STRENGTHENING IAEA SAFEGUARDS USING HIGH-RESOLUTION COMMERCIAL SATELLITE IMAGERY

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In May 1997, the IAEA Board of Governors adopted the Additional Safeguards Protocol to improve its ability to detect the undeclared production of fissile material. This new strengthened safeguards system has opened the door for the IAEA to use of all types of information, including the potential use of commercial satellite imagery. We have therefore been investigating the feasibility of strengthening IAEA safeguards using commercial satellite imagery. Based on our analysis on a number of one-meter resolution IKONOS satellite images of military nuclear production facilities at nuclear states including Russia, China, India, Pakistan and Israel, we found that the new high-resolution commercial satellite imagery would play a new and valuable role in strengthening IAEA safeguards.

Since 1999, images with a resolution of one meter have been available commercially from Space Imaging's IKONOS satellite. One-meter images from other companies are expected to enter the market soon. Although still an order of magnitude less capable than military imaging satellites, the capabilities of these new high- resolution commercial satellites are good enough to detect and identify the major visible characteristics of nuclear production facilities and sites. Unlike the classified spy satellite photos limited to few countries, the commercial satellite imagery is commercially available to anyone who wants to purchase it. Therefore, the new commercial satellite open a new chance that each state, international organizations, and non-governmental groups could use the commercial images to play a more proactive role in monitoring the nuclear activities in related countries and verifying the compliance of non-proliferation agreements. This could help galvanize support for intensified efforts to slow the pace of nuclear proliferation.

To produce fissile materials (plutonium and highly enriched uranium) for weapons, a country would operate dedicated plutonium-production reactors and the associated reprocessing plants or uranium enrichment plants. These plants would have some characteristic visible features, which can be seen from 1m-resolution satellite images.

For example, from an initial study of these 1m-resolution IKONOS images, 1) it is quite straightforward to identify characteristic features of a dedicated plutonium production reactor site: a cooling system of cooling towers or other water source, a high narrow stack, a reactor building, and the security fence; 2)it can reveal identifiable features of a reprocessing plant: a reprocessing building, and a very high stack (which would be unable to be discerned by the medium-resolution images); 3) it suggests common characteristics of a uranium-enriched gaseous diffusion plant (GDP) would include large-area processing buildings; cooling towers or a nearby river or lake; a nearby fossil-fuel power plant to supply the enrichment complex; and waste management and disposal facilities at some enrichment sites. However, for smaller scales such as gas centrifuge plants (CEP) which could be a preferred way for future proliferants, they will have much less obviously observable characteristic as a GDP have for satellite images. The identification of a CEP had to rely heavily on other collateral information;4) the one-meter resolution images also show the observable features of a typical heavy water production plant using GS process: a row of exchange columns, the high tower for discharge pious H_2S gas, and a number of water storage tanks.

Facing this new challenge of widely available high-resolution satellite imagery, some states in

the future could take deceptions and antisatellite-imaging countermeasures to make their dedicated nuclear facilities hide such as underground. However, the cost of such clandestine program would be substantially higher. Moreover, based on the experience of a few known underground nuclear facilities, there are still some observable characteristic features for high-resolution satellite imagery, such as the above-ground high stack associated with the underground reprocessing plant at Israel Dimona nuclear complex is clearly visible in the IKONOS images. Furthermore, construction of nuclear production facilities not only involves a great many activities (such as the shipment of various materials), but also takes a long period of time. So commercial satellites with several days' revisit time and one-meter resolution would detect these facilities and activities. Finally, once these dedicated nuclear production facilities are operating, there would be some visible signatures to be detected by high resolution images, such as the vapor plumes from cooling towers associated with a plutonium-production reactor can be seen clearly in the IKONOS images.

These case studies show the new high-resolution commercial observation satellite imagery should be taken as one useful tool but not the standalone tool for strengthening IAEA safeguards.

REFERENCE

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