URENCO'S VIEWS ON INTERNATIONAL SAFEGUARDS INSPECTION

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ABSTRACT

The Urenco group has operated uranium enrichment plants, using the gas centrifuge process, for over thirty years in Europe. Throughout this whole period, the plants have been subject to a rigorous regime of safeguards inspection by Euratom – and since the late 1970's, the plants have been inspected by IAEA also. This paper describes the regime of inspection by international safeguards organisations at Urenco's enrichment plants. It also gives an insight into Urenco's views on this inspection regime and specifically touching following topics: the value of international safeguards to the nuclear industry; IAEA objectives in safeguarding gas centrifuge enrichment plants; the need to take account of safeguards requirements in the design of facilities; the secrets of success for new inspection techniques; the conflicts involved with the protection of sensitive technology; the meaning of effectiveness and efficiency; and future trends.

Key Words: centrifuge, enrichment, safeguards

Disclaimer: This paper expresses the views of Urenco and not necessarily those of the Troika governments.

INTRODUCTION

It is over 20 years since Urenco last gave a presentation[1] at the *International Conference on Facilities Operations - Safeguards* Interface. Much of that paper is still relevant today – but here I explain about what's happened over the last 20 years, give Urenco's views on the safeguards inspection regime and give our thoughts of the future of international safeguards. Whilst the focus of the paper is on international safeguards applied to uranium enrichment plants, some of the views are relevant to other types of facilities in the nuclear fuel cycle.

URENCO

Urenco operates uranium enrichment plants at three sites: Almelo in the Netherlands, Gronau in Germany, and Capenhurst in the UK. All of the plants use the gas centrifuge process for enrichment; all of them produce only low enriched uranium (LEU), currently at up to either 5 to 6% U235 enrichment. This is used only to make fuel for nuclear power stations. We do not make enriched uranium for military or defence uses.

Urenco also operates a small centrifuge facility at Almelo for separation of isotopes of elements other than uranium: the so-called stable isotopes production. Urenco also has a 50% stake, along with Areva, in the Enrichment Technology Company (ETC), which develops centrifuges, manufactures them, and builds plants. But this paper does not cover any of these areas.

In 1976, Urenco began commercial operations at Almelo (in the Netherlands) and Capenhurst (in the UK). In 1985, the site at Gronau (in Germany) started production. Urenco has increased capacity gradually every year. By end 2007, the capacity at all three sites combined had reached 9,600 tonnes of separative work (tSW). Urenco is also building the National Enrichment Facility (NEF) at Eunice in Lea County, New Mexico, USA – this will start production next year. By 2012 Urenco expects to have 15,000 tSW of capacity in operation.

SAFEGUARDS INSPECTION REGIME IN URENCO PLANTS

Urenco is very familiar with international safeguards, as all of our plants and all of the nuclear material held on the sites have been inspected for many years by two international safeguards organisations: the European Commission Nuclear Safeguards Directorate (Euratom), based in Luxembourg and carrying out inspection in Europe; and the International Atomic Energy Agency (IAEA), based in Vienna and carrying out inspection world-wide. Euratom began carrying out safeguards inspections on Urenco sites right back in the early 1970's when there were only small pilot plants. By 1979, IAEA joined the inspections, initially on an ad-hoc basis. Ever since then, inspections at the sites have been by a *joint team* consisting of both Euratom and IAEA inspectors.

From 1980 to 1983, Urenco participated in the *Hexapartite Safeguards Project* (HSP), involving Australia, Euratom, the IAEA, Japan, the USA and the "Troika" consisting of

Germany, the Netherlands and the United Kingdom (UK). This looked at how best to carry out safeguards inspections in centrifuge enrichment plants. When that was concluded, full scope safeguards inspections began at all Urenco sites, based on the principles of HSP, including access to cascade halls. *Facility attachment* agreements were concluded between IAEA, Euratom and our governments: these describe precisely the inspection regime taking place at our plants, and they are legally binding on Urenco.

Urenco's experience of international safeguards is immense. Urenco has calculated that between 80 and 90% of all the enrichment production in the world which has been subject to IAEA verification has been Urenco production. None of the plants of Urenco's major competitors (operated by Areva, USDOE/USEC and Minatom/Rosatom) have been subject to IAEA safeguards inspection (other than a small amount of production in the early 1980's in the fledgling centrifuge enrichment plant in USA). It is estimated that IAEA and Euratom have each carried out over 8,000 man-days of inspections on Urenco sites - that's over 16,000 man-days of inspections over the last 30 years. Urenco has seen more of IAEA nuclear safeguards inspectors than any other enrichment company in the world – and probably more than any other company.

TYPES OF SAFEGUARDS INSPECTIONS IN URENCO PLANTS

A *joint team* of Euratom and IAEA inspectors carries out the following inspections at each of the European sites (Almelo, Capenhurst and Gronau):

- Routine inspections, one week in every month, at which the main activity is the verification of flow: i.e. uranium hexafluoride (UF_6) newly received onto site, and newly produced enriched and depleted UF_6.
- An annual *physical inventory verification* (PIV), to verify the entire stock of nuclear material on site.
- *Design information verification* (DIV), to confirm that the plants are built in line with what has been declared in the *design information* documents submitted to the inspectorates: these DIVs are normally carried out once on a new plant and repeated up to once a year thereafter.
- *Limited frequency unannounced access* (LFUA) inspections, to verify that the cascade pipework has not been modified, for example to introduce feed points and product take-off points. These LFUAs take place inside cascade halls, several times each year.
- *Complementary access* visits, as required by the *additional protocol* agreements between our governments, Euratom and the IAEA. These are unannounced, and mainly take place at ETC locations adjacent to our plants. There are a few such visits per year.

SAFEGUARDS INSPECTION TECHNIQUES USED IN URENCO PLANTS

Most of the inspection activity concerns the verification of flow of nuclear material and the inventory of nuclear material on Urenco sites. Urenco submits inventory change reports and lists of inventory items, which are verified by inspectors as follows:

- checking the weights of cylinders, either with the inspectors' load cells or Urenco weigh scales, and at the annual inventory check on process plant station load cells,
- verifying the U235 enrichment of the UF_6 in the cylinders which are due to be used in the plants or have recently been produced, by non-destructive analysis (NDA) techniques, by hand-held gamma detectors of either germanium or sodium iodide crystal type,
- taking samples of UF_6 gas from cylinders, or sometimes from the gas flow in the plants, for analysis by mass spectrometry, and
- visually checking identity numbers of cylinders (on labels or nameplates), to make sure that the cylinders in stock are those that are declared.

Various types of seals are used: metal cap seals are used on cylinders and other equipment; for short-term use there are paper seals; on two plants, electronic seals are used in combination with camera surveillance, to ensure continuity of knowledge of on-line cylinders during the physical inventory verification.

Design information verification is carried out by visual observation: inspectors examine the process pipework and equipment to make sure that the plant is as declared, and look carefully inside cascade halls to make sure that cascades, pipework and connections are not modified to produce or take off *high enriched uranium* (HEU), which is defined by IAEA as having a U235 content of 20% or more.

Note that a fuller description of all of the above inspection measures is given in reference 1.

The inspectors use the *continuous enrichment monitor* (CEMO) on two Urenco plants. this equipment monitors the enrichment level in the gas in the product pipe as it is being produced, and is designed to give a rapid alarm signal direct to Vienna and Luxembourg if either HEU is detected or if the equipment is not working properly. CEMO has in the main operated reliably, but it has falsely indicated HEU on two occasions, to the consternation of Urenco and the inspectorates.

The *complementary access* visits to ETC centrifuge manufacturing and assembly areas mainly involve visual observation. These are aimed at making sure that there are no undeclared activities in these areas, such as carrying out enrichment production. Access to these areas is allowed carefully, to avoid compromising sensitive technologies.

ENVIRONMENTAL SAMPLING

The inspectors carry out e*nvironmental sampling* in Urenco plants: this is a technique which was introduced into safeguards in the mid 1990's. They take swipes many times each year at many locations, and these swipes are analysed in their analytical laboratories (IAEA Network and Seibersdorf) for the isotopic composition of uranic particles. *Environmental sampling* trials began in Urenco plants around ten years ago. These trials showed that the technique is immensely powerful, in that it detects all kinds of information about the enrichments produced – no matter whether such production had taken place recently or several years previously. An impressive example of the results that can be obtained by e*nvironmental sampling* was given in a paper to INMM in 2000[2]: this included the detection only two weeks after the start of production at a new, enrichment level. If Urenco were making HEU (of course, Urenco has no intention of doing so!), then there would be a very high chance of finding this out from *environmental samples*.

THE VALUE OF INTERNATIONAL SAFEGUARDS

Urenco really believes that the regime of international safeguards verification of the civil nuclear fuel cycle facilities and the nuclear material they use is very important for the world, for the following reasons:

- By reassuring the public: by demonstrating that civil nuclear programmes do not lead to the development of nuclear weapons.
- By helping international trade, because many countries will not buy uranium or nuclear fuel cycle services from countries which don't have international safeguards inspection, or will not sell to such countries. It seems clear that if one's nuclear plants are subject to international safeguards verification, then it increases the chance of doing business around the world.
- By helping the expansion of nuclear power worldwide. Many new countries are now thinking of building nuclear power stations and a thorough implementation of IAEA safeguards in all countries would assist that expansion.

IAEA SAFEGUARDS OBJECTIVES FOR CENTRIFUGE ENRICHMENT PLANTS

The IAEA has declared[3] that there are three objectives to be achieved in safeguarding a gas centrifuge enrichment plant (GCEP):

- To detect diversion of declared nuclear material. This is traditional safeguards, as defined in INFCIRC 153. Urenco completely agrees with this objective and considers that the inspectorates meet this objective extremely thoroughly.
- To detect production of enrichments higher than the declared maximum, in particular HEU. The last three words are the ones that really matter, as HEU can potentially be used for the manufacture of nuclear weapons. But this target, which was originally set by the *Hexapartite Safeguards Project* (HSP) in the early 1980's, is not just the detection of enrichments above 20% U235, it is also the detection of enrichments between the declared maximum (normally 5% U235) and 20% U235. In their recent re-appraisal[3], IAEA conclude that such misuse of

an enrichment plant is unlikely because it would have the disadvantages of both being open to detection in a declared plant and requiring further enrichment at an undeclared plant to produce HEU, and in any case this acquisition path would be covered by measures covering the three main paths. Urenco agrees with this reasoning. The wording of the objective should surely be revised, to make it clearer that it is just the detection of HEU production which is meant.

- To detect production using undeclared uranium. This objective is completely new in the IAEA model approach. The IAEA currently seems very excited about being able to detect undeclared enrichment production - using undeclared uranium. But Urenco can't understand why a proliferator would ever want to do that. If I wanted to produce HEU for nuclear weapons, why should I make secret LEU in a plant under the spotlight of IAEA, and then further enrich this in a completely separate, but secret enrichment plant? That doesn't make sense at all, since this is far too complicated, and there would be two opportunities for the IAEA to discover this. It would be far simpler to just enrich secret supplies of uranium in a secret plant. There would be less chance of being found out.

DESIGN OF PLANTS

Urenco believes that any new nuclear plant built should take account of the requirements of IAEA safeguards, preferably when it is being designed, i.e. before it is built. This is no problem for an operator like Urenco, with established plants and an established inspection regime. Urenco thinks its plants are quite well designed to take account of the needs of safeguards inspection – and that includes the National Enrichment Facility in New Mexico, which is in most respects a copy of the newest plants in Europe. Urenco has learnt lessons, and has simplified the design of its plants over the years. But if one is new to safeguards, it's very difficult to design a plant to take account of safeguards requirements, because they aren't published, and a dialogue with the IAEA might not start until it's almost too late to take account of their wishes. It could even be that by the time that IAEA has decided that they are going to safeguard a plant, it has already been built! Another problem is that from time to time, IAEA changes its requirements.

So IAEA should issue design guidelines. These could be quite brief: just one or two pages would suffice for each type of plant. For example, for gas centrifuge enrichment plants it seems to us that there are two important design aspects:

- Outside the cascade halls, equipment containing UF6 (e.g. process gas pipework, valves and cylinders) should be readily inspectable. IAEA hates it if they can't gain access to equipment containing nuclear materials.
- Inside the cascade halls, there should be as little equipment as possible, because the operator will inevitably restrict access in these areas for reasons of sensitivity of technology. Centrifuge casings and cascade pipework should be visible to an inspector during a LFUA inspection.

NEW INSPECTION TECHNIQUES

There are many organisations - particularly in USA – currently aiming to develop new equipment and new techniques for safeguards verification purposes. But many of the developers (who might not have many contacts with IAEA or with operators experienced in safeguards implementation) seem to be too interested in the technology per se, and should give a lot more thought into the practicalities. Questions which need to be addressed include:

- Where will the equipment be installed? Does it require access to sensitive areas?
- Will the operator accept the equipment in his plant? Because if he won't and you don't understand why, then it's a waste of your time developing the equipment.
- What is the benefit for safeguards?
- What is IAEA's view? Does it see a need for the new technique?
- How would the new technique fit into the safeguards approach? If a new technique being introduced means that an existing technique can be phased out, then there would be a benefit. Otherwise, costs will simply increase.
- Will the equipment be reliable? What will be the consequences if it fails? If the equipment is not highly reliable, then it is probably useless. For example, the inspectorates hate having to respond to lots of false alarms, and an operator could take advantage of safeguards equipment if he knows it is not working.
- What will be the full cost: for developing the equipment, for buying it, for installation, for routine use, and for maintenance? You need to talk to the people who you expect to pay for all this.
- Can the operator bypass the equipment or sabotage it? A malicious operator could take advantage of any shortcomings of the equipment or technique.
- Will the equipment be easy to use by inspectors?
- How will inspectors be trained in the use of the equipment?

The difficulty found with equipment which is a one-off is that inspectors don't get enough opportunity to learn about it - standard equipment which is in world-wide use is much better.

In Urenco's view, the presence of a competent inspector on site provides more effective safeguards than the use of complex remote monitoring equipment.

PROTECTION OF SENSITIVE INFORMATION

Urenco's enrichment plants contain very sensitive centrifuge technology. Potentially, all visitors to the sites contribute to proliferation of sensitive information. Of course, this statement particularly applies to safeguards inspectors, for several reasons: they are the most frequent group of visitors, they are allowed to see much more of the plants than other visitors, and they come from a wider range of countries than other visitors.

That means that the safeguards verification regime has to be designed well, to avoid disclosure of sensitive information and technology: Urenco does not want its competitors to know what it is doing and especially Urenco does not want to help potential proliferators. In practice IAEA and Euratom act very professionally in this regard: they are well aware of the sensitivities. Urenco has very careful security procedures agreed with IAEA and Euratom, and to Urenco's knowledge they've never divulged secrets.

EFFECTIVENESS AND EFFICIENCY OF SAFEGUARDS

In recent years, the IAEA has referred many times to improving the *effectiveness and efficiency of safeguards* – but it is strange that they have never properly defined either term. In Urenco's opinion:

- The *effectiveness* of a safeguards measure relates to whether an operator is deterred from carrying out illicit activities by it. If he's not, then it is not very effective.
- The *efficiency* of a safeguards measure relates to whether it gives value for money. One has to compare different measures and chose the one that gives best value for money.

But the IAEA - and to some extent Euratom also - seem to use the expression of *improving the effectiveness and efficiency of safeguards* to justify <u>any</u> extra measures. There really should be a more critical evaluation of existing and proposed new safeguards measures in order to choose the right ones. To keep on adding new safeguards measures on top of those in place is not good practice, as it merely increases costs - both for the plant operator and for the inspectorates (and therewith the international taxpayer) . There should be the aim of cutting back on those safeguards measures which are evaluated to have low effectiveness or efficiency.

FUTURE TRENDS IN SAFEGUARDS IN GAS CENTRIFUGE ENRICHMENT PLANTS

It is clear to Urenco that, in the coming years, there will be more centrifuge enrichment plants around the world subject to international safeguards inspection by IAEA. Urenco understands that the plant currently being built by Areva at Pierrelatte in France will be under IAEA safeguards and Urenco is pleased to hear that. In America, there may soon be not one but three new plants under construction: the National Enrichment Facility, the USEC plant and the Areva plant. Urenco understands that IAEA has not yet decided to inspect any of these plants. Urenco's view is that all three plants should be inspected by IAEA: all are being built as "commercial" plants, to provide LEU for fuel for electricity-generating nuclear reactors. The clear intention of the HSP agreement in 1983 was that all commercial centrifuge enrichment plants sited in HSP countries would be placed under IAEA safeguards. The whole basis of this agreement was so that the different companies would be operating on a "level playing field" in the commercial marketplace. Furthermore, if these three plants were under IAEA safeguards and could contribute their experience, it would enable the enormous wealth of technical expertise in USA to be better exploited in developing improved techniques for safeguards verification under real operational conditions, for IAEA to use world-wide.

In Russia, Urenco does not know what is happening regarding IAEA safeguards inspection at the “international enrichment centre” under development at Angarsk. Very little of any substance has been published on this matter, either by IAEA or by the Russians. However, it will be disappointing to Urenco if all that transpires is that a store containing a few cylinders of enriched UF_6 is inspected by IAEA. In no way would such a limited scheme meet any of the declared IAEA safeguards objectives for gas centrifuge enrichment plants. Are the Russians merely paying lip-service to the concept of international safeguards, and trying to use the good name of IAEA for marketing purposes?

But there will no doubt be new enrichment plants built in other countries around the world in the coming years.

CONCLUSION

It is physically possible to misuse enrichment plants, and it is important that they’re properly safeguarded, to ensure that weapons-grade HEU is not produced illicitly. Urenco feels that IAEA should spend more time in guiding the development of new techniques, to make sure that the considerable expertise available is utilised wisely. Urenco hopes that IAEA will take an increasing role in leading the development and implementation of safeguards in all uranium enrichment plants worldwide, irrespective of whether in Nuclear Weapons States or in Non-Nuclear Weapons States: this is an important role which the IAEA is well placed to carry out.

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