abusers out of the workplace, it has its disadvantages: (1) pre-employment screening will not reveal psychological disabilities or other stressors that might cause impairment; (2) abusers could avoid detection by abstaining long enough before the test to ensure a clean sample; and (3) pre-employment screening will not detect abuse problems with existing workers and will not deter drug use in the same manner as random testing.

- Announced, Periodic Testing - Announced, periodic testing has few, if any, advantages over random testing and has all of the disadvantages of random testing, as well as additional disadvantages. Users could avoid detection by abstaining from the substance for a sufficient period of time prior to the test. None of the companies surveyed for this report use announced, periodic testing.

- For-Cause Testing - If an organization has reason to believe that an employee is impaired, a drug test could be administered at that time. A for-cause testing program has advantages over random testing in certain cases, primarily because the program targets persons who appear to be impaired. However, if supervisors are unable to identify impaired employees, tests might not be administered until an accident has occurred.

- Employee Assistance Programs (EAPs) - EAPs provide professional assistance to employees whose performance is impaired. The primary advantages of EAPs are that they respond directly to impairment and that they can also be used in instances where impairment does not result from substance abuse. Even with drug-testing programs in place, EAPs can play a significant role in the identification and management of troubled employees. An EAP should be supported by management and unions, should be well known among employees, should have a well-trained supervisory staff, should be supported by adequate financial resources, should be compatible with the company's health insurance plans, and should be evaluated with a formal process.

- Access Authorization Programs - The NRC is considering promulgating an access authorization program that would require that personnel with unescorted access be subject to background investigations, psychological assessments, and on-going behavioral observation. These programs alone are not an effective deterrent to substance abuse once access authorization is granted and do not provide for an objective assessment of substance abuse (e.g., drug testing).

- Supervisory Observation - Properly trained supervisors can identify fitness-for-duty problems. While this can be a useful means of detecting impaired employees, a supervisory observation program alone is not an effective means of assuring fitness for duty. However, because supervisors are the first line of defense against fitness-for-duty problems, it is important that they be trained to recognize these problems and handle them appropriately.

- Medical Screening - Employees can be medically screened for signs of substance abuse, either when hired or on a for-cause basis. Although medical screening could detect impairment due to other medical causes, it does not seem to be an effective deterrent to substance abuse.

- Workplace Security Measures - These measures include searches by dogs trained to detect drugs and searches of employees (usually when arriving at the site) and their possessions. These searches would likely discourage drug use and sales at the site; however, they will not detect impaired persons.

- Employee Awareness and Education Programs - As an adjunct to other approaches to fitness for duty, employee awareness and education can contribute to a drug- and alcohol-free workplace.

A drug-testing program, probably a combination of random, pre-employment, and for-cause testing, is a crucial aspect of a fitness-for-duty program. The most common and accurate method of drug testing is urinalysis. Drug testing procedures should consist of an initial test and a more sensitive and specific confirmatory test that is administered to confirm initial positive test results.

To be accurate, effective, and fair, a drug-testing policy must recognize and address the social and technical limitations of drug testing. Drug tests must be conducted accurately and under stringent quality-control procedures. Proper cut-off levels must be set that will detect those who have used drugs but will not yield positive results for cross-reacting substances. Furthermore, drug levels in the urine are not directly correlated to impairment. Finally, drug testing is seen by many as intrusive and an invasion of privacy. These and other drawbacks of drug testing should be avoided if licensees follow the guidelines developed by the U.S. Department of Health and Human Services.

Several new techniques to detect impaired persons are being developed. These techniques include blood, saliva, and hair analyses, as well as behavioral and psychological testing. Field sobriety tests, which are administered by a

police officer to a motorist suspected of drinking and driving, are a basic behavioral testing technique. More advanced tests are given in some police departments by specially trained officers, known as drug recognition experts (DREs) who are trained to recognize impairment and to determine the type of substance abused. None of these techniques are sufficiently developed yet to replace urine testing for drug use.

If an individual is deemed unfit for duty, the individual should be referred to an EAP and access to protected areas should be revoked until the worker is fit for duty. Abusers of all substances are prone to relapse. Consequently, if access is revoked on the basis of a positive drug test result, a two-week evaluation period would be adequate for trained personnel to assess the individual to determine the nature and severity of the substance abuse problem and to develop a plan for treatment and future employment.

Continuing evaluation of a fitness-for-duty program's effectiveness is essential for assuring that licensees' fitness-for-duty programs are effective. Indicators that focus specifically on the extent of fitness-for-duty problems seem to be the most important elements in a valid and reliable evaluation system.

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1.0 INTRODUCTION

In response to the growing need to assure the public that nuclear power plant workers with unescorted access to protected areas in nuclear power plants are always fit for duty, the United States Nuclear Regulatory Commission (NRC) has been working to develop a fitness-for-duty rule. This report presents information gathered and analyzed to support the NRC's rulemaking activities as part of a project conducted by staff of the Department of Energy's Pacific Northwest Laboratory (PNL) and Battelle's Human Affairs Research Centers (HARC). Although fitness for duty encompasses a wide range of potentially impairing substances and conditions, the emphasis of both the proposed rule and the work documented here is on designing a rule primarily to deter and detect employee impairment from the abuse of illicit drugs by individuals with unescorted access to protected areas in nuclear power plants. Impairment caused by alcohol abuse and psychological problems are also of concern.

1.1 BACKGROUND

Since the late 1970s, the NRC has been concerned with the potential threat to public health and safety created by drug and alcohol abuse among employees in the nuclear industry. On August 5, 1982, the Commission published for comment a proposed rule requiring licensees to develop and implement written fitness-for-duty procedures (47 FR 33980, 1982). Subsequently, the nuclear power industry made significant progress in implementing self-managed fitness-for-duty programs. To encourage such self-improvement, the Commission decided to defer implementation of the proposed rule. It was determined that the industry should be given further opportunity to develop fitness-for-duty programs, and the need for a rule was to be re-evaluated at a later date on the basis of the progress demonstrated by the industry.

A policy statement summarizing these conclusions was issued on August 4, 1986 (51 FR 27921, 1985). On December 1, 1987, the Nuclear Utility Management and Resources Council (NUMARC) and the NRC staff briefed the Commission on the progress made by the nuclear power industry in implementing programs consistent with the Commission's fitness-for-duty policy statement. Although the Commission recognized that the industry had made considerable progress in addressing fitness-for-duty concerns, the Commission also noted some inconsistencies in the licensees' standards and programs. On December 16, 1987, the NRC staff was requested to prepare a proposed fitness-for-duty rule. Information used by the NRC staff in forming this rule included the comments received under the 1982 proposed rulemaking and the comments received in response to the 1986 policy statement. The staff also considered industry experience reported to the Commission, together with lessons learned by the staff from evaluating the effectiveness of licensee fitness-for-duty programs, from assessing reported drug-related incidents, and from studying similar rules being developed by other agencies. It was also determined that further information from a variety of fields would be needed to provide the technical basis for an effective rule. This report summarizes the information developed and collected by PNL and HARC and provided to the NRC under the contract "Develop Techniques to Evaluate Fitness-for-Duty Programs," FIN I2007.

1.2 PURPOSE AND ORGANIZATION OF THIS REPORT

This report presents the information gathered and analyzed to support the NRC staff in its preparation of a draft fitness-for-duty rule. The report is divided into nine sections. Section 2.0 describes the nature and significance of fitness-for-duty problems across the United States and in the nuclear industry. Section 3.0 discusses current and proposed programs to address fitness-for-duty problems in the public and private sectors. Section 4.0 discusses several approaches to assuring the fitness of workers in nuclear power plants. Section 5.0 addresses technical issues central to a fitness-for-duty rule that requires drug and alcohol testing. Section 6.0 discusses the key elements of employee assistance programs. Section 7.0 discusses issues related to developing plans for treatment and for the future employment of workers who have received a confirmed positive drug test result. Section 8.0 describes methods of measuring the effectiveness of fitness-for-duty programs. Section 9.0 provides a summary of recommendations for consideration in developing a fitness-for-duty rule. The methods used in gathering the information presented in this report are described in Appendix A.

2.0 EXTENT OF FITNESS-FOR-DUTY PROBLEMS

Of primary concern to the NRC is the safe operation of nuclear power plants and the impact of substance use and other employee personal problems on safe operations. The illegal use of drugs and misuse of alcohol and prescription drugs, as well as the behaviors associated with other types of personal problems, can represent significant threats to workplace safety for the workers in nuclear power plants, and may place public health and safety at risk.

In recognition of the growing incidence of substance abuse problems in the workplace across the U.S., and in response to several incidents involving the use, sale, and possession of illicit drugs at nuclear power plants, the NRC sponsored a study of trends in alcohol and drug abuse in the nuclear industry to assess the need for a fitness-for-duty rule. The results of that study, conducted in 1982, were published in NUREG/CR-3196, Drug and Alcohol Abuse: The Bases for Employee Assistance Programs in the Nuclear Utility Industry (Radford, Rankin, Barnes, McGuire, and Hope, 1983), and indicated that substance abuse was likely to be an increasingly serious problem in nuclear power plants.

Since completion of the NRC study, licensees have implemented or upgraded their programs to aggressively address fitness-for-duty problems. However, further incidents with illegal drugs involving workers at nuclear power plants have occurred and, as will be discussed in this section, the prevalence of substance abuse in the U.S. workforce has continued to increase.

In this section, the need for further action to address fitness-for-duty problems is examined in three ways and the scope of concern is discussed. First, the recent literature documenting the extent of substance abuse problems among workers is briefly reviewed. Second, several studies of the incidence and effects on job performance of other types of employee problems are presented. Third, recent studies of impairment resulting from the use of various types of licit and illicit substances are briefly discussed.

2.1 SUBSTANCE ABUSE PROBLEMS IN THE U.S. WORKFORCE

Concurrent estimations by the National Academy of Sciences, the National Institute on Drug Abuse (NIDA), and the National Institute on Alcohol Abuse and Alcoholism suggest that approximately 10% of the U.S. workforce is afflicted with an alcohol or drug abuse problem (Saxe, Dougherty, Esty, and Fine, 1983). An additional 10% to 15% of U.S. workers are estimated to be affected by the substance abuse of an immediate family member (Wrich, 1988). Studies have primarily focused on identifying the extent of alcohol abuse and alcoholism within our society, and consequently, the full extent of the combined substance abuse problem is generally considered to be underestimated (Spicer and Owen, 1985). However, a recent NIDA survey indicates that among 18- to 25-year-olds, the population now entering the work force, 65% have used illicit drugs, with 44% using illicit drugs within the last year (Wrich, 1988). Some sources estimate the percentage of U.S. workers who use drugs on the job to be as high as 23% (Castro, 1986).

Estimates of the economic costs to the nation from substance abuse vary, but all estimates are extremely high. The Research Triangle Institute estimates the figure to be $117 billion annually (Spicer and Owens, 1985), while the Office of Technology Assessment estimates the figure as closer to $120 billion annually (Saxe et al., 1983). These estimates take into account factors such as lost productivity, medical expenses, absenteeism, accidents, theft, property damage, security measures, and workers' compensation, although the apportionment of $100 billion annually to lost productivity is most significant (Spicer and Owens, 1985; Wrich, 1988).

The use of drugs in the workplace reflects general drug use patterns in the U.S. Although use of marijuana appears to be declining (U.S. HHS, 1987), recent reports by NIDA (Community Epidemiology Work Group Conference, 1987) document increased drug use in several drug categories. For example, cocaine use has continued to increase over the past few years, and several U.S. cities report continued and increasing abuse of heroin. There is also a growing concern with an increase in the use of phencyclidine (PCP) (U.S. HHS, 1987).

Many U.S. companies report problems with employee drug abuse, and the prevalence of these problems appears to have increased over the past fifteen years. Schreier (1983, 1987) conducted a series of surveys to track the prevalence of substance abuse in the workplace. He surveyed from 75 to 141 companies representing various industries and found that the companies reporting incidents of drug abuse rose from 36% in 1971 to 82% in 1981. In the most recent survey (1986), 95% of the organizations reported having drug and alcohol problems. Although this statistic could represent a general increase in awareness of drug problems, it could also reflect increased use of drugs in the workplace. The percentage of organizations reporting specific drug problems in 1981 and 1986 respectively included: alcohol (82%, 95%); marijuana (55%, 73%); barbiturates/amphetamines (41%, 59%); heroin (21%, 40%); cocaine (21%, 58%); and other drugs (31%, 55%). Many firms in the 1981 survey also reported that they judged the drug problem as serious (55%) or more serious (30%) in their own organization than in previous years. Similarly, 41% of the respondents in the 1981 survey believed there would be no change in drug abuse problems in the next five years; 37% believed there would be future increases in drug abuse; and only 16% believed it would decrease (Schreier, 1987).

Large companies appear to experience problems with drugs in the workplace more than small companies, possibly due to greater numbers of employees, or to the anonymity that a larger workplace setting provides. A 1981 survey of 73 Los Angeles businesses found that larger organizations were more likely to report moderate or very serious drug problems than were smaller companies (Madonia, 1984). No companies with less than 1,000 employees reported very serious drug problems, whereas 26% of companies with over 10,000 employees reported having very serious drug problems.

A survey by the American Management Association (AMA) conducted in late 1986 reported that 93.5% of the 1,090 respondents nationwide reported dealing with cases of employee drug abuse in that same year (Masi, 1987). It should be

noted, however, that this survey was sent to human resource directors on the AMA membership list and Personnel subscription list, which may represent only medium- to large-sized companies. Further, the survey had a response rate of only 11%. Yet, the findings are consistent with other surveys which show an increased reporting of employee drug abuse by U.S. organizations.

Alcohol abuse, alcoholism, and problems related to alcohol use are judged to present a vastly more pervasive workplace problem than does drug abuse (Hawks, 1986; Hoffman and Harrison, 1987; Walsh, 1987; Smith, 1984; Danovitch, 1984; Gordon, 1987). Although nationwide substance abuse patterns indicate a trend toward polydrug abuse, alcohol abuse currently retains its position as the number one "drug" problem in the country, and alcoholism remains the number three cause of death among adult males, following heart disease and cancer (Smith, 1984; Danovitch, 1984). The major role that alcohol plays in on-the-job accidents, traffic fatalities and injuries, civil aviation accidents, drownings, and fire fatalities has been well documented (Saxe et al., 1983; Danovitch, 1984; Spicer and Owen; 1985).

Although drug testing is a new phenomenon to the workplace, at least one report on the outcome of a drug testing program has noted that while a decrease in illicit drug use is indicated by urinalysis results, a shift to alcohol use is apparent among those being tested. This preliminary finding suggests a potential increase in the significance of the alcohol problem as attempts are made to control the drug abuse problem (Smith, 1984). Consequently, as the nuclear power industry attempts to address the drug abuse problem, they should also be concerned with a potential increase in alcohol abuse possibly resulting from the "crack down" on drugs.

2.2 EXTENT OF OTHER TYPES OF EMPLOYEE PERSONAL PROBLEMS

In addition to substance abuse, a wide range of psychological disorders and job-related stress can result in impaired job performance. Although research has not been conducted within the nuclear power industry to assess the prevalence of these problems among nuclear workers, it is reasonable to expect that they are subject to the same types of problems as workers in other industries.

Estimates regarding the prevalence of psychological disorders in the workplace vary between 5% and 25% of the workforce. The entire continuum of mental health disorders, including minor depressions, anxiety disorders, personality disorders, and psychoses is believed to be represented (MacIver, 1969; Madonia, 1985; Rosen, Locke, Goldberg, and Babigian, 1973). Job impairment due to these problems occurs in approximately 5% to 10% of the workforce. These figures constitute only rough estimates, however, because the occupational mental health literature is primarily anecdotal, and acknowledges the need for additional research (Madonia, 1985).

One recent study surveyed 73 companies, ranging in size from 10 employees to over 100,000, to learn the extent to which emotional problems affect the work setting (Madonia, 1985). The range of problems reported replicate the disorders mentioned above, with symptoms including withdrawal, erratic behaviors, and disturbed interpersonal relations. The companies reported

using a range of measures to assess the effects of these disorders on job performance, including work accidents, reduced productivity, frequent errors that increased in magnitude over time, lack of attention, lack of interest, and absenteeism. Of the 73 companies, 59% reported that between 1% and 9% of their employees demonstrated emotional problems that interfered with job performance, 28% reported that between 10% and 19% of their employees experienced job impairment due to emotional problems, and 13% reported that 20% to 29% of their employees fell into this category. The study concluded that approximately 9% of a given workforce are shown to suffer from some form of psychological disorder that interferes with job performance (Madonia, 1985).

An earlier study, similar in intent, reviewed the assessments of 3,165 employees provided by their companies' medical staffs. Five percent of the employees were assessed as experiencing a psychological disorder, with 88% of the group experiencing a measurable degree of on-the-job impairment (Rosen et al., 1973).

The substantial, recent attention assigned to job-related stress has forced business and industry to recognize and respond to the impact of stress on the nation's workforce. Three current trends appear to be responsible for this recognition. First, workmen's compensation laws are being enacted or interpreted in such a manner as to result in specific compensation for injuries resulting from continued stress on the job. A study by the California Workers' Compensation Institute reports that the number of claims granted for "anxiety reactions unrelated to a specific traumatic incident" doubled between 1980 and 1982 (Rothman, 1986, p. 36). The National Compensation Institute reports that 59% of the individuals receiving awards for job-related emotional stress are 39 years old or younger (Rothman, 1986). The relative youth of the recipients indicates that this trend will continue into the future. Second, due to continuing research in this area, the medical community is accepting the cause-and-effect relationship between workplace stress and disease. Heart disease, hypertension, upper respiratory infections, ulcers, reduced immunity, chronic pain, depressions, and suicidal tendencies have all been linked to chronic workplace stress. Medication abuse, emotional disorders, and vulnerability to accidents and injuries have also been indicated as related. Third, employees across the nation believe that a link exists between workplace stress and illness, albeit mental or physical, and are demanding that employers acknowledge the cause-and-effect relationship (Ivancevich, Matteson, and Richards, 1985; Walsh, 1983; Rothman, 1986).

Although the prevalence of psychological disorders and stress reactions among workers with unescorted access to protected areas in nuclear power plants is currently unknown, the experience of other industries suggests that these factors may also affect the job performance of nuclear workers. Given the magnitude of the potential effects of these disorders and stress on job performance, careful attention to them is an essential part of a comprehensive fitness-for-duty program.

2.3 SUBSTANCE ABUSE AND IMPAIRMENT

Although the foregoing suggests that the prevalence of fitness-for-duty problems in the nuclear industry warrants NRC regulatory action, the major justification for action rests on evidence indicating that the use of illicit drugs and the misuse of alcohol by workers with unescorted access can interfere with their job performance. This section presents a very brief overview of the recent literature which suggests that on-the-job impairment is the likely result of using marijuana, cocaine, opiates, phencyclidine, and amphetamines, the most commonly used illicit drugs (U.S. HHS, 1987). The relationship between low levels of alcohol consumption and impairment is also discussed, as are the impairing effects of licit substances on job performance.

Meaningful studies of substance use in the workplace are scarce, especially as they pertain to the nuclear industry. The majority of studies on the behavioral effects of drugs have traditionally been conducted in controlled laboratory settings. Consequently, the extrapolation of these results to any workplace environment and to tasks and personnel within the nuclear industry, in particular, can be questioned. However, the findings of many of the studies that have been conducted suggest the possible effects of substance use on job performance in nuclear power plants. These effects include the behavioral, physical, and cognitive effects of intoxication, the effects on performance of withdrawal and drug "hangover," as well as longer-term effects of chronic drug and alcohol use.

2.3.1 Marijuana

Marijuana, or cannabis sativa, is one of the most commonly used drugs. There have been 421 compounds identified to date in the cannabis plant; 61 of these compounds are of the cannabinoid structure. The primary cannabinoid and psychoactive substance of interest is delta-9-tetrahydrocannabinol (THC), which is responsible for the phenomenological effects sought by users (Fehr and Kalant, 1983). Like alcohol, marijuana acts as both a stimulant and depressant, but it remains in the body for a longer period of time. Marijuana varies greatly in potency and effect. Variation in potency may reach a factor of 2,000, making it difficult to accurately measure the relationship between potency and effect (Murray, 1986). Marijuana abuse currently ranks fourth among the top 20 controlled substances based on emergency room admissions (Frank, 1987).

2.3.1.1 Physical Signs of Abuse

Symptoms of marijuana drug use are chronic fatigue and lethargy, chronic dry irritating cough, chronic sore throat, and chronic conjunctivitis (red eyes) or dilated pupils (Blum, 1984).

2.3.1.2 Effects on Performance

Several studies have shown that marijuana intoxication affects cognitive and task performance in a variety of ways (Fehr and Kalant, 1983). Marijuana interferes with learning, impairs numerical reasoning, interferes with the transfer of information from short-term to long-term memory, and makes subjects more susceptible to distraction or stress. Marijuana can induce acute memory impairment, which directly affects learning through a dysfunction of normal storage and retrieval mechanisms (Fehr and Kalant, 1983; Walsh, 1987). The effects of marijuana intoxication on social interaction vary. Some subjects become withdrawn; other subjects become more aggressive. Research has clearly demonstrated that degree of impairment in individual subjects is related to dose. Studies show that the larger the dose, the greater the perceived subjective effect of a "high;" the greater the increase in physiologic indexes, such as heart rate; and the greater the impairment (Blum, 1984; Chesher, 1986).

Complex psychomotor skills are clearly impaired by marijuana (Smiley, 1986). Studies have shown that marijuana intoxication can shorten attention span, decrease manual dexterity, and impair motor steadiness. Other studies have also shown that marijuana intoxication impairs sensory and perceptual performance. For example, marijuana use has been found to affect hearing and vision (Murray, 1986; Radford et al., 1983).

Subjects under the influence of marijuana have difficulty driving a vehicle. Motor coordination, eye tracking skills, and the perceptual functions involved in driving are affected (Schwartz and Hawks, 1985). Studies by Klonoff (1974) and Fehr and Kalant (1983) showed that even small doses of marijuana impair driving ability. Another study has shown that drivers tend to become more conservative while under the influence of marijuana; for example, they hesitate to pass other automobiles (Chesher, 1986). A study by Blum (1984) also showed that users tend to become more conservative when making decisions.

Marijuana can produce residual behavioral effects up to 24 hours after ingestion, as was shown in a study on aircraft pilot performance. In this study, simple performance measures returned to within baseline levels in a relatively short time; however, highly complex aspects of the task showed deficits 24 hours after ingestion (Yesavage, Leirer, Denari, and Hollister, 1985). Chait, Fishman, and Schuster (1985) found that marijuana can induce significant subjective and behavioral effects at least nine hours after smoking (i.e., the next morning). Such residual effects can be considered a marijuana hangover.

Subjects intoxicated on marijuana appear to realize that they are impaired and compensate for this impairment whenever they can. Pilots in a study by Janowsky, Meacham, Blaine, Schoor, and Bozzetti (1976), for example, knew that they were under the influence of marijuana and attempted to compensate. However, subjects may have difficulty compensating in an emergency situation (Smiley, 1986). Furthermore, one study noted that, even though the subjective feeling of being "high" is no longer present, subjects may still be intoxicated and performance decrements may still exist, possibly lasting

for several hours (Blum, 1984). Thus, an operator in a nuclear power plant, for example, may be impaired from smoking marijuana the night before he works a day shift without realizing that his performance is still being affected.

2.3.1.3 The Combination of Marijuana and Other Drugs

Marijuana is usually combined with tobacco and alcohol, and less frequently with cocaine, PCP, and other drugs (Fehr and Kalant, 1983). Most research has focused on the combination of marijuana with alcohol. Sutton (1983) found that relatively low amounts of marijuana combined with alcohol can have serious disruptive effects on performance. Chesher (1986) found that while low doses of alcohol and marijuana produce a less-than-additive reaction, high doses of marijuana combined with alcohol produce additive effects. Another study concluded that both marijuana and alcohol had significant effects on driving performance, and the effects were particularly detrimental when both drugs were combined. Marijuana affected subjects more rapidly than alcohol but, for most tasks, less severely (Peck, Biasotti, Boland, Mallory, and Reeve, 1986). The combination of alcohol and marijuana can have detrimental effects on hand steadiness, execution of movements, and body sway (Moskowitz, 1985).

A study of airplane pilots under the influence of both alcohol and marijuana was conducted using flight simulators. This study demonstrated that pilots made major errors (becoming lost or stalling) and minor errors (altitude and heading deviations) while intoxicated (Janowsky et al., 1976). Similar studies in driving simulators have shown that subjects' performance suffered on such tasks as maneuvering, negotiating curves, following a car, or passing a car (Smiley, Moskowitz, and Ziedman, 1981).

2.3.1.4 Tolerance and Withdrawal

Tolerance to cannabis is a complex phenomenon, although it does appear to develop with prolonged use. Novice users have a moderate degree of tolerance, which actually decreases with use. Tolerance then increases with heavy use. There is no definitive evidence that chronic users require increasing amounts of cannabis to maintain the same effects, however. Experienced users withstand higher doses than novices, though, and it is evident that chronic marijuana users develop tolerance to some of the effects of THC (Agurell and Hollister, 1986; Blum, 1984).

There are significant differences between casual and heavy users of marijuana when intoxicated. In one study, casual users of marijuana made five times as many errors on a divided-attention task when they were smoking an ad libitum dose of marijuana (i.e., as much as they desired) as they did when they were smoking a placebo. Heavy users, on the other hand, did not show any increase in errors when consuming an ad libitum dose. However, a similar study showed that heavy users displayed more hostility, poorer work adjustment, and poorer interpersonal relations than did the casual users (Mirin, Shapiro, Meyer, Pillard, and Fisher, 1971).

Studies of the long-term or chronic effects of marijuana use on behavior are sparse. However, one study notes that chronic cannabis users exhibit

behavior labeled as an "amotivational syndrome." Characteristics of the amotivational syndrome include apathy, reduced drive and ambition, impaired ability to carry out complex tasks, failure to pursue long-term plans, reduced tolerance to frustration, diminished communication skills, neglect of personal appearance, and sluggish mental responses. These characteristics are not specific to chronic cannabis use; they are found with a number of psychoactive drugs, primarily those of a sedative-hypnotic nature. Fehr and Kalant (1983) called this syndrome "chronic cannabis intoxication."

Withdrawal symptoms after marijuana intoxication are mild, such as lassitude or a mild headache. Withdrawal symptoms after chronic marijuana use is halted (e.g., headaches, stomach cramps, feelings of lassitude) are attributed to psychological dependence or mild physical dependence (Murray, 1986).

2.3.1.5 Discussion

Marijuana impairs human judgment, short-term memory, and psychomotor functioning, although findings on the behavioral effects of marijuana are somewhat limited and qualified. It appears, however, that marijuana can significantly impair performance during intoxication. Impairment due to hangover effects and withdrawal are also possible. However, factors such as dosage, degree of impairment, and the age and experience of the user must be considered when generalizing from clinical results to work settings (Fehr and Kalant, 1983).

Studies have focused primarily upon the observable short-term effects of marijuana intoxication. These studies show significant effects on cognitive and physical task performance, but the findings are not entirely conclusive. There are inconsistencies, for instance, in the findings regarding memory and learning. These inconsistencies are attributed to the methodology of the studies as well as the unique characteristics of THC. The majority of studies suggest, though, that the more complex a physical, cognitive, or behavioral task becomes, the greater the likelihood that marijuana intoxication will significantly affect or impair performance. Certainly, the performance of many routine and emergency-related tasks in a nuclear power plant would qualify as complex.

Long-term studies of chronic marijuana use are less conclusive. This is attributed to the general inadequacy of reported data in clinical studies, small sample sizes, and a lack of adequate differentiation between intoxication, withdrawal, and residual change. There have also been few before-and-after longitudinal studies of regular users (Fehr and Kalant, 1983). Evidence is accumulating that marijuana may also have long-term health effects, such as impaired memory, that directly affect performance (Murray, 1986). Physiological damage to chronic users is also possible (Cohen, 1986a).

Cultural and socioeconomic factors may influence the definition and identification of adverse effects, especially those related to complex emotional or cognitive functions (Fehr and Kalant, 1983). For example,

impaired performance due to marijuana intoxication is more likely to be recognized in a control room operator than a contract janitor.

2.3.2 Cocaine

Cocaine is a powerful central nervous system stimulant that is taken in a variety of ways and at a variety of doses. Cocaine has many behavioral and pharmacological properties that are similar to those of amphetamines (Fischman, 1984). Cocaine primarily affects brain functions: cocaine can induce feelings of euphoria, relieve fatigue and boredom, and produce effects that are similar to local anesthetics (Washton and Gold, 1987). Because cocaine has become popular only recently, cocaine psychopharmacology and studies of the behavioral effects of its consumption by human beings are not as well-developed as studies of other abused drugs (Jones, 1984).

Cocaine consumption has risen dramatically in the United States throughout the 1980s. Cocaine was listed as the second most dangerous controlled substance in 1986, based on national estimates of drug-related emergency room admissions. In comparison, it ranked eleventh in 1980. This statistic represents an increase of 253% in six years (Frank, 1987).

2.3.2.1 Physical Signs of Abuse

Psychological and behavioral symptoms of cocaine use include irritability, decreased or dysfunctional attention, restlessness, hypervigilance, insomnia, paranoia, delusions, and hallucinations (Siegel, 1987; Jones, 1984). Cocaine psychosis may occur with prolonged and heavy use (Fischman, 1984).

The primary physiological effects of cocaine are cardiovascular. Heart rate, blood pressure, and body temperature increase significantly following ingestion (Byck, 1987). Single doses of cocaine have been known to induce seizures (Washton and Gold, 1987). Acute physical symptoms of cocaine use include increased blood pressure and heart rate, hypertension, blurred vision, increased muscle tension, tremors, palpitations, slurred speech, thirst, anorexia, mydrisis, increased body temperature with sweating, headaches, dizziness, nausea, and diarrhea (Siegel, 1987).

Cocaine intoxication dramatically affects vision. Subjects report increased sensitivity to light, halos around bright objects, difficulty focusing the eyes, and hallucinations such as flashes or movements of light in the peripheral field of vision. In one study, 43% of intranasal users reported some visual impairment (Siegel, 1978).

2.3.2.2 Effects on Performance

Cocaine is a relatively short-acting drug that heightens mental stimulation (Jones, 1984). Cocaine takes effect quickly and is rapidly metabolized and excreted from the body. Peak effects are usually experienced 10 to 20 minutes after ingestion, with total effects lasting no more than 40 to 50 minutes (Walsh and Yohay, 1987). Subjects under the influence of cocaine can become confused, anxious, friendly, vigorous, elated, aroused, or simply "in a good mood." In these aspects, cocaine is similar to other stimulants such

as amphetamines. Cocaine is also similar to amphetamines in that it can increase the performance levels of subjects that have been deprived of sleep (Fischman, 1984). Cocaine can increase irritability, hyperexcitability, and startle responses. Sudden sounds such as horns or sirens cause violent responses (e.g., rapid steering or braking while driving an automobile) in intoxicated subjects (Davis, 1985).

Many cocaine users believe that cognitive and task performance is improved under the influence of cocaine. Studies do not support this contention, however, and, in fact, demonstrate that cocaine intoxication interferes with learning (Fischman, 1984). Walsh (1987) noted that impairment in learning occurs in the first 10 to 15 minutes after intravenous administration of cocaine.

Cocaine also impairs the ability to drive. Driving accidents and court cases involving drivers intoxicated on cocaine underscore the severe physical and cognitive impairment caused by cocaine; these accidents often resulted in fatalities. During one study, 100% of the subjects reported lapses of attention while driving and that they ignored relevant stimuli, such as changes in traffic signals (Siegel, 1987).

Strength and reaction time do not appear to be affected by cocaine: tests that measured subjects' hand-grip strength and reaction time under the influence of cocaine showed no significant enhancement or decrement in performance (Fischman, 1984).

2.3.2.3 The Combination of Cocaine and Other Drugs

Cocaine is often used with other drugs such as alcohol, opiates, or central nervous system depressants. The use of other drugs with cocaine can affect performance; however, specific performance effects have not been adequately studied (Byck, 1987). Cocaine may mask alcohol's effects, i.e., a person may feel sober and alert under the influence of cocaine and alcohol though he or she may be significantly impaired (Stone, Fromme, and Kagan, 1984).

2.3.2.4 Tolerance and Withdrawal

Tolerance develops quickly in cocaine users; Ambre, Belknap, Nelson, Ruo, Shin, and Atkinson[1] found that tolerance develops exponentially. The cocaine "high" diminishes rapidly if subjects use cocaine frequently (Washton and Gold, 1987). In a recent study, the subjective euphoric effect increased in intensity, peaking one hour after intravenous cocaine injection, then declined toward the baseline in four hours, despite the presence of a constant level of cocaine in the body. This rapid tolerance development is acute in persons who use cocaine on a regular basis. Cocaine smokers in one study reported impaired driving during withdrawal; several were involved in separate collisions resulting in major injuries (Gawin and Kleber, 1986).

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[1]Ambre, J. J., Belknap, S. M., Nelson, J., Ruo, T. I., Shin, S., and Atkinson, A. J. (In press-a). Acute tolerance to cocaine in humans. Clinical Pharmacology and Therapeutics.

If a user develops an acute tolerance, symptoms of withdrawal from cocaine can occur even with relatively high doses of cocaine still present in the user's system. Increasing the frequency or size of the doses will fail to produce the desired effects. The euphoric effects are consistently replaced by dysphoria, and global sensations of "feeling bad".[2]

Complete withdrawal from cocaine is marked by depression, social withdrawal, craving, tremors, muscle pain, eating disturbance, and changes in sleep patterns. Jones (1984) suggests that these changes are inadequately explained by the term "psychological dependence." These withdrawal symptoms pose a strong negative incentive that makes it difficult to quit using cocaine as long as the drug is available (Jones, 1984; 1987). Further use following withdrawal can produce irritability, paranoia, delusional and confused thinking, and other unpleasant effects leading to a cycle of ceasing and resuming the use of cocaine known as the "run" (Jones, 1987). Because of these runs, the nature of cocaine abuse in the workplace will presumably be cyclical within individuals over time (DuPont, 1984).

2.3.2.5 Discussion

Acute tolerance development and severe withdrawal symptoms pose a two-fold problem for cocaine users: increasing amounts of cocaine are required to maintain a euphoric "high" that becomes harder to achieve, while cessation of cocaine use is difficult and painful.

Acute tolerance development hinders accurate studies of cocaine's effects. Many single-dose studies have been conducted, yet their applicability to regular users (i.e., persons who use cocaine daily) is questionable. However, experimental, clinical, and case studies indicate cocaine-induced impairment during intoxication and withdrawal.

There are serious implications for users of cocaine in the workplace at all levels. Social interaction is worsened by cocaine use, as cocaine abuse can cause paranoia, suspiciousness, and aggressiveness. Cyclical "runs" of cocaine use by a worker create withdrawal and recurrent use symptoms such as irritability and lassitude followed by the previously mentioned symptoms of chronic use. Thus, although the immediate effects of the drug on the central nervous system may not necessarily cause impairment, the overall effects on the individual and his interaction with others are likely to create performance problems. The behavioral effects of cocaine during all phases of use--intoxication, hangover, dependence, and withdrawal--appear to impair cognitive and task performance, and may at times represent a serious threat to public health and safety if cocaine is used by workers with unescorted access to protected areas of nuclear power plants.

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[2]Ambre et al., in press-a.

2.3.3 Opiates

Opiates, or opioids, encompass both natural drugs derived from the opium poppy and synthetic drugs that possess distinct chemical structures but similar pharmacological characteristics to natural opium products. The term "narcotics" is used to describe this class of drugs (Woolf, 1983).

Opiates are used both for medical treatment and for personal (recreational) reasons. Opiates are among the most effective drugs for relieving pain. They primarily affect the central nervous system. Natural opiate drugs include opium, heroin, codeine, and morphine. Synthetic opiates include hydromorphone (Dilaudid), oxymorphone (Numorphan), oxycodone (in Percodan), hydrocodone (in Hycodan), methadone, propoxyphene (Darvon), meperidine (Demerol), and other synthetic variations (Woolf, 1983; Blum, 1984). Though these various opiates have subtle differences in the duration of effects, withdrawal patterns, and absorption into the system, the pharmacologic characteristics of these drugs can be described for the group as a whole (Woolf, 1983). Opiates are ingested in a numerous ways: intravenously, orally, nasally, or smoked.

Heroin, an opiate, is the most dangerous controlled substance, based on national estimates of emergency room admissions. The incidence of heroin in emergency room admissions has doubled since 1980. Codeine combinations and the licit use of Percodan are listed as the fifth and fourteenth most common drugs in emergency room admissions, respectively (Frank, 1987).

2.3.3.1 Physical Signs of Abuse

Common effects of opiates include mood changes (i.e., euphoria) and mental clouding (Jaffe and Martin, 1980). Characteristics of opiate users include pupillary constriction, depression, apathy, or lethargy. Side effects of opiate use include drowsiness, constipation, nausea, vomiting, and orthostatic hypotension (Woolf, 1983).

2.3.3.2 Effects on Performance

Cognitive and psychomotor performance can be impaired by opiates, although the duration and extent of impairment depends on the type of opiate, the dose, and the experience and drug history of the user. Ingestion of low to moderate amounts produces a short-lived feeling of euphoria followed by a state of physical and mental relaxation that persists for several hours (Walsh and Yohay, 1987).

Research results on the effects of opiates on performance have been inconsistent. Inconsistencies may be partially attributed to the broad variety of opiate-based products and varying patterns of consumption. For instance, one study revealed that the probability of coming to the attention of police for driving inattentatively or aggressively increased in drivers who had used antitussives (which contain codeine or dextromethorphan) and decreased among those who used narcotic analgesics and cough and cold preparations (Perl, Starmer, and Homel, 1983). In another driving-related study, opiate usage was associated with a 300% to 400% increase in crash

rates (Smart and Fejer, 1976). One study found that "in investigations where body fluids from arrested drivers have been examined, narcotic analgesics have not been featured prominently" (Starmer, 1986, p. 26). The effects of a high dose of codeine (50 mg) on simulated driving performance with non-tolerant subjects showed that the drivers did not consider themselves to be impaired; however, there was a significant increase in the number of collisions (Linnoila and Hakkinen, 1973).

2.3.3.3 The Combination of Opiates and Other Drugs

Opiates are often used with other drugs. For instance, in an analysis of driving accident studies where drivers tested positive for opiates, other drugs were also present in the drivers' systems (Warren, Simpson, Hilchie, Cimbura, Lucas, and Bennett, 1981). Use of other drugs with opiates can produce additive effects: combining alcohol with opiates produces marked sedation and respiratory depression due to the effects of these drugs on the central nervous system. This combination can lead to unconsciousness or death (Woolf, 1983).

2.3.3.4 Tolerance and Withdrawal

Tolerance may develop to one effect of an opiate but not to others; such tolerance is known as selective tolerance (Woolf, 1983). Tolerance decreases rapidly following cessation of the drug. Chronic users may abstain from opiate use for short periods of time to regain the "high" that they lost due to increased tolerance.

All opiates are physically and psychologically addictive, and produce withdrawal symptoms that differ in type and severity. Flu-like symptoms are common during opiate withdrawal, e.g., watery eyes, nausea and vomiting, muscle cramps, and loss of appetite (Blum, 1984). Withdrawal symptoms can be violent. For instance, withdrawal from morphine produces the following symptoms in the four days to ten weeks following cessation of use: runny nose, extreme yawning, nausea, vomiting, diarrhea, sweating, cold and hot flashes, aching joints and bones, sore muscles, muscle spasms, twitchings and tremors, elevated temperature, goose flesh, dilated pupils, blurred vision, high blood pressure, restlessness, anxiety and irritability, increased respiration, and insomnia (Woolf, 1983).

2.3.3.5 Discussion

Opiates are a large class of drugs primarily derived from the poppy. Opiates are either natural or synthetic. Cognitive and psychomotor performance may be impaired during opiate intoxication, but there is wide variance in behavioral effects due to the multiplicity of opiate-based drugs. Opiates are physically and psychologically addictive. Severe withdrawal symptoms can occur during abstention and can last from four days to ten weeks (Woolf, 1983)

Particular attention should be given to licit use of opiate-based products, such as pain relievers or other prescription and over-the-counter drugs, on the job. Sufficient dosages can impair on-the-job performance, especially

when combined with other drugs such as alcohol (Moskowitz, 1985). Requiring workers to register their prescriptions and use of over-the-counter drugs with medical personnel at a nuclear power plant and then temporarily assigning potentially impaired workers to other jobs can ensure that legal users of opiates do not affect plant safety.

2.3.4 Phencyclidine

Phencyclidine, commonly known as PCP, was first produced in 1957. It is now a major drug of abuse and is ranked eighth among common controlled substances involved in emergency room admissions (Frank, 1987). PCP has a variety of effects on the central nervous system, making an adequate classification of the drug difficult. It is best classified as a hallucinogen, but can also be considered a depressant (Holbrook, 1983b). PCP intoxication begins several minutes after ingestion of the drug and usually lasts eight hours or more (Walsh and Yohay, 1987). PCP is well known for producing unpredictable side effects, such as psychosis or fits of agitation and excitability. Subjects who are intoxicated with a low dose of PCP (5 to 20 mg) become acutely confused (Marwah and Pitts, 1986). Doses in excess of 20 mg can elicit serious neurological, cardiovascular, and psychotic reactions. In fact, PCP-induced psychosis is similar to clinical schizophrenia (Marwah and Pitts, 1986).

There have been relatively few studies of the behavioral effects of PCP on humans due to the volatility and unpredictability of its side effects and because PCP's popularity as a drug of abuse is relatively recent. However, there are sufficient clinical studies, criminal cases, and behavioral observations to demonstrate PCP's erratic and severe behavioral effects.

2.3.4.1 Physical Signs of Abuse

PCP intoxication is marked by difficulties in coordination; severe confusional or agitated states; inexplicable mood changes between lassitude and extreme agitation; moods such as suspicion, anger, or terror; and erratic or violent actions (Balster, 1986; Holbrook, 1983b).

2.3.4.2 Effects on Performance

PCP users have reported unique intoxicating effects of the drug unlike those of other drugs of abuse (Balster, 1986). The effects of PCP on behavior vary, depending on both the person and the environment. Clinical studies have identified four phases of PCP abuse.

The first phase is called acute PCP toxicity and may last up to 72 hours. Behavioral effects are dose-related and may include combativeness, catatonia, convulsions, and coma. Visual disturbances are common, particularly distortions of size, shape, and distance perception. If the dose is sufficiently high, grand mal seizures, coma, or death due to respiratory depression or cardiovascular failure may occur.

The second phase is known as toxic psychosis. In the second stage, subjects may experience visual and auditory delusions, become agitated or paranoid, or

become unable to make judgments. The second phase does not always follow the first phase, and seems to occur most commonly in chronic abusers. It is not clear whether occurrence of the second stage is related to dose. The second phase may last seven days or longer.

The third phase is characterized by schizophrenia and may last a month or longer. If a subject has an underlying psychological condition, this phase may occur after a single ingestion of the drug.

The fourth phase is PCP-induced depression. Suicides are possible during the fourth phase. This depression may force subjects to turn to other street drugs. Mental dysfunction lasting for several months may also occur in the fourth phase (Holbrook, 1983b).

Studies have also demonstrated that PCP can elicit behavioral effects in users similar to those induced by barbiturates or other sedative-anesthetics. It is obvious that the motor skills of heavy users of PCP would suffer. Tasks requiring motor coordination, such as driving an automobile, would be significantly disrupted by PCP (Balster, 1986). In fact, a study of several fatal accidents involving PCP-intoxicated drivers underscored the effects of PCP on humans: drivers' coordination was severely impaired, they were acutely confused, and they were unable to think abstractly or make rational decisions (Lerner and Burns, 1986).

Persons under the influence of PCP may become involved in life-threatening situations due to the disorientating and hallucinogenic effects of the drug. A user may feel he has superhuman strength or may become suspicious, angry, or terrified. Holbrook (1983b) states that "unlike most of the other hallucinogenic drugs, a number of deaths have been directly attributed to the use of PCP, and, in addition, numerous accidental deaths have occurred due to overdose and to the behavioral changes the drug precipitated" (p. 95).

2.3.4.3 The Combination of PCP and Other Drugs

PCP significantly enhances the effects of classical depressant drugs, such as barbiturates and alcohol (Balster and Wessinger, 1983). PCP taken with other depressants is potentially lethal because depressants have an additive effect on PCP intoxication. This additive effect may explain some of the behavior exhibited by subjects intoxicated by PCP (Balster, 1986).

2.3.4.4 Tolerance and Withdrawal

Animal studies have shown that tolerance develops if PCP is used continuously (Balster, 1986). Tolerance develops in human subjects only if the drug is used daily (Holbrook, 1983b). The long-term implications of this tolerance are not fully understood (Jain, Budd, and Budd, 1977).

Animal studies have shown dramatic withdrawal symptoms following the termination of PCP use: vocalizations, hyperactivity, lassitude, tremors, and, in one case, convulsions. These symptoms appeared within 8 hours of abstinence and were most severe at 24 hours (Balster, 1986).

PCP has not been reported to produce physical dependence in humans, even if used chronically. However, psychological dependence is reported frequently among chronic users (Holbrook, 1983b).

2.3.4.5 Discussion

PCP clearly has drastic effects on performance. Clinical cases have documented the severe debilitating physical and psychological effects of PCP abuse and the extremely unpredictable behavior caused by the drug. Although the understanding of PCP's physiological and psychological effects on humans is still relatively limited, there is no question that PCP is an unusually dangerous psychoactive substance.

PCP causes significant and adverse long-term health effects. Irreversible memory loss, personality changes, and thought disorders have been documented. Spontaneous recurrences of drug effects (flashbacks) are possible. PCP has been responsible for numerous fatalities (Walsh and Yohay, 1987). Obviously, these characteristics of PCP use and withdrawal have serious implications for job performance in nuclear power plants. It may be assumed that any use of PCP will significantly impair the abuser's job performance. Permanent long-term damage is also possible.

2.3.5 Amphetamines

Amphetamines are central nervous system stimulants and are found in licit and illicit forms. The term "amphetamine" is generic and applies to the group of synthetic compounds derived from ephedrine. Examples of common trade name amphetamines are Benzedrine (racemic amphetamine), Dexedrine (dextroamphetamine), and Desoxyn (methamphetamine). The behavioral effects of amphetamines are similar to those of cocaine; however, the two types of stimulants differ in that amphetamines affect users for a longer period of time and are more toxic than cocaine (Holbrook, 1983a).

2.3.5.1 Physical Signs of Abuse

In general, amphetamines stimulate pulse, heart beat, blood pressure, respiration and perspiration. At higher doses, amphetamines increase body temperature and basal metabolism (Caldwell, 1980). High doses of amphetamines may alter gastrointestinal function and cause nausea, vomiting, diarrhea, and cramping. Amphetamines also affect the cardiovascular system: abusers may experience headaches, hypertension, pallor, and palpitations. Effects of heavy use on the central nervous system include hyperreflexia, restlessness, talkativeness, insomnia, violence, and increased libido (Caldwell, 1980). High doses may result in amphetamine psychosis, which clinically resembles a true paranoid schizophrenia. Users are likely to become addicted if amphetamines are used frequently (Holbrook, 1983a).

Intoxication occurs with increasing doses; subjects become hyperexcited and driving skills deteriorate (Ellinwood and Nikaido, 1987). Aggression and violence are other potential effects of higher doses of stimulants. High doses can induce hallucination, delirium, and delusions (Ellinwood, 1971).

2.3.5.2 Effects on Performance

Amphetamines are widely used to increase alertness and fight fatigue. Studies have shown that in therapeutic doses amphetamines increase alertness, decrease fatigue, elevate mood, and frequently produce euphoria. Motor activity is increased and physical performance of simple tasks improves. Users tend to take risks (Hurst, 1987). Sleep patterns are disturbed and total sleep time is decreased (Holbrook, 1983a). Users of small doses experience a heightened sense of well-being, sharp attentiveness, and an increased acuity of reflexes; moderate doses produce frank euphoria, energetic restlessness, and idealization (Caldwell, 1980).

The effects of amphetamines on cognitive and task performance are well documented. Amphetamines improve short-term physical performance in a variety of ways. Amphetamines increase vigilance (i.e., the ability to attend to sensory input), motor performance (e.g., swimming, running), and the ability to learn motor skills. Amphetamines also decrease reaction time. Simple short-term cognitive performance improves with controlled doses. Subjects are better at repetitive tasks that would otherwise be fatiguing or boring. Performance also improves on simple math tests, verbal ability tests, the learning of visual information, and the ability to read and understand a foreign language. Tests of cognitive task performance requiring relatively more complicated skills, such as calculus, do not show performance changes under the influence of amphetamines. With controlled doses, the adverse effects on physical performance are minimal (Radford et al., 1983).

Larger doses of amphetamines do have detrimental effects on performance, however. High doses of amphetamines produce an exaggerated sense of well-being, high energy, restlessness, urgency, overideation, and gross temporal distortion. Secondary effects of amphetamine abuse, such as hangovers, rebound depressions, and insomnia, also affect cognitive and task performance. Amphetamine abuse among truck drivers is cited as one example of these effects (Caldwell, 1980).

Amphetamine abusers develop a tolerance to the drug and are less likely than infrequent users to experience performance decrements. One study revealed, however, that once tolerance was established and drug levels were sustained in the body throughout a 24-hour period, drug cessation produced the following effects: performance impairment initially decreased as the drug level in the subject declined; however, impairment increased as the adverse effects of drug withdrawal (i.e., hyperexcitability, delirium, or both) appeared (Ellinwood and Nikaido, 1987).

2.3.5.3 Tolerance and Withdrawal

Users rapidly develop a tolerance to amphetamines; in this sense these drugs are similar to cocaine (Caldwell, 1980). Once tolerance is developed, abusers become insensitive to the stimulant and appetite-suppressant effects of amphetamines. Tolerance occurs even when amphetamines are administered in low therapeutic doses. Chronic abuse leads to high tolerance (Holbrook, 1983a).

Amphetamines create psychological dependence. Although no physical withdrawal symptoms occur following abrupt discontinuation of use, psychological changes may be prominent for several months. These changes include apathy, long periods of sleep, irritability, depression, and disorientation. Paranoia may follow the first seven days of withdrawal if heavy use is abruptly stopped; delusions may persist for up to a year (Holbrook, 1983a).

2.3.5.4 Discussion

Amphetamines stimulate the central nervous and cardiovascular systems. This stimulation heightens short-term physical and simple cognitive task performance to a minor degree, but these performance enhancement effects decrease considerably as the complexity of the task increases (Ellinwood and Nikaido, 1987). Complex cognitive task performance is not heightened by the use of amphetamines. ly short-term gains in cognitive and task performance appear to be outweig by the adverse performance effects due to regular use of amphetamines and high potential for abuse.

2.3.6 Alcohol

In contrast to most of the other drugs discussed in this section, the effects of alcohol consumption on various types of task performance are well documented. (See Radford et al., 1983, for a detailed discussion pertinent to the nuclear industry.) An issue that has recently received increasing attention in the literature, however, and that has significant implications for an NRC fitness-for-duty rule, is the effects of relatively small amounts of alcohol on performance, such as those associated with the one or two drinks a nuclear power plant worker might consume before dinner if he believed he would be off duty for the night. Evidence suggesting that even low levels of alcohol consumption may impair performance is presented in this section.

Ethyl alcohol (ethanol) is typically swallowed and absorbed through the gastrointestinal tract. Approximately 5% is absorbed into the bloodstream through the stomach wall, and the remainder is absorbed through the small intestine. The alcohol is then distributed to the liver, from there to the heart and lungs, and then back to the heart. From the heart it is pumped to all parts of the body. Alcohol distribution in the body is proportional to water content and blood supply in the body organs and tissue (Winek and Esposito, 1985).

Alcohol concentrations in the body are measured by blood alcohol level (BAL), or blood alcohol concentration (BAC), which is the amount of ethyl alcohol per unit measure of blood (sometimes calculated by body weight). BAC determinations for driver testing purposes are usually expressed as a percentage based on a weight per volume equation. For example, if a driver's BAC is 100 mg of alcohol per 100 ml of blood, then the driver's BAC is 0.10%. For consistency, BAC is referred to as a percentage of alcohol per unit volume of blood (mg/ml) in this section.

The mean rate of alcohol dissipation from blood is between 0.015% to 0.020% per hour, with an average of 0.018% per hour. In addition to dissipation rates, BAC is also dependent on the subject's weight, percentage of alcohol in the beverage, and the rate of consumption (Winek and Esposito, 1985). Also, the rate of absorption is affected by the presence of food in the stomach, which consequently reduces BAC for a given dosage (Moskowitz, 1985).

2.3.6.1 Effects on Performance

The effects of alcohol are dose dependent. In conjunction with BAC, the effects of alcohol are also dependent on the individual's history of alcohol use, the rate of alcohol consumption, and the presence of food in the gastrointestinal tract. As one researcher states, "Although such factors can significantly alter the variability of impairment, blood alcohol concentration remains an excellent index of impairment" (Moskowitz, 1985, p. 12).

The effects of alcohol may be felt prior to reaching peak BAC in the body. In one study, researchers found that the time to peak BAC was an average of 24 minutes later than the time to peak alcohol effect as measured by subjective estimations: subjects may be affected or impaired at a BAC below peak BAC levels in the body (Radlow and Hurst, 1985).

Performance decrements due to alcohol consumption can occur at relatively low BACs. Epidemiological studies clearly show that the risk of crash involvement increases with BACs higher than 0.05% (Moskowitz, Burns, and Williams, 1985). It has been suggested that BACs less than 0.05% can actually enhance driving skills performance. However, this contention is not supported by research. One study which measured skilled performance (divided attention and information processing) at low BACs showed evidence of impairment beginning at 15 mg/dl BAL (0.015% BAC) and increased impairment with increasing BACs (Moskowitz et al., 1985). The researchers concluded that no evidence exists for enhanced performance at low BACs, and that impairment did occur in the 15 mg/dl-60 mg/dl (0.15%-0.06% BAC) range. One interesting note on this study is the sample of ten male subjects averaging 25 years of age, all moderate drinkers. According to epidemiological studies, this group is relatively resistant to the effects of alcohol; thus it is anticipated that greater degrees of impairment at BACs between 0.015% and 0.06% would exist for younger, older, and less frequent drinkers (Moskowitz et al., 1985).

In a major study of the role of alcohol in accidental falls, Honkanen, Ertama, Kuismanen, Linnoila, Alha, and Visuri (1983) studied accident causes in a sample of 301 cases of accidental falls and 598 controls with known BACs (for a 2:1 ratio of controls to case samples). Cases were selected for interviews at a hospital emergency room. Controls were selected and matched based on the location and time of the accident. BACs were determined by gas chromatography. The results of the study indicate that alcohol was a powerful causal factor in both accidental falls and motor-vehicle accidents. Based on the research results, the relative risk of accidental falls was estimated at 3 times greater with BACs between 0.05% and 0.10% than at a zero percent BAC; 10 times greater in the 0.10-0.15% BAC range; and 60 times

greater at 0.16% BAC and higher. The risk of accidental falls at BACs greater than 0.10% is so high that "practically all cases with such BACs can be considered to have been caused by alcohol." To summarize, the researchers noted that alcohol is a common cause of accidental falls even at a low BAC of 0.05% (Honkaren et al., 1983, p. 244).

A review of literature on physiological studies of low BACs by Linnoila, Guthrie, and Lister (1986) shows that the amplitude and velocity of smooth pursuit eye movements and saccadic eye movements are reduced by alcohol. These changes are physiologically significant at a BAC of 0.05% (Linnoila et al., 1986). Smooth eye pursuit and saccadic eye movements have been shown to play a significant role in visual information processing (Flom, Brown, Adams, and Jones, 1976).

In a review of studies investigating the incidence of alcohol-related aviation accidents, Ross and Ross (1985) note that toxicological tests on deceased pilots from general aviation accidents found BACs ranging from 0.02% to greater than 0.30%, with approximately half of the BACs below 0.14% (Ross and Ross, 1985). The researchers note that experienced pilots were involved more often in alcohol-related accidents than those in fatal accidents where alcohol was not involved: experience did not compensate for performance degradation resulting from alcohol use (Ross and Ross, 1985).

In a review of experimental studies of simulated flight, it was shown that aircraft position errors and procedural errors increased during the approach phase of landing and instrument flight involving standard maneuvers at all BACs between 0.02% and 0.09% (Ross and Ross, 1985). The researchers noted the Federal Aviation Administration's proposal in 1981 for setting the level at which a pilot would be considered to be under the influence at 0.04% BAC, as well as the National Transportation and Safety Board's position that any alcohol in a pilot's blood jeopardizes safety, and concluded that decreasing acceptable cut-off levels for alcohol "appears justified pending further research" (Ross and Ross, 1985, p. 39).

Research on lower BAC limits for newly-licensed drivers introduced by Australian States shows that imposing a zero percent BAC limit in Tasmania, a 0.02% BAC limit for in Western Australia, and a 0.05% BAC limit in South Australia was followed by significant reductions in automobile and motorcycle accidents not requiring hospitalization in all three states (Smith, 1984). The lowering of the BAC limit in New South Wales from 0.08% BAC to a 0.05% BAC limit for the general driving population resulted in a 13.9% reduction in male drivers admitted to hospitals due to automobile accidents (Smith, 1984). However, other factors such as random breath testing in New South Wales and changing societal attitudes and drinking practices in Australia may have contributed to these results (Hurst, 1985).

In a letter to the editor of the Journal of the American Medical Association, several physicians at the Centers for Disease Control state that drivers with BACs above 0.05% and below 0.10% are significantly impaired, and that a BAC of 0.05% should be established as "per se illegal for driving" (Anda, Remington, and Williamson, 1986).

Verdugo and co-workers examined the BACs of drivers involved in fatal accidents in the United States (Verdugo, Malin, and Lowman, 1983). Verdugo studied accidents involving 18,402 drivers where BACs were known. In 12.6% of these accidents, drivers had BACs between 0.01 to 0.10%. While the percentage of fatal accidents involving drivers with BAC levels lower than .05% was lower than for drivers with levels between 0.05 to 0.10%, the difference was only 2.8%. The study showed that in 4.9% of the accidents, drivers had BACs between 0.01 to 0.04%; in 7.7% of the accidents, drivers' BACs ranged between 0.05% and 0.09%.

2.3.6.2 Discussion

These findings clearly indicate that even low levels of alcohol in an individual's blood are related to significant decrements in performance. BACs below 0.05% have been associated with accidental falls, aviation accidents, and fatal motor vehicle accidents. Regarding alcohol and safety in industry, Emery (1986) says that in any task which requires judgment, reasoning, memory or a quick reaction will be impaired by alcohol and that this impairment presents a possible safety hazard. With higher BACs, the threat to the safety of nuclear power plant workers and the public is likely to be even greater.

2.3.7 Prescription Drugs: Sedatives

Although there are many different types of prescription drugs, the most commonly physician-prescribed drugs are sedatives. Other common prescription drugs such as amphetamines have been discussed previously in this report and so will not be discussed further in this section. The focus of this section is on prescription sedatives, particularly the minor tranquilizers and barbiturates.

All drugs that fall into the sedative class are central nervous system depressants. Familiar sedatives are anxiolytics or minor tranquilizers, barbiturates, ethanol, and general anesthetics. At low doses, all of these drugs are capable of producing behavioral disinhibition and euphoria. At higher doses, each of the drugs produces drowsiness, and can induce unconsciousness if taken in sufficient quantities (Julien, 1981).

The first barbiturate, barbital, was introduced in 1903. In 1961, benzodiazepines (minor tranquilizers) were introduced and were considered to be clinically superior to barbiturates. Today, benzodiazepines represent a larger share of the drug prescription market than barbiturates (U.S. HHS, 1987).

Included in the minor tranquilizer category are benzodiazepines and dicarbamate derivatives. There are over 2,000 benzodiazepine compounds; those most commonly prescribed are diazepam (Valium), chlordiazepoxide (Librium), and flurazepam (Dalmane). Among dicarbamates, meprobamate (Miltown or Equanil) is the most widely prescribed. These drugs are used to treat tension, anxiety, and psychosomatic disorders. They are also used to treat alcoholism and phobic states (Gaston and Walker, 1981). Valium is prescribed for symptomatic relief of anxiety and tension, alleviation of the

symptoms of acute alcohol withdrawal, relief of muscle spasms, treatment of convulsive disorders, alleviation of presurgical anxiety, and as a hypnotic to induce sleep. Standard doses for these purposes range from 2 to 10 mg, taken orally two to four times daily. In some cases minor tranquilizers are administered by injection intramuscularly or intravenously in doses ranging from 2 to 15 mg (Physician's desk reference, 1982). Dalmane is prescribed as a sleep inducer (i.e., a hypnotic). Standard doses are 15 to 30 mg. Miltown is prescribed for relief of anxiety and tension and to induce sleep in anxious, tense patients. The usual dosage is 1200 to 1600 mg per day, administered orally in three or four doses (Physician's desk reference, 1982).

Barbiturates are prescribed primarily to produce sedation or sleep and to prevent epileptic seizures. Examples of generic and trade name barbiturates include amobarbital (Amytal), secobarbital (Seconal), pentobarbital (Nembutal), phenobarbital (Luminal), butabarbital (Butisol), and secobarbital (Tuinal) (Woolf, 1983). Although usually taken orally, these drugs may also be administered by intravenous and intramuscular injection.

At therapeutic doses, barbiturates depress the transmission of nerve impulses across the synapses in the arousal centers of the brain. At larger doses, all neurons in the body are affected and activity in the muscles, heart, and other organs of the body is decreased.

2.3.7.1 Physical Signs of Abuse

Effects from using minor tranquilizers include psychomotor impairment, anterograde amnesia, impaired awareness of degree of drug effect, other psychiatric/behavioral disturbances, and death (U.S. HHS, 1987). Side effects of barbiturates include drowsiness, particularly hangover drowsiness. Some patients exhibit paradoxical excitement, irritability, or delirium when taking barbiturates. Indicators of excessive barbiturate dosages include severe inebriation or coma. In severe cases, respiration may require mechanical assistance (Woolf, 1983).

2.3.7.2 Effects on Performance

Although barbiturates differ chemically from minor tranquilizers, effects of barbiturates on human performance are very similar to the effects of larger doses of minor tranquilizers. Below, the effects of minor tranquilizers and barbiturates on sensory functioning and psychomotor and cognitive abilities are examined. A large portion of this section represents a summary of information presented in Radford et al. (1983).

Effects of minor tranquilizers on sensory functioning have not been extensively examined. Studies indicate that 5 mg or more of Valium will slow the rate at which neurons fire in the eyes, optic nerve, and brain, indicating that vision my be impaired (Haffner, et al., 1973; Morland et al., 1974; Kleinknecht and Donaldson, 1975). Results from studies in which hearing was assessed also indicate that Valium slows the rate at which aural neurons fire, suggesting that hearing sensitivity is decreased (Healy, Robinson, and Vickers, 1970).

Little research has been conducted to investigate the effects of barbiturates on sensory functioning, although one study investigated the effects of barbiturates on perception. Results indicated that the eyes' ability to track a moving object is disrupted at therapeutic doses (Holzman, Levy, Uhlenhuth, Proctor, and Freedman, 1975). This suggests that the ability to monitor dials and gauges may be impaired with barbiturate use.

For minor tranquilizers, vigilance performance is impaired to a greater extent than visual and auditory performance. Performance decrements are found with 5 to 10 mg of Valium on measures designed to assess the ability to detect signals presented briefly against a background of distracting lights or sounds and the ability to continuously scan information presented to identify a particular type of information (e.g., the letter "X" among columns of letters) (Hart et al., 1976; Wittenborn et al., 1979; Bernheim and Michiels, 1973; Clarke et al., 1970). These findings suggest that the ability to sustain attention and concentration decreases following ingestion of minor tranquilizers even in prescribed doses.

Barbiturates also impair one's ability to sustain attention. Results from several studies indicate that the number of errors subjects make on vigilance tasks increases after consuming barbiturates (Hutt, Jackson, Belsham, and Higgins, 1968; Hart et al., 1976; Lehembre, 1963).

The effect of minor tranquilizers on reaction time is influenced by the dose and individual tolerance to the drug. In general, low doses (5 to 10 mg) do not appear to affect simple reaction time whether administered on only one occasion or over a period of days (Bernheim and Michiels, 1973; Tansella, Zimmermann-Tansella, and Lader, 1974; Ghoneim, Mewaldt, and Thatcher, 1975; Ghoneim et al., 1981). Choice reaction time, a reaction time measure involving decision making, is affected when a drug-free individual consumes drugs during the experiment or when a drug user is given a dose higher than normal. When minor tranquilizers are chronically used at low doses, no changes in speed of reaction or number of response errors have been found (Seppala et al., 1976; Bernheim and Michiels, 1973; Ghoneim et al., 1975; Ghoneim et al., 1981; Landauer, Pocock, and Frott, 1974; Bond and Lader, 1973).

Unlike minor tranquilizers, therapeutic doses of barbiturates slow reaction times. Studies of simple reaction time show that response speed decreases under the influence of barbiturates (Blum, Stern, and Melville, 1964; Tharp et al., 1974; Goldstein, Searle, and Schimke, 1960; Hart et al., 1976). Barbiturates also increase choice reaction time, but were not found to increase the error rate (Rundell, Williams, and Lester, 1978).

Standard or low doses of minor tranquilizers do not appear to significantly impair most motor performance. For example, in tests assessing the speed with which one taps a pencil or presses a key, subjects given minor tranquilizers were able to tap as quickly as subjects given a placebo (Bernheim and Michiels, 1973; Milner and Landauer, 1973; Bond and Lader, 1973; Ghoneim et al., 1975; Ghoneim et al., 1981; Jaattella et al., 1971; Hart et al., 1976). Other studies have also shown that eye-hand coordination

is not impaired with minor tranquilizers (Haffner, et al., 1973; Morland et al., 1974; Kleinknecht and Donaldson, 1975; Linnoila and Mattila, 1973).

Effects of barbiturates on psychomotor performance depend upon the size of the dose administered. At the doses prescribed by physicians, simple motor performance (e.g., finger or toe tapping) is not noticeably affected, but it is impaired when the dosage is increased (Dalton et al., 1975; Hart et al., 1976; Epstein and Lasagna, 1968; Klerman et al., 1960). For more complex tests of psychomotor performance, however, barbiturates taken at therapeutic doses impair performance. For example, barbiturates have been shown to impair eye-hand coordination and manual dexterity (Klerman et al., 1960; Billings, Gerke, and Wick, 1975; Dalton et al., 1975).

Within the cognitive ability domain, minor tranquilizers have the greatest effects on learning and, to some extent, memory. Substantial evidence exists to suggest that tranquilizers impair short-term memory (i.e., the ability to retrieve information presented seconds or a few minutes beforehand), only when the subject is in a drug-induced state at the time the information is presented. If the information is presented to the subject in a non-drugged state and the subject is asked to recall the items in a drug-induced state, no impairment is observed. (Ghoneim et al., 1975; Ghoneim et al., 1981; Liljequist, Linnoila, and Mattila, 1978; Ghoneim and Mewaldt, 1975). Research has also shown that minor tranquilizers do not affect long-term memory (Peterson and Ghoniem, 1980; Ghoneim and Mewaldt, 1975; McKay and Dundee, 1980; Brown et al., 1978).

Minor tranquilizers do, however, impair learning. These drugs can induce amnesia for events as well as for words and digits (Clark et al., 1970; McKay and Dundee, 1980). Subjects given minor tranquilizers also require more time than drug-free subjects to memorize a series of digits or pairs of words (Liljequist et al., 1978; Ghoneim et al., 1975; Peterson and Ghoneim, 1980). These findings suggest that tranquilizers impair the ability to store new information in memory.

Barbiturates impair a broader range of cognitive abilities. For example, long-term memory, the ability to retain information for hours, days, or longer, is adversely affected by barbiturates (Rundell et al., 1978). Research has also shown that therapeutic doses of barbiturates impair the ability to perform arithmetic problems. Experimental subjects required more time and made more errors than did drug free subjects (Epstein and Lasagna, 1968; Klerman et al., 1960; Blum, Stern, and Melville, 1964).

Barbiturates also affect communication skills. Persons who have been given therapeutic doses of this drug speak less frequently in a social situation and speak slower than persons given a placebo (Hutt et al., 1968; Stitzer et al., 1981b). These findings suggest that performance at any job that requires communication skills will be impaired to some degree by barbiturate use.

2.3.7.3 The Combination of Sedatives and Other Drugs

Sedatives as a class, when combined with other central nervous system depressants such as alcohol, produce potentiating effects; that is, the effects of sedatives and alcohol combined are greater than a simple sum of the two drugs. For example, an individual who has a standard dose of a sedative and then an alcoholic drink for lunch will experience an effect that is greater than the simple addition of one unit of effect due to the sedative and one unit of effect due to the alcohol.

Performance decrements due to sedative interaction effects have not been addressed in the scientific literature. It is likely, however, that the effects on performance described above would become more severe when two different sedatives are taken together. Given the information about performance decrements due to sedative drug use, it appears that learning and attention would be significantly impaired with a combination of sedatives and other depressants.

2.3.7.4 Tolerance and Withdrawal

Tolerance to minor tranquilizers and cross-tolerance to other central nervous system depressants occurs when drugs are used chronically. Evidence of physical dependence has been demonstrated by withdrawal symptoms. The literature, however, provides varying data on quantity and the length of time a minor tranquilizer must be taken for dependence to develop (Woolf, 1983). According to some sources, physical dependence to minor tranquilizers may require as little as two to six weeks, while other sources indicate that it may take as long as eight months for dependency to develop (U.S. HHS, 1987).

Signs and symptoms of chronic minor tranquilizer use include anxiety, insomnia, agitation, anorexia, tremor, muscle twitching, nausea and vomiting, hypersensitivity to sensory stimuli, and other perceptual disturbances (U.S. HHS, 1987). At non-chronic use levels, withdrawal symptoms also vary with the individual, dosage consumed, and length of time the drug has been consumed. Mild withdrawal symptoms are sometimes misdiagnosed as anxiety or gastritis (nausea, vomiting, and diarrhea). For this reason, mild withdrawal is often overlooked or denied in humans (Woolf, 1983).

In animal studies, results have clearly shown that barbiturate withdrawal severity is an increasing function of dose and duration of administration (U.S. HHS, 1987). The most severe signs of withdrawal from barbiturates are delirium and grand mal convulsions. Okamoto (1984) demonstrated that for animals the severity of withdrawal is a function of the rate of disappearance of the drug from plasma. For example, when the drug is slowly eliminated, severity of withdrawal is markedly reduced. Conversely, when the rate of elimination is increased, withdrawal signs intensify. The relationship between rate of elimination and severity of withdrawal has been demonstrated for barbiturates only; no such relationship has been found for minor tranquilizers (U.S. HHS, 1987).

For humans, withdrawal symptoms from some barbiturates are clinically similar to alcohol withdrawal symptoms. As with alcohol, these symptoms are severe

and death has resulted in some cases. Symptoms include anxiety, panic, weakness, muscle twitching, sweating, insomnia, nausea, vomiting, or diarrhea; these are most severe during the first two to three days of withdrawal. Grand mal seizures are a common feature of barbiturate withdrawal (Woolf, 1983).

Overall, tolerance and physical dependence occur with most drugs used to produce sedation, to produce sleep, or to allay anxiety. Withdrawal symptoms are very similar and are often called the general depressant withdrawal syndrome (Woolf, 1983). Differences in withdrawal symptoms vary for individuals and depend upon the type of drug, dosage, and length of time the drug has been taken. In some cases, withdrawal symptoms can be life threatening and require close medical supervision. The most severe withdrawal signs are generally observed only after prolonged exposure to high doses (U.S. HHS, 1987).

2.3.7.5 Discussion

In this section, two major classes of prescription sedatives are identified and discussed: minor tranquilizers and barbiturates. Of the two, minor tranquilizers are more frequently prescribed. The non-medical use (or abuse) of minor tranquilizers and barbiturates has decreased in recent years (U.S. HHS, 1987).

These drugs, when used for legitimate purposes and at therapeutic levels, have been shown to impair sensory functioning, and psychomotor and cognitive abilities. For example, minor tranquilizers and barbiturates impair sensory functioning and vigilance performance. In control room operations, sensory functioning is necessary to perceive incoming stimuli. Vigilance and sustained attention represent critical components of a control room operator's job.

Increases in minor tranquilizer dosage levels produce an increase in average simple and choice reaction times. When these drugs are used at low levels with no changes in dosage, performance is not impaired. Barbiturates, however, have been shown to decrease speed of response in simple and choice reaction time tasks. These data suggest that therapeutic use of barbiturates is likely to impair an operator's potential to respond rapidly to stimuli.

Minor tranquilizers appear to have little or no effect on simple or complex psychomotor abilities. Barbiturates, on the other hand, have been shown to impair complex psychomotor performance at therapeutic dosage levels.

Minor tranquilizers impair short-term memory, but have little or no effect on long-term memory. Both minor tranquilizers and barbiturates have been shown to affect learning. Barbiturates have also been shown to impair communication skills and ability to perform arithmetic problems.

To the extent that sensory functioning, short-term memory, and learning are required as part of a nuclear worker's job, therapeutic doses of minor tranquilizers can be expected to degrade job performance. Similarly, to the extent that sensory functioning, sustained attention, simple and

choice reaction time, psychomotor ability, learning, communication skills, and ability to perform arithmetic operations are requirements of effective job performance in nuclear power plants, then, therapeutic use of barbiturates can also be expected to have an impairing effect on job performance.

2.3.8 Over-the-Counter Drugs

Over-the-counter (OTC) drugs represent the classes of drugs that are available without a prescription and are generally indicated for self-medication of minor ailments, such as aches, pains, fevers, and colds. OTC drugs embody a wide range of drugs, all of which have a point of toxicity (Moore, 1983). However, only four clinical classes--sedatives, cough and cold medications, appetite suppressants, and analgesics--have psychoactive properties. Although these drugs rarely appear as an individual's primary drug of abuse, they are frequently misused. OTC drugs are often taken in larger than recommended dosages, taken in unsafe combinations with other substances, taken persistently over a period time, resulting in dependency or toxic reaction, or taken as a substitute when a primary substance is not available. Each of the four OTC drug classes contain substances described above or share properties with other drug types.

2.3.8.1 Physical Signs of Abuse

Psychological and behavioral symptoms associated with OTC sedative use include sedation, confusion, memory impairment, excitement, fixed and dilated pupils, fever, and hallucinations (Moore, 1983). Many OTC sedatives contain antihistamine, the primary substance also found in cough and cold medicines, allergy preparations, anti-motion sickness relievers, and analgesics (Blum, 1984). Antihistimines behave similarly to barbiturates, producing similar symptoms of intoxication as well as dependency.

Appetite suppressants and weight-loss drugs contain phenylpropanolamine, which is a central nervous system stimulant and is pharmacologically related to amphetamines. Phenylpropanolamine is also used as a decongestant, in combination with antihistamine. As would be expected, the symptoms of high dosage are similar to other central nervous system stimulants, and include elevation of mood and increased confidence and initiative (Moore, 1983). Side effects include hyperglycemia, hypertension, palpitations, headaches, irritability, nausea, apprehension, psychosis, and hallucinations (Moore, 1983; Blum, 1984). Like the amphetamines, frequent use of phenylpropanolamine can result in dependency (Blum, 1984).

In addition to containing antihistamine and phenylpropanolamine, OTC cold and cough medicines can also contain significant amounts of codeine, dextromethorphan, an isomer of codeine, and alcohol. Given their abuse potential, several states now require that these products be available through prescription only. In those states that allow cough syrups containing narcotics to be sold over the counter, opiate addicts are provided with a constant legal source, should illicit markets become scarce (Moore, 1983; Blum, 1984). Toxicity from these products resembles opiate overdose. Many cough and cold medicines also contain a significant amount of alcohol.

These products are commonly used by alcoholics when alcoholic beverages are not available (Moore, 1983).

Although analgesics are probably not consumed for their psychoactive properties, they have long been recognized to produce toxic psychosis at high doses. The delirium simulates alcoholic inebriation. Several physical side effects are also common, including hyperventilation, tinnitus with hearing loss, encephalopathy, gastrointestinal symptoms, hemorrhage, and kidney and liver disorders (Moore, 1983).

2.3.8.2 Effects on Performance

Because each of the four clinical drug classes have psychoactive properties, they also share the potential to adversely effect performance. Those OTC drugs that contain substances described in previous sections also share these drugs' effects on performance. For example, OTC drugs that contain narcotics or narcotic-like substances will impair performance in the same manner as the other opiates, and OTC medicines that contain alcohol will manifest themselves similarly. Sedation is one undesirable side effect of narcotics and antihistamines that can dangerously affect motor coordination, specifically when operating machinery or driving. Antihistimines produce sedation even at low therapeutic doses, and have been used clinically as sedative/hypnotics, similar in use to benzodiazepines (Linnoila et al., 1986). Individuals taking antihistamine medications will experience motor and sensory impairments, both of which impair the visual system (Linnoila et al., 1986). Analgesics also possess some capacity to impair driving by affecting perceptual, cognitive, and motor functions. Aspirin and acetaminophen, the two most common OTC analgesics, have not been shown to significantly impair performance; however, indomethacin and phenylbutazone have been shown to affect psychomotor performance (Linnoila et al., 1986).

2.3.8.3 Discussion

Although most OTC drugs appear to have relatively low abuse potential, some OTC drugs have significant abuse potential, and may cause impairment when taken in larger than recommended amounts, or consistently over a long period of time. Because of their psychoactive properties, the OTC drugs discussed above also present concern for individuals with drug and alcohol abuse histories as the consumption of some OTC drugs may contribute to relapse (Moore, 1983). While OTC drugs vary considerably in their dependence-developing qualities, and in the qualities that produce impairment, it is clear that the potential for misuse and abuse exists, and that they warrant attention in a comprehensive fitness-for-duty plan.

2.3.9 Summary

Use of the substances discussed in this section can directly and indirectly impair on-the-job performance in all phases of use: initial use, chronic use, hangover, dependence, and withdrawal. Studies have demonstrated effects due to drug use in the following areas: physical (physiological, psychomotor), cognitive (attention, numerical reasoning, short-term and long-term memory), psychological (depression, elation, delusions), and social

(interpersonal and group interaction). Areas in need of further research are the behavioral effects of polydrug use (a common yet complex phenomenon), the effects of over-the-counter and licit drug use, and the effects of long-term drug use.

With the exception of alcohol, it is very difficult to accurately predict the behavior of an individual under the influence of a particular substance and there is insufficient information to predict impairment from specific drug concentrations (McBay, 1986; Walsh, 1987). Many variables confound the relationship between drug dosage and impairment, including the type and potency of the drug, patterns or rates of consumption, the individual's physical and psychological characteristics, the environment in which the drug is used, and group interaction or the specific social environment involved. These confounding variables preclude generalizations regarding a specific drug intake and consequent behavioral effects. However, three generalizations can be made regarding the relationship between drug dosage and impairment: high doses generally have a greater behavioral effect than low doses, well-learned tasks are less affected by drugs than novel tasks, and motivation regarding the task is an important factor (Walsh, 1987). Although the specific effects of drugs cannot always be predicted, it is obvious from the research that use of any of these substances alone or in combination has the potential to impair workers in the performance of their duties.

2.4 CONCLUSIONS

The data presented in this section, in addition to that published in NUREG/CR-3916 (Radford et al., 1983), suggest that the use of illicit drugs, the misuse of legal substances, and performance-impairing psychological disorders are likely to be found among workers with unescorted access to protected areas in nuclear power plants. The important role that nuclear power plant workers play in ensuring safe operations has been demonstrated by events in nuclear power plants where even unimpaired employees have committed errors that challenged plant safety systems. Impaired workers with unescorted access may not only act in ways that could lead to additional events, but are unlikely to be able to respond appropriately to potentially dangerous situations that arise. Taken together with the findings of the 1982 research, the literature presented here indicates that NRC concern with a spectrum of fitness-for-duty issues is warranted.

3.0 PRACTICES IN OTHER INDUSTRIES

In response to the apparently growing need to address drug and alcohol abuse in the workplace, both public and private sector organizations have developed, or are in the process of developing, fitness-for-duty programs. In this section, current and proposed fitness-for-duty requirements for federal employees and private sector employees subject to federal regulation are discussed. The approaches taken by private organizations to preventing and detecting employee impairment and data that address the prevalence of these approaches are also presented. In addition, a description is provided of fitness-for-duty practices in six organizations that are in regulated industries and whose operations can affect public health and safety. The information in this section is useful for identifying the range of approaches that nuclear licensees are likely to take in developing their fitness-for-duty programs with or without a specific NRC rule.

3.1 CURRENT AND PROPOSED FITNESS-FOR-DUTY REQUIREMENTS FOR FEDERAL EMPLOYEES

The Department of Defense (DoD) has implemented the most extensive fitness-for-duty program currently in existence for both military and civilian personnel. The DoD has a goal "to be free of the effects of alcohol and drug abuse; of the possession of and trafficking in illicit drugs by military and civilian members of DoD; and of the possession, use, sale, or promotion of drug abuse paraphernalia" (32 CFR 62.4(a)). Although the programs vary somewhat across service branches and for different units within branches, all members of the U.S. Army, Navy, Marine Corps, and Air Force on extended active duty have been subject to mandatory drug testing on at least an annual basis since 1972. The DoD began random urinalysis testing programs to detect illegal drugs for these service branches in 1982. The U.S. Coast Guard (USCG), a branch of the armed forces that is part of the Department of Transportation during peacetime and the Navy during war, also has a drug testing program.

Testing of active duty military personnel is conducted pursuant to DoD Directive 1010.1, issued December 28, 1983. Department of Defense regulations for implementing a systematic drug abuse testing program in each service branch appear in 32 CFR Part 60; the policy for education and training in alcohol and drug abuse prevention appears in 32 CFR Part 62a. Drugs tested include marijuana, morphine, methadone, codeine, amphetamines, and barbiturates (32 CFR 60.3(b)(3)).

Civilian employees of the DoD were the first non-military federal employees to be subject to drug testing. The basis for the programs is DoD Directive 1010.9, issued April 8, 1985, which authorized each military department to establish a Civilian Employees Drug Abuse Testing Program. The Directive requires civilian employees in critical jobs and applicants for such positions to participate in urinalysis drug testing (1) before appointment or selection, (2) periodically thereafter on the basis of neutral criteria, (3) when there is probable cause to believe that the employee is under the influence of a controlled substance while on duty, and (4) in the course of investigating an accident for the purpose of accident analysis and the

development of countermeasures. Critical jobs include jobs in law enforcement; positions involving national or internal DoD security in which drug abuse could cause disruption of operations, destruction of property, threats to the safety of personnel, or unwarranted disclosure of classified information; and jobs involving protection of property or persons from harm. The Department of the Army implemented the directive with Regulation 600-85, Interim Change No. I11, issued February 10, 1986. The Regulation provides for urinalyses that may be required periodically or a random basis.

Non-DoD civilian employees of the federal government have only recently become subject to mandatory drug testing programs. The basis for most of the programs is Executive Order 12564, signed by the President on September 15, 1986 (3 CFR 224). The order requires each executive agency to develop a plan for achieving the objective of a drug-free workplace, a program to test for the use of illegal drugs by employees in sensitive positions, and an employee assistance program. The extent and criteria for drug testing are to be determined by the head of each agency. The Federal Office of Personnel Management issued guidelines implementing the Order on December 1, 1986.

The Department of Transportation (DOT) began random drug testing of its employees in safety-related jobs in September 1987. Most of the DOT employees being tested initially are in aviation-related positions. Of the first 720 employees tested, five had positive tests for illegal drugs ("Drug Testing," 1988). Approximately one-half of DOT's 60,000 civilian employees are eventually to be tested. The Department of Justice has also implemented a drug testing program for employees in sensitive positions.

The U.S. Customs Service requires employees seeking promotion into certain covered positions to undergo mandatory urinalysis testing for illegal drugs. The covered jobs include positions that directly involve the interdiction of illicit drugs, require the carrying of a firearm, or involve access to classified information. The requirements were initiated in July 1986 pursuant to a directive by the Commissioner of the Customs Service.

3.2 FEDERAL REQUIREMENTS FOR PRIVATE SECTOR EMPLOYEES

The DOT has been the leading federal agency in implementing drug testing programs for private sector employees subject to federal regulatory jurisdiction. As of this writing, none of the agencies in the department require random drug or alcohol testing, but such requirements are being actively considered. The DOT is currently reviewing the drug regulations of each of its administrations that regulate transportation modes (52 FR 40566, 1987).

The Federal Railroad Administration has detailed regulations covering alcohol and drug use by railroad employees whose working hours are regulated under the Hours of Service Act (15 U.S.C. 61). Employees are prohibited from using, possessing, or being impaired by alcohol or controlled substances while on duty (49 CFR 219.101). Blood and urine samples of employees involved in railroad accidents are to be taken and preserved (49 CFR 219, Subpart C). Railroad companies may require breath or urine tests from employees when there is reasonable cause for suspecting prohibited use of

alcohol or drugs (49 CFR 219, Subpart D). Railroads also are required to administer a drug test to new employees covered under the Act (49 CFR 219.501).

The Federal Highway Administration prohibits interstate commercial truck drivers from using amphetamines, narcotics, or any habit-forming drugs, and also requires that they have no current clinical diagnosis of alcoholism (49 CFR 219.501). The Administration is preparing a notice of proposed rulemaking that will mandate a comprehensive drug control program applicable to all drivers in interstate commerce (52 FR 40630, 1987).

The Federal Aviation Administration (FAA) prohibits flight crew members from being under the influence of alcohol or drugs. Tests must be taken within four hours of acting as a crew member when there is a reasonable basis to suspect a violation (51 FR 44433, 1986). The FAA has suggested that random and scheduled drug and alcohol testing may be needed for flight crew and certain ground crew members to protect the public safety (51 FR 44434, 1986). A proposed rule that would require random testing of airline employees has been submitted by the DOT to the Office of Management and Budget for review and clearance prior to publication in the Federal Register (Bureau of National Affairs, 1987a). Under Executive Order 12291 issued by the President on February 17, 1981, virtually all proposed rules by executive branch agencies must be submitted for review to OMB.

The USCG is the primary maritime law enforcement agency for the U.S. It has proposed regulations prohibiting operation of a vessel while intoxicated (52 FR 4116, 1987). For commercial operators, intoxication is defined to be a blood alcohol level of 0.04% or more, or when the effect of alcohol or an illegal drug on the operator's manner or behavior is apparent. For recreational operators, the applicable percentage is 0.1%.

The USCG also is preparing a notice of proposed rulemaking covering use of dangerous drugs by merchant marine personnel. The option being considered is a requirement that individuals applying for licenses, certificates of registry, and merchant mariners' documents provide the results of drug tests before issuance or renewal (52 FR 40582, 1987). The proposal will also address the need for random drug testing.

Thus, the NRC's concern with the impact on public health and safety of drug and alcohol abuse by workers at nuclear power plants is occurring at a time when similar concerns are resulting in the expansion or development of fitness-for-duty programs in other areas of federal activity. Data pertaining to the effectiveness of these other programs, as they become available, will be useful to the NRC in refining the fitness-for-duty rule that is promulgated. In addition, information about programs developed in the private sector to address fitness-for-duty problems may be useful to the NRC and to licensees in deciding how these problems can best be resolved.

3.3 APPROACHES TO ASSURING FITNESS FOR DUTY IN THE PRIVATE SECTOR

Just as there is an increasing trend in government toward programs to address fitness-for-duty problems, particularly drug abuse, the private sector also is characterized by increasing attention to the resolution of fitness-for-duty problems. There are several approaches used by private organizations to cope with employee fitness-for-duty concerns: company policies that address drug and alcohol abuse, employee assistance programs, and drug testing programs. The available data indicate that the use of all three approaches is increasing as the private sector seeks to minimize the effects of troubled employees on their organizations.

In this section, the literature that describes private sector efforts to address fitness-for-duty problems is reviewed. The prevalence of company policies, employee assistance programs, and drug testing are discussed separately, although many organizations use these approaches in some combination.

3.3.1 Company Policies

Company policies on drug abuse vary significantly among organizations and industries. Despite such variations, private sector organizations are increasingly implementing formal, written policies that address drug abuse. Comparing companies with substance abuse policies in 1981 and 1986, Schreier (1987) reported that, of the companies surveyed in 1981, 50% had written policies addressing all substance abuse, 6% had written policies on alcohol exclusively, and 44% had no written policies. By 1986, 72% had written policies addressing all substance abuse, 6% had written policies on alcohol exclusively, and only 22% had no written policies. Thus, there is a clear trend for companies to formalize their concerns with substance abuse into written policies.

A number of factors have motivated companies to develop formal, written drug and alcohol policies. When asked what factors led to their current drug abuse policy, the primary factors cited by organizations in Schreier's 1981 survey were: impacts of substance abuse on job performance (57%), absenteeism (36%), and a rise in the cases of drug and alcohol abuse among employees (25%) (Schreier, 1983).

Organizational characteristics appear to affect the type of policy each company develops. Among these factors are the organization's need for safety, the extent of the problem, organizational size, workforce composition, and federal, state and industry-specific regulation.

The organization's need for safety is one of the major factors that may affect the type of drug policies and programs that an organization decides to institute. The Department of Health and Human Services (1987) recommends this need as one of the major criteria for decisions to implement drug testing policies and programs. Furthermore, a study by Gomez-Mejia and Balkin (1987) found that a drug testing program directed specifically at safety-related jobs was considered more effective than other programs.

Another force motivating the institution of corporate drug and alcohol policies is the existence of a significant substance abuse problem in the workplace. When asked what led to policy development in their organizations, a rise in the cases of drug abuse within the company was the answer given the third most often by respondents in Schreier's 1976, 1981, and 1986 surveys (Schreier, 1987). Other authors have described specific companies where the workers themselves have called for a drug policy because of extensive drug use among co-workers (e.g., Bales, 1987).

Organizational size is also related to policy development. Large companies are more likely to report having problems with drugs in the workplace and having mechanisms such as policies and programs in place to deal with them. Madonia (1984) concludes from the results of his survey, "Emphasis on company sponsored programs begins when workforce size exceeds 3,000 employees. Companies with more than 10,000 workers almost always provide a company sponsored program" (p. 137).

Workforce composition can also influence corporate policy. A survey conducted by American Viewpoint (1986) found that women, blacks, persons of lower/middle income, persons over age 45, and individuals from the South are more likely than men, high-income respondents, persons under 45, and non-southern residents to support a policy of mandatory drug testing by their employers (American Viewpoint, 1986). Putnam and Stout (1985) found that the chances of an organization adopting a policy on alcohol increased by 15% when a union representative was present. Roman (1980) also suggests that unions have been very active in the institution of a number of broad-based assistance programs.

3.3.2 Employee Assistance Programs

Employee assistance programs (EAPs) are in existence in an increasing number of companies, especially larger organizations. As will be discussed in greater detail later in this report, EAPs are company-sponsored programs that assist employees with personal problems that may affect the quality of their job performance. Repeated surveys of Fortune 500 companies showed EAPs in 25% of the companies in 1972, 34% in 1974, 50% in 1976, and 57% in 1979 (Roman, 1980); in 1986, 80% of the Fortune 500 companies had EAPs ("Drugs at Work," 1986).

Much of the literature suggests that EAPs in the U.S. are moving to a broad-brush approach; expanding their programs from treating only alcohol and drug problems to providing personal counseling in a wide range of areas such as counseling for marital, financial, or personal problems (Walsh, 1982; Roman, 1981a). When asked if they saw the move to include alcohol and drug abuse assistance programs in a broader fitness or wellness program, over half the organizations in the Schreier survey (1983) responded that they did see this as a trend in the coming years.

3.3.3 Drug Testing

Drug testing is also becoming more prevalent as a means for private sector organizations to confront fitness-for-duty issues. Types of drug testing used by organizations in the private sector are:

- pre-employment drug testing
- observed-impairment drug testing (also called for-cause testing)
- post-accident drug testing
- testing as part of scheduled physical examinations
- random drug testing
- follow-ups to verify continued abstention.

Data are currently unavailable on the percentages of each type of testing conducted by private corporations in the U.S., although it appears that large private organizations are increasingly using pre-employment testing, and that all types of drug testing are being used more now than five years ago.

Several surveys have documented the increased prevalence of drug testing in large U.S. corporations. A 1987 telephone survey of the Fortune 100 Industrial Corporations found that 50% conduct pre-employment drug tests for all applicants, 8% allow local/divisional decisions, 19% are reviewing whether to have drug testing, and 20% have no plans to test (Masi, 1987). Miners, Nykodym, and Samerdyke-Traband (1987) reported that about one-third of all Fortune 500 companies were conducting some form of drug testing in 1987, while less than 5% of these companies were testing in 1983. A survey conducted by the College Placement Council (Babush, 1987) found an expected increase in pre-employment drug tests across all industries surveyed, (e.g., licensees, aerospace, petroleum and allied products, research and consulting organizations, construction, and banks). Within two years, 47.7% of the firms surveyed planned to be conducting pre-employment screening tests in comparison to the 28.2% that tested at the time of the survey.

When a sample of the Fortune 500 companies was asked why they have implemented drug testing, 42% answered because of "incidents of drug use at the company." Other answers included implementing drug testing to respond to a general concern for safety of employees (26%), government regulation (10%), or a national rise in drug use (6%); to follow the lead of other companies (3%); to try to keep down health care costs (3%); to allow the enforcement of drug policy (3%); and to improve public image (3%). Another 3% indicated drug testing was a "sign of the times." This information comes from "Drug Testing in Major U.S. Corporations: A Survey of the Fortune 500," October 1985, conducted for Compu Chem Laboratories, Inc., by Noel Dunivant and Associates, as cited by Kendall (1986).

Drug testing also appears to be increasing among smaller businesses. A survey by the American Managerial Association, primarily of small- to medium-sized firms, reported that 21% tested for drugs (92% of which conduct pre-employment screening tests) (Masi, 1987). The organizations in this survey cited the following reasons for conducting pre-employment drug tests: workplace safety (72%), job impairment/productivity (57%), public safety (42%), workplace morale (22%), and public trust (13%).

Gomez-Mejia and Balkin (1987) investigated differences between companies that have drug testing programs and those that do not. They found that firms using drug-testing are larger in size, are typically manufacturing industries, are located in the Northeast, have younger employees, and have a higher proportion of blue-collar production employees than firms that do not test. Firms not using drug testing expressed concern with the legal ramifications of drug testing and were more likely to agree with the statement "management prefers a hands-off approach to employee personal problems."

3.4 FITNESS-FOR-DUTY PRACTICES IN RELATED INDUSTRIES

To gain a more detailed understanding of how organizations that are similar to nuclear licensees assure that their employees are fit for duty, a survey of the fitness-for-duty practices of six organizations was conducted. These organizations are similar to nuclear licensees in that they are regulated and their operations can affect public health safety. The six organizations surveyed were a railroad company, a public transport company (county bus), a shipyard with both civilian and military personnel, a commercial airline, the petroleum industry, and a Department of Energy (DOE) contractor.

These organizations were selected based on discussions among project staff and NRC personnel. All identified organizations agreed to participate in the survey. To provide confidentiality, company names are not reported here. The survey interviews were conducted with the EAP director of each organization during January 1988. A structured interview guide was developed and used during each two- to three-hour survey interview.

It should be noted that opinions provided by EAP representatives (program directors) cannot be presented as entirely unbiased. As with viewpoints expressed by anyone on drug testing approaches, there are likely to be strong opinions. The following steps were taken in the interview process to minimize potential bias.

1. Interviews were conducted with a structured interview guide, which has been shown to result in more accurate and less biased information than other less structured interview approaches (Pursell, Campion, and Gaylord, 1980).

2. Except at the end of the interview, when EAP representatives were asked for their opinions about various drug testing approaches, interviews focused on questions of a factual nature (such as, what is the organization's approach to drug testing? and does the company have a written policy related to drugs?)

3. EAP directors were chosen as interview sources because they have an in-depth knowledge of the topic and are less likely to be biased than other company employees who are less knowledgeable and who might be subject to various drug testing approaches.

Table 3.1 summarizes the approaches used by each organization and the applicable regulatory requirements. Descriptions of each organization's approaches are provided below, followed by a summary of the findings and their implications for the nuclear industry.

TABLE 3.1. Summary of Industry Approaches

INDUSTRY	EAP	Drug Policy	Supervisory Training	Drug Testing Required					Regulator	Regulator Requirements (as of Feb. 1988)
				Pre-Employment	Observed-Impairment	Post-Accident	With Physical Exams	Random		
Railroad	Yes	Yes	Yes	Yes	Yes	Yes*	Yes	No	Federal Railroad Administration	Pre-employment, observed impairment, post-accident [1]
Public Transport (County Bus)	Yes	Yes	Yes	No	Yes	No	No	No, unless test positive, then 2 years	Dept. of Transportation	None, although DOT requires random drug testing in aviation-related positions
Shipyard										
Civilian Employees	Yes	Yes	Yes	No	No, but b'alyzer requested	No	No	No	Laws for federal employees	None, although random being proposed [2]
Military Employees	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Dept. of Defense	"Pre-employment," when a recruit, observed-impairment, post-accident, random
Commercial Airline	Yes	Yes	Yes	Yes	No, but requested	Yes, by FAA	No	No	Federal Aviation Administration	Report to FAA if pilot unfit; considering random for flight and some ground personnel
Petroleum	Yes	Yes	Yes	Yes	Yes	No	No	No	Applicable state laws	Varies by state; none require testing, most restrict
DOE Contractor (Energy-Related Activities)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No, unless test positive	Department of Energy	None, although DOE has a drug statement.

1 On February 11, 1988 a federal court in California ruled that mandatory post-accident drug testing of railroad workers is unconstitutional.
2 On March 1, 1988 a federal district court ruled that the Army's random drug testing of civilian employees is unconstitutional.

3.4.1 Railroad Company

The EAP at the railroad company was established in the early 1950s as one of the country's first occupational alcoholism programs. Drug abuse diagnosis and treatment became a part of the EAP in the late 1970s in response to the drug abuse problems of returning Vietnam veterans. Since that time, the EAP has continued to broaden in scope and now addresses a wide variety of employee personal problems, including assisting employees in the adoption of children.

Employees are informed about the EAP's services in several ways. A booklet that describes the EAP and the company's drug policy is distributed to all new employees. The EAP also provides brochures on a range of issues that may be of concern to employees, and EAP representatives give talks to employee and supervisory groups on these issues. In addition, EAP staff train supervisors on how to identify impairment and confront employees, if necessary. A manual is distributed covering these topics.

The company's policy related to drugs is called "Rule G." Rule G states that "employees who operate company vehicles at any time must not report for duty with a blood alcohol content greater than .000 . . . or under the influence of illegal controlled substances . . . or under the influence of prescription drugs that may affect alertness, coordination, reaction or response to safety." In practice, the policy applies broadly to anyone who assists with the movement of vehicles or is in some way responsible for the safety of vehicles (i.e., most unionized operations jobs).

Because Rule G primarily applies to union employees, the unions have been a major factor in its implementation. For example, an appeals process has been devised for union members who wish to protest how a case is handled. The appeal is heard by a three-member group that includes one union representative, one management representative, and one neutral arbitrator.

Rule G and the associated EAP were designed to reflect Federal Railroad Administration (FRA) regulations regarding drug and alcohol use. However, the policies at this company are more stringent than those required by FRA regulations. The company sets the cut-off limit for alcohol as any amount of alcohol in the system (above 0.0% BAC), whereas FRA regulations stipulate 0.04% BAC.

Drug testing is a major component of the railroad's approach to assuring that its employees are fit for duty. Company policy requires pre-employment, post-accident, and observed-impairment testing, as well as testing during an annual physical examination. However, a recent federal court ruling in California that limits the post-accident testing of railroad workers may result in a change in the company's post-accident testing policy.

Observed-impairment testing occurs if an individual appears to be intoxicated on the job. Two supervisors must concur that there is a reasonable cause for testing and one of these supervisors must have received training on signs of drug intoxication from the EAP. Employees who refuse to be tested, either

post-accident or based on observed-impairment, are removed from service until there is an investigation.

If an employee tests positive after an accident or as the result of an observed-impairment test, the individual is terminated from employment. The person is then given the opportunity to be reinstated by obtaining treatment through the EAP and agreeing to be on probation for a year following treatment. When the individual contacts the EAP, the EAP counselor arranges for evaluation through an external treatment program, such as the substance abuse unit in a local hospital. Based on this evaluation, the type of further treatment necessary is determined and may consist of either continued hospitalization or outpatient treatment.

In the case of an individual who has tested positive for marijuana (i.e., a test result exceeding the company's cut-off level of 100 ng/ml), a more stringent urinalysis drug test with a cut-off level of 20 ng/ml must be passed before returning to work. If the individual has been a heavy user of marijuana, it may take months before this test can be passed because of the length of time marijuana metabolites are present in the body. (See Section 5.1.7.1 for a discussion of this issue.)

Once the individual returns to work, he or she is on employment probation for one year. The employee signs a contract pledging total abstinence from drug use, attendance at weekly support group meetings, and monthly discussions with the EAP counselor. A person violating the probation requirements may be allowed a second one-year probation. There is no scheduled or random drug testing of this person once back on the job. However, the individual continues to be subject to the observed-impairment and post-accident testing requirements applied to everyone. If the employee has a second positive test as a result of post-accident or observed-impairment testing within 10 years, and if an investigation shows that Rule G was again in fact violated, the person is permanently dismissed.

In addition to the post-accident and observed-impairment drug testing described above, employees are subject to drug screening during physical examinations. This program is administered by the company's medical personnel, who work with the EAP when an employee tests positive. All employees in operations are obligated to take a physical, some on a yearly basis, as well as all employees who have been off service for a period of time (e.g., due to the seasonal nature of some jobs).

A urinalysis drug test is conducted by the company's laboratory as part of the physical. If someone tests positive, a letter is sent to the employee and the EAP, but not to company management. This letter states that the person was found to test positive and provides instructions to contact the EAP within seven days. When the employee contacts the EAP, he or she is sent for an external evaluation and a treatment plan that is matched to the person's needs. As long as the recommended treatment plan is followed, no mention of the positive test is made to anyone in management. However, if the person does not contact the EAP, another letter is sent and the employee is given an additional five days to contact the EAP. If the person still fails to make the contact, a letter is then sent to the person's manager that

states that the individual has failed the physical, will be removed from the job, and will be placed on medical leave. The employee cannot return to work until he or she has been evaluated and received appropriate treatment.

The railroad does not use random drug testing. The EAP representative interviewed stated that he thought random testing would result in employee animosity toward the company and would be detrimental to morale. In the past, workplace searches for drugs using dogs were tried. These searches were dropped because of strong objections by employees.

3.4.2 Public Transport Company

The public transportation company's focus on drugs in the workplace began as a management statement that drugs will not be tolerated in the workplace. The present policy, developed over a two-year period, states that "the use, sale, or possession by an employee of an intoxicating liquor, controlled substance, drug not medically authorized, or any other substance which impairs job performance or poses a threat to safety . . . will result in termination." The union was opposed to the policy at first. However, the union's lawyer could not find a legal basis for challenging the policy and so it went into effect over the union's objections.

The EAP at this company was not developed in response to regulatory requirements, but rather in response to a perceived need. In fact, as of January 1988, the DOT, which regulates this company's activities in other areas, has not developed specific substance abuse policies that pertain to the company's drivers. Like the railroad's program, this bus company's EAP is designed to address a wide variety of employee problems. For example, an EAP representative intervened when an employee was unable to sleep at night due to the barking dog of an unresponsive neighbor. Because this company's policy and its implementation are innovative within the industry, both the DOT and the National Transportation Association have sought to learn about the organization's program.

Supervisors are considered to be the key to administering the company's program. They are responsible for educating employees about company policies and programs, and are given an Alcohol and Substance Abuse Manual to guide their efforts. Included in the manual are procedures and forms for supervisors to use when administering program requirements. Supervisors are trained by EAP representatives to identify and deal with employee impairment of all types. This training includes role-play and instructs supervisors on how to recognize different types and levels of impairment.

Company employees are encouraged to seek voluntary and confidential assistance from the EAP before substance abuse problems affect their employment status. Consequently, self-referral is the primary means by which employees come to the EAP. When first contacting the EAP, the employee signs a pre-diagnosis contract agreeing to seek treatment if a substance abuse diagnosis is made. The employee is then referred outside of the EAP for evaluation and treatment. If the individual fails to follow-through on the agreement to seek treatment, the EAP counselor reports the employee's lack of compliance to his or her supervisor. If the individual requires in-patient

treatment, the supervisor is notified that the person is on medical leave, but no mention is made of the nature of the problem.

The EAP representative interviewed perceives the company's drug program as proactive, both in terms of encouraging employees to address their problems and in terms of preventing harm to the workers and the public. The representative views observed-impairment testing, the company's testing method, as a reasonable method to achieve the company's safety goals.

If a supervisor observes a person to be impaired on the job, the person is sent to a local hospital where a physical examination is conducted. In this way, an undiagnosed medical problem can be ruled out (as was the case for one person with a brain tumor). The examination includes a urine test, which screens for drugs, and a blood test to check for the presence of alcohol. In order for the testing to be done, consent forms must be signed by the employee, and the supervisor must complete an Impaired Behavior Report Form. This form requires the supervisor to assess the employee's speech, dexterity, judgment and decision making, and appearance.

If the person tests positive for drugs or alcohol (above 0.0% BAC), the person is terminated. However, the individual then has the opportunity to contact the EAP to be evaluated and receive treatment. Following treatment, the person will be reinstated in his or her job if he or she agrees to random drug screening for two years. In cases where the supervisor has referred the person for testing and the test results are positive, the EAP counselor may advise that supervisor on how to handle other employee inquiries in order to maintain confidentiality for the employee being treated.

To identify treatment programs for employees, the EAP counselor interviews representatives of the various programs, reviews their treatment methods, and stays in contact with them when there is an employee in the program. There are some treatment programs that the company will not use due to their questionable effectiveness. However, patients who are self-referred are free to choose their own programs.

The company does not use pre-employment drug testing. The EAP representative interviewed gave several reasons for not conducting this type of test: the tests are expensive; with the exception of marijuana, most people can rid their systems of evidence of drug use in 72 hours or less; and other selection procedures, such as an interview process where an interviewer is trained to discern whether or not a person is impaired, may be able to determine if an applicant has a substance abuse problem.

The company also does not conduct post-accident, annual, or random drug testing (unless a person has tested positive, as described above). The EAP representative's perceptions of random drug testing for all employees were that it is ineffective because a positive test result does not indicate whether or to what degree the person is impaired and the cost of such a program would be very high. In the representative's opinion, the money required for random testing would be better spent on education and treatment.

Some recent trends noted by the EAP representative include the return of heroin and hallucinogens as drugs of abuse in the workplace, an increase in cocaine abuse, and the drug user with AIDS. In addition, the pure alcoholic who uses no other drugs is now typically someone over 40 years old. People under 40 may use alcohol, but are more likely to combine it with other substances.

3.4.3 Shipyard

The shipyard has two types of personnel, civilian and naval. The programs that the organization has developed to address drug issues differ for these two employee populations, reflecting differences in the regulations that apply to each group.

A broadbrush EAP is available to civilian employees, including managers. The key to this program is supervisory observation for impairment. Supervisors and managers receive two-and-one-half hours of EAP training on drug and alcohol abuse and yearly two-hour refresher sessions. Supervisors are trained in this program to carry out interventions. Union representatives may intervene as well. The union has been supportive of this program, and there have not been problems in implementing it. Civilian employees can contact the EAP themselves, or they may be referred by supervisors and, in some cases, co-workers. Forced rehabilitation can occur when a supervisor follows the disciplinary process and informs the employee that he or she must seek help or else be terminated due to job performance problems.

Civilian personnel are not subject to drug testing except for being requested to take a breathalyzer test for alcohol if they are observed to be impaired on the job. If an employee is requested to take a breathalyzer test and refuses, he or she is removed from the job for that day and an investigation is undertaken to determine whether the person was in fact impaired. A 0.1% BAC reading on the breathalyzer is considered to be evidence of impairment. Lower (unspecified) cut-off levels may be considered to be evidence of impairment if the person performs a safety-related job. If the employee tests positive on the breathalyzer, he or she is referred to the EAP for evaluation and a treatment recommendation. The treatment may include signing a contract which states that the person consents to follow the recommended treatment plan.

While civilian employees are not currently subject to drug testing, if new federal regulations requiring random drug testing of all federal employees are implemented, random drug testing will be implemented for civilian shipyard personnel. The EAP representative interviewed voiced several concerns about random drug tests. The primary concern was that random testing may identify innocent people; the representative noted, for example, that a person may test positive if he or she has used a prescribed cough medicine containing codeine, forgets about it, and fails to inform the company about it when being tested. The representative also felt that random drug testing may be reasonable in a military setting where national security is an issue and people have agreed to forego certain rights, but that it is inappropriate for civilian personnel. Further, the representative questioned its effectiveness by stating that there are a number of "designer" drugs

available now that are too quickly metabolized to be detected by drug testing and that a "smart" addict is likely to be able to avoid detection. In the representative's opinion, only observation of impairment by a trained supervisor will identify these people.

The military personnel at this shipyard are subject to DoD regulations which require random drug testing of all naval military personnel. The tests are conducted by the shipyard's medical laboratory. Confirmatory tests are conducted on any samples that are positive on the first test. If any military personnel receive confirmed, positive test results, they are removed from their jobs and offered treatment through an EAP. Military supervisory personnel receive EAP training. In addition to random drug testing, drug testing for military personnel is conducted for new recruits (the equivalent of pre-employment screening), for individuals who are observed to be impaired, following accidents, and with physical examinations.

3.4.4 Commercial Airline

The commercial airline company has a broadbrush EAP, with an EAP office in each of its major regions. The EAP was established in the 1960s and focused primarily on alcohol, but it has since expanded in size and in the scope of its services. The FAA requires the airline to report any known problems a pilot has with alcohol, drugs, psychosis, or suicidal depression, but with the exception of pilots, use of EAP services is kept confidential. Participation is strictly voluntary. A company assessment of the EAP concluded that it provided the organization with an 8:1 return on investment. The primary savings were due to reduced sick leave time. In addition to an EAP, the company conducts pre-employment drug screening, which is performed by the airline's medical department. Individuals who test positive are not hired.

The airline's personnel policies contain a section that specifically addresses drug and alcohol abuse. The policy section encourages employees to seek assistance voluntarily when needed, assures confidentiality, and stresses that problems should be addressed prior to severe decrements in job performance (and possible discipline). It also outlines the steps a supervisor should take if performance decrements are observed and describes the role of the employee assistance representative. In addition to the policy statement, brochures and posters are provided in the workplace to make the EAP's services known.

Supervisors, managers, and union shop stewards receive training from EAP personnel on how to handle fitness-for-duty problems. There is initial training at the corporate office, as part of the new supervisor training program, and periodic one-and-one-half hour refreshers. The focus of the training is to teach supervisors how to approach the employee; document performance problems, if necessary; and then encourage the person to contact the EAP representative. Supervisors are not trained to diagnose problems. Also as part of their training, supervisors see the film, "The Troubled Employee," which emphasizes five major points: (1) recognition of a problem, (2) performance-based documentation, (3) action (and if necessary, progressive discipline), (4) referral to the EAP, and (5) reintegration after

assistance or treatment. The film discourages moralizing and attempts by the supervisor to diagnose or to cover up the employee's problem.

This organization conducts pre-employment drug screening. The tests are performed by the airline's medical department. Individuals testing positive are not hired.

If an employee is observed to be impaired on the job, he or she is removed from job responsibilities and then asked, but not required, to take a test for drugs. Most union members are advised by their union representative not to submit to testing. Company policy states that an employee will be fired if an investigation and a hearing determine that he or she has been under the influence of drugs or alcohol while on the job. The services of the EAP are always offered and, although the EAP does not formally serve as a route to reinstatement, the employee may be reinstated if treatment is completed and the employee's supervisor would like the individual to return. The EAP does not provide follow-up services after treatment.

The airline does not conduct random drug tests. The EAP representative interviewed saw random drug testing as conflicting with the goals of an EAP. The representative felt that an EAP program offers help to employees, whereas random drug testing seems "out to get" them. The EAP representative was concerned with the following issues related to random drug testing:

- Most random drug testing would focus on the use of illegal drugs only, whereas alcohol is one of the most abused drugs.
- Drug testing would only be able to detect a portion of the drugs that employees may abuse.
- If an employee could produce a prescription, then he or she might be allowed to test positive without referral to the EAP for assessment.
- Evidence of a certain level of drugs in a person's system may not correlate with impairment.
- If the EAP were used as a route to reinstatement, employees might not view the EAP positively and so become reluctant to self-refer.
- Tests may not be accurate and "innocent" employees may be subjected to disciplinary actions.
- There is increasing evidence that certain harmless, legal foods (e.g., poppy seeds) can cause positive test results.

Each of these issues is discussed in later sections of this report.

3.4.5 Petroleum Industry

EAP representatives from three major petroleum companies were interviewed about their approaches to fitness for duty and drugs in the workplace.

Because their approaches are very similar, a summary of all three companies' programs is provided in this section.

Each company has a written policy on drug and alcohol use in the workplace. The policy applies to all employees and contractors and prohibits drug and alcohol use which adversely affect job performance. The policy requires pre-employment drug and alcohol screening and allows for-cause drug testing only when there are documented and observable job performance problems. The policy does not address the use, possession, or sale of drugs off the worksite. Drug use off the worksite is addressed only when it results in behavior that interferes with job performance. The current policy was developed because of a perceived need for pre-employment drug screening and a desire to formally state the company policy. Although the unions generally do not like the policy, union activities have had little impact on its development and implementation.

All employees are made aware of the drug policies and company EAPs through employee education seminars and meetings that include the use of lectures and videotapes. Supervisors receive additional training on how to recognize drug abuse, what to do if an employee is suspected of abusing drugs or alcohol, and how to document unacceptable job performance. Contractors receive a copy of the company policy, but they do not receive training.

Each company had an EAP in existence before its drug policy was developed. These companies use external EAPs because each company's operations are spread over various states and countries. The EAP services are available to company employees but not to contractors. The programs address drug, alcohol, emotional, marital, and financial problems. Employees can be self-referred, referred by a supervisor, or referred by the company's medical department; for one company, the percentage of the total referrals for these three categories is estimated to be 60%, 30%, and 10%, respectively. No disciplinary action is taken if an employee self-refers. The EAP representative maintains the confidentiality of employees participating in the program, and there is no "forced" rehabilitation, although supervisory referral implies that the employee's job is in jeopardy.

The petroleum companies use pre-employment and observed-impairment drug testing, but do not test for drugs during annual physical examinations. Companies can also search the workplace for possession of drugs, although such searches are rarely conducted. Drugs tested for include marijuana, codeine, morphine, PCP, cocaine, methamphetamine, amphetamines, and opiates. Blood alcohol content is tested in observed-impairment tests only when alcohol is suspected of contributing to the employee's adverse behavior. RIA or EMIT® tests are used for initial screening and GC/MS is used for confirmatory testing; cut-off levels are those set by the U.S. Department of Health and Human Services. Testing is contracted out to drug testing laboratories and results are provided to the company's medical department, which informs the employee. Positive test results for alcohol usually result in the employee being referred to the EAP for rehabilitation. Employees who test positive for drugs are terminated, although there may be rare exceptions in cases involving extenuating circumstances.

Each company believes their drug policy has reduced drug abuse in the workplace. The main element in the policy they view as responsible for this reduction is the pre-employment screening. Although there is a "feeling" that the drug program and EAP are effective, no data are collected to substantiate effectiveness.

3.4.6 DOE Contractor

The Department of Energy (DOE) contractor is in the process of implementing a recently developed drug policy, subject to negotiations with its unions. The policy applies only to employees in safety-sensitive positions. About one year ago, top managers decided that all business units should develop a drug policy. Lacking detailed guidance from its regulator, the DOE, the company formulated its own policy. The policy addresses illegal drugs, legal drugs used for nonmedical purposes, and alcohol. Substance abuse off-site is not addressed unless such use affects job performance. The policy includes pre-employment drug screening, observed-impairment drug testing, and drug tests as part of annual physical examinations. Random drug testing is not part of the program, but is required for employees returning to work after treatment in a substance abuse program. The policy states that it is the employee's responsibility to seek rehabilitation and to report suspected drug use to supervisors.

The EAP at this company was implemented several years ago. It is an "in-house" program and addresses drug, alcohol, emotional, family, legal, and financial problems. The program focuses on prevention through communication and education of employees and supervisors. All employees have received an initial four-hour training class on EAP services. In addition to the EAP training, managers receive an additional two-and-one-half hours of training in the identification and deterrence of drug use, how drug use can affect an employee and the co-worker, and how to document unacceptable job performance. These lectures include the use of videotapes. Management reception of the program is reported to be very positive.

The EAP is accessible to all employees, but not to contractors. Employees can be self-referred or referred by their supervisor. Supervisory referral occurs when a manager identifies poor work performance. Rates of self- and supervisory-referrals are about equal. Confidentiality is maintained by the EAP counselor except when an employee threatens to harm himself, others, or company property. There is no "forced" rehabilitation, but an employee can be terminated for continued poor work performance. Following rehabilitation, the employee, EAP counselor, and supervisor develop a contract that outlines what is expected of the employee and what steps will be taken if unacceptable job performance occurs. Following drug rehabilitation, the employee must provide a negative urine test and agree to subsequent random drug testing.

Pre-employment drug screening, observed-impairment drug testing, and drug testing with annual physical examinations are all used by this company. Pre-employment screening is considered a preventative measure. Upper management approval is required before observed-impairment drug testing can be ordered. Employees who have positive test results following this testing are terminated and treatment is not offered.

The administration of the testing and laboratory analyses are contracted out to an independent laboratory. The test results are reviewed by a company medical director, and confirmed positive test results are reported to the company's employee relations manager, who notifies the employee and the employee's supervisor. The drugs tested for include marijuana, opiates, codeine, morphine, barbiturates, PCP, cocaine, benzoylecgonine, amphetamines, and methamphetamine. Thin Layer Chromatography is used for the initial tests and GC/MS is used for confirmatory testing. Cut-off levels for initial and confirmatory tests are as follows:

marijuana	100 ng/ml
opiates	1000 ng/ml
codeine	1000 ng/ml
morphine	100 ng/ml
barbiturates	1000 ng/ml
PCP	500 ng/ml
cocaine	2500 ng/ml
benzoylecgonine	1000 ng/ml
amphetamines	1000 ng/ml
methamphetamine	1000 ng/ml

All tests include tests for alcohol. The cut-off level for alcohol is 0.1% BAC.

Program effectiveness will be measured at this company by tracking the number of employees seeking EAP counseling and the number of employees in the EAP specifically for substance abuse. Employee turnover, absenteeism, use of sick leave, and use of personal leave are currently measured and also will be used to assess program effectiveness. It is expected that the number of employees seeking counseling will increase if the program is effective. There are no data yet on the effectiveness of the policy in reducing drug abuse, since the program is not yet fully implemented.

3.0.7 Summary and Implications of the Related Industry Survey

The problem of drug and alcohol abuse is occurring in a changing social, regulatory, and legal environment for all of the organizations discussed above. Thus, the organizations' programs are also in a state of change. As shown in Table 3.1, there is some variation in the ways that the six organizations approach fitness-for-duty problems. However, several consistent themes emerge that are instructive for the development of fitness-for-duty programs in the nuclear industry.

The first theme is the recognition that a significant problem exists. Most respondents indicated substantial concern with drug and alcohol in the workplace, which appears to be due both to a perception of unacceptably high levels of use among employees and to the perceived negative impact that impairment due to drug and alcohol use might have on safety. The second theme is that these organizations, with the exception of the military side of the naval shipyard, see fitness for duty as best handled within the existing EAP framework, but with suitable coordination with line management.

There are several factors that are incorporated into the organizations' EAP approaches that appear to make them effective: understanding the key role of supervisors in identifying workers with problems, having rehabilitation as a primary goal, and seeing drug testing as a useful tool in assuring a fitness-for-duty perspective. Supervisors play a key role in identifying workers with problems. Having made the identification, the supervisor is not only responsible for removing the worker from the job, but also for referring the worker to the EAP and, in several cases, for continuing to monitor the worker. Thus, the organizations stress training and support for supervisory personnel concerning fitness-for-duty issues.

Rehabilitation is seen as a primary goal. Both through assuring confidentiality and by providing second chances to workers using the EAP, the organizations attempt to promote self-referrals to the programs. In most cases, however, termination is the primary outcome of failure to take advantage of the EAPs.

Drug testing is viewed as a useful tool in assuring fitness for duty, but with some important qualifications. The use of pre-employment testing and for-cause testing is supported by most of the organizations. At the other extreme, random testing is used only for the military side of the naval shipyard. The dominant criticism expressed concerning random drug testing was that it created too many organizational problems--primarily in regard to the lowering of morale and conflict with the unions. Although the imposition of a mandatory random drug testing program by the NRC will not necessarily lead to increased conflict between labor and management, the problem of morale deserves careful consideration.

3.5 CONCLUSIONS

The information presented in the preceding sections indicates that a number of approaches to resolving fitness-for-duty problems are common across both the public and private sectors. These approaches include (1) organizational policies to prohibit the use, sale, and possession of illegal drugs and the misuse of alcohol, prescription, and over-the-counter drugs on the job; (2) various types of drug and alcohol testing, such as pre-employment, random, annual, and observed-impairment procedures; and (3) the implementation of EAPs to prevent, detect, and treat employee personal problems of all types that may interfere with job performance. The practices described in this section represent a sample of the approaches to fitness for duty that the NRC may want to consider in developing a fitness-for-duty rule.

4.0 APPROACHES TO ASSURING FITNESS FOR DUTY IN THE NUCLEAR INDUSTRY

In this section, ten approaches to assuring the fitness for duty of employees with unescorted access to protected areas in nuclear power plants are presented and evaluated in terms of their potential for deterring and detecting drug and alcohol abuse and for addressing other types of employee personal problems that may impair job performance. These approaches have all been discussed in the literature and many of them are already implemented in the nuclear power industry. Because one of the major components of the proposed NRC rule under consideration is the requirement for random drug testing, the potential of random testing for deterring drug and alcohol abuse is discussed first and then each of the alternatives is compared to random testing.

4.1 RANDOM DRUG TESTING

There are two reasons for the use of random drug testing as part of the NRC's proposed fitness-for-duty program. The primary reason is to provide a strong deterrent against the initial or continued use of drugs. The other is to detect current drug users so that they can be removed from activities that may affect the safe operation of the plant. This section discusses both the deterrent and detection aspects of random drug testing.

The selection of a drug testing strategy is guided by several objectives. The first objective is deterrence: the testing strategy should assure that the risk of being selected for testing is sufficient to inhibit drug use by most, if not all, potential users. The second objective is detection: the drug testing strategy should be effective in identifying those users who have not been deterred. These two objectives are advanced by creating a testing program that is adequate in testing frequency and that is random. A program that tests too infrequently may not be able to deter or to detect. A program that is not random will potentially allow some individuals to escape detection.

Finally, the strategy should not be overly burdensome to the licensee, the employee, or the NRC. The strategy should be cost-effective, and it should be easy to administer. Specific individuals should not be tested overly frequently (unless they have had a confirmed positive test). The strategy should be nondiscriminatory--it should be administered fairly across all individuals and categories of individuals. Fairness and limiting the burden of testing and administration are necessary to minimize negative effects on licensee performance and employee morale. While it might be demonstrated that different categories of workers may be more inclined to drug abuse (e.g., males vs. females, younger vs. older, contractor personnel vs. utility employees), considerations of perceived fairness suggest that all categories of workers be tested at the same rate.

A review of the evidence available on random testing programs indicates that random testing appears to have a deterrent effect on drug and alcohol use. Studies to examine the effects of random alcohol testing on drivers in such countries as Finland (Dunbar, Penttila, and Pikkarainen, 198?) have shown

that the implementation of random testing of drivers substantially decreases the instances of drinking and driving. The deterrent effects in such cases may be expected to have strong parallels to random testing in the workplace.

The experience of the DoD and the U.S. Coast Guard (USCG) shows decreases in apparent drug use since the implementation of random drug testing. Specifically, illicit drug use in the Army has been reported as dropping from 29% of those tested in 1980 to 11.5% of those tested in 1986 (Raezer, 1987). In the Navy, rates have been reported to have dropped from 47% in 1981 to around 4% in 1986 (Hanson, 1986). Rates among USCG personnel are down from 10% in 1983 to 3% in 1986 (Bureau of National Affairs, 1987b). In all three cases, the reduction was measured by rates of confirmed positive tests, and the observed changes followed implementation of the random drug testing program. A survey of drug use in the military found that the decline in use cannot be attributed to changes in the demographic makeup of the armed forces, and that increased concern over the consequences of being identified as a drug user has contributed substantially to the decline in drug use (Bray et al., 1983; see also Cohen, 1986b).

While random drug testing does appear to have a significant deterrent effect, one important question that has yet to be answered in the research literature is, what is the most appropriate frequency or intensity of testing to assure both adequate deterrence and efficiency in testing? In one study addressing this question, Stoloff (1985) compared the effects of random drug testing and military discharge as deterrents to drug use in the Marine Corps. He simulated data to vary discharge rates and the frequency of tests. The results indicated that random tests and discharge from the service had independent effects on drug use rates. Varying the frequency of random tests while keeping the discharge rate at a baseline level decreased the simulated drug use rate from 16% at two tests per year to 11% at six tests per year. Varying the likelihood of discharge while keeping test frequency at the baseline level decreased the drug use rate from 16% to 13%.

Stoloff also examined the effects of increasing the frequency of tests with data obtained from the Marine Corps. The results of this analysis showed that the detection rate of drug use (the proportion of those who tested positive) declined as the frequency of tests was increased over a 26-month period. The greatest decline occurred during the first six months of testing when the number of tests per month was still relatively low. Increasing the rate to as high as an annual rate of 700% of the workforce continued to show increasing deterrence. However, most of the deterrent effect was realized below an annual rate of 300%.

Nuclear power plant personnel may be involved in drug abuse at a lower rate than military personnel and, thus, may be effectively deterred by lower testing rates. However, an effective program must assure that all workers subject to the fitness-for-duty rule are continuously subject to testing.

It is also important to note from Stoloff's research that a small percentage of those tested continued to test positive, even with a very high frequency of

testing. That is, not everyone was deterred, even by a very aggressive testing program. Thus, the development of a testing strategy that is sensitive to both deterrence and detection requires additional discussion.

In selecting from among the various strategies, some compromise among the various objectives will be necessary. For example, decreasing the testing rate relieves some of the burden on the licensee and the individual worker. However, decreasing the rate may jeopardize the deterrent and detection objectives of the program.

A strategy that combines a high testing rate for workers not yet tested in a given period, with a relaxed testing rate for already-tested workers (those with negative test results), may provide for a reasonable balance among the program objectives. To explore this possibility, estimates of population coverage and amount of redundancy in testing were calculated for several example models, including:

- Models that tested at the flat rates of 100, 125, 150, 200, and 300% of the population for the year (see Table 4.1).

TABLE 4.1. Probabilities Associated with Various Sampling Rates

Probability of being selected for testing	Sampling Rates				
	100%	125%	150%	200%	300%
Not at all	0.37	0.29	0.22	0.13	0.05
At least once	0.63	0.71	0.78	0.87	0.95
At least twice	0.26	0.36	0.44	0.60	0.80
At least three times	0.08	0.13	0.19	0.32	0.58

- Models that tested various rates per year of the population for the first period and continued at this rate of testing for subsequent periods for those not yet tested. The rate of testing of the already-tested population was reduced to a lower rate during subsequent periods of the testing year. Several variations of the basic model were considered, using:

- monthly, quarterly, and semi-annual periods for adjusting the tested population

- testing rates for the untested population of 100, 125, and 200% per year of the total population

- testing rates for the already-tested population of 10 and 30% per year.

(See Table 4.2 for these variations.)

An examination of Table 4.1 shows the trade-off between population coverage and testing redundancy. Testing at a flat rate of 100%, for example, assures, on average, that only about 63% of the total population will actually be tested in a given year; 26% will be tested more than once. To assure that almost all workers will be tested at least once in a given year requires a high overall rate of testing and a resulting high level of redundant testing.

An evaluation of the alternatives in Table 4.2 indicates that strategies can be developed that achieve an acceptable balance among the program objectives. For example, Case 9 in Table 4.2 has the following characteristics and advantages:

- Case 9 tests at a rate equal to 100% per year for the first month (for a population of 1,000, about 83 tests).

- For the part of the population that remains untested at the end of a month, Case 9 tests at a rate equal to 100% per year of the entire population.

- For the part of the population that has been tested prior to the start of a given month, Case 9 tests at a rate equal to 30% per year (2 1/2% per month) of the already tested population. A testing rate of 30% per year for individuals already-tested at a rate of 100% or more would provide a modest level of detection and deterrence while relieving some of the burden from the individuals who have been tested and found free of drugs at the time of their initial test.

This strategy results in only a few more total tests than testing at a flat 100% rate, and it substantially increases the percent of the workforce sampled during the year (from about 63% to about 91%). Further, the amount of retesting of particular individuals is not excessive, given the need to retain some deterrent effect for the already-tested population. While these models demonstrate how program objectives can simultaneously be addressed, these models do not necessarily constitute the most effective and efficient ones. More research will be requried to identify the optimal strategy.

As discussed in greater detail in Section 5.0, the ability of the testing program to detect drug use depends not only on the testing frequency, but also on the duration of the drug or its metabolites in the drug user's system. For many drugs, approaches such as those outlined above will result in the detection of users with moderate and heavy drug use frequency. However, for

TABLE 4.2. Probabilities Associated with Various Sampling Strategies**

Probability of being selected	Base 1 100% flat rate	Base 2 200% flat rate	Case 1 100/10/S	Case 2 200/10/S	Case 3 100/10/Q	Case 4 200/10/Q	Case 5 100/10/M	Case 6 100/30/Q	Case 7 125/10/Q	Case 8 125/30/Q	Case 9 100/30/M	Case 10 125/30/M
Not at all	0.37	0.13	0.26	0.02	0.18	Nearly 0.00	Nearly 0.09	0.18	0.07	0.07	0.09	0.00
At least once	0.63	0.87	0.74	0.98	0.82	Nearly 1.00	0.91	0.82	0.93	0.93	0.91	Nearly 1.00
At least twice	0.26*	0.60	0.21	0.57	0.16	0.46	0.12	0.22	0.28	0.36	0.21*	0.3
Total tests 1,000 workers	1,000	2,000	1,020	2,032	1,032	2,053	1,.043	1,097	1,288	1,368	1,128	1,443

Key: 100/10 means 100% rate for untested/10% for tested; other numbers indicate rates chosen for that case.
S = Adjusted semi-annually
Q = Adjusted quarterly
M = Adjusted monthly

* The figures for "at least three times" are .03 for Base 1 and 0.62 for Case 9.

** These figures were developed using methods based on approximations.

occasional users, and for drug types that are quickly eliminated from the body (e.g., cocaine), even extremely aggressive testing programs cannot assure detection. Thus, to be effective with these types of drugs and users, the program must either be an effective general deterrent (perhaps by implementing severe sanctions against those detected) or it must be augmented by a systematic program of behavioral observation designed to spot impaired workers and other indications of drug use.

Although the evidence available from studies on random drug testing is limited, it does indicate that properly constructed random testing programs can have significant deterrent and detection effects in the workplace. Because there is some empirical evidence that random testing does deter on-the-job substance abuse and because evidence is lacking to show that other fitness-for-duty strategies would be as effective, random testing would appear to be an important element in a fitness-for-duty program.

4.2 ALTERNATIVES TO RANDOM DRUG TESTING

Although the literature is silent on several significant points, and lacks systematic evidence on most others, several tentative conclusions can be drawn with regard to random testing. First, as noted above, there is a developing body of literature that credits random drug testing for a substantial reduction in drug use for certain workforce populations. Second, there are still significant technical problems regarding the implementation of random drug testing that require a careful structuring of a requirement for random testing. These problems will be discussed in Section 5.0. Third, there is currently insufficient information to systematically evaluate the relative effectiveness of the various alternatives. The various alternatives to random drug testing do not have proven superiority, and may thus more reasonably be considered along with drug testing as useful parts of a comprehensive fitness-for-duty program.

There are a number of potential alternatives to random drug testing. They include the following:

- No additional action
- Institution of pre-employment drug screening
- Institution of periodic, announced drug screening
- Institution of for-cause drug screening
- Reliance on the traditional EAP approach to identify users through self-referral or referral from others (particularly supervisors)
- Implementation of the NRC's proposed Access Authorization Program
- Supervisory observation
- Medical screening

- Institution of workplace security measures
- Institution of employee awareness and education programs.

Although systematic data do not exist to compare the efficacy of these approaches, the literature and the findings of this project's data-gathering activities do suggest some advantages and disadvantages for each.

4.2.1 No Additional Action

The first alternative to random drug testing to be considered is to maintain the status quo and take no additional action. This does not appear to be a viable alternative. As noted in Section 2.0, statistics available on drug use indicate that a significant minority of workers have or are currently abusing drugs or alcohol in the workplace. Although the incidence of drug abuse in the nuclear industry can be expected to be lower, based in part on the existing security measures at nuclear power plant sites and the relatively aggressive fitness-for-duty programs that characterize the industry, the potential for drug and alcohol abuse still exists. Certainly, recent incidents involving drug use by nuclear power plant personnel have underscored the fact that some type of additional action appears to be needed by either the NRC or by industry. Further, the potential for other fitness-for-duty problems, such as psychological and family problems, may be just as great in the nuclear industry as elsewhere.

One of the options available to the NRC is to allow the industry to take the responsibility for making additional progress in fitness-for-duty issues. A fitness-for-duty rule focusing on drug testing would not mean that the industry could not continue to take the initiative in other fitness-for-duty areas. However, the results of the industry initiatives to date strongly suggest that maintaining the status quo would be inappropriate. Two main issues can be cited:

- Clarification is needed on acceptable approaches to drug testing that can be made standard for the industry.
- Licensees face substantial impediments in the form of state laws and union intervention from taking aggressive action in drug testing. A rule would take the onus off the licensees for dealing with these impediments.

Thus, neither the NRC nor the industry appear to be in the position of being able to accept the status quo in fitness-for-duty issues.

4.2.2 Pre-employment Screening

Pre-employment screening is the testing of job applicants to ensure that the selection process includes only those individuals who meet fitness-for-duty standards. Considered by industry as the first-line protection against drug problems, pre-employment testing is specifically used to detect and identify the nature of drug use, if any, by job applicants, and to identify abusers prior to hiring. Pre-employment testing is currently the most prevalent type

of drug testing (Hanson, 1986). Virtually every nuclear utility currently employs this type of testing.

Reliance on any pre-employment testing program to identify substance abuse by an applicant must be weighed against its disadvantages. For example, drug testing will not reveal other disabilities or stressors that may cause impairment. It also cannot be relied upon to predict future behaviors, or to indicate that substance abuse may develop as a future problem.

Pre-employment testing as a part of a company's hiring policy will certainly be known to most applicants. This knowledge removes any element of surprise, and allows applicants to be prepared for the test. A sophisticated or "street-smart" drug abuser may be able to avoid detection, and less frequent users may be likely to abstain long enough to guarantee a "clean" sample. New testing techniques are in the process of being developed that may be capable of identifying previous drug and alcohol use (i.e., over the past several months). However, these techniques have not yet been refined. Consequently, the ability of pre-employment testing to detect substance abusers currently is limited. Further, pre-employment testing is subject to the same technical limitations of all drug testing programs (e.g., issues of cut-off levels, testing accuracy, cross-reactions).

The primary disadvantage to using pre-employment testing as an alternative to random drug testing is that it in no way addresses substance abuse problems that exist in the workforce or that arise subsequent to employment. Workers employed at the time the policy is implemented are generally "grandfathered" in under the new policy without testing, and the applicants who pass the testing and become employees will never face testing again. The deterrence factor implicit in random drug testing programs is absent. Pre-employment testing is probably most effective when it is directed to keeping individuals currently experiencing chemical dependency out of the workforce, and thus may be a necessary but not sufficient part of a total fitness-for-duty program.

4.2.3 Announced, Periodic Testing

Announced, periodic testing appears to have few, if any, advantages over random testing. This method has most, or all, of the disadvantages of random testing, and it has additional disadvantages as well.

Announced, periodic testing may be perceived by employees as less discriminatory than random testing, however. In a random testing program, there are two techniques that could be used to determine when an employee must submit to a test: (1) on a given random date all employees are tested, or (2) at various dates some employees are selected at random and tested. Because it may be impractical to test the entire body of employees on any given day, licensees using a random testing program may opt to use the second of these techniques. If this technique is used, some employees may coincidentally be tested more frequently than others, and the licensee may be required to document that the selection process is truly random. If testing is announced and scheduled at regular intervals, however, all employees would perceive that they are being tested equally.

Further, if selection for random testing is truly random, an employee could, strictly through chance, not be selected for testing for an extended period of time. As a result, employees with substance abuse problems may not be detected in a timely manner, and their abuse problems may increase in severity before they are detected in the random testing program. Announced, periodic testing could ensure that all employees are tested with adequate frequency.

Another potential advantage of announced testing is that immediate, pronounced disciplinary action can be taken without concern that the action is inappropriately severe. It might be argued that any employee who cannot remain drug- or alcohol-free for an announced test has a severe substance abuse problem and should be immediately removed from his or her duties.

It is apparent that announced, periodic tests would not identify some drug abusers that random testing would identify, and that the deterrent value of announced testing would only be short-term. Announced, periodic testing would be especially insensitive to abuse of drugs that are rapidly metabolized, such as cocaine. It is expected, however, that an announced, periodic program would identify some regular users of prescription drugs, and users of slowly metabolized drugs such as marijuana. Because announced, periodic testing would potentially allow many employees who abuse drugs and alcohol to escape detection, it seems clear that announced tests would be less effective than random tests at identifying and deterring the occasional drug users.

Like random testing, periodic testing would be limited to the identification of drug or alcohol abuse problems that might make an employee unfit for duty. Announced, periodic tests, however, appear to be less effective at detecting and deterring employees with substance abuse problems. None of the industries surveyed in our review of other regulated industries or described in the literature have adopted this approach.

4.2.4 For-Cause Testing

If properly implemented, a for-cause testing program can have some pronounced advantages over a random testing program. In a properly implemented program, when there is cause for a supervisor's or peer's suspicion that an employee is unfit, or the employee has been involved in an on-the-job accident, the employee is given a complete physical examination, which includes drug testing. This examination may identify health problems other than drug abuse that have diminished the employee's ability to perform his or her job. The examination can also include testing for legal drugs of potential abuse, such as alcohol, over-the-counter, and prescription drugs. A for-cause testing program is especially useful for identifying occasional drug users and for identifying fitness-for-duty concerns other than or in addition to drug abuse.

A for-cause testing program can more effectively identify some drug abusers than can a random testing program. That is, an occasional drug user could be impaired while on duty with some frequency over an extended period of time before he or she is identified through a random testing program. It is

possible for an occasional drug user to pose a significant safety risk, but to be drug-free on the day he or she is given a random test. Random tests can only guarantee that occasional users will be identified if the tests are administered frequently. By contrast, if supervisors and peers are trained to recognize impairment, an occasional drug user ideally can be identified as a drug user on the first occasion he or she is impaired on duty. It is thus possible that an occasional drug user may be identified through a for-cause test months before the individual would happen to be using drugs at the same time as he or she is given a random drug test.

Occasional users may have more reason to fear for-cause testing than random testing. An occasional drug user can hope to escape being detected by a random drug test, especially if both the tests and the employee's drug use are infrequent. However, if supervisors are trained to observe probable impairment, the employee may realize he or she is more likely to be caught while impaired and be subjected to a for-cause drug test. Knowing that fellow workers are being disciplined for on-the-job impairment may also deter employees from being impaired on the job. Therefore, for-cause testing might deter occasional users from being impaired on the job more effectively than would a random testing program. No data exist, of which we are aware, to support a conclusion regarding the relative effectiveness of this alternative.

The principal disadvantage of for-cause testing is that, if managers are unable to identify impaired employees, for-cause tests will only be administered after a gross indicator, such as an accident, shows that the tests are warranted. Therefore, with the exception of post-accident testing, the value of for-cause testing is highly dependent on managers' and co-workers' abilities to identify when employees are impaired. Thus, supervisor behavior observation training appears to be an important aspect of for-cause testing. While for-cause drug testing is an important element of a fitness-for-duty program, it does not appear to be an acceptable alternative to random testing, either when it is used alone or when it is used in conjunction with behavioral observation.

4.2.5 Employee Assistance Programs

The review of the literature pertaining to EAPs indicates that these programs can play a significant role in assuring that persons with unescorted access to protected areas are fit to perform their duties. The major advantage of the EAP approach is that the EAP can respond to fitness-for-duty problems, such as psychological disorders, that cannot be detected in any drug testing program. There are several disadvantages to this approach, however, that suggest that the NRC may not want to rely on EAPs alone to assure a drug- and alcohol-free workplace.

4.2.5.1 Definition of an EAP

Employee assistance programs have been defined as systems that "provide professional care to employees whose job performance is or may be adversely affected by alcoholism, drug dependence, emotional problems, family difficulties, legal issues, eating disorders, and similar personal problems

that not only threaten the employee's effectiveness on the job but also tend to trigger a whole range of health problems" (Blair, 1985, p. 1). A comprehensive EAP generally addresses the promotion of optimal health in the workplace, the provision of voluntary and informal routes for employees seeking assistance in the early stages of problem development, and the provision of an alternative to disciplinary action during the late stages of problem development (Albert, Smythe, and Brook, 1985). Thus, the EAP alternative is relevant to the entire range of fitness-for-duty concerns.

Employees typically gain access to EAP services through two routes: self-referrals and supervisory referrals. When the employee self-refers, he or she may contact the EAP counselor directly or seek assistance from a supervisor to make the contact. The EAP counselor then meets with the employee to assess the nature of the problem and to determine what resources are needed to resolve it. The counselor may provide the required assistance in some cases, but more frequently will refer the employee to existing resources in the community. The EAP counselor maintains contact with the employee during the problem resolution phase and often acts as a coordinator between the employee and his or her supervisor while the employee receives in-patient treatment for an alcohol problem, for example, and when the employee returns to work.

Supervisory referrals typically occur when a job performance problem becomes apparent. In these cases, the supervisor is responsible for identifying and documenting the job performance decrement. In addition, he or she meets with the employee to describe the problem, to refer the employee to the EAP, and to indicate that continued impaired performance is likely to lead to disciplinary action or termination from employment. The supervisor is discouraged from trying to diagnose the root cause of the problem or from trying to provide any counseling (Trice and Beyer, 1984; Hoffman and Roman, 1984). The EAP counselor usually takes the responsibility for these tasks and for referring the employee to appropriate resources, as when an employee self-refers to the program. If the employee's job performance does not improve, then disciplinary action is taken.

4.2.5.2 The Role of an EAP in Assuring Fitness for Duty

As noted above, the literature suggests that an EAP can serve as a valuable tool in assuring that employees in the nuclear industry are fit for duty. It is clear that the primary benefit of an EAP lies in the potential it represents for assisting employees to overcome personal problems that are not alcohol- or drug-related but that may interfere with job performance. For example, the stress associated with marital or financial difficulties can impair job performance but will obviously not be detected with drug testing.

Several EAP components also serve to encourage a drug- and alcohol-free work environment. First, the EAP training that supervisors receive in observing employee behavior may allow them to detect substance abuse problems that may be missed altogether by a drug screening program or that are only detected once the problem has reached severe proportions. Whereas a sophisticated and "street-smart" drug abuser may be able to avoid detection from drug tests, he or she is unlikely to be able to maintain satisfactory levels of job

performance on a day-to-day basis. Further, because employees in even the most aggressive random drug testing program will only be tested intermittently, a developing substance abuse problem may escape detection by the drug tests until the problem has reached such severe proportions that the deterrent effect of facing a drug test is nullified. In the meantime, the employee may have continued to work in an impaired condition. As a witness to the employee's daily functioning, however, the EAP-trained supervisor can identify and remove from duty the employee whose job performance is degraded.

The drug and alcohol abuse education provided to employees by an EAP may also serve a preventative role. Increased knowledge about the deleterious effects of drug and alcohol abuse, particularly the abuse of prescription drugs, may encourage some employees to reduce their use of alcohol and drugs or to change the manner in which they use them to avoid dependency problems. Such knowledge may also assist employees to self-diagnose developing substance abuse problems and motivate them to seek treatment before their problems become serious enough to be detected by their supervisors or by a drug test.

An additional benefit of requiring that EAP services be made available to nuclear workers is the potential they represent for rehabilitating troubled employees. Because many nuclear power plant workers possess unique skills as a result of years of specialized training (e.g., reactor operators), terminating these employees for positive drug or alcohol test results would result in the loss of their knowledge and experience to the industry. Temporary transfer to non-safety-related jobs while they undergo treatment and then reinstating their unescorted access authorizations when they demonstrate a successful treatment outcome would preserve the resources these employees represent. In fact, a rehabilitated employee who is highly trained and experienced may be more fit for duty than a less experienced employee who has never used drugs. The opportunity for treatment through an EAP, then, may promote plant safety by ensuring that the labor pool for highly skilled nuclear power plant workers is not unnecessarily diminished.

4.2.5.3 Disadvantages of the EAP Approach

There are several disadvantages in relying on the EAP approach alone to assure that employees in the nuclear industry are fit for duty. The primary disadvantage of the EAP approach is its reliance on supervisors' behavioral assessment skills to identify persons unfit for duty and willingness to confront troubled employees. Because of its significance, this issue is discussed in detail in Sections 4.2.7 and 6.1.5. There are two additional disadvantages of the EAP approach used alone. First, the deterrent effect thought to result from random drug screening will be absent, although fear of supervisory detection in an EAP may serve a similar deterrent function. Second, an EAP without random follow-up drug testing lacks any objective means of ensuring that employees who have entered treatment for drug or alcohol abuse problems have been rehabilitated and can be considered reliable.

Although the drawbacks in relying on the EAP approach are strong enough to recommend that it not be the only aspect of a fitness-for-duty program, the merits discussed in this section suggest that EAPs would perform a vital role

in assuring fitness for duty in the nuclear industry. An EAP's ability to address potential employee impairment caused by problems that are not alcohol-or drug-related justifies careful consideration. It is also apparent that an EAP can play a significant role in detecting substance abuse problems that may otherwise continue undetected through a drug testing program, as the EAP-trained supervisor has the opportunity to identify on-the-job impairment and a diminishing job performance.

4.2.6 Access Authorization Program

The NRC is proposing an access authorization policy endorsing nuclear power industry guidelines for the granting of unescorted access to workers in nuclear power plants. The industry program (53 FR 7534, 1988) includes background investigations, psychological assessments (i.e., testing and interviews), and an ongoing behavioral observation program for workers with unescorted access. The purpose of the access authorization program is to determine whether the individual considered is not only fit for duty, but also can be trusted with unescorted access to protected and vital areas in licensed nuclear power plants.

The unique benefit provided by the access authorization program is that the background investigations and psychological assessments are intended to detect an individual with a history of drug or alcohol abuse or other problems that might make him or her unfit for duty before the person is granted unescorted access. The program also incorporates continual behavioral observation by supervisors for signs of alcohol and drug abuse and other behavioral patterns that may reflect adversely on the individual's trustworthiness.

Disadvantages of the access authorization approach implemented alone include (1) relatively weak deterrence to drug and alcohol abuse, compared to that provided by an EAP or drug testing, and (2) lack of pre-clearance or ongoing objective assessment of drug or alcohol use (e.g., drug testing). Although the behavioral observation aspect of the program provides continual monitoring, the background investigations and psychological assessments would not detect individuals who develop substance abuse problems after they have been granted access and could not effectively predict which individuals would be likely to develop problems (Perry, Bennett, and Wood, 1979; Perry, Lindell, Bennett, and Wood, 1981).

4.2.7 Supervisory Observation

The significant impact of supervisors on safety has been emphasized by safety specialists (e.g., Hannaford, 1976; Heinrich, 1959; Simonds and Grimaldi, 1963) and organizational researchers (e.g., Dunbar, 1975). A variety of studies demonstrate the effectiveness of supervisors when they observe for and provide feedback on behaviors that may lead to unsafe situations (Komaki, Heinzmann, and Lawson, 1980; Reber and Wallin, 1984; Rhoton, 1980). Similarly, within the organizational literature, it is well accepted that the immediate supervisor has major responsibility for observing and providing employees with positive and corrective feedback on behaviors related to job performance (e.g., Fleenor and Scontrino, 1982; Latham and Wexley, 1981).

With regard to substance abuse in the workplace, the immediate supervisor is often in a position to observe the performance decrements that are an early sign of employee substance abuse (Rosen, 1987), which, in turn, may affect safety.

As discussed in Section 6.1.5 regarding the role of supervisors in EAPs, the immediate supervisor is a key individual in the success of resolving fitness for duty problems. The supervisor's role in fitness for duty issues is to identify and deal with employees who are displaying signs of impairment (Hoffman and Roman, 1984). Johnson (1986) found that companies with a high percentage of substance abuse referrals also had the highest rate of supervisory referrals (versus self-referrals), indicating the potential importance of supervisory observation.

The American National Standards Institute, in conjunction with the American Nuclear Society, has established a voluntary standard for reviewing employee reliability:

> A continued observation program shall be established and administered by or under the direction of owner organization. Supervisory personnel instructed to recognize unusual behavior shall observe employees for performance of job-related duties, attendance, and attitude toward work and fellow employees. When unusual behavior of a person granted unescorted access is observed, it shall be reported to plant management for evaluation and appropriate action. Supervisory personnel responsible for providing of continued observation may be employed by the owner organization or by a contract or vendor organization. (ANSI/ANS-3.3, 1982, p. 4-14)

Supervisors can identify fitness-for-duty concerns that may not be immediately discerned by other approaches (e.g, random drug testing) or only after a significant incident (e.g., post-accident drug testing). Yet, supervisory observation is not necessarily a stand-alone alternative for dealing with drugs in the workplace. Supervisory observation should be used as a supplement to or a necessary condition for other approaches. For example, supervisory observation is an important aspect of a successful for-cause drug testing program, since for-cause drug testing frequently involves someone noticing a problem. However, in order to maximize the success of supervisory observation, several important issues need to be considered.

First, the supervisor's span of control and amount of contact with subordinates must be considered. An effective supervisor is often defined as having frequent contact with each subordinate; however, this may not always be the case. For example, a supervisor may be responsible for a large number of employees or may be physically removed from his or her employees. For a supervisor to adequately observe possible indicators of fitness, he or she must have frequent contact with all subordinates.

Second, there must be assurances of fair administration of the supervisory observation procedures. If there is a possibility for supervisors to inconsistently apply the standards, intentionally or unintentionally, the

program will not be a success. Any concerns regarding potential misuse of such procedures must be addressed, and checks and balances considered. For example, a supervisor's observation is generally not considered as ultimate proof of a fitness-for-duty problem. As with the application of behavioral observation in other areas, the observation (e.g., swerving on the road) should be verified by other individuals or validated with other measures (e.g., breathalyzer tests).

Third, supervisors must be taught proper behavior observation techniques to discern potential fitness for duty problems, including substance abuse. While the immediate supervisor plays an important organizational role in observing for and addressing performance problems, the accuracy of these observations improves with training (Latham, Wexley, and Pursell, 1975). A study examining the effectiveness of employee drug-testing programs suggests that supervisory training is an important factor in successful drug testing programs (Gomez-Mejia and Balkin, 1987), and lack of training might be a reason for a move away from supervisory referrals to self-referral EAPs in organizations (Albert et al., 1985). Meeting these three requirements for an effective supervisory observation program may be difficult for some licensees or for supervisors of some types of jobs that do not involve extensive daily contact between supervisors and employees. Because random drug testing does not require reliable human judgment, frequent interpersonal contact, or extensive training of supervisors, it may prove to be the more cost-effective approach of the two. However, the combination of these two approaches is likely to be most effective at deterring and detecting fitness-for-duty problems than either approach used alone.

4.2.8 Medical Screening

Our review of possible alternatives to random drug testing has included a medical screening program that is currently being used at a large installation where highly sensitive nuclear-related work is performed (R. Booth, W. Milroy, and D. Lowe; L. Jones, personal communications, July 26-August 2, 1988). Thorough medical and psychological examinations are the primary concerns of this screening program. The physical examination is essentially a standard exam. Heart, lungs, eyes, ears, mouth, and reflexes are examined. A blood test is administered for blood chemistry. A urinalysis is done for urine chemistry, not to detect drug use. The physical exam may also include a chest X-ray and a cardiogram.

The psychological examination is administered in two parts. The employee first takes a paper-and-pencil test--either the Minnesota Multiphasic Personality Inventory or the Sixteen Personality Factors Questionnaire. The test results are then analyzed by a clinical psychologist who conducts an interview with the employee based on those results.

If the medical or psychological examination indicates that an employee may have a problem that could negatively affect work performance, trained personnel attempt to counsel the employee. The aim is to encourage the employee to recognize the problem and to take corrective action in the form of medical treatment, psychological counseling, or drug or alcohol treatment.

If an employee is unwilling to seek treatment for a problem that is discovered, that employee can be terminated for insubordination.

These combined medical/psychological tests are administered at various times in the employee's period of employment. The employee is first examined directly after his or her application for employment has been approved. Thereafter, employees have physical and psychological examinations on a routine, scheduled basis. Employees in critical job categories such as reactor operators, security service personnel, and employees with unescorted access receive both a physical and a psychological examination annually. Other non-critical employees take only the physical examination as part of their pre-employment screening and are screened thereafter once every two years.

Employees can also enter the medical screening program by direct referral from their supervisor. While the regularly scheduled examinations form an important element of the screening program, supervisory referral of impaired employees is the program's most effective component. Supervisors have a fairly clear mandate to refer employees to the screening program if the employee's behavior indicates potential problems, and are given basic training on how to recognize and document impaired behavior. If the employee's behavior indicates a problem, he or she is referred to the screening program for the medical or psychological testing that appears to be appropriate for the particular case. A drug test is normally not used after a supervisor's referral although such testing can be administered if the employee's behavior indicates drug or alcohol abuse. Undergoing these tests may be made a condition of continued employment.

While drug testing is not part of the routine medical screening process, this means of testing is used in at least two instances. Pre-employment drug tests are part of the job application process for all employees. If no drug use is detected, the prospective employee proceeds to the pre-employment medical and psychological exams. Other than the pre-employment screening, drug tests may also be used in cases of supervisory referral (as mentioned above) and, in at least one medical screening program, for employees with a history of drug use. If a person has a known past history of drug use and has undergone treatment, the person will be required to sign an agreement to stay drug free and to be tested on a periodic basis.

Medical personnel who administer medical screening programs report that they cannot be confident that most drug or alcohol abuse occurring during the employment period is detected by the program. Nor does medical screening provide as much deterrence to substance abuse as does random testing.

A medical screening program of this type can be expected to effectively detect pre-employment drug or alcohol abuse, however. It can also detect some substance abuse during the period of employment through supervisory referral and as a result of the regularly scheduled medical and psychological testing. A thorough medical screening program should be quite effective in detecting non-substance-related medical and emotional problems that could pose a threat to effective and safe job performance.

4.2.9 Workplace Security Measures

This approach to assuring that employees with unescorted access are fit for duty includes such techniques as the use of dogs trained to detect drugs; searches of employee cars, possessions, and work stations; and physical searches of employees when entering the site. The advantage of this approach is that employees are likely to be deterred from possessing or selling illegal drugs or alcohol on-site, because these security measures directly detect possession. The disadvantages of this approach used alone are that it cannot establish use of drugs or alcohol and it cannot address other types of fitness-for-duty concerns. Therefore, workplace security measures should not be considered an adequate substitute for random drug testing.

4.2.10 Employee Awareness and Education Programs

Any fitness-for-duty program based solely on employee awareness and education about the deleterious effects of drug or alcohol abuse is likely to be ineffective. Behavior is notoriously resistant to change on the basis of such knowledge. Consequently, this approach is unlikely to provide a powerful deterrent to drug or alcohol abuse. As an adjunct to other fitness-for-duty approaches, however, employee awareness and education can contribute to a drug- and alcohol-free workplace.

An employee awareness and education program is a necessary component to drug testing and employee assistance programs (EAPs). Employees must be informed about the rationale for drug testing and about procedures for making referrals to the EAP for the program to be effective. Employee awareness and education also provide evidence of the seriousness with which management views fitness-for-duty issues.

In addition to these benefits, an employee awareness and education program can be developed to make use of the troubled employee's co-workers to detect potential fitness-for-duty problems. With training in behavioral observation, co-workers may be able to spot a fellow employee's unusual behavior even before the employee's supervisor notices it. Or, co-workers may hear of drug use, alcohol abuse, or other employee problems that would not reach the supervisor's ears until the problem has become so severe that job performance suffers. Although co-workers may be reluctant to report unusual behavior or potentially damaging information in a public manner, the availability of a confidential hotline can encourage them to report and provide management with an opportunity to investigate the problem. Knowing that his or her co-workers are trained to identify aberrant behavior also may serve to deter an employee from on-the-job substance abuse.

4.3 CONCLUSIONS

Each of the approaches to assuring fitness for duty discussed in this section has advantages and disadvantages, although none of these approaches alone can adequately address the wide range of employee problems that may result in impaired job performance. For example, the different types of drug testing are likely to reduce the incidence of drug abuse among employees with unescorted access, but these drug tests do not include breathalyzer or blood

tests for alcohol and, therefore, will not detect use of the substance most commonly abused by adult males in the U.S. Further, drug or alcohol testing alone will not identify individuals with significant psychological disorders that may make it difficult for them to perform acceptably in the stressful conditions of a transient. Although the empirical evidence is scant concerning the effectiveness of individual approaches, it is clear that the NRC may wish to consider a combination of approaches in developing an effective fitness-for-duty rule. The information presented in this section suggests that the combination of random, for-cause, and pre-employment drug and alcohol tests with strong employee assistance, workplace security, and access authorization programs are needed for a comprehensive fitness-for-duty program.

5.0 DRUG DETECTION TECHNIQUES

This section discusses the various methods that are used to detect the drugs of abuse. Because urinalysis is currently the most widely used, reliable, and accurate method for detecting abused drugs, it is discussed in Section 5.1. Section 5.2, discusses alternatives to urinalysis, including blood (plasma), saliva, and hair analyses, as well as behavioral and psychological testing techniques. Although these techniques are still relatively new and are currently less accurate and specific than urinalysis, they are discussed here as potential future substitutes.

5.1 URINALYSIS

Properly administered urinalysis, consisting of an initial test followed by a more sensitive and more specific confirmatory test if the results of the initial test are positive, can effectively identify persons who abuse drugs. However, urinalysis techniques are far from perfected. Improper laboratory procedures can lead to inaccurate results. Subjects can dilute or substitute urine samples. Common, legal substances can generate true positive results; for example, a person who has eaten a poppy seed roll may test positive for heroin. Finally, the correlation between impairment and the level of drug or drug metabolite in the urine varies, and it is difficult to determine the appropriate cut-off levels that will identify impaired persons.

Section 5.1.1 discusses the interpretation of urinalysis results. Section 5.1.2 discusses the various testing techniques that are used. Cross-reactions, where licit substances generate positive results for illicit drugs, are discussed in Section 5.1.3. Section 5.1.4 discusses quality control. Section 5.1.5 discusses laboratory performance. Section 5.1.6 addresses the general issues associated with determining cut-off levels. Tests and probabilities of detecting the various drugs of abuse are discussed in Section 5.1.7.

5.1.1 Interpretation of Urine Test Results

Prior to implementing a urinalysis program, it is important to understand what information urine tests provide and how the results can be interpreted. Urine tests provide information about the concentration of a drug or a metabolite of the drug in the urine. Concentrations are generally expressed in terms of nanograms per milliliter (ng/ml). Urine tests for drugs may yield three different types of results: qualitative, quantitative, and semi-quantitative. Qualitative tests simply indicate whether or not a specific substance is present in the urine. Some qualitative tests will indicate presence of a substance if there is any at all in the sample; other qualitative tests will be positive only above some specified cut-off concentration. Quantitative tests provide specific information about the concentration of a substance in the urine. Semi-quantitative test results will indicate that the concentration of the drug or metabolite is within a certain range, thus they provide information about the approximate amount of a drug in the urine. For example, a semi-quantitative test may indicate that there are more than 20 ng/ml and less than 75 ng/ml of substance in the sample.

The greatest problem with urinalysis is interpretation of the results (Sutheimer, Yarborough, Hepler, and Sunshine, 1985). The concentration of a drug or drug metabolite in the urine does not provide information about drugs pharmacologically affecting the person's system nor does it provide information about impairment (Hawks and Chaing, 1986). The concentration of a drug or drug metabolite in the urine is influenced by several factors; these include the dose of the drug taken, the route of administration, frequency of use, and time lapse from drug use to urine collection (Manno, 1986a). The concentration is also influenced by several factors unrelated to drug use, such as amount of liquid consumed recently, time elapsed since urination, time of day (urine is more concentrated in the morning than later in the day), and recent dehydrating exercise. Hence, a positive confirmed test result indicates only that an individual has ingested the drug recently. A positive result does not provide information about the frequency of use, pattern of use, addiction, legitimacy of use, or whether the person was under the influence of the drug when the urine was collected (Manno, 1986a). Similarly, a negative test result only means that a person's urine sample did not have the drug or drug metabolite in sufficient concentration to give positive results (Manno, 1986a). It provides no information about whether or not someone has ever used the drug or whether someone currently uses the drug infrequently.

Different drugs are metabolized and excreted from the body at different rates. Water-soluble and lipid-soluble substances differ in how long after use they will appear in the urine (Cohen, 1986b). Water-soluble drugs appear in the urine shortly after use and are completely excreted within a few days of use. Alcohol, barbiturates, stimulants, and opiates are water soluble. Lipid-soluble substances may be stored in fat tissues and are excreted more slowly. Marijuana and PCP are lipid soluble.

Because of the numerous factors that influence the concentration of a drug or drug metabolite in the urine, it is impossible to set cut-off levels that relate directly to performance impairment. A body of research is developing that can begin to address impairment based on blood serum analysis. However, even this relationship is complex. Impairment is a function of several variables. Thus, it is difficult or impossible to make definitive statements linking drug levels in the system to impairment (Ambre, personal communication, January 26, 1988). For example, Ambre noted that the effects of cocaine are influenced by previous exposure to the drug because as people develop a tolerance to cocaine they require larger doses to achieve the same effect.

5.1.2 Overview of State-of-the-Art Assay Procedures

Schaffer and Warren (1987) identify three criteria for evaluating a test for drugs or alcohol in body fluids. These are the sensitivity, specificity, and practicality of the test. Sensitivity refers to the ability of the test to detect low levels of a substance and to differentiate small differences in the amount of a substance in the sample. In other words, what is the minimum concentration and increment in concentration that can be reliably detected? Specificity refers to the ability of a test to distinguish the substance from

other substances. In other words, can other substances cause a positive result? The practicality of a test involves several considerations including the cost of the test, the ease of use, and the availability of laboratories that perform it.

The current state of the art for urine testing for drugs of abuse is a two-phase procedure. The first phase involves screening urine samples for drugs or drug metabolites. The second phase involves conducting confirmatory tests on all specimens screened positive in the initial phase. Several different assay methods exist for both the initial screening and confirmatory testing. However, there is considerable agreement on which techniques provide the best results at a reasonable cost. The U.S. Department of Health and Human Services (HHS) (53 FR 11970 1988) recommends use of immunoassay procedures for initial screening and use of combined gas chromatography/mass spectrometry (GC/MS) for confirmatory tests. This two-phase drug testing protocol is currently in use by the Department of Defense (DoD). Immunoassays are fairly sensitive and specific and they are relatively inexpensive and easy to use. GC/MS is a complex and expensive assay procedure, but it is very specific and sensitive.

Neither immunoassay nor GC/MS procedures are capable of testing for more than one drug at a time. Separate immunoassays must be performed to test for amphetamines, cocaine metabolites, marijuana metabolites, opiates, and PCP. Likewise, separate GC/MS assays must be performed to confirm each presumptive positive result if the screening tests find evidence of more than one drug in a specimen.

5.1.2.1 Immunoassay Procedures

Immunoassays use antibodies to detect the presence of a drug in the urine. Antibodies are proteins that chemically bind with specific substances called antigens, in this case a drug or drug metabolite. In immunoassay tests, a known amount of an antibody is added to the urine sample. In addition, a known amount of the drug or drug metabolite that has been labeled with either a radioactive label (radioimmunoassay [RIA]) or with an enzyme label (enzyme immunoassay [EIA]) is added to the sample. Any drug or drug metabolite in the sample will compete with the labeled drug or metabolite to bind with the antibodies forming antigen-antibody complexes. The amount of radioactive- or enzyme-labeled antigen that is able to bind with an antibody is inversely proportional to the amount of drug or drug metabolite in the urine.

In RIA the antigen-antibody complexes are separated from the rest of the sample and the radioactivity of either the precipitated antigen-antibody or the remaining supernatant fluid is measured in a gamma counter. If the precipitant is being measured, then a positive result occurs when the radiation counted is less than or equal to the radioactivity counts of a prepared positive control. If the radioactivity of the supernatant is being measured, then a positive result occurs when the radioactive count is equal to or higher than the radioactive count of a prepared positive control.

In EIA, the enzyme used to label the antigen added to the sample will react with a second substance, added to the sample only if the enzyme-labeled

antigen does not bind with an antibody. The enzymatic reaction breaks down specific cell walls causing the sample to change from cloudy to clear. Enzyme activity is directly related to the amount of drug in the urine. The amount of enzymatic reaction can be measured by the shining a beam of light through the specimen. A positive result occurs when the amount of light that passes through the sample is equal to or greater than the light passing through a prepared positive control.

Immunoassay procedures are relatively inexpensive to perform. Some specialized equipment is necessary to perform both types of immunoassays; however, kits to perform RIA and EIA are widely available. The two most widely used immunoassays are the Roche Abuscreen, an RIA test; and the Syva Corporation's EMIT® (Enzyme Multiplied Immunoassay Test), an EIA test. Kits of both types are available to test for all the drugs discussed in this chapter. The HHS guidelines (53 FR 11970, 1988) require that the immunoassay tests used for screening meet the requirements of the Food and Drug Administration.

The specificity and sensitivity of immunoassays vary depending on the type of assay and on the specific test performed. The primary disadvantage of immunoassays is that the antibodies are seldom specific to a single drug or drug metabolite; therefore, the antibodies may bind with other substances. This is called cross-reacting. This cross-reactivity can cause false positive results. Therefore, positive results based on immunoassay tests alone are referred to as "presumptive positives" and must be confirmed using a different assay technique.

5.1.2.2 Gas Chromatography/Mass Spectrometry

Gas chromatography/mass spectrometry is a combination of two different techniques; chromatography procedures are used to separate the different components in a biologic specimen (in this case, urine) and mass spectrometry is used to identify very specifically the components of the specimen. According to Foltz, Fentiman, and Foltz (1980), GC/MS is the best technique currently available to identify and quantitatively measure organic compounds in complex mixtures. It is very sensitive and very specific. However, both these procedures are complex and there can be a great deal of variation in how they are performed (Foltz et al., 1980; Hawks, 1986).

In general, GC/MS involves the following steps:

1. An internal standard is added to each specimen. This standard must behave identically to the drug or drug metabolite during all phases of the assay. The internal standard is a pure sample of the drug itself that has been labeled so that it can be distinguished from the drug or metabolite during the mass spectrometry. Generally the internal standards are labeled by replacing hydrogen ions with deuterium ions; this increases the molecular weight of the standard so that it can be distinguished from any drug in the specimen. Tritium is also used to label internal standards.

2. The substance being analyzed is isolated from other substances in the specimen by solvent extraction. Several different solvents and extraction procedures may be used.

3. The GC/MS analysis is used to separate and identify the compounds. Gas chromatographic procedures separate the organic compounds. Mass spectrometry using electron impact ionization or chemical ionization with selected ion monitoring is used to identify the compounds.

4. Finally, the concentration of the drug or metabolite in the specimen is determined using the ratio of the drug to the identified internal standard. The internal standards are not completely pure and some percentage of the internal standard (e.g., 7%) will not have been labeled and thus will show up as the drug or drug metabolite. This can be subtracted out based on analysis of controls run during the same assay. Also, the efficacy of extraction procedures varies; only 75% to 80% of the drug or metabolite may be extracted. Because known amounts of the internal standard are added to each sample, the internal standard can be used to adjust for variation in extraction rates.

GC/MS is a very complex procedure requiring specialized equipment and highly skilled personnel. There are several variables in the assay procedure that affect the sensitivity, specificity, and reliability of the assay; therefore, it is impossible to make general statements about these characteristics of GC/MS assays because they are likely to be performed differently in different laboratories. Nonetheless, some guidelines are available. The National Institute of Drug Abuse has issued a monograph describing GC/MS assay procedures for detecting drugs of abuse in body fluids (Foltz et al., 1980). However, it is important to realize that GC/MS is a relatively new technology and that new and more reliable assay procedures are likely to be developed. Not surprisingly, GC/MS is more expensive than immunoassay. Ensuring quality in testing is difficult for various reasons, including the following: (1) there is a great deal of variation in the way that different laboratories may perform these assays; (2) there is a great deal of variation in factors affecting the assay--such as the quality of internal standards; and (3) there is a potential for carryover from one specimen to the next. Therefore, quality control is critical. However, those laboratories that follow HHS guidelines should provide accurate, reliable test results.

5.1.2.3 Assay Comparisons

Several researchers have conducted studies comparing the different assay techniques. Generally these studies focus on only one drug. For example, several studies have compared assays detecting marijuana metabolites (O'Connor and Rejent, 1981; Cook, 1986; Frederick, Green, and Fowler, 1985; Irving, Foltz, Cook, Bursey, 1984; Kogan, Razi, Pierson, Willson, 1986; McBurney, and Sepp, 1986; Sutheimer et al., 1985). Similarly, other researchers have examined assays for opiates (Sutheimer et al., 1982) and cocaine (Cone and Menchen, 1987; Joern, 1987). A thorough review of the comparisons of different assay techniques for each of the drugs discussed is beyond the scope of this report. However, it is important to realize that there are several different assay procedures available and that the different

procedures are appropriate under different circumstances. There is general consensus that a combination of immunoassay procedures for screening and GC/MS for confirmatory testing is most appropriate for employment-related programs testing urine for drugs of abuse.

Hoyt, Finnigan, Nee, Shults, and Butler (1987) conducted a survey of technical experts, laboratory directors, and arbitrators to determine the defensibility of the most frequently used methods and combinations of methods for testing urine for drugs of abuse. There was general agreement that one could not rely on a single assay procedure but that a second assay should be performed on all specimens initially screened as positive. There was also agreement that the two procedures used should be based on different types of assays. For example, if the screening used an immunoassay procedure then the confirmatory testing should be based on a different procedure, such as chromatography. Of the single procedure methods examined in this study, GC/MS was regarded as the most defensible. Of the multiple procedure methods examined, those using an immunoassay screening test (either EIA or RIA) followed by GC/MS confirmation of presumptive positive results were rated as the most defensible methods.

5.1.3 Cross-Reactions

One reason for confirmatory testing procedures is that RIA and EIA screening procedures may produce false positive results when certain other substances are in the urine (Cohen, 1986b). Confirmatory testing eliminates the possibility of a false positive resulting from a cross-reacting drug detected during initial screening. Table 5.1 presents potential cross-reacting drugs for the five major drug types as summarized by Cohen (1986b). Because these cross-reacting substances are generally prescription or over-the-counter medications, testing procedures in a fitness-for-duty program should include an inquiry on the individual's use of these medications.

5.1.4 Quality Control

When properly performed, a urine testing program that follows immunoassay screening with GC/MS confirmatory testing on presumptive positive samples will provide valid and reliable results with few false positives and false negatives. However, several issues of quality control must be addressed before a program using these technologies can be considered adequate. Care must be taken during the actual collection of each urine sample to ensure that it was provided by a particular individual and that it was not tampered with in any way. Additional procedures must be followed during storage, transportation, and testing of the samples to protect them from tampering and to document chain of custody and handling in the event of a legal challenge. Further, it should not be assumed that any laboratory that performs urine tests will provide test results that are accurate.

The Department of Health and Human Services (HHS) describes the mandatory guidelines and procedures for the collection and handling of urine specimens for federal drug testing programs in "Mandatory Guidelines for Federal Workplace Drug Testing Programs" (53 FR 11970, 1988). Similar procedures are described by Manno (1986b). The information presented in the following

TABLE 5.1. Potential Cross-Reacting [illegible]s for the Five Major Drug Types

EIA/RIA Assay	Potential Cross-Reacting Substance
Marijuana (cannabinoids)	Ibuprofen (Advil, Nuprin, Motrin)
	Fenprofin (Nalton)
	Naproxen (Naprosyn)
Cocaine	Coca leaf tea
Opiates	Dextromethorphan
	Chlorpromazine (Thorazine)
	Poppy seeds (large amounts)
Phencyclidine	Chlorpromazine
	Thioridazine (Mellaril)
	Meperidine (Demerol)
	Detromethorphan
	Diphenhydramine (Benadryl)
	Doxylamine (Unisom)
Amphetamines	Ephedrine
	Methylphenidate (Ritalin)
	Phenylpropanolamine (PPA)
	Other weight-reducing and decongestant drugs

sections regarding collection and handling of urine specimens has been drawn from these two sources unless otherwise noted.

5.1.4.1 Collection Procedures

Certain procedures must be followed to ensure that unadulterated specimens are obtained from each individual and to allow individual privacy. It is important to realize that there is widespread information on how to "beat" urine tests, including techniques for adulterating specimens by diluting them with water and by adding substances, such as soap, that may interfere with the assay procedures (cf. Hoffman and Silvers, 1987).

The HHS proposed guidelines recommend that the following procedures be implemented to ensure an unadulterated sample:

1. Place blue dye in toilet tanks to detect and discourage adding water to the specimen.

2. Check the identification of subjects when they arrive at the collection site.

3. Have the subject remove unnecessary outer garments and personal belongings that could be used to conceal substances to tamper with urine.

4. Require that the subject wash and dry his or her hands prior to providing the specimen.

5. Restrict access to water fountains, faucets, soap dispensers, and cleaning agents.

6. Allow the subject to provide the specimen in the privacy of a stall or partitioned area.

7. Carefully approximate the above conditions if a public restroom rather than a designated collection site must be used.

8. Collect at least 60 ml of urine.

9. Allow the subject to wash his or her hands after the specimen has been given to collection personnel.

10. Immediately after collection, inspect the specimen for color and signs of contamination and measure the temperature of the specimen. The temperature should be between 32.5 and 37.7 degrees centigrade or 90.5 and 99.8 degrees Fahrenheit.

11. Keep the specimen in sight of both collection personnel and the individual being tested until it is sealed and labeled.

12. Label the specimen with an individual identification number and date. Have the subject initial the label.

13. Note identifying information in a log with signatures of both the subject and collection personnel.

14. Have the subject read and sign certification statement regarding the specimen.

In addition to the above, care should be taken to ensure that specimen containers are clean, sterile, and inaccessible prior to use.

5.1.4.2 Chain-of-Custody Procedures

Chain-of-custody procedures and documentation are critical to protect the reliability of a urine test. Without chain-of-custody procedures, opportunities would exist for an individual to tamper with, contaminate, or substitute a specimen. Further, a positive test result often elicits protests from a donor that the specimen was contaminated, mislabeled, or mishandled. Chain-of-custody procedures can counter these accusations by providing written documentation of custody and, more importantly, by ensuring that the opportunity for tampering is minimized.

Chain-of custody procedures ensure that every individual who handles a specimen takes personal responsibility for protecting the integrity of that specimen. Chain-of-custody procedures begin with the correct execution of three collection procedure steps that ready a specimen for transfer: the specimen should be sealed with evidence tape and labeled with an identification number in sight of both the collection personnel and the individual being tested; the individual should initial the label; and the specimen's identification number should be entered into a permanent log and signed by both the individual and collection personnel. These three steps provide documentation that the specimen was handled properly through the point of sealing, and that the individual being tested agrees to the integrity of the collection process. HHS guidelines propose the use of a chain-of-custody form, which is to be completed by the collection personnel at the time the specimen is readied for transfer to the laboratory. The collection personnel cannot leave the collection site before the specimen is secure.

Chain-of-custody procedures generally require that specific personnel be authorized with storage and transfer responsibilities. Each individual handling a specimen assumes custody and is responsible for the specimen's secure delivery to the next individual in the transfer chain. The chain-of-custody form, to be signed and dated by each individual when receiving the specimen and when transferring it to the next authorized person, provides written documentation of custody. HHS guidelines suggest that the number of individuals handling the specimens be kept to a minimum.

Once the specimens arrive at the laboratory for analysis, laboratory personnel check each specimen for tampering and confirm that the information on the chain-of-custody form matches the information on the specimen's label. Laboratory chain-of-custody procedures are then used to document the handling and storage of specimens, as described in Section 5.1.4.3. The chain-of-

custody form should be securely stored, as it provides documentation of the possession and transfer of all specimens. This information may be necessary for response or rebuttal to future inquiries regarding a specific specimen or the entire storage and transfer process.

5.1.4.3 Laboratory Certification

The HHS has established requirements for the certification of laboratories engaged in urine testing for federal agencies. Only certified laboratories will be authorized to perform urine drug testing for federal agencies. In order to be certified, a laboratory must satisfy the following conditions:

- The laboratory must be able to perform both initial and confirmatory GC/MS immunoassays on-site for the five drugs of abuse.
- The laboratory personnel must satisfy HHS qualifications standards.
- The laboratory must have a quality assurance program that encompasses specimen acquisition, chain of custody, security and reporting of results, initial and confirmatory testing, and validation of analytical procedures. Quality control procedures will be designed and reviewed to monitor compliance with the standards.
- The laboratory must satisfy security and chain-of-custody requirements specified by HHS.
- The laboratory must be able to store confirmed positive samples for a period of one year in accordance with HHS specifications.
- The laboratory must maintain specimen documentation for at least two years.
- The laboratory must report its results in accordance with HHS specifications.

The certification process requires a review by HHS of the laboratory's facilities. This review consists of an inspection of laboratory equipment, the expertise and experience of the staff, and the adequacy of the laboratory's quality assurance/quality control program. The laboratory's compliance with the standards and any other related factors that affect the accuracy of the test results and reporting methods are also considered.

The performance of the certified laboratories is evaluated by blind performance testing. The HHS requires the federal agency using the laboratory to submit blind performance test specimens according to statistical criteria established by HHS. On-site inspections of the laboratory by a qualified team of inspectors are required at least twice yearly.

5.1.4.4 Reporting and Review of Results

An individual with detailed knowledge of possible alternate medical explanations should review all positive test results. The HHS guidelines require that a Medical Review Officer position be established. The Medical Review Officer analyzes any positive test results prior to taking action on those findings. The Medical Review Officer examines alternate medical explanations, including a medical interview with the individual, and assesses any other relevant biomedical factors.

Once the results have been verified, the Medical Review Officer determines the appropriate action. In the case of true positive results that may be due to licit drug use, the Medical Review Officer determines whether the use of the drug was licit or illicit (e.g., opiate use or over-the-counter medications). The Medical Review Officer also allows the individual in question to discuss the test result.

If the positive result is determined to be true and attributed to illicit drug use, the Medical Review Officer refers the case to the agency's employee assistance program and to the appropriate management official. If the positive result is true and attributed to licit drug use (e.g., over-the-counter drugs), the Medical Review Officer will take no further action. If the result is false positive or declared negative due to insufficient evidence, the Medical Review Officer will attempt to determine the cause for error and report these findings to the HHS.

If necessary, the Medical Review Officer is authorized to have a certified laboratory reanalyze the sample. For instance, if the Medical Review Officer determines that the results are insufficient based on inspection reports, quality control data, or other findings, the Medical Review Officer may declare the test specimen negative and request reanalysis.

5.1.5 Laboratory Performance

Laboratories that process and analyze urine samples must follow quality control procedures to obtain accurate, consistent, and reliable sample results. The quality of the laboratory test results are affected by three interrelated factors: the competence of the analyst, the use of appropriate methodology to achieve the desired goals, and adequate instrumentation and laboratory facilities (Blanke, 1978). Several studies on quality control in the testing laboratory underscore the effect that laboratory quality control procedures can have on false positive and false negative rates ("Clinical Chemists," 1987; Hansen, Caudill, and Boone, 1985; Boone, Hansen, Hearn, Lewis, and Dudley, 1982; Blanke, 1978).

The Centers for Disease Control (CDC) has investigated the proficiency of several laboratories that perform both initial screening and confirmatory testing of urine specimens for barbiturates, amphetamines, cocaine, opiates, PCP, cannabinoids, and other drugs. In a blind study conducted to determine error rates that would occur under normal conditions, both the false negative rates and the false positive rates were found to be unacceptably high in many of the laboratories performing the tests (Hansen et al., 1985). The study by

Hansen et al. (1985) focused on false negative rates because failure to detect a drug or metabolite that is present is more common than detecting a drug that is not present. Not one of the 13 major laboratories examined in that study met the CDC acceptability criteria (false negative and false positive rates not to exceed .05%) on all of the drugs included in the study. Further, no single drug was reliably detected by more than 50% of the laboratories included in this study. The reliability and validity of the screening and confirmatory tests under actual rather than ideal conditions are crucial for the implementation of a drug screening program.

High accuracy rates were recorded in one study of 47 laboratories conducted by the American Association for Clinical Chemistry ("Clinical Chemists," 1987), however. Of 1,847 test results, 1,833 of the samples were correct, 13 were false negative, and 1 was false positive. Three criteria were used to select the labs in the study and may form the basis for laboratory proficiency measures:

- The laboratories were staffed by professionally trained scientists
- The laboratories had an external quality control program in place
- The laboratories had continuing education programs for lab staff.

To ensure high performance, the following standards should be considered as key components of an effective laboratory quality control program (Blanke, 1978):

- Proper calibration, maintenance, and cleaning of measuring devices
- Review of specific procedures and procedural manuals for particular assay( )
- Sufficient standards and controls for each particular assay and drug or drug metabolite
- Accurate reporting and interpretation of assay results
- Internal and external quality control standards.

5.1.6 Determining Cut-off Levels

According to Hawks (personal communication, January 14, 1988), there is no literature explicitly focused on establishing cut-off levels for urine test programs. Cut-off levels used by businesses and by the DoD in existing urine screening programs have been established on the basis of laboratory studies, policy considerations, legal defensibility, and implementation factors. Irving (personal communication, April 19, 1988) reported that the DoD requires that a cut-off level be at least double the sensitivity of the assay procedure.

Assay procedures exist that are capable of detecting very low concentrations of the drugs in question. However, it is not essential to use the lowest

cut-off levels technically attainable in order to detect drug abusers. Cut-off levels such as those proposed by the HHS (53 FR 11970, 1988) are low enough to detect recent drug use and are likely to be defensible against challenges based on measurement error, cross-reaction, and sample decay.

Further, at very low cut-off levels, true positive results are possible in cases where there has been no illicit drug use. For example, as explained below, the legal use of over-the-counter and prescription medications and the consumption of poppy seeds can cause true positive results in urine tests for opiates, passive inhalation can cause true positive test results for marijuana metabolites, and the consumption of certain herbal teas may cause true positives for cocaine. The cost of conducting urine tests and problems entailed in implementing a testing program will increase if cut-off levels are lower than those commonly used.

Cut-off levels are only partially based on scientific studies examining urinary concentrations of drugs or metabolites resulting from "normal" use. Ambre (personal communication, April 19, 1988) cautioned against citing average values or ranges for urinary concentrations of specific drugs or drug metabolites because concentrations depend upon too many variables. Literature providing information about concentrations of particular drugs or drug metabolites in the urine may not be safely applied beyond the specific conditions examined in a specific study. In addition, it is impossible to define the "average" user of a drug. Without explicit criteria defining occasional, habitual, regular, and intense drug users, even approximate estimates of average concentrations or concentration ranges are likely to be misleading.

Cut-off levels recommended by HHS are based on the levels established by the DoD for its drug testing program (52 FR 30638, 1987). The HHS guidelines specifically allow for future changes in cut-off levels as technology changes or as warranted by other considerations. This provision should be considered when establishing any urine testing program.

The HHS recently published updated guidelines for federal testing programs (53 FR 11970, 1988). The HHS initial cut-off levels have not changed since 1987. However, the confirmatory cut-off levels have been changed. The class of opiates has been broken down into two specific drugs, morphine and codeine. The class of amphetamines has been broken down into two specific drugs, amphetamine and methamphetamine; the confirmatory cut-off level has been raised from 300 ng/ml to 500 ng/ml for both amphetamine and methamphetamine; the confirmatory cut-off level for marijuana has been lowered from 20 ng/ml to 15 ng/ml. Table 5.2 presents the 1988 cut-off levels.

5.1.7 Urine Tests for Specific Drugs

This section provides a brief description of the assays used to detect amphetamines, cocaine, marijuana, opiates, and PCP. It also discusses recommended cut-off levels and special considerations in testing for each of the drugs discussed in this report. On a drug-by-drug basis, we identify what substance--either the drug itself or a metabolite of the drug--is tested

TABLE 5.2. Cut-off Levels Established by HHS for the Testing of Drugs and Their Metabolites

Drug or Metabolite	Initial Test Cut-off Level (ng/ml)	Confirmatory Test Cut-off Level (ng/ml)
Marijuana metabolites	100	15
Cocaine metabolites	300	150
Opiates	300	
Morphine		300
Codeine		300
Phencyclidine	25	25
Amphetamines	1,000	
Amphetamine		500
Methamphetamine		500

for in the immunoassay and GC/MS procedures. Next, the cut-off levels recommended by the HHS (53 FR 11970, 1988) and used by the DoD (Irving, personal communication, April 19, 1983) for both the immunoassay screening tests and the GC/MS confirmatory are provided. For each drug there is a discussion of potential sources of false positives due to cross-reactivity and true positives due to legitimate ingestion of a substance. Unless otherwise noted, Hawks and Chaing (1986) is the primary source for the drug specific information in this section.

5.1.7.1 Urine Tests for Marijuana/Cannabinoids

The primary psychoactive ingredient in marijuana is delta-9-tetrahydrocannabinol (THC); THC is quickly metabolized by the body and very little is excreted in its unchanged form. The major metabolite of marijuana is 11-nor-delta-9-tetrahydrocannabinol-9-carboxylic acid (THC-COOH). Approximately 20% of this major metabolite is excreted in the urine (Centers for Disease Control, 1983). Assays to detect marijuana screen primarily for THC-COOH.

As with all drugs, concentrations of marijuana in the urine are affected by dose; time since use; individual use patterns; variations in individual metabolism; and urine volume changes due to diet, exercise, or age (Centers for Disease Control, 1983). For example, McBurney et al. (1986) reported wide variation in both urine and plasma concentrations of THC and its metabolites among several subjects who had smoked two marijuana cigarettes each. Ambre (personal communication, January 26, 1988) referring to Cone's research, provided the following information about the relationship between

urinary concentrations of THC-COOH and exposure to or use of marijuana. Concentrations of 5 ng/ml or less may result from passive inhalation; other research, described below, indicates that higher concentrations can result from passive exposure. Concentrations of 6 to 9 ng/ml indicate possible previous use. Concentrations between 10 ng/ml and 49 ng/ml indicate previous use. Concentrations of 50 ng/ml or higher indicate use of marijuana within the previous 24 hours or regular use. It is important to keep in mind that these are only approximations and that a number of variables affect urinary concentrations of THC-COOH. Recent use, in the last one to three days, is likely to be detected using immunoassay cut-off levels of 50 to 100 ng/ml and GC/MS cut-off levels of 15 ng/ml (Irving, personal communication, April 19, 1988). Chronic or frequent use may also result in consistently positive tests at these cut-off levels for three to six weeks after use is discontinued.

Another consideration in setting cut-off levels for marijuana is that the major metabolites of marijuana deteriorate over time even in properly stored samples. Thus, samples confirmed positive at low concentrations may not test positive at a later date if a legal challenge requires retesting the sample (Irving, personal communication, April 19, 1988).

Initial screening and confirmatory testing. The HHS and the DoD recommend that the cut-off level for marijuana metabolites at initial screening be set at 100 ng/ml. Immunoassay test kits are designed to detect marijuana metabolites at concentrations of 20 ng/ml and 100 ng/ml.

GC/MS assay techniques can reliably detect 15 ng/ml concentrations of marijuana metabolites. The HHS 1987 guidelines and the DoD recommend that 20 ng/ml be set as the GC/MS confirmatory test cut-off level for marijuana metabolites. The 1988 HHS guidelines lower this level to 15 ng/ml.

Passive exposure. One major area of concern in testing urine for marijuana metabolites is the possibility that passive inhalation of marijuana smoke can result in detectable amounts of marijuana metabolites in the urine. Several studies have examined urinary excretion of THC-COOH resulting from passive inhalation of marijuana smoke. In general, they have found that passive inhalation can result in detectable amounts of marijuana metabolites in urine, but that this occurs under conditions of fairly high exposure.

Cone and Johnson (1986) reported a study of urinary levels of THC-COOH following passive exposure to the smoke of either 4 or 16 marijuana cigarettes daily for six consecutive days. Urine was tested using EIA, RIA, and GC/MS assay techniques. THC-COOH was detectable in the urine of all subjects exposed to the lower level of marijuana smoke using RIA assays and in only some of the subjects when tested with EIA and GC/MS assays. Urine samples for this group continued to test positive for an average of 23 hours after the last exposure in GC/MS assays and 30 hours in RIA assays. Passive exposure to the smoke of 16 marijuana cigarettes resulted in positive urine tests for all subjects using each type of assay. THC-COOH was detected in the urine of these subjects for three to five days past the last exposure. This study demonstrates that passive exposure to marijuana smoke can result in detectable amounts of THC-COOH in a person's urine. However, the authors

note that people are not likely to unknowingly tolerate the levels of exposure to marijuana smoke that subjects were exposed to in the hig exposure condition of this study. Further, marijuana showed up inconsistently in the urine of subjects in the low exposure level.

In a similar study, Morland, Bugge, Skuterud, Steen, Wethe, and Kjeldsen, (1985) found detectable amounts of cannabinoids in the urine of three subjects exposed to the smoke of 12 marijuana cigarettes in a closed car during a 30-minute period. RIA assays detected cannabinoids in concentrations of more than 13 ng/ml in all three subjects for two days following exposure.

Perez-Reyes, Di Guiseppi, Mason, and Davis, (1983), in a similar series of studies investigating passive inhalation of marijuana smoke, found that marijuana metabolites were detectable in subjects' urine during the 24 hours following passive exposure. The concentration of marijuana metabolites found in this study seldom exceeded 20 ng/ml; however, concentrations exceeding 20 ng/ml were found for two subjects. One of these subjects had been exposed to marijuana smoke for three consecutive days, and the other subject was exposed to a single high dose of marijuana smoke.

These studies indicate that it is possible for passive exposure to marijuana smoke to result in urinary concentrations of marijuana metabolites exceeding 20 ng/ml. There is disagreement among experts about what cut-off level should be set to avoid positives due to passive inhalation. Note that early in this chapter Ambre was cited as indicating that passive inhalation could result in urinary concentrations of marijuana metabolites of 5 ng/ml or lower. The figures given here indicate that passive inhalation can lead to substantially higher concentrations of marijuana metabolites. All of the studies cited in the previous paragraphs used relatively extreme cases of passive inhalation. These high levels of exposure in the studies discussed above may account for this discrepancy.

Probability of detection. It is possible to draw tentative conclusions regarding the probability of detecting marijuana users with a urine testing program using a 100 ng/ml cut-off level. Such speculations, however, must make a distinction between occasional and chronic users. Because marijuana is lipid soluble, it is excreted slowly. Thus, chronic users will not only have high levels of marijuana metabolites in their urine immediately subsequent to ingesting the drug, but they will maintain relatively high levels over an extended period of time. Recent (within an hour after ingestion) users of marijuana frequently develop urine THC-COOH concentrations that range from 20-200 ng/ml, as measured by specific chromatographic techniques. Levels as high as 2,752 ng/ml in a chronic heavy user have been recorded (Baselt, 1984; Schwartz and Hawks, 1985)). In a study by Manno (1986a), a graph displaying typical cannabinoid levels in the urine over time since last use by an uncontrolled marijuana user shows cannabinoid levels in excess of 100 ng/ml on the second and sixth day, then falling to levels between 100 ng/ml and 20 ng/ml until the sixteenth day. According to Irving (personal communication, April 19, 1988), tests for marijuana metabolites (principally THC-COOH) based on the current DoD cut-off level of 100 ng/ml

will yield positive results for one to three days after use for a moderate user and up to two weeks after use for a chronic or heavy user.

Table 5.3 provides estimates of the probabilities of detecting marijuana users through a program using a 100 ng/ml cut-off level. The table is based on Irving's (personal communication, April 19, 1988) estimates that marijuana metabolites would remain at detectable concentrations in the urine for up to three days. We have made the simplifying assumption that marijuana use is evenly spaced through the year and that the dose used is sufficient to be detected. Consequently, the probabilities calculated represent the maximum risk of detection, given that the assumptions used are accurate. We are assuming a testing rate of 125% per year.

TABLE 5.3. Estimates of Probability of Detecting Marijuana Users through a Urine Testing Program with 125% Testing/Year and a 100 ng/ml Initial Test Cut-off Level

Number of Times Used/Year	Probability of Detection
1	.01
6	.062
12	.576
50	1.00

5.1.7.2 Urine Tests for Cocaine

Cocaine is quickly metabolized by the body and excreted primarily as its metabolites. The major metabolite of cocaine found in the urine is benzoylecgonine. Ecgonine methyl ester, another cocaine metabolite, is also found in significant quantities in urine. Both initial screening and confirmatory assays test the urine for benzoylecgonine; the cut-off levels discussed in this report are for benzoylecgonine. Ambre (1985) reports that single doses of cocaine can probably result in detectable levels of benzoylecgonine in urine up to 48 hours after cocaine use.

Ambre, Ruo, Nelson, and Belknap[1] reported urinary concentrations of cocaine, benzoylecgonine, and ecgonine methyl ester in individual subjects following intravenous administration of several different doses of cocaine. Although it is not known how the laboratory doses compare to "street" doses or how intravenous administration compares to other modes of administration, urinary concentrations of benzoylecgonine exceeded 10,000 ng/ml for all subjects in these studies for several hours following drug administration. Irving (personal communication, April 19, 1988) also stated that a regular user of

[1]Ambre, J. J., Ruo, U. I., Nelson, J., and Belknap, S. (in press-b). Urinary excretion of cocaine, benzoylecgonine and ecogonine methyl ester in humans. Journal of Analytical Toxicology.

cocaine would be expected to have urinary concentrations of benzoylecgonine of 10,000 ng/ml; again, this is an approximation because use parameters were not defined. Because cocaine is ingested in several different ways and doses vary widely, it is difficult to estimate average urinary concentrations in a cocaine user.

One consideration involved in urine tests for cocaine is that cocaine can deteriorate in properly stored samples causing levels of benzoylecgonine to fluctuate over time (Irving, personal communication, April 19, 1988). This may pose problems if legal challenges require retesting of a sample.

Initial screening and confirmatory testing. Immunoassay kits are available that can detect 300 ng/ml concentrations of benzoylecgonine in the urine. This is the level recommended by HHS (53 FR 11970, 1988).

The HHS 1987 and proposed 1988 guidelines recommend that the cut-off level for confirmatory tests for cocaine metabolites be set at 150 ng/ml. According to Irving (personal communication, April 19, 1988) the DoD is planning to lower the confirmatory cut-off from 150 to 100 ng/ml. However, he feels that the 150 ng/ml cut-off is sufficiently low because regular users of cocaine are likely to have much higher concentrations in their urine. Ambre et al.[2] report that ecgonine metnyl ester is easier to identify using GC/MS techniques than is benzoylecgonine. This finding may affect confirmatory testing for cocaine at some point in the future.

There are a few reports that consumption of herbal teas containing coca leaves can result in urinary concentrations of benzoylecgonine exceeding the cut-off levels proposed by the HHS (El Sohly, Stanford, and El Sohly, 1986; Siegel, El Sohly, Plowman, Rury, and Jones, 1986).

Probability of detection. As discussed above, it is difficult to determine the relationship between urinary concentrations of metabolites and drug consumption because several variables affect this relationship. Recently Ambre (1985) has proposed a model that may provide the basis for estimating urinary metabolite concentration resulting from various cocaine doses. This model is based on empirical data linking cocaine dose to concentration of urinary metabolites and on the assumption that urine is produced at a rate of 1 ml per minute. There may, however, be a good deal of variation in this rate of urine production, so extrapolations from the model should be viewed with caution. According to Ambre, the model appears to predict actual data reasonably accurately; there is an average variation of only 25% for benzoylecgonine concentrations. Examination of Ambre's model supports the previously reported estimate that recreational use of cocaine would probably result in urinary concentration of benzoylecgonine above the HHS cut-off level for 40 to 50 hours after cocaine ingestion.

Table 5.4 presents estimates of the probabilities of detecting cocaine users through a urine testing program using the 300 ng/ml cut-off level. These probabilities are based on estimates derived from Ambre's modeled projections

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[2]Ambre et al., in press-b.

TABLE 5.4. Estimates of Probability of Detecting Cocaine Users through a Urine Testing Program with 125% Testing/Year and a 300 ng/ml Initial Test Cut-off Level

	Number of Doses Per Year			
Dose Level	1	6	12	50
50 mg	.005	.032	.065	.273
100 mg	.006	.038	.077	.324

of the length of time benzoylecgonine is likely to remain in concentrations of 300 ng/ml or higher. Based on Ambre (1985, Figure 5, p. 245), a dose of 50 mg of cocaine should result in urinary concentrations of benzoylecgonine of approximately 300 ng/ml or above for 37.5 hours and a dose of 100 mg should result in such metabolite concentrations for 45 hours. Using these figures, the probabilities of detection shown in Table 5.4 can be calculated. The estimates for probability of detection in Table 5.4 are based on the assumptions derived from Ambre's model described in the previous paragraph, the assumption that members of the population (workforce) are tested at a rate equal to 125% of the population per year and a 300 ng/ml cut-off level.

The table shows the probability of detecting individuals who use small (50 mg) and larger (100 mg) cocaine doses with varying frequencies. Because of the rapid excretion of cocaine, it is assumed that chronic and infrequent users are equally detectable on a per dose basis.

5.1.7.3 Urine Tests for Opiates

The major opiate drugs are morphine, codeine, and heroin. Some morphine and codeine are excreted in their unchanged forms. However, the majority is excreted as conjugated metabolites. The primary metabolite of morphine is morphine-3 glucuronide; the primary metabolite of codeine is 6-codeine-glucuronide. Most heroin is converted to morphine in the body. Initial screening and confirmatory tests can detect opiates and opiate metabolites in urine at the proposed HHS (53 FR 11970, 1988) cut-off concentrations for 48 to 96 hours after the most recent dose. According to Irving (personal communication, April 19, 1988), regular users of opiates are likely to have urinary concentrations as high as 30,000 ng/ml. Again, this is an estimate that may vary as the parameters of use vary.

Initial screening and confirmatory tests. Immunoassay kits are available that can detect morphine, codeine, and their metabolites at concentrations of 300 ng/ml, the level recommended in the HHS guidelines (53 FR 11970, 1988). Immunoassays do not distinguish between the different opiates or their metabolites.

Though GC/MS tests can confirm very low concentrations of these drugs, the proposed HHS 1988 guidelines recommend cut-offs for confirmatory tests of

300 ng/ml for both morphine and codeine. Confirmatory tests made with GC/MS can identify the type of opiate in the specimen.

True positives from other sources. The major difficulty with opiate testing is the potential for true positive results due to consumption of poppy seeds, legitimate use of prescription medications, and over-the-counter drugs (especially cough syrups) containing opiates (Hawks, 1986). Several over-the-counter drugs, prescription drugs, and some foods contain enough opiates to cause positive screening and confirmatory test results at the proposed HHS cut-off levels. For example, testing someone who took cough syrup shortly before the test could yield a true positive test result. Legitimate antitussive and analgesic drugs can produce positive test results for opiates. Studies have also reported that consumption of food containing poppy seeds can cause opiates to be detectable in urine (e.g., Bjorver, Jonsson, Nilsson, Schuberth, and Schuberth, 1982). Zebelman, Troyer, Randall, and Batjer (1987) report urinary concentrations of morphine metabolites of between 468 ng/ml and 979 ng/ml two hours after consumption of two poppy seed cookies. Similarly, Struemper (1987) examined urinary concentrations of both codeine and morphine following consumption of three poppy seed bagels. Codeine concentration peaked at 214 ng/ml three hours after consumption and was detectable at 16 ng/ml 22 hours after consumption. Morphine concentration peaked at 2,797 ng/ml at three hours after consumption and was detectable at a concentration of 416 ng/ml 25 hours after consumption. According to Hawks and Chaing (1986), Fehn and Megges (1985) have reported that a GC/MS assay for 6-O-acetylmorphine can distinguish poppy seed ingestion from heroin use.

5.1.7.4 Urine Tests for Phencyclidine

Unchanged phencyclidine (PCP) and its metabolites are excreted in the urine after use of the drug. Assays to detect PCP test for both PCP and its primary metabolite found in urine, 1-(1-phenylcyclohexyl)-4-hydroypiperidine.

Immunoassay kits are available which can detect concentrations of PCP and its metabolites at concentrations of 25 ng/ml. This is the cut-off level used by the DoD and recommended by the HHS. The HHS and the DoD guidelines recommend that cut-off levels for the GC/MS confirmatory tests of PCP be set at 25 ng/ml. According to Irving (personal communication, April 19, 1988), detection of PCP at lower concentrations is unnecessary. At this level, GC/MS assays can reliably detect PCP.

Immunoassays for PCP may also yield positive results caused by prescription drugs including thioridazine, dextromethorphan, and chlorpromazine. Confirmatory testing using GC/MS can distinguish PCP from these drugs.

5.1.7.5 Urine Tests for Amphetamines

Unchanged amphetamine and methamphetamine and their metabolites are excreted in the urine. Most methamphetamine is excreted in its unchanged form. However, some ingested methamphetamine is converted to amphetamine in the body. The primary metabolite of amphetamine is benzoic acid. The fraction of a dose excreted in the urine depends on the acidity of the urine; more

amphetamine is excreted in acidic than in alkaline urine. Up to 40% of the unchanged drug may be excreted in the urine. Nelson and Moffat (1980) report that ingestion of sodium bicarbonate may be used to suppress urinary excretion of amphetamines and to prolong the effects of the drug. According to Irving (personal communication, April 19, 1988) a chronic user of amphetamines is likely to have urinary concentrations of between 5,000 and 15,000 ng/ml. Recall that this figure is only an estimate and that the parameters of use are not defined here. Amphetamines can be detected in the urine for about 24 hours following a single dose and for up to 48 hours for a chronic user (Hawks and Chaing, 1986).

Immunoassay techniques are available that can detect both amphetamine and methamphetamine in the urine. The EMIT® (Syva) assay will detect both drugs. The RIA Abuscreen (Roche) does not detect methamphetamine; however, enough methamphetamine is changed to amphetamine to be detected by RIA assays. Although concentrations of 300 ng/ml can be detected reliably using these immunoassay kits, both the HHS and the DoD recommend that the screening assay cut-off level be set at 1,000 ng/ml (Irving, personal communication, April 19, 1988).

The fundamental problem with setting lower immunoassay cut-off levels for amphetamines is that several over-the-counter cold remedies and diet aids contain amphetamines. Cut-off levels lower than 1,000 ng/ml may result in true positive results in as many as 25% to 30% of samples tested due to legitimate use of over-the-counter medications (Irving, personal communication, April 19, 1988). Nelson and Moffat (1980) report that immunoassays for amphetamines are relatively less sensitive than immunoassay tests for other drugs and that available RIA and EIA tests cross-react with several other drugs. They report that the following drugs have been found to cross-react with one or both of the immunoassays: benzephetamine, chlorphentamine, diethylpropion, ephedrine, fenfluramine, methamphetamine, methylphenidate, phenmetrazine, phentermine, phenylpropanolamine, and propylhexedrine. Several over-the-counter cold and diet medications contain ephedrine and phenylpropanolquamine. Benzephetamine, fenfluramine, mephentermine, and phenmetrazine are contained in prescription medications (Hawks and Chaing, 1986).

Gas chromatography/mass spectrometry assays can reliably detect low levels of amphetamines and reduce cross-reaction problems. The HHS 1988 guidelines set the confirmatory cut-off level at 500 ng/ml. Lower cut-off levels would very likely lead to the detection of drugs resulting from legitimate use of over-the-counter medications. The HHS breakdown of the class of amphetamines reflects the fact that GC/MS assays are capable of distinguishing amphetamine and methamphetamine from other substances causing presumptive positive results.

5.2 ALTERNATIVES TO URINALYSIS

Because of the limitations of urine testing for drug use discussed in the preceding sections, researchers are working to develop alternative testing technologies. In this section, several of those alternatives are discussed and compared to urine testing.

5.2.1 Blood (Plasma) Analysis

The analysis of blood has a significant advantage over urinalysis due to the potentially more direct correlation between blood levels of a drug and an individual's degree of impairment. Blood levels are typically more closely related to effects on the central nervous system than drug or metabolite concentrations in urine.

Although a consensus has been reached among researchers that an analysis of blood can identify cases of drug use where other clinical indications of impairment do not exist, for drugs other than alcohol current data remain insufficient to establish cut-off levels to distinguish between individuals who are impaired and those who are not (Council on Scientific Affairs, 1987). However, blood tests can be useful in post-accident analyses if the subjects can be sampled quickly. An additional consideration is that blood analysis can generally deal directly with the drug of interest rather than the drug metabolites, as in the case of urine testing, and may thus avoid some of the problems associated with cross-reactions.

The testing of plasma presents some logistical barriers that may be difficult to overcome. The intrusiveness of drawing blood can be significant for some individuals (Dogoloff, Angarola, and Price, 1985), as the drawing of blood can involve both pain and trauma. The anxiety that accompanies blood drawing may be heightened, though unreasonably, by the AIDS epidemic. The collection of blood samples also requires trained medical personnel, unlike the collection procedures associated with urinalysis (Walsh and Yohay, 1987).

Finally, there are particular substances, such as cocaine, that exhibit a short half-life in the blood; consequently, the chances of identifying users of these substances through blood tests are substantially reduced (Washton and Gold, 1987). The concentration of metabolites in urine is sometimes higher than the concentration of the drug in plasma, as in the case of amphetamines (Nelson and Moffat, 1980; Washton and Gold, 1987). Further, drugs and their metabolites can be identified over a longer period of time through urinalysis than through the analysis of blood (Washton and Gold, 1987).

5.2.2 Saliva Analysis

The analysis of saliva for drug detection purposes is receiving current attention. RIA procedures have been established for several drugs, and a commercial testing kit is available. If saliva analysis is determined to be technically and logistically feasible, its use would avoid some of the intrusiveness and embarrassment of urinalysis, in addition to the anxiety associated with drawing blood.

Although clinical studies of saliva testing have been conducted for a number of years (Caddy, 1984), the practical and technical limitations associated with saliva analysis currently present a barrier to its implementation as a viable alternative to urinalysis (Walsh and Yohay, 1987). Analyses of saliva for detecting marijuana use, for example, have found that such factors as food consumption and mode of ingestion can dramatically affect the ability of

assays to detect marijuana use (Hawks, 1982). The collection of an adequate volume of the specimen for confirmation purposes can also be problematic.

5.2.3 Hair Analysis

Hair specimens can be used to identify a past history of drug abuse. Hair analysis has a significant advantage over urinalysis testing in that it can provide information on drug use over a much longer time period than can urinalysis (Baumgartner, Black, Jones, and Blahs, 1982) and is much less invasive than blood or urine testing. However, Walsh and Yohay (1987) point out that "hair analysis has not been validated extensively enough in clinical studies to make an adequate assessment of its suitability for general drug screening" (p. 93). Its usefulness in detecting recent or current drug use is not known. Further, this is a very expensive test, which would prohibit its use for a large volume of tests, such as initial screening tests for nuclear power plant workers in a random testing program. Hair analysis is consequently regarded primarily as a research tool.

5.2.4 Behavioral and Physiological Testing Techniques

Behavioral and physiological testing techniques have traditionally been used in the area of law enforcement to determine whether an individual is impaired. These tests differ fundamentally from chemical tests in that behavioral and physiological signs are used as direct measures of impairment. In contrast, chemical testing techniques determine the presence of drugs or drug metabolites in biological samples; the presence of a drug or drug metabolite is then used as an indirect measure of impairment. Both approaches have distinct advantages and disadvantages, including varying degrees of reliability, accuracy, and specificity.

Three such behavioral and physiological testing techniques--field sobriety tests, the Drug Recognition Expert program, and drug analysis instruments--are discussed in this section.

5.2.4.1 Field Sobriety Tests

Behavioral and physiological testing techniques can be used to determine whether an individual is impaired based on observable signs and behaviors, such as a driver under the influence of alcohol who cannot maintain his balance. The test battery is usually referred to as a field sobriety test (FST) and includes measures of physical and mental skills such as balance, coordination, the ability to follow instructions, and the ability to perform two tasks simultaneously, and observation of drug paraphernalia (Studdard and Page, 1988). Although such tests are quickly and easily administered, they are not necessarily reliable indicators of impairment, nor do they provide much information about the cause of impairment.

Recent improvements in FSTs have led to a standardized three-test battery introduced by the National Highway Traffic Safety Administration (NHTSA) (Burns, 1985). These improvements have resulted in greater reliability, validity, utility, and higher prosecution rates. The battery is comprised of the walk-and-turn test, the one leg-stand, and the horizontal gaze nystagmus

test (Burns, 1985). The walk-and-turn test and the one-leg stand are measures of balance and coordination. The horizontal gaze nystagmus test, which has been shown to be the most sensitive field test for alcohol and drug impairment, (Burns, 1985; Good and Augsburger, 1986; Stapleton, Guthrie, and Linnoila, 1986), measures eye movement:

> Nystagmus is defined as a jerking movement of the eyes. Horizontal gaze nystagmus (HGN) is a jerking movement which appears as the eyes are deviated laterally. If the individual has ingested alcohol or certain other central nervous system depressants, the jerking appears at an earlier angle of lateral deviation and is more distinct than if no such substances were present in the body. (Burns, 1985, p. 24)

Field sobriety tests were initially developed to detect alcohol intoxication. Although much work has been done recently to expand the FST methodology to allow for testing for other substances, the tests remain a better indicator of alcohol intoxication than intoxication from drugs. According to Burns (1987):

> At the present time, however, there are no FSTs specifically for drugs. With only a few exceptions, neither research nor law enforcement has given attention to the problem of drug recognition in the field. (p. 26)

To obtain more reliable and meaningful information about a suspect's impairment, law enforcement agencies are improving their FSTs. In some agencies, such as the Los Angeles Police Department (LAPD), the FST is only the first part of a drug recognition program that extends through booking and into the prosecution phase (Burns, 1987). Thus, FSTs have grown into a technology that no longer is used strictly in the field. The Drug Recognition Expert program offers a more comprehensive testing technique.

5.2.4.2 Drug Recognition Experts

In response to a growing need for standardized testing procedures that could identify drug-related impairment, the Los Angeles Police Department instituted the Drug Recognition Expert (DRE) program in the 1970s. The DRE program consists of the administration of a standardized battery of behavioral and physiological tests intended to determine if a suspect is impaired, and if so, what type, or types, of drugs have been used. Although the DRE testing techniques have their basis in field sobriety testing, DRE programs may prove to be more objective and useful than FSTs. The DRE program has been adopted by several law enforcement agencies across the U.S.

In a DRE program, selected police officers are trained to recognize the signs and symptoms of drug influence. The training required to certify a drug recognition expert is extensive. Drug recognition experts must be versed in the physiological effects of drug ingestion and be trained to administer and evaluate FSTs and an additional battery of standardized tests to determine drug impairment. A typical DRE training program includes classroom lectures, self-study, and on-the-job training.

When conducting an examination for impairment, the DRE administers a series of standardized tests to the suspect. The test battery includes (Studdard and Page, 1988):

- An evaluation of the suspect's clinical eye signs, i.e., horizontal and vertical nystagmus, pupil size and reaction to light. Clinical eye signs are one measure used to determine drug type.

- Measures of pulse, blood pressure and body temperature. These are other clinical signs used to determine the type of intoxication or drug type.

- A Standardized Field Sobriety Test (SFST) to determine impairment in both mental and physical skill areas. The DRE measures balance, coordination, the ability to follow simple instructions, and the ability to perform two tasks simultaneously (divided attention). Divided attention is an especially important measure of impairment because many complex tasks involve a combination of skills such as sight, hearing, and judgment of depth and time perception.

- Administration of modified FSTs to determine the specific type of impairment. For example, the improved walk and turn test requires the individual to place both feet, heel to toe, on a line and remain in this position while the officer gives performance instructions. The DRE evaluates the individual's overall ability to maintain balance while listening to instructions (the impaired person tends to concentrate on either task and neglect the other). The DRE also administers other modified FSTs, including the walking phase test, the modified Romberg standing balance test (divided attention), the "internal clock" test (time estimation task), the one-leg stand test, and the finger-to-nose test. The one-leg stand test and the finger-to-nose test are designed to measure divided attention, muscle rigidity or tremors, and other drug-related symptoms.

These comprehensive tests are then used by the DRE to determine whether the individual is impaired and the cause of impairment (drug impairment or impairment due to other causes such as injury). If impairment appears to be due to drugs, the DRE attempts to determine the type or types of drugs involved.

A field study conducted by the National Highway Traffic Safety Administration to assess the validity and reliability of DRE examinations provided mixed results:

> The DREs judged the 173 suspects (from which a blood sample was obtained) as impaired by a drug other than alcohol. In just one case the blood analysis detected no drugs or alcohol, and in ten cases only alcohol was found. Thus, 94% of the time (152 suspects) a drug or drugs other than alcohol were found when the DREs judged the suspect was impaired by drugs. (Compton, 1986, p. 15)

However, the DREs' accuracy in identifying the specific type of drug used (as indicated by the blood test) was not as high. The DREs' accuracy rates in identifying the drug used by a suspect are presented in Table 5.5.

TABLE 5.5. DREs' Accuracy in Identifying Drug Used

Drug	False Positives	False Negatives
PCP	8%	12%
Marijuana (THC)	22%	27%
CNS Depressants	50%	3%
Opiates	15%	1%

Thus, although the DRE approach appears to be a promising alternative to urinalysis in detecting current impairment due to drug use, it lacks the specificity and sensitivity of urinalysis. That is, the DRE program does not yet appear to be able to provide accurate information about the type of drug that has caused impairment, in contrast to the information provided by urinalysis. Further, the DRE approach cannot detect recent drug use that is not causing observable levels of impairment, and so could not provide information pertinent to a nuclear worker's reliability. Urinalysis results, on the other hand, can indicate recent substance use for many classes of drugs, and so provide important information about the reliability of the individuals tested. Although further research and development of the DRE program may satisfactorily address the limitations with regard to specificity, it is unlikely that the DRE approach will detect recent drug use as reliably as urinalysis when that drug use does not result in observable degrees of impairment at the time of testing. Therefore, the DRE program may be a useful adjunct to a for-cause testing protocol, but it does not appear to be an acceptable substitute for urinalysis in a random testing program.

5.2.4.3 Alcohol and Drug Analysis Instruments

Automated techniques to administer and analyze behavioral and physiological tests of impairment are being developed. Westerman, Gilbert, and Shrewsbury (1981) demonstrated that when nystagmus can be measured with an electronystagmograph (ENG), rather than by human observation, specific drugs of impairment can be identified. The ENG produces a printout that is drug specific, and "research presently being conducted indicates that combinations of drugs with other drugs and/or alcohol result in a specific printout pattern also" (p. 1545).

One firm that is in the process of developing and evaluating an ENG device that reportedly measures eye movements more precisely and objectively than human observation (Waldorf, personal communication, July 8, 1988). The system evaluates the information gathered (eye movement and vital signs) to determine the drug or drugs that the subject has consumed, if any. Preliminary

independent evaluations indicate that the system is reliable and sensitive, and that it can accurately detect polydrug consumption. In addition to providing immediate results, the system has the advantage that tests can be administered very quickly and easily. It requires approximately two to five minutes to administer a test and obtain test results. Problems inherent in urinalysis, such as chain of custody of samples, are eliminated with this technique, although substantially more research is necessary to ensure the validity and reliability of the method.

5.3 CONCLUSIONS

There are several significant limitations affecting current testing technologies and procedures for assuring that workers are fit for duty in protected areas of nuclear power plants. The results of urine tests do not provide objective evidence regarding an individual worker's patterns of drug use or level of impairment. Further, a negative test result may not indicate abstinence from substance use. Nor are other testing technologies capable of overcoming these weaknesses, at least in the short run. For example, behavioral and physiological testing techniques may eventually prove quite useful in determining levels of impairment in for-cause testing, but they will never be able to establish patterns of drug use or abstinence from substance use.

As research on the various alternatives to urinalysis for alcohol and drug testing progresses, the NRC may conclude that one or more of them should replace urine testing for drugs. For example, hair analysis may prove to be superior to pre-employment urine testing to identify individuals with a history of drug use, and blood sample analysis may eventually be useful in assessing degrees of current impairment due to drug use. However, there is insufficient research at the present time to indicate that any of the alternative techniques can substitute for urinalysis. Further, the technical and logistical limitations of these alternative techniques indicate that urinalysis testing is likely to remain the most feasible for large-scale applications over the next several years.

Despite the limitations of urine testing, the promulgation of a rule requiring drug and alcohol testing of workers with unescorted access may serve to deter substance abuse. Licensee implementation of such a rule reflect a substantial concern with quality control in drug testing procedures at plants and in the laboratories used, and takes into account the limitations of drug testing when employment decisions are made. Further, the cut-off levels that are identified in the rule and any differences between the rule and the levels set by licensees may require periodic review as new evidence in this rapidly evolving field becomes available.

6.0 ISSUES RELATED TO EMPLOYEE ASSISTANCE PROGRAMS

There are a number of issues related to EAP design currently under discussion in the EAP literature that the NRC may want to consider in implementing a fitness-for-duty rule that requires licensees to provide EAPs. Literature pertaining to these issues is discussed in this section.

An NRC requirement that nuclear utilities implement EAPs to address fitness-for-duty issues is unlikely to be as controversial as a requirement for drug and alcohol testing programs. Occupational alcoholism programs have been in existence since the 1950s and many licensees already make the services of an EAP available to their employees. Because occupational alcoholism programs have been used to address fitness-for-duty issues for a relatively long period of time, standard practices for developing an EAP have evolved. In fact, guidance for implementing EAPs is currently available to the nuclear industry in the EEI Guide to Effective Drug and Alcohol/Fitness for Duty Policy Development (Edison Electric Institute, 1985).

Although these standard practices have evolved over a period of time, they have not been empirically evaluated (Johnson, 1986). Nevertheless, the EAP literature describes several program elements that are considered necessary to the successful resolution of employee fitness-for-duty problems (McGaffey, 1978; Sonnenstuhl and O'Donnell, 1980; Foote and Erfurt, 1981; Phillips and Older, 1981; Roman, 1981b; Bierman, 1982; Walsh, 1982; Gam, Sauser, Evans, and Lair, 1983; Wrich, 1988). The "ideal" EAP has been described as including the following elements:

- Management support for the EAP in the form of a written policy statement describing the program and explicit, written procedures for implementing the program
- Support for the EAP and cooperation from employee unions
- Clearly defined job performance standards
- Knowledge of the EAP among employees
- Well-trained supervisory staff
- A recognition by management that performance problems can result from many different causes
- Program staff who provide problem diagnoses, appropriate referrals, treatment coordination and follow-up
- Adequate financial resources to provide comprehensive treatment resources
- Health insurance coverage that is compatible with the EAP
- A program evaluation process.

Most of the EAPs established within companies the size of a nuclear utility provide a variety of services. For example, typical services include employee education on substance abuse and other types of impairment, training of supervisors and other key employees to act as referral agents, provision of case consultation to supervisors, assessment and diagnosis of employees referred to the EAP, referral and placement services to outside treatment facilities or mental health providers for those employees requiring assistance beyond the scope of the EAP, follow-up contact once treatment is completed, and assistance with the employee's transition back to work (Walsh, 1982; McClellan, 1984). The components of the "ideal" EAP listed above are described in greater detail in the following sections.

6.1 NEED FOR WRITTEN POLICY AND PROCEDURES

Of primary importance prior to EAP implementation is the need for executive managers and, if appropriate, union representatives to develop and endorse a written policy statement that clearly articulates the company's goals and objectives for the EAP, and the procedures for identifying, confronting, and referring employees for assistance (Albert, Smythe, and Brook, 1985). The policy statement and written procedures must adequately reflect top managers' intentions, so that employees, supervisors, and managers share similar expectations. Written policies and procedures can help to alleviate any perceptions that management is not serious in its attempts to assure a safe workplace (Segalla, 1982). In addition, Trice and Beyer (1984), in a study involving over 600 supervisors concluded that the existence of a formal policy not only motivated supervisors to confront employees with declining work performance, but also "legitimated those actions and made the threat of discipline more credible" (p. 393).

6.2 UNION PARTICIPATION AND SUPPORT

The implementation of an EAP traditionally has been considered by unions to be to the employee's benefit rather than a substantial change in the conditions of employment. Therefore, unions have typically not objected to their institution.

As noted in Section 3.0, experience in other industries has shown that coordination with unions in developing the EAP and in increasing employee awareness of it are valuable. Because unions often provide medical benefits to their members, designing the EAP to coordinate with drug and alcohol abuse treatment programs that will be paid for by the employees' benefits through the union can improve program effectiveness. Further, shop stewards can encourage troubled employees to seek help through the EAP before performance problems come to the attention of a supervisor. Finally, local union meetings provide an opportunity to educate employees about the purposes of the EAP and the services it provides.

6.3 JOB PERFORMANCE STANDARDS

The EAP literature recognizes the need for clearly defined job performance standards and written job descriptions (Roman and Trice, 1976; Kurtz, Googins, and Howard, 1984; Albert et al., 1985). Detailed job descriptions and performance standards are necessary to document declining work performance and to assist supervisors in describing performance deficits to employees (Johnson, 1986).

6.4 EMPLOYEE AWARENESS OF THE EAP

To facilitate self-referral, employees must be made aware of the EAP and its purposes. Although a policy statement and written procedures can demonstrate management support of the program, employee training is also considered to be essential. Employee education can serve the dual purpose of first informing employees of the existence of the EAP and how to use it, and second, of educating employees about the various types of problems that can affect job performance.

Several studies have examined methods to retain heightened employee awareness throughout the work year, following initial EAP training. The results of these studies have demonstrated the successful use of fliers, posters, articles included in the employee newsletter, and notes included in employee pay envelopes (Segalla, 1982; Hobson, 1982).

Proponents of EAPs suggest that a high percentage of self-referrals to a company's EAP is a measure of employee awareness and acceptance of the program (Dubreuil and Krause, 1983). However, one study that used a systems approach to develop, implement, and evaluate an EAP for a university found that even when employees indicate that they value their organization's EAP, they remain more willing to refer others than themselves. The perception of risk in seeking assistance in the workplace was reported to be uncomfortably high, but employee education was cited as an effective method for reducing employee fears (Hobson, 1982).

6.5 THE ROLE OF THE SUPERVISOR

Many investigators have suggested that the success of an EAP depends on the supervisor, as the responsibility rests with supervisors to identify, confront, and refer employees who are displaying signals of impairment, or whose job performance has deteriorated (Hoffman and Roman, 1981; Roman, 1981b; Johnson, 1986). For example, post-treatment employees have reported that on-the-job difficulties and job absenteeism were the first visible symptoms of their problem drinking, attesting to the important role that supervisors play in detecting fitness-for-duty problems (Hoffman and Harrison, 1987). Further, a study that attempted to account for variance in the treatment outcomes of employees who participated in an EAP concluded that supervisory cooperation and participation were the key elements in controlling performance problems associated with alcohol abuse (Iutcovich, 1983).

Although management can provide tangible support for the supervisors' efforts in the form of written policies and defined job standards, training is of primary importance to ensure that supervisors understand their responsibilities and are willing to carry them out (Gregoire, 1979; Morgan-Janty, 1983; Martin, Heckel, and Long, 1984). The training provided to supervisors must address a number of topics, including the warning signs of poor performance, types of impairment, documentation requirements, employee confrontational techniques, referral information, and what to expect from a case consultation with EAP staff. In addition, supervisors may need assistance with handling employees who are returning to work following rehabilitation (Kurtz, Higgins, and Williams, 1980; Segalla, 1982; Dubreuil and Krause, 1983).

Ongoing refresher training is also considered to be necessary. In the course of a regular work day, supervisors have little, if any, opportunity to exercise the skills they have received in training. If training is provided once or on an annual basis only, their skills can become rusty, and heighten any reticence the supervisors may have initially experienced in using these skills (Wrich, 1988).

Several barriers to supervisory participation in EAPs have been identified in the literature. These include the supervisor's desire to help the impaired employee, rather than expose him or her to potential disciplinary action; a belief that the formal system (i.e., the EAP) should be used only as a last resort; and the attempt on the supervisor's part to counsel the impaired employee (Hoffman and Roman, 1984; Dubreuil and Krause, 1983). Under a fitness-for-duty rule, the possibility that an employee could lose his or her unescorted access authorization if found to be unfit for duty as the result of an evaluation by an EAP counselor may make supervisors in the nuclear industry even more reluctant to refer than supervisors in other settings. The effectiveness of ongoing supervisory training in overcoming such barriers has been repeatedly demonstrated (Albert et al., 1985).

The most desirable mix of self- and supervisory referrals to an EAP is an issue under debate in the EAP literature. Data are not available on the average rates of each type of referral in various industries or for different types of programs. However, EAPs appear to be moving away from an emphasis on supervisory referrals to encouraging self-referrals (Dubreuil and Krause, 1983). Many argue that the increasing number of self-referrals, and the decreasing number of supervisory referrals, indicate the degree of penetration and effectiveness of a company's EAP. This argument assumes that an increasing number of self-referrals correlates with employees' acceptance of the program and demonstrates program credibility (Dubreuil and Krause, 1983). Others express concern that the traditional EAP model, dependent for success on supervisory referral and participation, is being abandoned. These individuals interpret the move away from supervisory referrals as indicating management's discomfort confronting employees over deficient job performance (Nathan, 1983), that supervisors may not being doing their job, or that they are not trained (Albert et al., 1985).

The primary concern driving the increasing proportion of self-referrals stems from recognition of the nature of addictive disease. Substance

abusers are the least likely population to self-refer (Weiss, 1987). Therefore, an EAP that relies heavily on self-referrals may be missing the highest percentage of employees needing assistance (Weiss, 1987; Albert et al., 1985).

One study which addressed this issue appeared to support the need for a high rate of supervisor referrals to ensure that substance abusers receive services. In a comparison study of 21 EAPs, the majority of which reported at least a 60% self-referral rate, only three reported that substance abuse was the most frequent diagnosis. These three EAPs had the highest rates of supervisory referrals (Johnson, 1986).

Because drug abuse is of particular concern to the NRC, and because substance abusers are the least likely employees to self-refer to an EAP, the supervisor's role in licensee fitness-for-duty programs is of prime importance. The quality and frequency of supervisor training may warrant special attention from the NRC in developing a fitness-for-duty rule and in assessing licensee programs to implement it.

6.6 THE "BROADBRUSH" APPROACH

The broadbrush approach to EAP design is widely recommended in the literature as an improvement to the occupational alcoholism programs that preceded present-day EAPs in many companies. Approximately 80% of the nation's EAPs are now estimated to be broadbrush in scope (Wrich, 1988). As the name implies, broadbrush EAPs provide a breadth of services to employees rather than focusing only on the detection and treatment of drug or alcohol abuse.

The broadbrush approach is believed by proponents to be superior to substance abuse programs for several reasons. The broadbrush approach is thought to increase the potential for reaching troubled employees, since the stigma attached to the use of alcohol-only workplace programs is greatly reduced (Foote and Erfurt, 1981; Walsh, 1982; Rothman, 1986; Roman, 1981a; Dubreuil and Krause, 1983; Shore, 1984). Further, the broadbrush approach is believed to better address the variety of factors, such as psychological, marital and family, medical, financial, and legal problems, that in addition to substance abuse, can result in job performance decrements (Dubreuil and Krause, 1983; McClellan, 1984).

Despite the wide acceptance of the broadbrush approach, Roman (1981a) and others have argued against it, asserting that it dilutes efforts to control workplace alcoholism. Foote and Erfurt (1981) examined this contention in their study of General Motors' 118 EAPs which operate autonomously and without centralized procedures. Sixty-one of the EAPs considered their service orientation to be alcohol-only, while the remaining 57 provided broadbrush services. The study found that expanding the scope of the services provided by the programs from alcohol-only to broadbrush in no way reduced the effectiveness of the EAPs in reaching alcoholics: both groups of programs had the same average diagnosis rates of 12 employees with alcohol-related problems per 1000 employees. The study also showed that individuals without alcohol problems, who were subject to other types of problems that could place workplace safety at risk, were identified by their supervisors on

the basis of job performance decrements in the broadbrush programs. The researchers noted that these individuals will not receive such assistance in alcohol-only programs, and their problems may in fact be ignored by supervisors once it is recognized that there is no available mechanism for referral.

6.7 EAP STAFFING

Although the responsibilities of EAP personnel vary depending upon the characteristics of the program they serve, EAP counselors typically assess the nature of the troubled employee's problem and then act as case managers. The scope of the services an EAP counselor provides depends on two issues; the professional training and credentials of the EAP counselor, and the program's design. Most EAPs are staffed by professional social workers or occupational health specialists, many of whom are certified at the state level to provide alcohol and drug abuse counseling (Johnson, 1986).

When reviewing the various approaches to EAP design and implementation discussed in the literature, a debate arises as to whether the goals of an EAP are best served by providing the EAP diagnostic and referral services in-house or by contracting with outside entities. The question of how to staff an EAP is viewed as a management decision that requires an evaluation of the individual company's corporate environment and needs (Walsh, 1982). Internal staffing of the EAP can have the advantages of increasing the company's control over the program, allowing for easier monitoring of an employee's progress, providing greater convenience to employees, and demonstrating greater sincerity and support by management. Advocates for staffing the EAP externally state that external programs increase the perception among employees that self-referrals to the EAP will remain confidential and separate from personnel actions (Walsh, 1982; Dubreuil and Krause, 1983; Shore, 1984). Further, combining with other companies in an external consortium EAP may be the only type of EAP that a smaller company can afford (Blair, 1985).

Conclusive data on the effectiveness of one design over the other are not available. A comparative study reported that only three of the 2. EAPs studied, ranging in size from 500 to 55,000 employees, had external programs, but did not provide further insight (Johnson, 1986).

Either approach appears to be acceptable in the nuclear industry. Given the reporting requirements that may be associated with a fitness-for-duty rule, the need for close supervision of EAP users with unescorted access, and the fact that many nuclear power plants are located in remote areas, staffing the EAP in-house may be preferable. However, reporting requirements and an on-site EAP presence can be made part of a licensee's contract with an external EAP as well.

6.8 ADEQUATE FINANCIAL RESOURCES

A 1980 study of 346 corporate EAPs found a strong relationship between the effectiveness of an EAP and the level of resources that management dedicated to the program (Weiss, 1987). For example, providing various treatment

alternatives that are adequately covered by employee medical insurance was linked to a higher proportion of employees that were considered "recovered" once they had been through treatment and returned to work, and a higher degree of willingness among employees to self-refer. Additional results showed that a high ratio of EAP staff to company employees correlated with an increased number of employees willing to enter the EAP, and that the employees were more likely to maintain their pre-treatment job status. Adequate financial resources, demonstrated by the level of EAP staffing, health insurance coverage for EAP services and rehabilitation, program promotion, and an allocation of funds for evaluation, are tangible indicators of management support for the program.

6.9 HEALTH INSURANCE COVERAGE FOR EAP AND REFERRAL SERVICES

Health insurance coverage that is compatible with EAP services has been identified as an important element for an EAP to effectively address fitness-for-duty problems. The first step to ensure that health insurance coverage complements EAP services is to identify the scope of EAP services. Generally, the types of services that require third-party coverage include inpatient and outpatient treatment. An EAP staff can maximize insurance coverage by developing a referral and placement network with facilities or clinics that meet an insurance plan's criteria for reimbursement. For example, many insurance carriers require that a facility and its staff be licensed or certified by an appropriate state agency before authorizing reimbursement.

Lack of appropriate or adequate health insurance coverage can pose a significant barrier to obtaining treatment. Treatment costs for drug and alcohol abuse are currently on the increase ("Health Care," 1988). Private treatment facilities are generally expensive and require a financial commitment beyond the resources of many individuals. A standard 28-day inpatient treatment program commonly costs between $8,000 and $20,000, although some inpatient facilities are reported to charge up to $10,000 a week (Holden, 1987). Even at the lower end, the cost of treatment would be prohibitive to most licensee employees and contractors were they required to pay without assistance. Less expensive options, such as publicly funded or non-profit facilities, although often authorized to receive health insurance reimbursements, are typically located in urban settings and are not geographically close to licensees.

Nationwide, the percentage of employer-paid health insurance benefits is declining. The Bureau of Labor reports that in 1986 only 54% of workers had the full cost of health insurance paid by employers, compared with 72% as recent as 1980 ("35 Million Americans," 1987). The cost of group health insurance continues to escalate, and, in response, employers are making efforts to contain the cost of coverage. These efforts include requiring that employees share the burden of premium costs, cutting back on types of benefits offered, and experimenting with cafeteria-style benefit plans that allow employees to choose from a variety of benefits options ("Group Health Care," 1987). Because drug and alcohol treatment is both increasing and considered a high-cost service, coverage may become another point at which employers make an effort to curb costs. These trends could seriously impact

the extent and nature of an employee's drug and alcohol treatment coverage, or, in some cases, eliminate it altogether. Because insufficient health care insurance can deter an individual from seeking treatment, the NRC may decide that it has an interest in assuring that licensees and their contractors provide adequate and appropriate health insurance for their employees.

6.10 PROGRAM EVALUATION

Although program evaluations are necessary to assess and improve EAP effectiveness, companies typically do not conduct ongoing evaluations of their EAPs (Lewis, 1981; Korr and Ruez, 1986; Albert et al., 1985). Evaluation research is uncommon for several reasons.

First, lengthy follow-up studies of treatment outcomes are costly and time consuming, and they are not of primary concern to an organization's purpose in providing an EAP. Most organizations take for granted that their EAP is working and has intrinsic worth, so that motivation for conducting a program evaluation is low (Johnson, 1986).

Second, corporations typically do not have in-house expertise for conducting formal evaluations of human resource programs. Such evaluations are not a part of the human resource managers' traditional training or responsibilities (Kurtz et al., 1984).

Obtaining access to EAPs for research purposes presents a third obstacle to conducting program evaluations. External researchers have had difficulty garnering the commitment of time and resources required for a long-term study. The resistance from organizations arises from fears of public exposure of substance abuse problems and fears of potential conflicts between management, employees, and EAP staff. Employee confidentiality is an additional concern of managers and EAP staff. Finally, EAP staff are perceived as a barrier, in part due to their professional training that builds confidence and belief in the efficacy of EAPs. As a group, they tend to resist participation in research that randomly assigns employees to treatment modalities, or to control groups that receive no treatment at all (Kurtz et al., 1984; Albert et al., 1985; Johnson, 1986).

A lack of commitment to conducting program evaluations is also likely to characterize nuclear licensee programs unless licensees are required to collect and evaluate performance data by an NRC rule. In fact, the EEI Guide to Effective Drug and Alcohol/Fitness for Duty Policy Development (Edison Electric Institute, 1985) does not currently address the need or methods for conducting program evaluations.

6.11 CONCLUSIONS

Even with drug testing programs in place, EAPs can play a significant role in the identification and management of troubled workers who have unescorted access to protected areas of a nuclear power plant. Consequently, the NRC may wish to provide guidance to the industry regarding the design and implementation of EAPs to address the issues discussed in this section.

A number of program elements have been identified through practice and in the literature as necessary for an effective EAP, although research findings to support the relative importance of each element or different combinations of elements are scant. Given current limitations in the empirical evidence regarding EAPs, however, an NRC rule based on these EAP practices may represent an acceptable approach to providing licensees with guidance.

7.0 ISSUES RELATED TO DEVELOPING PLANS FOR REHABILITATION AND FUTURE EMPLOYMENT

A major component of the proposed NRC rule requires that persons with unescorted access to protected areas who have been determined to be unfit for duty, as a result of random drug testing, for-cause testing, or follow-up testing, be denied unescorted access until management determines they are fit for duty. Any requirement of the NRC's fitness-for-duty rule that results in the revocation of unescorted access will require licensees to address the person's fitness-for-duty problem prior to the reinstitution of unescorted access authorization. To ensure that licensees carefully assess the nature and extent of the individual's problem and develop an appropriate treatment and employment plan prior to reinstitution of unescorted access, the NRC's proposed rule could include a mandatory evaluation period.

In this section, topics pertaining to the development of rehabilitation and future employment plans are discussed. The first section describes the substance abuse cycle and its implications for recovery and relapse. Section 7.2 discusses the recent literature on treatment and reviews the success of treatment for breaking the substance abuse cycle. This section includes discussion of the different types of treatment and the factors associated with positive outcomes. Section 7.3 describes and addresses the standard steps routinely taken by substance abuse professionals to formulate a plan for rehabilitation and future employment, and the role of the EAP in this process.

7.1 SUBSTANCE ABUSE CYCLE

The treatment and recovery literature indicates that an individual's pattern of substance abuse can best be viewed as a cycle that includes both recovery and relapse (Senay, 1984; Tims and Leukefeld, 1986; Maddux and Desmond, 1986). The cycle, which has been described as the "substance abuse career" by Maddux and Desmond (1986), ranges from no use, to recreational and social use, to problem use, to dependence with the inability to abstain. During recreational or social use, the individual views his or her substance intake as harmless, experimental, enjoyable, and, most importantly, controllable (DuPont, 1987). Substance abuse professionals generally define problem use as the point in the cycle at which the individual experiences any negative consequences resulting from his or her substance use. Receiving a positive drug test result at one's workplace would obviously qualify as a negative consequence.

Patterns within the substance abuse cycle vary not only from individual to individual, but over time for a given person. Substance abuse careers differ in the intensity, and the number of substances used; and by whether substances are used sequentially, concurrently, episodically, or continuously. Little is understood about the sources of these differences. Further research has not yet provided a valid set of predictors that would allow individuals to be screened for susceptibility to substance abuse.

Describing substance abuse in terms of a cycle provides a valuable means of differentiating between the various degrees of substance abuse.

Differentiating the degrees of substance abuse is critical to the development of an appropriate treatment plan. For example, a distinction is made between individuals who meet the criteria for dependency and individuals who occasionally engage in dependent-like behaviors but who are not dependent. Many individuals who use drugs or alcohol but are not yet dependent are nevertheless in the process of acquiring a dependency (Keller, 1986), and may be appropriate candidates for early intervention.

7.1.1 Dependency

Dependency and addiction are frequently used interchangeably, although recent developments described by the literature suggest that differentiating between the two terms is useful. Dependency has been described as a "socially learned, biologically based, psychologically mediated condition that impairs an individual's ability to exercise voluntary control over such substances as alcohol, nicotine, and other drugs" (Babor, Cooney, and Lauerman, 1986, p. 20). The older term "addiction" currently appears less frequently in the literature, as it has been historically defined as the compulsive intake of a substance that results in a dramatic withdrawal syndrome when intake is reduced or stopped. However, the addictive quality of the newer drugs of abuse such as cocaine and marijuana is intensely disputed due to the lack of a clearly defined withdrawal syndrome. Many experts agree that while the dispute has yet to be resolved, it remains useful to view the physical, psychological, and social manifestations of the various substances in terms of the behaviors associated with the substance's use. Although approximately synonymous with "addiction" (Maddux and Desmond, 1986), "dependency," described as the "loss of control over intake of a drug that leads to its compulsive use despite adverse effect to the person's health or psychosocial functioning" (Washton, 1987, p. 16), is viewed as the more comprehensive term. Those individuals who meet the diagnostic criteria for dependency will most likely experience successive cycles of abstinence, occasional use, daily use, and treatment.

7.1.2 Recovery

The treatment of substance abuse does not appear to fit the usual medical treatment model of a disease; that is, it is not responsive to a singular treatment episode (Senay, 1984). Rather, the recovery research indicates that there is no one point in time at which an individual can be considered "cured." Consequently, recovery is most accurately described as a process rather than as a state. Recovery can be defined as the process by which substance abuse and related behaviors become decreasingly problematic for the affected individual (Maddux and Desmond, 1986).

Alcoholics Anonymous developed their 12-step recovery model on this premise. Members refer to themselves as "recovering alcoholics," recognizing that they are always at risk for relapse (Senay, 1984; Maddux and Desmond, 1986; Wesson, Havassy, and Smith, 1986). More recently, Narcotics Anonymous and Cocaine Anonymous have been organized, based on the same set of assumptions (Washton, 1987). It is noteworthy that the alcohol and drug treatment community has recognized for several years that a combined approach to drug and alcohol treatment is most effective, as the recovery process is similar

across the various substance categories (Cole, Cole, Lehman, and Jones, 1981; Waldorf and Biernacki, 1981; McClellan, 1984).

Despite the recognition that recovery is most usefully described as a process, attempts to identify a point in time at which an individual can be considered fully recovered have been made. For example, the American Medical Association has developed criteria for recovery that include three years of abstinence from the primary drug of abuse and no abuse of other substances. Other investigators have recommended five years of abstinence as a reasonable benchmark (Maddux and Desmond, 1986). As will be discussed below, however, longitudinal studies have failed to isolate a threshold for length of abstinence that determines permanent recovery.

7.1.3 Relapse

Relapse occurs in the majority of substance abusers who complete treatment, and should consequently be considered a potential risk to assuring fitness for duty among licensee employees and contractors who have successfully completed treatment and regained unescorted access authorization. Why relapse occurs and how soon or how often it occurs is unknown. However, several investigators have identified contributing factors. These factors include deficient coping skills, inappropriate responses to stress, a lack of commitment to recovery, and the use of substances other than the primary substance abused (Babor et al., 1986; Tims and Leukefeld, 1986; Maddux and Desmond, 1986).

7.1.3.1 Definition of Relapse

"Relapse" has been defined as the "return to substance use, following a period of voluntary or enforced abstinence, at a level of intensity comparable to that attained before abstinence" (Babor et al., 1986, p. 20). As a phenomenon, relapse is recognizable almost immediately. However, as Wesson et al. (1986) point out, the term "relapse" may refer to the moment that an individual resumes any substance use, or to the stage described in the above definition. Several investigators assert that the current definition of relapse does not adequately address the abuse of multiple substances or the substitution of substances that frequently follows rehabilitation (Tims and Leukefeld, 1986; Maddux and Desmond, 1986).

7.1.3.2 Relapse Rates to Different Substances

Relapse to the use of alcohol and opiates has been extensively studied. Far less information is available on the substance abuse cycles of those who primarily abuse marijuana, cocaine, phencyclidine, or drugs found in the other drug categories (Jaffe, 1984), primarily because abuse of those substances is a relatively new phenomenon.

Many studies are available that address the occurrence of alcohol relapse on both a short-term and long-term basis. The short-term studies, defined by tracking of post-treatment individuals for a period of two years or less, indicate that relapse rates for alcohol are quite high. For example, one study that followed 685 post-treatment individuals found that 63% were

abusing alcohol when contacted at the two-year mark. A second two-year study found a 67% relapse rate (Vaillant, 1983).

The relapse rates for opiates are dramatically similar to those of alcohol. One study found 67% of opiate-dependent individuals to be re-addicted within the first six months following treatment (Maddux and Desmond, 1986). In a follow-up study of 2,099 post-treatment opiate addicts, 56% to 77% had resumed daily use at one year post-treatment (the variance occurred due to individual measurement of treatment groups) (Simpson and Sells, 1982).

A comparison of the longitudinal studies (i.e., studies that have followed alcohol and opiate patients for a period of five years or longer after the initial treatment episode) again shows a significant similarity in patterns of alcohol and opiate abuse relapse. For the majority of individuals, multiple episodes of relapse are followed by periods of abstinence (Maddux and Desmond, 1986; Simpson and Marsh, 1986). However, the most critical finding suggests that while multiple episodes of the abstinence/relapse cycle occur, the frequency of relapse decreases as the period since treatment increases (Simpson and Marsh, 1986).

Although there are few studies on relapse to substances other than alcohol and opiates, what research has been conducted suggests that relapse patterns to other substances are similar to those to alcohol and opiates. A study conducted by Hubbard and Marsden (1986) compared the relapse rates of four drug categories: heroin, other narcotics, cocaine, and other non-narcotics (including amphetamines, sedatives, barbiturates, and the minor tranquilizers). The study reviewed the post-treatment history of 2,280 patients who were randomly selected from 41 different treatment facilities and who represented the full spectrum of treatment types--methadone maintenance, detoxification, therapeutic communities, inpatient facilities, and outpatient drug free counseling. The timing of relapse was similar for all four drug categories. Two-thirds of those who relapsed did so within 90 days after leaving treatment. A widely cited study that reviewed relapse rates over 12 months following treatment showed that smokers, alcoholics, and heroin addicts are alike in having relapse rates of greater than 50% in the first three months post-treatment, and 60% within the first year post-treatment (Rounsaville, 1986).

7.1.3.3 The Role of Substance Substitution in Relapse

Substance substitution following treatment has been identified as a primary factor in relapse, and is of further significance because of the high frequency with which it occurs (Maddux and Desmond, 1986). The abuse of multiple substances is currently considered a national trend (Senay, 1984). For example, among current cocaine abusers, few are involved with cocaine only; excessive alcohol use is extremely common (Blume, 1987; Washton, 1987). Investigators also report that cocaine abusers frequently self-medicate with tranquilizers, sleeping pills, marijuana, and opiates in an attempt to minimize the unpleasant side effects of cocaine (Washton, 1987). The widespread trend toward multiple substance abuse is reflected in the role of substance substitution in relapse. The resumptive use of a secondary

substance is as likely to result in relapse as is the resumptive use of the primary substance (Hubbard and Marsden, 1986; Rounsaville, 1986).

7.1.3.4 Summary

In summary, the literature suggests that patterns of relapse may be consistent across drug types among dependent individuals in both frequency and rapidity. Because relapse to substance abuse is likely for dependent individuals and can occur at any time, reliance upon elapsed time since treatment to assure that the individual will remain substance free in the future is not supported by the research literature. Rather, the goal of assuring fitness for duty suggests that among licensee employees and contractors who have successfully completed treatment and regained unescorted access, relapse prevention may be a primary component of the rehabilitation process.

7.1.4 Applicability of Recovery and Relapse Literature to the Nuclear Industry

It is critical in the interpretation of the relapse and recovery literature to understand that the primary focus of study has been the seriously dysfunctional alcoholic or drug abuser. There are several reasons for this. First, alcohol and opiate abuse have been the focus of a federally funded system (DuPont, 1987), and a high percentage of the individuals who elect to participate in publicly-funded treatment are also recipients of public assistance. The employed and educated middle class with employer-paid medical benefits have typically sought treatment in private facilities or with private practitioners. Private facilities, unfortunately, generally do not participate in the government-sponsored data collection systems required of public agencies or in published research. Second, publicly-funded facilities often have no control over the selection or retention of their patients due to legislatively mandated open-door policies and consequently cannot select those patients for admission who have the best prognosis for rehabilitation. Rather, the public facilities become a "dumping ground" for difficult cases whose prognoses are bleak (Strug, Priyadarsini, and Hyman, 1986). Third, studies of treatment populations are most representative of those individuals with significant substance-related problems; individuals experiencing the earlier stages of substance abuse rarely seek treatment (Washton and Gold, 1987).

Because most of the research literature is based upon the publicly-funded client, it may only indirectly apply to the types of individuals employed in the nuclear industry. As will be discussed in the next section, there are a number of factors that may contribute to the effectiveness of treatment for some individuals with unescorted access that do not apply to seriously dysfunctional substance abusers. Thus, although relapse to substance abuse is likely for dependent individuals and can occur at any time post-treatment, it is possible that these factors coupled with early detection and treatment may prevent relapse among licensee employees and contractors with unescorted access.

7.2 TREATMENT EFFECTIVENESS

The effectiveness of treatment is well documented, although it remains unclear as to why treatment works. Numerous longitudinal studies have demonstrated that pre-treatment levels of substance abuse are generally higher than those of post-treatment abuse (Jaffe, 1984). Consequently, the NRC's goal of ensuring fitness for duty may be enhanced by assuring that individuals whose substance use is detected receive treatment.

Within the context of the substance abuse cycle, treatment remains the most likely means by which the successive cycle will be broken. As mentioned above, treatment may also serve to prevent relapse in those individuals whose substance abuse problems are still in the developing stage.

7.2.1 Treatment Factors Associated with Positive Outcomes

Of particular interest to the NRC is the suggestion by the treatment literature that the critical factor in obtaining a positive outcome is not the type of treatment, but the amount of treatment contact (Simpson, 1984; Senay, 1984). In fact, several large-scale follow-up studies have shown that the treatment outcomes for those participating in such diverse treatment types as outpatient drug-free counseling, methadone maintenance, and therapeutic communities are statistically indistinguishable (Rounsaville, 1986; Simpson, 1984). One suggested explanation for the nearly equal success rates among the different types of treatment is the selection process that is assumed to occur among individuals seeking treatment and treatment professionals. Substance abusers in search of treatment may investigate several types of treatment before finding a facility that best suits their specific needs. Substance abuse professionals are also trained to screen treatment applicants for their appropriateness; patients accepted for treatment are generally those who are perceived to have the greatest potential for success under the particular method of treatment (Keller, 1986). Consequently, the selection process may match individuals with treatment types that will provide them with the most positive outcome, resulting in similar success rates across treatment types.

Although the evaluation of treatment effectiveness is regarded by the research community as being in an evolutionary stage, several factors associated with positive outcomes have been identified. The most powerful determinant appears to be the individual's commitment to treatment and to recovery (Simpson, 1984; Tims and Leukefeld, 1986; Washton, 1987). The therapeutic process itself can also directly impact the outcome. To be effective, the therapeutic process should incorporate the individual's commitment to change, sustain the commitment, and translate it into action (Simpson, 1984). The length of time in treatment has also been identified as a factor, with longer participation in treatment being positively related to outcome (Simpson, 1984; Tims and Holland, 1984; Hubbard, Craddock, and Cavanaugh, 1984).

Further support for the importance of treatment contact is provided by several studies that suggest significantly poorer outcomes for seriously dysfunctional individuals who receive only assessment or detoxification

services, without accompanying treatment (Simpson and Marsh, 1986). Studies of detoxification facilities suggest that enrollees frequently depart before detoxification is complete, and that few enrollees maintain contact after detoxification (Rubington, 1986). Detoxification will generally not provide the necessary treatment contact or therapeutic process that is associated with a positive treatment outcome.

7.2.2 Personal Characteristics Associated with Positive Outcomes

In addition to the various factors associated with treatment, there are several personal characteristics of patients that have been linked to a positive treatment outcome. These factors include a stable family background, an intact marriage or relationship, a stable and supportive job situation, minimal involvement with the criminal justice system, and limited psychological problems. Higher socioeconomic status is also a predictor. Those patients with the least severe problems, and the greatest social and psychological assets, tend to have the best prognosis (Goodwin, 1988; Holden, 1987; Rounsaville, 1986; Washton, 1987; Maddux and Desmond, 1986). While the typical worker within the nuclear industry cannot be assumed to have all of these characteristics, some or most may be applicable.

7.2.3 Prognosis for Rehabilitation Among Nuclear Workers

Based on the treatment and relapse literature, it appears that the prognosis for rehabilitation among licensee employees and contractors may be positive. Many licensee employees possess the personal characteristics that have been linked to a positive treatment outcome, and are also likely to share a commitment to their career and their employer. The presence of these attributes may also provide an increased motivation for rehabilitation. This motivation is also likely to exist for many contractor personnel. Further, the literature suggests that the likelihood of a positive outcome is increased when early detection and intervention can occur prior to an individual's loss of job. Licensees can increase the likelihood of a positive prognosis by emphasizing the factors associated with positive treatment outcomes in the development of treatment and future employment plans.

7.3 DEVELOPMENT OF TREATMENT AND FUTURE EMPLOYMENT PLAN

It is clearly important to public health and safety that an individual regains unescorted access only after a determination has been made that he or she is fit for duty. As discussed above, elapsed time since treatment cannot be used as an indicator that the licensee employee or contractor will remain substance free in the future. However, prompt response to an initial confirmed positive test result in the form of a treatment and employment plan is likely to be effective in resolving substance abuse problems among the types of persons granted unescorted access to protected areas in a nuclear power plant.

Under the NRC's proposed rule, any individual receiving a confirmed positive test result will be immediately referred to the licensee's EAP for assessment of the suspected substance abuse problem and formulation of a rehabilitation

and future employment plan. This section discusses the various steps that could be considered to ensure that individuals regain unescorted access only after strong assurances can be given that the individual will not place public and workplace safety at risk.

7.3.1 The Use of Qualified Substance Abuse Professionals

The evaluation of a substance abuse problem involves numerous factors unique to the individual, and is appropriately left to the trained judgment of qualified substance abuse professionals or medical personnel with substance abuse training. Because the furthering of the NRC's goals depends upon the reliability of the initial assessment, the NRC may consider requiring each licensee to engage qualified individuals with specific substance abuse training for this purpose. Typically, medical personnel who have been trained through traditional curricula have not received instruction specific to substance abuse and cannot be assumed to be able to competently diagnose a substance abuse problem. Academic coursework specific to substance abuse is generally a requirement for state certification as a qualified substance abuse professional.

7.3.2 Evaluation of a Substance Abuse Problem

The assessment process should specifically identify the nature and extent of the individual's substance abuse problem. Although various interviewing techniques can be used, each should share the common goal of eliciting informative answers and breaking through the denial and self-deceit that are characteristic of substance abusers. For example, individuals who are dependent commonly present themselves as occasional recreational users; the trained substance abuse professional will expect this response and will engage the individual in such a manner as to move past this misrepresentation. The assessment should determine the individual's location in the substance abuse cycle, specifically identify the substances used by the individual, identify the degree of severity and regularity of use, and assess the degree to which the substance use has resulted in negative psychological and social consequences for the individual. The assessment and diagnosis will determine the appropriate method for rehabilitation, and suggest an appropriate time frame for the individual's safe return to work within protected areas.

7.3.3 Design of the Treatment Plan

To be most effective, the treatment plan should be designed to meet the specific needs of the individual, giving consideration to the various factors discussed above. An individual approach is essential because a positive test result can indicate any level of substance abuse within the substance abuse cycle. For example, an appropriate treatment plan for a recreational user might include the completion of the EAP assessment and additional designated hours of drug education. Treatment may not be necessary. Instead, it may be more effective to place an emphasis on follow-up random drug testing and monthly EAP contact. It is possible that the employment plan in this case could include a return of unescorted access authorization at the end of the two-week evaluation period, with minimal risk to plant safety.

At the other end of the spectrum, an appropriate treatment plan for a dependent abuser would be more complex. In this case, the EAP would likely make a referral to an inpatient facility, and the individual would not be allowed to regain unescorted access until intensive rehabilitation is completed, or not at all. As indicated above, more extensive treatment involvement appears to be necessary for these individuals. Inpatient treatment is generally considered necessary for those patients whose dependency requires gradual detoxification, substitute medication, or both. Substance abusers with a history of multiple substance use, intravenous drug use, free-basing, medical or psychiatric problems, or who have failed at successfully completing outpatient treatment should also be considered as candidates for intensive inpatient treatment (Washton, 1987).

With either case, an increased frequency of follow-up urine testing can provide three points of information important to recovery or to the maintenance of a substance-free lifestyle. First, it can help the patient face the denial and self-deceit factors that are characteristic of problem use and dependency. Secondly, testing can foster a sense of self-control over drug impulses. Finally, it can serve as an indicator of the patient's progress in recovery or maintenance of a substance-free lifestyle (Washton, 1987).

Preliminary research on the current cocaine epidemic suggests that the middle-class substance abuser, similar in socio-economic standing to some licensee employees, is more responsive to a rehabilitation process that emphasizes professional staffing, confidentiality, and privacy. Because this class of substance abuser also appears concerned about the possible disruption to their employment, they show preference for either outpatient treatment or shorter residential stays (Washton, 1987). Outpatient treatment is often suitable for individuals who do not require substitute medication or gradual detoxification. For example, cocaine, marijuana, and amphetamine abuse problems are commonly treated successfully on an outpatient basis. Outpatient treatment can be attractive for several reasons: it costs significantly less than inpatient treatment; it is less disruptive to work and home life; and it is less stigmatizing than inpatient treatment. Generally, outpatient treatment requires intensive counseling, often several times a week (Washton, 1987). In appropriate cases, this level of contact maintained over a significant period of time, combined with follow-up urine testing, could assure the NRC that a nuclear worker is fit for duty.

7.3.4 Development of the Follow-up Plan

The literature indicates that it is important to ensure that the individual's progress is monitored once he or she has regained unescorted access. The relapse and recovery literature stresses the need for aftercare and follow-up monitoring to prevent relapse (Ito, Donovan, and Hall, 1988; Simpson, 1984; Tims and Leukefeld, 1986). Because the critical period for relapse falls during the first 90 days, frequent contact by the EAP during this period, possibly weekly, can increase the probability that the individual will remain substance free. However, because most individuals who relapse do so within the first year (Maddux and Desmond, 1986), the literature also suggests that

the follow-up plan should provide for continued EAP contacts following the first ninety days, with decreasing frequency to perhaps one contact per month. Follow-up random testing, with increased frequency above the requirements of the proposed rule, should also be emphasized in all follow-up plans, as follow-up testing can also serve to assure the NRC that the goal of public health and safety continues to be met.

7.4 CONCLUSIONS

It appears that the goals of a fitness-for-duty program will best be served if employees and contractors receiving a first positive test result are referred to the EAP for assessment of their substance abuse problems. Assessments by qualified substance abuse professionals will increase the validity of the assessment process. The assessment results should then direct the development of a treatment and employment plan which is best designed to meet the individual's specific fitness-for-duty needs. Finally, a follow-up plan should be developed that specifies the frequency of EAP contact and follow-up random drug testing.

The NRC has a strong interest in assuring that, among licensee employees and contractors who have been determined to be unfit for duty, only those who have succeeded in rehabilitation are allowed to regain their unescorted access authorization. Because substance abuse careers vary to such an extent between individuals, and because the research indicates that a relapse to substance abuse can occur at any time after an apparently successful treatment episode, revocation of an licensee employee's or contractor's unescorted access authorization for an arbitrary period of time following a confirmed positive test result would not ensure that the individual would remain substance free and so would not contribute to public health and safety. Consequently, the NRC may wish to consider a mandatory evaluation period to facilitate in the assessment and eventual resolution of substance abuse problems prior to the reinstitution of unescorted access authorization. A period of two weeks would appear adequate to achieve these objectives.

8.0 MEASURING THE EFFECTIVENESS OF FITNESS-FOR-DUTY PROGRAMS

Once the NRC's fitness-for-duty rule is published and licensee programs are implemented, the NRC will want to monitor and evaluate the effectiveness of the licensee programs. As discussed in previous sections, some relevant experience exists to provide models for effective fitness-for-duty programs, but these models have never been fully tested and evaluated. Thus, what constitutes a fitness-for-duty program of optimum effectiveness is still to be established.

The collection and analysis of fitness-for-duty program performance data can serve to identify the more effective approaches to assuring fitness for duty. Further, as patterns of substance abuse and other fitness-for-duty problems change in the population and in the workforce, these performance data can help assure that existing fitness-for-duty programs remain relevant and effective.

Therefore, the purposes of this chapter are to outline the characteristics of a system for monitoring and evaluating fitness-for-duty program effectiveness, and to provide an initial listing and evaluation of candidate effectiveness indicators. This evaluation is based primarily on assumptions concerning the indicators, and a literature review focused on evaluations of EAP effectiveness indicators. However, a complete evaluation of the candidate indicators will require data collection and analyses that are beyond the scope of this report.

The following section, Section 8.1, discusses the criteria to be considered in the development of a fitness-for-duty program effectiveness indicator system. Section 8.2 provides a listing and initial evaluation of a set of candidate indicators. Section 8.3 provides a summary and conclusions.

8.1 CRITERIA FOR THE DEVELOPMENT OF FITNESS-FOR-DUTY PROGRAM EFFECTIVENESS INDICATORS

This section discusses a series of issues, derived from general principles of experimental design and measurement, that must be addressed during the development of a system of fitness-for-duty program effectiveness indicators. These issues include establishing the goal congruence and validity of the indicators, defining acceptance criteria, and assuring the indicators' sensitivity, cost effectiveness, timeliness, and lack of susceptibility to manipulation and unintended consequences. Each of these issues requires additional discussion.

8.1.1 Goal Congruence

The first step in establishing a system for monitoring and evaluating fitness-for-duty program effectiveness is to explicitly identify the program's goals so that the indicators that are selected provide information about the program's performance in meeting those goals. Although it is obvious that indicators of effectiveness should be designed to reflect the extent to which the program is reaching its goals, this step cannot be taken

for granted. It is possible that the organizations implementing the program have only general ideas about what the program is to accomplish. It is also likely to be the case that the NRC, the licensee, and the director of the licensee's EAP may have different goals for the program. Under these conditions, it may be difficult to clearly establish whether or not a particular fitness-for-duty program effectiveness indicator will provide the desired information about program performance.

The identification of program goals requires establishing the areas that the program is designed to address. For fitness-for-duty programs in the nuclear industry, several questions and a range of possible answers can be presented:

1. What fitness-for-duty problems are addressed by the program?

    - All illicit drug use
    - Use of selected illicit drugs
    - Licit drug abuse
    - Alcohol abuse
    - Emotional/psychological stress
    - Physical impairment
    - Fatigue

2. What are the boundaries of the fitness-for-duty program?

    - All employees of the licensee
    - All employees of the licensee plus all contractors
    - Only those employees in safety-related positions
    - Only those employees with unescorted access

3. What are the organizational goals that the fitness-for-duty program is designed to protect or enhance?

    - Public health and safety
    - Productivity
    - Security

The answers to these questions will determine the domain of performance dimensions on which licensee fitness-for-duty programs should be evaluated. However, these questions will be answered somewhat differently by different interested parties. For example, the NRC is required by law to focus on the goal of public health and safety. Consequently, its concern is with effectiveness measures that reflect the extent to which all workers engaged in safety-related activities are fit for duty at all times: any source of challenge to fitness for duty is of concern. On the other hand, the director of a licensee's EAP may have the rehabilitation of workers as his or her primary goal, while top utility management may be concerned both with safety and productivity. These different perspectives on goals will lead to different choices of specific indicators to measure program effectiveness.

8.1.2 Validity

Validity refers to whether a particular indicator actually measures what it is intended to measure. The first step in establishing validity is to establish logical or "face" validity. Simply stated, does the indicator make sense?

Establishing the validity of indicators, however, can rarely stop with face validity. Too many factors can intercede to make even the most logical of indicators unreliable. To have confidence in the validity of the indicators, face validity must be augmented by systematic analyses of the indicators using real data. These analyses take the general form of correlating the candidate indicator with accepted criteria of performance. If the candidate indicator is highly correlated with the criterion, then it is accepted as a valid indicator. For example, if objective information is available on drug use (the criterion), and it is found to vary systematically with health care costs, then health care costs may be used as an indicator of drug use. This type of validity check is essential for the development of an acceptable indicator system.

Just as the validity of individual indicators must be assessed, the validity of the entire set of indicators also must be assessed. It is possible to have indicators that are individually valid, while the set of indicators is either incomplete, or is too heavily weighted toward one or more aspects of program performance. In this situation, incorrect inferences can be drawn about overall program success, even though the individual indicators all contribute a valid though partial understanding of the level of effectiveness. For example, an indicator system that does not provide measurement of alcohol-related problems may give the false impression that the fitness-for-duty program is totally effective.

A key step in validation is turning general concepts into precise measures; that is, turning the general concepts into concepts with explicit measurement rules. The more specifically the indicators can be defined, the easier it is to develop the measurement rules. For example, even the relatively well-defined indicator of number of confirmed positive test results for illicit drug use must still be further specified before indicators can be developed for it: the drugs to be considered must be selected, cut-off levels must be defined, and the population to be tested must be identified before it is possible to measure the number of confirmed positive test results. The development of these detailed measurement rules is beyond the scope of the current discussion.

8.1.3 Acceptance Criteria

Another issue relative to the development of the indicators concerns the interpretation of the indicators once they are developed. That is, what level of performance on the indicator constitutes acceptable achievement? Similarly, what patterns of performance across the set of effectiveness indicators constitutes overall program success? Although it is not possible to answer these questions here, their answers are both necessary and difficult.

Two issues can be anticipated in addressing these questions. The first of these is the need to establish the relative weighting to give to different indicators. That is, what indicators, if any, are more important in defining effectiveness than others? Another important issue will be whether objective performance standards can be established for each of the indicators, or whether standards based on relative performance are more appropriate. The question here is, "Should individual licensee performance on an indicator be compared to industry averages or should it be assessed in terms of trends in the licensee's performance over time?"

To further complicate the interpretation of indicator data, the meaning of the indicators may change as the fitness-for-duty program matures. For example, for a new fitness-for-duty program, a high level of referrals and confirmed positive drug test results may be taken to indicate that the program is working and is fulfilling the "detection" part of its goal. However, in a mature program, similar results may be taken as indicators of failure, since the program does not appear to be fulfilling the "deterrence" part of its goal. Thus, expectations for trends in the indicators must be established in order for the indicators to be interpreted accurately.

These difficulties in interpretation suggest that the indicator system will not completely obviate the need for periodic program reviews (e.g., audits by the licensee and inspections). The indicator system can be used, however, to monitor licensee performance in the periods between program reviews.

8.1.4 Sensitivity

The issue of sensitivity revolves around how directly and quickly changes in the underlying performance of the program are reflected in changes in the indicators. For example, it may be the case that the level of medical expenditures is, in the long run, a very valid indicator of fitness-for-duty problems at a plant. However, increased health care needs may only become manifest at advanced stages of alcohol and drug addiction. Thus, a substantial increase in the rate of drug and alcohol abuse by workers at a plant may not be reflected in an indicator based on health care costs until sometime later.

Similarly, performance on many of the candidate indicators discussed in Section 8.2 (e.g., absenteeism, accident rates) may be attributable to a variety of factors other than fitness-for-duty concerns. To the extent that these other factors dominate, it is likely that the indicators will be relatively insensitive to changes in the rate of fitness-for-duty problems. Thus, desirable indicators are ones that are not only valid, but that also are capable of detecting small changes in the underlying levels of program performance.

8.1.5 Cost Effectiveness

The issue of cost effectiveness hinges on the tradeoff between the difficulty (cost) of collecting and analyzing data for a particular indicator, and the amount of relevant information measured by it. It is unfortunately the case

that some of the most valid and sensitive indicators (e.g., supervisory ratings of worker behaviors) are also the most difficult to obtain because of the costs of data collection and the burdens that are placed on the licensee. Other potentially less valid and less sensitive indicators (e.g., accident rates) may have to be substituted because they are less costly and intrusive.

8.1.6 Timeliness

Related to the issue of sensitivity is the issue of timeliness. It is frequently the case that the availability of data lags far behind the conditions that the data represent. For example, indicators of health care costs may lag far behind the time when the care was actually needed and provided, simply because of the time it takes for final billings to be settled and for the data to become available in aggregate form. Thus, the greater the lag in the availability of data, the less accurate and useful the indicator is for assessing the current effectiveness of the fitness-for-duty program.

8.1.7 Manipulation and Unintended Consequences

Two other issues are relevant to the selection of indicators: manipulation and unintended consequences. With respect to manipulation, indicators should be selected that minimize the ability of individuals to make program performance appear to be other than it actually is. Some indicators can be expected to be more subject to manipulation than others. For example, data on EAP referrals may not be auditable in any direct sense, since participation in the EAP may be confidential. Because the data are not auditable, they may be more subject to manipulation than are data that can be audited (e.g., the results of a mandated drug testing program).

Some indicators may also have unintended consequences that conflict with the goals of the fitness-for-duty program. For example, an indicator that assumes that higher levels of referrals to EAPs for substance abuse indicate high levels of fitness-for-duty problems may discourage the licensee from promoting the use of the EAP. The overall result of the selection of such an indicator may be a detrimental effect on safety.

8.1.8 Summary

In summary, there are a number of criteria that the indicators used to evaluate fitness-for-duty program effectiveness must meet to ensure that the information obtained about licensee program performance that is timely and meaningful. Some of these criteria require that the indicators be carefully conceptualized while others require the actual collection and analysis of data. Candidate indicators that may meet these criteria are discussed in the following section.

8.2 A SYSTEM FOR MONITORING AND EVALUATING FITNESS-FOR-DUTY PROGRAM EFFECTIVENESS

This section describes the types of indicators that could be used to develop a system for monitoring and evaluating fitness-for-duty program effectiveness. Categories of candidate indicators are listed and an initial evaluation of them is presented.

Several categorization schemes have been used in the literature to identify and evaluate EAP effectiveness indicators. These discussions are relevant to the discussion of fitness-for-duty effectiveness indicators as well, although the goals of an EAP and a fitness-for-duty program differ, as will be discussed below. The literature on evaluating the effectiveness of EAPs usually describes four types of indicators:

- Indicators of program utilization or penetration into the subject population
- Indicators of rehabilitation success
- Indicators of employee behaviors reflective of fitness-for-duty problems (e.g., absenteeism)
- Indicators of the cost savings or cost-effectiveness of an EAP.

Several recent review articles have summarized the EAP effectiveness literature (Weiss, 1987; Albert et al., 1985; Kurtz et al., 1984; Jerrell and Rightmyer, 1982). A primary theme of these reviews is the overwhelming lack of reliable data to support the claims of effectiveness made by business and industry, most of which are anecdotal and testimonial in nature. This lack of empirical evidence is viewed as a major impediment to further program development (Lewis, 1981; Korr and Ruez, 1986; Albert et al., 1985; Kurtz et al., 1984; Weiss, 1987; Steele and Hubbard, 1985; Nadolski and Sandonato, 1987). The literature generally agrees that EAPs are probably effective, but that reliable measurements of program effectiveness have yet to be developed.

In some ways, however, EAP effectiveness is a substantially different issue from fitness-for-duty program effectiveness, because of discrepancies in the goals of the two types of programs. Although both programs emphasize prevention, as noted in the previous section, the primary focus of an EAP is the rehabilitation of problem workers so that they can better contribute to the success of the organization. In contrast, the focus of a fitness-for-duty program is on assuring that impaired workers are not allowed to adversely affect the safety of the plant. Thus, additional indicators must be added to the categories listed above in order to assure a systematic assessment of fitness-for-duty program effectiveness.

Figure 8.1 provides a relatively simple categorization system for possible fitness-for-duty effectiveness indicators. These indicators can be divided into three general categories:

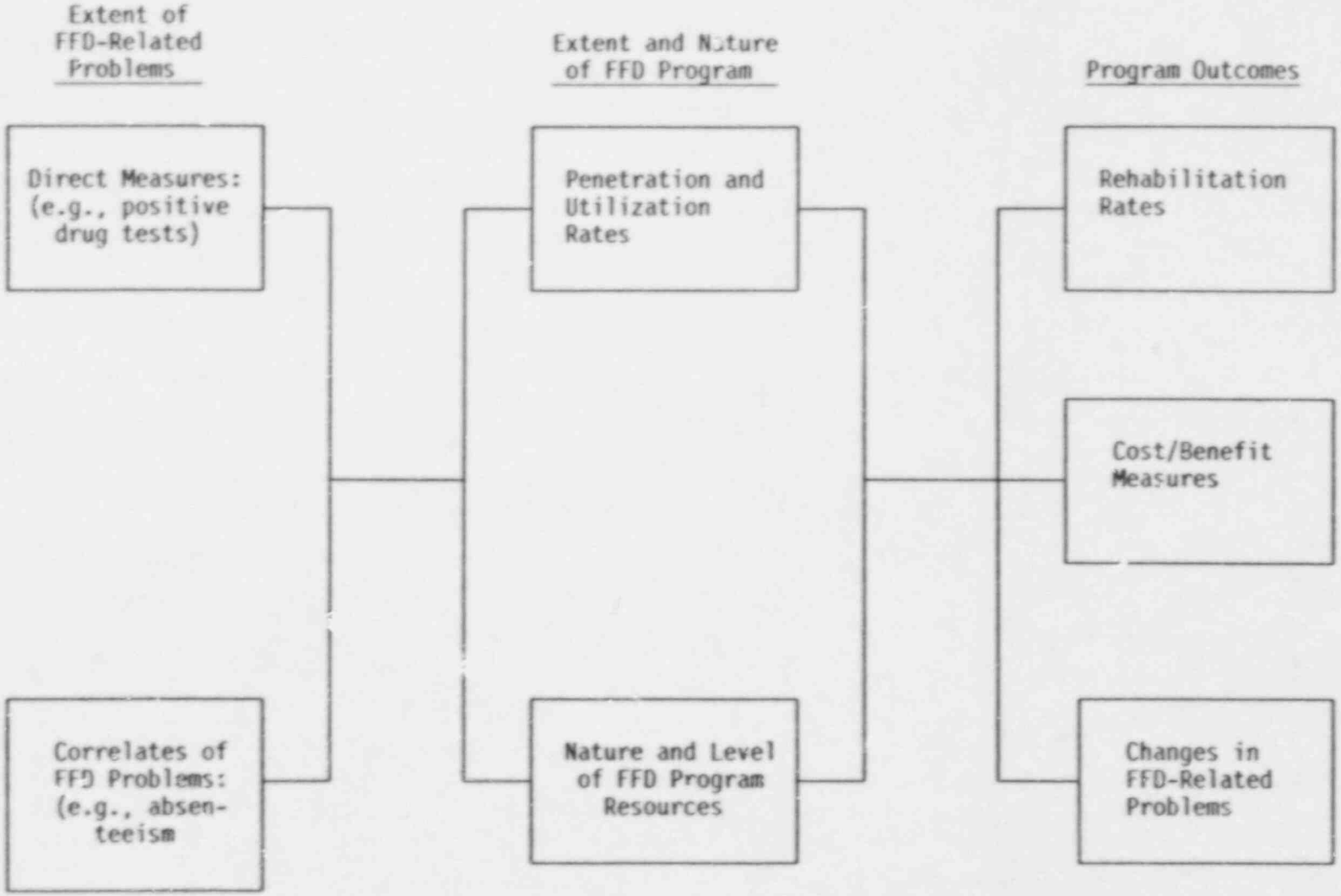

FIGURE 8.1. Types of Indicators of Fitness-for-Duty Program Effectiveness

- Indicators of the extent of fitness-for-duty problems
- Indicators of the extent and nature of the fitness-for-duty program
- Indicators of program outcomes.

Each of these categories will be discussed below.

8.2.1 Indicators of the Extent of Fitness-for-Duty Problems

Indicators of the extent of fitness-for-duty problems are of two types. One type of indicator consists of direct measures of fitness-for-duty problems and the other type consists of indirect measures based on correlates of the fitness-for-duty problems.

8.2.1.1 Direct Measures

Direct measures of fitness-for-duty problems might include those listed in Table 8.1.

TABLE 8.1. Example Indicators: Direct Measures of the Extent of Fitness-for-Duty Problems

Frequency of finding drugs or alcohol on premises
Type and quantity of drugs and alcohol found on premises
Rate of employee drug arrests/convictions
Rate of employee DWI arrests/convictions
Rate of confirmed positive drug tests
Rate of EAP self-referrals
Rate of for-cause impairment tests
Rate of allegations involving fitness-for-duty concerns
Reports from employees about their own or their co-workers relevant problems
Rate of psychological tests or evaluations indicating fitness-for-duty problems

Direct-measure indicators have several advantages over indirect-measure indicators. One advantage is that direct-measure indicators are likely to be more reliable. Some require objective data collection techniques (e.g., drug testing), and, in general, they depend less on the observational skills of the supervisor than indirect-measure indicators. Even the indicators in this group that do depend on supervisory observation (e.g., the number of for-cause tests) allow the supervisor the opportunity to incorporate a range of information into the specific decision of whether or not to request a for-cause test. This fact probably leads to higher reliability in the indicator.

A second advantage of direct-measure indicators is that, as counts of decisions made (e.g., number of referrals to EAPs, number of confirmed positive drug tests), direct-measure indicators constitute a smaller volume of data than indicators of the many factors that go into making the decisions. Therefore, they are more manageable and present a more cost-effective means of data collection.

Finally, these indicators have very direct and logical relationships to the fitness-for-duty problems of concern. For example, the number of confirmed, positive drug test results has considerable face validity as an indicator of the level of drug use.

Although direct-measure indicators will still require validation, it is anticipated that they will constitute the most valid and the most practical indicators of fitness-for-duty program performance. Should data pertaining to direct-measure indicators not be available, however, other types of indicators would need to be considered.

8.2.1.2 Indirect-Measure Indicators

A large number of indirect-measure indicators of fitness-for-duty problems have been mentioned in the literature. These indicators are thought to assess behaviors that could be caused by an underlying fitness-for-duty problem such as substance abuse. Some of these indirect-measure indicators pertain to observations of individual behaviors on the job, while others pertain to aggregate measures for the workforce as a whole.

Individual Behaviors. A number of individual behaviors have been identified in previous research as correlates of fitness-for-duty problems (Edison Electric Institute, 1985). Examples of these behaviors are provided in Table 8.2.

Although many of the individual behaviors have face validity as indicators of fitness-for-duty problems, reliance upon this type of indicator to assess the performance of a fitness-for-duty program has the major disadvantage of requiring observations by supervisory personnel.

Dependence upon supervisory observations is problematic for several reasons. First, without extensive training and support, it is unlikely that supervisors will be very consistent in their observations concerning behavior patterns that may reflect substance abuse or other fitness-for-duty problems (Googins and Kurtz, 1980; Hoffman and Roman, 1984). Supervisors' abilities to accurately record these patterns can be expected to vary widely, with the consequence that data on the number of individuals with particular behavior patterns are likely to be incomplete or unreliable. Further, even if problems of reliability could be overcome, the systematic collection of such data would require a major effort by licensees. The number of behavior patterns that could be relevant is substantial and licensees would find that a considerable amount of supervisor time is required just to maintain records on relevant observations.

TABLE 8.2. Examples of Individual Behaviors Correlated with Fitness-for-Duty Problems

Sleeping on duty
On-duty violence
Low job efficiency
Unsatisfactory work
Decreased work quantity/quality
Mistakes/bad judgments
Concentration difficulties
Violations of company policy/regulations
Excessive risk-taking
Uncooperative behavior
Anti-social behavior
Overly social behavior
Manipulative behavior
Displays of "nerves"
Changes in energy levels
Changes in routines
Sloppy appearance/dress
Hostile attitude about fitness-for-duty program
Tardiness
Absenteeism

Although many of the individual behaviors have face validity as indicators of fitness-for-duty problems, reliance upon this type of indicator to assess the performance of a fitness-for-duty program has the major disadvantage of requiring observations by supervisory personnel.

Dependence upon supervisory observations is problematic for several reasons. First, without extensive training and encouragement from upper management, it is unlikely that supervisors will be very consistent in their observations and reporting of behavior patterns that may reflect substance abuse or other fitness-for-duty problems (Googin and Kurtz, 1980; Hoffman and Roman, 1984). Supervisors' abilities and motivations to accurately record these patterns can be expected to vary widely, with the consequence that data on the number of individuals with particular behavior patterns are likely to be incomplete or unreliable. Further, even if problems of reliability could be overcome, the systematic collection of such data would require a major effort by licensees. The number of behavior patterns that could be relevant is substantial and

licensees would find that a considerable amount of supervisor time is required just to maintain records on relevant observations.

Aggregate Measures. Table 8.3 provides examples of indirect, aggregate measures of fitness-for-duty problems. These types of indicators typically have been proposed as measures of EAP program effectiveness (see the review of this literature by Kurtz et al., 1984). However, their usefulness for assessing either EAPs or fitness-for-duty program effectiveness is questionable, because these measures are also highly influenced by factors unrelated to fitness-for-duty concerns.

TABLE 8.3. Example Indicators: Aggregate Measures of Behaviors Correlated with Fitness-for-Duty Problems

Frequency and patterns of tardiness

Frequency and patterns of absenteeism

Frequency of need for disciplinary actions

Employee turnover rate

Lost time accident rate

Injury rate

Number of violations involving fitness-for-duty concerns

Number of events (LERs) involving fitness-for-duty concerns

Frequency and patterns in sick leave

The primary factor that limits the usefulness of these indicators is the fact that relationships that hold true at the individual level do not necessarily hold true at the aggregate level. The literature pertaining to the effect of EAPs on accident rates in the workplace provides an example of this problem. Rowland Austin of General Motors reported that employees who participated in the company's EAP, as a group, reduced their on-the-job accidents upwards of 50% ("Assistance Programs," 1983). An evaluation of Detroit Edison's EAP reviewed accident rates of employees at the one year mark following treatment for substance abuse; accidents occurring on the job had declined 41% (Nadolski and Sandonato, 1987). A study done by the Firestone Tire and Rubber Company found drug users almost four times as likely to be involved in plant accidents ("Human Beings," 1984-1985), while AT&T found that of 110 participants in the EAP, 26 had been involved in accidents in the two years before participation and only 5 were involved in accidents after participation (Gaeta, Lynn, and Grey, 1982). The U.S. Postal Service also reported that the rate of on-the-job accidents has been significantly reduced since implementation of their EAP ("Assistance Programs," 1983).

These figures clearly imply that something about the EAP has resulted in reduced accident rates. However, to show that employees who participate in the EAP reduce their accident rates is not proof that EAPs reduce accident

rates. Similarly, the fact that if you are drunk you are more likely to have an accident than if you are not drunk does not support the conclusion that high accident rates are due to high levels of alcohol abuse. This conclusion would be warranted at the aggregate level only if most accidents were caused by alcohol abuse, which is not the case (Lings, Jensen, Christensen, and Meller, 1984). As this example demonstrates, indirect, aggregate measures such as industrial accident rates are only partially sensitive to changes in the underlying variables of interest (e.g., the prevalence of fitness-for-duty problems at a nuclear power plant), and so are less desirable as indicators of fitness-for-duty program effectiveness.

8.2.2 Indicators of the Extent and Nature of the Fitness-for-Duty Program

Three types of indicators have been used in the EAP literature to reflect the extent and nature of the EAP: indicators of penetration and utilization (defined below), rates of self- versus supervisory referrals, and indicators of program resources. Use of these indicators for evaluating fitness-for-duty programs is discussed below.

8.2.2.1 Utilization and Penetration

Self-evaluations of EAPs commonly report rates of program use and penetration as evidence of their effectiveness (Korr and Ruez, 1986). Utilization rates refer to the percentage of individuals within a particular organization who have used the EAP within a given time. Utilization rates vary from organization to organization, reflecting the range of EAP structures and objectives. The literature does not describe an optimal rate; however, one study reports that between 2% and 3% of employees use their EAP at any given time (Marino, 1986). Penetration rates are purported to be measures of the effectiveness of the EAP at reaching a particular at-risk group within an organization. The concept of penetration rates is based on the assumption that at-risk groups exist in the workforce at the same levels as in the general population. An organization's penetration rates are derived by dividing the number of EAP referrals of a specific problem type by the number of total estimated at-risk individuals within the problem-type group. A high or improving percentage rate is an indicator of the EAP's effectiveness. Jerrell and Rightmyer (1983) reported that penetration rates typically vary over the duration of a program, usually starting around 2% to 3% during the initial phase, increasing to between 5% and 12% once the program is established.

The value of utilization and penetration rates as indicators of fitness-for-duty program effectiveness depends largely on the accuracy of the assumptions made about the levels of substance abuse and other fitness-for-duty problems in a particular organization. It has been argued that the target goals that have been established are based on erroneous and inflated assumptions about the prevalence of alcohol abuse among workers (Weiss, 1987). Even less information is available on the prevalence of other fitness for duty concerns (e.g., fatigue, abuse of legal and illegal drugs, psychological stress). Further, there is no reason to expect that the levels of these fitness-for-duty problems will be constant across licensees. Thus, it would be difficult

to develop accurate indicators using rates of utilization and penetration and even more difficult to define the link between these indicators and the safe operation of nuclear power plants.

8.2.2.2 Self- versus Supervisory Referral

The method of entry into an EAP is also considered an indicator of program effectiveness in some literature (see Albert et al., 1985, for a discussion). Specifically, EAPs with relatively high levels of self-referrals are seen as being more effective than programs with high levels of supervisory or other types of referrals. However, there is not a substantial logical or empirical basis for this argument. As Heyman (1976) has pointed out, the line between voluntary and coerced referral is so vague that the distinction is very difficult to make in many individual cases.

Another disadvantage of using indicators based upon method of entry into the EAP is that the rate of supervisory referrals may be artificially low because of the possible inability or unwillingness of supervisors to refer workers to the EAP. As previously discussed in this report, there are numerous barriers to supervisory referral. The literature also indicates that many substance abusers are able to hide their substance abuse from supervisors and co-workers for many years (Weiss, 1987). Thus, indicators based on the method of entry into the EAP do not appear to hold much promise.

8.2.2.3 Indicators of Program Resources

Examples of indicators related to the nature and scope of fitness-for-duty program resources include the following:

- Number of hours of supervisory training for fitness-for-duty issues
- Scope (types of drugs) of the licensee's drug testing program
- Size of the fitness-for-duty training budget
- Number of drug searches conducted each month
- Size of the EAP budget.

These indicators are not, strictly speaking, performance indicators. Instead they reflect the resources that the licensee has dedicated to the detection and correction of substance abuse problems. Such indicators have the advantage of being "before the fact" and represent conditions that can be manipulated in order to avoid significant fitness-for-duty problems. In some cases, such as the hours of supervisory training provided, it may be found that the indicators are strong predictors of program success. However, there are some disadvantages to using this type of indicator. The major one is that their validity is uncertain: there is not yet a firm technical basis for assuming, with a high level of confidence, that particular program characteristics lead to the solution of fitness-for-duty problems. Empirical research can address this issue.

8.2.3 Indicators of Program Outcomes

Three types of measures are included in this category: rehabilitation rates, cost-benefit measures, and changes in fitness-for-duty problems.

8.2.3.1 Rehabilitation Rates

The literature cites the rate of successful rehabilitation of employees referred to an EAP as between 50% and 80% (Mathis and Jackson, 1982; Schuler, 1983; Albert et al., 1985). Within this context, "successful rehabilitation" is typically defined as those employees who "return to the workforce and do a satisfactory job in the opinion of their supervisors" (Schuler, 1983, p. 306).

As evidence of EAP effectiveness, several studies have pointed to the fact that EAPs have higher rehabilitation rates than other types of treatment programs. EAP proponents suggest that the higher rates result from the EAP "job hook" advantage where continued employment is dependent upon a successful treatment outcome (Hoffer, 1983; Walsh, 1982). The treatment and recovery research literature provides ample documentation to support the assertion that those individuals still employed have a much higher likelihood of recovery from substance abuse (Maddux and Desmond, 1986).

The use of rehabilitation rates to assess the effectiveness of a fitness-for-duty program is problematic on several grounds. As pointed out by Weiss (1987), it is likely that there is a high degree of bias in the EAP literature toward reporting successful programs and that the many unsuccessful programs have not been factored into the 50-80% success estimate. Further, there are numerous methodological problems with the statistics reported, including inconsistencies and subjectivities in the measurement of success and the lack of long-term follow-up of EAP participants (Jerrell and Rightmeyer, 1982). Also, rehabilitation rate statistics that are not based on chemical testing will always contain a substantial subjective element.

A related problem is that even the high rate of success reported in the EAP literature may constitute an inadequate level of success for nuclear power plant safety. The goal of the fitness-for-duty program should be that no un-rehabilitated worker is returned to duty. Whether this goal is achieved through rehabilitation, reassignment, or termination may be immaterial to the evaluation of fitness-for-duty program effectiveness.

Due to these problems, setting a precise target goal for rehabilitation rates and evaluating a licensee's fitness-for-duty program relative to this goal does not appear to be feasible at this time. It is unlikely that rehabilitation rate indicators can play a major role in the assessment of fitness-for-duty program effectiveness.

8.2.3.2 Cost-Benefit Measures

Indicators in this category refer to the organization's net savings due to such factors as decreases in health care costs, insurance premiums, breakage,

training, absenteeism, and theft. The EAP literature frequently discusses program effectiveness in terms of the benefits accrued from program implementation compared to program costs. Ideally, EAP utilization statistics could be used in cost-benefit analyses to quantify direct and indirect costs of the EAP's operation and tangible and intangible EAP benefits. These figures could then be compared to estimated and measured costs that would occur if the EAP did not exist. To be reliable, the analysis would require a sophisticated reporting system, as all program costs and benefits must be identified, measured, and then translated into monetary values using an assigned common denominator (Starr and Bryam, 1985). However, such information and reporting systems are not the standard for the majority of EAPs; one study involving 40 EAPs found that only 50% were required by management to keep records (Ozawa, 1983).

Most of the available statistics which speak to EAP effectiveness in terms of costs and benefits rely upon anecdotal self-reports drawn from businesses' experiences. For example, Alexander and Alexander, a national benefits consulting firm, maintains that for every dollar invested in an EAP, the company receives a return of $8 to $10 in increased productivity and decreased health care claims (Wyrtzen, 1985). Phillips Petroleum reports an $8 million annual savings from reduced sick leave, accidents, and increased productivity. General Motors calculates that every dollar spent treating substance abuse saves $3 for the corporation in the long run (Rothman, 1986). Other studies have documented benefits along the following dimensions: reduced employee turnover (Lewis, 1981; Gam et al., 1981), reduced training and employee replacement costs (Starr and Byram, 1985), reduced employee utilization of insurance benefits (Foote, Erfurt, Strauchy, and Gazzarro, 1978), reduced costs associated with incidental absence (Gaeta et al., 1982), and reduced disability payments (Shore, 1984). These rosy statistics, however, have been questioned (Kurtz et al., 1984; Weiss, 1987; Cerrell and Rightmeyer, 1982; Albert et al., 1985). Criticisms have focused on the lack of precision in the estimates of the size of the dollar loss due to fitness-for-duty problems as well as the lack of precision in the measurement of program expenditures. In summary, the reliability and validity of cost-benefit measures is questionable and these issues must be resolved before cost-benefit measure can be considered useful indicators of fitness-for-duty program effectiveness.

8.2.3.3 Changes in Fitness-for-Duty Problems

Indicators in this category pertain to observed changes in fitness-for-duty problems, as measured by trends in the indicators previously discussed. A major problem with this type of indicator lies in interpreting its meaning. For example, a "high" rate of confirmed positive drug tests could indicate that a fitness-for-duty program is ineffective at deterrence but effective at detection; a "low" rate of confirmed positive drug tests could indicate a fitness-for-duty program that is effective at deterrence or one that is ineffective at detection. One strategy to resolve these problems is to examine trends in performance data. As long as the structure of the program is judged to be adequate based on periodic inspections, decreases in the rates of observed fitness-for-duty problems should be taken to indicate improving program effectiveness. Effective programs should not continue to

report high rates of confirmed positive tests and other direct measures of fitness-for-duty problems.

8.3 SUMMARY AND CONCLUSIONS

Indicators of fitness-for-duty program effectiveness are needed for licensees to assess the performance of their programs and for the NRC to monitor them. The development of a valid and reliable indicator system, however, is a complex and difficult undertaking. It ultimately depends on the systematic evaluation of data for a number of alternative indicators of performance.

Indicators that focus more directly on the extent of the fitness-for-duty problem hold the greatest promise for the development of a valid and reliable indicator system. Highest priority should be given to the development of these indicators, including the development of detailed definitions of the indicators, guidance on data collection, and a systematic statistical analysis to confirm their validity. Once validated, these indicators could be used in an empirically-based evaluation of alternative models of fitness-for-duty programs. Based on this evaluation, clearer statements could then be made about the type of program that is most likely to be effective.

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APPENDIX A

PROJECT METHODOLOGY

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PROJECT METHODOLOGY

This project involved several types of data gathering activities: (1) review of literature pertaining to fitness-for-duty issues, (2) telephone conversations with experts regarding drug testing methodologies, and (3) interviews with employee assistance personnel in industries facing similar types of drug problems and regulatory concerns as those found in the nuclear industry. In this appendix we provide detailed descriptions of these three activities.

A.1 SURVEY OF THE LITERATURE

Project staff surveyed literature from a number of fields pertinent to fitness-for-duty concerns, including psychophysiology, psycho-pharmacology, law, sociology, social work, psychology, and drug and alcohol testing (i.e., toxicology). The object of this search was to provide the NRC with the scientific and technical bases for developing a fitness-for-duty rule. The search was designed to provide as much information as possible about the issues involved in rulemaking (e.g., determining cut-off levels for drug screening, and characteristics of effective employee assistance programs) where such information is available, as well as to inform NRC staff about issues that have been raised but that have not been addressed or have only been incompletely addressed in the literature.

In addition to manual searches of libraries and journals, on-line searches of a number of computerized databases were conducted. These searches included the following: (1) a free text search of the Federal Register for entries keyed to "fitness for duty"; (2) a search designed to find references pertaining to employee assistance programs, alcohol or drugs, safety, and work in the NTIS, ABI/INFORM, TRIS, Management Contents, DOE Energy, and Health Planning and Administration Occupational Safety & Health (NIOSH) databases; and (3) a search of the Psychinfo database for references pertaining to employee assistance programs.

A.2 CONVERSATIONS WITH EXPERTS

Because the technology of drug testing is rapidly evolving, it was necessary to contact experts in the field to ensure that the information available in the literature is current. Over the course of the project, we discussed initial and confirmatory cut-off level determinations with (1) Dr. John Ambre, Associate Professor, Department of Internal Medicine at Northwestern University; (2) Commander John Irving of the Navy Drug Laboratories, Naval Medical Command, Washington, D.C.; (3) Dr. Stanley Ezinger in the Office of Workplace Initiatives, U.S. Department of Health and Human Services; (4) Dr. R. L. Hawks, Chief, Research Technology Branch, Division of Pre-Clinical Research at the National Institute of Drug Abuse; (5) Dr. Marcelline Burns of the Southern California Research Institute, Los Angeles, California; (6) Sergeant Richard C. Studdard, Training Coordinator, Drug Recognition Expert Projects Unit, Los Angeles Police Department; (7) Mr. Robert Stevenson,

Director of Toxicology Services Division, Office of Dade County Criminal Justice Council, Miami, Florida; (8) Dr. Ron Waldorf, Chairman, Oculokinetics, Inc., Torrance, California; and (9) Chuck Peltier, International Association of Chiefs of Police, Inc., Gaithersburg, Maryland.

A.3 SURVEY OF RELATED INDUSTRIES

In order to understand how organizations, under different forms of regulations and with different types of employees and safety concerns, address drug abuse and fitness-for-duty issues, interviews were conducted with employee assistance program (EAP) representatives in six organizations. The six organizations were selected to represent a range of regulations, employee groups, and safety concerns. Additionally, they were selected because they have addressed the issue of drugs in the workplace in some way.

A structured interview guide was developed and used during each two- to three-hour interview. The interviews took place during January 1988.

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13. ABSTRACT (200 words or less)

This report presents information gathered and analyzed in support of the United States Nuclear Regulatory Commission (NRC's) efforts to develop a rule that will ensure that workers with unescorted access to protected areas in nuclear power plants are fit for duty. The primary potential fitness-for-duty concern addressed in the report is impairment caused by substance abuse, although other sources of impairment on the job are discussed.

The report examines the prevalence of fitness-for-duty problems and discusses the use and effects of illicit drugs, prescription drugs, over-the-counter preparations and alcohol. The ways in which fitness-for-duty concerns are being addressed in both public- and private-sector industries are reviewed and a description is provided of fitness-for-duty practices in six organizations that, like the nuclear industry, are regulated and whose operations can affect public health and safety. Methods of ensuring fitness for duty in the nuclear industry are examined in detail. The report also addresses methods of evaluating the effectiveness of fitness-for-duty programs in the nuclear power industry.

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