Sept 19, 2006

JASRI International Advisory Council
(*JIAC* 2006)

Report of the Council

Meeting held on July 3-5, 2006
in
Himeji, Japan

Executive Summary

In the following are described our observations, conclusions from those and, based on those, the recommendations of the JASRI International Advisory Committee, briefly called JIAC in the text. These were presented in the closing session by the Chairman to the management of JASRI and Riken Harima having been unanimously agreed by the committee.

1. Science and Technology

- JIAC found that the overall quality of science and technology presented was very high and comparable with the best at other leading synchrotron radiation (SR) facilities in the world.

  Research highlights include structural biology, materials science and nanotechnology, investigation of systems under extreme conditions, and the development of new imaging techniques.

  High resolution structural studies on integral membrane proteins and large protein-protein complexes have enabled unique observations of practical importance for drug discovery and design, of profound importance for an understanding of basic biological functions.

  In an exciting advance in materials science, the mechanism of an "intelligent" catalyst has been elucidated. This perovskite-structure material, $La(FeCoPd)O_3$ has a very long duration against aging in automobile engine exhausts and is now in actual use with very wide market potential. This remarkable research connects basic science to real applications.

  By exploiting a special variant of X-ray Magnetic Circular Dichroism (XMCD), researchers at SPring-8 have discovered that gold nanoparticles develop a magnetic moment. This could lead to revolutionary applications for spintronic devices.

  Science at the extremes of temperature and pressure is a speciality of SPring-8. X-ray diffraction under ultra high pressure using a diamond anvil cell resulted in the discovery of a post-perovskite phase transition (at 120 GPa) of $MgSiO_3$. This work, in which the conditions deep within the earth at the core-mantle interface were reproduced, has had a major impact in the earth sciences.

  The Kirkpatrick-Baez high energy microprobe was used for fluorescence mapping of the cadmium distribution in hyper-accumulating plants. Comparison of the micro-XANES spectra from the Cd-rich regions with model compounds provided important information on the chemistry of Cd binding in the plant.

  These advances and many others have established SPring-8 firmly at the forefront of world science.

2. Management and Operation

- JIAC observes very significant improvements at SPring-8 over the past 6 years since the last review in 2000. Most of the recommendations of that panel have been implemented; this is reflected in a very strong increase in the number of papers in general, as well as those in high impact journals. The administrative structure has also been simplified and a very good level of cooperation has been achieved between RIKEN and JASRI to the benefit of the entire SPring-8 operation. In addition an intense dialogue has been started with industrial companies, which has lead to a strong and unequalled level of industrial activity at SPring-8. The committee particularly notes the remarkable breadth of industrial engagement, stretching well beyond the macromolecular investigations which dominate at other SR centers. The Committee wishes to congratulate SPring-8 on this success.

- JASRI has become responsible for all operation (accelerator complex and beamlines). RIKEN has also delegated the responsibility for building new public beamlines and for the refurbishment of operating public beamlines to JASRI. After the withdrawal of JAERI from the management of SPring-8, a strong and efficient cooperation between JASRI and RIKEN is mandatory for the success of SPring-8. The committee recommends strongly that this arrangement be maintained and encourages RIKEN to implement a robust and transparent review and audit process to oversee the SPring-8 operation and development. The committee has been pleased to notice that the current arrangement has included a transfer of funds to JASRI, either from RIKEN or directly from government, to ensure that JASRI can fulfill its responsibilities.

- To ensure that SPring-8 will continue to flourish as a leading state-of-the-art SR facility, under the new model of governance, the committee considers it essential that a single entity should remain responsible for the full operation of SPring-8. This accords with experience at all other major SR sources where a single operating authority, responsible for operation, maintenance, user programme and scientific strategy, has led to successful, efficient and effective management. The effective scheduling of scientifically highly rated proposals needs to rely on a detailed knowledge of the beamlines and their scientific programmes and capabilities. Conversely, the technical development of the beamlines requires a profound understanding of crucial scientific needs.

3. Budget, Staffing and In-house Research

- JIAC notes with concern the substantial reduction in the operating budget. JIAC notes JASRI's successful efforts in obtaining compensatory funds by the introduction of targeted national programme funding. Nevertheless, the budget position of SPring-8 is

becoming increasingly complicated, and is inherently unstable. A rolling medium term (5 year) financial plan should be considered to ensure the most effective use of the facility.

- JIAC notes enthusiastically the significant increase in industrial activity, distributed across the beamlines including those dedicated to industrial science. JIAC suggests that industrial income should be employed to enhance the service to industrial users and the scientific infrastructure. This would act as an incentive to JASRI and to Japanese industry to deepen their involvement in the exploitation of SPring-8.

- JIAC notes that SPring-8 operates with less staff than other comparable facilities, especially where the beamlines are concerned. JIAC advises that JASRI consider a flexible approach to the staffing, giving scientific activities and service to the user community the highest priority.

- If SPring-8 is to fulfill its mission by remaining competitive internationally and attractive to leading scientific staff, in-house research must be supported. JASRI staff should be encouraged to develop strong scientific programmes, on their own or in collaboration with external users. In order to properly bench-mark the quality of in-house research, competitive participation of in-house staff proposals in the peer review process for the allocation of beamtime is mandatory.

4. Accelerator Complex

- JIAC notes that the quality of the whole accelerator complex has reached a very high level comparable with other leading international facilities. Top-up, stability, reliability, ultra-small emittance reflect a constant improvement of a superbly running machine. Careful evaluation of any proposed future machine development is required to maintain the high quality and the current level of user beamtime.

- JIAC recommends that, to fully exploit the potential of SPring-8, every effort be made to increase the total number of operating hours of the accelerator complex, with the goal of achieving at least 5500 hours per year, as at other comparable SR facilities.

5. Beamlines and Instruments

- JIAC recommends that all public beamlines be involved in the prioritised beam-time allocation procedure and that the International Advisory Committee carry out an in-depth review and analysis of the beamtime allocation procedures, on all beamlines, at SPring-8.
- JIAC further notes that over-subscription factors vary widely across the current beamline portfolio. These factors should be taken into account when beamline upgrades, or new beamline construction, is proposed.

- JIAC is impressed by the large number and high technical quality of the beamlines operating at SPring-8. JIAC supports JASRI's wish to further improve service to the users by increasing the number of JASRI staff directly working on the beamlines. JIAC observes that at comparable facilities a "standard" beamline will have typically 2 scientists, plus 2 postdoctoral scientists, plus a technician, as support staff.

- Where new beamlines are concerned, JIAC feels that the primary impetus should come from the external scientific user community. New beamlines should only be built if adequate staffing and financial resources are available for the future operation of the beamline.

- JIAC observes that for the non-public beamlines, only a relatively small fraction of the beamtime is available for the general user.

- SPring-8 has a strong tradition of instrument development, with significant potential for commercialisation; other facilities benefit from developments at SPring-8. JIAC notes the particular strength in X-ray optics (monochromators, mirrors, focusing optics, etc), insertion devices (in-vacuum undulators, cryogenic insertion devices, etc) and robotics for PX/MX applications. JIAC believes that these efforts must be continued, at least at current levels, where appropriate in collaboration with other SR facilities and with industry.

6. Further Observations and Comments

- JIAC observes that experience at other facilities has shown that the implementation of a fixed user fee (per shift, to cover consumables) for non-proprietary research acts as a disincentive to optimal use of the facility.

- JIAC considers that the training of young scientists and the collaboration with universities and industry are important activities at central research facilities and notes the strong implication of SPring-8 in these activities.

- JIAC was very impressed by the progress with the prototype SCSS X-ray FEL. The success of the joint construction of SPring-8 by JAERI, RIKEN and JASRI leads JIAC to suggest a similiar approach to the construction and operation of SCSS as a joint effort of RIKEN and JASRI.

- IAC suggests that an International Advisory Committee be established which should meet regularly. Further, JIAC considers it appropriate that other advisory committees (for example, on technical matters) meet as needed.

- JIAC welcomes the efforts and support of the SPring-8 Users' Society and the Industrial Users' Society of SPring-8 towards the success of the facility.

- The members of JIAC wish to thank most enthusiastically the staff of SPring-8 for their excellent support in advance of and during this Review Committee meeting.

1. Science and Technology

Experiments related to **life science** research take place at about one third of the 48 beamlines at Spring-8. The beamlines are distributed evenly between bending magnets and insertion devices. At least three of these are contract beamlines like the one operated by the pharmaceutical industry (BL32B2). Life science activities at these beamlines comprise structural biology (PX), small angle X-ray scattering (SAXS), trace element analysis and medical imaging.

Of the eight beamlines dedicated to **structural biology** (genomics) studies only two, BL41XU and BL38B1 are under the full responsibility of JASRI; the remaining are Riken beamlines. Data measured at the structural biology beamlines have been the basis for the determination of an impressive number of high profile protein structures, among them several membrane proteins.

The beamlines at SPring-8 play also an instrumental role for the success of the **Protein 3000 project**. The aim of this five year project started by RIKEN in 2002 was the determination of 3000 protein structures. All the major protein crystallographic groups in Japan have contributed to Protein 3000. With 2838 structures determined half a year before the end to the project, it seems clear that the ambitious goal will be achieved. Of course many of those structures have not required access to the SPring-8 facilities, having been completed as part of the NMR-focussed efforts at RIKEN-Yokohama. Nevertheless, in the future JIAC anticipates that a greater proportion of the protein structures determined in the successor program will be done by crystallographic approaches. This implies an expanding need for access to state-of-the-art synchrotrom beamline facilities; particularly as larger, more complex systems are addressed. SPring-8 should be in an excellent position to commission and sustain such additional resources and capitalise on its proven expertise in supporting the Structural Biology community.

The Protein 3000 project has stimulated the developments of High Throughput methods at the structural biology beamlines. In this the group is distinguishing between more routine experiments that should be made easier to perform and special experiments on microcrystals and crystals with large volume unit cells, which should be made possible. In both cases the future development of the PX beamlines will require standardisation and joint administration as proposed in the plans presented to JIAC. JIAC strongly supports this development.

The participants of Protein 3000 have planned the succession of the project, Post-Protein 3000 to start in 2007. This project will target even more difficult structures like membrane proteins and macromolecular complexes which both offer challenges in crystallisation and data collection. To deal with the more complex structures the Post-Protein 3000 project contains an instrumentation component that includes construction of a microfocus beamline. JIAC is supportive of the idea that the portfolio of PX beamlines at SPring-8 is developed to have a microfocus beamline.

Three of the life science beamlines are dedicated to **Small Angle X-ray Scattering** (SAXS). They comprise one bending magnet beamline and two undulator beamlines. The biological studies at the high flux undulator beamlines provide for trace element analyses and for time resolved studies of membranes. JIAC recommends that these activities should be continued at least at the present level.

Two beamlines are dedicated to **medical imaging** (BL20XU, BL20B2). The bending magnet beamline is used for microtomography and refraction enhanced imaging. Imaging experiments have been performed on rabbits and mice. However, the BL20XU beamline is now being used for special optics experiments.

The **Material Science** group of JASRI consists of 32 staff and is in charge of 21 out of 25 public beamlines. The group has developed impressive research activities which cover a broad range of applications and make good use of the high energy photons with high brilliance and with a very high degree of beam stability from Spring-8. Some group members are involved in the Nanotechnology Support Project. It is difficult to separate the organization and budget between these projects. Areas of research include crystallography and electron charge density measurements, electron spectroscopy, magnetic scattering, inelastic scattering, and elemental and chemical state analysis. Many research projects are the result of collaborations between JASRI staff and outside scientists. This mode of joint operation to pursue science in a motivated group under a strong leadership could well be an excellent model for the rest of JASRI.

Highlights of these research activities include;

- Powder X-ray diffraction found, with the help of maximum entropy analysis, a strong change of electron density distribution between paramagnetic and antiferromagnetic states in $NdSrMnO_7$; observation of chemical bonding of hydrogen in MgH_2; unexpected spatial ordering of various molecules such as O_2, N_2, CO_2, CH_4, C_2H_2 in coordination polymers with pillared layer structure, $[Cu_2(pzdc)_2(pyz)]_n$.
- Structural analysis by X-ray diffraction under ultra high pressure by the use of a diamond anvil cell resulted in the discovery of a post-perovskite phase transition of $MgSiO_2$ at 120GPa. This was done under core-mantle conditions and has had a major impact in earth science.
- High sensitivity XMCD spectroscopy discovered a ferromagnetic polarization of Au nanoparticles.
- X-ray magnetic diffraction experiments revealed the existence of reverse spin polarization at the inner interface in $SrRuO_3/SrTiO_3$ films.

The research activity of this group is highly visible, and the present mode of operation is recommended as a model for public user beamlines. We believe that the research activity of this important group in JASRI would even be more

impressive if priority were given to research projects based on successful collaborations between JASRI and RIKEN at both Harima and Wako.

The Synchrotron Radiation Centre of **JAEA at SPring-8** has 4 beamlines which have specialized in inelastic scattering, with 51 staff members divided into 8 groups. They carry out both extensive and intensive studies on dynamics of processes in electronic excitations, chemical reactions, and crystal growth. The choice of important subjects has produced very stimulating scientific results which are visible worldwide.

Highlights include;

- RIXS studies on electronic excitations in hole- and electron-doped high temperature copper oxide superconductors revealed characteristic features of carrier doped Mott insulators.
- IXS studies on phonon softening in hole-doped $La_{2-x}Sr_xCuO_4$ and B-doped diamonds revealed the coupling between electrons and a particular phonon mode.
- ARPES studies studying the 5f levels of UPd_2AL_3 showed a strong dependence on temperature.
- Nuclear resonant X-ray scattering identified two different Fe sites in magnetites. This finding is expected to shed new light on the classical controversy about the existence of charge ordering of Fe-B sites.
- The identification of the mechanism of the intelligent catalyst with a perovskite structure, $La(FeCoPd)O_3$, is very noteworthy. This material survives actively a very long time in the engine exhaust system and is now in actual use. It has a possible wide market. This is one of the most remarkable examples of research activities bridging basic science and real application, which SPring-8 can be proud to have achieved.

The research activity of this group is very visible and the present mode of operation is recommended to continue. This group could even play a more strategically important role if it was encouraged to choose research subjects based on collaborations within JAEA.

Since the withdrawal of JAERI from the management of SPring-8 in September 2005, **RIKEN** has been the sole owner of the facilities on the Spring-8 campus. Thus, the RIKEN Harima Institute has assumed a critical responsibility for the management of the SPring-8 facility. At the same time they have founded a new research center, "**Riken SPring-8 Center**" (RSC), in order to promote their own research activities and to concentrate their efforts to SR sciences and also the construction of the XFEL. The Center consists of three research groups so far, dealing with life sciences, materials science, and SR science and technology. In addition, they have set up a fourth group for XFEL research and construction, in April 2006. RSC keeps 7 beamlines for their own uses; 4 BLs (2 undulators and 2 bending magnets) for life science including 3 BLs for protein crystallography, and 2 BLs for coherent x-ray optics and 1 for soft x-rays.

RIKEN has been the leading institute for structural biology in Japan, and has been pursuing the initiative in the national project of Protein 3000 (2001-2006), by using these RIKEN protein cystallography BLs as well as the public BLs. Through these national projects SPring-8 has assumed a crucial role in the recent impressive progress of protein crystallography in Japan.

Recent scientific highlights include:

- The mechanism of bioluminescence in the Japanese firefly was elucidated by the 3D structural analysis of “luciferase”. The finding that the mutation of the key amino-acid controls the color will open the way to a new imaging technology.
- The indoleamine 2,3-dioxygenases, which was discovered by a Japanese scientist 50 years ago, is known to catalyze the reaction of oxygen incorporation into tryptophan. The structure of the enzyme was determined, revealing the detailed mechanism.

The coherent x-ray group of RSC has so far been developing state-of-the art SR technology. Recent progress includes the development of the 3D imaging technique by using the over-sampling diffraction method and highly-coherent x-rays at the 1 km long BL. These are most challenging experiments at a third generation SR source. They also succeeded in building a 25-nanometer x-ray Kirkpatrick-Baez mirror system, which can be used for many types of microscopies.

One of recent developments in SR technique is the hard x-ray PES technique for biomaterials in liquids. JIAC is convinced that the HXPES is a very promising and important SR technique in materials science and nanotechnology.

The XFEL project in Japan had originally been significantly behind the projects in Europe and US. However, very recently, the XFEL group, which is organized by RSC and JASRI, has succeeded in lasing VUV light using the prototype machine. They have used unique ideas and devices developed at SPring-8. These innovations include a low emittance electron gun, a high gain C-band accelerator, and an in-vacuum micro-undulator. JIAC congratulates the team on the government’s approval, in FY 2006, of the 8-GeV XFEL project. This started as a five-year project. If the project proceeds according to schedule, it will catch up with the TESLA and LCLS projects.

Although these activities are not within the scope of the JIAC evaluation, it should be emphasized that the Riken Institute plays an important role in the activities of Spring-8.

JIAC is convinced that future **Nanotechnology** will be enabled by enhancing fundamental research in the critical areas of nano-materials synthesis, nano-materials analysis and nanomaterials modelling. A detailed knowledge of the chemical, electronic and magnetic structure of nanomaterials is a prerequisite for the “tailoring” of their functions in a controlled way. Modern 3rd generation synchrotron radiation facilities such as SPring-8 carry the potential to meet

future analytical challenges for the development of new nanomaterials and for the advancement of nanotechnology. The **Nanotechnology Support System of SPring-8** comprises Technical Support (Transmission-Electron Microscopy, Synchrotron Radiation Technology and Molecular Synthesis Technology) as well as Information Support (Information Exchange Platform on the Web, Organization of Workshops, Technology Transfer). The partners of the SPring-8 Nanotechnology Support System are JASRI, NIMS and JAEA.

This support system was founded in 2002 as a five year project to develop nanoscience and nanotechnology.

The supporting themes are 9 subjects performed at 7 undulator beamlines. Staff involved in this project are divided into two teams; spectroscopies and structure analysis. The former consists of 4 postdocs, 4 beamline scientists, and the latter of 2 postdocs and 3 beamline scientists. The roles of these staffs are (a) to support the planning of experiments, (b) technical support, and (c) advice on experimental data analysis.

JIAC is convinced that these efforts must increase to involve users who are not familiar with SR, but have prepared unique nanomaterials.

This nanotechnology project also develops new fields of SR research. The highlights of the experiments are;

- Direct observation of ferromagnetic spin polarization in gold nanoparticles.
- Direct observation of 1D array of O_2 molecules in a polymer network by MEM analysis.
- Electronic and chemical state analysis of high gate insulator HfO_2 studied by high-energy PES.
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Within this project, JASRI has installed state-of-the-art equipment, such as micro-CT, micro-MCD, hard-x-ray PEEM and micro-diffraction.

JIAC congratulates the SPring-8 management for implementation of this innovative nanotechnology platform which exploits the high analytical potential of Spring-8 for the development of new nanomaterials and the advancement of nanotechnology and very strongly encourages the management to continue these efforts.

JIAC also recommends to carefully analyzing which research projects and which x-ray technology should be integrated into this SPring-8 nanotechnology platform.

2. Management and Operation

As the SAC pointed out in its review in 2000, despite a very successful construction period, the management structure of SPring-8 during the operational phase had become too complicated. The withdrawal of JAERI in September 2005 promised to reduce the complexity somewhat. The recent

amendment of the Promotion Law, however, seems to direct the management of such an advanced scientific facility again in the wrong direction. JIAC is not in a position to review the on-going innovation of Japanese management systems. However, as far as SPring-8 is concerned, the separation of the management of SPring-8 into two parts, the owner (RIKEN) and the registered institution (JASRI), will be very demanding on both parties, increasing the likelihood of inefficiency, and could negatively impact the scientific success of SPring-8. SPring-8 is not a common public service facility but one of the most advanced scientific facilities operating at a worldwide level. Although the operation has to satisfy the large number of public customers, it should not be forgotten that this huge investment was made to produce science of the world's highest quality. This goal has now been achieved. Unless the Government or the academic community of Japan decides to sacrifice this high quality, it is the function and duty of SPring-8 to explore the frontier of synchrotron radiation sciences.

The best solution will be to leave both management and operational responsibility to JASRI on the presumption of tight cooperation with and strict control by RIKEN, as both institutes are now attempting. Although the amended law formally divides the business of SPring-8 into two parts, it should intrinsically be fully unified.

The **industrial application** at SPring-8 is one of the most successful in the world. Until now, JASRI has improved the system so that untrained proposal holders could use the beamlines, assisted by the Government's policies, the Trial Use and Promotion Program. As a result, the number of the industrial users increased substantially. So far, efforts were concentrated on the increase in the number of industrial users. Quality has not been discussed enough. For this discussion it is necessary that both the industrial users and JASRI consider the targets of utilization of SPring-8 by industry.

The leadership of JASRI is important for the effective utilization of SPring-8, as the Government Interim Report pointed out. The three major national projects now being carried out at SPring-8 were introduced by JASRI. The amended law separates JASRI's beam time from public beamtime in order to secure the fairness of beam-time allocation. This fairness could be assured in other ways, e.g. through the proposal review process.

3. Budget, Staffing and In-house Research

JASRI has encountered a substantial reduction in the operating budget from about 11BYen in FY2000 to 6.5BYen in FY2005. To obtain compensatory funds JASRI has successfully made a great effort for the introduction of targeted national programme funding from MEXT. However, the budget position of SPring-8 is becoming increasingly complicated and is inherently unstable. This is not an effective way to operate a national facility for science and technology and JIAC strongly recommends that a rolling medium term (5 year) financial plan should be considered to ensure the most effective use of the facility.

At such an advanced large facility as SPring-8 a reasonable minimum number of beamline (BL) staff would be 2 scientists, 2 postdocs and 1 engineer per BL. This is the internationally recognized minimum standard. At SPring-8 where the Research and Utilization Division is responsible for supporting users, there is a clearly visible lack of staff for the 25 public BLs.

If these new positions are not supported, JIAC recommends that JASRI should make an effort to shift manpower from other Divisions or Groups such as the Beamline and Administrative Divisions.

The scientific and technological activities at SPring-8 have received wide recognition and have placed SPring-8 in a leading position in many research fields. Such an activity has been strongly supported and enhanced by JASRI members of staff who have maintained their own high level research activity. If SPring-8 is to fulfill its mission to remain competitive internationally and to attract leading scientific staff, in-house research must be supported. JASRI staff should be encouraged to develop strong scientific programs, either on their own or in collaboration with external users.

JIAC recommends that to properly bench-mark the quality of in-house research, competitive participation of in-house staff proposals in the peer review process for the allocation of beamtime is essential.

4. Accelerator Complex

The Spring8 accelerator complex consists of the 1GeV linac, the booster synchrotron, the storage ring, and the low energy ring, New Subaru. It is a superb facility by international standards. It is the largest such facility in the world in physical size and the storage ring, operating at 8 GeV is the highest energy source dedicated to providing synchrotron radiation in the world.

The Accelerator Division deserves a great deal of credit for the excellent job of continually improving and upgrading the complex. It now operates in an extremely stable and reliable fashion, with low emittance, and in top-up mode. In addition to the more usual aspects of the lattice, the ring features four 30m long straight sections (the longest in the world), providing extremely bright, high flux beams. Bunch distributions are flexible, and a variety of different patterns are scheduled on a regular basis. When large gaps are used between filled buckets for timing experiments, the cleanliness of the empty buckets is rated at an impressive 10^{-9} relative to the filled ones.

Operating at 8GeV has significant costs in terms of a large electricity bill, but it provides easy access to very high energy X-rays. The copious radiation produced will also lead to radiation damage to accelerator components in time. This, the inevitable obsolescence of control electronics, software and the ageing of power supplies and other equipment will require careful planning and budgeting for timely maintenance and replacement of the affected components.

The size of the staff operating the complex on a routine basis (a team leader and 4 operators around the clock) appears generous, relative to similar facilities elsewhere.

5. Beamlines and Instruments

The Beamline Division is made up of the following five groups: Insertion Device and Front End Group; Optics and Transport Channel Group; Control Group; Instrumentation Development Group; and Technical Support Group.

The Division is responsible for the construction and the upgrade of beamlines, and much of the infrastructure beyond the accelerator systems. Overall, the technical quality of the SPring-8 beamlines is remarkably high.

The Division's activities have gained worldwide acclaim in several areas:

- The SPring-8 insertion device team has a tradition of designing and constructing custom-built undulators for particular beamlines and scientific applications. This is evident from the wide range of insertion devices placed around the storage ring, including revolver devices.

- The team has been in the forefront in the development of in-vacuum undulators from the outset. This technology has been adopted in numerous laboratories overseas, and is also critical for the success of the SPring-8 XFEL project.

- The group's contributions to cryogenic permanent magnet undulator development have also attracted wide attention.

- The development of ultra precisely figured mirrors has led to impressive advances in hard X-ray nanofocusing

- Work on beryllium windows has led to important advances in coherence preservation on X-ray beamlines

- The PILATUS detector, under development jointly with the Swiss Light Source (PSI), is attracting wide interest internationally.

- Robotics yields dramatic gains in throughput on PX/MX beamlines

JIAC believes that the strong tradition in instrumentation development must be continued, at least at current levels, where appropriate in collaboration with other SR facilities and industries.

Industrial application has been a strong concern of industry and government. It was also taken into account as one of the important roles of Spring-8 from

the planning stage. Industrial applications were initially promoted by 'hard-industry' companies such as electric, electronic, material and automobile companies and they invested in the basic funding for JASRI. Thirteen companies jointly constructed two contract beam lines. Pharmaceutical companies came later and 22 companies jointly constructed a contract beam line.

JASRI has been making efforts to increase the number of industrial applications in various fields. The group to support industrial application was formed in April 2001, promoting programs were also set up in 2001 and industry user evaluation has been introduced. The number of industrial users has increased significantly in these five years and most of the users seem to be satisfied by the programs for industrial applications.

Highlights are:

- Enhancement of the support organization for industrial use;
  The Industrial Application/Utilization Support Group started in 2001, was reorganized in 2003 and the Industrial Application Division was established in 2005.
- Increase in the number of industrial users and application fields;
  The number of people and companies using Spring-8 has increased by more than a factor of two in five years. The number and percentage of industrial research proposals have also increased, by around three and two, respectively.
- Fruitful industrial research results;
  Research has been carried out in the fields of electronics, metals and soft materials, automobile, energy and environment, material analysis and life sciences. Many important findings from the industrial point of view are being applied in industry.

JIAC's recommendation is to enhance the support for the non-specialist users since many industrial users, specialist in their own fields, are not able to make SR measurements or data analysis. JIAC is impressed by the large number and high technical quality of the beam lines operating at SPring-8. It seems very important to improve services to the users further by increasing the number of JASRI staff directly working on the beam lines. JIAC observes that at comparable facilities a "standard" beam line will have typically 2 scientists, plus 2 postdoctoral scientists, plus a technician/engineer as support staff.

JIAC notes enthusiastically the significant increase in industrial activity, distributed across the beam lines including those dedicated to industrial science. JIAC suggests that industrial income should be employed to enhance the service to industrial users and the scientific infrastructure. This would act as an incentive to JASRI and to Japanese industry to deepen their involvement in the exploitation of SPring-8.

JIAC found that the Industrial Application Division covers the research fields of electronics, metals, soft materials, environment, but not life sciences which has been the responsibility of the Riken Institute. This might arise for historical reasons, but industrial use which combines nanotechnology with

bioscience will certainly become more and more important. JIAC recommends the organization of a unified support system in the future.

6. Further Observations and Comments

Overall, the committee is very impressed by the performance of SPring-8. However, due to budget problems, the facility is not operated at its optimum level. In addition, JIAC believes that JASRI should be given the authority and responsibility for all aspects of the operation and development of SPring-8.

Finally, JIAC wishes to congratulate the JASRI management and the staff of SPring-8 for their excellent work during the years since the last review. Further JIAC thanks the staff of JASRI for the excellent support in advance of and during this Review Committee meeting.

This report is transmitted to the JASRI management on behalf of the JASRI International Advisory Council

Prof Gerhard Materlik, Chairman

September 19, 2006

Attachments A)-C):

A) JIAC 2006 Member List

Prof Gerhard Materlik, CEO, Diamond Light Source, UK (Chair)
Prof Hidetoshi Fukuyana, Tokyo University of Science, Japan (Co-Chair)
Prof William G. Stirling, Director General, ESRF, France
Prof J. Murray Gibson, Associated Laboratory Director, ANL, APS , USA
Prof Helmut Dosch, Director, Max-Planck Institute fur Metallforschung, Germany
Prof Janos Kirz, Acting Director, Advanced Light Source, USA
Prof Sine Larsen, Director of Research, ESRF, France

Dr Drake S. Egglestone, Vice President, Computational, Analytical and Structural Science, GlaxoSmithKline, USA
Prof Toshiaki Ohta, Ritsumeikan University, Japan
Dr Yasuhiko Fujii, Japan Atomic Energy Agency, Japan
Dr Mutsuhiro Arinobu, Executive Director, Toshiba Corporation, Japan

B) JIAC Agenda

July 3-5, 2006

July 2nd (Sunday)

Hotel Nikko, Himeji

Sunday July 3

18:00 Welcome Dinner (Buffet)
Hosted by Dr. Akira Kira
(at Hotel Nikko Himeji)

20:00 Brief Meeting (Closed)

July 3rd (Monday)

Monday July 4

9:00 Welcome Address (Dr. Akira Kira)
9:05 Opening Remarks (Prof. G. Materlik)
9:10 Concerns and Issues (Dr. Akira Kira)
9:40 User Support System (Dr. Hideo Ohno)
10:10 Discussions (Closed)

10:40 Coffee Break

11:00 Nanotechnology Support Project (Dr. Shigeru Kimura)
11:30 Protein 3000 Project (Dr. Masaki Yamamoto)
12:00 Discussions
12:30 Lunch (at Restaurant *Serena*, ground floor, Hotel Nikko Himeji)
14:00 Materials Science (Dr. Masaki Takata)
14:30 Life Science (Dr. Masaki Yamamoto)

15:00 Coffee Break

15:30 Industrial Applications (Dr. Norimasa Umesaki)
16:00 RIKEN Harima Institute (Dr. Tetsutarou Iizuka, RIKEN)
16:30 Japan Atomic Energy Agency (Dr. Junichiro Mizuki, JAEA)

17:00 Discussions

17:30-21:30 Banquet: *Sea Shore Mitsu-misaki*
17:30-18:30 *Hotel Nikko Himeji* to *Sea Shore Mitsu-misaki* (Bus)
18:30-20:30 Banquet
20:30-21:30 *Sea Shore Mitsu-misaki* to *Hotel Nikko Himeji* (Bus)

July 4th (Tuesday)

9:00 Accelerator Division (Dr. Haruo Ohkuma)
9:30 Beamline Division (Dr. Syunji Goto)

10:00 Coffee Break

10:30 Research & Utilization Division (Dr. Masaki Takata)

11:00-18:00 SPring-8 Site Tour
- 11:00-12:30 *Hotel Nikko Himeji* to *SPring-8* (Bus)
- 12:30-14:00 Lunch
- 14:00-16:30 SPring-8 Site Tour
- 16:30-18:00 *SPring-8* to *Hotel Nikko Himeji* (Bus)

18:00 Dinner (at Banquet Room *Fuji*, Hotel Nikko Himeji)

20:00 Drawing Up Report

July 5th (Wednesday)

9:00 Discussion (Closed)

10:00 Coffee Break

10:30 Drawing Up Report

12:30 Lunch (at Restaurant *Serena*, ground floor, Hotel Nikko Himeji)

14:00 Release of the Draft Report (Prof. G. Materlik)

15:00 Closing Remarks (Dr. Hideo Ohno)

15:10 Coffee Break

15:30 Additional Work on Report

17:00 Dissolution

C) *JIAC* Guideline

In its recommendations of 2004, *Council for Science and Technology* in Cabinet Office, Government of Japan advised that *Japan Synchrotron Radiation Research Institute* (*JASRI*) should organize an international advisory council and should respect their recommendations, with which *JASRI* could improve the transparency and efficiency in the *SPring-8* management system to ensure the scientific and technological productivities at the facility for full-fledged exploitation.

In order to appropriately respond to the recommendation given by the *Council*, *JASRI* establishes *JASRI International Advisory Council* (*JIAC*) with the following guidelines:

1. The mission of *JIAC* is to review the overall SPring-8 management undertaken by *JASRI* as well as the scientific attainments and activities embodied by *JASRI*, and to deliver the recommendations to *JASRI* for accomplishing the aim indicated above.
2. *JIAC* consists of about ten (10) members of eminent scientists internationally acknowledged from various fields of *SR* science and technology, two-third of which is from abroad.
3. The director general of *JASRI* appoints the chairperson of *JIAC*.
4. The director general appoints other members of *JIAC*, based on recommendations made by the chairperson.
5. *JASRI* submits information materials requested by *JIAC*.
6. *JASRI* functions the office for *JIAC* by the request from the chairperson.
7. The chairperson organizes and proceeds a meeting (or meetings, if needed) for review.
8. In reference to the circumstances surrounding *JASRI*, the *JIAC* meeting held in 2006 also pays attention to new management scheme under the SR law to be amended.
9. *JIAC* indicates its recommendations to *JASRI* upon completing the review process.