

# **MEETING REPORT**

## **Fourth International Nuclear Desalination Advisory Group (INDAG)**

**held at the IAEA Headquarters, VIC, Vienna  
12 to 14 April 2000**

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## **A. General**

The fourth meeting of the International Nuclear Desalination Advisory Group (INDAG) was held from 12 to 14 April 2000 at the VIC, Vienna. The meeting was attended by 15 members and three observers from Canada, Russian Federation and the Arab Atomic Energy Agency (AAEA). Mr. S.H. Kim of the Republic of Korea served as the Chairperson.

Mr. Juhn, Director of the Division of Nuclear Power, 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. Juhn stressed his strong hope, in view of the Agency's new policy of matrix management, for evaluation of achievements and recommendations, particularly on: (i) Agency proposed activities for 2002/2003; and (ii) a mechanism for facilitating effective implementation of a nuclear desalination demonstration.

INDAG reviewed the proposed meeting agenda and adopted the agenda as given in Attachment 1. The report of the previous meeting was approved without change.

INDAG reviewed and assessed ongoing IAEA activities in the relevant field. INDAG also discussed future tasks being proposed by the Secretariat for the year 2001 and planned for 2002/2003.

## **B. Recent Developments in National Programmes**

Status and prospects of programmes and activities in individual members' countries were updated by all participants. Summaries of reports are as follows:

### ***Argentina***

In the framework of the implementation of the law for CAREM prototype construction, economical and environmental assessment reports are being issued for their presentation to Cabinet Chief. It was made public that the site selected is one of the former Experimental Heavy Water Plant sites, within the Atucha site. An external General Design Review was performed by a competent and active international nuclear power plant (NPP) supplier with a very encouraging output.

In the framework of the Agency's Coordinated Research Project (CRP) on "Optimization of the coupling of nuclear reactors and desalination systems," INVAP has already produced a useful software tool (DESNU) for the analytical evaluation of coupling.

### ***Canada***

Significant progress has been made since the last INDAG meeting. The areas of progress have encompassed the CRP project on optimization of the coupling between reactors and desalination systems, co-operative programs, technology development and commercial development.

With respect to the CRP project, the RO technology analysis phase has been completed. Re-analysis of the CANDESAL - CANDU 6 coupling with improved RO membranes (having higher surface area) has shown improved performance characteristics, lower energy consumption and lower water production costs. The design of the experimental rig for demonstration testing has been completed and procurement of components is underway. CANDESAL Technologies will carry out

fabrication of the experimental system.

With respect to co-operative projects, a request for fellowship training has been received from Egypt through IAEA/TC. Processing of the request is currently underway. The joint project with Russia for the development of a Floating Nuclear Desalination Facility has received strong support from MINATOM, and working meetings in Russia are being planned for mid-2000. Regarding the Interregional Project (INT/4/134), AECL and CANDESAL have responded to the IAEA follow-up questionnaire, noting that both organizations are prepared to participate in co-operative projects and are prepared to provide training and technical assistance if the specific requirements of “technology seekers” can be clarified.

With respect to technology development, system design optimization studies have been advanced considerably, and are showing that even more significant benefits can be realized from a sophisticated design optimization than were originally envisioned. In addition, a cost evaluation code has been developed to address cost calculations specifically for optimized RO system designs. General cost evaluation continues with the DEEP code, but it is not suitable for addressing optimized system designs.

### ***China***

An MOU was signed in the end of 1998 between China and Morocco governments to establish a demonstration nuclear desalination plant with 8,000 m<sup>3</sup>/day in Tan-Tan, using an INET 10 MWt nuclear heating reactor coupled with an MED. Two government delegations held discussions in October 1999 how to proceed with the project preparation based on the agreement.

The programme of SMR development related to nuclear seawater desalination is being implemented. A new project of 2 x 300 MWt NHRs for district heating in Shenyong city has been approved by the State Development Planning Commission and Shenyong Municipal. The basic and detail design are underway.

### ***Egypt***

The work to complete Feasibility Study of nuclear power and desalination at El Dabaa site (EGY/4/040) is continuing. It is planned to be completed late this year. Also, bids to construct a test facility to study the effect of pre-heating RO at El Dabaa have been evaluated technically. The contract will be awarded soon.

### ***France***

France has started a nuclear desalination feasibility and economic studies as part of CEA’s own innovation programme and as part of a proposed joint-European Study (The EURODESAL Project) which regroups 4 EU industrials, 3 R&D organizations and the IAEA.

Under the first call for proposals by the EU Commission, it was decided that EURODESAL be re-proposed in the 2<sup>nd</sup> call for proposals in October 2000. For this call, extension of the partnership in EURODESAL is currently being considered to include CANDESAL (Canada), General Atomics (USA), companies from Malta and Cyprus and, possibly, an organization from Japan (under discussion).

## ***India***

India is setting up a 6,300 m<sup>3</sup>/d combined MSF-RO nuclear desalination demonstration plant (NDDP) at 2 x 170 MWe PHWR station at Kalpakkam. The tenders for the major equipment of this plant are released and are under various stages of procurement/fabrication. The civil and electrical work has started. Tenders for seawater intake/outfall and steam supply are under preparation.

Useful design data is expected from this plant on the coupling of a small PHWR with a hybrid desalination plant. India will share the O&M experience of NDDP with Member States when the plant is commissioned around March 2002.

India has an active programme to study the possible use of large amount of moderator waste heat from a heavy water research reactor and PHWR by coupling low temperature evaporation of seawater. A small pilot plant earlier established at the Desalination Division is to be shifted shortly to the CIRUS research reactor for coupling. The data from this pilot plant will be useful for design of a 1000 m<sup>3</sup>/d desalination plant at a PHWR for the production of process water.

India actively participates in the CRP on "Optimization of Coupling of Nuclear Reactor and Desalination Systems". During the 2<sup>nd</sup> RCM held at Mumbai on 10-14 February 2000, the focus was on working together by the Member States on common aspects related to the performance evaluation of desalination system and different types of SMRs for coupling.

## ***Israel***

The government decided a year ago (as reported in the previous INDAG meeting) to initiate a large scale desalination programme on a national scale. Thus, the objectives of this program are to improve both the country's overall water balance and the average water quality. During the last year, most of the preparations toward an international bid have been carried out:

- a) The optimal site was identified;
- b) Very detailed bid documents (of a few hundred pages) have been written giving a lot of specified flexibility and freedom of choices to the bidders regarding many of the project specifications, including the desalination and the energy technologies;
- c) A large scale meeting took place where the major features of the project and bid terms were presented, while 6 candidate bidders presented their technologies and possibilities regarding the project.

The first project of the program itself is a 50-55 millions m<sup>3</sup>/year of low salinity water, suitable to be used first for domestic needs and then reused as treated sewage for agricultural irrigation. In principle the project is a BOOT arrangement. Thus the winning bidder will sell desalted water for 20 years and then transfer the desalting plant to the Israeli government.

The final decision of the government to actually announce the official tender is expected in mid April 2000.

Along the process and procedures of this program a lot of detailed information, data and know-how will be accumulated which may be of a significant use in other large scale desalination projects and programmes.

## ***Japan***

A sub-committee of seawater desalination was established under the Science Council of Japan, in order to investigate desalination technologies to supply fresh water for agriculture and also to review the R&D items for the current desalination technologies.

To incorporate recommendation for the implementation of future R&D for small and medium nuclear reactors into the “Long Term Program for Development and Utilization of Nuclear Energy” in Japan, a sub committee was established under the Atomic Energy Commission of Japan. Application scenario of SMRs, for instance for nuclear desalination, will be discussed in this committee.

A new RO plant with the capacity of 40,000 m<sup>3</sup>/d will be constructed to supply drinking water at Fukuoka-shi of Kyushu island. It will provide useful design and operational information because it is planned to apply several latest technology improvements in the RO process, such as new treatment technology and high recovery ratio of around 60%.

## ***Korea Rep. of***

Since 1 April 1999, the Korea Atomic Energy Research Institute (KAERI) has been carrying out the basic design for the integrated nuclear desalination system with SMART and will complete the basic design by 31 March 2002. In this basic design phase, Korea Power Engineering Company (KOPEC) performs the BOP design and Korea Heavy Industry and Construction Company (KHIC) develops the major components and seawater desalination technologies.

## ***Libya***

Activities in the field of nuclear desalination in Libya are embedded in the work of three groups (committees) that have been formed. One group is concerned with nuclear reactor and desalination system coupling. The second group is doing some economic studies using DEEP. The third group is studying and following the development of SMRs.

The objective of these group’s work is to investigate the most useful and practical coupling between the two systems which will be used to produce potable water economically.

## ***Morocco***

The Tan-Tan nuclear desalination demonstration project is under examination by the Government. A memorandum was concluded between China and Morocco in December 1998 in order to go ahead with the project. Guidance and orientation from the decision-maker are due.

## ***Russian Federation***

The design and licensing activities for a floating co-generation plant based on a Nuclear Floating Power Unit (NFPU) with KLT-40C reactors are in progress now. A decision to start construction is expected later this year. Application of the NFPU as an energy source for seawater desalination is also under consideration. A conceptual design of coupling the NFPU with MED facilities was prepared and further development is planned. The co-operation project on development of a nuclear floating desalination plant using the Russian NFPU and Canadian barge mounted RO desalination facility is being considered and will probably be started in the middle of this year.

Various coupling schemes for several Russian small reactors (RUTA, NIKA, KLT-40C) are being investigated in the framework of the CRP on “Optimization of the coupling of nuclear reactor and desalination system”. Optimal coupling design, safety considerations and economic evaluation of nuclear desalination plants using DEEP software are the objectives of the study.

### ***Saudi Arabia***

Saudi Arabia produces large quantities of desalted water. The planned capacity of desalted water approaches 850 mgd. It is planned to use desalted seawater as a primary source of freshwater in the country and brackish water as backup. There is a recent trend to install large seawater RO plants. Nuclear application in the field of desalination is considered as a possible option to Saudi Arabia to practically expand the increasing need for water and power.

### ***Tunisia***

Tunisia already has a deficit of 50,000 m<sup>3</sup>/day potable water, covered by brackish water desalination using the RO process powered by electrical energy. This deficit will reach about 100,000 m<sup>3</sup>/day in 2010. It should be filled only by seawater desalination. Several studies are being done to select the suitable desalination process including those using nuclear energy. Two sites, Skirat and Zarat located in the southern area of the country, could be offered for such studies. Tunisia is involved in IAEA nuclear desalination activities through technical and economical studies using DEEP software and CRPs results. Tunisia will join the IAEA Interregional Project (INT/4/134).

### ***United States of America***

Suppliers of nuclear desalination technologies are available upon request for assistance through traditional commercial channels. The US is willing to authorize expenditure of remaining extrabudgetary funds contributed to the program for obtaining the services of a US expert in desalination.

### ***Arab Atomic Energy Agency (AAEA)***

As a regional organization AAEA is not engaged in or responsible for a specific project in nuclear desalination. AAEA is mainly involved in manpower development for nuclear desalination in the Arab region. Most of the AAEA’s activities and contacts with IAEA contribute largely to that effect, e.g. preparation of user requirements documents for nuclear desalination and compilation of the Technical Report Series (TRS) on “Introduction of Nuclear Desalination: A Guidebook”.

For facilitating the AAEA programme on nuclear desalination, the principal nuclear desalination committee was formulated one year ago. Based on resolution of the first meeting, which was convened in April 1999 with two IAEA experts, five sub-committees of specialized experts were formulated to deal with specific topics on nuclear desalination. These sub-committees are: (1) Siting and reactor technology; (2) Desalination technology and coupling; (3) Economic aspects; (4) Safety and regulatory issues; and (5) Local participation.

In conformity with that resolution, about 60 experts and specialists have been chosen for membership on these committees. The main tasks of these committees have been identified and allocated. The first two sub-committees will be convened in June/July 2000 to assume their responsibilities.

### 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 June 1999. Related activities were also briefly reported to INDAG. A brief summary of discussions is given below for each task in the project as well as related and proposed future tasks. Progress and future plans foreseen for project A2.06 are summarized in Attachment 2. The recommendations agreed upon are provided in **Section E**.

- 1) Review nuclear desalination programmes and provide recommendations to the Agency (INDAG) (Task-1)

The Agency presented an overview of the nuclear desalination programmes for review. The Agency was commended for the presentations and encouraged to make the information available earlier for the next INDAG meeting in order that the members might be better prepared.

Recommendation: Continuation of an INDAG-type forum within Agency.

- 2) Co-ordinate a CRP (1998-2003) on "Optimization of the coupling of nuclear reactors and desalination systems" (Task-2)

The Agency presented the status of the CRP. The progress of the CRP up until the second RCM in February 2000 was reported and reviewed. Discussions by members of INDAG who are also members of the CRP followed. It was noted that good progress had been made and continuation of the CRP activities as they were planned was supported. INDAG reconfirmed its support to the extension of the CRP to five years beyond the standard three years. The next RCM is planned to be held in October 2001 in Cairo, Egypt. INDAG also supported the plan to organize two interim meetings in view of the time interval till the next RCM: A consultancy on the modeling of coupling configurations for safety and plant behavior analyses in late 2000 and a consultancy of the evaluation of analytical and experimental work on RO preheating in 2001.

Recommendation: INDAG recommends that the proposal for extending the CRP to five years be supported.

- 3) Technical Report Series (TRS) on "Introduction of Nuclear Desalination: A Guidebook" (Task-3)

The Agency reported that the new Technical Report Series on "Introduction of Nuclear Desalination: A Guidebook" had been approved for publication by the Publications Committee in February 2000. INDAG commended the work of the Agency.

Recommendation: To publish the Technical Report Series before the 44<sup>th</sup> General Conference in September 2000 for timely distribution.

- 4) Identification of potential improvements of economics in nuclear desalination (Task-4)

As recommended by the last meeting of INDAG, this task is split in two distinct areas: economic assessment of energy/desalination options and development of economic evaluation tools. (Extrabudgetary funds needed).

#### 4.1) *Economic assessment of energy/desalination options*

One of the suggestions from the Research Co-ordination Meeting #2 (CRP on “Optimization of the Coupling of Nuclear Reactors and Desalination Systems) held in Mumbai in February 2000 was that a new Co-ordinated Research Programme be initiated to deal with the subject of “economic research and assessment of selected nuclear desalination projects and case studies”. The background of this suggestion was described by IAEA staff and preliminary comments on the possible scope of the proposed new CRP “*Economic research and assessment of selected nuclear desalination projects and case studies (planned for 2001-2006, provisional title)*” were presented. It was also noted that the IAEA planned a Consultants Meeting for the second half of 2000 to establish the Terms of Reference and the scope for the new CRP. With respect to the scope of the new CRP, INDAG noted that evaluation of socio-economic impact, which was one of the possible topics to be considered, was of a sufficiently different nature that it should be addressed separately, and not as a part of this CRP. INDAG also noted that keeping the focus narrow would increase the likelihood of a successful CRP and that in addition to economic evaluations, research into mechanisms for reducing the cost of water production should be considered as a possible area of activity for the CRP.

Recommendation: INDAG acknowledged the importance of economics in establishing nuclear desalination as a viable technology, agreed in principle that a CRP on economics was a worthwhile activity, and concurred with the Agency’s plan for a Consultants Meeting to establish the Terms of Reference and scope for the proposed CRP “Economic research and assessment of selected nuclear desalination projects and case studies.” INDAG requested that the final plans for the CRP be presented at INDAG 2001.

#### 4.2) *Develop and maintain the economic evaluation tool DEEP*

A copy of DEEP 2.0 on a CD-ROM was distributed to all INDAG members. IAEA staff described the current status of DEEP and the options for future activities related to the code. The four options presented range from a minimum level of effort for on-going maintenance and updating to more extensive options that would include varying levels of code development and expert support. During discussion amongst INDAG members an Internet based Users Group forum was also suggested as a mechanism for sharing information, results and user-based code development amongst users. INDAG commended the IAEA for its excellent work in the development of DEEP as an economic evaluation tool, and noted that the type of comparative evaluation provided by DEEP is not possible with any other available codes.

Recommendation: INDAG recommended that on-going maintenance and updating of DEEP be continued for 2001 and for the period 2002-2003. INDAG further recommended that until additional user experience and feedback is obtained no additional code development activities be pursued. INDAG endorsed the idea of an Internet based DEEP Users Group, and suggested that the IAEA convene a small group of interested users to explore the form that such a group might take, to define the nature and scope of activities to be included, and to examine the level and type of support required from the IAEA to host and moderate such a group. INDAG also recommended that the Agency continue direct assistance to Member States for special cases of DEEP applications upon request.

#### 5) *Prospects of Non-electrical applications of nuclear energy (Task-5 and Task-6)*

A technical document is being prepared jointly with the Department of Nuclear Safety as the

meeting proceedings of the Technical Committee Meeting on “Prospects of Non-electrical applications of nuclear energy (Task-5)” held in 1999. No further activity is being planned for 2001. The next activity for updating the status report will be planned for 2002/2003.

Regarding the data collection of non-electrical applications at nuclear power plants (NPPs) (Task-6), the Agency presented the status of integrating experience data on non-electrical application of nuclear energy into the PRIS database (Extension of the PRIS). The extended PRIS was successfully tested in November 1999 in its phase 1 in order to accommodate design characteristics data of heat application systems connected to nuclear power plants. The design characteristics data at some 60 nuclear power units providing heat for non-electric products were compiled in the extended PRIS database. Seawater desalination is one of the main non-electric applications of nuclear energy. The data collection and processing of non-electric applications at NPPs and preparation of a technical document on the extended PRIS table should continue into 2001-2003. After completion of data collection for the design characteristics, compilation of a TECDOC will be planned. The existing data tables will be further appended as new data becomes available. The next phase of data collection for the performance data (operating statistics, etc.) will be planned from 2000.

Recommendation: INDAG supported the continued work and encouraged the Agency’s plan to make available the performance data. However, in view of the practicality of collecting historical performance data for non-electrical applications made operational in the past but not currently being used, it was recommended that the efforts be focused on collecting only current information. Once the database parameters for non-electrical applications have been completed and the data inserted, it is recommended that the function be given to NPES for unified supervision by PRIS personnel.

- 6) Preparations for international co-operation in nuclear desalination demonstration projects (Extrabudgetary funds needed) (Task-7)

The status of the interregional TC Project (INT/4/134) on “Integrated Nuclear Power and Desalination System Design” was presented. In June 1999 INDAG proposed an improved Questionnaire (Questionnaire-2) to deepen the specification of needs by “Technology Seekers” and opportunities of “Technology Providers”. The responses to the Questionnaire-2 from Member States, as summarised in Attachment 3, and their follow-up investigations of selected Member States by the Secretariat were reviewed. INDAG reconfirmed its support to the interregional TC project for facilitating the effective implementation of nuclear desalination demonstration. INDAG recommended that the Department of Technical Co-operation evaluate the responses for identifying the most practical framework to meet the project objectives of facilitating nuclear desalination demonstration projects in Member States.

Recommendation: Department of Technical Co-operation and Department of Nuclear Energy should continue close co-operation for facilitating international co-operation in nuclear desalination demonstration projects.

- 7) Provide direct assistance to Member States for special cases of DEEP applications upon request (Extrabudgetary funds needed)

INDAG acknowledged the importance of such support to Member States.

Recommendation: The IAEA is strongly encouraged to provide such assistance when requested.

- 8) Prepare a technical document on socio-economic impacts of introducing nuclear desalination plants (in cooperation with NPES: lead A.1.) (proposed for 2001)

A brief presentation was given on the work being done by Nuclear Power Engineering Section (NPES) to prepare a technical document on the socio-economic impacts of introducing nuclear power. It was noted that the impacts of introducing nuclear desalination plants is planned as a part of that document.

Recommendation: INDAG endorsed this activity as a co-ordinated effort within the IAEA, and agreed with the current plan to include nuclear desalination as a part of the overall evaluation of the socio-economic impact of introducing nuclear power currently taking place. INDAG recommended that consideration of the positive impact of making available an adequate supply of safe, clean drinking water should be one of the factors considered.

- 9) User Requirements Documents (Task carried over from 1998)

The Agency reported that the new TECDOC “Guidance for Preparing User Requirements Documents (URDs) of Small and Medium Size Reactors and its Application in Developing Countries” was approved for publication by the Publications Committee in March 2000. INDAG acknowledged the joint work between the Projects A.2.01 on SMR development and A2.06 on Cogeneration.

- 10) The Progress Report to the General Conference

INDAG was informed that the interim report on the progress in nuclear desalination and SMR development, as requested by the General Conference last year, had been drafted in January 2000 for the submission to the March Board. The submission had been postponed to the September Board and the General Conference to include more updated contents of substantial accomplishments.

- 11) Safety

INDAG was updated on the latest development in the revision process of the IAEA Safety Standards for the design and the activity on safety of the nuclear desalination that is being carried out at the Division of Nuclear Installation Safety (NSNI). A TECDOC on safety aspects of nuclear desalination has been drafted and it was agreed that this draft will be distributed to the INDAG members as soon as it is approved by the publications committee. INDAG was informed that this TECDOC concludes the work that NSNI is carrying out to investigate basic aspects of the nuclear safety for nuclear desalination plants. Further activity will be carried out on request by Member States for specific projects or designs (advice on safety matters, safety design review, etc.).

- 12) Small and Medium Size Reactor (SMR) Development

The scope, objectives, and basis for the activities of the SMR Project were reviewed. Current activities are being adjusted to respond to the recommendations of an AGM on Development of a Strategic Plan for an International R&D Project on Innovative Nuclear Fuel Cycles and Power Plants, held in October 1999. The results and recommendations of the AGM were briefly presented along with planned and proposed responses. The completion of a TECDOC on staffing for SMRs and another jointly with the Desalination Project on development of user requirements were noted. Continuing activities in SMR simulator development and training were also noted. Conduct of an international Seminar on SMRs was identified as a major activity for 2001 in the SMR project.

The seminar will take place in Cairo, Egypt during May 2001. The objectives of the Seminar are to identify challenges for small and medium sized reactors and solutions into the 21st century and to make this information available to all IAEA Member States interested in the development and /or introduction of small and medium sized nuclear power plants. It will be an excellent forum for exchange of information on technical, economic, environmental and social aspects of SMRs.

The seminar will include keynote addresses on energy demand and supply, international trends, non-nuclear competition, and SMR feasibility; three Panels to discuss (i) meeting the challenges of SMR deployment, (ii) incentives for introduction of SMRs in developing countries, and (iii) solutions leading to increased deployment of SMRs; and five Sessions on economics and financing, applications and experience, SMR technology and design, safety, licensing and regulation, and deployment environment in developed and developing countries. There will be a poster session and an exhibit. The Announcement to the Member States will be sent out in May and all are encouraged to submit contributed papers relevant to the SMRs.

- 13) Liaise with other international organizations (ACC, IDA, OECD/NEA, AAEA, EU Commission, MEDRC)

In his presentation on Co-ordination and Co-operation with other International Organizations, Mr. Gowin reported from the last session (1999) of the United Nations Administrative Committee on Co-ordination Subcommittee for Water Resources (UN ACC SWR).

In particular, Mr. Gowin presented plans and outlines for a UN “World Water Development Report”. Collaboration and co-ordination options with the Water Supply and Sanitation Collaborative Council (WSSCC) on the development of a status report on desalination, and with the World Health Organization on a revision of the guidelines for drinking water quality were presented. INDAG was informed about three pre-proposals submitted to the Middle East Desalination Research Centre.

Mr. Gowin reported on the World Water Forum and Ministerial Conference and presented various documents for INDAG to note:

- World Water Vision
- World Water Vision Commission Report
- Framework for Action

Information was also presented on the “Desalination Strategies in South Mediterranean Countries” Conference and on the International Water Association, a merger of International Water Services Association and International Association on Water Quality.

Recommendation: INDAG commended the Agency on the increased efforts made since INDAG 1999 to coordinate activities with other international (and Inter-governmental) organizations, and, in particular, to seek options for active collaboration. INDAG noted the preparation for collaboration and coordination with WSSCC on the development of a “Status Report on Desalination Technologies”, and with WHO on the revision of the Drinking Water Guidelines: i) regarding the chapter on radiological limits; ii) regarding and addendum on water from desalination plants.

In particular, INDAG welcomed efforts to disseminate information gained in that process to INDAG members, and suggested to broaden this dissemination. INDAG recommended that the

Agency continue its efforts for coordination and collaboration, both with UN and non-UN organizations, e.g. International Water Association (IWA), International Desalination Association (IDA) and EU.

- 14) Establishment of an Internet based information system on advanced nuclear technology activities (in cooperation with NESI)

Virtual Office and “Business Collaborator” are recent Internet tools which allow a “secured” interaction (synchronous and asynchronous) between different (often geographically separate and distant) members of a group or project. Thus, through the use of such tools, these members can download details of the reports, can correct the reports in real time, using the latest and the same version of the report. Virtual Office can equally well be used to prepare for meetings, CRPs and other project meetings, etc. Hyper links to interested institutions throughout the world could also bring up to date information virtually instantaneously.

INDAG made no specifications as to what extent its members would actively contribute (e.g. by including individuals e-mail addresses).

Recommendation: INDAG noted efforts made at the Agency to facilitate and increase the use of the Internet for information exchange in the field of nuclear desalination. INDAG supported plans presented by the Agency to establish a homepage for nuclear desalination and in a second step to use “Virtual Office” technology for Internet-based collaboration among INDAG members.

### **Proposed but Unfunded tasks for 2001**

- 15) Case study on applying the clean development mechanism (CDM) to nuclear desalination plants (in cooperation with Programme C)

As the effects of CDM relate to nuclear Power with no additional specific aspect related to desalination, the activity proposed for 2001, namely continuing this year's work, (modest scope without specified funding and in cooperation with Program C) seems reasonable. In view of this modest scope activity it could continue similarly in 2002-3. (Unless a meaningful development occurs in 2000-1, which may justify a different approach).

- 16) Preparation of an international symposium (2002) on Status and prospects of nuclear desalination deployment (in coordination with NPES, NSNI, SG)

Based on the recommendation of the last year’s INDAG and in view of the successful symposium in 1997, another symposium “From study to reality: nuclear seawater desalination” (provisional title) was proposed to the programme co-ordination committee in March 2000. If approved, necessary steps will be taken. INDAG reconfirmed to support the proposed symposium in 2002.

### **New Proposed Tasks for 2002/2003**

- 17) Prepare a technical document on the status and prospects of nuclear desalination activities in Member States

Recommendation: INDAG acknowledged the value of such a document, produced periodically, and encouraged the IAEA to continue in its planning efforts to more precisely define the outline and content for such a document. INDAG urged the IAEA to investigate the possibility

of developing and publishing the document electronically, recognizing that in doing so due consideration must be given to maintaining the accuracy and “balance” of information presented.

- 18) Prepare a technical document on methodology for nuclear desalination project implementation

The preparation of a technical document describing the steps towards the implementation of nuclear desalination in a concise way, suitable for reading by decision makers, was evaluated as an issue to discuss in the next INDAG meeting. Particularly, it was considered important to receive feedback on country specific aspects once the Nuclear Desalination Guidebook is published and distributed.

- 19) Development of a computer code for coupling optimization

One of the outputs foreseen from the current CRP on “Optimization” is an algorithm for evaluating thermal couplings through steam extractions. INDAG suggests considering the development of a computer code for evaluating and optimizing nuclear desalination coupling, as a continuation of this task beyond the CRP, only in case no such code were available (on commercial or academic basis). The issue will be discussed further during the next INDAG meeting.

- 20) Prepare a technical document on environmental issues related to nuclear desalination plants

An important design objective for nuclear desalination plants is to minimize the impact of various releases from the plant to the environment. Sources of potentially hazardous releases from nuclear desalination plants include radiological gases and liquid effluents, heat discharge from reject streams, brine and chemical discharges and solid waste discharges from different units of the plants.

Individual environmental issues arising from nuclear plants or desalination units have been more or less investigated in the past. But potential issues from an integrated complex have not been thoroughly examined. Due consideration in the Agency’s future activities may be necessary.

#### D. INDAG Self-assessment

INDAG carried out its self-assessment through the evaluation of its activities, using a methodology very similar to the one employed for the PPAS of several IAEA programmes or sub-programmes:

- Two questionnaires were sent to selected Member States (MS) in order to determine INDAG’s success in meeting MS needs (relevance) and benefits to MS (impact).
- A random sample of INDAG members was also contacted in connection with the PPAS of sub-programme A.2.
- The demands for INDAG related publications, TECDOCS and software programmes were also considered.

The analysis of the responses indicated that INDAG’s activities were indeed pertinent to MS needs and impacted their national programmes in a positive manner.

An increasing number of MS are now requesting membership for INDAG. Frequent requests are made for detailed information on INDAG’s activities. These include in particular the results of

various evaluations already undertaken and the planned and future work programmes, elaborated under INDAG guidance. These requests are being formulated by a wide range of MS comprising countries which already have nuclear desalination programmes or which are envisaging such programmes in the near future.

The economic assessment code DEEP, developed under INDAG advice is now being internationally used and demands for its maintenance and updating have been repeatedly made.

It is thus proposed that INDAG continue its activities for an additional term in order that MS can continue to benefit from the various accomplishments made in the first term: the Technical Report Series (TRS) on "Introduction of Nuclear Desalination: A Guidebook", the DEEP code, the documents related to the specific safety aspects of nuclear desalination, the results of the CRPs, in particular the one on optimized coupling schemes, and the guidance for user requirements documents for nuclear desalination plants in developing countries.

Based on the information provided by the Scientific Secretary, INDAG performed its work in a focused manner. The Agency's activities were reviewed and recommendations made based upon result orientated, matrix management and impact analysis. A brief analysis of the results of these activities and their impact upon Member States is presented for the first time.

The Activity Report of the INDAG is enclosed as Attachment 4.

## **E. Recommendations**

### **1. CRP on "Optimization of the coupling of nuclear reactors and desalination systems"**

INDAG reconfirmed its support to the extension of the CRP to five years beyond the standard three years. INDAG also supported two interim meetings being planned in view of the time interval till the next RCM, which is planned to be held in October 2001 in Cairo, Egypt. A consultancy on the modeling of coupling configurations for safety and plant behavior analyses in late 2000 and a consultancy of the evaluation of analytical and experimental work on RO preheating in 2001.

### **2. Technical Report Series (TRS) on "Introduction of Nuclear Desalination: A Guidebook"**

INDAG recommended publication and distribution of the new Technical Report Series before the General Conference in September 2000 for timely distribution.

### **3. Economic assessment of energy/desalination options**

INDAG acknowledged the importance of economics in establishing nuclear desalination as a viable technology, agreed in principle that a CRP on economics was a worthwhile activity, and concurred with the Agency's plan for a Consultants Meeting to establish the Terms of Reference and scope for the proposed CRP "Economic research and assessment of selected nuclear desalination projects and case studies." INDAG requested that the final plans for the CRP be presented at INDAG 2001.

### **4. Development and maintain of the economic evaluation tool DEEP**

INDAG recommended that on-going maintenance and updating of DEEP be continued for 2001 and for the period 2002-2003. INDAG further recommended that until additional user

experience and feedback is obtained no additional code development activities be pursued. INDAG endorsed the idea of an Internet based DEEP Users Group, and suggested that the IAEA convene a small group of interested users to explore the form that such a group might take, to define the nature and scope of activities to be included, and to examine the level and type of support required from the IAEA to host and moderate such a group. INDAG also recommended that the Agency continue direct assistance to Member States for special cases of DEEP applications upon request.

#### **5. Data collection and processing of non-electrical applications**

INDAG supported the continued work and encouraged the Agency's plan to make available the performance data. However, in view of the practicality of collecting historical performance data of non-electrical applications made operational in the past but not currently being used, it was recommended that the efforts be focused on collecting only current information. Once the database parameters for non-electrical applications have been completed and the data inserted, it is recommended that the function be given to NPES for unified supervision by PRIS personnel.

#### **6. Socio-economic impacts of introducing nuclear desalination plants**

INDAG endorsed this activity as a coordinated effort within the IAEA, and agreed with the current plan to include nuclear desalination as a part of the overall evaluation of the socio-economic impact of introducing nuclear energy currently taking place. INDAG recommended that consideration of the positive impact of making available an adequate supply of safe, clean drinking water should be one of the factors considered.

#### **7. Co-operation with other international organizations**

INDAG commended the Agency on the increased efforts made since INDAG 1999 to coordinate activities with other international (and Inter-governmental) organizations, and, in particular, to seek options for active collaboration. INDAG noted the preparation for collaboration and co-ordination with WSSCC on the development of a "Status Report on Desalination Technologies", and with WHO on the revision of the Drinking Water Guidelines: i) regarding the chapter on radiological limits; ii) regarding and addendum on water from desalination plants.

#### **8. Establishment of an Internet based information system on advanced nuclear technology activities**

INDAG noted efforts made at the Agency to facilitate and increase the use of the Internet for information exchange in the field of nuclear desalination study. INDAG supported plans presented by the Agency to establish a HomePage for nuclear desalination study and in a second step to use "Virtual Office" technology for Internet-based collaboration among INDAG members.

#### **9. Technical document on the status and prospects of nuclear desalination activities**

INDAG acknowledged the value of such a document, produced periodically, and encouraged the IAEA to continue in its planning efforts to more precisely define the outline and content for such a document. INDAG urged the IAEA to investigate the possibility of developing and publishing the document electronically, recognizing that in doing so due consideration must be given to maintaining the accuracy and "balance" of information presented.

#### **10. Interregional TC Project (INT/4/134) on "Integrated Nuclear Power and Desalination System Design"**

INDAG reconfirmed its support to the interregional TC project for facilitating effective

implementation of nuclear desalination demonstrations. INDAG recommended that the Department of Technical Co-operation evaluate the responses for identifying the most practical framework to meet the project objectives of facilitating nuclear desalination demonstration projects in Member States.

#### **F. Schedule of Next Meeting**

Although subject to reformulation and/or restructuring of INDAG for the second term, INDAG recommended to plan the next meeting in Cairo, Egypt, from 2 to 4 June 2001, on the occasion of the Seminar on “Status and Prospects of Small and Medium Sized Reactors”. INDAG noted the significance to review the latest information on SMR developments at the Seminar for providing advice to the Agency programmes in nuclear desalination.

#### ***Attachments***

1. Agenda of the INDAG Meeting 2000
2. Progress and Future Plan foreseen for Programme A2.06
3. INT/4/134: Summary of the responses to Questionnaires
4. INDAG Activity Report