possibility of producing heavy water at other fertilizer plants under construction in the country is also being considered. Besides, studies have been made for the production of nuclear graphite from indigenous raw materials, and a decision on a plant is likely to be taken soon.

SAFEGUARDS FOR THE ATOM

The reason why the development of atomic energy should be regulated by a system of appropriate safeguards hardly needs any elaboration today. Concern over the destructive potentialities of nuclear energy has grown all over the world. In fact, it was this concern, coupled with an awareness of the equally great potentialities for peaceful prosperity, that led to the establishment of the International Atomic Energy Agency.

That nuclear energy should be used solely for peaceful purposes is an ideal to which all people would subscribe. Realization of this ideal, however, is dependent on many complex factors which are outside the scope of the Agency. In its own limited sphere, however, the Agency has the responsibility to ensure that in its efforts to promote the peaceful uses it does not in any way increase the potentiality of military use.

Need for Agency Safeguards

Why it should be necessary for the Agency to be concerned with this problem will be clear if it is remembered that the basic science and technology of nuclear energy is the same for both peaceful and military applications. Essentially, the release of energy follows the same principle in a reactor as in a nuclear weapon; the difference is in the technical arrangements and consequently in the manner of release. It is, therefore, not impossible to divert some of the basic installations or materials from peaceful to military use.

The purpose for which the Agency was set up would be defeated if the development of atomic energy brought about by its assistance or under its auspices were to be used to further any military purpose, and the Agency must do whatever it can to prevent misuse of its assistance. The importance of this function was clearly recognized when the Agency was set up, as can be seen from the statement of its objectives in its Statute, which says that the Agency "shall ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose".

The possibility of military application is not the only danger that the Agency must guard against, it has a further function arising from the nature of the materials needed in atomic energy work. Since the basic materials are radioactive and since all ionizing radiation is potentially dangerous, the Agency must ensure that in helping its Member States to develop the peaceful uses of atomic energy it does not increase the hazards of nuclear radiation or radioactive contamination. It must establish standards of safe practice for activities carried out under its auspices or with its assistance. The Statute, therefore, authorizes the Agency to establish, adopt and provide for the application of standards and measures for the "protection of health and minimization of danger to life and property". If requested, the Agency may also apply safeguards and the health and safety measures to a State's own nuclear activities or to any bilateral or multilateral arrangement.

Since its inception the Agency has been engaged in a careful examination of all aspects of the problem, and after many months of expert study and consultation certain draft regulations have been worked out. These regulations, which embody the principles and procedures, for the application of Agency safeguards are being considered by the Agency's Board of Governors.

Two Types

Since the safeguards will have two distinct objectives, a distinction can be made between those which will be designed to prevent the diversion of Agency assistance to military use and those against health and safety hazards. So far as the health and safety measures are concerned, a good deal of work has already been done in determining the standards of safe practice which will be the basis for the relevant rules. The Agency has published the first in its series of safety manuals, "Safe Handling of Radioisotopes", which deals with such standards.

Safeguards against the diversion or loss of nuclear materials and facilities are more difficult to devise. It is not considered feasible for the Agency to set up a system of safeguards that would guarantee that no nuclear material at all could be diverted to unauthorized use. What the Agency intends is to apply its safeguards in such a manner as to achieve a high probability of detecting the diversion of even small quantities of materials, and when larger quantities are involved, to make detection almost certain.

Not all types of materials and facilities needed in peaceful atomic energy work can be of much use for military purposes, and the safeguards against diversion need not be applied to all projects with which the Agency may be concerned. The need for safeguards would obviously arise in the case of fissile materials, because of their possible use in the production of weapons. Materials ordinarily used as fuel

in a reactor are not entirely fissile, but contain fissile isotopes in varying proportions. Besides, ordinary reactor fuel like natural uranium or uranium enriched in its fissile isotope (uranium 235) can be a source, through its use in a reactor, for the production of plutonium, which is an entirely fissile substance. Similarly, thorium, which is not a fissile material, can be used in a reactor to produce uranium 233, which is another fissile substance. The Agency safeguards may, therefore, be applied - depending on the quantity and other factors involved - to all types of these materials, namely natural uranium, thorium, enriched uranium, uranium 235, uranium 233 and plutonium. The greater the quantity of the actual fissile substances involved and the greater the possibility of diversion, the greater will be the need for safeguards.

The chief factors for determining the relevance of particular Agency safeguards to various types of nuclear materials and facilities are the type and amount of assistance supplied by the Agency and the degree to which this assistance could be used to further any military purpose, and the factors for determining the relevance of health and safety measures are the health and safety hazards connected with the activity. The regulations being formulated by the Agency will specify the types and amounts of materials to which safeguards will be applied. They will also specify the particular safeguards that will be applicable to different types of nuclear installations or facilities and to various amounts of materials. Measures against health hazards will naturally have a much wider area of application than those against diversion.

Procedures and Techniques

Details of the safeguards procedures are yet to be finally approved. Broadly speaking, they are expected to provide, inter alia, for the approval by the Agency of designs of facilities or installations in which materials subject to Agency safeguards are to be used, processed, recovered, produced or stored; the maintenance by the State concerned of records concerning accountability, inventory, operation and waste disposal; submission of periodic reports to the Agency; the deposit of excess fissile materials with the Agency; and visits by Agency representatives to the locations where the materials or facilities provided by the Agency are in use. Procedures for the application of health and safety measures will be set out in similar detail.

No safeguards are likely to be applied to cases where the possibility of diversion is negligible or where the materials that could be diverted are insignificant in quantity or are of little military use. Provision must be made for the application of health and safety measures to all Agency assistance involving radiation or radioactive materials, whether or not it is subject to safeguards against diversion as well.

Japanese Project

The Agency has already provided for the application of Agency safeguards to the project under which Japan has bought from it three tons of natural uranium for use in a research reactor. It has decided that pending the adoption of general safeguards procedures that are being worked out, certain initial safeguards will be applied to the Japanese project. It has been specified that from the time the reactor goes critical, the Japanese Government will supply semi-annual reports on the location and status of the material supplied by the Agency.

A number of bilateral agreements also contain clauses referring to the possible application of Agency safeguards to projects to be carried out under the agreements. At the second session of the IAEA General Conference, the delegations of Japan and the United States announced that their Governments intended to request the application of Agency safeguards to operations planned under their bilateral agreement.

In addition to the various steps described above, the Agency is currently preparing a manual which will describe the methods of accounting, stock-taking, storehousing and measuring nuclear material that may be in various plants under Agency direction. The general principles for control of the hazards to health and safety at the plants due to radiation, radioactive contamination, criticality, or fire, will also be discussed. This manual is expected to become a valuable source book on internal safeguards procedures for all countries embarking on atomic energy programmes.

The regulations drafted by the Agency's Secretariat are for those types of safeguards which, it is expected, the Agency will be required to apply during the next few years. As further safeguards methods are developed, the regulations may have to be modified accordingly. The Agency will conduct and sponsor research to improve the methods so that the desired security and safety may be assured with the least possible expense to the Agency and inconvenience to its Members. It has already taken some steps to devise effective methods for the accounting, measurement, stock-taking and safe-keeping of nuclear materials. Research contracts have been placed in Belgium, France and the United States for the development of techniques for the non-destructive analysis of irradiated fuel elements. Such techniques, which do not cause any physical or chemical changes in the materials tested, should make it possible to establish precisely, rapidly and economically the amount of uranium 235 contained and plutonium generated in reactor fuel.