**7.2** **Best** **Practices**

**BEST PRACTICE**

**Title of the Practice**

To make available the extensive and unique experimental facilities available with DAE Institutions for advanced research by HBNI students and faculty and also other Research Institutions/Universities

**Objectives of the Practice**

The CIs/OCC of HBNI have unique, state-of-the art research facilities, such as nuclear reactors, accelerators, etc. HBNI aims to advance indigenous nuclear technological capability by making available these research facilities to the young research students. The experimental facilities are also extended to students of other Universities, with the twin objectives of enhancing the utilization of the national facilities and aiding the development of human resources for the country.

**The Context**

DAE is pursuing indigenous development of materials, equipment, processes, systems and mega science facilities relevant to nuclear science and technology. Such a program involves challenging experiments such as measurement of properties of radioactive fuel, degradation of structural materials subjected to irradiation, production of radiopharmaceuticals, enrichment of nuclear fuel materials, radiation applications, etc. DAE has set up a wide variety of unique experimental facilities to address these R & D requirements, which are of high value, not only with regard to research on topics related to nuclear sciences, but also several other domains of science and technology.

**The Practice**

HBNI encourages faculty and students to take up research programs that make use of the immense experimental facilities available within DAE units. Apart from state of the art High Performance computing facilities, DAE has laboratories to cater to major experimental research activities in various disciplines. Some of the unique experimental facilities available are research reactors, accelerators, tokamaks, synchrotron, neutron spectrometers, large telescopes, laboratories for experiments with ultrapure / reactive/ radioactive materials, high temperature sodium test facilities, shake table for seismic simulations, facilities to study materials under extreme conditions, etc. Other advanced experimental facilities available in the CIs/OCC include crystal growth facilities, spectroscopic facilities, ultrafast chemistry, thin film deposition, plasma processing, laboratories for stress analysis, robotics and remote handling, electromagnetic forming/welding equipment, etc. The students of HBNI from various CIs/OCC have access to such unique and complex experimental facilities and thus develop unique expertise in challenging experimentation. DAE also participates in international collaborative ventures, viz. LHC, ITER, FAIR, Project X of Fermi Lab, LIGO, etc. Several HBNI students have the privilege of working with international teams on experiments, computations and instrumentation development related to these projects.

DAE units also make available the large experimental facilities to students from other organizations / universities, through a UGC-DAE consortium. The beamlines available at Indus synchrotron facilities at RRCAT are routinely used by researchers from other Universities. At BARC, university scientists and students are provided access to the National Facility for Neutron Beam Research (NFNBR) at Dhruva reactor. The Kolkata Center of the Consortium coordinates accelerator based experimental work, both in-beam and offline at the VECC and the 3 MV Pelletron at IoP. The Kalpakkam node provides access to the sophisticated scientific equipment of IGCAR for the university researchers. HBNI faculty are deeply involved in the collaboration programs pursued in these facilities.

**Evidence of Success**

The research problems selected by HBNI students have direct bearing on the ongoing programs of the department. The result of this is that the students get opportunities to work on sophisticated experimental facilities and their work gets published in high impact journals. At the same time, DAE gets valuable research inputs for the projects which are a part of its mission. It has been observed that more than 40% of the PhD dissertations involve experimental work using DAE facilities. The utilization of the Indus synchrotron and other facilities by researchers across the country has continued to increase over time, producing excellent results in several domains of science. These are all evidences of success of such best practice.

**Problems Encountered and Resources Required**

The experimental facilities available in DAE units are under high level of security as they are considered as strategic installations. Use of some facilities involve handling of radioactive elements. Access to such facilities by students needs formal permissions and special training. Similarly, facilities are shared by many researchers at a time and students need to wait for getting access. These factors may lead to time pressure on completion of the academic program, in comparison to conventional universities. No difficulty has however, been encountered in terms of availability of funds to carry out research and payment of fellowships to the students, since such funds are provided by DAE as a part of their regular annual budget.