

International Safeguards: Summarizing “Traditional” and “New” Measures

Matthew Bunn

Summary of INFCIRC 153

The traditional IAEA safeguards system for the NPT is laid out in INFCIRC 153, “The Structure and Content of Agreements Between the Agency and States Required in Connection With the Treaty on the Non-Proliferation of Nuclear Weapons.” The goal of safeguards under INFCIRC 153 is to provide “timely detection” of diversion of “significant quantities” (defined as 8kg of Pu or U-233, or 25 kg of U-235 contained in HEU) of nuclear material from peaceful activities for use in explosives, and “deterrence of such diversion by the risk of early detection.” The basic tools to be used are material accountancy and containment and surveillance.

Written at a time when nuclear energy was expected to become a central element of the economies of many states, INFCIRC 153 represents a compromise between those states who sought highly intrusive nonproliferation verification (largely states that would not have been subject to it, such as the United States and the then-Soviet Union) and those who sought to minimize the intrusiveness of the verification regime and its interference with civilian nuclear energy programs. Hence, INFCIRC 153 lays out a regime based primarily on following nuclear material at selected key “strategic points” at declared sites.

INFCIRC 153 is replete with provisions designed to ensure that safeguards would not be too intrusive. They are to be implemented in a manner designed “to avoid hampering” technological development, “to avoid undue interference” in civilian nuclear energy, and “to reduce to a minimum the possible inconvenience and disturbance to the State.” The IAEA is not to ask for more from the state than “the minimum amount of information and data consistent with carrying out its responsibilities,” and specific upper bounds are placed on the number of person-days of inspection permitted at various types of nuclear facilities.

Under INFCIRC 153, each non-nuclear-weapon state party to the NPT is obligated to accept (and the IAEA is obligated to apply) safeguards “on all source or special fissionable material in all peaceful nuclear activities.” This is specified *not* to include uranium ore, or any uranium before it reaches the point where it has “a composition and purity suitable for fuel fabrication or for being isotopically enriched.” Safeguards are to cover all source or special fissionable material in “peaceful nuclear activities,” rather than simply *all* source or special fissionable material, because there is a loophole in the NPT allowing material to be removed from safeguards for use as naval fuel, though this loophole has never been used.

Each state with an INFCIRC 153 agreement with the IAEA is expected to maintain a national system of accounting and control that keeps close track of all material subject to

safeguards, and to provide reports to the IAEA specifying the amount of material in each material balance area for each material balance period. The IAEA's role is to verify the accuracy of these reports through independent checks on and measurements of a statistical sample of the material reported. For this purpose, IAEA inspectors are to be given access to all declared facilities, although for routine inspections "the Agency's inspectors shall have access only to the strategic points specified in the Subsidiary Arrangements" for each facility. The IAEA also receives and verifies design information on each facility, to facilitate safeguards on it, and receives reports of imports and exports greater than one "effective kilogram" of safeguardable material.

INFCIRC 153 is both more and less comprehensive than its predecessor, INFCIRC 66, which established the pre-NPT safeguards regime. Since INFCIRC 66 safeguards are intended to verify obligations that particular facilities and material are not used for military purposes, not comprehensive nonproliferation obligations such as those in the NPT, its safeguards are focused on the particular facilities and material in question, rather than applying to all nuclear material in peaceful activities, as in the case of INFCIRC 153. But INFCIRC 66 safeguards cover both facilities and material, and are not limited primarily to agreed strategic points, so that for those facilities and materials that *are* covered, safeguards can be more comprehensive. Moreover, the limits on inspection frequency in INFCIRC 66 allow substantially more intensive safeguards activities. (Unlike INFCIRC 153's limits on total inspector days, the INFCIRC 66 limits are set by numbers of inspections per year, not number of inspector-days, so that in principle each inspection could involve a very large number of inspector-days. Moreover, while INFCIRC 153 allows no more than one-sixth of a man-year of inspection for each reactor or sealed store, INFCIRC 66 allows continuous inspection of any reactor with an inventory or potential production of more than 60 effective kilograms per year (meaning all power reactors, and some large research reactors); similarly, while INFCIRC 153 limits inspection of reprocessing plants to 30 times the square root of inventory or annual throughput (whichever is greater), INFCIRC 66 allows continuous inspection for any reprocessing plant capable of processing more than 5 kilograms per year, a tiny level for such facilities.)

In addition to these routine inspections, INFCIRC 153 in principle gives the IAEA the right to carry out "special inspections" at undeclared sites or other areas of declared sites, if the "information made available by the State... is not adequate for the Agency to fulfill its responsibilities." However, under the system as it actually evolved for its first two decades, the IAEA member states strongly discouraged any such action by the IAEA, and in practice requests for "special inspections" were essentially never made – though the IAEA did carry out some invited "visits" to clarify particular situations. (The recent IAEA trips to suspect locations in Iran, for example, were invited "visits," not "special inspections.")

Thus, although in principle INFCIRC 153 gives the IAEA legal authority to implement virtually whatever types of inspections it considers necessary "to fulfill its responsibilities," in practice the document created an environment in which inspectors were politically constrained to checking the declared information about declared material

at agreed points of declared sites, and were strongly discouraged from inquiring into activities elsewhere at the declared sites or at other, undeclared sites.

Moreover, there were a variety of fundamental and less fundamental weaknesses of the safeguards system established by INFCIRC 153:

- The system could only *detect*, not *prevent*, removal of material for weapons purposes. Any state would be perfectly within its rights to produce weapons-usable material under safeguards, then withdraw from the NPT, expel the inspectors, and use the material in nuclear weapons. In principle, therefore, the system allows states to get right up to the edge of nuclear weapons capability before leaving the regime.
- The system was only designed to address *diversion* by the inspected state, not to prevent *theft* by unauthorized parties. The latter remains a responsibility of individual states, and the degree to which they fulfill it varies widely.
- For some types of facilities, especially large bulk-handling facilities processing direct-use material (such as plutonium reprocessing plants), traditional material accounting alone is not accurate enough to ensure that a significant quantity of material could not be diverted without being detected. A variety of supplementary measures, including frequent partial inventories (“near real time accounting”), intensive transparency throughout the plant, and extensive use of containment and surveillance, are used to ensure that any unusual activity associated with diversion would be detected, but their effectiveness is difficult to quantify.

INFCIRC 540

In the wake of the 1991 Iraqi experience, a consensus developed that it was necessary to go beyond the traditional approach of focusing on monitoring declared facilities and develop measures that would help detect any undeclared facilities and activities as well – that is, to attempt to confirm that each state’s declaration were not only *accurate* with respect to the activities declared, but that they were *complete* as well, that is, that all the activities that should be declared were declared. Finding secret nuclear activities that might be anywhere in the vast territory of a country was a much more challenging task than monitoring declared material at declared locations, and it is clear that the IAEA’s confidence in concluding that there are no undeclared activities will never be as high as the confidence it can offer in concluding that there is no diversion from declared activities.

In addition to this concern over undeclared facilities, there was also a hope that more reliance on “new” safeguards measures would allow the IAEA to reduce the intensity, expense, and intrusiveness of “traditional” safeguards measures. Thus improving both the “effectiveness” and the “efficiency” of safeguards became the dual watch-words.

To address these new concerns over traditional approaches, the IAEA eventually got agreement from the Board of Governors on two sets of measures. “Part I” was additional

steps that could be taken under the existing legal authority provided by INFCIRC 153. This included reaffirmation by the Board of the IAEA's right to conduct special inspections when necessary; earlier access to design information and earlier work with the state to design safeguards for new facilities; some expanded reporting by states on nuclear material and facilities (including a new questionnaire on state systems of accounting and control); environmental sampling at agreed points of declared facilities; development of a new approach to consolidating and analyzing all the information available to the IAEA about the nuclear activities of each inspected state; increased use of INFCIRC 153's provision for no-notice routine inspections; greater reliance on advanced technologies such as remote monitoring and unattended measurements with remote transmission; and greater cooperation with, and reliance on, state systems of accounting and control, along the lines of the New Partnership Approach with Euratom, to reduce the IAEA's inspection effort and costs.

In addition, the IAEA secretariat concluded there were additional measures that would be desirable to take but would require new legal authority. (There was some debate as to where the dividing line was between measures the IAEA already had the right to carry out and measures requiring a new agreement; my father was among those who argued that the existing authorities in INFCIRC 153 and the NPT would go very far.) Ultimately, after a negotiation of several years among key member states, a new "Additional Protocol" to existing safeguards agreements (INFCIRC 540) was drafted and approved by the Board, which would provide new legal authorities. INFCIRC 540 is intended to supplement and strengthen, not replace, INFCIRC 153.

INFCIRC 540 includes several areas of measures going beyond those called for in INFCIRC 153:

- **More information.** Each state that agrees to the Additional Protocol must provide the IAEA with a declaration that describes (and provides the location of) all nuclear fuel cycle-related research and development activities that do not involve nuclear material (those that do already have to be declared under INFCIRC 153); describes all the buildings at declared sites and their uses; outlines the "scale of operations" of each location that produces listed types of equipment for enrichment, reprocessing, or certain reactor and fuel materials; describes activities involving nuclear material of safeguards relevance both inside facilities that typically handle a kilogram or more of such material and even outside such facilities; outlines production and capacity of all uranium mines and uranium and thorium concentration plants, and describes all big stocks of uranium and thorium (though material not yet ready for enrichment or fabrication is subject only to declaration, still not safeguards); details all imports and exports of an extensive list of equipment related to enrichment or reprocessing, and of non-nuclear material (nuclear material import and exports were already subject to declaration under INFCIRC 153); and an outline of its "general plans" for the nuclear fuel cycle for coming 10 years. With this additional information, outlining all the nuclear material flows in a country (including those not yet pure enough to be subject to safeguards), all the other buildings at sites that do not include agreed "strategic points," and all the exports and imports of technologies related to the nuclear fuel cycle, the IAEA can get a much better picture of the overall status of a country's

nuclear program and whether there are any apparent discrepancies in the declared information. This additional information is being combined with additional information being collected by the IAEA under existing legal authorities: open source information (from the press and visitors' accounts); intelligence information provided by member states; nuclear material export and import information; and safeguards information. (Simply integrating these diverse sources of information, for each state, into a coherent picture that might reveal discrepancies or patterns of activity is itself a giant task that the IAEA is still struggling to figure out how to manage.)

- **More access.** INFCIRC 540 gives the IAEA the right to access: (a) “on a selective basis in order to assure the absence of undeclared nuclear material” to “any place” on the site of a declared facility, not just agreed strategic points, and to all the facilities that handle uranium and thorium which is not yet pure enough to be subject to safeguards, or small quantities of material exempted from safeguards under INFCIRC 153, or material on which safeguards have been terminated; (b) access to all sites of nuclear fuel cycle R&D activities on which information is provided, all facilities producing enrichment and reprocessing equipment, and all facilities receiving such equipment imported from abroad, “to resolve a question relating to the correctness and completeness of the information provided” – though for this type of access, the state can declare that it is “unable to provide such access” if it makes “every reasonable effort to satisfy Agency requirements, without delay, through other means”; (c) access to decommissioned facilities to confirm they are decommissioned; and (d) most important, perhaps, access to “any location specified by the Agency” to carry out “location-specific environmental monitoring” – though here, too, the state can declare itself “unable to provide such access” if it makes “every reasonable effort to satisfy Agency requirements, without delay, at adjacent locations or through other means.” A separate article obligates the state to “provide the Agency with access to locations specified by the Agency to carry out wide-area environmental sampling” if such wide-area sampling and the procedural arrangements for it have been approved by the Board (which has not yet occurred) and after consultations between the IAEA and the state. Here, too, there is an “every reasonable effort...at alternative locations” provision if the state is “unable to provide such access” at the places the IAEA requests.
- **Better arrangements for getting inspectors in and information out.** There are several provisions of INFCIRC 540 intended to allow faster, less bureaucratically constrained access for IAEA inspectors than was possible under INFCIRC 153. INFCIRC 153 requires the IAEA to get affirmative consent (not just silence) from the inspected state for each inspector to be sent there, and gives the state the right to veto any inspector at any time without having to offer a reason. This was getting to be a problem, as some states were rejecting entire classes of inspectors. (Iraq before the Gulf War, for example, basically was only being inspected by inspectors from Eastern Europe, who it considered more sympathetic.) INFCIRC 540, by contrast, says that if a state does not object to an inspector within 3 months of being notified of the inspector's designation, the state effectively accepts that inspector – only failure to act, not active support, is needed, and a specific time limit is placed on objections.

Another provision requires the state to give the IAEA inspectors multiple-entry visas: previously, the visa application process for each inspection often introduced weeks of delay (and warning to the inspected state). Required advance notice of inspections in INFCIRC 540 is down to 24 hours, but can be as little as two hours or even less for “any place” on a declared site in conjunction with ad hoc or routine inspections. (INFCIRC 153 has a complicated provision on this topic that provides for a week’s notice in most cases, 24 hours for particularly proliferation-sensitive facilities, “as promptly as possible” (not further defined) for special inspections, and at least the possibility of no-notice inspections for a limited portion of the routine inspections at declared facilities.) In addition, INFCIRC 540 requires parties to allow inspectors to communicate directly with IAEA headquarters or regional offices, including real-time satellite communication, and to allow direct transmission of information from surveillance and measurement devices. This greatly improves the timeliness with which information can be collected and integrated, and allows inspectors to check with IAEA superiors on resolving particular issues while inspections are still underway.

INFCIRC 540’s broad-ranging access provisions are limited to some degree by a specific provision allowing the state to offer only “managed access” (not defined, but presumably including shrouding sensitive items and the like as in the case of other arms control regimes) “in order to prevent the dissemination of proliferation-sensitive information, to meet safety or physical protection requirements, or to protect proprietary or commercially sensitive information.” But the restrictions on access may not be such as to “preclude the Agency from conducting activities necessary to provide credible assurance of the absence of undeclared nuclear material and activities at the location in question.” In this as in many other cases, the tone has shifted from INFCIRC 153 to INFCIRC 540: while INFCIRC 153 was written with a strong emphasis on avoiding any interference with civilian nuclear energy, the general tone and language of INFCIRC 540 puts much more of the emphasis on ensuring the IAEA gets the information and access it needs. While the need to avoid interfering with civilian nuclear energy is mentioned in the preamble, it essentially never comes up again in the Protocol. And unlike INFCIRC 153, the access in INFCIRC 540 is at times, places, and frequencies of the IAEA’s choosing, not generally limited to strategic points and limited numbers of inspection-days as in INFCIRC 153.

In short, INFCIRC 540 gives the IAEA far greater access to information to build up a comprehensive picture of a state’s nuclear capabilities – including information that can be cross-checked with information from other states, such as export-import data; access to sites anywhere in the state to conduct environmental monitoring and other inspection activities; and significantly better freedom of movement and communication for IAEA inspectors.

Environmental Monitoring

Environmental monitoring is an important new technical approach at the heart of INFCIRC 540. All nuclear facilities, no matter how well contained, release at least a few

atoms of the nuclear materials they are working with. These traces can in principle be detected – for example in swipes taken from the interior walls of a facility, or from samples of soil or vegetation taken nearby – and analyzed to reveal whether plutonium or HEU, for example, are being processed at the facility. A variety of tests and some real experience (including the post-Gulf War Iraqi inspections, and the swipes in North Korea that revealed that North Korea had reprocessed at times it had not declared) have demonstrated the potential of the technique. Swipes taken within facilities can provide high confidence, for example, of whether enrichment beyond 20% or separation of plutonium has taken place in that facility. Environmental monitoring can also potentially detect facilities at some distance. IAEA tests, for example, confirmed that clear evidence of the presence of power reactors and reprocessing plants could be detected from 20-30 km from the facilities.

So far, however, the greatest consensus has been in support of local environmental monitoring – on top of or close to the site in question. Wide-area environmental monitoring techniques – designed to detect undeclared uranium or plutonium facilities over broad areas – are still being developed and discussed, and have not yet been approved by the Board. Such techniques played an important role in monitoring in Iraq, however, and considerable initial experience was gained there.

Integrated Safeguards

With the adoption of INFCIRC 540, a critical question for the IAEA has become how best to integrate the new and traditional safeguards measures. With a limited safeguards budget, one can't do everything, and the optimum balance of new and old remains a matter of dispute. Some states that are inspected particularly heavily under the old regime (such as Canada) have argued that if they voluntarily provide comprehensive data on everything nuclear they do, and allow environmental monitoring whenever the IAEA deems necessary, it should be possible to substantially reduce the intensity of traditional safeguards measures, perhaps even giving up on the notion of “continuity of knowledge” about where all fuel is going (a key element of the traditional approach). Others have argued that there remains a need for much of the inspections that have traditionally been carried out. The IAEA Secretariat itself suggested a likelihood that with the new measures in place, the resources expended on inspections of LWRs could be reduced by two-thirds. The idea of integrated safeguards continues to evolve.

Since INFCIRC 540 does not link particular types of facility and material to particular levels of inspections, as INFCIRC 153 does, and gives the IAEA the discretion to decide when more monitoring trips are required, it may be a mechanism for allowing the IAEA to allocate more of its resources to the areas of greatest concern, reducing the fraction of the inspection effort that goes to Canada, Japan, and Germany. The issue of “discrimination” among different countries remains extremely “hot” politically, however.