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Working Material

Consultants Meeting on Strategic Planning and Regional Networking for Sustainability: concerted actions on neutron scattering in Asian-Pacific region

Report of the IAEA Consultants Meeting

Bragg Institute, ANSTO, Lucas Heights, Australia

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CONTENTS

1. FOREWORD

Research Reactor (RR) Coalitions and Networks presently promoted and supported by the IAEA aim at consolidation of the international/regional RR sector by establishing grouped entities to serve as international/regional user centres. In this way, countries/regions that do not have RRs or are considering closing an old reactor can gain access to nearby facilities which have up to date technical capabilities including high levels of nuclear safety and security. It is expected that Member States (MSs) will increasingly need Agency assistance in strategic planning and institutional arrangements for possible national and regional RR coalitions, networks and shared-user facilities. The Agency support is ensured both through the regular budget and extra-budgetary contributions, including ongoing regional Technical Cooperation (TC) projects.

In 2007-2009, with the assistance of the IAEA a number of RR coalitions have been formed in Eastern Europe, Central Asia, Latin America, Caribbean and Baltic regions and more are being discussed (e.g., the Mediterranean, Asian/Pacific, African regions,…). These cover different areas for collaboration, including radioisotope production, neutron activation analysis, fundamental research, education and training activities.

2. BACKGROUND

Currently there are more than 240 operational RRs world wide, and over 100 have a thermal power greater than 1 MW. This provides the potential for effective neutron beam applications including neutron scattering.

Nowadays many well known RRs with neutron scattering capabilities are over booked, receiving nearly 3 times more basic research proposals or requests from industry than available neutron beam time. Regional collaboration, networking and coalitions of RRs providing neutron beams and their users among Member States may result in the development of synergies and joint offering of complementary services, leading to better and more efficient utilization of all involved facilities. This could not only contribute towards upgrading existing facilities and/or developing new facilities, but also make them more accessible to users in countries without RRs and providing better training opportunities. As it is already experienced in Europe, some of the medium and smaller reactors could create dedicated quality niche expertise in topical areas such as development, testing and qualification of innovative methods and instruments in neutron scattering. In other cases, when appropriate and technically feasible, one could also examine the capabilities to re-direct existing over-demand from the major neutron scattering centres to the less “busy” facilities.

In 2007 ANSTO was designated as an IAEA Collaborating Centre (CC) for Neutron Scattering Applications, where the OPAL RR aims to become one of the world leading RRs in the area of neutron scattering research. This new element, in addition to the future opportunities with neutron beams offered by the J-PARC/JAEA (Japan), HANARO/KAERI (Korea) and CARR/CIEA (China), opens very promising possibilities for expanded cooperation and collaboration between neutron scattering institutions in the Asian-Pacific region. This includes the efforts of re-directing non-accepted proposals from the major user centres, support for education and training, and technology development for neutron scattering instruments, as well as technology transfer to improve the level of neutron scattering facilities and scientific personnel in developing countries. One should mention in this context the very recent (2008) creation of the Asia-Oceania Neutron Scattering Association (AONSA) being an affiliation of neutron scattering societies and committees which aims to represent directly neutron beam users in the Asia-Oceania Region (more information available at http://j-parc.jp/MatLife/en/AONSA/index.html). The similar and already very well established organization called European Neutron Scattering Association (ENSA) successfully operates and represents more than 4500 members in Europe (more information available at http://neutron.neutron-eu.net/n_ensa).

It is noted separately that this Consultants' Meeting (CM) was scheduled intentionally just before the AONSA neutron school, also held at ANSTO as the IAEA CC for Neutron Scattering Applications from 17 to 21 August and partially supported by the IAEA. Mr Danas Ridikas, Scientific Secretary of the Consultants Meeting, has attended the opening session of the AONSA neutron school and welcomed both the students and lecturers from the Asia-Pacific region.

3. OBJECTIVES OF THE MEETING

The main objectives of this meeting were:

- Critically examine the situation in neutron scattering domain in Asian-Pacific region, characterize and asses accessibility information on instruments available at various neutron scattering centres

- Evaluate the support needed for education, training and mobility of researchers from developing countries in order to have access to available neutron scattering centers in Asian-Pacific region

- Share the experience and lessons learned from other regional-international initiatives for neutron beam related research (e.g. Europe, Africa, North and South America, Asian-Pacific region)

- Promote outreach to potential new user communities in academia and industry (e.g. interdisciplinary use of neutron beams in the fields of physical and life sciences)

- Propose concrete actions and recommendations for establishment of a regional neutron scattering coalition or network centred at ANSTO as an IAEA Collaborating Centre for neutron scattering applications (e.g. host regional neutron scattering school, provide special access to the OPAL neutron beam lines, establish long term training programs for scientists from developing countries, etc.)

4. WORK DONE AND RESULTS ACHIEVED

The meeting was attended by 15 international experts, mainly from the Asian-Pacific region (Australia, Bangladesh, China, Indonesia, Japan, Malaysia, New Zealand, Philippines, Singapore, South Korea, Thailand, and Vietnam) but also from Argentina, Italy, and South Africa. After the official host opening remarks by Mr A. Paterson, Chief Executive Officer of ANSTO, and Mr R.A. Robinson, head of Bragg Institute at ANSTO, welcome address was given by Mr D. Ridikas, the IAEA Scientific Secretary. The self presentation of all meeting participants followed afterwards. Mr M.-W. Kim (KAIST, Korea) was nominated as a chair person and Mr D. McGillivray (Univ. of Auckland, New Zealand) was appointed as a *rapporteur* of the meeting. Right after followed a brief presentation by Mr D. Ridikas, the IAEA Scientific Secretary, on specific region background and main objectives of the meeting.

The entire 1st day and the morning session of the 2nd day of the meeting were exclusively dedicated to evaluate needs and/or availability of neutron beams in Asia-Pacific region. In this regard, individual presentations from both neutron beam facility host countries and non-RR/facility countries were given (see Annex I).

After a technical tour to the Bragg Institute and Neutron Guide Hall, organized and guided by Mr R.A. Robinson (head of Bragg Institute), the afternoon session of the 2nd day was held on share of experience and lessons-learned from already existing regional/international initiatives for neutron beam related research and applications. At the very end, Mr A. Deriu (co-chair of the European Neutron Scattering Association - ENSA) and Mr M.-W. Kim (chair of the Asia-Oceania Neutron Scattering Association - AONSA) gave dedicated presentations on existing affiliations of neutron scattering societies and committees, which aim to represent directly neutron beam users in Europe and Asia-Oceania respectively. These two presentations followed by discussions and summary session, relevant to needs/availability table and further actions towards creation of network of institutions involved in neutron beam research and applications in Asia-Pacific region.

During the 3rd day a number of round table discussions took place on

- support needed for education, training and mobility of researchers from developing countries in order to have access to available neutron scattering centers in Asia-Pacific region

- promotion outreach to potential new user communities in academia and industry in the Asia-Pacific region (e.g. interdisciplinary use of neutron beams in the fields of physical and life sciences, non-destructive methods to characterize/qualify materials/devices/objects, etc.)

- concrete actions and recommendations for establishment of a regional neutron scattering coalition or network centered at ANSTO as an IAEA collaborating centre for neutron beam applications (e.g. host regional neutron scattering school, provide special access to the OPAL neutron beam lines, establish long term training programs for scientists from developing countries, etc.)

At the very end of the 3rd day, the meeting conclusions and recommendations were prepared including common work-plan for the future actions.

5. CONCLUDING REMARKS

It was concluded that the Asian-Pacific region has great potential with significant prospects for an expansion in neutron beam uses, with unique opportunities, but at the same time with some difficulties including geographical and cultural diversity. To realise this potential it is essential for a strong regional network of neutron beam users and facilities to be expanded, building on the existing IAEA Collaborating Centre for Neutron Scattering Applications at ANSTO. A number of important remarks were highlighted during the discussion sessions of the meeting:

- Actions need to be undertaken to support the education, training, and mobility of researchers, especially from developing countries, in order to have access to available neutron scattering centres

- Smaller and medium facilities need to have at least one well-operated (frequent availability, with good quality measurements) standard neutron beam instrument that can help develop an expanded user base

- Instrument development is an area with good potential for substantial cooperation, as there is a real need and potential for a better collaboration on instrumentation

- Use of neutrons is interdisciplinary. Beyond physics, there should be increased outreach efforts to other areas, including chemistry, biology, geology, cultural heritage, engineering, and life science communities and others

- The potential regional network must include representatives of facilities, user societies, academics and industry. Such a concept would certainly strengthen relationships between facilities and various users. Equally it would promote use of neutron beams and advertise their products and services.

6. RECOMMENDATIONS

It was recognized that the IAEA has undertaken a number of activities through Coordinated Research Projects and national Technical Cooperation (TC) projects to assist some developing countries in establishing or improving neutron scattering capabilities. Continuation and expansion, where appropriate, of such activities was encouraged, especially to promote development of early career scientists.

Based on the discussion on current status and future needs in the domain of neutron scattering and applications using neutron beams in the Asian-Pacific region, the participants formulated the following specific recommendations:

- **Continue ANSTO’s status as an IAEA Collaborating Centre for Neutron Scattering Applications.** Indeed, building a strong regional network of neutron beam users and facilities on the existing IAEA CC for Neutron Scattering Applications at ANSTO was seen as a unique opportunity with a great potential and prospects for an expansion in neutron beam uses

- Recognising the existence of AONSA as a regional network of user groups and facilities in neutron scattering and applications, **encourage and support the formation of user representative groups in developing countries to expand and strengthen AONSA.** In this context, continuation of support of students and young scientists from developing countries in the region to attend the AONSA Neutron School was highly recommended. Equally, assistance/coordination in creation of a database on neutron instruments available in the region, their capabilities and contact people was emphasized.

- **Support and implement a new regional TC project on neutron scattering applications.** An organisation of a dedicated workshop/consultancy to elaborate and design a future regional TC project was strongly supported. Already after this meeting it was seen that the future regional TC project would be an effective tool to

    - support expert missions and scientific visits to improve facilities in developing countries
    - provide financial support for travel and subsistence for experimenters from developing countries
    - support long-term fellowships from developing countries to well-developed neutron centres to learn advanced methods and neutron instrumentation
    - support round-robin experiments and standardised samples to calibrate and qualify instruments between facilities
    - create a user-friendly database on facilities and neutron instruments available in the region
    - develop an open-access online educational portal for neutron scattering and applications, including promotion of products and services provided by neutron beams to the industrial partners

- **Support national TC projects relevant to optimization/building specific neutron instruments of appropriate complexity at facilities in developing countries.** In this regard, the IAEA is encouraged to strengthen relationships with mature neutron scattering centres in the region for assistance and expertise.

- **The IAEA was urged to examine whether there are means to bring the issue of transporting of deuterated samples to the attention of the Agency's Steering Committee on the Denial of Shipment.** Indeed, it was noted that the IAEA definition of deuterated research sample and quantities for states to apply exceptions to transport between research institutions in different states has led to difficulties in sharing deuterated samples for neutron scattering.

7. RECOMMENDED WORK PLAN FOR THE NEXT 12 MONTHS

Action	**Deadline**	**Coordination**
Hold regular AONSA Neutron School in the region (e.g. in 2010 in India)	Annual action	AONSA
Collection of educational material suitable for inclusion in an online educational resource portal (e.g. AONSA neutron school	Q1 2010	AONSA

lectures and exercises)		
Collection of standardised information on facilities, instruments and contact information relevant to neutron scattering in the region (e.g. preparing template, collection of information, hosting webpage)	Q2 2010	JAEA/J-PARC
Draft individual country inputs in order to prepare a new regional TC project for circulation before the workshop	Q3 2010	ALL
Organization of a dedicated workshop in the region to prepare a proposal for a new regional TC project relevant to neutron scattering applications	Q4 2010	IAEA

8. CONCLUDING SESSION

The participants concluded that the Meeting was a very useful and constructive event. Mr D. Ridikas (IAEA) thanked Australian representatives for hosting this meeting, for exceptionally good local organization and assistance, and also for providing financial support for two participants from developing countries. Equally, the Scientific Secretary thanked all participants for their valuable contribution to this meeting and recommendations.

ANNEX I. INDIVIDUAL EXPERTS' SUMMARIES

(In the order of presentations)

1.1 Md. Muslehuddin Sarker – INST Bangladesh

Current Status of Irradiation Facilities of TRIGA Mark-II Research Reactor of Bangladesh

EXPERIMENTAL AND IRRADIATION FACILITIES:

The TRIGA Mark-II research reactor at AERE, Savar, Dhaka has extensive experimental facilities. It can be used to provide intense fluxes of neutrons and gammas for research, training and radioisotope production. The experimental and isotope production facilities of the reactor are mentioned below:

- A CENTRAL THIMBLE THAT ENTERS THE CENTER OF THE CORE LATTICE MAKES POSSIBLE THE EXTRACTION OF A HIGHLY COLLIMATED BEAM OF RADIATION OR INSERTION OF SMALL SAMPLES INTO THE REGION OF MAXIMUM FLUX.

- A ROTARY SPECIMEN RACK (LAZY SUSAN) TO ACCOMMODATE UP TO 81 SAMPLES SIMULTANEOUSLY FOR ACTIVATION ANALYSIS AND ISOTOPE PRODUCTION IS LOCATED IN A CIRCULAR WELL IN THE REFLECTOR ASSEMBLY OF THE REACTOR.

- A PNEUMATICALLY OPERATED "RABBIT" TRANSFER SYSTEM IS LOCATED IN THE G RING OF THE CORE, WHICH PENETRATES THE REACTOR CORE LATTICE, AND IS USED FOR THE PRODUCTION OF VERY SHORT-LIVED RADIOISOTOPES.

- THE REACTOR HAS THREE RADIAL AND ONE TANGENTIAL BEAM PORTS FOR THE EXPERIMENTAL PURPOSE.

- In-core irradiation facilities, there is a large thermal column hexagonal and triangular cutouts that has initially filled with concrete blocks.

- THE SPACE IN THE WATER AROUND THE REFLECTOR CAN ALSO BE USED FOR THE IRRADIATION OF THE SAMPLES.

Beam Port Facilities:

The beam ports provide tubular penetrations through the concrete shield and the reactor tank water, making beams of neutrons and gamma radiation available for a variety of experiments. They also provide an irradiation facility for large (up to 15.24 cm in diameter) specimens in a region close to the core. There are four 15.24 cm diameter beam ports divided into two categories as follows: (i) Radial beam ports, and (ii) Tangential beam port

Radial beam ports

There are three radial beam ports, each of which penetrates the concrete shield structure and the reactor water. One radial port terminates at the outer edge of the reflector aluminum can. A second radial port terminates at the outer edge of the reflector can; however, 15.24 cm diameter radial hole is drilled through the graphite at this location. As a result, this port provides a beam of neutrons originating in the core, but is physically separated from the core by the outer edge of the aluminum reflector can and the end of the beam tube. The third radial beam port pierces the graphite reflector (called Radial piercing beam port) and terminates at the inner edge of the reflector can. This beam port permits insertion of samples to a position adjacent to the core.

Neutron Scattering using Radial Piercing Beam Port

Bangladesh has stepped into the area of neutron scattering research with the installation of a Triple Axis Neutron Spectrometer (TAS) at the piercing beam port of the TRIGA Mark-II research reactor at AERE, Savar in June, 1992. The objective of establishing the facility is to carry out research in condensed matter physics using neutron scattering technique. The technique is essential for characterizing and developing of condensed matter by studying their structural and dynamic properties.

Scope of research

Triple Axis Neutron Spectrometer is mainly used for the following studies:

a) Neutron Powder Diffraction Studies

Structural characterization of condensed matter like metals, alloys, ceramics, polymers, super conductors and various types of magnetic materials is done by these studies.

b) Small Angle Neutron Scattering (SANS) studies

Shape, size and molecular weights of particles in various kinds of biological aggregates and polymers are determined by this method.

c) Studies of texture in materials

Existence of texture in industry important and structural materials is identified using this technique.

Further plans

a) A High Resolution Powder Diffractometer (HRPD) has been procured and it will be installed at the position of Radial-1 beam port very soon for R & D activities.
b) The Radial-2 beam port has been assigned for the future use of PGNAA Purpose.

To run the above activities effectively and make useful in the field of Neutron Scattering, it is necessary to have educational/advanced training of the young scientists from developing countries like Bangladesh through IAEA and AONSA.

1.2 Edy Giri Rachman Putra – BATAN, Indonesia

The neutron scattering facilities at the Science and Technology Research Center Complex in Serpong, Indonesia which is operated by the National Nuclear Energy Agency of Indonesia (BATAN) located about 30 km south of the Jakarta international airport and has been in operation for about 15 years.

What we have presently:

1. The 30 MW Research Reactor operating at (only) 15 MW with the maximum flux at core $\sim 1 \times 10^{14}$ n cm^{-2} s^{-1}
2. Seven neutron beam instruments are running or in operation at very different conditions.
3. Experienced and skilled-scientists and technicians for maintaining the instrument and doing the neutron experiment.
4. The young and eager personnel needed to be exposed to any established neutron scattering instruments and facilities in the region such as OPAL, HANARO, JRR3-M, etc. for capacity building.
5. A low cost guest house (~ USD 15/day) which is quite comfortable for users is available within 20 minutes walk to the laboratory.
6. Local seminar on neutron and X-ray scattering organized every 2 years started from 1998. In 2005 and 2007 (ICNX2007), the workshop was held prior to the seminar and the event was at the regional/international level.

What we offer:

1. 170 days yearly of beam time.
2. Open for regional users, based on the scientific interest (research collaboration under the IAEA or other schemes).
3. To train the postgraduate students, young scientists from the region (educational program).
4. Preliminary studies on neutron scattering experiment using; diffractometer for residual stress measurement (RSM), SANS spectrometer (SMARTer), high-resolution powder diffractometer (HRPD), texture diffractometer (FCD/TD), and neutron radiography (NRF), as well as neutron instrument development.

Challenges:

1. Under-utilized instruments due to lack of local, regional and international end users.
2. Lack of scientific maturity in application of the instruments for conducting high quality research.
3. Old-fashion detecting and controlling system that constraints our activities in maintenance, repair and developing new instruments. Different problems for each instrument.
4. About 3 - 5 young scientists (fresh-graduate) are joining the laboratory for the next few years.

The goals:

1. Enhancement of the utilization of neutron scattering instruments and at the same time increased use of the research reactor.
2. Improvement of the capacity and the capability of personnel attached to each instrument.
3. Strengthening collaboration in the region by sharing the modalities with others, in particular close neighbours as Malaysia and Singapore.

What we need:

1. Training the young personnel (scientist and technician) for the neutron experiment and instrumentation development to replace or update the old system.
2. Meetings/workshops providing information sharing and exchange to maintain and to increase the use of the instruments.
3. The experts from the established neutron scattering facilities or universities in the region who regularly visit and meet with the members of the particularly research project under the IAEA or other schemes.
4. A strong user group including both national and regional user communities.

Commitment:

1. The Instruments are available for other member states, even improvement and needed development will be ensured.
2. Support the possibility of improving the capability of other member states in developing their instruments by providing the chance of using our instruments (resource sharing).

1.3 Abdul Aziz Mohamed, Nuclear Malaysia, Malaysia

As Malaysian research reactor is a low power/flux reactor (1MW with flux ~10^{13} n/(s cm^2) in the reactor core), the instruments built were mainly for training and education with some moderate level of research activities. We need to seek support from regional high flux facilities for extension of actual research to a certain level of high quality science. Training and research attachment are also important to increase the level of knowledge and skills of young Malaysian neutron scientists. It covers instrumentation capability, scientific understanding and capability to prepare high level proposals, perform experiments and analyse experimental results. This is linked to our plans for upgrading existing reactor and eventually building a new MPR of ~20 MW power. IAEA could assist in establishing bi-lateral agreement between neutron groups from different countries under regional cooperation and it should be 2-4 years duration. Common research areas should be formulated before the bi-lateral agreements signed. The areas of interest may be in energy generation related and advanced materials. It includes nano-materials, biotechnology, genome/protein and engineering structural problems (e.g. creep and residual stress). Grid computing and simulation are also of our interest to couple the experimental design and data sharing amongst research members. Currently, we have established QuantumGRID computing platform for Malaysian nuclear researchers. It covers all areas of nuclear research.

1.4 Duncan McGillivray – University of Auckland, New Zealand

New Zealand is a developed country, which, for political reasons, has no foreseeable aspirations to hosting domestic nuclear facilities for either research or power. However, there is a well-supported research environment in the country, strongly but not solely focused around industrially relevant areas of research. There is significant potential for the use of neutron beam methods, but little established history in this field and limited familiarity with either the available facilities or even the methods. However, New Zealand researchers have relatively simple access to the facilities in Australia, and the capability to gain financial support for travel to perform experiments.

The primary needs to increase the utilisation of neutron facilities by New Zealand researchers are:

- education of researchers as to the complementary advantages of neutron methods to established research programmes, with particular relevance to industrial significance of problems

- reduction/removal of initial barriers to novice users. These include travel difficulties (transport of samples across international borders); access difficulties (security requirements at facilities); lack of familiarity (with methods, sample preparation, beamtime application systems and instrument scientists); and timeliness issues (typical long turn-around between conception of idea and ability to perform experiment)

1.5 Dong Zhili - Nanyang Technological University, Singapore

In my presentation, I have briefly introduced the materials research activities in Nanyang Technological University, as well as the commercialization based on the materials research.

The second part of my presentation is focused on the education of undergraduate / graduate students in materials science and engineering. E-learning experience in our university has been shared, and the emphasis is that there is demand in e-learning / training on neutron scattering from Singapore materials communities.

Lastly, facilities, training and co-funding issues are discussed. Normally, the work based on granted projects can support travel expenses. However, for some projects without travel budget, support from IAEA or neutron scattering centres would be a solution at least for the very 1st experiments and establishment of closer collaboration.

1.6 Pablo P. Saligan - Philippine Nuclear Research Institute, Philippines

The Philippine Nuclear Research Institute (PNRI), formerly the Philippine Atomic Energy Commission (PAEC), is the sole agency of the government mandated to advance and regulate the safe and peaceful applications of nuclear science and technology in the Philippines.

Neutron scattering at PNRI was started on the 1960's with assistance from India and the IAEA and was part of the long term manpower development program for nuclear energy. The main objectives were to

1. gain and maintain knowledge and expertise in neutron beam control and instrumentation through the operation of neutron scattering facilities

2. promote and make available to local scientists the neutron scattering techniques Today the circumstances are vastly different than what they were before, however these objectives remain valid.

In the years that passed since then, the Philippines built and completed a nuclear power plant. Eventually the government decided not to operate it due to public opposition. The various manpower development program related to nuclear energy stagnated. Also, the Philippine research reactor is being decommissioned since 2006 after being out of operation for more almost twenty years. So, the last neutron research activities conducted in the Philippines were done way back in the early 1980's.

PNRI recognizes that there is a need to reinvigorate neutron scattering in the Philippines. There are now more people in the universities doing materials research and use x-ray methods. So more potential neutron users than what it was in the 1960's. And also, there is a small but finite possibility that the Philippines may revisit nuclear energy in the near or far future. So it is necessary for PNRI, as part of its mandate, to maintain expertise and knowledge in neutron technology, including neutron scattering.

The two pressing problems PNRI faces: (1) its personnel who have actual experience in neutrons are already retired or are soon to retire, and (2) the lack of suitable neutron source. PNRI has decided to pursue its program on neutron technology based on accelerators for education and training, and niche research. Neutron diffraction/scattering requirements of local users needing advanced neutron sources will be implemented through collaborations with other countries and organizations. The PNRI needs assistance from IAEA in at least three areas:

1. Training in the installation and operation of small accelerator driven neutron source, and neutron beam utilization from such sources for education and training, and niche research application.

2. Exchange and sharing of information and experience with other counties who are pursuing neutron technology program based on small accelerator driven neutron sources.

3. Collaboration and networking with other organizations for access training to advanced neutron source for neutron diffraction/scattering activities. These could be in the form of graduate/post graduate, fellowship and workshop trainings.

1.7 Nhi Dien Nguyen – NRI, Vietnam

NEUTRON BEAM UTILIZATION AT THE DALAT RESEARCH REACTOR

After the completion of its renovation and upgrading from the previous TRIGA Mark II reactor, the Dalat Research Reactor has been operated at the power level of 500 kW since 1984. The reactor is mainly used for radioisotope production, neutron activation analysis and neutron beam utilization for fundamental research and training. There are four beam ports and one thermal column at the reactor. At present only two beam ports and a thermal column are used. Because of low power and low neutron flux, neutron scattering technique can not be properly used at the Dalat reactor. Some experimental facilities have been installed and operated at two beam ports and the thermal column, including:

+ Prompt gamma neutron activation analysis (PGNAA) system at piercing horizontal channel No. 4;

+ Two-HPGe detector spectrometers at tangential channel No.3 for fundamental research.

+ Cyclic neutron activation analysis (CNAA) system at thermal column.

The PGNAA has been used for

- analyzing Fe, Co, Ni, C, in steel samples; Si, Ca, Fe, Al in cement samples; Gd, Sm, Nd in Uranium ores; Sm, Gd in rare earth ores; etc. using the filtered thermal neutron beams;
- investigating the correlation between boron and tin concentrations in geological samples as a geochemical indication in exploration and assessment of natural mineral resources; analyzing boron in sediment and sand samples to complement reference data for river samples.
- in-vivo activation analysis of essential elements Ca, Cl, N and P in the whole body and of the toxic elements Cd, Hg in a body organ for medical diagnosis of various diseases.
- determination of Ko-factors to use in PGNAA technique: H, B, C, N, Na, Cl, K, Ca, Cr, Mn, Fe, Hg, Cu and Sm.

Based on the two-HPGe detector spectrometry system, the spectrometer of summation of amplitudes of coinciding pulses has been developed for (n, 2γ) reaction research and for measuring activity of activated elements with high possibility of cascade transitions

The neutron filtered technique with some kinds of neutron filters such as Si, Al, Fe, S, Ti, B has been developed and utilized at the Dalat reactor to extract different quasi-monoenergetic neutron beams for nuclear data measurements and nuclear structure studies.

In the keV energy region filtered neutron beams are the most intense neutron sources which can be used to obtain neutron data for reactors and other applications. The following experiments have been carried out at the Dalat reactor:

- Total neutron cross section measurements for U^{238}, Fe, Al, Pb on filtered neutron beams at 144 keV, 55 keV, 25 keV and evaluation of average neutron resonance parameters from experimental data.
- Gamma ray spectra from neutron capture reaction of some reactor materials on filtered neutron beams at 55 keV, 144 keV.

- Average neutron radiative capture cross sections of U^{238} for 55 keV and 144 keV neutrons.
- Isometric ratio of $Br^{82m,g}$ created in the reaction $Br^{81}(n,\gamma)Br^{82}$ for 55 keV and 144 keV neutrons.
- Other investigations such as average resonance capture measurements, (n, 2γ) reaction, etc.

The CNAA system has been used for development of the rapid and reliable analytical techniques with good sensitivity for trace element determination and multi-elemental capabilities, in particular associated with environmental research programmes.

Other applications

- Development of neutron radiography method as a NDT technique for various kinds of objects such as electrical and electronic products, mechanical devices, etc.
- Utilization of the filtered neutron beams for research on estimation of the radiobiological effectiveness (RBE) of different energy neutrons and on calibration of neutron dosimeters
- Utilization of transmission measurements on the thermal neutron beam for determining thermal neutron absorption cross section of samples from drill holes in oil and gas exploitation.

We have no neutron scattering instruments at our research reactor at present, so Asian-Pacific regional collaboration is needed for training our staffs. Support from IAEA and Government of Vietnam is important for such collaboration.

1.8 Sirinart Laoharojanaphand – TINT, Thailand

Thailand has one simple neutron diffractometer (ND) utilising of the radial beam line form the 1.2 MW TRIGA Mark III research reactor. The reactor is 47 years old. The trained researchers who have some experience on neutron diffraction are no longer available (retirement, quit job, got promotion to higher position in the other section or under further study abroad etc.). After the establishment of the institute in 2006, no activities on neutron scattering is being carried out. Latest test on the ND system was carried out in 2004. The upgrading program of the existing ND is time consuming and needs lots of inputs in terms of budgeting and expertise.

Nevertheless, TINT recognized the important role of neutron scattering technique particularly in materials science, biotechnology and life science. Thus we would like to carry on with the potential research area namely: gemstone colour enhancement, morphology of elastomer under strain, high temperature superconductors, biopolymers, proteins, composite materials of rare earth compound and supermagnet.

Suggested solutions for sustainable utilization on neutron scattering:

- Sharing of experimental facilities, balance between our own investments or to use the available facilities elsewhere.
- We foresee strong need for getting assistance and expertise through regional and or national training course. Thus TINT staffs are capable of convincing on the usefulness and uniqueness of the technique.
- Build up end-user’s and executive’s recognition on the utilization of neutron scattering in various field.
- Generate networking on neutron scattering laboratories will be an efficient and low investment way for sustainable regional/ global utilization of the technique. IAEA will be the best coordinators for this.
- Leading n-scattering laboratory(s) should be appointed with IAEA/AONSA assistance.

1.9 Yuntao Liu – CIAE, China

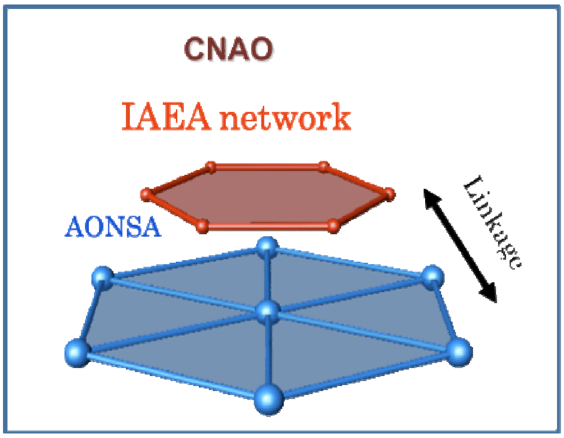
The China Advanced Research Reactor (CARR) will go critical at the end of 2009, neutron scattering applications being the main purpose to build this reactor. For the first stage 11 instruments are expected to be constructed, which are high resolution powder diffractometer, residual stress diffractometer, four circle diffractometer, texture diffractometer, reflectometer, small angle neutron spectrometer, high intensity powder diffractometer, triple axis spectrometer(cooperation with Juelich, Germany), triple axis spectrometer (cooperation with institute of Physics of Chinese Academy of Sciences), thermal neutron radiography, cold neutron radiography. The commissioning of instruments needs the experts' support and young scientist training. After commissioning, the in additional to local users, both regional and international user communities outside China are welcome to use CARR neutron scattering facilities.

1.10 Masatoshi Arai – JAEA, Japan

J-PARC Neutron facility has been operational since May 2008. We have been demonstrated the potential of the facility and can anticipate a good performance on neutron scattering experiments when it can have a reasonable power, although it can be much less than 1MW, eventual performance. However we still have various issues to be addressed as soon as we can.

J-PARC may accommodate 1000 experiments/year and 2000users. It can be difficult to increase the number of users only inside Japan, and it is necessary to have users outside Japan so as to extract full potential of J-PARC. J-PARC has been approved as an international public facility from the Japanese government and it is a crucial issue to be addressed by having regional cooperation with Asia-Oceania countries.

A combination of a concrete networking funded by IAEA with the central institute, ANSTO, and the established regional users' society, AONSA, may give an answer for this issue. Hereafter I refer as a Coordinated Networking in Asia Oceania region (CNAO). Especially education and training of young scientists are important to develop science & technologies in developing countries. CNAO can have a good role with a travel fund from IAEA under consultation of AONSA. Therefore, I can have an image of CNAO here. CNAO can give formal political messages to the governments, and can facilitate mutual cooperation and human exchanges. This can also help us to persuade the Japanese government to find a more organized and secure way to accept researchers from developing countries to J-PARC. This arrangement gives benefits to help internationalization of J-PARC, which is a one of main objectives of our facility.



1.11 Rob Robinson – ANSTO, Australia

The OPAL Reactor in Sydney Australia is a 20-MW pool-type multi-purpose reactor, operating up to 340 days per year with low-enriched uranium fuel. It has an excellent 20-litre liquid-deuterium cold-neutron source, with provision for up to 6 neutron guides based on supermirror technology, and supporting 18 instruments.

At present 4 guides are installed (two thermal and two cold), with funding announced for a new split cold guide. 7 instruments are operating, and we have funding for 6 more. The reactor achieved criticality in 2006, and the first user experiments were performed and published in 2007. To date, 17 refereed articles have been published from OPAL, from 5 instruments. In the 3rd and latest call for proposals, 36% of the demand came from overseas, and ~50% from Australian universities. Some instruments (high-resolution powder diffraction, single-crystal diffraction and 3-axis spectrometer) are undersubscribed, but most are solidly oversubscribed. In the case of small-angle neutron scattering, demand is roughly 4x the available supply of days, and we have decided to build a second SANS machine as a consequence.

In it's May 12th budget announcement, the Australian government announced an extra A$37M of funding for the split cold guide, 3 new instruments (2nd SANS, back-scattering and radiography/tomography/imaging) along with more advanced sample-environment apparatus.

In addition to the neutron-beam facilities, we run the National Deuteration Facility for both bio- and chemical-deuteration, as a user service, and we have an in-house x-ray reflectometer and two SAXS machines.

User access is typically via an open 6-monthly call for proposals, with national and international peer review, with non-proprietary proposals accepted from all countries on the basis of scientific merit. We also accept longer-term program proposals, for a body of work over 3 years, and have initiated an "express" mail-in service for standard neutron powder diffraction experiments. Commercial jobs are also undertaken on a contractual basis at a daily cost for beam time of ~A$7000.

We have an aspiration to be in the top-3 research reactors in the world, and are very keen to serve potential users in the Asia Pacific region, and amongst the Southern Hemisphere countries.

1.12 Gawie Nothnagel – NECSA, South Africa

1. SUMMARY

The purpose, as required by the program, is to share experiences learned with beam line research and applications at SAFARI-1 and in African context.

I introduce our beam line and complementary X-ray techniques (done by the same guys) namely: Diffraction, small angle scattering and radiography/tomography.

The following statements form the crux of the presentation:

Even a small neutron beam line group, sharing time with other techniques, can make an impressionable contribution to new knowledge creation, training and networking. This because neutron beams are unique in the sense that only reactors (or related neutron sources) produce them and they allow material analysis inaccessible by other techniques.

Neutron beam line techniques allow analysis of nuclear materials, normally not allowed by nuclear regulators to be done elsewhere than on nuclear sites as these techniques are already on nuclear sites. Thus collaboration with nuclear institutes provides the only easy means for academia to get involved in nuclear materials research of this nature. Neutron diagnostics can be viewed as a gateway for academia into nuclear materials related research.

Through the use of well-known complementary X-ray techniques (done widely) and the visually intuitive neutron tomography techniques, potential industrial users are introduced to techniques such as neutron strain scanning and neutron small angle scattering.

Policy makers and public are more easily convinced of the practical usefulness of neutron diagnostics via the visually pleasing, "easily understood" demonstrations such as provided by full 3-D neutron tomography. Demystification of beam line science needs to be done actively and the useful outcomes stressed to policy makers.

Local networks can only work effectively if they are imbedded in a larger international network system, preferably planned (say through a collaboration of local networks and/or IAEA) to be more synergistic and complementary and less "competitive".

2. WHAT SHOULD COME OUT OF THIS MEETING

A. The realization that the neutron beam line community of the region (and in fact world) indeed provide a necessary and important service that is increasingly important for fundamental understanding of condensed matter and that contributes to an eventual improvement in the quality of life of all people.

B. A request to all contributors to provide a standardized facilities description (i.e. type of diagnostic, operating hours available, applications currently exploited, neutron flux at target, resolution, etc.) to be completed in detail upon return to their facilities and to be provided to the steering committee for distribution to network members. This is because some presenters provided some information and others approached their presentations from a different angle.

C. The IAEA usually prioritizes by firstly assist with capacity building at an institute through expert missions and fellowship support as well as user group stimulation (from regional experts and at beam line facilities elsewhere in the region) and then assist with well-considered TC projects to develop local facilities as dictated by needs dictated by a regional perspective. It is advisable to perhaps appoint a regional steering committee to assist with this task to access readiness, program feasibility in local and regional context in consultation with the requester and other regional players. This can also help strengthen proposals to governments and IAEA.

D. Identify, where applicable, specific nuclear materials programs (as dictated by GEN-IV and related nuclear energy needs) that will require neutron beam line techniques for fundamental understanding of, and/or technological advancement of, R&D programs in this regard. This elevates the incentive to do beam line science beyond the level of research curiosity into the realm of global greenhouse free energy production.

E. Identify interfaces (and cooperation models) with other regional networks to feed into a global network vision and plan.

3. WHAT THE MEETING SO FAR INDICATED

A number of institutes pointed out specific training or facility upgrade needs, and apparently do not yet benefit substantially from the fact that a collaboration network exists.

Indonesia clearly offers established facilities with high availability in terms of reactor duty cycle, that clearly conform to the needs stated by “near-by” regional partners. The Indonesian facilities can thus be utilized as local attractor within a larger network that contains ANSTO as IAEA Collaboration Centre. See “cartoon” of such a model below:

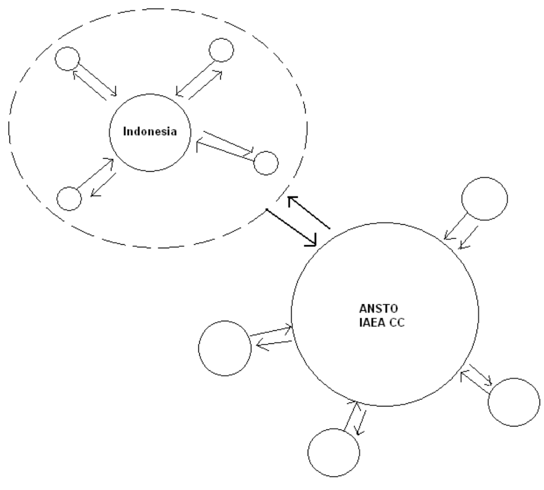


Figure 1: Indonesia as satellite centre that provide local group capacity building whilst tapping into the expertise of the IAEA coordination centre.

Some countries/institutes have specific needs, such as for manpower development and facility upgrade assistance that can already be listed in a needs list that can also contain a column indicating who can assist with achievement of these goals.

1.13 Rolando Granada – CAB & IB, Argentina

Centro Atómico Bariloche & Instituto Balseiro (CAB & IB)

Bearing in mind the role played by the IAEA in organizing this meeting, it is convenient to review its position on the matters of present interest.

The Agency's Research Reactor Group has pointed out that:

"There is a need to develop strategies for effective utilization on a national, regional and international basis for an important number of Research Reactors (RR) worldwide that are under-utilized and consequently under-funded, as well as for organisations in need of RR goods and services located within Member States with no reactor facilities."

"As a consequence, the IAEA provides assistance in strategic planning and institutional arrangements for possible national and regional RRs, regional and international research reactor coalitions, networks and shared-user facilities and in the management of spent fuel prior to decommissioning."

In a very recent statement (Vienna, March 2009), Mr. Y. Sokolov, IAEA Deputy Director General, Head of the Department of Nuclear Energy, said:

"The IAEA is helping countries pursue utilization strategies on national and regional bases through so called coalitions. These regional arrangements envision joint activities in the areas of nuclear education and training, isotope production and industrial applications, material and fuel science and testing, and in sharing of best practices, etc. It is also envisioned that these arrangements will make available the use of RR facilities and irradiation services to scientists and users from Member States that do not have RRs but which need to use them."

Those ideas have been already put into practice in different world regions, within or outside the IAEA's umbrella. Histories and realities are of course not the same, and the agreements, networks or coalitions that have emerged reflect that diversity, thus demonstrating that there is no a single model or recipe to achieve the objectives that in each case the regional actors have define for themselves. As an example, ARCAL (Regional Cooperative Agreement for the Advancement of Nuclear Science and Technology in Latin America and the Caribbean) provides a framework for Member States in Latin America and the Caribbean to intensify their collaboration through programmes and projects focused on the specific shared needs of its members. It was established in 1984, and was made a formal inter-governmental agreement in 1998 with the coordination of the Agency.

In this Consultants Meeting, organized to explore possibilities of "Strategic Planning and Regional Networking for Sustainability: concerted actions on Neutron Scattering in Asian-Pacific region", we have essentially tried to identify the situation in the countries as characterized by a few relevant parameters:

a) NEUTRON SCIENCE Knowledge, Expertise, Projection
Past Experience / Education & Training / Neutron Users community

b) NEUTRON SCATTERING FACILITIES Experimental Capabilities
Neutron Sources / Neutron Scattering Instruments / Ancillary Equipment Accessibility /Users Programme

c) UTILIZATION Demands, Impact, Networks
Basic Research / Applied Research / Industrial applications / Domestic/International Collaborations

Then, the potential decision by the regional countries to establish an East Asia – Pacific Neutron Scattering (EAPANS) Coalition, should be taken on the basis of, among other aspects:

1) Acceptance of different experiences and capacities.
2) A shared vision about the importance of neutron scattering applications.
3) A commitment to do a 'best effort' to be an active participant:
   - Institutional decision to share its experience and capacities,
   - National commitment to support the initiative at internal and external levels.

4) Within an expanded horizon, definition of a Strategic Plan to
   - optimize and synergize experimental resources,
   - assure sustainability in terms of utilization of those resources,
   - consolidate an education and training scheme,
   - to expand utilization of those techniques into new areas.

ADDITIONAL REMARKS

The availability of neutron sources and associated experimental capacities is quite different across the region, but instead of consider that as a weakness I prefer to rescue the concept of **complementarities**.

In my point of view, the key words are **NEUTRON SCIENCE**, as they embody the different aspects that in many respects are unique to our community.

1) One of those aspects is related to the *Knowledge*, the *Expertise* and the *Capability* to use and to develop new methods and applications in the field of Neutron Physics, which are not only deposited in large, highly technical groups. This is not a minor point, as the prospective widening of Neutron Techniques applications in Science and Technology will be motivated by the demand (how far from the large Neutron Centres we can bring the possibilities of neutron techniques: *small local or regional sources*) and materialized by our capacity to produce innovations in the techniques (advanced instrumentation, optics, detectors, methods, algorithms,…).
2) The preceding tasks cannot be on a rule be performed at large facilities, as their mission is to provide the users with well established and reliable tools to tackle specific problems, rather than using their very expensive infrastructure both in capital and human resources to explore new ideas and concepts. It is necessary to emphasize that large facilities are not amenable for those endeavours, as they lack the flexibility of small sources to make changes without compromising beam schedule commitments or safety aspects. **It is not then a question of priorities, but rather of different rôles for large and small neutron facilities.**

The paragraphs above intend to establish a scenario through the identification of basic missions and objectives for large and small communities, without pretending to be comprehensive.

Clearly, we are not discussing simply hardware, but a far wider range of interests and responsibilities. **In this context, we should also identify common elements in the areas of Education, Innovations and Outreach, that are central to provide stability and projection to the field, both in scientific and political terms.**

1.14 Antonio Deriu - ENSA/Univ. of Parma, Italy

Almost 4500 users of neutron facilities and experts on the scientific and instrumentation aspects, reside in Europe and exploit European facilities. This is the largest, most experienced and diverse community of neutron scatterers in the world. The continuous action of organizing the contacts between the user community, facilities and funding agencies at the UE level (NMI3: Integrated Infrastructure Initiative) has provided an easier transnational access to the neutrons, produced coordinated, collaborative actions for the improvement of methods and techniques reaching beyond the facilities themselves, as well as for communication and dissemination.

ENSA, the European Neutron Scattering Association is an affiliation of the national neutron scattering societies which directly represent neutron beam users. It is a platform for discussion and a focus for action in neutron scattering and related topics within Europe. Main ENSA objectives:

- To identify the needs of the neutron scattering community in Europe.
- To optimize the use of present European neutron sources.
- To support long-term planning of future European neutron sources.
- To assist with the co-ordination of the development and construction of instruments for neutron scattering.
- To stimulate and promote neutron scattering activities and training in Europe.
- To support the opportunities for young scientists.
- To promote channels of communication with industry.
- To disseminate to the wider community information which demonstrates the powerful capabilities of neutron scattering techniques and other neutron methods.
- To assist, if appropriate, national affiliated bodies in the pursuit of their own goals.

NMI3: Integrated Infrastructure Initiative for Neutron Scattering and Muon Spectroscopy

In the EU Framework Programme 7 (FP7) all of the different activities related to a common type of Research Infrastructure are combined into this single project - an Integrated Infrastructure Initiative (I3). The Integrated Infrastructure Initiative for Neutron Scattering and Muon Spectroscopy (NMI3) is a consortium of 23 partners from 13 countries, including 10 research infrastructures. The objectives of integration are achieved by using several tools:

- Transnational access will be provided by 10 partners offering more than 1400 days of beam time. This will give European users access to all of the relevant European research infrastructures and hence the possibility to use the best adapted infrastructure for their research.
- Joint Research Activities focusing on seven specific R&D areas will develop techniques and methods for next generation instrumentation. They involve basically all those European facilities and academic institutions with major parts of the relevant know-how.
- Dissemination and training actions will help to enhance and to structure future generations of users.
- Networking and common management will help strategic decision-making from a truly European perspective.

1.15 Mahn-Won Kim - AONSA/KAIST, Korea

The Asia-Oceania Neutron Scattering Association (AONSA) is an affiliation of neutron scattering societies and committees which directly represent users in the Asia-Oceania Region. The overriding purposes of the Association are to provide a platform for discussion and a focus for action in neutron scattering and related topics in the Asia-Oceania Region.

The following presents a number of articles of AONSA, including its status, aims, affiliations, etc. (Source: http://j-parc.jp/MatLife/en/AONSA/index.html)

Article 1: Status

The Asia-Oceania Neutron Scattering Association (hereafter referred to as the Association) is an affiliation of neutron scattering societies, which directly represent users in the Asia-Oceania Region. The overriding purposes of the Association are to provide a platform for discussion and a focus for action in neutron scattering and related topics in the Asia-Oceania Region.

Article 2: Aims

(i) To identify the needs of the neutron scattering community in Asia and Oceania.

(ii) To promote optimised use of present neutron sources in the region.

(iii) To stimulate and promote neutron scattering activities and training in the Region, and in particular to support the opportunities for young scientists.

(iv) To support long-term planning of future neutron sources.

(v) To assist with the co-ordination of the development and construction of instruments for neutron scattering.

(vi) To promote channels of communication with industry.

(vii) To disseminate to the wider community information which demonstrates the powerful capabilities of neutron scattering techniques and other neutron methods.

(viii) To assist, if appropriate, affiliated bodies in the pursuit of their own goals.

(ix) To facilitate cooperation and networking amongst the neutron sources in the region.

Article 3: Affiliation

Affiliation to the Association is open to bodies representing neutron scattering users in Asia or Oceania. The present affiliation is listed in Annex.1. Further affiliations shall be approved by the Association Executive Committee.

Article 4: The Asia-Oceania Neutron Scattering Association Executive Committee

4.1 Delegates

Each paying Regular Member (affiliated society) will nominate two delegates to the Association Executive Committee (hereafter referred to as the Committee). A substitute delegate will be allowed. The individual delegation is recommended to be 2 years and is renewable.

4.2 Observers

Invited observers to the Committee will include representatives nominated by:

? The major neutron scattering facilities in the Region

? Projects for new neutron sources in the Region

? Other non-paying neutron scattering societies

? Further individual observers may be co-opted according to the needs of the Association.

Article 5: Organisation of the Committee

5.1 Board

The Committee will nominate a Board which will represent the association between formal meetings. It will comprise the President, the Vice-President, the Treasurer and the Secretary. The holder of each of these positions will be elected by the committee from amongst the current registered delegates. The normal term of office will be 2 years. The President then becomes an ex-officio member of the Committee. In normal circumstances, the Vice-President will succeed to the Presidency after 2 years.

5.2 Board members act in an exclusively honorary capacity.

5.3 The Committee will meet at least once per year, if possible associated with a member user meeting. Meetings will be called by the President.

5.4 On the demand of at least one quarter of the committee members, the President will arrange a meeting within two months of that request.

5.5 Decisions other than modifications to the articles (Article 7) and new memberships which will require the approval of more than one half of all registered delegates at formal meetings of the Committee, will be made by a simple majority of delegates present.

Article 6: Financial Matters

6.1 Regular Members will pay an annual fee to the Association, at a rate determined by the Committee.

6.2 The Association is pursuing no commercial purposes and not aiming for financial earnings.

6.3 The Committee may provide funds for any action appropriate to fulfil its aims according to Article 2 (sponsoring of research prizes, travel support, membership in other scientific institutions, support of studies and surveys). Payments of salaries for board members are excluded.

6.4 The costs associated with a delegate participating in a meeting of the committee shall ordinarily be found by the delegate or his/her nominating body.

6.5 For obligations of the Association, the liability spans the Association's assets only. There exists no private liability of its delegates or affiliates for a financing of any financial debt of the Association.

Article 7: Modifications to the Articles

Any modification to the Articles of Association shall require the approval of more than one half of all registered delegates at formal meetings of the committee. One month's notification in advance of any proposed modification is required.

Annexe 1 Member Societies

Regular Members:

A. The Japanese Society for Neutron Science (JSNS), www.jsns.net/jp/
B. The Australian Neutron Beam Users Group (ANBUG), www.anbug.org
C. The Korean Neutron Beam Users Association (KNBUA), www.neutron.or.kr
D. Taiwan Neutron Science Society (TWNSS)
E. Indian Neutron Scattering Society (INSS)

Observers (Other Affiliates):

….

Observers (Facilities):

A. J-PARC spallation neutron source
B. JRR-3M reactor
C. OPAL reactor
D. HANARO reactor
E. Dhruva reactor

ANNEX II. LIST OF PARTICIPANTS

Consultants Meeting on Strategic Planning and Regional Networking for Sustainability: concerted actions on neutron scattering in Asian-Pacific region

12-14 August 2009

ANSTO, OPAL Visitors Centre, B83

New Illawarra Road, Lucas Heights, NSW2234, Australia

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ANNEX III. METING AGENDA

Consultants Meeting on Strategic Planning and Regional Networking for Sustainability: concerted actions on neutron scattering in Asian-Pacific region

12-14 August 2009

ANSTO, OPAL Visitors Centre, B83, Lucas Heights, NSW2234, Australia

Wednesday, 12 August 2009

0930-1030	Registration followed by Morning Tea
1030-1100	Welcome & Opening Remarks
	Mr Adi Paterson, CEO, ANSTO and Mr D. Ridikas, IAEA
	Introduction of participants
	Selection of the Chairperson and Rapporteur
	Approval of the Agenda
	Objectives of the Meeting, Mr D. Ridikas, IAEA

Session #1: Needs and/or availability of neutron beams in Asian-Pacific region

1100-1130	**Mr Md. Muslehuddin Sarker**, INST, Bangladesh
1130-1200	**Mr Edy Giri Rachman Putra**, BATAN, Indonesia
1200-1230	**Mr Abdul Aziz Mohamed**, Nuclear Malaysia, Malaysia
1230-1400	Lunch break

Session #1 (continued): Needs and/or availability of neutron beams in Asian-Pacific region

1400-1430	**Mr Duncan McGillivray**, Univ. of Auckland, New Zealand
1430-1530	**Mr Dong Zhili,** Nanyang Technological Univ., Singapore
1530-1600	**Mr Pablo P. Saligan,** PNRI, Philippines
1600-1630	Break

Session #1 (continued): Needs and/or availability of neutron beams in Asian-Pacific region

1630-1700	**Mr Nhi Dien Nguyen**, NRI, Vietnam
1700-1730	**Ms Sirinart Laoharojanaphand**, TINT, Thailand
1730-1800	All: discussion, summary of needs/availability table

Thursday, 13 August 2009

Session #1 (continued): Needs and/or availability of neutron beams in Asian-Pacific region

0900-0930		**Mr Yuntao Liu,** CIAE, China
0930-1030		**Mr Masatoshi Arai**, JAEA, Japan
1030-1100	Break	

Session #1 (continued): Needs and/or availability of neutron beams in Asian-Pacific region

1100-1230		**Visit of Bragg Institute and Neutron Guide Hall**
1230-1400	Lunch break	

Session #2:

Share of experience and lessons-learned from other regional/international initiatives for neutron beam related research and applications

1400-1430		**Mr Robert A. Robinson**, ANSTO, Australia
1430-1500		**Mr Gawie Nothnagel,** NECSA, South Africa
1500-1530		**Mr Rolando Granada**, CNEA, Argentina
1530-1600	Break	

Session #2 (continued):

Share of experience and lessons-learned from other regional/international initiatives for neutron beam related research and applications

1530-1600	**Mr Antonio Deriu,** ENSA/Univ. of Parma, Italy
1600-1630	**Mr Mahn-Won Kim,** AONSA/KAIST, Korea
1630-1730	All: discussion, summary of needs/availability table, regional/international initiatives

Friday, 14 August 2009

Session #3: Discussion on support needed for education, training and mobility of researchers from developing countries in order to have access to available neutron scattering centers in the East Asia and Pacific region

0900-1000 **ALL**

Session #4: Discussion on promotion outreach to potential new user communities in academia and industry in the East Asia and Pacific region (e.g. interdisciplinary use of neutron beams in the fields of physical and life sciences, non-destructive methods to characterize/qualify materials/devices/objects, etc.)

1000-1030 **ALL**

1030-1100 Break

Session #5: Discussion on concrete actions and recommendations for establishment of a regional neutron scattering coalition or network centered at ANSTO as an IAEA collaborating centre for neutron beam applications (e.g. host regional neutron scattering school, provide special access to the OPAL neutron beam lines, establish long term training programs for scientists from developing countries, etc.)

1100-1230 **ALL**

1230-1400 Lunch break

Session #6:

Summary of discussions #3, #4 and #5, draft of recommendations, elaboration of work-plan and preparation of summary report

1400-1530 **ALL**

1530-1600 Concluding remarks and wrap up

1600 End of the meeting