

SECTION 7: REPORT FINDINGS

In this section we summarize the findings of this report. We open with a summary of access policies. We go on to why scientists seek access to facilities abroad. We identify some specific means of obtaining access. We identify some factors that limit access. We conclude by discussing how the availability of facilities is evolving in the world, how the user community is evolving, how the nature of experiments at facilities is evolving and the perceived impact of these changes on access to major international facilities.

1. Basic Access Policies:

- None of the facilities responding to the questionnaire charge “user fees.” All major facilities have adopted the policy that government-funded laboratories provide the beam and instruments and users, who bring science and manpower, have access to these facilities without charge,. This is recognized worldwide as the most effective facility/user relationship.
- At all facilities responding, access is obtained by submitting a written proposal to the facility to conduct an experiment on a specific instrument or beamline. At all facilities, the proposals are reviewed by external reviewers or committees, and a recommendation for experimental time is made based on the scientific merit and feasibility of the proposal.
- Following the recommendation based on scientific merit, other factors may enter the decision to award time, such as national origin of user, balance of science proposed to the facility, previous record of achievement and other factors (see Section 4).
- In addition to the proposal program, time may be obtained by funding or being a member of a team that builds an instrument or beamline or other equipment (for example, a PRT or a CAT) at the facility (see below). Some other informal mechanisms, such as “Director’s time,” exist.
- At most European facilities, the travel and living expenses incurred by users in conducting an experiment at a facility are paid by the facility. At most US facilities, they are not.
- Major facilities may be classified as National (the operating budget is provided by a single nation) or as Multinational (operating budget provided by a consortium of nations and associates).

2. Bilateral access policy and multinational facilities

- The US policy for access to foreign facilities is effectively a bilateral, nation-to-nation understanding for reciprocal use of national facilities. It is an informal understanding that US scientists use foreign facilities and foreign scientists use US facilities as if there were no national barriers. This admirable and open-access policy operates well between individual nations having comparable availability of national facilities. However, it does not adapt well or join on well to multinational facilities such as ESRF and ILL that are supported by several member nations. The multinational facilities report to and rely upon support from many members and associates. They have to allocate use of the facility to scientists from member countries in approximate proportion to the member's support of the facility. The mismatch of the US nation-to-nation policy with access policies of multinational facilities needs to be recognized in the US simply as a mismatch to be addressed and transcended. It is a barrier to access. The mismatch of a bilateral policy and multinational facilities is not unique to neutrons and X-rays but has been cited as a barrier to collaboration in other fields (cf OECD Reports 1998, NSB Report 1990, Appendix 8).
- The chief multinational facilities are the ESRF and ILL, which are among the largest (in number of users and instruments) and most productive (scientific publications) facilities in the world. Current US use of ESRF is 3 % and ILL 5 %, down from 11 % 15 years ago. Negotiations between DOE (or NSF) and ESRF and ILL to establish collaboration agreements and to facilitate access to these multinational facilities is highly recommended.
- Most new synchrotron and neutron scattering facilities coming on line, under construction or planned will be national facilities (see Appendix 3). This is contrary to the finding of the OECD Megascience Forum Study of 1998, which projected a further concentration toward large regional and multinational facilities, probably in other fields. However, there are important exceptions, and access to multinational facilities will remain important. For example, the major upgrade in progress at ILL (2001-2008) and the major upgrade planned at ESRF means that these multinational facilities will remain world leaders in the coming 10 years. There is the major European X-ray Free Electron Facility coming on line in Hamburg. An announcement of the European Spallation Source (ESS) is anticipated (18 months). As stated for British scientists in the CCLRC 2005 Report, US scientists will seek access to the best possible facilities in the world.
- A bilateral, reciprocal access policy also functions well only if there is an approximate balance in the availability of facilities in the two nations. If this availability gets too far out of balance for too long the policy comes under strain. There have been significantly fewer neutron instruments available in the US than in Europe for many years. Even with the full complement of instruments (24) at SNS, the number of instruments in the USA will still be less than one half that in Europe (see OSTP Report 2002 and our Figure

1). In contrast, the availability of synchrotron beam lines in the US has been comparable and is projected to remain comparable to that in Europe or Asia.

2. Why we want Access:

- Access to foreign facilities is sought because foreign facilities may have:
 1. Unique instruments or specialty instruments not available in the US or the competition for certain instruments in the US may be high.
 2. Unique or specialty sample environment facilities or sample handling capability not available in the US.
 3. Unique or specialty scientific programs not being pursued in the US.

Until relatively recently, there were, for example, no spin-echo or high-energy resolution quasielastic spectrometers in the US. At present, there are few Time of Flight (TOF) spectrometers for inelastic neutron scattering in the US, especially ones that combine high energy resolution and high beam intensity.

3. Means of Obtaining Access:

1. Scientific Collaborations

- Access to foreign facilities can always be obtained by collaborating with foreign scientists. For example, proposals to multinational facilities that include an investigator from a member country of the facility are immediately classified as a member-country proposal. At many European facilities, more than one half of the teams conducting experiments contain a foreign national. Collaborations involving US scientists need to be encouraged and supported financially.

2. Cooperative agreements

- Access can be obtained via nation-to-nation cooperative agreements such as the US-Japan cooperative agreement in neutron scattering.

3. Building Instruments or Sample Environment Facilities

- Access can be obtained by building an instrument at a foreign facility. For example, Canadian scientists are currently building the VULCAN instrument and German scientists the neutron spin echo (NSE) instrument at the SNS. Japan has been particularly successful in placing instruments and gaining access at facilities abroad. However, we found no examples of instruments built by US scientists at facilities abroad. Indeed, there is no mechanism for funding instrument or sample environment building by

individual US scientists abroad. This is a major gap in routes to access for US scientists and engineers at foreign facilities.

- Access can be obtained by creating or participating in a Participating Research Team (PRT). PRTs are also denoted Collaborating Access Teams (CATs) and are called Collaborating Research Groups (CRGs) in Europe. This mechanism has been used extensively by US scientists at US synchrotron facilities but is now somewhat out of favor. The CRG in Europe is regarded as an important and successful means of flexible access. At ESRF, for example, the CRG must demonstrate that the CRG instrument is unique, that the instrument will be constructed following facility guidelines and the CRG is reviewed periodically to ensure that funding for operation remains adequate. Although it may need review in the USA, the PRT or CAT remains an important access mechanism.

4. Factors Affecting Access and Barriers to Access

- Knowledge of facilities remains a barrier to initiating experiments at foreign facilities. Getting started, usually within a collaboration, is also a barrier.
- Restrictions on visas for entry into the USA and the security reviews of non-US citizens at DOE facilities which may result in delay or limits on access remain a barrier to access. For example, 50-75 % of science and engineering graduate students in the USA are foreign nationals chiefly from Asia. The security review at DOE facilities and on occasions the lack of transparency of the process and delay of access for these students often means that these students elect to pursue other research.

5. Availability of Facilities and the Community is Evolving

- New facilities are coming on line that will improve access and modify international balance. The US has been through (and still is in) a low point in availability of neutron instruments. SNS will greatly improve the balance in number and sophistication of instruments between US and Europe, for example. However, the number of instruments in the US will remain significantly below that in Europe without a second target station at SNS plus a full complement of instruments, new guide halls at HFIR and NCRC and significant expansion of the number of instruments at LANSCE. Availability of synchrotron X-ray facilities in the US has been much better. However, limited operating funds for X-ray facilities, which limits the length of time the facility can operate in a year and the number of instruments scientists it can support, appears to be a limiting factor for X-Ray facilities.
- The number of users and the number of accepted proposals on a facility or in a region of the world is highly correlated with the number of instruments at the facility or in the region (see section 4.5).

- Specifically, funds devoted to beamlines and instruments yield rich returns in terms of increased availability of X-rays and neutrons for users and the productivity of facilities in terms of scientific publications arising from experiments. This is particularly true for funds devoted to the continuing upgrade of guide halls, beamlines and instruments at existing and newly completed facilities. This is the basis of the recommendation in the NRC report, CMMP 2010, that the priority for funds at X-Ray facilities should be on beamline upgrades and sample environment facilities. NIST and ILL are important examples where continuing expenditure on instruments has created an outstanding neutron scattering facility.
- Japan and China are building major new facilities that will change the balance of availability of major facilities between the East and the West. J-PARC will be a sophisticated major facility sought by scientists in the West. China is building both world-class reactor (CARR) and spallation (CSNS) neutron sources. This is a significant change and it is likely that US scientists will seek access to these facilities.
- ILL and ESRF with their upgrades are predicted to remain world leading facilities for the next 10 years in size, in spectrum of instruments, in sample environment facilities and in scientific productivity. With the upgrades to US synchrotron X-Ray that are currently being planned, we expect the United States will have facilities comparable to the best in the world in the X-Ray field when these plans are implemented.

6. Critical role of Instrument Scientists

- The nature of the user community is evolving. While in the early days many users were experts in the use of neutrons and X-rays, today most users are experts in their own fields but largely unfamiliar with neutron and X-ray scattering. As the user community in the US grows, this trend will continue. This evolution will place increasing reliance and demand on facility instrument scientists to guide users to the best use of facilities. Scientifically productive access for most users will require increasing intervention and assistance from instrument scientists with planning experiments, with “hands-on” assistance during the experiment and with assistance in interpreting and analyzing the data.
- With increased beam intensity and spectrometer efficiencies, data will be collected more quickly and the length of time of experiments will be reduced. In many cases, this will also place increasing reliance on instrument scientists for assistance at a scientific level during the experiment to make the best use of the facility.

- Given the evolving nature of the user community and increased data collection rates, concern was expressed that instrument scientists are under increasing time pressure as they assist users. This has made the position as an instrument scientist less attractive and made it more difficult for instrument scientists to assist users at a scientific level. It also made it difficult for instrument scientists to maintain an independent research program at the facility. Ensuring that instrument scientists have sufficient time to pursue their own research interests and sufficient time to carry out their own experiments is essential in making the position of instrument scientist attractive.
- Specifically, users expressed the view that assistance at a science level was often critical for the success of their experiments. As the pace of experiments increases and as the user community expands to include less experienced users, instrument scientists will become increasingly important in securing scientific access for users. It is therefore critical that they have an attractive career path with clear promotion prospects and time to pursue their own science as well as to devote to user teams. Equally, it is important to support the educational research programs in universities that train new instrument scientists to ensure a continuing flow of bright young scientists into the X-ray and neutron scattering fields.