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Indicators for Characterizing Possible
Thefts of Fissile Materials

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16. Abstract (Limit: 200 words) An exploratory investigation was undertaken to establish typologies of criminals (and crimes) that could become involved in the theft of sufficient fissile material to make an illicit nuclear explosive. Questionnaire surveys were conducted of criminology experts outside the nuclear industry and also of professionals involved in managing nuclear fuel activities. Results show that employee involvement for fissile materials is probable and that either profit or political motivation is likely. Employees involved in thefts of fissile materials are likely to be highly trained and not faced with personal problems. Thefts by organized crime seem unlikely. Experts in management are concerned about theft of fissile materials by foreign groups or nations. Deterrents against fissile material thefts are physical security, stringent accountability, and personnel management. Respondents evaluate the effectiveness of personnel selection for security to be better for fissile materials than for other criminological fields surveyed.				13. Type of Report & Period Covered	
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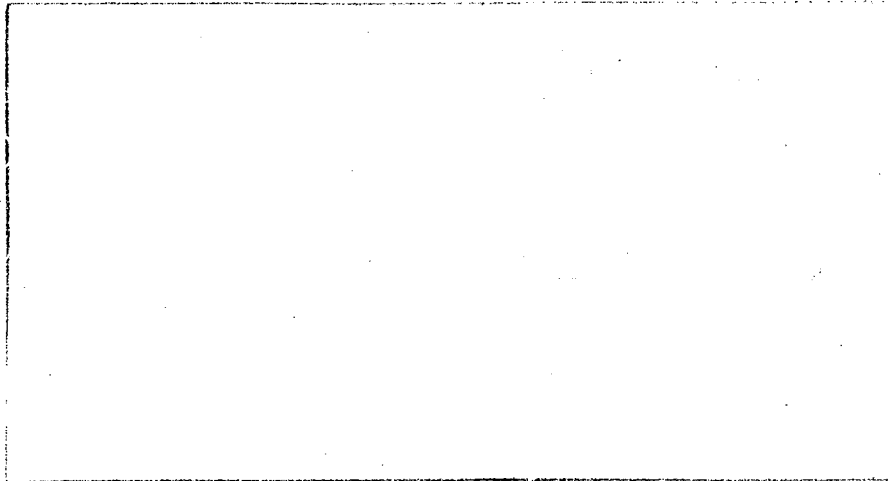
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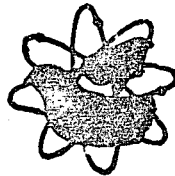
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INDICATORS FOR CHARACTERIZING
POSSIBLE THEFTS OF FISSILE MATERIALS*

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or recommendations expressed in this
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Abstract

Survey research has been adapted to the problem of inferentially predicting the pattern of a crime not yet committed, namely theft of sufficient fissile material to make an illicit nuclear explosive. Surveys were conducted both of experts knowing about large-value thefts in criminological fields that are similarly specialized and of experts in managing fissile materials. For fissile materials, both surveys indicate that employee involvement is probable and that either the profit motive or the political motive are likely. On the basis of findings for thefts of data, employees involved in thefts of fissile materials are likely to be highly trained and not likely to be faced with personal problems. The surveys infer that thefts by organized crime are unlikely. For fissile materials, experts in fissile material management are concerned about theft by foreign groups or nations. Although physical security is judged by respondents to be the primary deterrent to large thefts of most other specialized materials, the fact that thefts of data are judged to be better deterred by stringent accountability and by personnel management indicates that all three deterrents are important against fissile material thefts. Respondents evaluate the effectiveness of personnel selection for security to be better for fissile materials than for the other criminological fields surveyed.

Introduction

Possible misuse of nuclear materials for criminal fabrication of a nuclear explosive could have grave consequences to civilization. The criminal use of only one nuclear explosive by a small group or even an individual could imperil an entire population of millions in a major city, could destroy much of the city, and could accidentally initiate a major war if the criminal cause of the disaster were not immediately clear to all nations. Society would have little opportunity to adapt to such dire circumstances.

Under less serious circumstances, society necessarily does adapt to large criminal acts, even as spectacular as hijackings of large airplanes with the consequent imperiling of the airplane occupants and destruction of hijacked airplanes. In such cases the hazards are to perhaps one hundred lives and to perhaps ten million dollars worth of property. Tragic as these losses might be, they are not large compared to the accumulation of other losses normally sustained in a developed society in the course of daily life. Furthermore, any consequent calamity, like war, is very unlikely to follow even spectacular international hijackings.

Fortunately, no thefts of nuclear material sufficient to form a nuclear explosive are yet known to have occurred. However, in view of the possibly serious consequences of criminal acts with nuclear explosive material, certainly a worthy objective is to try to establish the typologies of likely criminals and crimes before any such act has been committed. To our knowledge, criminal typologies heretofore have been studied only on the basis of actual crimes committed and not before a new type of crime has been experienced. For example, typologies have been reported (Arey, 1972:

98-103; Trotter, 1972; 108-110) for actual hijackers of airplanes. However, different methods of investigation are obviously required for yet uncommitted crimes. In the present research, unusual applications of survey research techniques have been made with two different groups of elites in an effort to elucidate this criminological problem for which previous approaches are therefore not applicable.

Availability of Materials and Skills

Before considering the research techniques utilized, we first outline the criminological danger involved in the rapidly growing usage of nuclear material, both in this country and worldwide. The danger is from uranium that has been highly enriched in the isotope uranium-235 and from plutonium-239. Both are termed fissile materials. Fissile materials are required to sustain the chain reaction essential to a nuclear explosive.

When construction of an illicit nuclear explosive is considered, only in the control of fissile material is any prevention of nuclear-explosive crimes expected. Neither uranium-235 nor plutonium-239 is available in normal commercial channels. They result only from very complex technological operations that involve extraordinary outlays of capital and that are legally under governmental regulation (Willrich, 1971: 43-66). On the other hand, neither the high explosive (chemical) required to trigger a nuclear explosive nor the technology of fabricating a nuclear explosive is likely to provide opportunities for realistic means of forestalling illicit weapons. High explosive is readily obtainable for commercial purposes. Basic designs of nuclear explosives are readily available in the open literature (Gamow and Cleveland, 1969: 503; Shortley and Williams, 1961:

894). Furthermore, technology adequate for fabrication of such an explosive device having a credible chance of success has been described as requiring only a similar degree of technological complexity as the clandestine laboratories recurrently being assembled in the Marseilles area (Taylor, 1972: 275-284), apparently even without great effort or unusual financing.

The danger arising from the availability of fissile material has continually increased. At the start of our nuclear age, all production of fissile materials was by governments and was almost exclusively for production of nuclear weapons for the military. In its revision of the Atomic Energy Act of 1954, Congress encouraged the involvement of private sectors of the economy in nuclear power by allowing commercial companies under license to own and to fabricate fissile materials. In the latter part of the 1960's, commercial power reactors for production of electrical power became prevalent, although almost all were fueled by uranium with sufficiently low enrichment in the fissile uranium-235 that this fuel can not be used for a nuclear explosive. (An exception is the few U.S. gas-cooled power reactors planned to operate with highly-enriched uranium-235; these particular fuels are of criminological concern.) However, each year of operation of a large reactor with low-enrichment fuel results in the production of 200 to 300 kilograms of plutonium-239 as a valuable by-product (Galinsky, 1971: 14-41). At its current price of \$7,000 per kilogram, plutonium-239 is seven times as expensive as gold. On the basis of 10 kilograms of plutonium-239 as being adequate for the critical mass needed for a nuclear explosive (Avenhaus and Gupta, 1970: 345-374), this yearly output is sufficient for more than 20 Nagasaki-type weapons per year from just one nuclear

power plant. So great is the expected production of nuclear power that by the end of the century the nuclear industry is expecting to be processing about twenty tons (20,000 kg) of plutonium-239 each year (Galinsky, 1971: 14-41).

The intended use of the nuclear power plant by-product plutonium-239 is itself to be fuel for nuclear power plants. However, even in the best of industrial practices, uncertainties in material accountability is hardly less than one percent of throughput. Therefore, the criminological concern is not only of overt theft of increasingly abundant fissile material, but also of possibly undetected theft of the embezzling type that might be masked within the uncertainties of plant operation (Thornton, 1972: 69-84). On the basis of these figures, the cumulative yearly uncertainty in all plant operations would be the equivalent of roughly twenty Nagasaki-type bombs per year at the end of the century.

This growing availability and widespread use of fissile materials will significantly increase the danger of theft and misuse. Similarly, the skills to convert the material into a nuclear explosive are sufficiently widespread that authorities should be prepared to assume that the thief is either capable of fabricating the explosive or able to pass it to persons with this capability (Hall, 1972: 275-284).

Survey Methods

Since the present research is an exploratory investigation of a yet uncommitted major crime, opinions were sought from all experts having applicable knowledge. Accordingly, the survey was in two parts with basically different groups of elites: (1) a survey of elites outside of the nuclear

industry but actively involved broadly in law enforcement of criminal justice or else having knowledge of crime prevention in an relevant field of specialization and (2) a survey of professional persons actually involved in nuclear fuel activities through plant operation, government regulation, or laboratory developments.

For the survey (1) of criminological elites, separate questionnaires were prepared on five different fields of crime for which experience exists and which possess most of the distinguishing traits of what is expected to be involved in any theft of fissile material. By this means, the respondents were involved with topics on which they had knowledge, thereby eliminating any need for involvement with what was to the respondents the unfamiliar field of fissile materials. Of course, the relevance of results of this survey to the field of fissile materials largely depends upon the similarity of characteristics of the five criminological fields studied to the characteristics of possible criminology in fissile materials.

Particular care was taken to delineate the monetary magnitude and time span of the crime in the questionnaire in these other fields so they would be comparable to the nuclear theft of concern. A one-year time span for executing the theft was specified, since particularly in the management of fissile materials a longer time span would lead to detection of any attrition. The minimum theft specified in the questionnaires was set at the amount corresponding to the monetary value of the fissile material needed to fabricate a nuclear explosive, namely a \$70,000 minimum for the value of the stolen items in question. This is the monetary equivalent of the needed ten kilograms needed for a plutonium-239 nuclear explosive. This monetary

minimum also assured that responses were confined to unusual and rare crimes, just as nuclear crimes are likely to be if they unfortunately occur. This restriction to rare crimes is acknowledged to act as a severe restraint upon the number of qualified responses that can be obtained, but in survey research bearing on possible nuclear thefts such a restraint is obviously inherent.

Any theft of fissile material obviously involves specialized characteristics. For the survey (1), the other criminological fields studied should have as many as possible of the characteristics of fissile materials:

- a) has high unit value
- b) has limited marketability for disposal
- c) requires special technology in handling
- d) is under U.S. governmental control or license

It is readily seen that the most common large theft, namely that of money, is excluded by the above criteria. The following fields were characterized best by a) through d) and so were individually studied in the survey (1):

- I) data (particularly in computers)
- II) weapons (particularly automatic-fire weapons)

III) narcotics

IV) objects of art

V) precious metals and gems (particularly gold)

The correspondence of characteristics for these fields with the field of fissile material is shown in Table I. In the opinions of Rappoport and Pettinelli (1972) and of Taylor (1972), the field of narcotics has particular parallels. Unit costs are similar ("wholesale" value of several thousand dollars per kilogram for heroin). The care, skill, and equipment for handling are similar in both cases; that is, conversion of morphine base to heroin is similar in complexity to the conversion from the oxide form of plutonium-239 (the form for reactor fuels) to plutonium-239 metal needed for an explosive. However, the large thefts of narcotics of interest in the present research were carefully distinguished from the more common illegal production and distribution of heroin, which do not fulfill the requirements of theft and large value in the present study.

The survey (1) of criminological elites was first pretested by interviews with various experts in Kansas. From lists of elites in law enforcement and criminal justice (mainly from the 1971 listing of The National Directory of Law Enforcement Administrators and Correctional Institutions¹), 264 persons were selected as most likely to know about large-value crimes in several of the five fields; questionnaires for each of the five fields were sent to these selections. On the other hand, specialists knowledgeable about criminology or security in only one of the fields were mailed

¹Compiled and published by the National Police Chiefs and Sheriffs Information Bureau, Milwaukee, Wisconsin.

questionnaires pertaining only to his field. Between 25 and 110 specialists in each field were so identified. An overall total of 511 questionnaires were mailed. In addition, individual interviews following the questionnaire form were conducted with 18 selected specialists for the purpose of expanding the background information.

In the survey (2) of professionals in management of nuclear fuels, the criminological questions about possible thefts of nuclear materials were a small part of a larger survey intended to identify locations in the nuclear fuel industry most susceptible to losses and thefts. Instead of specify the \$70,000 minimum value of survey (1), the questionnaire of survey (2) concerned "significant amounts", which was expected to be self-defining for fissile material experts.

This questionnaire was pretested with nuclear scientists at Kansas State University and then mailed to 488 persons randomly selected from a compilation of 1100 professionals involved with the control of nuclear materials. Of the 127 responses, 59 were from industry, 27 from governmental regulatory agencies, 33 were from governmental development laboratories, and the remaining eight were from universities.

The fact that the respondents were asked some questions related to criminology, which was not their field of specialization, is offset by the fact that the respondents were the professionals in the field of fissile materials, a field for which no criminological experience yet exists. Furthermore, the respondents best know the security exerted for fissile materials and the technical difficulties involved in any theft and any illicit use. Although perhaps whimsically, it can be said that the respondents

themselves have the knowledge that makes them the most likely thieves.

Of equal significance is the fact that these responses reflect the attitudes and background beliefs of persons actually responsible for security of fissile materials in the United States.

Relation Between Fissile Materials and Other Fields

Of fundamental importance is the need to relate the salient features of criminology in the other specialized fields to that of fissile materials. Deepest insight of these relations came from personal interviews with the national experts in security and criminology for these other specialized fields. These interviews were structured on the topics in the mailed questionnaires, but ranged further in scope and deeper in detail than feasible by written responses on questionnaires.

In regard to the rarity of large-valued crimes in these other specialized fields, probably only in the case of precious metals and gems are these large-valued and specialized crimes found to be as frequent as once a year on a worldwide basis. Therefore, in regard to the rareness of the crimes the study was properly designed, although respondents consequently were often familiar with only a few actual cases. (In fact, we were unable to learn of any actual narcotics thefts of the specified \$70,000 magnitude. It is then perhaps ironical that the field with the greatest return rate of completed questionnaires was narcotics.) In contrast, even million-dollar thefts of money have occurred at the rate of one per year over the last decade, while greater than one hundred thousand dollar thefts occurred at the rate of five per year (Taylor, 1972: 219-230). These money thefts usually required planning and capital, the same requirements expected of most

large-value thefts; nevertheless, thefts of money were justifiably not included in the present study because they do not conform with the technological and marketing restrictions expected to apply to fissile material thefts.

The characteristics of usual thefts are now considered. Except for data thefts, interviewees stated that the theft pattern often involved three classes of participants:

- A) Broker. The stolen items being considered in these five areas generally have a limited market, but for the \$70,000 minimum considered the marketing problem is particularly great. Therefore, the broker in the crime is important by being the arranger between customer and thief. The broker is not usually an employee of the victimized establishment and often never sees the stolen items.
- B) Informant. Since the material to be stolen is of specialized nature, an employee informant is needed for information on the time, location, and access methods for the theft.
- C) Thief. The actual theft is performed by a professional thief who is not an employee. He is characterized by low education and expensive living habits.

Objectives for thefts of fissile material would be of sufficient importance to warrant a similar scale of operation.

On the other hand, experts claimed the usual modus operandi for data thefts is distinctly different. The theft is usually by a single trusted employee, but remote thefts by a single person are also possible by telephone line communication with a central computer (Morton, 1970a: 1 and 4). It is interesting to note that prosecution is legally complicated by the

fact that the data in question are taken from computer storages by one of a variety of duplicating methods, and so nothing is removed (Morton, 1970b: 1-2). The \$40 million planned to be spent over the next five years by International Business Machines to study techniques for assuring confidentiality of data stored in computers attests to the growing criminological importance of data thefts.² Fissile materials similarly have fast growing commercial importance, and thefts similarly would be facilitated by the involvement of a professional employee.

The possible markets for stolen materials was also discussed with experts. Speculations on possible markets for fissile material have been published (Lovett, 1972: 207-218; Hosmer, 1972: 3-16; Taylor, 1968: Vol. 1 (first three issues of this then-discontinued Journal)). In the face of a total lack of actual thefts of fissile materials in the needed quantities, it is not surprising that these speculations about possible illegal markets vary widely. Implicit in all these speculations is that the worldwide market for stolen fissile material might be only one buyer (individual or group) at an occasional time. This underscores the need for studying criminological fields characterized by limited marketability. In this connection, experts in criminology and security for objects of art emphasize that logically no market should exist at all for stolen objects of art. Each is unique and readily identifiable, and so the worldwide notices following theft should thwart any display or resale of any stolen object. Nonetheless, art thefts continue, and often the stolen objects simply do not

²"IBM to Seek Ways to Teach Computers How to Keep Secrets", Wall Street Journal, May 17, 1972.

appear again. (Occasionally, thefts are instead to collect ransom for the stolen object of art.) The parallel to be made is that an apparent lack of an assured market for stolen fissile material is not by itself any indication that the material would not be a desirable target for theft.

Discussions with experts disclosed that the history of the formative period of physical security and personnel selection methods in an industry determines to a considerable extent the existing security situation. Among the fields considered, the field of narcotics is exemplary. Decades ago a meeting was held by union leaders, industry management, and governmental regulators in which the serious need for security was emphasized. Consequently, industry assumed several security procedures as its responsibility for maintaining its license status: large shipments are accompanied by several armed guards, narcotics work is done in buildings that are an enclave well within the fences of a factory having other activities, and employees are observed while proceeding between clothes-changing rooms. The unions cooperate with the management for security in personnel selection for narcotics work, and assignment to narcotics work by the union is considered to be an honor. In contrast, much of the precious metal industry is characterized by insecure buildings and unions that are less cooperative on security matters.

In this regard, the outlook for security of fissile materials seems intermediate between these extremes. Whole corporations and factories are devoted to nuclear fuels. Therefore, operations are unlikely to be an enclave within a factory. Similarly, any financial losses resulting from security measures are unlikely to be covered by other larger operations of

the corporation. On the other hand, governmental licensing provisions for nuclear plants set minimum standards of security and accountability.

In regard to motive for thefts, interviews revealed that the large-valued crimes in the other specialized fields studied are usually for profit. The principal exception is political purposes motivating thefts of automatic-fire weapons in recent years for arming extremists groups. (In a few cases, objects of art are sometimes ransomed also for political purposes.)

Survey of Large-Valued Specialized Crimes

Including mailings and interviews in survey (1), responses to questionnaires on thefts of over \$70,000 value of specialized materials, ranged from a high of 22 for narcotics to a low of 14 for objects of art. As a result of these small sample sizes, findings from the survey are regarded as only suggestive rather than precise. However, these limited numbers are offset by the fact that all respondents were experts on these rare crimes.

The questionnaire asked respondents whether the thief being described was an employee or non-employee of the victimized establishment. Table 2 presents results for the five criminological fields. Respondents overwhelmingly believed data thefts would be by employees and that thefts both of precious metals and gems and of objects of art would be by non-employees; therefore responses only for these employment classifications have adequate sample size for inclusion in Table 2. On the other hand, questionnaire responses for fields of weapons and of narcotics were similar in number for thefts by employees and by non-employees; for these two fields, responses for both employment classifications are given in Table 2.

The profile obtained for a data thief obtained from Table II is a young

college-degreed employee motivated by profit. A clear majority of the responses to other questions in the survey are of the belief that the data thief does not have problems in drinking, in gambling, or in a socially unacceptable sex life. Slightly more respondents characterized the thief as living within his legitimate income than not, but the difference was not statistically significant. The extent of specialized knowledge needed for possible thefts of fissile materials is sufficiently similar to that needed for thefts of data that thief profiles for employees with data could be an indicator of employees prone to thefts of fissile materials for a profit motive.

This dependence upon specialized knowledge interestingly also appears in the non-employee thief profile for the field of objects of art. The high educational level for art thieves in Table 2 is matched only by data thieves. Age is expected to be greater for art thieves, reflecting the newness of the computer field. The fact that art thefts are not readily concealed is consistent with non-employee thieves. The knowledge needed of the victimized computer for data thefts is consistent with employee thieves. Again, profit is the motive overwhelmingly given for art thefts.

Only for the case of theft of weapons by non-employees do the responses in Table 2 give political reasons as the likely motive. This can reasonably be associated with the fact that only weapons among the five fields in survey (1) provide opportunities for destruction or for threats of physical damage. Since fissile materials similarly provide these same opportunities, motives for thefts of fissile materials by non-employees could logically be political as well as for profit. For weapons thefts in Table 2, the younger age expected for employees relative to non-employees presumably represents

young men in military service.

For the field of narcotics, respondents are seen in Table 2 to have expressed the clearest difference between employees and non-employees in terms of age, with the younger age applying to non-employees.

In responses to other questions, the majority of respondents for each field believed persons prone to thefts did not have problems of drinking nor of a socially unacceptable sex life. Except for the cases of narcotics thieves and data thieves, the majority of respondents expected persons prone to these thefts to have gambling problems. Except for the cases of the (politically motivated) non-employee prone to weapons thefts and except for (professional) persons prone to data thefts, respondents expected living expenses to be extravagant compared to legitimate income.

The questionnaires also attempted to identify the likely operational nature of thefts. The respondents overwhelmingly expected the thefts to be either situational or by professionals, with roughly equal splits between these. Significantly, in none of the five fields studied did more than 20% of the respondents expect organized crime to be involved. This result implies that these rare thefts of specialized items are less attractive to organized crime than high volumes of readily marketable items.

A significant part of this survey (1) on large-valued crimes was concerned with the effectiveness and expense experienced in each of the fields for security measures. To identify the best method to insure that these large thefts do not take place, respondents in each of the specialized fields selected the most effective among the methods of stringent accountability, physical security, and personnel management. The results of Table

3 generally indicate a spread among opinions of the experts queried, but usually physical security was believed to be the most effective in insuring against these crimes. The exception was for data thefts, for which both stringent accountability and personnel management are expected to be more effective. This is consistent with the professional employee identification of data thieves; in normal employment activities they would be involved with the target items, and so physical security has limited effectiveness.

The questionnaires explored further into personnel management practices. Respondents indicated in a five-step scale from step 1 as "very poor" to step 5 as "very well" how effectively they believed present personnel selection methods in each field insured against hiring persons prone to these thefts. The individual evaluations of personnel selection made by respondents ranged over the entire scale, except that none responded with "very poor" (step 1) for the field of weapons and none responded with "very good" (step 5) for either the field of precious metals and gems or for the field of objects of art.

On this five-step scale, the weighted average of the respondents was the following:

data	1.7
weapons	2.9
narcotics	3.0
objects of art	2.4
precious metals and gems	2.9

Thus, in this evaluation of experts, personnel selection currently is providing least deterrence against data thefts and also is substandard for

thefts of objects of art. An explanation for the case of data thefts is likely to be the newness of the employers' realization of the crime potential that exists; the explanation provided by interviews for the case of objects of art is the limitation of budgets available for employee salaries at museums. For the other fields of crime, deterrence by personnel selection is seen to be evaluated as midway between good and poor.

Respondents to the questionnaire also provided evaluations of whether precautions taken against thefts unduly increased the operating costs of the activity in each of these fields under study. Both for objects of art and for precious metals and gems, respondents were approximately evenly divided between the opinion that the cost was burdensome and that it was not. However, in the evaluation of over two-thirds of the respondents in each of the other fields, namely weapons, data, and narcotics, precautions did not unduly increase operating costs in these fields. This evaluation for narcotics is particularly significant in view of the stringent security practices of this industry. These security practices apparently have been established sufficiently long to have been incorporated into the price structure of the industry; furthermore, the licensing provisions by the government apparently result in the industry accepting these security provisions as an integral part of doing business.

Survey of Experts in Nuclear Fuel Management

In this survey (2) of experts in nuclear fuel management, respondents were asked (without cuing) to list which groups or persons were most likely to divert materials. Up to three responses were provided per respondent, providing a total of 260 responses. Following are the categories together

with the percentage of these 260 responses:

Dissident U. S. Group	24%
Organized Crime	19%
Foreign Countries	14%
Dissident Foreign Group	11%
Psychopaths	8%
Plant Employees	8%
Confidence Type People	5%
Professional Criminal	4%
Amateur or Situational Criminal	4%
Group for Profit or Power	3%

The percentages responding in these categories were the same within statistical uncertainties for each of the respondent subdivisions of industry, governmental regulatory agencies, and governmental development laboratories.

It is particularly significant in the above listing that the leading four categories, comprising 48% of responses, were groups organized for purposes other than simply performing the theft. Except for weapons thefts by non-employees, this result is in sharp contrast to the results of survey (1) on other criminological fields. These opinions from experts in nuclear fuel management could be explained by either

- a) a realization by nuclear fuel managers of the different criminological attractions of fissile materials or
- b) by their being misled by popularized versions of crimes while possessing only limited knowledge of criminological patterns in large-valued thefts of specialized materials.

Without nuclear thefts having been committed, the correctness of this group-theft concept by respondents can not be tested by experience. Nevertheless,

this concept might be underlying present security precautions taken by officials for fissile material management.

When respondents were asked "which diversion situation is most likely to occur", 96 responses divided as follows:

Trusted Employee for Profit	26%
Trusted Employee for Political Reasons	26%
Non-Employee for Profit	22%
Non-Employee for Political Reasons	26%

Other than the exception that respondents from governmental regulatory agencies believed non-employee theft for profit to be even less likely, percentages for the respondent subdivisions were the same within statistical uncertainties. These responses show that experts in nuclear fuel management believe employee theft to be only slightly more likely than non-employee theft and political motives to be only slightly more likely than the profit motive. On the other hand, when asked the likely motive without employment being specified, the results in Table 4 show the profit motive to be slightly more likely than the political motive. This profit vs. political difference between the two questions is not statistically significant.

The same question on personnel selection was asked as in the previous survey (1). On the same five-step scale as in survey (1), namely "very poorly" as step 1 and "very good" as step 4, the 127 responses resulted in a value of 3.7 for the weighted average over the steps. Thus, persons involved with nuclear fuels responded with a significantly higher rating for personnel selection methods insuring against hiring of persons likely to divert materials than are the corresponding ratings on hiring for any of the five specialized fields as provided by criminological respondents. This

perhaps represents the difference between pride of an unscathed industry relative to the concern involved in the other victimized fields.

Summary

Profit motivations or political motivations are both likely possibilities for fissile material thefts, just as is experienced in weapons thefts. Experts in nuclear materials management cite dissident groups and foreign powers as quite likely to try to divert material. Only weapons have similar operational importance for these groups. For foreign groups, weapons are often commercially openly available, whereas fissile materials are not. Therefore, between the two surveys, only very limited carry-over is possible for the case of these foreign groups.

Both surveys indicate that organized crime is unlikely to engage in these rare thefts of specialized materials, including fissile materials.

Of particular significance is the fact that half of the responding experts in nuclear fuel management perceive the theft danger to be from groups organized for purposes other than a particular theft, whereas criminology experts in other fields do not identify this as the danger for their fields. Whether or not this assessment by experts in nuclear fuel management is correct, nevertheless the precautions against fissile material thefts are undoubtedly heavily influenced by this evaluation of these groups as a real danger.

The technical complexity of handling and identifying fissile materials probably requires the involvement of an employee either as the thief or else as an informer in a multiperson theft. Typologies for single-person thefts might then follow that for data thieves, namely a college-educated

employee not driven by personal problems in drinking, gambling, socially unacceptable sex, or extravagant living.

Personnel selection methods in the nuclear fuel industry are evaluated as being significantly above average in insuring against hiring persons prone to thefts, while personnel selections are judged to be average in effectiveness in most of the other specialized fields studied. The significant exception is the field of data, where a poor evaluation of personnel selection is given by respondents.

For fields of possible crime where non-employee thieves are often involved, physical security is rated as the best method of insuring against theft. On the other hand, in the field of data theft, where involvement by a knowledgeable employee is important, stringent accountability and personnel management are rated as more effective. Since both types of theft are expected as likely possibilities for fissile materials, the surveys indicate that no one of these three methods clearly provides the best deterrence.

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TABLE 1

Relations of the Characteristics of Fissile Materials with Materials in the Other Fields Surveyed.

	High Unit Value	Limited Marketability	Special Technology in Handling	Controlled or Licensed
Data	Yes	Yes	Yes	No
Weapons	No	Yes	No	Yes
Narcotics	Yes	Yes	Yes	Yes
Objects of Art	Yes	Yes	Sometimes	No
Precious Metals & Gems	Yes	Yes	No	Yes (for gold)

TABLE 2
Characteristics and Motives of Thieves of Large-Values of Specialized Materials as
Determined by Survey Responses.

Employment Category	Data	Weapons		Narcotics		Objects of Art	Precious Metals and Gems
	Employee	Employee	Non- Employee	Employee	Non- Employee	Non- Employee	Non- Employee
<u>Age</u>							
up to 25	19%	60%	33%		67%		
25 - 40	75%	20%	67%	75%	33%	57%	71%
40 & over	6%	20%		25%		43%	29%
Number of Responses	16	5	6	8	12	7	14
<u>Education</u>							
Less than High School		40%	50%	17%	45%	17%	29%
High School Graduate	31%	40%	50%	83%	45%	33%	71%
College Graduate	69%	20%			10%	50%	
Number of Responses	16	5	6	6	11	6	14
<u>Motive</u>							
Profit	80%	71%	33%	100%	100%	100%	100%
Political	7%	29%	67%				
Personal	13%						
Number of Responses	15	7	6	7	10	6	14

TABLE 3

Choice of Method to Insure Against High-Value Crimes in the Five Specialized Crime Fields

	Stringent Accountability	Physical Security	Personnel Management
Data	45%	20%	35%
Weapons	24	57	19
Narcotics	36	42	22
Objects of Art	18	59	23
Precious Metals and Gems	16	72	12

TABLE 4

Motives for Diversion of Nuclear Materials Obtained from 108 Responses by
Experts in Nuclear Fuel Management

	Most Likely Motive	Least Likely Motive
Profit	46%	20%
Political	43%	16%
Personal Grievances	11%	64%

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