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PLAN FOR PRODUCING POTABLE WATER ECONOMICALLY:

THE NUCLEAR DESALINATION OF SEAWATER AND SMALL AND MEDIUM REACTOR DEVELOPMENT

I. Introduction

1. Resolution GC(41)/RES/14 requests the Director General to report on the progress made in the implementation of the resolution to the Board of Governors and the General Conference at its forty-second session. This document provides an overview of actions on nuclear desalination and small and medium sized reactors implemented in the Secretariat since the last General Conference and presents information updated from that contained in GOV/1998/4-GC(42)/1 submitted to the meeting of the Board of Governors in March 1998.

2. In order to assist Member States in their planning and implementation of nuclear desalination programmes and projects, preparation of a Guidebook on "Introduction of Nuclear Desalination" is underway. The Guidebook will comprise three major parts, namely, (1) Overview of nuclear desalination, (2) Special aspects and considerations relevant to the introduction of nuclear desalination, and (3) Steps to introduce nuclear desalination. The first draft was reviewed by the International Nuclear Desalination Advisory Group (INDAG) at their last meeting in June 1998.

II. International Nuclear Desalination Advisory Group (INDAG)

3. INDAG had its first meeting in September 1997 and the second meeting from 22 to 26 June 1998. In the course of the meetings national programmes and projects in Member States were reviewed and discussed. Highlights of these activities in Member States presented at the meetings include the following.

For reasons of economy, this document has been printed in a limited number.
Delegates are kindly requested to bring their copies of documents to meetings.

4. In Argentina a small reactor, which is planned to be coupled to a desalination process is under design (CAREM). Detailed engineering work is being performed, which is needed prior to construction. Some delay is, however, anticipated due to changes in the institutional framework of the project. In Canada activities on nuclear desalination comprise desalination technology development and studies for coupling to CANDU reactors and, in cooperation with the Russian Federation, to a small reactor formerly used for ship propulsion. In China a feasibility study has been initiated for a heating reactor combined with a desalination unit that could produce 150,000 m³/d of potable water. In India an existing PHWR at Kalpakkam will be coupled to a desalination unit. The first draft of the modified Preliminary Safety Assessment Report has been presented to the regulatory body and detailed engineering of the coupling system is under way. Civil work for the desalination systems has started and the commissioning is foreseen for year 2001. India offers this demonstration project for international cooperation. The status of operating nuclear seawater desalination facilities in Japan was presented; ten units are in operation and have accumulated about 85 reactor years of operational experience. The Republic of Korea is about to complete its conceptual design of the System-Integrated Modular Advanced Reactor (SMART) Project this year. The reactor is planned to be coupled to a desalination unit. A detailed programme for the development and construction phases of the project was presented, including a proposal of international cooperation by a joint-project structure with KAERI as leading organization. The feasibility study for a nuclear desalination plant in Morocco based on a 10 MW heating reactor from China will be completed this October. The site has been identified and economic assessments have been completed. The development of the concept of a floating power unit based on KLT-40 reactors was reported from Russia, proposing international co-operation for a feasibility study of a nuclear desalination plant at a specific site with this floating power unit.

5. INDAG stressed the need for international cooperation in the planning and implementation of nuclear desalination demonstration programmes and pointed out that the Agency should provide an international forum for coordination and sharing of resources. More detailed discussion about actions for international cooperation will be reviewed during an Advisory Group Meeting (AGM) in autumn 1998. INDAG also reviewed current and planned Agency activities and provided the Secretariat with recommendations for future activities. The first draft of the Agency's Guidebook on Introduction of Nuclear Desalination was reviewed by INDAG and their comments are now being incorporated. The final draft will be presented to INDAG at its meeting in 1999.

III. New Activities

6. Preparatory work for establishing an information system of nuclear heat applications has been initiated. The new database is being designed to comprehensively encompass plant design specifications, performance data, operating and outage statistics and other relevant information on nuclear plants for non-electrical applications, which include nuclear desalination, district heating, heavy water production and others. The new database will be a

set of new tables to be integrated into the existing Power Reactor Information System (PRIS) database.

7. A new Coordinated Research Project (CRP) on "Optimization of the Coupling of Nuclear Reactors and Desalination Systems" has been implemented with participation of 8 institutes. The CRP addresses the review of reactor designs intended for coupling with desalination systems, optimization of this coupling, performance improvements of desalination systems and a review of advanced desalination technologies for nuclear desalination. The first Research Coordination Meeting is scheduled for November 1998.

8. The computer programme Cogeneration and Desalination Economic Evaluation (CDEE) was validated during an Advisory Group Meeting (AGM). It was concluded that it can be used to perform comparative economic assessments of nuclear desalination plants and fossil fueled desalination options. A user friendly upgraded version is currently being prepared. Together with a revised Manual, the software package will be made available to Member States under the new name of DEEP (Desalination Economic Evaluation) as soon as possible.

9. Work has been initiated on the safety aspects of desalination using nuclear energy. A specific safety requirement for nuclear reactors used in desalination or other co-generation applications has now been drafted and has been included in the proposed update to the NPP safety requirements that have been circulated to Member States for comments. A preliminary report on the safety aspects of nuclear desalination has been prepared, and areas requiring further investigation have been identified. It has been generally acknowledged that the incremental risk associated with the addition of a desalination capability to a nuclear power plant is low. Nevertheless, the work now underway should help to characterize the risk and provide guidance to Member States in how to manage it.

IV. Interaction with Other Organizations

10. Interaction with other non-Agency organizations on nuclear desalination of seawater has been continued. Contribution of nuclear technologies on the sectoral theme of "Freshwater Management" was reported for discussions at the sixth session of the United Nations Commission on Sustainable Development in late April 1998. The Commission stressed in its report the "need for research cooperation and technology transfer to developing countries in the area of desalination".

11. As a follow-up of earlier contacts options for cooperation were discussed in May 1998 at the Middle East Desalination Research Center (MEDRC) in Oman in the desalination research fields. The MEDRC was established in the framework of the peace process in the Middle East. Co-operation with MEDRC was initiated by inviting MEDRC as an observer to the INDAG meeting in 1998.

V. Small and Medium Sized Reactors

12. Small and Medium Sized Reactors (SMRs) are of particular interest for non-electrical applications of nuclear energy, such as desalination of seawater and district heating. But SMRs are also a suitable option for electricity generation in countries with small electricity grids or for remotely located areas. The Agency has initiated a programme to assist Developing Countries in the preparation of user requirements, recognizing their special needs, circumstances and particular interests in small and medium reactors (SMRs). The "User Requirements Document for Small and Medium Reactors in Developing Countries -- A Guide for Their Preparation" is being drafted for publication as an IAEA TECDOC. This document will present guidelines and recommendations to support Developing Countries in the preparation of SMR requirements including special aspects of nuclear desalination. The draft version of this document was reviewed and endorsed in an AGM held in Vienna in June 1998.

13. The Agency has prepared an educational simulator (a software package) for universities and research centers, which would operate on a personal computer and simulate responses of a number of reactor types in the SMR size range to operating and accident conditions. This simulator is very useful in providing training for students and junior engineers in their nuclear engineering courses. The computer code can simulate selected BWRs, PWRs, PHWRs and PWRs with passive safety features such as the AP600. Five training courses on this Advanced Reactor Simulator have been provided and further courses are planned. An additional PC based Nuclear Heating Reactor simulation, PC-NHR, was recently received for incorporation into this program.

14. To perform an economic design optimization of integral type SMRs, i.e. reactors where the steam generators are included in the pressure vessel, the Agency has initiated the development of a computer code for interested organizations in Member States. This code is to be available by the end of 1998.

15. The design and development of the programme for a new concept of SMR which does not require on-site refuelling was reviewed in a Consultancy held in June 1998. Based on recommendations from this meeting, an AGM on "Propulsion Reactor Technology for Civilian Applications" has been organized for July 1998 in Obninsk, Russian Federation. This AGM advised the Agency on future activities within different types of SMRs including those used for ship propulsion, barge mounted reactors, power reactors not requiring on-site refuelling and other small reactor types presently in existence or under consideration by Member States.

16. A technical document on optimizing the staffing requirements of future SMRs based on current experience in the Member States is being developed. An AGM is scheduled for September, 1998, in Obninsk, Russian Federation, to discuss activities in progress, including

the perspective of the reactor suppliers, on achieving reduction in staffing levels in future SMRs, and to advise the Agency in the development of the technical document.

VI. Financial Requirements

17. The draft budget for 1999-2000 includes nuclear desalination activities under Project A.2.06, SMR activities under Project A.2.01, and safety-related aspects under Project H.2.01. For full implementation of all activities in projects A.2.06 and A.2.01 extra-budgetary resources in form of funds and cost-free manpower are required and the Secretariat has sent letters to potential donor countries asking for financial and technical support. By August 1998 positive responses were received from five Member States.

VII. Publications

18. To complete the update of activities on nuclear desalination and small and medium reactors a list of relevant reports prepared by the Agency in 1997/98 is provided for reference.

- Nuclear Desalination of Sea Water (Proceeding Series STI/PUB/1025), IAEA, Vienna (1997)
- Small Reactors with Simplified Design, IAEA-TECDOC-962, Vienna (1997)
- Design Approaches for Heating Reactors, IAEA-TECDOC-965, Vienna (1997)
- Introduction of Small and Medium Reactors in Developing Countries, IAEA-TECDOC-999, Vienna (1997)
- Floating nuclear energy plants for seawater desalination, IAEA-TECDOC-940, Vienna (1997)
- Energetic cost evaluation of co-production plants for electricity and potable water, IAEA-TECDOC-942, Vienna (1997)
- Integral design concepts of advanced water cooled reactors, IAEA-TECDOC-977, Vienna (1997)
- Methodology for Economic Evaluation of Cogeneration/Desalination Options: A User's Manual, (Computer Manual Series No. 12), IAEA, Vienna (1997)
- Non-electric applications of nuclear energy, IAEA-TECDOC-923, Vienna (1997)
- Nuclear Heat Applications: Design aspects and operating experience, IAEA-TECDOC-(in publication)
- Potential for Nuclear Desalination as a Possible Source of Low Cost Potable Water in North Africa, IAEA-TECDOC-917 (Arabic Version in publication)
- Options Identification Programme for Demonstration of Nuclear Desalination, IAEA-TECDOC-898 (Arabic Version in publication).

