1. INTRODUCTION

Large stockpiles of civil plutonium have accumulated in the world from the different countries' nuclear power programs. There is a serious public and political concern in the world about misuse of this plutonium and about accidental release of highly radiotoxic material into the environment. It therefore becomes necessary to keep the plutonium under strong security. One alternative for the management of plutonium is to incinerate it in reactors. But if the plutonium is fueled in reactors in the form of uranium/plutonium mixed oxide (MOX), second-generation plutonium is produced. A possible solution to this problem is to incinerate plutonium in combination with thorium. The thorium cycle produces ^{233}U which, from a non-proliferation point of view, is preferable to plutonium for two reasons. Firstly, it is contaminated with ^{232}U, which decays to give highly active daughter products. This would make handling and diversion difficult. Secondly, in case this is not sufficient deterrent, the ^{233}U could be denatured by adding some U^{238} to the thorium. The quantity of ^{238}U could be fine-tuned so as to be sufficient to denature the ^{233}U, but not so much as to produce a significant quantity of plutonium. The thorium option not only produces electricity, but also replaces the plutonium with denatured ^{233}U, which can be used in other reactors at a later date. All this can be done in existing reactors.

In the framework of IAEA activities on the use of thorium as nuclear fuel, a report on the performance of the thorium cycle, entitled "A Fresh Look at the Thorium Fuel Cycle" was drafted in 1991 and distributed as Working Material. As a follow up action, the preparation of a report on the status of thorium-based fuel cycles was started describing the state of the art of the thorium cycle. This report, an IAEA-TECDOC, titled "Thorium Based Fuel Options for the Generation of Electricity: Developments in the 1990s", has been published (IAEA-TECDOC-1155).

CRPs are tools that are effectively used by the Agency to promote exchange of scientific and technical information and assist advanced nuclear power reactor technology research and development. CRPs allow the sharing of efforts on an international basis, benefiting from the experience and expertise of researchers from the participating institutes, and fostering international team building.

At the Consultancy on "Important Consideration on the Status of Thorium" held in Vienna from 29 November to 1 December 1994, participants recommended the IAEA to organize a CRP on thorium-based fuel cycle issue. In 1995, the Agency approved the topic for the CRP: "Potential of Thorium-based Fuel Cycles to Constrain Plutonium and to Reduce Long-term Waste Toxicity"). The scope of this CRP was discussed and agreed upon by the participants of the Consultancy on "Thorium-based Fuel Cycles", held from 6 to 9 June 1995 at the Agency's Headquarters in Vienna. The participating countries in the CRP were: China, Germany, India, Israel, Japan, Republic of Korea, the Netherlands, Russian Federation and the United States of America.

This CRP examined the different fuel cycle options in which plutonium can be recycled with thorium to incinerate the burner. The potential of the thorium-matrix has been examined through computer simulations. Each participant has chosen his own cycle, and the different cycles were compared through certain predefined parameters (e.g., annual reduction of plutonium stockpiles). The toxicity accumulation and the transmutation potential of thorium-based cycles for current, advanced and innovative nuclear power reactors were investigated. As a final outcome, the CRP as next step would suggest to concentrate on the practical demonstration of plutonium-thorium incineration in a reactor in one of the member countries.