WORKSHOP SESSION I REPORT: WORLDWIDE FACILITIES PLANS FOR VARIOUS USER NEEDS

J. B. Hayter

Plans for Various User Needs

John Hayter (ANS, Chairman) presented an overview of neutron scattering and other beam research techniques, from the viewpoint of their impact on reactor design. The major change in emphasis in recent years has been the need for specialized sources of cold, very cold and ultracold neutrons, in addition to the more conventional thermal neutron beams. Research reactors now handle experiments on an incredibly wide range of subjects, from the most fundamental elementary particle physics through materials science and engineering to chemistry and biology. This leads to very specialized requirements, not only in the reactors, but in the surrounding infrastructure, such as the provision of sample-handling laboratories for, *e.g.*, biochemical materials. Some beam instruments, such as those used for studies of neutron optics, now have such extraordinary sensitivity that stringent anti-noise and anti-vibration requirements are imposed on certain experimental positions at reactor facilities.

In almost all areas of activity, conventional methods are expanding into new areas of application. In the case of materials irradiation, testing of materials for fission and fusion reactors continues apace, but considerable production irradiation also takes place, for example to dope silicon with phosphorus for the semiconductor industry, or to generate color centers in synthetic gemstones. Activation analysis is becoming an even more important tool than in the past, as more emphasis is placed on finding traces of pollutants in the environment. Another analytical tool, depth profiling, is also finding widespread use, particularly by the semiconductor industry.

Radioisotope production, both low-Z and transuranic, remains a necessity, providing sources for industrial radiography and cancer therapy, and as tracers in medical research. The need for explosives detection at airports has increased the need for californium, and this need may increase further if epithermal sources based on ^{252}Cf prove useful for neutron capture therapy. Special sources are also being requested. These are often of a very "hot", short-lived isotope, for example for positron production or for Mossbauer spectroscopy, and require special facilities in place.

Nuclear physics research has made steadily increasing use of reactors in the past two decades. Studies of neutron-rich nuclides by fission product spectroscopy requires local hot cell handling of small (mg) quantities of fissionable materials. Thermal neutron beams without background-creating material in the reflector ("through" tubes) are required for precision γ-spectroscopy, with other types of access needed for β-spectroscopy. Finally, in-pile loops of various types are always needed for testing, and for R&D on new ideas. These are often related to a primary function of research reactors, namely education and training.

Medium flux reactors ($\phi < 10^{19}$ $m^{-2}.s^{-1}$) are able to perform many of the tasks discussed above, and they are irreplaceable as training centers. Almost all new ideas have been conceived and taken through R&D at medium flux reactors, for well-understood reasons: time on high flux reactors is so scarce, relative to the number of users requesting it, that there is rarely the opportunity to undertake preliminary development projects at reactors such as HFBR, HFIR or ILL.

One of the most immediate needs for high flux reactor centers is thus a healthy community of medium flux reactors. The fundamental role of high flux sources is to push the state-of-the-art, especially in neutron scattering, which will always be signal-limited on any currently conceivable neutron source. Most of the new methods which have been initially developed at small reactors have led to improved resolving power, for which the cost is always a need for higher flux. As a result, the practical implementation of such new techniques as backscattering, contrast-matched SANS, or neutron spin echo, has required the highest flux possible. There is thus an essential symbiosis between medium and high flux reactor centers.

Otto Harling (MIT) continued the session with an number of comments on in-pile loops, irradiation techniques and medical therapeutic uses of neutrons, especially in the epithermal range. MITR is an example of the type of facility which can be designed for the latter purpose, and details will be found in his article elsewhere in these proceedings. Some other aspects of medical isotope use were discussed by Charles McKibben (MURR), and Ken Thoms (HFIR) spoke on materials irradiations for users from the nuclear industry. Finally, Bernard Farnoux (Saclay) and Hank Prask (NIST) offered commentaries on practical aspects of running user facilities, and the extent to which industries could be interested in joint instrumentation projects through the *Participating Research Team* (PRT) concept; many of these ideas will be found in the articles by these authors.