Quality Assurance and Control in Nuclear Fuel Manufacture

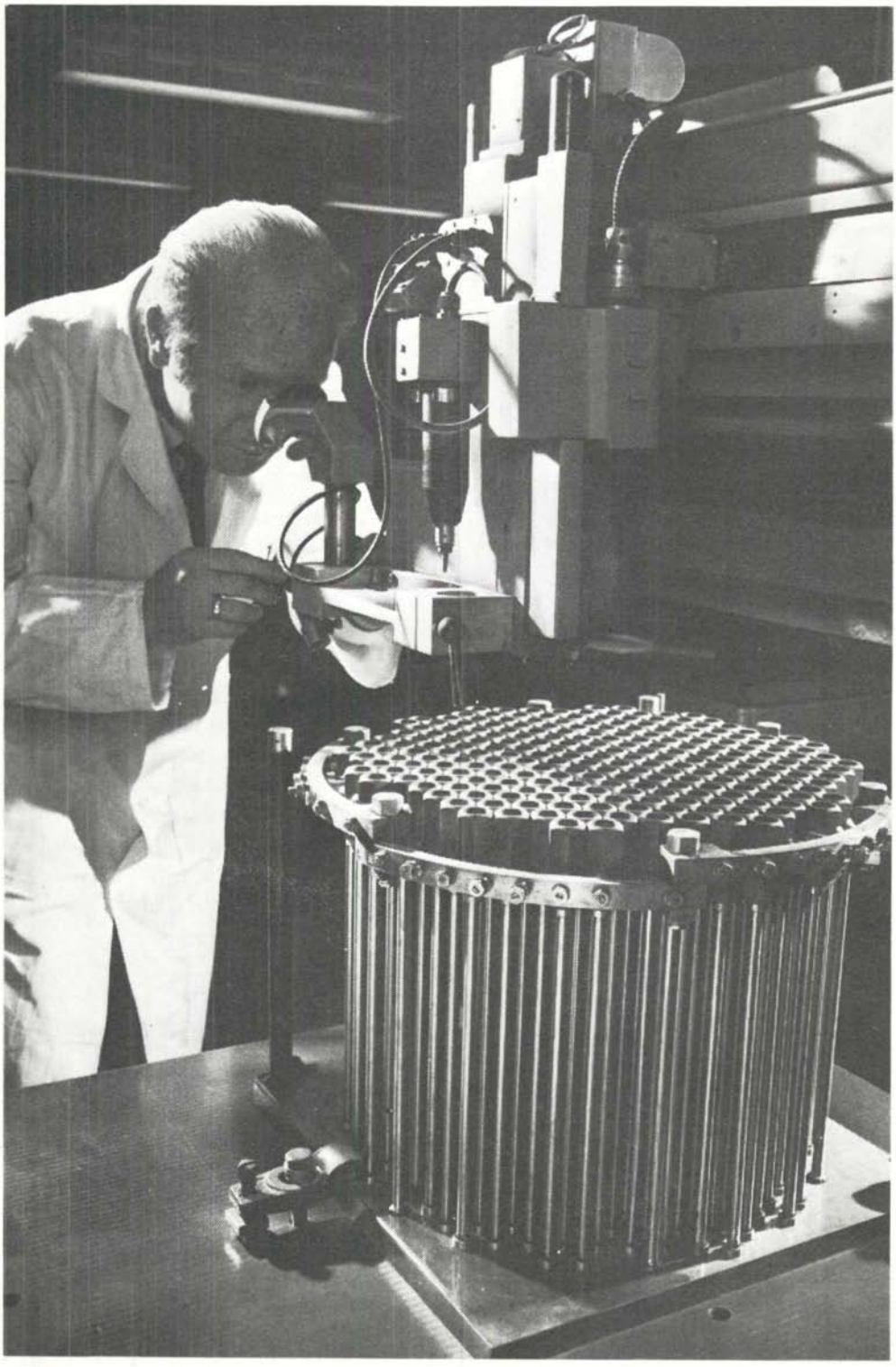
Product quality is an important consideration in any manufacturing program. The basic incentive for this is economic; the product must sell, and this factor is equally important for nuclear fuels. However, in this case there are other strong reasons for making an effort to obtain especially high product quality. Two of the most important of these are safety and reliability. Safety, because with a properly made fuel the majority of the radioactivity in the reactor is safely contained within the fuel elements; reliability of fuel elements is becoming increasingly important as more of the world's supply of electric energy is being produced in nuclear power plants. These considerations led to the IAEA Panel Meetings on Quality Assurance and Control in Nuclear Fuel Manufacture and the discussions of that panel form the basis of this report.

Any discussion of Quality Assurance (QA) and Quality Control (QC) must begin with a definition of these terms. For present purposes we may view QA as the overall formalized procedures used to provide for the assurance of a quality product including planning, records, audits, QC, etc. Quality control is the detailed part of QA dealing directly with the technical aspects of testing and use of test data.

The wide range of the effects of fuel quality (or the lack of it) leads to the involvement of three groups who are concerned with fuel quality. These are the manufacturer (vendor), the user (utility) and the public (governmental regulatory body). While all of the parties concerned with QA and QC in nuclear fuel manufacture agree that a structured or planned approach is necessary, there are differences of opinion regarding access to the manufacturer's production information. The manufacturer wishes to provide the minimum amount of information regarding his technical activities, consistent with acceptance of his product. On the other hand the users and governmental regulatory bodies require access to some production details and to the manufacturer's plans for QA and QC.

One obvious effect of the restriction of manufacturing information in the past was to produce a situation where the manufacturers supplied fuel under performance guarantees, with little accompanying technical information. With the present growth in the use of nuclear power reactors, and the increasing tendency toward supply of fuel by manufacturers other than the original supplier of the reactor, the vendors are beginning to furnish

Safety and reliability of nuclear fuel elements is becoming increasingly important as more of the world's ▶ supply of electric power is being produced by nuclear power plants. Here a model of a Prototype Fast Reactor core and the equipment used to check hexagon packing. Photo: UKAEA



more information to utilities and regulatory bodies in response to their demand for better assurance of the fuel quality. In fact, it became clear at this meeting that in the opinion of most manufacturers their normal production quality assurance program would permit them to satisfy any reasonable user request on QA and QC with little extra effort.

Perhaps of more importance to the Member States of the Agency are two other effects caused by the tendency to restrict information on technological processes. This restriction tends to encourage differences in production and QA techniques, and to make recent QC information unavailable to new manufacturers entering the field. This can be good, in that it tends to provoke different manufacturing approaches which can lead to the development of improved products. However, the use of different techniques by different manufacturers can also be detrimental, because it makes QA more complicated for the user. Or, viewed from the other side, if different QC test techniques are required by different users, it will have the effect of causing manufacturers to change their procedures and thereby increase the risk of producing fuels of less than optimum quality.

The fact that the most recent technological information on fuel manufacture is difficult to obtain is understandable from the point of view of the competitive position of the private companies. However, there is a real need to make available the most recent information on quality assurance test techniques. If this can be accomplished, standardization of QA procedures will be greatly enhanced. Perhaps more importantly, these techniques would then be available to permit the new manufacturers, such as those in the developing countries which are just entering the nuclear field, to evaluate their products and the adequacy of their processes.

The panel on QA and QC in Nuclear Fuel Manufacture provided a forum for a positive exchange of views between representatives of all of the groups interested in the subject. At its conclusion the panel recommended that the Agency encourage the standardization of QA and QC procedures and techniques in its program. To achieve this, the panel recommended that a basic manual on QA for Nuclear Fuel Fabrication be prepared, that the preparation of a listing of useful basic QC tests procedures for metal clad UO_2 fuels be pursued, and that a summary of the information exchanged during the panel meetings be published for the benefit of the IAEA Member States. Steps are under way to implement these recommendations.

Fusion research is asking steadily for bigger devices to carry out the necessary experiments. In the USSR ▶ at present T-10 is under construction, follower of a series of Tokamaks of which the picture shows the Tokamak T-6. Photo: USSR