MEETING REPORT

Sixth International Nuclear Desalination Advisory Group (INDAG)

held at the IAEA Headquarters, VIC, Vienna 10 to 12 July 2002

CONTENTS

LIST OF PARTICIPANTS

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A. General

The sixth meeting of the International Nuclear Desalination Advisory Group (INDAG) was held from 10 to 12 July 2002 at the VIC, Vienna. The meeting was attended by 13 members and one observer (from Russian Federation) and represented by one International Organization (OECD). Members from Japan, Saudi Arabia and Tunisia excused themselves. Mr. Nisan of the Commissariat a l'Énergie Atomique of France served as the Chairperson.

Welcoming Pakistan as a new member of the INDAG, Mr. Mourogov, Deputy Director General of the Department of Nuclear Energy, opened the meeting by briefing on the relevant progress and development in the Agency's activities in the field of nuclear desalination. Concerning the specific expectations from this meeting, Mr. Mourogov stressed the importance of deliberating how early deployment of nuclear desalination could be facilitated. He also expressed his expectation of fruitful feedback to the proposed programme plan for 2004/2005.

The meeting provided a forum for the exchange of information on the progress of national programmes in this field. INDAG also reviewed and assessed ongoing IAEA activities in the relevant field and future activities being proposed by the Secretariat for the year 2004/2005 and made certain recommendations.

B. Recent Developments in National Programmes

All participants updated status and prospects of programmes on nuclear desalination in their respective countries. Copies of presentation materials are available in the office of Mr. T. Konishi (Room A2563).

Argentina

Despite the severe financial crisis that is affecting the country, some relevant activities concerning CAREM project have continued. The first stage of experimental tests to characterize the hydraulic behavior of the Fuel Assembly has been performed, and the second stage, corresponding to flow-induced vibration tests has been programmed for the end of this year.

On the other hand, CNEA has submitted the CAREM concept for evaluation to the *Generation-IV International Forum* (GIF). "Generation IV" refers to the development and demonstration of one or more Generation IV nuclear energy systems offering advantages in the areas of economics, safety and reliability, sustainability, and that could be deployed commercially by 2030. Six to eight most promising concepts of reactor system and fuel cycle, and the R&D necessary to advance these concepts have been identified for potential commercialization. Organized by US-DOE-NE, eight countries have joined the effort: Argentina, Brazil, Canada, France, Japan, Republic of Korea, Republic of South Africa, and the United Kingdom. As a main conclusion, CAREM concept was considered among the most promising reactors having great potential in the areas of economics and safety. Our country has also participated in the International Senior Technical Experts Group of the GIF, in charge of the technical evaluation of the different nuclear systems.

Besides the ongoing programs of the Agency on nuclear desalination, our country is supporting a new Coordinated Research Program (CRP) on "Economic Research on, and Assessment of Selected Nuclear Desalination Projects and Case Studies". The new project is aimed at the collection and analysis of site-specific data (economic and other) required for evaluating the feasibility of nuclear desalination options in Argentina and Latin America.

INVAP presented an advance report on the tasks performed to upgrade the modeling tool, DESNU spreadsheet, for producing the RETRAN input file of an MSF desalination plant at the 3rd Research Coordination Meeting in October 2001 of CRP, "Optimization of the Coupling Nuclear Reactors and Desalination Systems". During this year, a new upgrade of the spreadsheet for producing RETRAN input file of an RO desalination plant was performed, leading to the completion of INVAP's scope of models to be developed.

According the request of previous INDAG meeting, we have elaborated a presentation with a systematic and practical approach on safety aspects: how to define in scope and organize the Contents of the Safety Analysis Report for a Nuclear Desalination Plant.

Canada

Activities in Canada on nuclear desalination comprise nuclear reactor development by AECL and desalination technology development by CANDESAL Technologies. From its successful experience of more than 50 years with CANDU, AECL supplies complete nuclear generating stations in all aspects of nuclear technology including its application to non-electrical products.

CANDESAL has been developing a unique approach to the design and operations of reverse osmosis systems, including their coupling to the energy generation system, to improve energy efficiency and significantly reduce the life cycle production cost of potable water.

On the reactor side, AECL has initiated the design of an advanced CANDU reactor that will meet all requirements of the Generation IV initiative, including the application of "energy products." Cooperation between CANDESAL and AECL is foreseen in the coming year to integrate the advanced CANDU design and the CANDESAL RO technology. Analysis has also been carried out in the past year to utilize the moderator cooling system, a feature unique to the Pressurized Heavy Water Reactor, as a source of additional waste heat to further improve the effectiveness and efficiency of the coupling between the reactor and the desalination system.

With respect to the desalination development, an experimental program has been carried out to investigate and demonstrate the validity of the CANDESAL design methodology. The results of the experimental program have demonstrated that the unique, non-traditional CANDESAL approach to design and operation of RO desalination systems will yield the performance improvements suggested by the design models. Actual system performance exceeded that predicted by analysis. This demonstration has shown that the CANDESAL technology is viable for commercial implementation and a new operating company, CANDESAL International Corporation, has been created to carry out the sales & marketing, design, manufacture, installation, commissioning and after-market services for commercial units.

CANDESAL's participation in EURODESAL has continued, as has the collaboration with Russia on the application of its technologies to a floating nuclear desalination system, consisting of a barge-mounted Russian reactor and a barge-mounted Canadian desalination unit.

China

Northern China is one of the regions suffering from freshwater shortage, particularly in Shandong peninsula. Its freshwater availability per capita is only 300m^3/yr, one-sixth that of the national average level. In order to promote constructing a demonstration plant of nuclear seawater desalination, a pre-project study of the Shandong Nuclear Seawater Desalination Plant (SNDP) was carried out in 2001.

The technological base for the SNDP is to use a 200MWth nuclear heating reactor (NHR-200) as the heat source and couple it to an MED process with vertical tube foamy flow evaporation for desalination. The SNDP will produce 160,000 m^3/day of potable water and provide a base for future construction of the desalination units for coastal regions in China. The pre-project study was finalized in August 2001. It is in the review by China International Engineering Consultant Co.

In order to validate the design performance and optimize the thermal-hydraulic parameters, a test system of a vertical tube MED process has been set-up in INET, Tsinghua University. The test system consists of four effects, four feedheaters, a steam generator powered by electricity, a final condenser, a brine tank, pumps and valves etc. All of the effects and feedheaters have once-through vertical tube heat transfer bundles. The system is now in the commissioning test.

Egypt

NPPA is carrying out a number of integrated studies to provide the decision makers with detailed information. Also, NPPA is working to complete the necessary infrastructure of El-Dabaa site. A feasibility study for the construction of a co-generating nuclear plant at El-Dabaa to produce potable water and generate electricity is completed. An experimental facility is under construction, and will be used to study the characteristics of SWRO over the range of allowed temperature and pressures. It is planned to have a nuclear power plant in operation early next decade.

France

CEA, Nuclear Energy Directorate (DEN), is involved in several nuclear desalination studies:

- Own studies under the Future Reactor Systems Division, Project No. SF/13.
- European Union project EURODESAL, of which CEA is the Coordinator. This project is being conducted with four EU and one Canadian Industrial organisations and two leading EU R&D institutions.
- Site-specific study for the La Skhira site in Tunisia under the bi-lateral agreement between CEA and CNSTN under the aegis of IAEA's INT/4/134 programme: The TUNDESAL Project.
- Bi-lateral collaboration agreement between CEA and CNESTEN for site-specific studies of the Agadir and Laayoun sites in Morocco: the AMANE project.

CEA, along with its EURODESAL partners, is actually preparing a proposal for EURATOM's 6th Framework Programme (FP) for a nuclear desalination demonstration project, named EURODESAL Demo.

CEA is also participating in the IAEA CRP: Economic Research on, and Assessment of, Selected Sites and Case Studies.

Among the major achievements of the EURODESAL projects are:

- The elaboration of optimised and innovative coupling schemes based on the utilisation of waste heat from nuclear reactors.
- Consistent economic evaluation of nuclear desalination with well validated codes and comparison with fossil energy, (Pulverised Coal, PC, and Gas Turbine Combined Cycle, CC) and renewable energy, based systems such as Solar Thermal (ST), Solar Photovoltaic (PV) and Wind (W) energies.

First results are highly encouraging: safety verification studies including transient studies have shown that, provided certain design considerations are respected, the use of a nuclear reactor does not in any way affect its operation or lead to a contamination of product water.

The economic assessment leads to the conclusion that desalination costs by nuclear reactors could be about 10 to 30% lower than PC or CC. Even in conditions favouring fossil energy systems (low fuel costs, 10% discount rate) the nuclear option remains competitive.

Desalination costs by renewable energy sources, except by wind, appear to be much higher even when land acquisition costs are not included.

India

India is setting up a 6300 m^3/d combined MSF-RO Nuclear Desalination Demonstration Plant (NDDP) connected to the two 170 MWe PHWR units at Kalpakkam with the following objective:

- To gainfully employ the years of experience and expertise in various aspects of desalination activities on laboratory scale/ pilot scale
- To demonstrate nuclear desalination technology on large scale
- To demonstrate safe and economic production of good quality water by nuclear desalination of seawater
- To cater the desalted water requirement for the dual needs

Considerable progress has been made in the implementation of the project. Installation of RO section has been completed. Pre-commissioning trials of the RO has been taken up. Commissioning of the MSF section is expected in 2003.

The location of desalination plant at an existing nuclear reactor has resulted in many experiences not encountered in coupling to a new nuclear plant. NDDP utilizes power, steam and seawater from the existing nuclear power plant (MAPS). The steam tapping for NDDP could not be done in either back pressure or extraction mode from the LP turbine as it required modification in the station which was not desirable. Steam tapping was taken from cold reheat lines after the HP turbine and employing moisture separator. No additional seawater from the existing seawater intake from the MAPS was available. Studies were conducted for the independent seawater system for NDDP. Kalpakkam site is prone to excessive biofouling from raw seawater. Kalpakkam site is also known to have excessive sand movement. It was decided to use the process seawater coolant outfall as feed to the desalination plant. The blending of product water from MSF with the permeate of RO simplifies the post treatment and achieves appropriate LSI with the minimal post treatment.

Useful design data are expected from this plant on the coupling of small and medium size reactors (SMR) based on PHWR. This will enable us to design a large size plant up to 50,000 m^3 /d capacity. India will share operation and maintenance (O&M) experience of the NDDP to Member States when the plant is commissioned.

India has an active programme to study the possible utilization of waste heat from a heavy water research reactor and PHWR by coupling low temperature evaporation (LTE) desalination systems for seawater desalination. A small LTE desalination plant earlier established in the Desalination Division, BARC, has been shifted, installed and coupled to the CIRUS research reactor. The data from this pilot plant will be useful for design of a larger desalination plant at a PHWR for the production of process make up water.

India is also engaged in collaborative actions through CRPs. In the CRP on “Optimization of Coupling of Nuclear Reactor and Desalination Systems”, India has focussed on working together with other participants on common aspects related to the performance evaluation of desalination systems and different types of SMRs for coupling. India is also participating in the CRP on “Economic Research on, and Assessment of Selected Nuclear Desalination Projects and Case Studies” and focussing on working together with the other participants on the economic assessment of hybrid nuclear desalination systems.

Israel

The Israel government decided to intensify the desalination program in view of the severe water situation, where the natural water supply fall by more than 10 % behind the 2 billion m^3/year demand, causing additional irreversible damages such as salination of the aquifers due to overpumping.

The decision calls for the construction, as soon as possible, of desalination plants to produce 400-M m^3/year of desalinated seawater and about 100-M m^3/year of desalinated brackish water. Average improved quality of the national water is also expected.

Description of activities

- 100-M m^3/year desalinated seawater near Ashkelon [Mediterranean seashore, a few kms north of Gaza strip, about 50 kms south of Tel-Aviv]. This is a BOOT project, well on its way. The financing issue is thus removed from the government to the contractors, as well as supply risks. The tender was published in 2001; the winning bidder is a group constituting IDE and Vivendi and the contract to carry out the project was signed some months ago. The project is scheduled to be completed in 2005. It should be interesting to point out that:
  - The project was conceived as a 50-M m^3/year project. After the winning bidder was chosen, it was decided to double the project's size.
  - The price of the desalted water is slightly less than 52.7cents/m^3.
  - The quality of the desalted water is relatively high – no more than 20ppm chlorides and 0.4ppm boron.

Up to 65-M m3/year of desalinated seawater on two sites proposed by the owners. This is a BOO project (Build, Own, Operate). The tender was published and offers were submitted but no winning bidder has been chosen so far. The plants are expected to be completed in 2005.

- 45-M m^3/year desalinated seawater at the Eshkol power station near Ashdod [30 kms south of Tel-Aviv]. This is a turnkey project initiated and tendered by Mekorot Co. [the national water utility]. The tender was published and offers were received but no winning bidder was yet declared. A decision is expected by the end of July 2002.
- 50 to 100-M m^3/year of desalinated seawater at or near the Hadera power station [50 kms north of Tel-Aviv]. This area is contemplated as a major desalination center, which may ultimately provide up to 300-M m^3/year of desalinated water for Israel, the Palestinian Authority and Jordan. Requests for prequalification were issued and are pending. The tender has not been published yet.
- 20 to 28-M m^3/year brackish water at the Yerucham/Rotem plain in the middle of the Negev desert [130 kms south of Tel-Aviv]. This is a BOT project for extraction and desalination of up to 30-M m^3/year of brackish water. (20 to 28-M m^3 fresh water). The tender is now being prepared and requests for prequalification have been published and are still pending.
- Several small (up to 2-M m^3/year) seawater desalination projects have been proposed and await government approval.
- Several brackish water desalination projects are being developed by Mekorot Co. itself.

In parallel, import from Turkey of 50-M m^3/year of fresh, high quality river water is planned. This is still a controversial project and is pending final government decision.

The described activities are obviously not nuclear, but they may contribute to the IAEA activities in 2 ways:

- The real data evolving from those projects may be used as input to DEEP regarding real large plants.
- The low cost (which will be hopefully less than the mentioned price of ¢ 52.7 /m^3) is expected to be even lower for the doubled capacity as indicated. This, and with relatively low energy costs that are attained by marginal improvements (which are justified at large scale) hints that grid-energy may be competitive with nuclear energy but has the advantage of site-selection flexibility.

Japan (absent)

Korea Rep. of

Well-established nuclear energy and desalination technologies pursue their extended applications to resolution of fresh water shortage problem by seawater desalination using nuclear energy. The objectives are mainly to develop an integrated desalination plant with SMART (System-integrated Modular Advanced ReacTor) for a dual-purpose application. The programme is being carried out by the Korea Atomic Energy Research Institute (KAERI) as the leading organization with the support of Government and participation of industries. This nuclear desalination plant developed by KAERI aims to supply forty thousand (40,000) tons of fresh water per day and ninety (90) MW of electricity to an area with approximately a ten thousand (100,000) population or an industrialized complex.

This programme started in 1997 with the projected plan of eight years until readiness for the initiation of construction, focusing mainly on the small and advanced reactor and associated technology development. The scope of the programme includes reactor and fuel design, associated technology development, design verification (experiments, tests), power plant design, component design, and manufacturing technology development, desalination system design, etc. Both the conceptual design and basic design of SMART with a desalination system were successfully completed in March 1999 and in March 2002, respectively. Now, the SMART design verification phase is currently underway to conduct separate effect tests and comprehensive integral tests as well as construction of the one fifth scaled pilot plant (SMART-P) for demonstration of overall SMART performance.

Inputs from IAEA programmes are: use of DEEP code for economic evaluation of the nuclear desalination plant with SMART, participation in the CRP on “Optimisation of the coupling of nuclear reactors and desalination systems” based on the activity in the SMART project and on “Economic Evaluation of SMART in Korea”, and forum for technical information exchange. From the very beginning, the Korean programme has been open to co-operation from any interested Member States. For this purpose, the SMART project has been brought to the IAEA interregional technical co-operation project (INT/4/134) on “Integrated nuclear and desalination system design” which started in 1999. KAERI started at January 2, 2002 the joint study with BATAN, Indonesia, and the Agency on “Preliminary Economic Study of Nuclear Desalination in Madura Island, Indonesia” as one of Korean contributions to the IAEA Interregional TC project.

Libya

Libya is already suffering from water shortage problem, the deficit has reached about 673 Mm^3/y in 2000 and expected to reach about 4202 Mm^3/y in 2025. It is foreseen that desalination of seawater is the only solution to be in line with other national projects to cover the need for potable water.

Considering the huge quantity of water required to cover the need for water, activities in nuclear desalination has been launched since 1989. In the framework of CRP's, working groups are carrying out studies and investigation regarding viability and competitiveness of nuclear energy for desalination of seawater in Libya, and in order to broaden the involvement of different sectors in the country some departments at the university of Alfateh are involved in this activity via assigning postgraduates and researchers in the field of coupling optimization.

A national plan has been put forward to build series of desalination plants along the sea coast to supply coastal cities with potable water. Some plants are already in commissioning stage. Some have been contracted and others are under evaluation.

Morocco

The implementation of nuclear desalination pilot project has witnessed some delays due mainly to some infrastructure and organizational issues. In order to establish an adequate and sound legal and institutional framework, allowing safe development of nuclear activities, Morocco created in 2001 the standing commission in charge of nuclear affairs (COPSAN). The standing commission has responsibilities, inter alia, in preparing, a unique nuclear safety law, which covers all aspects of radiation, waste, nuclear and transport safety. This law will create a unique and independent nuclear safety regulatory authority under the prime minister. With active co-operation with the Agency, the legislative and regulatory framework is in very advanced stage of approval.

The Government of Morocco strongly believes that existence of effective regulatory infrastructure is a prerequisite for the development of any promotional nuclear activities. In addition, Morocco has: (a) a specific law (covering management, transport, distribution, pricing and environmental issues) related to water; (b) a vision aiming at meeting its water needs in a sustainable manner including desalination; and (c) a strategy with clear responsibilities of and coordination among all concerned parties (e.g., ONE, ONEP, CNESTEN...etc.).

In addition to the above elements, Morocco is committed to become familiar with all existing and available technologies and expertise in nuclear peaceful activities in general and desalination in particular. This is done and will be further strengthened in co-operation with the IAEA and other countries through multilateral and bilateral arrangements. This was the case with China, under the TC programme of the Agency, and other on going programmes involving national operators with other countries.

Pakistan

Pakistan Atomic Energy Commission (PAEC) has initiated a feasibility study for coupling 4500 m3 /d capacity desalination plant with the existing 137 MWe (PHWR), Karachi Nuclear Power Plant (KANUPP), to demonstrate the technical and operating features of nuclear desalination. IAEA is providing technical assistance and expert advice under the interregional TC Project (INT/4/134), "Integrated nuclear and desalination system design".

At an Agency mission to Pakistan in March 2002, the technical aspects of the project and the matter regarding technical support and manpower training plan were discussed. Further expert missions to Pakistan are being planned for assistance, the first one being in September 2002. PAEC has extended request to IAEA for participation in the interregional TC Project (INT/4/134) and the various programmes in the Member States that are open for international cooperation.

A small Reverse Osmosis (RO) desalination plant of 2 x 227 m3 /d capacity, already installed at KANUPP, is operating satisfactorily since February 2000.

PAEC is participating in Agency's Coordinated Research Project (CRP) on "Economic Research on, and Assessment of, Selected Nuclear Desalination Projects and Case Studies" since January 2002. Title of CRP is "Economic research/assessment of coupling 137 MWe KANUPP with a desalination plant of about 4500 m3/d (1 MGD) capacity. (Research Contract No. 11867/ RBF). DEEP code is being used for initial economic assessment of the project.

PAEC is also planning to carry out a feasibility study for a large dual-purpose NPP to meet the water and power requirements in the Karachi region.

Russian Federation

The work in the field of nuclear desalination is aimed at the analysis of technical and economic problems of utilizing various nuclear reactor types as electric power and heat sources for seawater desalination plants. A scientific and technological basis resulting from these activities will be applied to detailed development in the practical implementation of nuclear desalination systems.

The systematic R&D has been conducted for applying small KLT-40C (35 Mwe) and NIKA (70 Mwe) PWRs and a RUTA (55 MWth) heating reactor.

Various coupling schemes of these nuclear reactors with desalination plants have been developed. Design, technical and cost characteristics of nuclear desalination plants have been assessed using DEEP 2.0 as well as its modified version suitable for modeling reactor features and coupling options under consideration. The technical specifications are optimized with due regard to the results of economic assessments.

These activities form the basics for participation in the IAEA's CRP "Optimization of the Coupling of Nuclear Reactors and Desalination Systems" and the new CRP on "Economic Research on, and Assessment of, Selected Nuclear Desalination Projects and Case Studies".

Preliminary studies have been carried on or started to assess use of other Russian medium-sized reactors under development now such as VVER-640, GT-MGR, BREST-300, VK-300 and SVBR-75/100, for nuclear desalination. These are generic studies including economic evaluations only, and are not oriented to specific sites or conditions.

An important element of the future work is the joint Russia-Canada project of a floating nuclear desalination complex on the basis of the Floating Power Unit with KLT-40C reactor plants and an optimized Canadian desalination system with reverse osmosis desalination modules. Now the Floating Power Unit project development is coming to the end, and construction of a pilot plant at the shipyard in Severodvinsk, Arkhangelsk Region, is planned for 2005-2006.

Saudi Arabia (absent)

Tunisia (absent)

United States of America

In recent years there has been no development activities related to the use of nuclear energy for co-generation of fresh water in the US. However, as global and US domestic fresh water shortages grow more acute, there is new interest in developing concepts for nuclear energy production of fresh water.

The soon to be released US DOE Generation IV roadmap initiative report will include a detailed discussion of potential nuclear energy products. Included in this report will be recognition of the important role that future nuclear energy systems must play in producing fresh water. Four areas have been identified as potential topics for further investigation:

- Development of relevant models and adaptation of the IAEA model for nuclear desalination to Generation IV systems,
- Monitor R&D progress in the fields of optimized reverse osmosis and multi-effects distillation for use with Generation IV concepts,
- In the field of multi-stage flash distillation processes, track developments on heat exchangers, crud control and brine disposition, and
- Evaluate commercial opportunities for coupling to product extraction from brine of materials such as uranium and other products with market value.

Recognizing the maturity of desalination technology, a project has been initiated by Argonne National Laboratory in the framework of the IAEA's CRP on "Economic Research on, and Assessment of, Selected Nuclear Desalination Projects and Case Studies" to document existing nuclear desalination experience at the Diablo Canyon Nuclear Power Plant (DCNPP). Pacific Gas and Electric is collaborating to develop desalination cost models for the coupled evaporators and reverse osmosis fresh water systems that have been operated at the DCNPP. The results of this work will be used to identify potential enhancements for the systems at DCNPP and provide input to designing future nuclear energy desalination systems.

OECD

The OECD Nuclear Energy Agency will initiate a project on non-electrical applications of nuclear energy in 2003. The outline of the project was presented. IAEA will be invited to participate.

C. Progress Review of Nuclear Desalination Activities

INDAG reviewed the progress of the Agency's nuclear desalination activities implemented since the last INDAG meeting in July 2001. Following activities were specifically reported to INDAG:

- INPRO
- International Symposium on "Advances in nuclear desalination: Options and Challenges"

- Economic Assessment Studies
- DEEP User's Group
- PRIS Extention for Non-electric Applications
- Regulatory aspects of nuclear desalination.

D. Technical Topics

INDAG elaborated on the latest technological review on the following topics. Members appreciated this session. Copies of presentation materials are available in the office of Mr. T. Konishi (Room A2563).

- Contents of the SAR for a Nuclear Desalination Plant *C. Mazufri, INVAP, Argentina*
- Utilisation of the waste heat in a GT-MHR and/or PWR *S. Nisan, CEA, France*
- Advanced RO Technology for Application in Nuclear installations *J.R. Humphries, CANDESAL, Canada*
- Potential Application of Waste Heat for Desalination in PHWR *P. K. Tewari, BARC, India*

E. Findings and Recommendations

Noting that 2002-2003 activities are continuing as planned, INDAG has:

1. Supported the proposed programme of activities for 2004-2005.
   - Develop and maintain DEEP.
   - Provide direct assistance to Member States for special cases of DEEP applications upon request.
   - Compile a Technical Document on the results of the CRP (1998-2003) on Optimization of the Coupling Of Nuclear Reactors and Desalination Systems.
   - Prepare a Technical Document and co-ordinate the CRP (2001-2006) on "Economic research and assessment of selected nuclear desalination projects and case studies".
   - Launch and co-ordinate a new CRP on "Potable water production at co-generation nuclear plants with special reference to HTGRs (provisional title)", if significant interest is expressed by Member States.
   - Continue data collection and processing on non-electrical applications at NPPs (Extended PRIS) and preparation of a technical document on extended PRIS tables (in cooperation with NPES).
   - Support the Interregional TC Project (INT/4/134) on "Integrated Nuclear Power and Desalination System Design":
   - Provide training on nuclear desalination technologies and desalination economic evaluation program DEEP.
   - Co-operate with other international organizations, for (i) joint activities and (ii) co-ordination of programmes.
2. Recommended, in addition, that Technical Meetings be organised by the Agency on specific topics of interest in nuclear desalination in the years in which INDAG meetings are not held. These could be in the form of Technical Meetings (TM) or symposia (SM)
3. Proposed that a first TM be held in 2003 on the following specific technical topics,
   - Power-to-Water Ratio and load following aspects
   - Waste heat utilization

- Environmental and socio-economic aspects related to the deployment of integrated nuclear desalination systems
- Regulatory and Licensing aspects

4. Recommended to publish a general Status Report on Nuclear Desalination related activities in MS (and other international organisations) periodically. Proposed table of contents for a first report could be:

- Executive Summary
- Introduction and Background
- Operating Experience
- Activities of IAEA and Other International Organisations
- International Cooperation
- On-going Developments in Member States (4 pages at most/country)
- Conclusions

Proposed schedule of compilation (Members' input by Feb. 2003 on the Business Collaborator; Publication by the next INDAG meeting) was agreed as the target.

5. Recommended that the publication of the NEWSLETTER be continued including the following items in the next issue due for the General Conference in September 2002.

- Message from the Chairman
- Use of waste heat (input from France, India, Canada)
- International collaboration (INT, bilateral)
- Participations in international conferences such as IDA, IYNC, ICONE and ANS/ICAPP
- Highlights of symposium in Marrakesh
- Highlights of on-going and future activities (from the current 2002/2003 programmes).

It was agreed that the Scientific Secretary informs by the end of July the different contributors regarding respective contributions to the NEWSLETTER.

6. Proposed that the next meeting be held in 2004 after the PPAS and sufficiently before finalising the draft programme for 2006-2007. Also proposed to include a session on specific technological topics, requesting that members be communicated before finalizing the topics.