Council for Science and Instrumentation (CSI) of the Laboratoire Léon Brillouin

Report

Executive Summary

We were all impressed by the motivation of the LLB staff and their clear commitment to achieve the three fold mission of the facility – science, neutron instrumentation, and teaching – often with somewhat limited resources. The science output is world class, and the instrument suite is being continually upgraded to meet the demands of the French user community and the education activities are well thought out and effective.

We applaud the efforts made to bring coherence into critical activities with the creation of the extended instrument groups, platforms, and technical groups focused on instrument development. This approach should enable LLB to achieve its principle missions in a cost effective manner.

The CAP2010 instrument development project is just now completed and has delivered major upgrades to 14 instruments, using a combination of operating funds and external grants.

The facility is now embarking on a more ambitious instrument renewal program, CAP2015, with large projects such as PA20 and FA# funded as part of the Swedish-French collaboration. These are ambitious projects, and since schedule and cost expectations must be adhered according to the agreements, they must be managed within an appropriate project management approach. This requires **dedicated, ring-fenced, budget line, manpower resources, and a supporting project infrastructure**. LLB management has clearly recognized the need for a more sophisticated project management approach for the successful on time delivery of these instruments, and has been shifting the structure of the organization to achieve this. The newly formed technical groups are putting into place the project management infrastructure that will be required to deliver these projects. These groups are clearly well coordinated and highly motivated, and are achieving a great deal with limited resources.

The committee was concerned, however, with flexibility that the LLB management team has to make staffing changes required to enable an ambitious instrument upgrade program to be managed effectively. A staffing contingent with instrument development and project management expertise needs to be developed; however, compared to any similar national or international neutron facility, the number of permanent staff operating the instruments at LLB is already alarmingly low. The situation is somewhat exacerbated by the fact that CNRS researchers clearly do not seek or receive recognition for instrument development activities. Their careers depend almost entirely on their scientific productivity. This leads to the excellent scientific collaborations that users experience at LLB, but in the long-term will compromise the facility as the instruments are not maintained at the leading edge. The required transition has been recognized and is being handled appropriately by LLB management. We reinforce their actions by the following recommendations:

1. Develop a long range instrument development plan that sets priorities on which instruments should be upgraded/constructed and which should no longer be supported. This plan should be developed in consultation with the user community. We have observed that LLB management

has put into place such a plan, but would suggest that more engagement of the potential user community could be solicited.

2. In order to focus limited resources effectively on key areas, we suggest that LLB put a mechanism in place to gather centrally the causes and impacts of instrument down time.
3. Develop a resource (budget and staffing), loaded integrated schedule required to deliver the upgrade plan and identify a specific budget line separated from operations budgets.
4. Researchers, who have a desire to undertake instrument development activities, in addition to and support of their research programs, should be engaged and recognized for these talents.
5. LLB management will need flexibility in hiring decisions in order to ensure the appropriate complement of staff.

Given the demographics of the present research staff at LLB, there is a near-term opportunity to manage the mix of staff over the coming years.

Our conclusion is that the LLB fulfills a unique role in providing neutron scattering resources and training for a broad research community. Each year approximately 100 new users take advantage of the facilities. Many of these users would not be able to learn the technique elsewhere. We found that the laboratory has developed a long range instrument upgrade plan aimed at maintaining this capability for the French research community. However, the long range plans of the LLB are intimately intertwined with the long range plans for the ORPHÉE reactor. Although we did not have the opportunity to discuss the long-term future of the reactor, and such plans are beyond the direct remit of the committee, we emphasize that the two are inextricably related. We are particularly concerned about the inevitable fuel conversion from HEU to LEU which, irrespective of the final outcome, will impact the neutron scattering program.

We re-iterate our very favorable impression of the productivity of the facility; this could not be achieved without the commitment and professionalism that we witnessed amongst the staff.

Introduction

The Council for Science and Instrumentation (CSI) was created at beginning of 2012, following the signature of the renewed convention between the CEA-CNRS for the management of the LLB. The purpose of the CSI is to provide expert advice on the development of the instrumentation, research and education missions of the LLB, and recommendations on how to reach the long-term goals. The committee reports formally to the LLB Steering Committee.

The CSI is comprised of three members with two year terms: Claude Berthier (CNRS - retired), Gérard Gebel (UMR 5819 CEA-CNRS-UJF), and Ian Anderson (ORNL – chair). Three additional members, with one year terms, can be solicited each year to address the particular focus that year. This year (2012) the CSI was asked to focus its attention on the status and development of the neutron instrument suite, neutron techniques, and related education activities. Hence André Chabre (CEA), Kurt Clausen (PSI), and Marc Rabaud (University Paris-Sud) were invited to join the CSI for 2012. The committee members for 2012 are listed in Appendix 1.

The scope of this first CSI report was discussed at length with LLB management and can be summarized by the following charge:

Evaluate, and provide advice on, the LLB instrument development strategies and planning according to the mission of the LLB, within the national and international context, and with respect to the future operation of the Orphée reactor.

The report guidelines, approved by the LLB steering committee are provided in Appendix 2.

The CSI will report on the LLB science programs in 2013.

Methodology

The background information that allowed the committee to develop their report was gathered in three ways:

1. Offline documentation (annual reports, instrument descriptions, publications, etc.) were provided on an external web site.

2. The committee spent two days at LLB (October 4-5) talking with staff in the various organizational groups. The committee also met with Jean Daillant, General Director of Soleil, over lunch, and with representatives from the LLB steering committee (CEA: Patricia Roussel-Chomaz, CNRS: Amina Taleb). The program for the on-site visit is provided in Appendix 3. Unfortunately Claude Berthier and Gérard Gebel were unable to participate in the on-site visit.

3. A survey of a selected set of regular LLB users was carried out via email. The intent of the survey was to solicit the user perspective of the status of the instrument suite (and ancillary

infrastructure) at LLB, the relevance to their research, suggestions for improvements and access. The survey questionnaire is provided in Appendix 4.

The members of the CSI would like to thank all LLB staff for hosting them during their visit to the facility on the 4th and 5th of October. We appreciated the open conversations with the members of staff that we met. There is so much going on and so much for us to learn that we could have spent more time on site. All of us were particularly humbled by the fact that all staff spoke to us in English – we thank all for making the effort to do that.

We would also like to thank Patricia Roussel-Chomaz and Amina Taleb for taking time from their very busy schedules to talk with us. We were very impressed with their knowledge of the facility and their frankness during discussion. They clearly expressed the over-arching support and commitment of both CEA and CNRS to the LLB within an environment of severe budget restraints.

This report has been compiled and approved by all committee members, and verified for factual accuracy by LLB management.

Organization and Management

The LLB is located within the « Centre CEA de Saclay » and operates instruments for research with neutrons around ORPHEE reactor, a 14 MW reactor operated by the CEA since 1980. Its mission is threefold:

- Provide neutrons to the French and international scientific communities for experiments. This target includes user service and instrument development.
- Lead the scientific community and the industry in the field of neutron scattering, opening up new possibilities and applications of neutrons; broaden the use of neutron scattering and popularize the technique. This target includes the training and education of potential users.
- Carry out its own research programs

The governance of the LLB is assumed by a Steering Committee composed of 3 representatives of the CEA and CNRS. The CSI reports to the steering committee annually. The status, objectives, organization and financing of the LLB is subject of a « Convention » between the CEA and CNRS, renewed every five years since 1976. The ORPHEE reactor is managed and operates by the Nuclear Energy Division of CEA.

The LLB management team consists of the Director and Deputy Director (one CEA and one CNRS alternatively) supported by an Administration Group, a Selection Committee for evaluation of beam time proposals, and a Laboratory Council that deals with interactions with staff.

Staff are principally organized into two main lines: Experimental Groups (Spectroscopy, Diffraction, Large Scale Structures), which operate the instruments and ancillary equipment for research; and Technical Groups (Instrument Development, Information Technology, Electronics, Support and Sample Environment), whose role is to support the technical aspects of instrument operation and development.

In addition, cross-cutting 'platforms' have been established (Biology, Chemistry, Theory/Modelling) which aim to give coherence to these key components that support the research endeavor. Users do have access to these facilities in collaboration with LLB scientists.

The science research themes are also cross-cutting and are organized in three different areas: Strongly Correlated Materials and Magnetism, Materials and Nanosciences, Soft Matter and Biophysics; indicating both the broad scope of science addressed by the facility and the large range of expertise of the scientific staff.

This is a new organization structure that has been established by the LLB leadership team in recognition of the need to emphasize, and coordinate coherently, the support infrastructure for the instrument upgrades and development programs. Clearly individual staff members may have multiple roles in different components of the organization. Such a matrix organization structure is necessary given the staffing levels but can lead to overload if not effectively managed.

The committee was impressed by the strength of the LLB management team. They have a clear strategy for taking the LLB forward over the coming years and are well respected by staff. The LLB has always maintained a very strong science based culture that has led to the high recognition of its research programs, the excellent publication record, and the world renowned stature of the scientific staff.

However, in order to effectively maintain and develop the instrument suite, a subtle but necessary culture change is required towards a project management approach. We observed that the management team is steering and enabling this subtle culture change delicately but effectively. Generally, we found that the management team had the support of the staff and are well respected. On occasions though we did get the impression that, possibly due to the strength of the management team, staff have a tendency to rely on 'direction (decisions) from above' without taking full ownership of those decisions. This we believe is due to the strength of the team, their awareness of the required changes, and the difficulties involved in enabling the change given the budget constraints. Change management is always difficult to achieve and requires constant communication of the directions being taken. As the new structure settles into place, the communication lines will develop.

The committee felt that the structure being put into place was appropriate for the mixed role that LLB plays within the National and International landscape. However, we do have serious concerns with the respect to the staffing levels, and hence the ability of the laboratory to transition through the changes.

Our major concern is the low number of permanent staff involved in operating the instruments (77 in total, including management).That's just over 3 staff per instrument, which is critically low. The internationally accepted standard for neutron user facilities is at least 4.5 staff per instrument (the major international user facilities aim for 6 staff per instrument. Moreover the 77 staff comprises 46 researchers and engineers and 31 technicians (not counting 4 associate professors, 4 emeritus researchers, and 7 part time collaborators). The weighting of staff towards research has stood the LLB well in developing its strong science reputation; however this may be problematic as more emphasis needs to be put onto maintaining the instrument suite at the appropriate level and hence ensuring the appropriate level of technical staff for instrument development. The situation is somewhat exacerbated by the fact that CNRS researchers clearly do not seek or receive recognition for instrument development activities. Their careers depend almost entirely on their scientific productivity. This leads to the excellent scientific collaborations that users experience at LLB, but in the long-term will compromise the facility as the instruments are not maintained at the leading edge.

On the other hand we have observed that many instruments are run by a single scientist who, not only drives the science on that instrument but is the "keeper" of corporate memory concerning the instrument (history, settings, optimizations, shortcomings etc.). In such case the departure of the scientist usually leads to the loss of relevant expertise in the laboratory (note the high pressure work and the MICRO instrument – see below).

So we have a perceived dilemma: an increased staff component with instrument development expertise is required to take the instrument development projects forward, but scientific capability in key areas must be retained. We believe this situation can be somewhat relieved with the following actions:

6. Develop a long range instrument development plan that sets priorities on which instruments should be upgraded/constructed and which should no longer be supported. This plan should be developed in consultation with the user community. We have observed that LLB management has put into place such a plan, but would suggest that more engagement of the potential user community could be solicited.

7. Researchers, who have a desire to undertake instrument development activities, in addition to and support of their research programs, should be engaged and recognized for these talents.

8. LLB management will need flexibility in hiring decisions in order to ensure the appropriate complement of staff.

Given the demographics of the present research staff at LLB there is a near term opportunity to manage the mix of staff over the coming years.

Orphée Reactor

The ORPHÉE reactor is a well designed, medium power, research reactor whose purpose is to produce neutron beams for fundamental research. The reactor is operated independently from LLB by the Nuclear Energy Division of CEA. In addition to furbishing neutron beams for the neutron scattering instruments at LLB, the reactor fulfills supplementary missions in silicon doping, radio isotope production, trace measurement by neutron activation, and neutron radiography. This latter function, although it could be of prime interest to LLB users, extending that range of the spatial domain covered by existing LLB instruments, and providing an excellent connection (incentive) to industrial partners, is managed independently of the LLB user program. Although the reactor first went critical in 1980, the recent safety assessment, carried out in 2010, was successfully completed and allows operation for at least the next 10 years. We are pleased to note that a specific safety/refurbishment budget of 5M Euros has been allocated over the next 5 years to ensure the continued reliable operation of the reactor.

The committee had concerns on the following issues:

1. Although there is agreement on the number of days that the reactor will deliver, and we saw that within constraints the reactor division made all attempts to deliver the number of days agreed upon, the reliability and the predictability (a published and maintained operating schedule) are critical to a successful neutron scattering user program. LLB staff have been obliged to manage flexible (and therefore sometimes inefficient) instrument schedules due to the non-predictable reactor schedules (delayed start-ups, unforeseen shutdowns etc.). Given that we consider the neutron scattering program as the priority service of the reactor, we strongly urge the reactor division to work with LLB management to determine and then maintain a predictable schedule.

2. The report on the post-Fukushima evaluation of 'beyond design basis events' has been provided to the ASN. The decision made following the evaluation the report may have impact on the long-term operation of the reactor

3. The quantity of fuel available for long-term operation, and the related question,

4. The inevitable fuel "conversion " from Highly Enriched Uranium (HEU) to Low Enriched Uranium (LEU)

The last 3 concerns impact the long-term operation of the reactor and hence, to some extent, critical strategic decisions for the LLB instrument development strategy. Clearly our recommendation to LLB management is to develop a strategy assuming the long-term operation of the reactor, but they should be informed of any developments as soon as possible.

Scientific Productivity

Although the science programs are not a focus of this report we offer the following observations:

- The scientific productivity of LLB is very high – the number publications emanating from LLB (~200 per year) place the facility third after ILL and ISIS — and the publications are of high impact.

- Typically a publication comes from 2 experiments performed. This is the norm in keeping with the top neutron facilities.

Our next report will consider the scientific activity of the LLB.

Instrumentation

The LLB operates 20 instruments in a "user access" mode plus two other instruments that are available for test purposes. The instruments cover a very wide range in the spatial and time domains, consistent with the broad mission of the laboratory. As stated above, the instrument operations are managed in groups that have been set according to their broad areas of application (Spectroscopy, Diffraction, and Large Scale Structures). Each instrument group is 'almost' independent in that the scientific staff, the technical staff, and in most cases ancillary sample environment equipment, belongs to, and is managed by the group. This does not mean that the groups do not interact and coordinate – they do. However, budget allocations, minor upgrades etc. are managed at group level. Larger projects are managed at laboratory level through the Instrument Development team, with oversight of LLB management. The up-side of this operational model is a very strong sense of ownership of the instruments in the group, and an excellent correlation between the instrument upgrades/developments and the science requirements. The comment often expressed to the committee by the team when questioned about the decisions on upgrades to instruments, and whether users were consulted, was that "the instrument scientists are scientific collaborators with most users and they know what the users need". This strong science driver on the instruments has been the key to the success and scientific productivity of the LLB. The downside of this operational model is that some inefficiency in manpower and shared resources are evident, and the instrument development is tied somewhat to the research interests of the group staff. Clearly this can be problematic as normal staff change-over occurs. One good example is the need for high pressure capability on the instruments which was one of the key strengths of the LLB – presently there is no one on the staff who can take forward the on-going development projects. Furthermore, even within each group there are multiple instrument control and data acquisition systems in use on different instruments

The committee saw clearly that the LLB management team has recognized the need to take a more 'matrix approach' to instrument support, and they have started this process with the establishment of the experimental groups and supporting technical groups. As stated above, their ability to make these changes will depend entirely on their flexibility to fill available positions with the suitable candidates.

We also noted that, due to the group structure, there is no centralized metric on the causes of instrument 'downtime'. We believe having a broad overview of the common causes of instrument downtime is essential in deciding how resources should be effectively applied.

We strongly recommend that LLB put a mechanism in place to gather centrally the causes and impacts of instrument down time.

Instrument Development

The strong scientific reputation of the LLB in magnetism and soft matter was built on the original instruments which included world class Triple Axis, Diffraction and Small Angle Instruments. However, over the early years the instruments quickly fell behind top level capability partly due to lack of budget, partly due to a lack of an instrument development strategy, and partly due to the lack of incentives to scientific staff to undertake instrument development activities. Still today, particularly for CNRS staff, instrument support activities are not appropriately recognized and rewarded.

In order to fulfill its mission, it is self-evident that LLB must continually maintain and upgrade its instrument suite. The instruments do not have to be best in class (ILL fills that role), but they should be world class, easily operable, and reliable. Given the complexity of neutron instruments, the cost of maintenance/upgrades can be quite high, and the budget required has to be balanced with other operational costs, ancillary equipment, etc. The world-leading facilities put a large fraction of their budgets into instrument maintenance and upgrade projects. (For example, for SNS, all manpower costs included - and don't be shocked by the high numbers - the accelerator operation budget is approximately $75M, the instrument operating budget is approximately $50M, and the projects/developments/upgrade budget is of the order of $40M, i.e. approximately 25%).

LLB put into place its first 'real' instrument development plan in 2005 with the CAP2010 project, followed in 2008 by the CAP2015 project. With these two programs, LLB has made significant improvements to the instrument suite, with major upgrades to 14 instruments, despite the very low level of resources that were applied. On average 0.9M€ per year is dedicated instrument upgrades.

The CAP2010 ended in 2012 and was financed entirely from the existing operating budget by squeezing the research budgets. Our experience from other facilities is that this is not a good way to manage projects. In order for a project to be completed on time and within budget, it is necessary to put into place a project, a team, a resource loaded plan, and a separate, 'ring-fenced' budget. When a project budget is continually being balanced with the everyday operating needs, then by definition the latter will take precedence and the project will be delayed and delays often lead to additional cost.

Furthermore, when resources are limited, decisions tend to be made on a financial rather than scientific or technical basis. In discussing with instrument groups we certainly got the impression that this was often the case. LLB management had no choice but to accomplish the project in this way due to lack of resources (both dedicated manpower and funds), and we commend them for their management and perseverance in bringing forward the project.

Nevertheless, CAP2010 furnished some impressive instrument improvements: 7C2, the new liquids and amorphous diffractometer with a 'state-of-the-art' multidetector, provides a huge increase in counting rate and will allow previously demanded but unrealizable, kinetic experiments to be performed; Super 6T2, a lifting arm, 4-circle diffractometer typically used for magnetic structure studies, which is highly competitive since its refurbishment; VIP (5C1), a very intense polarized neutron diffractometer; and TPA; a very SANS which is still going through commissioning and building its user community (see below). Various smaller scale, critical upgrades not highlighted here was also successfully completed.

The MICRO instrument, that is intended to re-establish the impressive record in high pressure research that LLB enjoys, has been halted due to the inability to recruit a top level scientist in the field. Once again this highlights the direct correlation between staffing and the instrument program that can be run. There is great demand at LLB for high pressure work, but the scientific/technical expertise is no longer available to maintain the program.

LLB, in a slight change in culture, has also attracted additional funding for some of these upgrade projects; notably from the Rennes Metropole for 6T2, and from the Aquitaine Region for 3T2. These additional sources of funds are an excellent opportunity for LLB to supplement its budget. However, discussions with staff highlighted the additional strain felt in having to seek external funding given; 1) the severe time overload that they already feel, and 2) the non-recognition for this effort.

The CAP2015 program is more ambitious than CAP2010, includes some much larger projects, including some major upgrades that were initiated in CAP2010. The priorities were set in consultation with the user community and external experts and will fill much needed gaps in scientific capability:

> Super 6T1: a versatile diffractometer for Texture and Stress provides much needed increases in counting rates (up to factor of 30) for the engineering and metallurgy communities for the characterization of microstrain and heterogeneities in mechanical behavior. This instrument will be completed in 2013.
>
> EROS-2: an upgrade of the existing EROS reflectometer to address the increasing demand for parametric studies. By transferring the instrument to the G6 guide position in 2013 (previously occupied by Mibemol), and providing anew chopper system allowing coarse wavelength resolution (up to 20%), the upgrade will provide a significant increase flux for specular reflectivity measurements.
>
> Multimuses: an upgrade of the Resonant Spin Echo instrument MUSES to provide a multi-angle option for high resolution dynamical studies in biology and soft matter, a strategically key area of research at LLB. The success of this project relies on the development of curved spin resonance coils and hence on one key person at LLB. Initial results of this ambitious development are very promising, and if successful the instrument will be world class. However, once again we are concerned that the success relies on one person.
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> PA20: a much needed high throughput SANS machine that will replace the ageing PAXE instrument in 2013. It includes a 'state-of-the-art' 2D detector, high angle detectors, and unique polarization capability. This instrument when complete will have very high performance in terms of flux, Q-range, and Q-resolution.
>
> FA#: perhaps the most ambitious project undertaken by LLB, this instrument replaces the recently decommissioned Mibemol, with a completely new state-of- the-art, time-of-flight instrument mainly for quasielastic measurements.
>
> Imaging: will fill a critical niche to examine distance scales of the order of tens of microns and above. This instrument will be key to any strategy to attract more industrial use of the facility and is therefore a crucial component of the long-term instrument development program. As an example we refer to the experience at HFIR in ORNL where a simple prototype imaging instrument that was operated in test mode for only 25 % of the reactor cycle attracted 11 industrial users in the first year!

PA20, FA#, and the Imaging instrument are being constructed within the Swedish-French collaboration program. They are ambitious projects, and since schedule and cost expectations must be adhered according to the agreements, they must be managed within an appropriate project management approach. This requires a dedicated, ring-fenced, budget line, dedicated manpower resources, and a supporting project infrastructure.

LLB management has clearly recognized the need for a more sophisticated project management approach for the successful, on time delivery of these instruments and, as discussed previously, has been shifting the structure of the organization to achieve this. The new technical groups, in particular the Instrument Development group, have been set up to address this need. The Instrument Development group uses basic project management approaches to the new instruments: a specific project manager (technical and scientific, though due to manpower limits these are shared across projects), Gant charts, rudimentary annual budget allocations, etc. However, since manpower resources and budgets are still intimately shared with operating instruments, allocations and budget changes (standard project change management) is decided at LLB director level, albeit at regular group leader meetings. Hence no real resource loaded integrated project schedule exits and until additional resources are applied, it would difficult to maintain.

We were very impressed during discussions with the Instrument Development group to see the level of motivation and dedication to completing these projects, even to the level of coming in at weekends to remove shielding so that an upgrade project could remain on schedule. However they are spread very thin and typically only one deep. For example, there is only 1 designer and not enough engineers to have one per project. There is no capability of running neutronics calculations (MNCPX or equivalent) but the group does undertake some Monte Carlo simulations for instrument performance, in coordination with instrument scientists.

Furthermore, the same teams (detectors, IT, sample environment etc.) that are allocated to projects have a ‘day job’ maintaining the operating instruments. Overall the instrument teams do an excellent job under somewhat constrained conditions. This is clearly thanks to their high levels of motivation and enthusiasm.

The above observation should not be taken as criticism of the LLB or of their funding agencies. We understand that severe budget environment and that in general LLB has received its fair share of support. Furthermore, both CEA and CNRS have expressed their commitment to the facility.

Organizational and culture changes have been set in motion but are taking place slowly. We recommend that the strategic direction put in place by the LLB management can be supported by allowing flexibility in the hiring of new staff as present staff reach retirement age, and by encouraging/recognizing research staff who engage in instrument development activities.

It is also crucial, as for any facility, that an upgrade/development budget line be put into place and protected. It is impossible to deliver projects on time and on budget when resources have to be balanced with operations.

Access to Beam Time and User Service

Proposals to use the instruments are evaluated twice per year by 5 Selection Committees (Chemical Physics and Biological Systems; Crystallographic and Magnetic Structures; Magnetism: Single crystals and thin layers; Disordered Systems, nanostructured materials and materials; Excitations), each composed of 10 -12 scientists nominated by LLB management. Typically half of the members of each committee are external to LLB, 2 or 3 are from foreign institutions. Available instrument days are distributed across the various selection Committees on a pro-rata basis, i.e. the percentage of days requested in that science area. Proposals are allocated a grading based on scientific excellence and graded A, B, or C. Typically the A graded proposals are allocated beam time and carried out. Depending on the instrument overload, some B proposals may be awarded time also. Final distributions are decided by LLB management. Educational requirements of students and young researchers are taken into account.

This beam allocation process is fair and typical of most neutron user facilities. Note that LLB scientists also have to apply for beam time in a similar manner – there is no beam time specifically set aside for instrument scientists. Given the high caliber of the LLB scientists, and the fact they often work in collaboration with external users, they have no problem in having access to the instruments for their research programs. In fact, we observed that many users work in collaboration in some manner with LLB scientists.

The actual number of beam days available depends on the reactor operation (an allocation period is typically 90 days), the state of the instrument (out of service, commissioning etc.), and the potential backlog of experiments. Of the 90 days potentially available, typically only 70 days are formally allocated, leaving 20 days to allow the flexibility to absorb, experimental back logs, down time and other issues. The statistics and results for the autumn 2011 Selection Committees are given in Appendix 5. Although, as mentioned above, there were no statistics available on individual instrument down time and the associated causes, rendering it somewhat difficult to evaluate the instrument demand and usage. We do have general observations arising from our discussions with staff.

It is essential to keep the flexibility in allocation of beam time mentioned above; it is not our impression this is being misused. It allows experiments that do not succeed at first to be optimized and rerun, a clear advantage, and indeed requirement, of a national facility compared to an international facility. Another very clear reason for scheduling flexibility arises from the continuing difficulty of providing site access to users, especially foreign nationals. These issues were certainly highlighted in the responses to the User Survey (see below). There are risks of additional regulations being implemented that would incur increased problems for users' samples and access. We understand that, given the present context, some of these issues are difficult to resolve, but they remain a major impediment to the full and efficient use of the facility.

Closer investigation of the difference between the 70 or so scheduled reactor days and the allocated days per instrument showed that these could be explained by:

1. Known instrument problems

a. G1.bis is a very specialized spin echo instrument built in collaboration with Munich. The instrument has been "off-line" for two years due to a failure in the coils. Given the complexity of these coils and the specific know how required to operate them, it has taken some time to implement the repairs. LLB did well in attracting a polarized neutron specialist who has taken over the instrument and bringing it back into service. Even though it is a very specialized instrument, it is likely to be well used given the large Q range and rather long-time scales available.

b. 1T1 is well used but rather old thermal triple axis instrument that has experienced serious problems with the monochromator mechanics. A new mechanics assembly has been procured.

2. Under demand

The underlying reasons for the lack of demand for beam time on certain instruments are known by the management and generally well managed. For example:

a. G5.2 is a diffractometer usually used for measuring stresses in large samples. The bulk of this work is being transferred to the new, high performance, 6T1 diffractometer, specialized for texture measurements in small samples (maximum 10 cm). Hence G5.2 is being operated without major effort to cater for the large samples that cannot be accommodated on 6T1, and hence caters to an industrial user base. We believe this is a sensible approach.

b. TPA is a new very small angle scattering instrument based on the multi-beam design. The instrument was started in 2010 and is still building its user community though demand is increasing slowly. Given the small beam size necessitated by this technique, the signal to noise ratio on the instrument is low and hence experiments are difficult. Successful experiments require a great deal of input from the instrument scientist, emphasizing once again the strong correlation between the scientific expertise of LLB staff and the successful user program. The instrument has the potential to develop a very strong community and may also be attractive to industrial users. Management should continue to monitor the build-up of demand.

c. G2.4 is a polarized neutron reflectometer used for the study of magnetic materials. It is not untypical that the user community for such instruments is small due to complexity of the technique. In the case of G2.4 this has exacerbated the fact that the external user community is not generally capable of making high quality samples of the size required for neutron reflectivity experiments. No sample fabrication capability exits at LLB. Although there are researchers at LLB who are experts in the field of magnetic thin films, given the low demand and the fact that excellent instruments and facilities exist at ILL, we do not recommend allocating precious resources to 'growing' this instrument, unless additional funding can be found.

3. Experimental backlogs

   Such backlogs are caused either by a major instrument failure or non-delivery of scheduled reactor days. In 2010 the reactor operated for 156 days instead of the 180 days scheduled – the impact of this can be seen in the allocation and instrument operation statistics for 2011. It is imperative that the reactor operates reliably and predictably for the scheduled number of days. We are pleased to see that a *special refurbishment budget* has been set aside to ensure that the reactor can operate reliably and note, in passing, that similar refurbishment budgets are also required on the instruments as both reactor and instruments need to be reliable to ensure scientific productivity. The reactor predictability is of equal importance: users' experiments need to be scheduled some weeks, if not months, in advance. Hence it is essential that the reactor operating schedule is published well in advance (a year if possible) and upheld. The prime purpose of operating the reactor is to furbish the neutron beams to LLB so the schedule should be put into place in advance, in consultation with, and with priority given to, LLB management.

User Survey

Although the user survey was sent to 12 regular users of LLB across the range of disciplines and instrument types, only 6 responses were received, so the summary presented here may not be entirely representative. The response was disappointing. LLB management intends to use a similar survey more generally - this would be a good source of user input to instrumentation decisions.

Users did comment on the Administrative problems linked to access to the Saclay campus: difficulties to reach the center by public transportation; limited accommodation on site (not authorized to the non EU visitors). These problems clearly remain unsolved and do present a significant impediment to the facility.

Responses

1. *Does the present suite of operating instruments adequately meet the needs of your research program? The response to this question should take into account the overlap and complementarity of LLB instruments to those provided at ILL, including the CRG's.*

A resounding yes! All users appreciated the range of instruments available but it was 'obviously' pointed out that: there is no single instrument unique to the LLB. The ILL instruments clearly outperform those of LLB, but in general the LLB instruments outperform the CRG instruments at ILL. Users clearly go to ILL when they specifically need the high flux (kinetic experiments etc.), or where special equipment is needed, but find that LLB instruments are adequate for a wide range of less demanding experiments. One of the responses expressed a desire to see an 'evolution' of instrumentation such as: 4 circles for stress analyses, furnace for in-situ analyses with various cooling rates (structure determination), 2D detector for texture analyses (the Super 6T1 project when complete will fulfill this need – see above), and also easy access for measurements concerning irradiated samples (dedicated furnace, sample holder, tensile test…).

2. *Do you have sufficient access to the instruments you use?*

    a. *Do you get enough beam time?*

All users highlighted that, given the overload at ILL, access to a source such as LLB was crucial to their research programs and often enabled an in depth study of a subject that would not be possible elsewhere. One user commented that although the access to beam time was sufficient, access to the instrument scientist, for aid with data analysis etc., was sometimes difficult due to their severe overload. Given our previous comments, this is not a surprising observation.

    b. *Is the access fast enough (time between proposal and experiment)?*

Generally yes – sometimes faster than other sources. This is clearly an advantage of the smaller operation and the very close connection between users and staff scientists.

3. *Are the instruments that you use operating at full capability?*

There were very mixed views on this question. The sense was that the instruments are operating reasonably well, but given the continuous upgrades and instrument developments at ILL (world leader in many techniques with a sizeable development division), the gap between ILL instruments and LLB instruments is widening and becoming greater than just the difference in reactor power. **The users appreciated that LLB management had taken on this challenge** and progress was evident (specific examples were quoted), but slow due to inadequate budget.

    a. *If not what are the opportunities for development?*

Suggestions included: larger monochromators and versatile multi-analyser systems for triple axis instruments; multidetectors, and focusing guides in general. Again it was realized that this required significant budget.

4. *Do you have critical needs for instruments that are not currently available but would fit into the purview of LLB?*

There were no suggestions for instruments – users seemed to be happy with the suite of existing instruments - but various additional sample environments were proposed, including a 4 circle cradle to reach mK temperatures and those outlined in the response to question 1.

5. *Is the appropriate additional infrastructure in place (sample environment, software, etc.) to enable the research, user, and teaching mission to be carried out?*

Generally the responses to this question were very positive – kudos to the existing suite of sample environments available despite the small number of technical staff.

    a. *If not, what are the additional needs?*

Two major suggestions were put forward: simple, friendlier analysis software for SANS; and a very strong request for a minimally functional chemistry laboratory for users (gloves, glassware, and clean water). Note that the newly formed platforms include a well-equipped chemistry laboratory but this is not generally available to users. The committee felt that it is essential to provide users access to minimally functional chemistry and biology laboratories. If the present platform facilities are restricted to users then alternative facilities should be made available.

  b. *How should they be developed (e.g. in collaboration with other institutions, universities, partnerships, etc.?)*
  c. *Would you be willing to partner with LLB to develop additional infrastructure?*

See next section.

6. *Are you interested in partnering with LLB on research and development activities for new instrumentation?*

There is some interest, and hence potential opportunities, to collaborate on the development of specific sample environments, e.g. for handling irradiated samples. Partnering with user groups to develop sample environments, often in return for dedicated beam time, is a model that has proved very successful at other facilities.

  a. *If yes, which?*

7. *Do you need access to any instruments specifically for teaching?*

No special needs were identified.

  a. *If yes, which ones?*
  b. *Do you have sufficient access?*

External Collaborations

It was clear to us that LLB profits enormously from external collaborations at all levels: research, local infrastructure and internationally. The LLB is already one of the 36 laboratories members of the new Labex PALM (that stands for Laboratory of Excellence “Physics: Atoms, light matter”), which allows it to apply for funding of collaborative research projects or of collaborative formation actions. Last year for example the LLB received some funding to adapt two spectrometers for practices of Master2 students. The LLB is also included in the new Idex (Initiative d’Excellence) Paris-Saclay that will be a good opportunity to reinforce the link with the other institutions that will build in January 2014 the new Paris-Saclay University. The committee decided that this would be a reasonable topic to address, together with an evaluation the science in the next CSI report. Here we restrict ourselves to comments on international collaborations as they relate to instrument development activities.

International Collaborations

Swedish-French collaboration program

This recently signed agreement is a major strategic initiative which links the LLB with the Swedish research community in preparation for the construction of ESS. The agreement provides funding for 3 major instrument upgrade projects, PA20, FA# and Imaging, in exchange for access and training. As mentioned above, the external funding for these instrument project will set expectations on achieving project goals on schedule.

NMI3 involvement

LLB has from the very beginning of the EU Access to Large Scale Facilities programs (Human Capital and Mobility starting 1990) been a key member and played an active role in establishing NMI3 - one of (if not) the most successful Integrated Infrastructure Initiatives (I3) in the EU. Apart from offering access to European users, LLB has led, or participated in joint development projects. LLB is at present involved in the following joint NMI3 activities *Structural and Magnetic Imaging at the Micro and Nanoscale*, *Advanced Neutron Tools for Soft-and Bio-Materials* and *Detectors*.

ESS involvement /New large instrumentation projects

With the present level of staff and the current level of "Performance Enhanced Maintenance" guided through strong collaboration between LLB staff and a solid group of professional users of LLB, LLB can at best maintain their currently very high scientific productivity. New Instrument projects (at present funded through collaboration with Sweden) and involvement in ESS, which is essential for the long-term future of the laboratory, will need either extra resources or revised priorities in the Laboratory. We have seen the first steps in this direction in terms of the very recent (this autumn) formation of new groups and platforms.

Industrial Cooperation

In 2011 LLB provided approximately 300 days of beam time (roughly 10% of the total) to industrial users, through various mechanisms: ANR thematic grants co-funded PhD's, services, etc. Most of the experiments carried out involving industrial partners are done so in collaboration with academic teams. This is typical of most neutron facilities given that the full cost of neutron beam time for proprietary research can be considered prohibitive by many industrial partners. It is strategically sensible to leverage the academic partnerships to increase industrial use. It is also clear that having a portfolio of examples of critical research carried out at LLB supporting French industry is important when justifying the maintained commitment to a large scale facility such as LLB.

The LLB management has developed a strategy for developing industrial relations based on 3 directions:

- Developing and formalizing existing relationships
- Establishing a training program focused on industrial needs and including co-funded PhD's
- Adapt the LLB outreach message to industrial partners, i.e. with in-hand knowledge of the real problems faced by industry; start to use the language of problem solving rather that fundamental research

We believe these proposed actions are reasonable and will bear fruit if followed. We noted that LLB is working initially with SOLEIL to develop a common strategy and action plan for some of these activities, later to be broadened IdEx partners.

We offer two comments:

- As with the other outreach activities, the strategy will only be successful if someone "owns" it and is provided resources and support to make it happen. It was not clear to us who this owner is at LLB. Experience at other facilities suggests that having a member of the research staff take on the role of 'industrial liaison' can be very effective. Moreover, the industrial liaisons at different facilities (e.g. SOLEIL, ILL etc.) can form a very effective network to engage industrial interaction.
- There is an opportunity to develop a neutron imaging capability at LLB that goes far beyond the basic radiography activity managed through the reactor division. The present SANS instruments cover a spatial range extending to a few hundred nanometers. TPA extends this range ever further. An imaging capability that extends the spatial coverage to a few tens of microns would be very attractive to industrial partners, and would be an excellent means of introducing them to the broader range of capabilities. LLB management has recognized this opportunity in proposing an imaging station as part of the CAP2015 program. We fully endorse this decision and recommend that it be allocated full resources as part of the industrial development activity.

Education and Outreach

Education and training of possible future users is one of the 3 missions of the LLB. The fact that this mission is strongly supported by the direction was clearly visible to the committee. We note that approximately 100 users (out of ~ 500) are new to the facility each year. These are mainly students and young researchers, evidence of the impact of the training mission of the facility.

Among the formation activities of the LLB one can cite:

- FAN of the LLB: courses and practices during 4 days for typically 30 participants, mainly post-docs and researchers

- Lectures on neutron scattering (70 hours by 16 scientists)
- Conferences and summer schools co-organised by the LLB each year
- Participation of LLB in Hercules courses
- Visits of the installations for the general public (around 1000 persons/year)
- The relatively new training activities that are practical classes organized for Master students of some French universities and Grandes Ecoles (about 100 students/year)
- A new collaboration program with Sweden (PhD students mainly)

These activities are already very impressive but clearly ask for an important time investment from staff. They are supported by some of the CNRS and CEA members of the lab and by the 3 'Maître de Conférence' that are present in the LLB.

The committee noted the following concerns:

- It seems that CNRS and CEA members of the LLB feel that teaching activities are not well recognized in their careers. This may not be entirely true and can usually be overcome if the commitment in teaching activities is clearly and positively described in the CV and promotion files. However, this perception seems to limit the participation in teaching activities by some members of the staff.
- Teaching periods have to be planned long in advance (in particular for master students) and are very difficult to postpone if the beam is not available. A more predictable (and reliable) schedule of beam time would be invaluable. Given the academic teaching schedules, one year advance scheduling would be reasonable.
- The conditions of access (lack of regular public transport, security issues, etc.) make the organization and scheduling of the training periods difficult and time consuming for the staff. Any improvement in this area will be welcome.
- The beam time devoted to teaching activities (typically 1.5 % of the total beam time) seems to be the major limiting factor for an increase in educational undertakings. The other factors (available staff, funding, or the number of candidates) are easily overcome. We recognize that it might be difficult to increase the beam time formally devoted to educational activities. Furthermore, it is not possible within the present budget constraints to operate instruments specifically for training activities; hence we do recommend that on-going "virtual" training courses be promoted, preferably after a visit to the facility.
- Contacts with professors' teaching fields that could involve neutron scattering should continue to be strengthened. Possible actions include: flyers presenting the teaching activities of the LLB

and the potential of neutron scattering, invitations to these professors to visit the LLB, and access of personal contacts that external users could have with faculty members, etc. A permanent (university funded) position at LLB would be an excellent asset.

Our overall evaluation of the education and outreach activities is very positive. The staff involved in these activities are highly motivated and very engaged. The establishment of a coherent platform where these activities are made visible emphasizes the clear commitment of the LLB director to this critical component of the mission. This stimulus should be maintained.

Appendix 1 Committee Members

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Appendix 2 Report Guidelines

The following guidelines for the present report were approved by the LLB Steering Committee:

GUIDELINES FOR A REPORT

Summary of your impressions and recommendations on the following terms of reference:

1. The LLB in general : organization and management
2. Quality of the current instruments and instrument development program?
3. Quality of the user service? Availability of beam time, principle of beam time allocation,
4. Scientific quality and timelines of research: expertise of the staff involved? novelty of concepts?
5. What recommendations can you make for

   - the medium term orientation of the instrumental program? in the view of European landscape and risks of reduced budget landscape (with a dedicated focus on the relationship towards ESS instrumentation developments);

   - the procedure for the selection, development of neutron instrument?

   - the organization of the technical support?

6. How do you assess the scope of cooperation? Participation in other programs, Involvement of partners (national, European,) Soleil, universities, NMI3, FRMII, ESS…

Appendix 3 Provisional Program for the Council for Science and Instrumentation of the Laboratoire Léon Brillouin

The actual program was kept flexible to ensure open discussions with all staff.

October 3

19.30-22h Meeting in the lobby of Hotel le Guichet

Dinner of the council with the direction of the LLB

October 4

8.30-9.00 Transport to LLB

9.00-9.30 Welcome *(CAS, JPV, AM): presentation of the members of the council and objectives of the meeting*

Introduction: Ian Anderson: list of questions, *documents, organisation of the work, and feedback from users*

9.30-10.15 Presentation of the facility: access and instrumental program

(Director, Co-Directors, group leaders): CAS, JPV, AM, + 14 members

10.15-10.30 Coffee

10.30-12.15 Meeting with instrumental groups, *salle 15, 2*45mn: (all members researchers, engineers and technicians)*

-Group Dynamics –spectroscopy

(short presentation of Jean Michel Mignot and Stéphane Longeville, discussion + 6 technicians and 9 scientists)

- Group Large Scale Structures

(short presentation of Annie Brulet and Jacques Jestin, discussion + 6 technicians and 8 scientists)

12.30-14.00 Lunch with Jean Daillant, General Director of Soleil

14.15-15.00 Meeting with instrumental groups *2*45mn: (all members researchers, engineers and technicians)*

-Group Diffraction

(short presentation of Arsen Goukassov and Gilles André, discussion + 5 technicians and 13 scientists)

15.00-16.00 Meeting with Technical Groups

(short presentation of Gilles Koskas, electronic, Gaston Exil, computing, Burkhard Annighöfer (sample env.), Sylvain Dessert, instrument design and conception, discussion + 12 technicians)

16.00-16.30 Meeting with platforms responsible (Chemistry, Biology..)

(short presentation Pierre Pfeuty, modelling, Sophie Combet, biology, Lay Theng Lee, Chemistry, and 3 scientists)

16.30-18.00 Coffee and posters of PhD students and postdocs (all, 1 poster each)

18.00-19.30 Time for reflection (only evaluators)

19.30-21.00 Dinner

October 5

8.30-9.00 Transport to LLB

9.00-9.30 Reflections from day 1, free questions – coffee

9.30-10.00 Meeting with Training & Education

(short presentation of Sylvain Petit in charge, discussion with 5 scientists)

10.15-11.00 meeting with the CEA/CNRS representatives, CEA: Patricia Chomaz, CNRS: Amina Taleb

11.00- 13.00 Time for reflection and to prepare the presentation and report

13.00-14.00 Lunch buffet with all people of the lab

14.00-16.00 Additional discussion and feedback to the directors

Appendix 4 User Survey

LLB Missions:

LLB is the French national neutron scattering facility with three principle missions: carry out internal research programs; develop and operate high performance neutron scattering instrumentation and facilities available to the National and European research community; educate and train the French scientific community in neutron scattering techniques.

Evaluation

LLB management is putting into place a User Survey to provide an additional mechanism for the user community to provide input on the adequacy of the present instrument suite and the priorities for development of the instrument suite and associated infrastructure. We would appreciate your response to the following questions:

Present instrument suite:

8. Does the present suite of operating instruments adequately meet the needs of your research program? The response to this question should take into account the overlap and complementarity of LLB instruments to those provided at ILL, including the CRG's.
9. Do you have sufficient access to the instruments you use?
    a. Do you get enough beam time?
    b. Is the access fast enough (time between proposal and experiment)?
10. Are the instruments that you use operating at full capability?
    a. If not what are the opportunities for development?
11. Do you have critical needs for instruments that are not currently available but would fit into the purview of LLB?
12. Is the appropriate additional infrastructure in place (sample environment, software, etc.) to enable the research, user and teaching mission to be carried out?
    a. If not what are the additional needs?
    b. How should they be developed (e.g. in collaboration with other institutions, universities, partnerships, etc.?)

c. Would you be willing to partner with LLB to develop additional infrastructure?

13. Are you interested in partnering with LLB on research and development activities for new instrumentation?

    a. If yes, which?

14. Do you need access to any instruments specifically for teaching?

    a. If yes, which ones?

    b. Do you have sufficient access?

Appendix 5

TABLES RONDES : BILAN PAR SPECTROMETRE								
Automne 2011								
APPAREILS	Nombre de propositions soumises	Temps demandé (Jours)	Temps distribué (attribution A)					
			Session 1	Session 2	Session 3	Session 4	Session 5	TOTAL
6T1	7	113	0	0	0	67	0	67
G5.2	6	58	0	0	0	52	0	52
Matériaux	**13**	**171**	**0**	**0**	**0**	**119**	**0**	**119**
5C1	6	63	0	0	37	0	0	37
5C2	9	74	0	17	22	0	0	39
6T2	13	96	0	0	65	0	0	65
Monocristaux	**28**	**233**	**0**	**17**	**124**	**0**	**0**	**141**
G4.5	1	5	0	0	0	5	0	5
Neutronographie	**1**	**5**	**0**	**0**	**0**	**5**	**0**	**5**
PACE	13	53	41,5	0	0	0	0	41,5
PAXY	32	124,5	77,5	0	2	13,5	0	93
TPA	3	8,5	3,5	0	3	0	0	6,5
Petits Angles	**48**	**186**	**122,5**	**0**	**5**	**13,5**	**0**	**141**
3T2	21	84	0	39	0	8	0	47
G4.1	22	105	0	36	6	14	0	56
G6.1	5	58	0	0	26	25	0	51
Poudres	**48**	**247**	**0**	**75**	**32**	**47**	**0**	**154**
G1.Bis	2	24	24	0	0	0	0	24
Quasi-élastique	**2**	**24**	**24**	**0**	**0**	**0**	**0**	**24**
G2.4	6	45	0	0	20	0	0	20
G3.Bis	12	80	39	0	0	21	0	60
Réflectométrie	**18**	**125**	**39**	**0**	**20**	**21**	**0**	**80**
7C2	7	54	0	0	0	48	0	48
Systèmes Désordonnés	**7**	**54**	**0**	**0**	**0**	**48**	**0**	**48**
1T1	11	85	0	0	0	0	39	39
2T1	12	113	0	0	0	0	61	61
4F1	20	182	0	11	0	0	115	126
4F2	7	60	14	0	0	0	46	60
Trois-Axes	**50**	**440**	**14**	**11**	**0**	**0**	**261**	**286**
TOTAL	**215**	**1485**	**199,5**	**103**	**181**	**253,5**	**261**	**998**