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Asian-Oceanian Neutron Sources

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In 1997 Yamada and Morii surveyed the status of neutron sources available mainly for neutron scattering research in Asian and Oceanian region [1]. Totally 11 existing sources were reported in 8 countries while 5 new sources were at the planning stage in 4 countries. Except for Japan all other sources were based on MW-class research reactors. Since 1997 a remarkable progress has been reported as successful funding for all of planned sources and for refurbishment of the existing reactor in Taiwan.

By taking an opportunity of ICANS-XV, the Meeting on Asian-Oceanian Neutron Facilities moderated by Y. Endoh (Tohoku University, Japan) was held for the purpose to update the current status of existing neutron sources/facilities and future plans in Asian-Oceanian region and to find any mechanism for regional collaboration. This is a brief summary report on the meeting contributed from 8 participating countries/regions.

Australia (reported by R. Robinson, ANSTO)

To replace the existing 42 years old HIFAR reactor (10MW), the construction of RRR (Replacement Research Reactor) was funded in 1999. It is planned as thermal power 20MW, neutron flux $3x10^{14}n/cm^2/sec$, cold source and guide hall, and it will be completed in 2005. A series of very active workshops and committee meetings for installation of instruments have been held domestically as well as internationally. ANBUG (Australian Neutron Beam Users Group) has been rejuvenated with about 100 members (President: B. Kennedy, University of Sidney). Updated information is available through http://home.ansto.gov.au/ansto/RRR/char.html for RRR and through http://www.anbug.org for ANBUG.

China (reported by C. Ye, CIAE)

HWRR reactor has been operational since its criticality in 1958 and upgrade in 1980 under the current performance as thermal power 10MW(max. 15MW), neutron flux $3.2x10^{14}n/cm^2/sec$, cold source and guide hall. The construction of the new higher flux reactor CARR started in 1998 and it will be completed in 2006. Its performance is specified as thermal power 60MW, neutron flux $8x10^{14}n/cm^2/sec$, cold/hot sources and guide hall. About 20 institutes and universities are the basis of users although no formal users society is established yet. More detailed information is available through Ye's paper in this Proceedings.

India (sent by M. Ramanadham and R. Mukhodpahyay, BARC, after the Meeting)

Two reactors have been operational, i.e. CIRUS since 1961 and DHRUVA. The performance of CIRUS is as thermal power 40MW, neutron flux $6x10^{13}n/cm^2/sec$ while that of DHRUVA thermal power 100MW, neutron flux $2x10^{14}n/cm^2/sec$.(some data cited from [1]). NFNBR (National Facility for Neutron Beam Research) is available for researchers from all over the country. More detailed information is available through the contributed paper in this Proceedings.

Indonesia (reported by S. Ridwan, BATAN)

RSG-GAS reactor has been operational since 1987. Its performance is as thermal power 30MW, neutron flux $2x10^{14}n/cm^2/sec$. Some activities based on accelerator were also reported, but not for neutron scattering. More detailed information is available through the contributed paper in this Proceedings.

Korea (reported by Chang-Hee Lee, KAERI)

After TRIGA MARK-II(200kW) and TRIGA MARK-III(2MW) reactors, the new HANARO reactor was built in 1995 with its performance as thermal power 30MW, neutron flux $2x10^{14}n/cm^2/sec$. Currently it has been operated at 24MW and a cold source is planned to install during 2002-2003. A series of active workshops and winter schools have been held to attract users to neutron scattering research and to accommodate users requirements. HANARO Users Association was formed in 2000 while the formation of KNBUG (Korean Neutron Beam Users Group) is now under discussion. Also reported was a brief description of KOMAC project mainly for transmutation and energy production based on an intense proton accelerator.

Japan (reported by Y. Fujii, ISSP)

Currently three neutron sources are available. JRR-3M reactor is a central facility for users since its criticality in 1990 with its performance as thermal power 20MW, neutron flux $3x10^{14}n/cm^2/sec$, cold source and guide hall. Two thermal guides are now replaced by supermirros. KUR reactor has been operational since 1965 with its performance as thermal power 5MW, neutron flux $8x10^{13}n/cm^2/sec$, cold source. KENS is only one accelerator-based neutron source in Asia-Oceanian region since its establishment in 1980 as the first dedicated pulse neutron facility in the world. Its current performance is as proton beam power 3kW, peak neutron flux $9x10^{14}n/cm^2/sec$, cold source and guide hall. Currently total number of users are roughly 450 for JRR-3M, 50 for KUR and 350 for KENS.

After the previous report by Yamada and Morii [1] where two accelerator-based neutron sources were proposed as JHF by KEK and CENS by JAERI, these two projects were encouraged to unite and to jointly promote as the "Joint Project" tentatively named. After a series of internatioal and third-party reviews of this Joint Project during the last two years, the Government finally decided to fund it from April 2001 (JFY-2001). Originally five major facilities of neutron beam, muon beam, nuclear physics, high-energy physics and transmutation sciences/technologies are planned on the basis of a common intense proton accelerator. Due to the current budget restriction, however, the neutron beam and nuclear physics facilities out of these five are built firstly hopefully by 2006. Its performance for neutron source (JSNS tentatively called) is as proton power 1MW(3GeV/333μA, 25Hz) at the 1st phase (by 2006) and 5MW at the 2nd phase, short-pulse, various moderators around a mercury target for about 30 instruments. A series of workshops and meetings have been held actively under the auspices of the Joint Project Team organized between KEK and JAERI and supported by the Neutron Scattering Association of Japan (350 members; President, Y. Fujii, ISSP).

Taiwan (reported by Chien-Hsiung Lee, INER)

There are a few kW-class reactors operational and two MW-class ones, THOR (1MW, $1.5x10^{13}n/cm^2/sec$, 1960-) and TRR (40MW, $6x10^{13}n/cm^2/sec$, 1972-1988 shut-down). The refurbishment of the TRR was funded in 1998 for the purpose of neutron source more dedicated to beam experiments. Thus renamed TRR-II under construction is designed as its thermal power 20MW, neutron flux $2.7x10^{14}n/cm^2/sec$, cold source and guide hall. It will be completed in 2006.

Thailand (reported by A. Sangariyavanich, OAEP)

The TRIGA MARK-III type TRR-1/M1 reactor is currently operational as its thermal power 2MW, neutron flux 3.1×10^{13}n/cm^2/sec. The new reactor has been under construction since 1997 and will be completed in 2001. Its performance is as thermal power 10MW, neutron flux 2×10^{14}n/cm^2/sec.

As one can see these status reports from 8 countries/regions as summaried in the figure, a large number of new neutron sources are funded or already under construction in Asian-Oceanian region in contrast to the situation in North America and Europe. Most of them are aiming not only at domestic use but also at regional/international use when they will become on-line around 2006. Some of them such as RRR in Australia, TRR-II in Taiwan and Joint Project in Japan have formed or will form the International Advisory Committee for reviewing the project from many aspects.

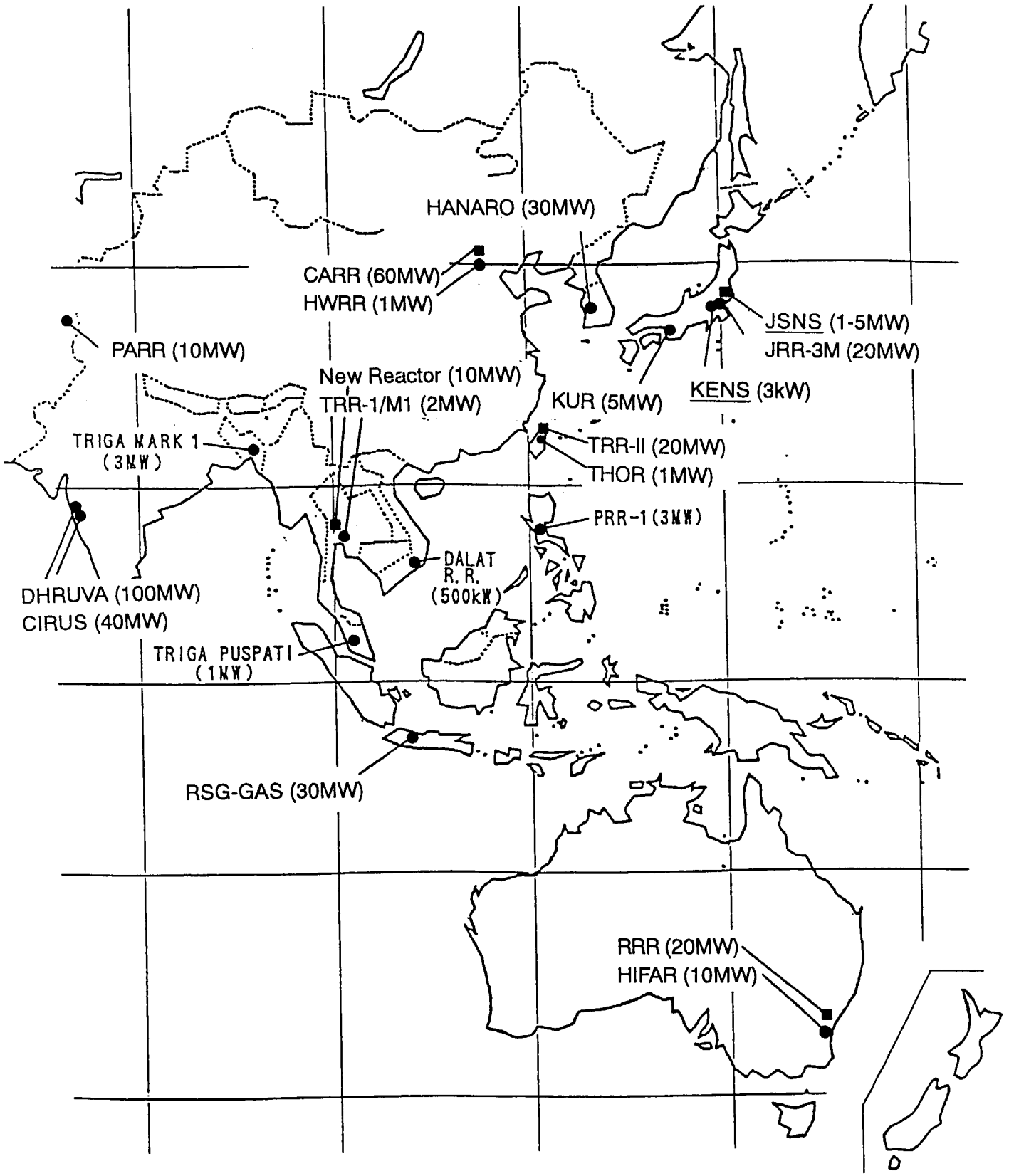
Finally discussion was made on a possible mechanism to coherently coordinate Asian-Oceanian neutron sources and facilities and to further develop regional collaboration. Australia and Japan, who already have formal users society as ANBUG and NSAJ, respectively, are expected to take the initiative in forming the Asian-Oceanian Neutron Scattering Association (tentatively named) in the next couple of years, similarly to ENSA (European Neutron Scattering Association) and NSSA (Neutron Scattering Society of America). Both facility representatives and users community representatives in each country/region will be contacted in several months for such a purpose. The next important step will be at Bangalore in India where the next AsCA (Asian Crystallography Association) Meeting is planned on November 18-21, 2001.

Y. Fujii (ISSP) also stated as Chair of Neutron Scattering Commission of IUCr (International Union of Crystallography) that his Commission has planned to compile "Neutron Source Catalogue" which collects basic information on reactors and accelerators available for neutron beam experiments all over the world. He asked everybody's cooperation on such a project.

[1] Y. Yamada and Y. Morii: Present / future status of neutron scattering facilities in Asian and Oceanian district, Physica B241-243 (1998) 22-29.

List of Attendants to the Meeting on Asian-Oceanian Neutron Facilities
ICANS-XV (Tsukuba), Nov. 7, 2000

S. Kennedy	(ANSTO, Australia)	Y. Morii	(JAERI, Japan)
R. Robinson	(ANSTO, Australia)	M. Arai	(KEK, Japan)
C. Ye	(CIAE, China)	M. Furusaka	(KEK, Japan)
G. Pépy	(LLB, France)	T. Kamiyama	(KEK, Japan)
R. E. Lechner	(HMI, Germany)	T. Ebisawa	(KUR, Japan)
S. Ridwan	(BATAN, Indonesia)	Y. Kawabata	(KUR, Japan)
F. Carsughi	(Univ. Ancona, Italy)	T. Kawai	(KUR, Japan)
Y. Fujii	(ISSP, Japan)	C. H. Lee	(KAERI, Korea)
Y. Endoh	(Tohoku Univ., Japan)	C. H. Lee	(INER, Taiwan)
N. Minakawa	(JAERI, Japan)	A. Sangariyavanich	(OAEP, Thailand)



Updated information on status of neutron sources in Asia-Oceanian region as of January 2001. The map and information except for 8 countries/regions represented in the present report are based on the original report by Yamada and Morii in 1997 [1]. The existing neutron sources currently operational are marked with ● while the new sources already funded or under construction with ■. The underlined one only in Japan represents an accelerator-driven spallation neutron source and others are research reactors.