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Advanced Neutron Source: The Users' Perspective

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To maintain scientific and industrial leadership requires increasingly sophisticated research. A century after Alexander Grahame Bell worked with a single assistant, the telephone industry operates one of the largest research laboratories in the world, and this story is repeated with industrial research facilities in many other fields of endeavour, such as electronics, petrochemicals, medicine, aerospace and pharmacology. However, these focussed research capabilities have proven to be insufficient. Facilities such as synchrotron light sources and neutron sources, which are too expensive for any one private laboratory to build and operate, are increasingly necessary to provide basic information on the properties of modern materials. In the U.S., these unique facilities are supported by the Office of Basic Energy Sciences of the Department of Energy (DOE) and are built and operated at DOE's Energy Research laboratories as a national resource. These facilities are made available to industrial, academic, and government scientists in the realization that America's position in world science and the global economy can best be advanced through close association between basic and applied research. However, the U.S. is not alone in recognising this fact, and in the key area of reactor-based neutron research, we have invested much less heavily than our competitors in Western Europe and Japan over the past two decades. The Advanced Neutron Source[1] is being designed to restore to American users the world's best neutron research capabilities.[2] To achieve this goal, the design of the facility must be tailored to its end use, and it

should be clear from the above discussion that users will come from all areas of industry and academia, with widely varying requirements.[3,4] User experiments will cover fields such as activation analysis of pollutants, irradiation of materials for the fusion program, and neutron scattering studies of materials as diverse as viruses, aerospace composites, and superconductors. Production capabilities must also be provided for the production of isotopes, especially of transuranic elements. The different ways in which these research areas and their required infrastructure influence the design of the Advanced Neutron Source will be the subject of this paper.

Once in full operation, the Advanced Neutron Source will accommodate more than 1000 industrial, academic, and government researchers each year. Apart from providing a platform for frontier research, the facility will play a national role in science and technology education. Figure 1 shows that the number of users quintupled in the first four years of operation of the Institut Laue-Langevin (ILL), currently the world's premier facility for neutron research. The same growth was observed when the world's brightest continuous source of x-rays and ultraviolet radiation (the National Synchrotron Light Source at Brookhaven National Laboratory) became operational, with the number of users increasing from about 280 to 1200 between 1985 and 1989. In each case, the number of users at startup represented the body of scientists using such facilities as then existed, with the massive growth engendered by new people attracted into the field by the availability of world-class equipment. One impact of this influx of talent has been the development of new uses which were never imagined in the original scientific case. Maintaining sufficient flexibility to accommodate totally new ideas, while designing a facility optimised for foreseeable research purposes, is one of the most challenging aspects of the project.

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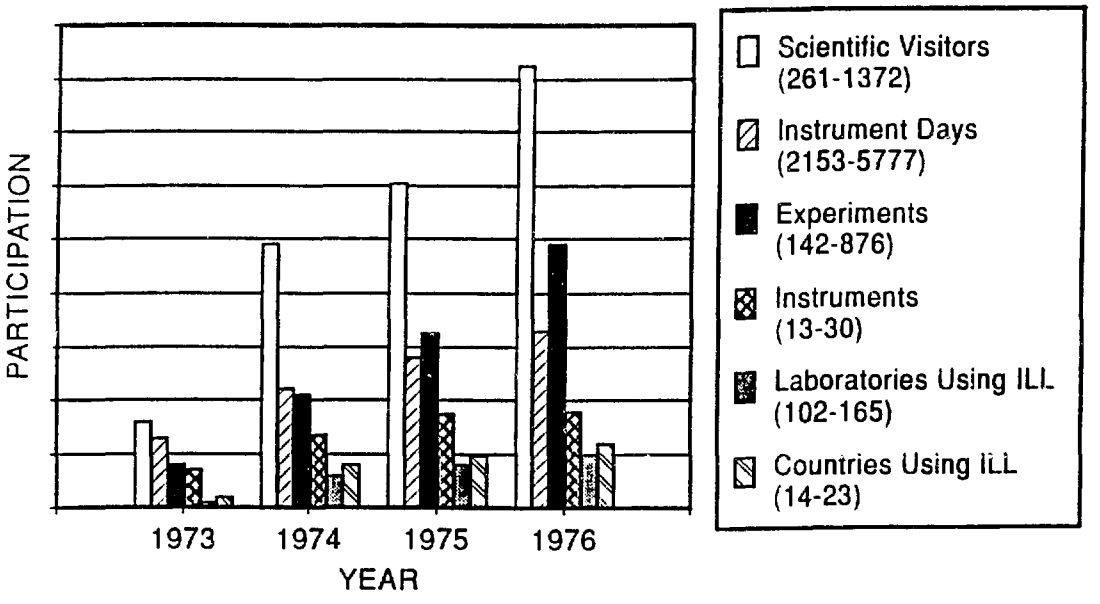

Fig. 1. The growth of user activity after startup of the multinational high-flux reactor facility at the Institut Laue-Langevin (ILL) in France. (Numbers in parentheses compare the 1973 figures with those for 1976.)