# A National Control System

by Alf Larsson*

*An effective control of nuclear fissionable material is dependent on three different kinds of control, the industry – laboratory mangement, a national control system and an international safeguards system.*

*The national systems of control differ greatly between various industrialized countries. Two principal reasons for fact can be mentioned. The type and the amounts for nuclear material may be different depending upon the stage of development of the nuclear industry in the country in question. Another reason may be that the country may wish to establish a very elaborate national system of control in order to minimize the IAEA control as much as possible. The two safeguards agreements between the Agency and Sweden on one hand and the Agency and Japan on the other hand can serve as examples for the understanding of the latitude of the IAEA safeguards system under NPT due to the influence of the national control system.*

*If it thus is apparent that the national control system is strongly interrelated to the international safeguards system it is equally influenced by the control and accountancy systems which exist at the nuclear plants and development laboratories.*

*A detailed study of national control systems and their relations to plant management control would fall outside the scope of this article. Some important features will however be examined.*

## CONTROL OF NUCLEAR POWER REACTORS

The control of fissionable materials in nuclear power reactors is greatly facilitated by the factor that the material usually is found only in fuel rods and fuel rod assemblies. Once the material content of the individual rods is known the control can be limited to keeping track of the rods and assemblies. For this reason the rods and assemblies must be satisfactorily marked. The uranium content of individual fuel rods can be measured with reasonable good accuracy. Unfortunately no analytical method has yet been developed for routine use for the determination of the uranium content of fuel assemblies. This implies that it is usually necessary to rely on data supplied by the fuel manufacturer for the amount of uranium and the enrichment.

In order to calculate the plutonium content of irradiated fuel a detailed knowledge of the irradiation history must be obtained. In spite of the considerable effort spent to get as good basic input data as possible, the estimation of the plutonium content can not be made very accurately for a discharged fuel core. The final value can only be acquired after dissolution of the fuel in a reprocessing plant.

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For the national system the control of power reactors starts already at the design phase. The control can be greatly simplified if due account is taken to the control at an early stage of the design. Above all it is important that the reactor operator becomes aware of all the requirements of the national authorities regarding fissionable materials accounts. This can e.g. result in selection of automatic data processing methods for handling all the necessary information.

Before operation the control and accountancy system for fissionable materials at the nuclear power station has to be approved by the national authorities. The operator must then follow some basic rules, e.g. for the selection of suitable material balance areas, data recording and reporting routines. But the details of the control and accountancy system should be worked out by the operator himself as an integral part of the reactor data recording and reporting system and approved by the national control authority after the latter is convinced that the overall system fulfills its purpose also as a materials control system.

One vital part of the national system is inspection. Visits to the station are especially important on those occasions when fuel assemblies are charged into or discharged from the reactor or when they are received at or shipped from the station.

In general, the control of a nuclear power station as a responsibility of a national control system due to international safeguards agreements is a fairly straight forward process. The extra amount of work needed may be much reduced if the station is designed with due regard to the materials control and especially if the normal operation recording and reporting procedures are set up to include also the accounting and control of fissionable material.

## POWER REACTOR FUEL ELEMENT MANUFACTURE

The control of fissionable material in a fuel element manufacturing plant is a much more time consuming and difficult procedure compared with reactors as the material is handled as powders or solutions before it is ready to be loaded into the fuel rods. The required accuracy of all measurements of uranium is much greater than can be motivated by the high economic value of the material.

As in the reactor case a careful selection of material balance areas must be made. A good design of the plant greatly facilitates the materials control. It is important that the authority responsible for the national system works closely together with the plant operator in order to find solutions to all the different steps of the control. This includes e.g. the accuracy of weighing and measurement tools used in the plant of significance for the estimation of the uranium content, including analytical methods. Especially important is the pellet loading station as it is so far not possible to obtain as good accuracy using indirect radiometric methods as by other analytical tools. Considerable effort has to be spent on methods for selection of representative statistical samples.

At certain intervals inventories have to be taken. This procedure is the final verification of accounts and reports. In adding up the total inventory it is also necessary to take measured losses into account. These losses may be composed of dust in filters, unrecoverable material in the form of scrap etc.

One large difficulty is the very great number of figures which have to be reported. The chances of introducing errors are great but can to some degree be diminished if some kind of automatic data handling technique is used.

## DEVELOPMENT LABORATORIES

In development laboratories the fission materials are usually present in much smaller amount than in production plants and reactors.

It is often of advantage to use a limited number of material balance areas in spite of the fact that the material can be geographically distributed over a large area and located in separate buildings.

Special attention must be paid to the circumstance that highly enriched uranium and plutonium may be handled at the development laboratory; the uranium e.g. as fuel for a research reactor and the plutonium for development purposes. The National Control Authority has to set up considerably more stringer rules for control and accountancy of these materials than for low enriched uranium.

Experience shows that the amount of paper work needed to control the fissionable material at a large size research station is considerable and data handling technique is usually required.

An effective control of fissionable material can usually be achieved if there is good co-operation betwen the National Authority and the operators of reactor production plants and laboratories.

In order to serve as one part of an international safeguards system it is very important to have close collaboration between the National system and the IAEA safeguards system. There are good indications that such concerted efforts between the three control organizations can be obtained and lead to satisfactory results.