Summary Minutes from the Meeting at KEK July 2-3, 2012, of the International Advisory Committee of the 3-GeV ERL Project.

Question 1 – Are the scope and strategies of the 3GeV-ERL project including the further upgrade of XFEL-O satisfactory as the future light source in KEK?

The ERL, with the XFEL-O, is a logical step in the development of next generation accelerator-based photon sources. It will have unprecedented characteristics, and will be complementary to high-gain FELs and ultimate storage rings. Going far beyond present state-of-the-art, and ERL will open up major new research areas. The ERL is therefore an exceedingly strong and logical candidate as a future light source at KEK, and is better than "satisfactory".

KEK/JAEA with its advanced capability in accelerator physics and, specifically, superconducting rf technology, is uniquely positioned worldwide for the successful construction of an ERL. KEK can play a leading role in establishing the necessary technology and extensive collaborations with international partners can be anticipated, within existing frameworks and/or within the recently proposed International Institute for Future Accelerators.

The XFEL-O, with a planned average flux of ~10^15 photons/second/meV has truly revolutionary potential: to the best of the review committee's knowledge, it is not matched by any device planned on a 10 or even 20 year time scale. This is an extremely exciting and un-paralleled game-changing instrument for nearly all areas investigating dynamics - electronic, atomic and perhaps even magnetic - on time scales of ps or faster.

Question 2 – The Science Case for the 3GeV-ERL project.

A. **Is the scope of the science case of the 3GeV-ERL reasonable and also satisfactory?**
B. **Is the effort to brush up the science case enough?**
C. **Further recommendation for this item**

A. Yes. The IAC is of the opinion that the scientific case for a 3GeV-ERL is mature and is solidly anchored in both the Japanese and the international scientific community. The Conceptual Design Report provided to the IAC before the July 2-3 meeting has an impressive expose of the breadth of novel scientific opportunities an ERL source offers. This was substantiated by the excellent review of Dr. Adachi and the three equally excellent talks on more specialized

topics by Drs. Nakao, Amemiya and Ishii. The IAC takes note that PF was a co-sponser of a series of six workshops held at Cornell in June 2011 providing a comprehensive coverage of future scientific directions with the next generation of coherent, high rep. rate, short-pulse sources. The workshops were attended by close to 500 participants.

B. As has been the case so far, the IAC recommends that PF/ERL-team play an active role in promoting the evolution of the scientific case with workshops, symposia, etc.

C. The ERL team should continue to pursue further advanced capabilities, such as sub-femtosecond pulse generation via echo-enhanced harmonic generation, and fold these into the scientific case.

Question 3 – Development for accelerator technologies

A. **Is the technical development for the accelerator components for the cERL sufficient?**
B. **Is there anything to check the technical problem in cERL before construction of the 3GeV-ERL?**

A. The IAC was very impressed by the advanced status and the rapid progress of the cERL project. The IAC commends the entire ERL team for these remarkable accomplishments. The progress is consistent for all subsystems: high brightness CW gun, high-Q HOM–damped superconducting cavities, rf sources, 2K cryogenic system, and re-circulating loop. The IAC noted that the achieved 526 keV for the gun is a world record. The cERL is well-positioned to be completed as scheduled with the first beam at the end of 2012.

B. The strategy to construct the cERL as a precursor to the 3GeV-ERL is critical since the cERL has the main technology components required for the 3GeV-ERL. In addition to the needed improvements covered within the presentations, the IAC recommends attention focus on beam stability issues.

Question 4 – Construction of 3GeV-ERL

A. **Is the construction of the 3GeV.ERL feasible under the R&D planning of accelerator development?**
B. **Further recommendations for this item.**

A. The IAC spent considerable time on the ”3GeV-ERL construction plan”. It is the understanding of the IAC that the cERL is expected to be operational /commissioned at the end of 2012 and that the experience from this endeavor will be the basis for a design plan to be largely finalized in 2014. The IAC fully supports this approach. The IAC stresses the importance that this plan must be scrutinized by outside review committees with appropriate technical

background.

A detailed list of topics was presented (e.g. during the talk by Prof. Kawata) where it was expected that additional R&D would be required for either partial or complete operation of the ERL. The IAC strongly recommends that this list be prioritized with, if possible, some indication of the resources expected to be necessary for appropriate progress in each area. The IAC also fully supports that a continuous R&D effort of the gun/laser is necessary and in parallel with the ERL construction, extending into the commissioning/operational phase .

The IAC finds the proposed construction time, with completion of the 3 GeV ERL in 2021, is timely and feasible, given sufficient resources. Notably, based on the information provided in the talks, this will require additional support in both manpower and funding, and should be discussed in detail with KEK management.

B. The IAC was presented with a possible layout of the ERL facility on the KEK site. The IAC recommends that a careful study is done to make sure that the chosen layout is optimal, with particular care that there is enough space for future expansion.

The XFEL-O requires major developments of x-ray optics. The IAC recommends that the ERL team initiates collaboration with Japanese and foreign universities or institutions with expertise in this area. This will also impact x-ray optical development for general SR advancement/usage.

The Committee expresses its appreciation to the ERL-team for providing it with the Conceptual Design Report and copies of all presentation well ahead of the meeting. The Committee wants to thank KEK/ERL management and staff for a well-planned meeting with a set of informative presentations and constructive discussions, and for the great hospitality throughout the meeting. The efficient administrative staff took exceptionally good care of all logistic manners.

Committee Members:

Dr. Alfred Baron (Riken SPring-8)
Prof. Masahiro Katoh (UVSOR)
Prof. Kwang-Je Kim (The University of Chicago and APS/ANL)
Prof. Ingolf Lindau, Chair (SLAC/Stanford)
Prof. Jun-ichiro Mizuki (Kwansei Gakuin Univ.)
Dr. Thomas Tschentscher (European XFEL), absent from meeting
Prof. Zhao Zhentang (Shanghai Institute of Applied Physics)

Stanford, July 7, 2012.

Ingolf Lindau (Chair, on behalf of the IAC)