# International Nuclear Inspections:

## *Can the IAEA Safeguard Civil Nuclear Energy from Being Diverted to Bomb-Making?*

The International Atomic Energy Agency (IAEA) today scrutinizes civil nuclear activities at over 900 nuclear facilities and related sites worldwide. The Agency's goal is to verify that States have not diverted any declared—or undeclared—nuclear materials and equipment to make nuclear weapons. However, recent problems in North Korea, Iran and Syria raise the following questions:

- *What exactly does the IAEA do to safeguard civil nuclear energy from being diverted to bomb-making?*
- *What are the IAEA's criteria for what constitutes effective safeguarding?*
- *Do IAEA nuclear inspections actually fulfill the Agency's criteria for effective safeguarding?*
- *What can be done to help the IAEA to meet its own criteria for effective safeguarding? And which safeguarding missions are still too difficult for the IAEA to pull off?*

## Q: *What exactly does the IAEA do to safeguard civil nuclear energy from being diverted to bomb-making?*

In efforts to verify that States have not diverted civil nuclear energy to make nuclear weapons, the IAEA:

- **Accounts for nuclear materials.** States declare to the IAEA changes to the types and amount of nuclear materials that they have at their nuclear facilities and related sites. The IAEA then uses statistical tests and other accounting methods to determine the accuracy of State declarations. From this, the IAEA arrives at estimates for declared *materials accounted for* (called "MAF"), as well as declared *materials unaccounted for* (called "MUF").

To support such materials accountancy, the IAEA also:

- **Visits nuclear facilities and related sites.** There, IAEA inspectors physically examine nuclear material inventories and equipment. They compare on-site operating and accounting records with State nuclear material declarations. They take environmental samples to look for chemical evidence of undeclared, clandestine nuclear activities and materials. These visits usually are announced, but in some cases they are conducted with only a few hours of prior notice
- **Physically contains nuclear materials.** When IAEA inspectors visit nuclear facilities and related sites, they can apply physical containment measures—such as low-tech tamper-resistant metal seals (*see* fig. 1)—to lock the entrances of areas where nuclear materials are being stored.

*Figure 1.* A low-tech IAEA tamper-resistant metal seal at a facility in Iraq. The IAEA is trying to develop more high-tech physical containment measures.

- **Conducts surveillance.** Some States have agreed to allow the IAEA to install cameras (*see* fig. 2) and radiological sensors to remotely monitor activity at nuclear facilities and related sites. In roughly a third of cases (mostly low-risk States), cameras can transmit near-real time information to the IAEA's headquarters in Vienna, Austria. In all other cases (*e.g.*, Iran), IAEA inspectors must actually visit cameras and physically download the data. As a result, the number and precise placement of cameras, and the frequency of inspector visits to download camera data, is very important.

*Figure 2.* An IAEA camera at Iran's uranium enrichment facility at Natanz. Here, IAEA inspectors must visit the camera to download recordings of activity.

## Q: *What are the IAEA's criteria for what constitutes effective safeguarding?*

The fundamental goal of IAEA inspections is not just to detect a State's diversion of declared or undeclared nuclear material, and related nuclear equipment and activities, to nuclear bomb-making or unknown purposes—but also to detect such a diversion **before** a State has enough time to make even one nuclear weapon.

The IAEA's estimate of the amount of nuclear material required to make one nuclear weapon—a metric that the Agency calls a *significant quantity*—varies by type of nuclear material and is conservative (*i.e.*, much higher than what might actually be required):

| *Direct-Use Nuclear Material* | *Significant Quantity* |
|---|---|
| Plutonium (Pu) | 8 kilograms |
| Uranium-233 ($^{233}U$) | 8 kilograms |
| High Enriched Uranium (HEU) | 25 kilograms |
| *Indirect-Use Nuclear Material* | *Significant Quantity* |
| Low Enriched Uranium (LEU) | 75 kilograms |
| Natural Uranium | 10 metric tons |
| Depleted Uranium | 20 metric tons |
| Thorium | 20 metric tons |

The IAEA's estimate of how much time a State needs to prepare nuclear material for use and insertion into a nuclear weapon—a metric that the Agency calls *estimated conversion time*—varies by type of nuclear material and also is quite conservative:

| *Direct-Use Nuclear Material* | *Est. conversion time* |
|---|---|
| Metallic Pu, HEU or $^{233}$U | 7-10 days |
| Unirradiated compounds & mixtures of Pu, HEU or $^{233}$U; or mixed oxides (MOX) | 7-21 days |
| Irradiated fuel with Pu, HEU or $^{233}$U | 1-3 months |
| *Indirect-Use Nuclear Material* | *Est. conversion time* |
| All types of indirect-use material | 3-12 months |

Therefore, to provide *timely detection* of a State's diversion of nuclear material from civil nuclear energy to bomb-making, IAEA inspections must objectively meet the following criteria for effective safeguarding:

IAEA nuclear inspections must be capable of actually detecting a State's diversion of a *significant quantity* of nuclear material **within an interval of time that is less than** the diverted nuclear material's *estimated conversion time*.

## Q: *Do IAEA nuclear inspections actually fulfill the Agency's criteria for effective safeguarding?*

As a practical matter, current IAEA nuclear inspection procedures face difficulties in meeting the Agency's own criteria for effective safeguarding.

For one, the IAEA's inspection goals for the *timely detection* of a State's diversion of nuclear material **are not less than** the diverted nuclear material's *estimated conversion time*. In the specific case of nuclear materials that are directly usable in nuclear weapons (*e.g.*, Pu and HEU), the *timely detection goal* is **far greater** than the material's *estimated conversion time* for use in a bomb.

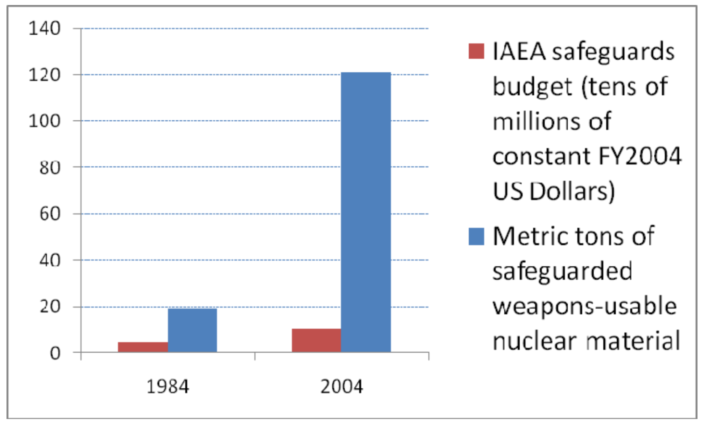
| *Direct-Use Nuclear Material* | *Timely Detection Goal* |
|---|---|
| Metallic Pu, HEU or $^{233}$U | 1 month |
| Unirradiated compounds & mixtures of Pu, HEU or $^{233}$U; or mixed oxides (MOX) | 1 month |
| Irradiated fuel with Pu, HEU or $^{233}$U | 3 months |
| *Indirect-Use Nuclear Material* | *Timely Detection Goal* |
| All types of indirect-use material | 12 months |

For another, when IAEA inspectors account for nuclear material at nuclear facilities and related sites, they have **decided to tolerate** a *false alarm probability* of 5 percent and a measurement error of ± 1 percent. To illustrate what this could mean: at a reprocessing plant through which 800 metric tons of spent nuclear fuel passes every year, IAEA inspectors could be willing to tolerate as much as 246 kilograms of "measured" **missing plutonium** (MUF of Pu) annually—an amount equivalent to over 30 *significant quantities* (or bombs-worth) of plutonium.

Transparency is also an issue. Due to a long outdated *safeguards confidentiality* rule, the IAEA does not publicly disclose and detail—by country—the types and amounts of declared nuclear *materials accounted for* (MAF) and *materials unaccounted for* (MUF).

## Q: *What can be done to help the IAEA to meet its own criteria for effective safeguarding? And which safeguarding missions are still too difficult for the IAEA to pull off?*

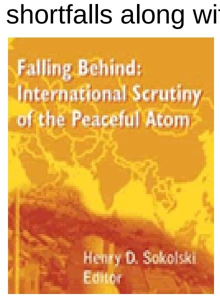
The IAEA's safeguarding responsibilities are growing much faster than its inspection funds. For example, between 1984 and 2004 the IAEA safeguards budget roughly **doubled** in constant dollars, while the actual amount of weapons-usable nuclear material that the IAEA is required to account for in non-nuclear-weapon States worldwide grew **six-fold***:*




This suggests the need for more safeguards funding pegged to each State's nuclear generating capacity.

IAEA inspections also **still cannot** reliably detect the existence of undeclared, clandestine nuclear fuel-making plants and activities; account for the production of declared nuclear fuel-making plants; or provide timely warning of a possible diversion from these plants to bomb-making. The IAEA should admit this by conceding that it cannot effectively safeguard—**at best, it can only monitor**—nuclear fuel-making activities. At a minimum, this suggests that having the IAEA verify a fissile material cut-off treaty is extremely problematic.

For a more detailed analysis of these and other IAEA shortfalls along with proposals to address them, see:




***Falling Behind: International Scrutiny of the Peaceful Atom***, edited by Henry Sokolski, executive director of the Nonproliferation Policy Education Center (U.S. Army War College's Strategic Studies Institute, 2008). Download at www.npec-web.org/FallingBehind.pdf.

For an official view of the IAEA safeguards system, *see*:

***Safeguard System of the International Atomic Energy Agency*** (Vienna, Austria: IAEA, 2002). Download at www.iaea.org/OurWork/SV/Safeguards/safeg_system.pdf.