UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of)
)
DUKE POWER COMPANY)
)
(Amendment to Material License) Docket No. 70-2623
SNM-1773 for Oconee Nuclear)
Station Spent Fuel Transportation)
and Storage at McGuire Nuclear)
Station))

TESTIMONY OF J. MARK ELLIOTT

I. Personal Background and Experience

Education and General Experience

B.S. (1966) Mechanical Engineering, University of Houston
MS (1968), PhD (1970), Mechanical Engineering, Auburn University

1970-1973: Assistant Professor, Mechanical Engineering, Auburn University and University of South Alabama; teaching and research.

1973-1975: Member Technical Staff, TRW Systems Group, London U.K. and McLean, VA: developed crisis management and command and control systems for U.S. Navy.

Specific Experience Related to Spent Fuel Sabotage/ Nuclear Terrorism

~~369 148~~

1975-1976: Safeguards Systems Analyst, Contingency Planning Branch, U.S. Nuclear Regulatory Commission, Washington, DC; responsible

for development of NRC Headquarters Safeguards Contingency Plan for dealing with threats, theft and sabotage directed at licensed nuclear materials and facilities. Throughly familiar with various studies, reports and activities concerned with potential terrorist acts against nuclear facilities, including the history of terrorist activities, capabilities of terrorist groups, tactics, etc.

1976-1978: Chief, Reactor Safeguards Development Branch, U.S. Nuclear Regulatory Commission, Washington, DC; managed activities of Branch responsible for the detailed development and review of the Commission's program for safeguarding nuclear reactors against sabotage and theft of nuclear materials. Continued responsibilities in analysis of terrorist activities.

Additional activities while at NRC included:

- Appointment by Chairman, NRC to serve as member of Task Force on Allegations of James Conran, concerning NRC's safeguards program.

369 149

- Appointment by Director, Office of Nuclear Reactor Regulation to be Office representative on a three man NRC team charged with evaluating threats against NRC licensed facilities.

- NRC representative to the President's Cabinet Committee to Combat Terrorism.

514 166

1978-Present: Senior Consultant, International Energy Associates Limited, Washington, DC; Manage IEAL's domestic safeguards projects. Current activities include support to the Department of Energy's program for safeguards technology research and development. Also a member, Atomic Industrial Forum's Committee on Domestic Safeguards.

Knowledge of Applicable Regulations

From my experience and continuing work and interests in the nuclear safeguards field, I am knowledgeable of current and proposed NRC regulations (10 CFR 73) and DOT regulations (49 CFR 170-189) that apply to spent fuel transportation.

Knowledge of Applicable Reports, Studies, Etc.

From my experience and continuing work and interests in the nuclear safeguards field, I am knowledgeable of numerous reports, studies, analyses, etc., related to terrorism in general and the possibility of nuclear terrorism in particular. In addition, I have attended numerous meetings, briefings and discussions on the subject.

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II. Spent Fuel Shipment History

Summary

The available information concerning history of spent fuel shipments in the United States can be divided into two categories--civil and military. Civil shipments, or those from commercial power reactors, comprise the larger percentage of all spent fuel shipments. Table I indicates the approximate number of spent fuel shipments that have occurred through 1978 and that are estimated for 1979, and includes an estimation of total shipping miles for each year.

Civil

Data for civil shipments have been obtained from two NRC studies.[1,2] The exact number of shipments are available for 1972 cumulative, 1975, as well as estimates for 1979, and are broken down according to mode of transport. The majority of shipments are made by truck (approximately 83%), followed by rail (approximately 16%) and the smallest number by barge (approximately 1%). The known number of civil shipments made in the United States to date is 3,435 (1972 cumulative, plus 1975). Further, the NRC expects 222 such shipments of spent fuel to occur in 1979 (216 by

truck, 6 by rail) and travel a total of 156,000 miles. Using actual data to approximate the number of shipments and miles traveled in the years lacking hard data (1973, 74, 76-78), then approximately 4,000 shipments will have occurred by the end of 1979, and traveled a total of approximately 3 million miles.

TABLE I

SPENT FUEL HISTORY

year	SPENT FUEL civil total number of shipments truck	civil rail	civil barge	military total number of shipments all by rail	SHIPPING DISTANCE MILES civil	military*** (Data in this column is by route rather than by year) from	to		
cumulative thru 1972	2,628	532	4	(Data in this column is by route rather than by year)	2,300,480				
1973*	200	8	0	from / to	200,000	from	to		
				Savannah River / Idaho Falls 96		Savannah River	Idaho Falls	192,00	
1974*	200	8	0		200,000				
				Richland / West Valley 40		Richland	West Valley	112,00	
1975	254	17	0		200,000				
				Chalk River / Richland 5		Chalk River	Richland	14,00	
1976*	200	8	0		200,000				
				Chalk River / Savannah River 41		Chalk River	Savannah River	41,00	
1977*	200	8	0		200,000				
1978*	200	8	0		200,000				
TOTAL	3882	549	4	182	3,300,480			359,000	
1979 (Est.)**	216	6	0		156,000				

* Estimates based on data thru 1972 and 1979 estimates

** NRC estimate

*** Does not include shipments in classified programs

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Military

Certain military spent fuel shipments are classified. However, some information on unclassified shipments was obtained through informal contacts with DOE which gave estimates of 182 shipments, all by rail. Of that group, approximately 96 have traveled from Savannah River, South Carolina to Idaho, 40 from Richland, Washington to West Valley, New York, 5 from Chalk River, Ontario to Richland, and 41 from Chalk River to Savannah River. The estimated total distance traveled by unclassified military spent fuel is 360,000 miles.

Malevolent Acts Against Spent Fuel

To the best of my knowledge, no civil or military spent fuel shipment has ever been lost, misrouted, or the subject of serious malevolent acts. Spent fuel shipments to date have neither been sabotaged nor placed public health and well-being in jeopardy.

This conclusion is based on my knowledge and experience, discussions with NRC and DOE staff, and NRC's Safeguards Summary Event List. (3)

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III. Potential for Sabotage of Spent Fuel During Transportation

I would like to briefly discuss the sequence of actions that a hypothetical terrorist (or group of terrorists) would have to successfully complete in order to have any realistic chance of endangering the public health and safety by sabotaging a spent fuel shipment.

In general, malevolent acts against any type of objective may be broken down into four phases:

1. Decision to act
2. Preparation
3. The act itself

Each of these phases will be discussed in turn.

Decision to Act

A combination of factors will influence the decision to attempt the sabotage of spent fuel in transport. The factors include: motivation, attractiveness of the target, resources required, and risks involved.

1. Motivation - In the case of spent fuel transportation, motivation to sabotage would most probably be to discredit the utility or Federal government as a result of opposition to nuclear power, or to endanger public health and safety through a release of radioactive

material. Other motives, such as the reprocessing of spent fuel to obtain special nuclear material, must be ruled out as unrealistic. The two most likely motives may have many facets, for example a terrorist might desire to steal the spent fuel cask (with its spent fuel) and then to extort money or other concessions by threatening to open or breach the cask.

2. Attractiveness of the Target - In the context of motivation, our potential terrorist must assess the attractiveness of the target. If he wishes to discredit the utility or Federal government, perhaps spent fuel might seem attractive. (Acts which would only discredit the utility or Federal government will not be discussed further since they would pose no danger to the public health and safety.) However, if the motive were to be to injure or kill members of the local population, spent fuel would be much less attractive than other nuclear and non-nuclear targets.

3. Resources Required - A terrorist must assess the availability of the resources necessary to accomplish the sabotage of spent fuel during transportation, including:

- o Tools and equipment
- o Weapons and explosives
- o Communications
- o Finances
- o Transportation
- o Imagination and ingenuity

Terrorists will typically acquire whatever resources are believed necessary to accomplish their objective. In addition, sophisticated equipment can be obtained by terrorist organizations, although not without considerable difficulty. For spent fuel cask sabotage, our terrorists would need either an extremely large amount (several thousand pounds) of high explosive or fairly sophisticated shaped charges, in addition to routinely obtainable equipment such as weapons, automobiles, trucks, communications gear, etc.

4. Perceived Risk - The terrorist, before making a decision to proceed, must make his own "cost/benefit" analysis and answer the following questions. "After the expenditure of the needed resources, will I be able to achieve my objective?" and "What risks will I be taking?" In the case of spent fuel, clearly the required resources will be people, large amounts or very sophisticated explosives, and careful planning. The objective would be public harm. The risks would be injury or death, possible failure, capture and incarceration, and extreme hostile public reaction. Should our terrorist decide that the "cost/benefit" analysis was in his favor, he would then proceed to the second phase.

Preparation

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The sequence of events involved in preparing for the sabotage of a spent fuel shipment would be: recruiting and training, acquisition of resources, reconnaissance and intelligence, and security.

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1. Recruiting and training - Our terrorist must recruit the necessary personnel to carry out this act.* These individuals would either have to share the same dedication as their leader, would have to be indoctrinated with such dedication or would have to be paid, the latter considered to be extremely unlikely, in this case.

   In addition, the team must possess the necessary talents and skills to carry out the act. Recruiting and indoctrinating capable and reliable specialists, especially in terrorist activities, is a problem. Specialized training can be accomplished but it enlarges the scope of the operation, can endanger the team physically (e.g., weapons and explosives training), and increases significantly the chance of discovery.

2. Acquisition of Resources - It is possible for terrorists to acquire very powerful and sophisticated arms and equipment. However, these items must be obtained at considerable cost either in terms of dollars, if equipment is purchased (usually on the black market), or in terms of risk of discovery, capture, injury or death, if equipment is stolen (e.g., from military sources.)

3. Reconnaissance and Intelligence - For the operation to have any reasonable chance of success, it must be carefully planned with as much detailed information as possible on the cask, shipping plans, procedures, schedules and routes. The terrorist group may perform their

*It is my judgment that at least two and probably as many as five individuals would be required to attempt a spent fuel sabotage act.

own reconnaissance from direct observation of activities or may rely on information from an "insider," i.e., someone connected with the transportation activities in some way. The preferred method, of course, would be to have inside assistance, but this presents problems unless the insider was a member of the group beforehand or shares the same motives of the group. Otherwise, the terrorist must recruit the insider with the clear danger that the latter may report such advances to authorities. There are, of course, other ways of obtaining this inside information, but it is important to keep in mind that rarely does one individual, in any organization, have access to all the information on a large project or effort. Therefore, the usefulness of this inside information may not be sufficient to enhance the success of the operation.

4. Security - The terrorist group must maintain a considerable amount of secrecy to avoid detection prior to the operation. The group's internal security can be compromised during acquisition of resources, recruiting and training, reconnaissance and intelligence

gathering, or as a result of defection of a member of the group. The terrorist will try to keep his group size to the absolute minimum to enhance security, and he will try to execute his plan as quickly as possible.

In summarizing the preparation phase, the important point is that everything must occur as planned or the terrorist will usually not proceed with a "risk/benefit" balance that has changed against him. Especially significant is the very real possibility that his plans may be discovered and his actions thwarted.

The Act Itself

Our hypothetical terrorists, assuming all has gone well in their preparation and that nothing has deterred them from their mission, will now proceed to attempt to carry out the act itself. Of interest here are: tactics, possibility of failure or achievement of limited objectives, possibility of defeat.

1. Tactics - Study of terrorist activities shows that they are capable of very sophisticated operations, ranging from very elaborate schemes involving deceit and subterfuge to direct, violent attacks using surprise and brute force. Spent fuel sabotage scenarios are limitless, but in order to produce any significant danger to the public health and safety, the following elements would probably be present:

369 160

- Large amounts (thousands of pounds) or sophisticated (shaped charges) explosives

514 177

- o Cask breached in high-density population zone
- o Cask breached during favorable weather conditions
- o Prevention of short term mitigation actions to limit release

Recent studies,[2,4] indicate that a spent fuel shipping cask might realistically be breached only through (1) detonation of thousands of pounds of high explosive in very close proximity to the cask (in which case the air blast might cause the cask closure mechanism to fail, thus exposing some of the spent fuel elements), (2) precise employment of large amounts of high explosives in an attempt to disrupt cask integrity, or (3) the use of lesser amounts of high explosive fabricated into a shaped charge which could be used to blow a small hole completely through the cask with resultant damage to some fuel elements, and release of radioactive material. Use of any of these approaches would require significant expertise in application of explosives, especially for the shaped charge, and would expose the terrorist to considerable personal danger.

To achieve significant public consequences, the cask and fuel elements would have to be breached in a high-density population zone. This presents significant tactical problems to the terrorist since use of the massive attack will be very difficult while the cask is underway, and the shaped charge attack will not prevent the cask from being moved to a less populated location. In order to maximize the consequences, the terrorist must consider the weather. This means being continually prepared until the weather for the limited number of locations is adequate. Finally, unless the terrorist prevents short-term mitigation, e g., moving the cask to less densely populated area, plugging the holes in the cask, evacuation, etc., it is unlikely that significant consequences could be generated.

In summary, a potential terrorist will be faced with formidable difficulty in carrying out the required tactics to produce a release of dangerous radioactive material. That is, the operation required to accomplish the objective will require a high degree of dedication, planning, and sophistication. 389 162

2. Possibility of Failure or Achievement of Limited Objectives - The chance of failure due to human fallibility exists even without intervention by 514 179

authorities. This is particularly true for terrorist activities where the entire group typically has no previous experience in what they are doing. Examination and analysis of terrorist activities shows numerous examples of these types of failures. So in the case of spent fuel, even if an attempt at sabotage is made, there will be a significant chance of failure or that the operation will achieve only limited results, e.g., cask damage but no release of radioactive material.

3. Possibility of defeat - On top of all of the other problems facing our hypothetical terrorist, he must finally have to deal with the expected response from the utility and responsible authority. Drivers may not stop during a hijacking, response forces may engage and defeat the terrorist group before any cask damage is done, etc. The utility and state and local law enforcement agencies have significantly more depth and resources than even the most sophisticated terrorist group and the only way in which spent fuel sabotage can succeed is for everything to go perfectly well for the terrorist and nothing to work for the utility or authorities.

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IV. Summary and Conclusions

Terrorism, including the possibility of nuclear terrorism, is and should be of concern to us all. Clearly, there are activities in our society, including nuclear activities, that present opportunities for malevolent acts that could result in a danger to public health and safety: Commercial air travel, large gatherings of people, industrial operations involving hazardous materials, common sources of food and water, to name a few. While no reasonable individual can conclude that it is impossible for someone or some group to intentionally breach a spent fuel cask for the purpose of releasing dangerous radioactive material to the environment, the following observations are in order:

- The act of intentionally breaching a spent fuel cask for the purpose of endangering the public health and safety during transportation involves a sequence of actions which, individually and collectively, involve considerable danger to the perpetrator and whose outcome is very uncertain, due to the difficulty of the actions and the ability of company and/or law enforcement personnel to thwart these actions.

- Should the perpetrator be successful in breaching the cask, the consequences are also very uncertain. It is possible that no fuel would be damaged; it is also possible that fuel could be damaged and radioactive materials released. If the latter were to occur, the consequences to the public health and safety would depend on the degree of fuel damage, the amount of cask integrity damage, the environmental conditions, population density, length of exposure to the released material, mitigating actions of authorities, etc.

- The history of spent fuel (and other dangerous radioactive wastes) transportation in both commercial and defense nuclear programs is devoid of incidents that would suggest, even remotely, that spent fuel transportation presents a risk to the public health and safety due to possible sabotage.

In closing, it is my opinion that the transfer of spent fuel from Oconee station to McGuire station can be executed with negligible risk to public health and safety due to sabotage or other malevolent acts.

Dated: June 4, 1979

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REFERENCES

1. Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants, WASH-1238, U.A. AEC, December 1972.

2. Environmental Statement on The Transportation Of Radioactive Material by Air and Other Modes, U.S. Nuclear Regulatory Commission, Office of Standards Development, NUREG-0170, 1977.

3. "Safeguards Summary Event List (Pre-NRC through December 31, 1978," U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Division of Safeguards, December 31, 1978.

4. Generic Environmental Assessment on Transportation of Radioactive Materials Near or Through a Large Densely Populated Area, U.S. Nuclear Regulatory Commission/Sandia Laboratories, SAND 77-1927 (Interim Report), May 1978.

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514 183