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Uzbekistan Radiation Portal Monnitoring System

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Uzbekistan Radiation Portal Monitoring System

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ABSTRACT
The work proposed in this presentation builds on the foundation set by the DTRA funded demonstration project begun in 2000 and completed in December of 2003. This previous work consisted of two phases whose overall objective was to install portal radiation monitors at four select ports-of-entry in Uzbekistan (Tashkent International Airport, Gisht-Kuprik (Kazakhstan border), Alat (Turkmenistan border), and Termez (Afghanistan border) in order to demonstrate their effectiveness in preventing the illicit trafficking of nuclear materials. The objectives also included developing and demonstrating capabilities in the design, installation, operation, training, and maintenance of a radiation portal monitoring system. The system and demonstration project has proved successful in many ways. An effective working relationship among the Uzbekistan Customs Services, Uzbekistan Border Guards, and Uzbekistan Institute of Nuclear Physics has been developed. There has been unprecedented openness with the sharing of portal monitor data with Lawrence Livermore National Laboratory. The system has proved to be effective, with detection of illicit trafficking, and, at Alat, an arrest of three persons illegally transporting radioactive materials into Turkmenistan. The demonstration project has made Uzbekistan a model nonproliferation state in Central Asia and, with an expanded program, places them in a position to seal a likely transit route for illicit nuclear materials. These results will be described. In addition, this work is currently being expanded to include additional ports-of-entry in Uzbekistan. The process for deciding on which additional ports-of-entry to equip will also be described.

INTRODUCTION
Central Asia is a historic center for transport of freight of high commercial value. Currently, illicit trafficking through Central Asia includes drugs from Afghanistan and Pakistan and nuclear materials from points north to points south; these two trades are likely connected. Uzbekistan (UZ) is one nexus for this trade. By identifying likely sources and users of nuclear material, it is possible to estimate trade routes and develop a prioritized list of ports-of-entry (POE) to intercept nuclear materials.

The former Soviet nuclear complex in Russia remains as the greatest potential source for illicit nuclear materials. There are eight (8) major nuclear sites in the Moscow vicinity and seven (7) in the Chelyabinsk region, making these the two most likely origins of illicit nuclear material. Potential users of illicit nuclear materials include states, like Iran, and sub-state groups. Users of highly enriched uranium and plutonium are most probably limited to states because of the degree of sophistication and technical infrastructure required to develop weapons with it. Other nuclear and radioactive materials could be used by a variety of organizations in radioactive dispersal devices, a relatively low technology weapon.

Interception of illicit nuclear and radioactive material in Central Asia states demonstrate that it is a smuggling route; several of these interceptions were via the current radiation detection monitoring system in UZ. The supply-demand geography implies a general north-to-south flow of material. Railroads are very high priority smuggling routes. Railroads account for about 70% of the legitimate trade; there is also a significant record of drug-related arrests using rail. The two major north-south rail routes in UZ are Keles-Khodjidavlet and Karakalpakia-Khodjidavlet. Drug trafficking, likely smuggling routes, POE traffic volume, and trade volumes indicate that the Kazakhstan-UZ highway POE is high priority.

Figure 1. Location of international ports-of-entry in Uzbekistan.

An indirect measure of vehicle traffic through UZ POE is highway traffic in Uzbekistan on roads leading to the POE (Table 1). These data are in a UN database and reported from an official non-customs service source. A qualitative independent assessment of both rail and highway traffic volumes can be obtained from trade data (Table 2). Excluding trade with Central Asia, 65% of the total trade comes from either Russia or Europe; this rises to 76% with the inclusion of Kazakhstan. This north-south trade suggests that the Uzbekistan-Kazakhstan POE should have the greatest freight traffic. The Central Asia trade data shows that total trade volume is greatest with Kazakhstan followed by Tajikistan, Turkmenistan, and Kyrgyzstan. This again suggests that the Uzbekistan-Kazakhstan POE should have the greatest traffic volume for traded goods.

Port-of-Entry	UZ Customs, 2004				UNESCAP, 2002b	
	Undated	2001	2002	2003	UZ	Border State
Alat		15,900.	18,700.	25,898.	5,191.	
Andarkhon	12,250.					
Arnasai	71,750.					
Avangard	5,250.					
Ayritom		0.	900.	18,838.	272.	
Daut-Ata		9,100.	7,100.	11,317.		
Dustlik	36,750.	24,572.	15,725.	8,419.	8,503.	554. (KG)
Gisht-Kuprik		7,300.	5,800.	30,421.	5,468.	6,742. (KZ)
Gulbakhor		216.	35.	45.		
Jar-Tepa	18,550.					
Kara-Kamar		263.	219.	61.		
Khanabad		8,940.	9,439.	0.		
Keskanyor		1,014.	2,270.	0.		
Madanyat		4,268.	4,002.	4,341.		
Navoi	21,000.	12,300.	11,400.	39,265.		
Oybek	19,250.	4,700.	5,200.	17,007.	6,227.	
Sary-Assia	8,400.	3,000	5,200.	12,473.	1,544.	3,388. (TI)
Shavat	3,500.					
Uch-Kurgan	57,750.					
Yallama	26,250.	700.	900.	12,709.		
Total	**280,700.**	**92,273.**	**86,890.**	**180,794.**		

Table 1: Annual Two-Way Vehicle Traffic at International Ports-of-Entry

Trading Partner	Export	Import	Total
Russia	311.	499.	801.
Central Asia	288.	391.	679.
Kazakhstan	**79.**	**178.**	**257.**
Tajikistan	**120.**	**80.**	**200.**
Turkmenistan	**34.**	**102.**	**136.**
Kyrgyzstan	**55.**	**31.**	**86.**
Europe*	268	141.	409.
Ukraine	193.	150.	343.
Korea	88.	207.	295.
North America	79.	154.	233.
China	25.	116.	141.
Other Asian States	66.	9.	75.
India & Pakistan	16.	20.	36.
Middle East	3.	22.	25.
Caucasus	14.	5.	19.
Africa	5.	—	5.
South & Central America	4.	—	4.

Table 2. Rank Order of Trade Among Uzbekistan and Trading Partners in $US M

PREVIOUS SMUGGLING

From the global perspective, Central Asia has been about transit – moving objects of commercial value from outside the region through Central Asia to distant commercial centers. From the possible origin of the wheel, through the Silk Road, to the current illicit shipments of nuclear material, drugs, and arms, to the future transport of petroleum to the world market, Central Asia has remained a nexus of transport. Transport of legitimate commercial goods is commonly accompanied by smuggling. Central Asia lies between sources of nuclear and radioactive materials in Russia and potential customers in Iran and Pakistan. It also lies between sources of opiates (primarily Afghanistan) and buyers in Russia and Europe. These latter bear special importance because they point to border locations that have been compromised and it is the compromise that is most critical and not necessarily the material being smuggled. For example, on 03/30/2000, Uzbeki customs officials seized an Iranian-registered, Iranian-driven truck and a load of scrap metal heading from Kazakhstan to Pakistan (and presumably on to Iran) when the load set off radiation detectors. The seizure occurred about 20km from Tashkent. Kasakhstani customs had cleared the truck and issued a certificate saying it had passed radiation screening, and later admitted that the radioactive cargo had been mistakenly allowed to cross over the border into Uzbekistan. Official notification to the IAEA was made by Kazakhstan. Available press reports, although often sensationalistic, appear to indicate that there was no intention to transport radioactive materials: the radioactive contamination was likely due to poor release procedures at the original source. On 06/29/2000, Kazakhstan officials seized 4 kg of 3.6% enriched LEU in Almaty. According to press information the suspects had expected to sell the LEU pellets for 100,000 dollars. The material was due to be taken to Afghanistan and then later transferred to Iran. The suspects are described as a citizen of Uzbekistan, assisted by two local residents.

INITIAL WORK

Since 2000, the Uzbekistan Customs Services, Uzbekistan Border Guards, and Uzbekistan Institute of Nuclear Physics has worked with Lawrence Livermore National Laboratory on a DoD funded project to install radiation portal monitors as a demonstration project at high priority ports-of-entry. This included installing pedestrian and vehicle monitors at Gisht-Kuprik on the border with Kazakhstan, vehicle monitors at Alat on the border with Turkmenistan and at Termiz on the border with Afghanistan, and pedestrian monitors at the Tashkent International Airport. A representative schematic based on Alat is shown in Figure 2, with Figure 3 depicting the overall installation . The central concept of this system is to increase the risk to smugglers. Smugglers will be most influenced by the risks they face, rather than the costs of smuggling, as the price per mass of the material is very high, and obtaining it is very difficult.

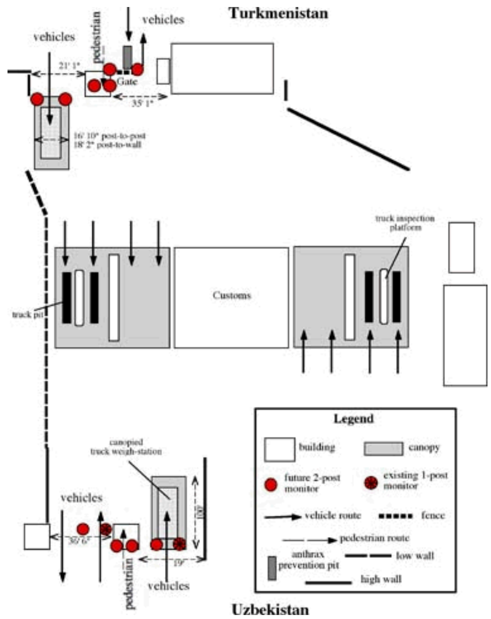

Figure 2. Schematic of portal monitor installation at Alat.


Figure 3. Alat POE showing the vehicle entry/exit on the left and the truck entry weight station on the right. The photograph is taken looking towards Uzbekistan.

DESIGN REQUIREMENTS

Numerous specifications were placed on the commercially available portal monitoring equipment. Pedestrian, vehicle, and rail monitors were specified depending on the POE. Enclosure(s) shall be provided for outdoor assemblies and shall be designed so monitors will not deteriorate during a period of five years under field conditions. The detection assemblies for road and rail vehicle monitoring may be subjected to vibration due to the weight of vehicles being monitored. Mounting techniques (i.e. concrete pads) which are not described here shall be designed to prevent normal vibrations and shocks of vehicle traffic from interfering with the operation of the detection system. Controls and adjustments which affect calibration and alarm settings shall be designed so that access to them is limited to authorized persons. Provisions shall be made to permit testing of visual or sound warning indicators. The monitoring system shall:

- be equipped with the occupancy sensor, which determines the presence of the object inside the portal monitor;
- have the ability to communicate signals from each detector or detection assembly and the occupancy sensor to a remote computer;

- be equipped with a high-resolution surveillance camera which constantly monitors the traffic going through the portal monitors. The live feed from the camera must be transmitted to the remote station. In an alarm event, the images of the object that triggered an alarm must be stored in the alarm log.
- continuously indicate that it is in an operational or non-operational condition.

Fault detection such as loss of high voltage, low count-rate, high count-rate, calibration expired, or other electronic failures shall be indicated. Testing throughout the standard shall be performed with encapsulated, but otherwise, unshielded point sources. The monitoring system shall communicate, save, and store time history data for later retrieval including background readings prior to and/or after an alarm; the alarm information shall include time and date. Communication capabilities are accomplished by providing outputs (e.g. via Ethernet) to external computers. Data transfer techniques and format methods shall be fully described by the manufacturer and should be based on available technology. The monitor shall be capable of providing a local indication and alarm signal (visual and audio), and of transmitting these signals to an additional remote station at a distance of at least 50 m. Finally, the operational availability of the portal monitors must be 99%, i.e. less than 4 days out of operation per year. Operating temperature was to be –25˚C to + 50˚C, with relative humidity up to 100% at + 40˚C.

Monitors should be tested for both gamma and neutron response. At a background level of not more than 20 µR/h (. 0.2Sv), an alarm shall be triggered when the exposure rate is increased due to the exposure of the monitor to the sources listed in Table 3 for a minimum duration specified by the manufacture at the test speed for dynamic-mode systems. The probability of detecting this alarm condition should be greater than or equal to 0.90 with 95% confidence, i.e. 59 alarms in 60 passages. This requirement shall be fulfilled over a continuous incident gamma energy range from 60 keV to 2.6 MeV (tested with ^{241}Am, ^{228}Th, ^{137}Cs, ^{133}Ba, ^{60}Co, and ^{57}Co).

Radionuclide	Primary Gamma Energies (keV)[b]	Evaluation test source activity[a]
^{228}Th	29.38, 86.53, 459.30	7 µCi (0.26 MBq)
^{241}Am	59.53	462 µCi (17 MBq)
^{57}Co	122.06	93 µCi (3.5 MBq)
^{133}Ba	356.00, 80.99, 302.85	23 µCi (0.85 MBq)
^{137}Cs	661.61	16 µCi (0.6 MBq)
^{60}Co	1,173.23, 1,332.50	4 µCi (0.15 MBq)
Neutron (^{252}Cf)	—	$2x10^4$ n/s ±20%

Table 3. Activity values for gamma ray and neutron sources.

CONCEPT OF OPERATIONS

Operations were divided into the customary primary, secondary, and additional expert screening categories. The functionality of the portal monitors must be checked daily using gamma and neutron radiation check sources provided to the customs officials. In an event of a primary alarm, in order to avoid false detection and if the situation permits, the alarming object/person should be made to pass through the monitor again. An object that triggered an alarm at the portal monitor is directed to the secondary radiation screening. After the secondary screening, customs officers may call for additional expert screening. This may become necessary when isotopic identification was not successful or when additional equipment is needed (such as for x-ray, weighing, etc.). The additional expert screening is conducted with the use of spectroscopy detectors in designated places by specially trained customs personnel or by the qualified experts from approved organizations. At the end of the additional expert screening, a report is created which addresses such questions as

- does cargo contain radioactive material
- does cargo contain radioactive waste
- what is the isotopic composition of the radioactive material
- what is the activity of the radioisotopes present in the cargo
- threat assessment
- recommendations on the course of action

Based on the report, custom officials must decide on what administrative action must be taken (such as impound the vehicle, not allow to pass, clear to proceed, detain etc.). Figure 4 illustrates the concept of operations logical flow chart.

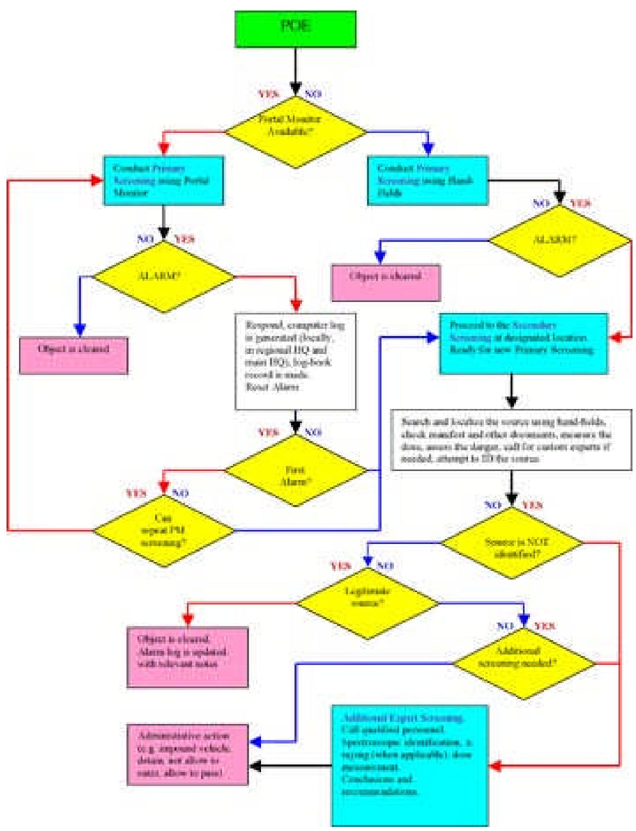

Figure 4. Concept-of-Operations flow chart.

CONCLUSIONS

The prioritized categorization of international POE was formed by considering the four identified factors. Of these four, likely nuclear materials smuggling routes and known POE compromises from drug trafficking are deemed as the most important and are the primary factors by which POE have been categorized as a 1 or 2. Coincidentally, many of the category 1 and 2 POE are also high traffic volume POE but not all. For example, one POE has a low traffic volume but is a category 2 because it sits astride a likely route and all of the truck traffic is from Russia. Though some of the category 1 and 2 POE have some concerns related to the ability to secure the border in the immediate vicinity of the POE, none of these concerns is large. In contrast, traffic volumes and the ability to secure the border in the immediate vicinity of the POE are important for the category 3 and 4 POE.

The inability to confirm written UZSCC traffic volume data prevents its quantitative use, especially in prioritization. However, its qualitative use coupled with personal observations of the scale of operations at the POE are consistent with classification of POE in category 1 and 2.

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