Security Assessment Report for Plutonium Transport in France

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Executive Summary

Greenpeace International commissioned an independent assessment of the risk to the health and safety of the French public during the cross-country truck shipment of weapons-grade plutonium oxide (PuO_2) from the United States in October 2004. The security assessment reviewed the policies and practices of the international community in the transport of the weapons-grade nuclear materials. The risk of the movement of the nuclear materials to the health and safety of the public is based on long-accepted evaluation methodologies used in the security field.

The data used in the risk evaluation is based on Greenpeace data obtained during the actual movement of the PuO_2 from the la Hague plutonium facility to the Cadarache mixed oxide fuel (MOX) facility in southern France. The data consisted of video tapes, photographs and personal observations. Data was also obtained from public records of the International Atomic Energy Agency (IAEA), the United States Department of Energy (DOE), and the French government.

The data was assembled, evaluated, and compared with actual performance testing by the U.S. DOE in the transport of nuclear materials. The evaluation of risk was based on a conservative documented design basis threat (DBT) for terrorist attributes and characteristics.

The most glaring weakness in the shipment of the PuO2 in France is the fragile and soft nature of the shipping container and casks. The short time to access the nuclear materials in the transport casks provides an attractive sabotage target in the creation of a radiological dispersal device (RDD) for the entire 140 kilogram inventory of the PuO2.

Two scoping scenarios were developed to evaluate the risk: (1) the on-the-road movement of the convoy during its 24-hour journey; (2) the multiple stops of the convoy at public locations such as petrol stations. In either scenario the risk to the U.S. nuclear materials was "HIGH" despite relatively large numbers of security personnel assigned to the convoy.

After the draft report was prepared, the Greenpeace reviewers asked a supplemental question in regards to the security of frequent movement of domestic-use weapons-grade materials across France. The primary difference of domestic shipments is the size and configuration of the convoy's protective force. The domestic shipments are protected by at least five times fewer guards while the convoy may carry twice the inventory of plutonium as was carried in the U.S. transport. A simple comparative analysis of the U.S. shipment and the domestic shipments in France result in a new adjectival risk evaluation of "EXTREME" risk to the health and safety of the public in France for domestic shipments of attractive nuclear materials.

Introduction

In October 2004, the United States Department of Energy (DOE) shipped 140 kilograms (kg) of weapons grade plutonium oxide (PuO2) to France for fabrication of mixed oxide (MOX) fuel. This report is to consider and determine if undisclosed vulnerabilities existed in the transport of the PuO2 materials in France and what the risk was to the health and safety of the public.

Risk Model

The risk assessment methodology employed in this report is used to evaluate the protection effectiveness for loss prevention. The risk assessment methodology, developed for the U.S. Department of Energy, is used in the protection of nuclear weapons and other attractive nuclear materials. It has been selected because it employs a robust approach in the evaluation of risk.

In order to evaluate risk the following basic equation was used:

$$\mathbf{R = C * T * [1 - P(E)]}$$

where:

R represents risk to the security and safety of the publics health and welfare.

C represents “consequence of loss” for assets (characterized as people, places, and things).

T represents the threat. The threat is reported in a formal document called a design basis threat (DBT). The DBT describes generic types of adversaries, including terrorists, and their traits, tactics, and characteristics, and use of weapons of mass destruction. The current DBT used by DOE is classified as to the number of adversaries for each generic type.

P(E) represents protection effectiveness through the use of physical security-related hardware and personnel (detection, delay, response) as well as policies, practices, and training.

Typically, each of the terms of the equation is expressed as a normalized value between 0.0 and 1.0. The objective of a loss protection program, in this case the transport of PuO2 in France, is to maximize the P(E) and thus reduce the risk to the health and safety of the public. It should be recognized that risk cannot be reduced to 0.0 in any practical sense of the word. In the U.S. DOE there is a classified numerical criterion for risk, as well as an adjectival equivalent of “low, moderate, high,” where low risk is the objective for operational considerations in the protection of nuclear assets. Risk to nuclear assets is typically measured in 0.1 increments, and “low” risk is typically less than 0.1. Expressed another way, if an attack occurs it will be successful less than 10% of the time.

Assets

The asset considered in this report is 140 kg of weapons-grade plutonium oxide. Within the “consequence of loss” importance for the United States only a nuclear weapon is considered more important. A nuclear weapon has a normalized **“C”** value of 1.0, the maximum value of any societal asset in the U.S., the quantity of weapons grade PuO2 in the French shipment is 0.8. The form of the U.S. PuO2 transportation in France is considered a prime sabotage target, a radiological dispersal device (RDD), as opposed to a form that could be readily made into an improvised nuclear device (IND). The PuO2 would have a potential secondary value as a theft target.

The PuO2 could become a RDD in the hands of terrorists by merely releasing into the atmosphere from the transport vehicle. This report will not calculate the effect on the public of the exposure of the PuO2 if it is uplifted into the atmosphere. The report will not examine the mitigation programs and plans that the French government may have in place to address such an event. Any loss prevention program has a crisis management portion to it to mitigate an event should it not be prevented through the P(E) protection factor for risk.

Threat

The threat to important assets, such as weapons-grade PuO2, and other nuclear materials and nuclear weapons is described in a Design Basis Threat statement. The DBT for the

Department of Energy is classified. Since the formation of the Department of Homeland Security (DHS), it and other U.S. federal agencies responsible for the protection of infrastructure assets have also generated DBTs. The common denominator in all the federal threats today are the adversary types that make them up, and they are:

Terrorists,

Criminals,

Gangs,

Extremists,

Disgruntled employees, and

Psychotics.

Additionally, Presidential Directives in recent years have emphasized national concerns over the protection of critical infrastructure and the use of Weapons of Mass Destruction (WMD) to include large vehicle truck bombs.

Of all the types of adversaries the one of most concern is the terrorist because of their suicidal and homicidal traits, training, equipment, weapons and large number of combatants. Table 1 is an overview of the general capabilities of the various adversary types. Not included in this table is the number of participants in each group, but the terrorist group has always had the largest number of persons to include an insider that can obtain sensitive information.

In 2001, before the 9/11 attack in the U.S., the DOE had specified the number of terrorists it considered a size that reflected current intelligence. The security plans for DOE were prepared to protect attractive nuclear materials and weapons had a standard size DBT and this was used in the development of "vulnerability analyses" (VA). The VA was used to determine the value of protection effectiveness P(E) that in turn was used to calculate risk. Part of the assumptions used to calculate the value of risk was that the threat was considered real and likely, therefore the normalized value of "T" was set as 1.0. As noted before, the numerical value of risk was in turn used to determine adjectival expressions for risk of low, moderate, or high. High risk was considered unacceptable, and compensatory actions had to be instituted within 24 hours of the high risk determination

TABLE 1. DBT DESCRIPTION

						Traits		WMD					
								DBV	NCBR				Tools (NT, HT, PT, Expl.)
Adversary	**O**	**I**	**No.**	**Objective**	**Tactics**	**Homicidal**	**Suicidal**	**Size**	**Time**	**Skills**	**Transportation**	**Weapons**	
Terrorist				Terror, sabotage, theft	Force, deceit, and stealth	Yes	Yes	Yes	Yes	Sophisticated	Sophisticated	Sophisticated	Sophisticated
Criminal	3	1	4	Theft	Force, deceit, and stealth	Yes	No	No	No	Sophisticated	Basic	Basic	Sophisticated
Gang member	3	0	3	Theft, sabotage	Force, deceit, and stealth	Yes	No	No	No	Basic	Basic	Basic	Basic
Extremist	5	0	5	Theft, sabotage	Force, deceit, and stealth	No	No	No	No	Sophisticated	Basic	None	Basic
Psychotic	1	1	1	Theft, sabotage	Force, deceit, and stealth	Yes	Yes	No	No	Sophisticated	Sophisticated	Basic	Basic
Disgruntled employee	0	1	1	Theft, sabotage	Force, deceit, and stealth	No	No	No	No	Sophisticated	Basic	Basic	Basic
White-collar criminal	0	1	1	Theft, sabotage	Deceit, stealth	No	No	No	No	Sophisticated	Basic	None	None

Notes:
O = Number of potential outsiders
I = Number of potential insiders
No. = Total final number of O and I used in DBT
WMD = Weapon of mass destruction
DBV = Vehicle bomb with about 60,000 pounds of TNT
NCBR = Nuclear, biological, chemical, and radiological
NT = No tools
HT = Hand tools
PT = Power tools
Expl. = Explosives

Source: U.S. Department of Homeland Security, federal, state, and local incident records.

to reduce the risk. For example, nuclear materials were taken from production or manufacturing processes and placed in hardened storage 24 hours a day until other corrective action were taken to reduce risk to "low." In other words, high risk was unacceptable in an operating mode.

In May of 2003, as a result of the World Trade Center attack, DOE revised its number of terrorist attackers upward. In November 2004, it revised them upward once again to their current size. The current size of the terrorist force is no longer a simple extrapolation of 2001 to 2003 to 2004. This report will deal with the current size of the terrorists groups in a qualitative manner rather than quantitative as it determines risk to the shipments of the PuO2 in France. It should also be noted that the number of terrorists in the DOE Design Basis Threat is used for the continental U.S. The threat for U.S. assets, such as weapons-grade nuclear materials, outside the continental U.S. is larger. Terrorist incidents in continental Europe since 9/11 are ample evidence to support this premise.

Table 2 is a description of the attributes of a "typical" terrorist group used in federal guidelines. DOE designated the insider as "passive" if they were in a human reliability program that included polygraph testing. Table 3 is an example of the types of armament that a terrorist group might use in a preemptive assault against a well guarded asset such as the nuclear materials in the convoy analyzed in this report. It should be noted that the adversary capability list does not include crew-served weapons that would most likely be used with the 2004 DBT nor the significant increase in the number of terrorists that could be used in an attack.

Table 2. Terrorist Description

TERRORISTS - Persons or groups who unlawfully use force or violence against persons or property to intimidate or coerce a government or the civilian population to further political or social objectives	classified
Outsiders	classified
Insiders – active or passive acting in collusion with outsiders (authorized access to facilities and information)	classified
Traits -	
Homicidal	Yes
Suicidal	Yes
Objectives	Terror, theft, sabotage
Tactics	Force, deceit, stealth
Weapons of Mass Destruction	
Design Basis Vehicle – Semi trailer with about 60,000 pounds of TNT	Very likely
Chemical (nerve and blood agents, fast-acting in about 60 seconds)	Likely
Biological (water, other)	Not likely
Nuclear weapon	Not very likely
Radiological dispersal device	Not very likely
Skills	
Well trained, well equipped – communications, night vision, etc.	Yes
Transportation – Sophisticated	
Ground	Yes
Airborne – armed helicopter, fixed-wing multi-engine	Yes
Weapons	
Side arms, MP-5, 7.62 rifles, 300 hundred rounds of ammunition, shoulder-fired sniper rifles up to 50 caliber with API, M-60 machine guns, rocket propelled grenade, light antitank weapon	Yes
Mines, 65 pound bulk charges, grenades	Yes
Tools	
Hand tools	Yes
Power tools and burn bars	Yes
Explosives – shape and platter charges, bulk explosives, personnel	Yes

Table 3. Adversary Armament

Hand Guns
Revolvers
Automatic, 9-millimeter
Machine pistols, MP-5, 9millimeter
Shoulder-fired Guns
AR-15, M-16 (.223)
M-308, 7.62 sniper rifle
M-203, M-16 with 20 millimeter grenade launcher
Squad automatic weapon M-16, 500-round drum
50 caliber sniper rifle with armor-piercing incendiary, 20 rounds
Shot gun
Machine Guns
M-60, 7.62 sniper rifle
Shoulder-Fired Explosives
Rocket propelled grenade, 20 millimeter
Light anti-tank weapon, AT4 or equivalent
Weapons of Mass Destruction
Tactical Chemical Weapons
Nerve agent, mustard gas, chlorine, phosphine, and phosgene
Biological Weapons
Anthrax, small pox virus
Radiological dispersal device
Explosives
Shape charges (about10 pounds)
Platter Charges (about 40 pounds)
Bulk explosives (about 65 pounds)
Improvised devices, including pipe bombs
Claymore mines
Fragmentation grenades, smoke grenades, flash-bangs
Design Basis Vehicle
Compact car, 220 pounds
Sedan, 500 pounds
Passenger van, 1,000 pounds
Box van, 4,000 pounds
Semi trailer truck, 60,000 pounds

Protection Effectiveness

The final expression in the risk equation is P(E), or protection effectiveness. Protection effectiveness is made up of three fundamental elements of hardware and manpower:

1. detection
2. delay, and
3. response

For fixed sites used to protect attractive nuclear materials, the three elements P(E) elements are applied in concentric layers of protection with varying degrees of effectiveness at each layer that taken together form a layered and graded security system. The hardware and manpower is supplemented by software, policies, procedures, and training to ensure their full effectiveness. A P(E) expression for a fixed site would consist of:

$$
\begin{aligned}
P(E) \simeq\ & \text{function (detection, delay, response) layer 1} + \\
& \text{function (detection, delay, response) layer 2} + \\
& \text{function (detection, delay, response) layer 3.}
\end{aligned}
$$

This expression is evaluated for: daytime (normal operations), and nighttime (closed operations). The worst case or lowest value of P(E) would be used to calculate risk, in an optimized configuration daytime equals nighttime though their respective configurations would be achieved in different manners. For transportation applications the P(E) equation only has a single layer, making it more fragile to single point failures or vulnerabilities than a fixed site.

$$\text{Transport } P(E) \simeq \text{function (detection, delay, response)}$$

For this report we will examine the protection effectiveness used to protect the PuO2 in the U.S. and France for a comparative analysis. In DOE's license application to the U.S. Nuclear Regulatory Commission for the shipment and transport of the PuO2 in October 2004, DOE stated "The French Government would determine the physical protection measures to be implemented while the material is in France…[1] In the same document it

[1] CLI-04-17, docketed 6/15/04. p.3.

also stated that "DOE emphasizes that the measures used by France will be comparable to the measures in the U.S. to transport… this type of radiological materials."[2]

Detection

Detection is the ability to sense an unauthorized intrusion and to assess it in a timely manner. This factor is referred to as P(D). For a convoy, both the sensing and assessment of an unauthorized intrusion is performed by the protective force members in the truck and the convoy with a view of the truck. This would be the case in the U.S. and in France. A hardened transport communications center is in direct communication with the convoy for remote detection of an attack and the dispatch of backup forces.

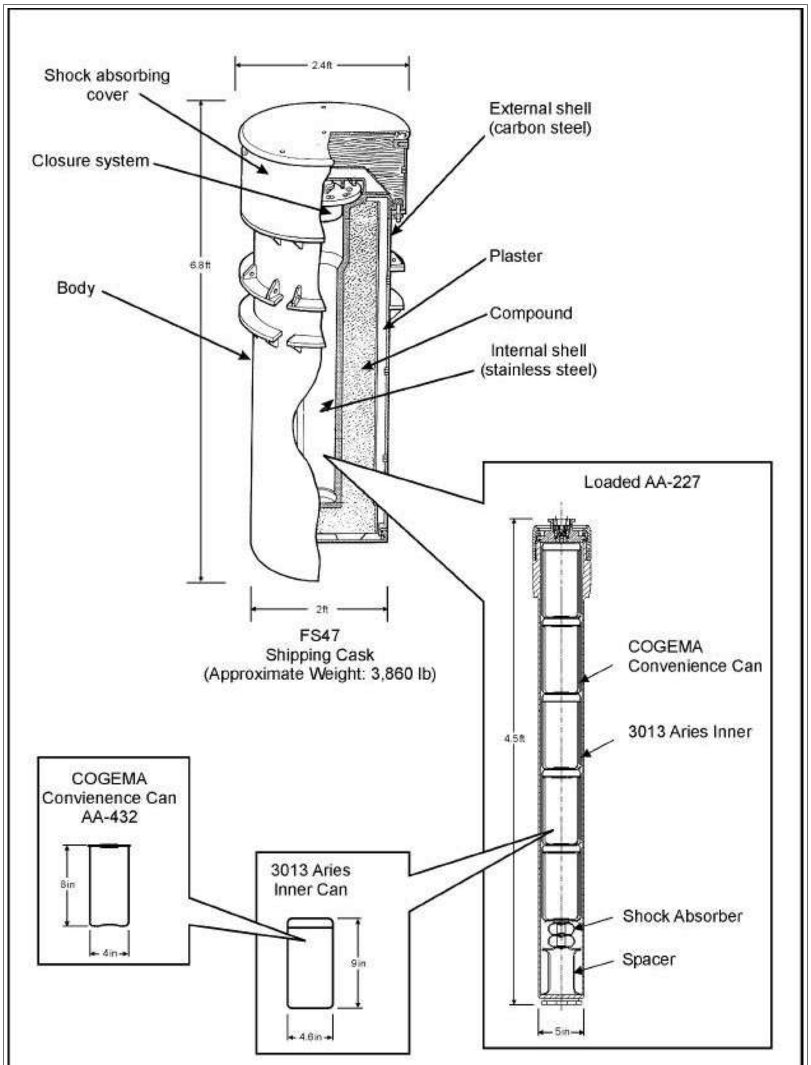
Delay

Delay is the time that an engineered barrier system will slow an adversary in the unauthorized penetration of a layer used to protect an asset after they have been detected. The time is not linear against adversary breaching methods using hand tools, power tools, or explosives. In the case of the transport of the PuO2 in the U.S. and France the nuclear materials are contained in FS 47 shipping casks in a transport trailer. This configuration is basically a single-ayer barrier system since the cask was designed for accident and safety criteria and not for security. The delay for the cask and the trailer will be examined in turn.

[2] p.4.

FS 47 Shipping Casks

The FS 47 cask consists of concentric steel cylinders separated with a mixture of plaster and boron compound. Radial copper blades linking a copper cylinder is inserted in the plaster mixture. See Figure 1 for a diagram of the FS 47 cask and PuO2 oxide cans carried inside it. Photo 1 shows up to 10 FS 47 containers in a transport trailer carrying rack. These casks were designed for normal transport and accident situations in terms of safety for radiological consequences to the health and safety of the public and the pollution of the environment. The casks were not designed for malevolent attacks.



Source: Duke Cogema Stone & Webster 2002-2003

Figure 1. Cross Section of FS 47 Cask

Photo 1: FS 47 containers in transport carrying rack

To address the security provided by the shipping casks, a paper was recently prepared by the IRSN "Institut de Radioprotection et de Surete Nucleaire"[3] to assess the behavior of shipping casks attacked by malevolent acts. In particular, the paper examined two methods of attack on the FS 47 using explosives to release the PuO2 powder. The two methods for breaching the casks were:

1. The FS 47 Cask Loaded by the Detonation of a Great Amount of Explosive
2. FS 47 Hit by a Conical Shaped Charge.

The purpose of the IRSN paper was to provide a method to limit the cost of empirical methods of testing by supplementing them with mathematical models. In fact, the methods of the attack in the paper do not represent a worst case scenario of a terrorist attack. In a terrorist attack (with their suicidal traits) their intent is to create a RDD with the maximum dispersal of the most amounts of nuclear materials. For example, the terrorists would like to gain hands on access to the casks to remove cylinders containing

[3] The French Approach Concerning the Protection of Shipping Casks Against Terrorism.

the PuO2 powder, and as an act of sabotage, to disperse it at the point of attack regardless of the consequence to themselves. The total delay to access the cylinders in each shipping cask is estimated to be minutes per cask using a variety or combination of hand tools, power tools, and explosives. A terrorist attack would not use the methods described in the IRSN report because of the low probability of success that was described in the IRSN report.

Transport Trailers

The transport of the FS 47 casks in the U.S. and France is markedly different from one another. In the U.S., three FS 47 casks are carried in each of three high security transport trailers (SST or SGT) and in France nine casks are carried in a single ISO container mounted to a reinforced heavy duty trailer. See Photos 2 and 3.

Photo 2: French plutonium transport truck

Photo 3: French plutonium transport trailer without ISO container

The U.S. SST and SGT trailers are specially designed to provide robust delay against terrorist attack. It is estimated that the engineered delay time to gain hands on access to nuclear materials being transported in shipping casks in the trailer is 30 minutes or more. These trailers are designed with a quick release mechanism that permits the hardened tractor and its occupants to separate from the trailer. This permits the tractor occupants the ability to escape an attack on the trailer and to dismount and redeploy away from the point of attack. The trailer has axle locking devices that prohibit it being driven away from the point of attack.

The ISO container used in France has few security features and the delay to breach and gain access to the FS 47 casks is estimated to be not more than tens of seconds using hand tools, power tools and/or explosives.

The transport delay against the terrorist attack and access to the inventory of PuO2 in the U.S. and France is dramatically different from one another.

Response

The final factor in protection effectiveness for the transport of the weapons grade nuclear materials is the armed personnel in the convoy. Their neutralization effectiveness, referred to as P(N) can be characterized by four key factors:

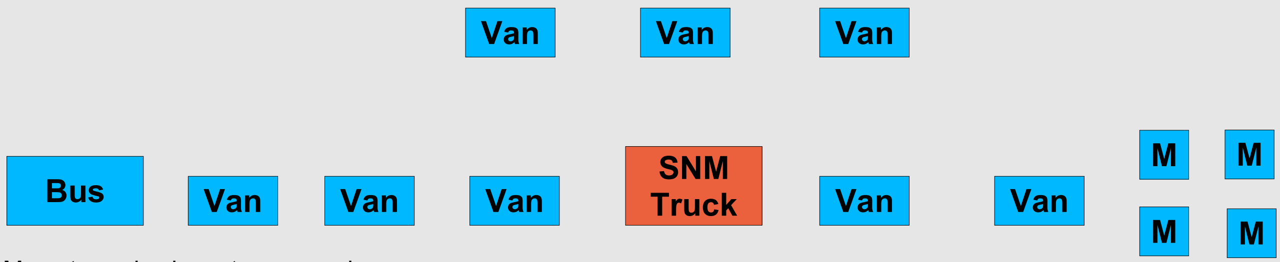
1. **tactics** to defend the convoy
2. **numbers** of personnel to protect the convoy
3. **armament** of the protective force
4. **training** to protect the convoy

The author has direct experience in convoy neutralization protection effectiveness testing by specially trained convoy couriers in the U.S. with the pre-9/11 threat. The experience was gained as part of the simulated terrorist team comprised of U.S. Army Special Forces personnel, as well as a controller in force-on-force testing. This experience will be used in the later section on scenarios used to evaluate the P(E) term for the convoy in France. It should also be noted that the scenario development and evaluation will consider the DBT as of November 2004.

Figures 2 and 3 are a diagram of the October convoy in transit in France. Figure 2 is the main convoy with the truck carrying the weapons grade PuO2. Figure 3 is the support convoy that could provide rapid response in the event of an attack on the main convoy. The support convoy may travel up to a few kilometers from the main convoy and likely consists of 60 to 80 armed personnel. The convoy was in transit 26 hours and varied in configuration in the metro areas and in the countryside. It appears that the metro configuration of the main convoy was supplemented with traffic control personnel, such as motorcycle officers. The countryside convoy had fewer personnel.

Figure 4 is a general routing of the convoy in transit to Cadarache from the French plutonium facility at la Hague.

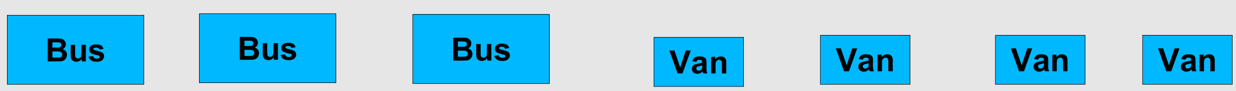
Figure 2: Main Convoy with PuO2



M: motorcycles in metro area only
SNM: Special Nuclear Material (i.e. Plutonium)

Source: see Video 2 at:
http://www.greenpeace.fr/stop-plutonium/en/20041001_en.php3

Figure 3: Support Convoy



Note: May function as a rapid response convoy

Ref: Greenpeace Video 593

Worst Case Scenarios

In conducting vulnerability analysis to evaluate the protection-effectiveness to manage risk there are a variety of attack methods the terrorists could use to achieve their goals. To limit the scope of analysis it is desirable to develop those scenarios which are deemed credible and that have a high degree of success from the terrorists' point of view. It is unlikely that a terrorist group will expend it resources on an attack that has a low probability of success. In interviews with the U.S. Special Forces personnel who have assumed the role of terrorists in training exercise, it was their observation that they had to assume the terrorist role for some time before they began to think like a terrorist. Lessons they learned included suicidal traits, violence of action, concentration of forces, and superior fire power. A cursory review of the terrorists' potential weapon set in Table 3 would seem to indicate the ability to mount superior fire power especially when it is coupled with a concentration of a large force in pre-staged positions.

A convoy can be intercepted and attacked in while it is in two possible configurations:

1. in transit on the highway at various speeds
2. rest stop, refueling, etc.

This report will examine each configuration in light of recent experience in testing with transport of nuclear materials in the U.S. by the Department of Energy.

Figure 4. Plutonium convoy route map

U.S. Protection Factors, P(E)			French Protection Factors, P(E)		
Detection, P(D)	Delay SST/SGT	Response, P (N)	Detection, P (D)	Delay ISO container	Response, P(N)
1.0	≃ 30 minutes	3:1 ratio	1.0	seconds	~ 3:1 ratio

Table 4. P(E) Convoy Comparison

Convoy in Transit.

The P(E) comparison of the convoys in the U.S and France are shown in Table 4. The calculation of P(E) is P(D) x P(N). Delay is a component part of the P(N) value. With little or no delay the stress on the protective force to execute their protection mission is such that testing has shown a very low success rate in their ability to neutralize the terrorists and protect the asset. Time is an important function both for the terrorists and the protective force. **Time on target is a significant factor in determining success or failure.**

When the DOE tested the configuration of its convoy in transit they found that it failed to protect the materials over 50% of the time with the 30 minutes of delay. In other words, the P(N) was less than 0.5. The attacks were initiated by pre-staged terrorists with superior fire power. Typically, the tractor/trailer was stopped with shoulder fired light anti-tank weapons (AT4), or their equivalent. Other escorts in close proximity to the tractor/trailer were also stopped with using an AT4. In most cases the occupants of the vehicles were killed. The adversary used such weapons as 50 cal sniper rifles with amour-piercing incendiary rounds to kill occupants of other vehicles before they could dismount. Even with a three to one ratio (3:1) ratio in favor of the protective force to terrorists, the terrorists killed all the convoy personnel in a matter of minutes. The few surviving convoy escorts who remained alive chose not to engage the terrorists, leaving the tractor/trailer assets vulnerable to the long penetrations times by the terrorists. It should be noted that a convoy's escorting protective force in the U.S. is specially trained to the highest degree available to the U.S. DOE for offensive tactics that are necessary for the protection of nuclear materials convoys.

The attack methods used in the simulations and the force on force exercises in the U.S. were very basic in their content. Sophisticated means of attack, such as the use of helicopters with armament or chemical weapons were not used; both are within the threat capabilities of the terrorists.

The shipment in France had no security delay features for the trailer or the casks; therefore the entire burden for protection or recapture of the PuO2 before it could be dispersed at the attack point was left to the main convoy forces and the rapid response of the support convoy forces. As noted earlier the main convoy in France was closely spaced leaving open to question the tactics and vulnerability to the concentrated attack of the terrorists that would stop the convoy and kill as many escorts as they could before they could dismount. The support convoy was also closely spaced. If the coaches in the rapid response convoys were destroyed through the use of shoulder fired anti-vehicle weapons the vast majority of the rapid response force would be neutralized or killed before they could dismount, much less link up with the main convoy. The separation of the main convoy from the support convoy was one of the weaknesses exploited in the DOE testing. The concentration of escort personnel in the buses would make them particularly susceptible to concentrated fire power.

The 50% failure rate of the tested convoys in the U.S. was against the pre-9/11 DBT. As noted earlier, the DBT today on in October of 2004 for both the U.S. and France is many times larger than that used previously in testing.

Convoy at Rest.

Convoys in the U.S. and France stop for refueling and rest periodically, typically every 3 to 4 hours. The time for the convoy to move from Cherbourg to Cadarache was 26 hours with multiple stops at commercial locations. The stops at commercial rest locations were occupied by civilian personnel and vehicles to include trucks and cars. The comparison of Protection Factors for a convoy at rest in the U.S. and France are the same as those described in Table 1.

The failure rates of testing results in the U.S. for rest stops were also greater than 50%. In fact the, the failure rates at rest stops were greater than a convoy in transit because the pre-staging of remote-controlled explosives during the attack is more effective against the large concentrations of protective force personnel.

Risk

As described earlier risk to the shipment of storage of weapons grade nuclear materials can be expressed in the equation:

$$R\uparrow = C * T * [1 - P(E)\downarrow]$$

The P(E) factor is less than 0.5.

P(E) for the convoy in France in transit or rest is low due to two key factors:

1. The lack of robust delay protecting the PuO2 in the trailer, and
2. The low effectiveness of the response in the convoy protective force.

Therefore, the risk to the U.S. weapons grade plutonium in transit in France is high, which is unacceptable from a societal point of view, particularly when viewed within the context of DOE Orders and International Atomic Energy Agency (IAEA) objectives and principles[4].

Conclusion

From a risk management point of view it is difficult to understand why this shipment of nuclear grade plutonium was made to France in the first place. Ostensibly it was made to "confirm that the MOX fuel performs as expected in a nuclear power plant"[5] Yet both the U.S. and Russia are currently designing plants using French technology to be fabricated in the respective countries based on a proven technology. Regardless of the reason, the basic review of the security elements used on the French portion of the shipment did not meet U.S. Standards. **Thus, the shipment of PuO2 made in France in October 2004 was at high risk.**

[4] INFCIRC/225/Rev4.

[5] License application p.2.

Addendum

The principal objective of this report was to determine the risk to the U.S. weapons grade PuO2 shipped across France; other similar shipments of attractive nuclear materials in France are subject to the same risk criteria. Today there are multiple transfers of PuO2 from La Hague to the Marcoule plutonium fabrication facility each month. They are transported in FS 47 casks in ISO containers. The convoy for these shipments consists of one or two trailer trucks with only two to three vans in the convoy. The total protection force to protect the PuO2 equivalent to or greater than the U.S. shipment, including drivers, is less than a dozen. Photo 4 is a recent picture of a single truck PuO2 convoy at a rest stop. A noticeable difference in the "normal" U.S. nuclear materials convoy is the size of the protective force in the convoy. In these shipments only a lead van and a trail van accompany the convoy, along with the personnel in the tractor/trailer. Sometime there are multiple tractor/trailers in this simple convoy configuration. Based on the risk and protection effectiveness evaluated for the U.S. shipment, it can be determined by comparative analysis, or simply inspection, that the risk to these shipments is greater than the high risk to the U.S. PuO2. Even with a pre-2004 design basis threat, these convoys would be at high risk. Since no adjectival rating greater than "high" for risk is commonly used we would have to propose one for the French convoys that move the materials in the everyday convoys addressed in this addenda and that would be "EXTREME."

Table 5 is a comparison of the risk to shipments of nuclear materials in the U.S. and in France. It should be noted that the shipments in the U.S. have been tested in a variety of manners to include table-top models, computer simulations, and force-on-force testing. Therefore, the comparative analyses for nuclear materials shipments in France are straight forward and direct.

Table 5. COMPARISON OF PROTECTION FACTORS AND RISK FOR NUCLEAR MATERIALS SHIPMENTS IN FRANCE

U.S. Protection Factors, P(E)			French Protection Factors for U.S. Shipments, P(E)			French Protection Factors for French Shipments, P(E)		
Detection, P (D)	Delay, SST/SGT	Response, P (N), 3:1 ratio	Detection, P (D)	Delay, ISO Container	Response, P (N), ~3:1 ratio	Detection, P (D)	Delay, ISO Container	Response, P (N), <<3:1 ratio
1.0	~30 minutes	~0.5	1.0	seconds	~0.5	1.0	seconds	~0.1
Risk	HIGH		Risk	HIGH		Risk	EXTREME	

The simple adjectival rating used above does not adequately describe the risk of the PuO2 shipment to the health and safety of the public in France. The nuclear inventory of a two-trailer van that is subject to a radiological dispersal device or theft of the materials to be used against other targets is of grave concern. The protection afforded these "every day" shipments is virtually non-existent. The protective force in the convoy is at best useful for accident conditions and would have no effect against a pre-emptive attack by even a small group of terrorists, estimated to be as few as three! It is not clear what mission the convoy members have, or their training, or even their weaponry, but a simple review of the photo shows no level of alert or preparation to address an attack. They basically would have no effectiveness. When the "zero" value of P(N) is coupled with almost no delay the P(E) for protection of the PuO2 approaches or is effectively "zero." It is not clear exactly what the French government is considering as a risk management program when routinely shipping this materials but clearly the implications of loss is an IAEA issue as well as an EU issue since either a RDD or theft of the nuclear materials has significant international implications.

Photo 4: Plutonium truck at public parking place in France, February 2005

Greenpeace

RONALD E. TIMM, CPP
SENIOR SECURITY ANALYST

EDUCATION/TRAINING

M.S., Electrical Engineering, University of Colorado, 1969
B.S., Engineering, Bradley University, 1964
Instructor for U.S. Department of Energy Central Training Academy for Advanced Vulnerability Assessments - ALPHA™

CERTIFICATION/REGISTRATION

Certified Protection Professional (CPP) American Society of Industrial Security International

RELEVANT EXPERIENCE

Risk and Security Assessment for Nuclear Waste Shipments. 1Mr. Timm reviewed and commented on existing security procedures and plans and made recommendations for security enhancements to address shipments of nuclear waste through the Panama Canal. Areas reviewed included treaties, codes and regulations, IAEA oversight, existing safety and security procedures, and the current status of security measures and staff.

DOE High-Threat Security Engineering. For DOE, Mr. Timm managed security system engineering, vulnerability analyses, system evaluation and design projects, and other special studies involving such security measures as interior and exterior intrusion detection systems, CCTV, lighting, barriers, alarm and video processing, access control, and force protection facility design. The projects centered around protection of special nuclear material storage, processing, and manufacturing operations as well as management of DOE-operated nuclear reactors and nuclear material and waste transportation.

Review of Security Plans for DOE Facilities Nationwide. For 5 years, Mr. Timm served as the senior analyst for review of DOE site safeguards and security plans. He reviewed protection programs and performed security and risk analyses for each of the 11 major DOE facilities in the United States. As part of this project, Mr. Timm prepared the definitive report that resulted in major security changes at the Rocky Flats facility in Colorado. He provided technical assessments to the DOE Secretary of Energy.

Security Consulting to Nuclear Utilities. Mr. Timm provided consulting services to several commercial nuclear utility companies. He helped these nuclear facilities address NRC considerations of expanded threat, including the design basis vehicle explosive and the proposed engineering solutions to reduce the risk.

Army Intrusion Detection System Designs. Mr. Timm upgraded perimeter intrusion detection systems at six Army chemical surety areas. He conducted comprehensive security surveys, developed concepts, provided final design and analysis services, and performed construction inspection. He co-authored TM-5-853-4 for Security Engineering of Electronic Security Systems.

Special Security Technology Application Studies. Mr. Timm led the effort to initiate deployment of state-of-the-art components and subsystems for high-threat security physical protection systems at DoD and DOE facilities. These technology applications included the first use of ported cable sensors by DOE, the Army's first use of solid-state CCTV, the early use of biometric personnel devices, and the development of physical protection systems that were the first to be rated as "superior" by DOE.