Report on the
AAP Review at TILC'09

April 17-21, 2009, Tsukuba, Japan

Overview

Participants:

C Damerell, J Dorfan, E Elsen, T Himel, M Kuriki, O Napoly*, K Oide, H Padamsee, T Raubenheimer, D Schulte, W Willis. External Members: N Holtkamp*, L Rossi*, T Tajima, M Uesaka, F Zimmermann.

(*) apologies received

Introduction

Prior to the meeting the committee members received background information, which was posted on the web-page of the TILC'09 conference. The information has been compiled under the coordination of the ILC Project Managers and in response to the guidance document of the AAP that is appended for completeness.

The advance information structured the meeting and was supposed to focus the discussion and assessments on the committee. The overriding goal of the assessment was to verify the readiness of the ILC for evaluation by government funding agencies following the Technical Design Phase in 2012 and before. As will become clear in the assessment of the various accelerator components the AAP has identified areas that need a rebalancing of the effort to achieve the project milestones.

Conventional Facilities and Siting

The Conventional Facilities and Siting (CFS) group is planning to investigate a variety of tunnel configurations both with single and with twin-tunnel layout. There will be two deep configurations and five configurations in which the main tunnel is at a rather shallow depth (typically around 30 m) and the service tunnel is near the surface or even in a surface building. The seven configurations will be characterized using the cost estimates based on the RDR methodology. The technical requirements are those as stated at the time of the RDR.

The assumptions on the thermal loads are based on the RDR estimates. Given those requirements the value engineering has concentrated on seven key items of the sixty considered to optimize the chilled water distribution and arrive at a cost savings of 30-35%. The numbers have been compared to similar projects and estimates such as TESLA, XFEL, Project-X and CLIC.

There has been active study of the RF distribution. Compared to the choice made for the RDR, two extreme configurations are now discussed in addition: a concentrated RF source with power distribution in extended waveguides (KlyCluster) and a system in which each RDR klystron is replaced by thirteen lower power klystrons in the main tunnel, the distributed RF system (DRF).

There has been considerable progress in 3d modeling of the tunnel layout. Despite the use of different CAD programs at various laboratories it is now possible to merge and visualize the evolving configurations. The integration of these tools is coordinated at DESY and eases the exchange of ideas in particular between CLIC and ILC and allows them to arrive at common solutions. The main application of the 3d tool will be in congested areas where several tunnels merge or considerable hardware will have to be installed.

> *The AAP encourages the CFS groups to continue their efforts to explore the various tunnel configurations with a uniform approach and common methodology.*

This effort will directly help any region that intends to propose a specific site for the ILC. For the studies to be fully useful in this respect the AAP is concerned that the technical implications and optimizations of a given configuration have not yet been fully propagated to the over-all design requirements of a particular tunnel configuration. In general, the AAP was worried that the interfaces between CFS and the technical design efforts were not sufficiently clear or active.

> *Technical designs of configurations such as RF power distribution and the treatment of operational reliability (downtime for klystron replacement etc.), safety and radiation aspects should be handled in a consistent and transparent manner. Each configuration should be subject to an in-depth risk analysis that includes consideration of the operation and maintenance aspects.*
>
> *The AAP encourages further exchange between the various area groups. In many cases, guidance from the project managers is necessary for systematic application across the project. For these CFS efforts to be most useful, it is important to define clearly the main assumptions and technical choices.*
>
> *The AAP is impressed by the progress of the 3d tool integration. The tools are recognized as an important aid in understanding critical aspects of a chosen layout, where the benefits from the resource-intensive implementation efforts may be justified.*

CesrTA and electron clouds

AAP is impressed by the skillful effort to reconfigure CesrTA into a unique facility for electron cloud studies. CesrTA constitutes a wiggler-dominated damping ring particularly suited for ILC DR studies.

The committee commends the development of sophisticated diagnostic tools for electron cloud measurements and low-emittance beam optimization in the framework of an international collaboration. On a worldwide scale, teams at Cornell, KEK, LBL, LNF, SLAC and CERN are working together to jointly advance the understanding of the electron cloud.

Various methods of electron cloud mitigation have been proposed, including grooved vacuum chambers, enamel based or coated clearing electrodes, and in particular vacuum chamber coatings with low secondary-emission yield (SEY). Many coatings can reduce the SEY of the vacuum chamber including TiN and NEG coatings. The recently proposed diamond-like structured carbon coating seems to be particularly successful in reducing the SEY and may maintain this property even after extended periods of air exposure and normal operation (though this has of course to be verified). In all cases, further efforts have to be made to explore the robustness of the solutions to long-term exposure to a radiation environment.

A wide-area thin clearing electrode, successfully tested in a KEK-B beam experiment, may also be considered as a future mitigation candidate to be characterized at CesrTA.

There is also progress in understanding in the simulation of the electron cloud effects. The collaboration is to be applauded for several impressive successful efforts in code benchmarking with up to five simulation programs, which included implementing identical surface models and considerable code modifications, and for the successful code validation against early CesrTA results on tune shifts and RFA signals. The input to the electron-cloud simulations comprises the photo-electron generation, the photon reflectivity and related distribution, the reflectivity of low-energy electrons, possible contributions from diffused secondary electrons, and the SEY including its dependence on the primary impact angle, as well as the emission properties of photoelectrons and secondaries.

To date more efforts are still necessary to achieve the targeted low vertical emittance of ~20 pm at CesrTA (which is about 10 times the ILC value). The vertical emittance value is currently limited to 35 pm as is revealed both by XBSM measurements and by the Touschek lifetime. The AAP is impressed by the vast amount of experimental and simulation work that has already been performed and continues to increase the understanding of the CesrTA facility.

The AAP encourages the CesrTA collaboration to continue with their ambitious e-cloud experimental program. It is important that the phenomenon be fully characterized. In particular it is important that the various input quantities for the simulation be separately and independently determined to increase the predictive power.

The AAP also encourages the CesrTA collaboration to achieve further reductions in vertical emittance by applying more diagnostics and correction techniques, especially for the vertical dispersion.

The AAP notes that the final ILC mitigation scheme must not only suppress secondary emission, but also provide acceptable photo-emission plus photon reflection properties, must not degrade in time and must not harm the machine performance, e.g. by introducing an unacceptable impedance or leading to elevated vacuum pressure. A complementary study would examine the reaction of mitigated test surfaces to an ILC-like synchrotron-radiation photon spectrum (in terms of photoemission, geometric and diffuse photon reflection, outgasing, and stability), possibly at CHESS or at another light source accessible to the ILC collaboration.

The expected experimental results of the CesrTA and the corresponding improvements in simulation models allow benchmark tests to understand present electron-cloud observations from around the world (including earlier non-observations at DAFNE) and thus test the predictive power of simulation. Eventually the electron cloud predictions will have to be corroborated by measurements at KEK-B, which more closely resembles the ILC damping ring currents.

The AAP notes that once the current rounds of measurements are completed and the modeling software has been updated to incorporate what has been learned from the measurements, the impact of the e-cloud must be reevaluated for the 12 ns and 6 ns bunch spacings in the damping ring designs. This will provide an updated assessment of the risk to damping ring performance from the effects of the e-cloud. Should the risk factor be too high, the AAP observes that a lower-current ILC machine with half the number of bunches in the 6-km configuration, i.e. 12 ns bunch spacing would operate in a safer regime with regard to electron cloud. Reducing the positron ring circumference to 3-km may risk losing this back-up solution.

The AAP would like to see a plan laid out showing how the damping ring group plans to arrive at a decision for the viability of the ILC damping ring choice with respect to electron-cloud immunity. A clear set of criteria for the vacuum system should be developed that will lead to the choice of a baseline solution. Alternates along with required R&D can also be specified. A schedule for establishing the criteria and the baseline should be shown.

FLASH

The AAP is pleased to see the progress towards high gradient, long pulse, high beam loaded 9 mA running at FLASH. The committee recognizes the importance and relevance of the program with respect to ILC. At the same time the program directly benefits the European XFEL.

AAP acknowledges the support from DESY as exemplified in a 2 weeks dedicated beam time program plus 3 weeks preparation for the studies by the FLASH/TTF collaboration on 9mA operation.

The program at FLASH represents a worldwide unique opportunity to demonstrate ILC-like beam in an SRF linac. Primary goals are to study beam energy stability, HOM absorption and LLRF control overhead. It is the only place to perform these studies before 2012 and to probe various aspects of the ILC main linac operation.

There is a strong international collaboration, which is committed to work towards clearly defined goals. AAP is impressed how technical difficulties have been addressed by the team. The LLRF system proves to be a continuous challenge.

> *AAP strongly encourages the collaboration to continue pursuing their planned program to fully exploit FLASH for the maximum benefit towards ILC.*
>
> *All aspects of LLRF should be explored and exercised under various bunch loading conditions to gain a complete understanding of the necessary control mechanisms. The program should include a study on HOM losses under operating conditions. Dark currents should be measured and characterized. These studies will allow better understanding of the system behavior at the level of a cryomodule.*
>
> *The collaboration is encouraged to extend both the international participation and the DESY engagement in these studies.*
>
> *The studies are crucial for the success of ILC. The studies can only be successful if a sufficient share of beam time is reserved at FLASH for dedicated high beam current running.*

SCRF

The committee is very impressed by the progress made in the gradient yield toward TDP 1 goals. New final rinse techniques have significantly reduced field emission problems. There has been substantial progress in understanding some of the causes of gradient limitations by developing effective thermometry-based diagnostic tools, 2nd sound quench detection tools, and optical examination tools. Several methods of cavity repair are under exploration with already encouraging results. Companion studies are underway to understand the origin of gradient limitations. Efforts continue at all laboratories to understand and improve process reproducibility. These tools raise the prospects of continued improvement in gradient yield towards the TDP 1 goals of 50% process yield. Prospects are high for achieving good statistics with more than 90 tests available by 2010.

The path towards the TDP 2 goal of 90% cavity yield in 2012 is under development with improved understanding of defects that limit performance, especially from new vendor cavities. Not counting the large XFEL production, more than 100 cavities will be available to collect good statistics. Valuable information from quench detection and corresponding inspection will be fed back to the vendors.

> *The AAP recommends a strong interaction between laboratory experts and new vendors during all stages of cavity fabrication.*
>
> *The AAP recommends that for the yield study further evaluation be made of the quality of cavities (Q-values) along with gradient. Electron loading and x-ray intensities at 35 MV/m should be closely monitored.*

There has been substantial progress in the two major new cryomodule assembly facilities at KEK and FNAL. The first 4-cavity cryomodule has been successfully tested at KEK at an average gradient around 24 MV/m with one cavity approaching 31.5 MV/m. The slide-jack tuner variant has been successfully developed for a stiffer cavity-He vessel system and successfully tested with Lorentz-force compensation at 30 MV/m. The first cryomodule has been assembled at FNAL using the DESY supplied kits with average vertical test gradient of 29 MV/m and several cavities over 30 MV/m. The full cryomodule test is expected in fall 2009 when the cryogenics will be ready.

The AAP recommends that a strong effort be made to complete this test on schedule.

The AAP is impressed by the rapid installation and commissioning of new cavity and cryomodule facilities at KEK-STF and FNAL-NML. Intense preparations are underway for the so-called S1-global test at KEK that combines two cavity packages from FNAL, two from DESY and four from KEK. Interface definitions have been developed to accommodate the different designs of cavity package components such as couplers and tuners. The variations will have an impact on the many interfaces for heat shields, magnetic shields, and instrumentation and these definitions need to be added to the specification list.

The AAP appreciates the big efforts made at KEK to accommodate such a variety of cavities, which is good example of integration at the international level. The AAP recognizes and appreciates this shift in emphasis but notes, however, that it may be difficult to maintain the high gradient goal for this mixed origin cryomodule.

The AAP suggests adapting the scientific goals for S1-global effort at KEK to better match the expectations.

Looking beyond the S1-global-effort it is understood that the primary goal is to achieve a global system test with the various plug-compatible elements provided by three regions in a global collaboration effort. The goal for the gradient research is to aim for the highest possible gradient, with every effort made to approach the S1 goal of 31.5 MV/m within the time constraints of completing the module and its test by 2012. In view of the complexities of the new plug-compatibility features, and the demands for global coordination, it will be important to further the prospects of fulfilling the S1 goal of 31.5 MV/m.

The AAP encourages support for the ongoing cryomodule efforts at DESY, in the context of the XFEL activities, and at FNAL.

Plans for an RF unit test (S2) are maturing at KEK-STF and FNAL-NML. These activities should continue to complement the important beam test work at FLASH with high-gradient cavities. The AAP notes that the schedule for the commissioning of either of the two facilities is such that the actual test will likely fall outside the time window of TDP 2.

The AAP recommends an evaluation of the Quantum beam Project at KEK on the timeline for achieving the S2 goal.

The AAP recognizes that the entire R&D program will not conclude by 2012, and still need results of these test facilities. The XFEL and Project-X will be also important, especially in evaluation of the manufacturing cost of a large linac.

Work continues to expand the industrial base for cavities. Besides two qualified industries in Europe, the Americas and Asian regions are working with several new vendors.

Similar efforts to expand the industrial base for other components such as couplers, tuners and the cryomodule should also be explored.

Plug-compatibility concept

The committee agrees with the general motivation for introducing the notion of plug-compatibility to support the development of variants on the cavity, coupler and tuner and other cryomodule elements. The definition of interface specifications eases the rapid development and use of new components and helps to iterate rapidly towards design improvement, particularly in the complex international environment. The development of interface specifications is essential before designs can be industrialized.

The AAP fully supports the plug-compatibility concept for the SCRF R&D and suggests introducing an element of competition by maintaining a score list of advantages and disadvantages of individual design variants for cavity, coupler and tuner.

The AAP has not understood the criteria that will be used to decide whether the variants are successful, should be continued for the next iteration, or stopped.

The AAP encourages the Project Management to develop criteria for evaluating and eventually selecting optimal design variants.

The AAP continues suggesting caution about the utility of plug-compatibility for the longer term for the production, commissioning and operating stages, as detailed in an earlier AAP memorandum. In this earlier recommendation, the AAP advised that the Project Managers convene a small group of accelerator (or industrial) cryomodule production experts to conduct an internal review of the plug compatibility plan, to thoroughly explore its possible advantages and expose its weaknesses. Such a review should be carried out before plug-compatibility is extended beyond the R&D phase.

The AAP believes that the final machine design, namely the design that will be sent to industry for manufacture, requires a single design for the RF components.

Incorporating multiple significantly different designs for major components will seriously complicate the quality control process during construction, and will introduce unacceptable operations and maintenance complications including increased costs. Each significant variant introduces an extra probability of having to find and correct a design problem and of having extra failures and shortfalls of the hardware to discover and compensate for.

RF System

The RF distribution has been reexamined and two alternatives with respect to the RDR have been proposed. The clustered RF (KlyCluster) system serves a 2.6 km section of the linac from a klystron cluster which may be placed in a surface building. The power is distributed in over-moded waveguides. The attractions of this proposal are ease of maintenance and reduced heat dissipation in the tunnel. In contrast the Distributed RF system (DRF) utilizes 13 lower power klystrons in the tunnel for each of the 10 MW klystrons of the RDR. The smaller klystrons could be placed in a single tunnel together with the beam pipe. With more flexibility in the RF control and less CFS cost the solution seems attractive. The large increase in the number of klystrons is critical since the lifetime of the smaller klystrons is not expected to be dramatically longer. Since maintenance will also be more demanding, the proposal still lacks a serious study of availability implications. The heat load in the tunnel is increased. The cost needs to be evaluated; early estimates indicate an increase of 20-30% for DRF over the present RF system.

The AAP recognizes the merits of the proposals and suggests continuing the value engineering of these options. The value engineering must include a risk assessment, i.e. availability studies and maintenance ability in addition to the cost comparison.

ATF

The Advanced Test Facility (ATF) and its extension ATF2 will demonstrate key features of the beam dynamics: profiting from a normalized vertical emittance of 30 nm from the ATF damping ring the ATF2 will focus a beam down to about 35 nm vertical spot size. The latter goal exceeds the achievements at the Final Focus experiment at SLAC and is to be reached with a novel final focus system based on local chromaticity compensation, which represents a scaled version of the ILC system.

A new extraction and final-focus line with more sophisticated diagnostics has been constructed and is currently being commissioned. This beamline includes active stabilization of the final quad, a Shintake spot size monitor and a laserwire scanner, together with a number of cavity beam position monitors (BPMs) including one with nm resolution. Following a realignment of the beam line the ATF collaboration has successfully reached a vertical emittance of 20 pm still above the earlier demonstration of 4 pm at ATF.

Particular measures have been undertaken to reduce or eliminate emittance growth at extraction from the damping ring. Preliminary evidence suggests that these measures have been successful.

An international ATF collaboration has been ongoing since 1997. The ATF2 study has been set up after the ITRP process in 2004, at which time the ATF collaboration was expanded and reconfigured. The experiments at ATF and ATF2 are proposed to a Project Committee which selects the proposals and follows their progress. Many foreign collaborators are active in the commissioning.

The ATF2 Collaboration has often been likened to a precursor of the envisaged ILC collaboration.

> *The AAP commends the ATF collaboration for the sequence of successful experiments that have been carried out and led to an impressive record of successful publications. The flexibility of the ATF to react to experimental proposals has been impressive.*
>
> *The AAP applauds the strong and well-organized effort of the collaboration to commission the ATF2 beam line. The collaboration is encouraged to focus on the diagnostics which are critical to understanding the ATF2 beam line.*

The collaborators are engaged in a strong effort to lead the planned experiment to success.

Minimum Machine

The AAP acknowledges the value of the “Minimum Machine (MM)” approach and welcomes this design and integration initiative. It has permitted the quantification of cost gradients with respect to scope and implementation options. Interesting new technical strategies, especially in the deployment of RF power, have emerged. The initiative also provides a chance to reexamine assumptions of the RDR design.

The proposed savings for any one of the MM options are not very large, which confirms that the choices made in the RDR are not far from the optimum, given the physics requirements for the machine. In fact, major cost savings are not to be expected unless the physics performance of the machine were permitted to deviate seriously from the ILC parameters document[1]. Consequently adoption of any of the MM strategies rests more on the assessment of technical performance and operability versus risk than on reducing total project cost.

Some design choices have global impact: the bunch compressor depends on the achieved bunch length that depends on damping ring momentum compaction which depends on tolerances and impedance which have not been fully modeled. Side effects of the envisaged changes in areas such as ease and duration of installation, commissioning conflicts and constraints, availability and ease of maintenance but also increased operating cost must be properly identified and quantified.

---

[1] ILCSC parameters subcommittee (Chair R Heuer): Parameters for the Linar Collider, Update November 2006, http://www.linearcollider.org/newsline/pdfs/20061207_LC_Parameters_Novfinal.pdf

The AAP suggests developing sufficient simulation and modeling capability to understand such dependences quantitatively.

The cost of ameliorating any degradations should be assessed to allow informed decisions on which aspects of the MM design to include in the new baseline.

With only little time left before the re-baseline decisions are to be made, management needs a focused process to make these decisions relatively soon and indeed the Project Managers are about to launch this process. The process should be driven and managed by the GDE Director and the Project Managers together.

The AAP encourages the Project Management to form and vigorously engage the planned task force to assess the re-baselining effort. The decision making on the emerging new definition should involve representatives of the MDI group and must be collectively propagated throughout all subgroups.

The rebaselining process is planned to be concluded by 2010. Until such time it will not be clear what changes will be absorbed in the new baseline.

The redesign should only be considered for those components and aspects where the benefits are high.

During the transition time the RDR solution must be preserved to maintain readiness for construction of the ILC.

Proper prioritization of the envisaged changes will enable the Project Managers to focus their coordination effort in the TD phases and demonstrate its success. Even if in the end none of the changes were implemented in the new design, there will be a benefit from the improved understanding and thus reduced risk of the design and the reduction of the entailed cost uncertainty.

Accelerator Systems

The accelerator systems (sources, damping rings, bunch compressor, main linac and beam delivery) were not in the focus of this review. Nevertheless it was important that the committee understood the technical areas sufficiently well to be informed of major technical hurdles that could become show-stoppers for ILC readiness.

Overall, the AAP is impressed by the progress in all accelerator systems. The work package goals and milestones are laid out in the technical design phase report.

The **electron source** activities focus on R&D to solve critical issues on the source laser system, primarily an engineering task, the DC gun research and R&D on photocathodes, which have to be optimized to overcome surface charge limitation.

Photocathodes must be tested with a laser that has the ILC time structure for optimization and to verify that the surface charge limitation has been overcome.

The AAP encourages the technical group to perform such a system test.

The **positron source** group has continued the study of the 4 m undulator prototype. It has been found that the undulator magnet in the prototype is not sufficiently straight and methods have been identified to stiffen the design. It may be possible to place the prototype in the extracted ATF2 beam. – The placement of the ILC undulator at the end of the linac (instead of at the 150 GeV position) is being studied in the context of the Minimum machine approach. While such an approach eases the handling of the electron beam it has implications for low energy running.

The group has made a risk assessment of the components in the positron production mechanism. While no high-risk items have been identified the flux concentrator and the rotating target wheel need further understanding to meet the required operating margins. If the current baseline for neither the flux concentrator nor quarter-wave transformer can be met a liquid lithium concentrator could be used. Such a device requires R&D and corresponding tests are foreseen. If the power load on the Ti-target wheel were excessive a liquid lead target could be used and is developed in collaboration with the Budker institute.

The beam dynamics implications of the undulator on the main linac beam are not sufficiently studied. The length of the undulator may have to be adjusted to the required photon flux.

> *The positron flux margins for the current layout are tight. The AAP suggests carrying out the detailed simulation studies to fully understand the requirements and possibly adapt the layout or choice of components.*
>
> *The AAP suggests studying or, if applicable, compiling the existing documentation on, the effect of the 150 m undulator on beam emittance, stability, and possibly implied constraints on, and requirements for, linac tuning.*

The positron group has also explored alternative designs based on an electron driven fixed target source and continues the effort of the Compton based source. These initiatives are welcome since they decouple positron production from the availability of the electron beam. R&D is need in both cases to develop realistic alternatives. However, the electron driven source does not provide polarized positrons and this would seriously diminish the ILC capability in some important areas of physics.

The **damping ring** issues are largely covered in the e-cloud discussion. The group showed a preliminary version of a "mitigation plan" for the e-cloud that will need to be corroborated by the experimental results. The low-emittance tuning is a high priority at CesrTA and ATF. The fast kicker for 3 ns extraction has shown good performance at ATF; however, the commercial pulser failed after about a months, probably due to radiation exposure.

The damping ring group has also started an integration effort in the context of the Minimum Machine. Apart from an effort to accommodate components for the central injector they have also launched a study for a 3 km-ring layout. The arcs are based on the cells of SuperB while the straight sections are scale from those of the 6 km ring. The lattice optimization will soon be concluded.

There has been significant progress on the **Ring-to-Main-Linac** section of the design. The work has been concentrated on emittance preservation studies in bunch compressors, the designs of a single stage bunch compressor and of extraction lines and the re-evaluation of the vacuum requirements in the return lines. The single stage bunch compressor can be considered with the shorter bunch length of 6 mm achieved in the damping ring.

> *AAP notes a reduction in operating margins in the range of IP bunch lengths and of damping ring instabilities.*
>
> *The AAP notes that resources in the RTML area are very limited.*

The magnetic stray field studies in a “noisy” environment close to klystrons and cryogenic equipment must be below 2 nT for frequencies above 1 Hz.

> *The AAP encourages the field studies at FNAL for noise measurements.*

The **Beam Delivery System** (BDS) group has concentrated on the program of the ATF2 test facility, the machine detector interface and several other key systems. The committee congratulates the group on the promising results of the crab cavity phase stability test carried out at Daresbury. The potential influence of the 50 m long cable noise on the feedback stabilizers should be studied.

Progress was reported on beam dynamics simulation for low-emittance beam transport lines. The results obtained so far indicate no major concern in emittance preservation. However, remaining issues need to be studied and then integrated into a full start-to-end simulation. Moreover, solutions for survey and alignment modeling and main linac BPM absolute scale have to be found.

> *The AAP recommends that these open issues should be addressed and more strongly supported by additional resources.*

Project Planning

The major GDE milestones of 2010 and 2012 loom large. Meeting these milestones is vital to the future of particle physics. Given their wide international visibility, the milestones also constitute a measuring stick for governments and the broader science community regarding our ability to collaborate successfully on a global scale.

The AAP recognizes that there are many challenges that confront the management team in the coordination of the GDE program. Maintaining project-style control of the work is hampered by the distributed nature of the personnel, the lack of direct control of the budget, the lack of control of the assignment and utilization of personnel and the challenge to profit from facilities with objectives that only partially overlap with those of the ILC. In addition, the three Project Managers (troika) are required to travel constantly to keep in touch with the geographically diverse institutions that are performing the work. Adding to this complexity, the forced transition, post RDR, to a more R&D-based program has naturally diversified the scope of the work. Dramatic and unanticipated funding reductions have added to the challenge. Only recently a more project-oriented management can be reconsidered.

Given all of these realities, the AAP enthusiastically applauds the GDE Director and Project Managers for their excellent achievements. The AAP has been exposed to a wealth of very impressive technical developments and achievements. Nonetheless, the AAP senses an urgent need for the management to assess what changes are required if they are to meet their milestones.

> *The AAP suggests that the following linked strategies would be helpful in sharpening the focus of the GDE effort: a) reserve, and protect, more time for the GDE Director and the troika to formulate and agree upon project objectives b) actively and visibly (to the GDE team at large) rebalance the objectives so that they are more focused on the milestone-related goals and less emphasize an ever broadening R&D program c) take active steps to create, and support broad and coherent ownership of the core goals.*

In short, the AAP suggests that a more tightly focused, more coordinated, project-oriented philosophy might well be the best forward-going strategy to ensure a successful outcome by the end of 2012.

> *Part of the 2012 report will be a new cost estimate. Unless the project simply wants to use the XFEL cryomodule costs it is necessary to start preparing this estimate.*

It should be noted though that it will be difficult to determine these costs since much of the work is being done at laboratories rather than in industry.

The AAP furthermore recognizes the need for sustained support from the collaborating laboratories. Activities once agreed upon should be carried out to specification and changes to the plan, if at all necessary, should be worked out between laboratory and ILC Project Management.

The AAP observes that the resources for the ILC project originate from the participating laboratories. The representatives of the laboratories express their plans and support in ILCSC to promote the construction of the facility.

> *The AAP suggests asking ILCSC to consider displaying and arbitrating the use of laboratory resources more formally. Proper orchestration of the in-kind contributions is mandatory to advance the likelihood of implementation of the ILC. Sudden changes in commitment should be avoided and, if necessary, should be communicated in the ILCSC.*

Conclusion

The ILC Project Management is fully committed to achieve the goals laid out in their plans where the year 2012 constitutes an important milestone. The AAP recognizes that there will be considerable progress in consolidating the design and assessing risk and cost by that time. A tightly focussed, more coordinated and project-oriented approach is likely to increase the success of that effort in the global context.

Some aspects of the R&D for the ILC will have to continue beyond 2012. The AAP notes for example that the goal of demonstrating 31.5 MV/m acceleration in a ILC cryomodule will be challenging. The cryomodule string test (S2) will not be completed in time for 2012 and must be demonstrated later. The results from test facilities at FNAL and KEK will be needed and will be complemented by the input from XFEL and Project-X. Other aspects of the design will still benefit from optimizations.

The milestone 2012 is however timely placed. The LHC will be providing operating experience of a large facility and with some luck the first physics discoveries will emerge. The HEP community is thus well prepared for the decision for the next facility. In a sense the construction of the ILC seems the natural evolution of that process, in which case the efforts for the ILC have to be ramped up without delay.

Nature may be less kind or science policy makers not ready for a decision on the next big HEP project. In this case the large community must be engaged to facilitate the decision for the construction of the next HEP project. Clear guidance will be needed to focus the effort and science policy makers should start preparing the corresponding strategies now.

Agenda

April 17, 2009

12:30	2:00	Working Lunch	
14:30	1:00	TDP1 – Interim Report	B Barish
15:30	0:30	Break	
16:00	1:00	Project Managers Report	M Ross, N Walker
17:00	1:00	Executive Session	

April 18, 2009

9:00	0:30	TDP I Overview	V Kuchler
9:30	0:30	Process Cooling Water and HVAC	V Kuchler
10:00	0:30	Distributed RFSystem Studies	E Huedem, L Hammond
10:30	0:30	Break	
11:00	0:30	Main Linac Tunnel Configuration Studies	T Lackowski
11:30	0:30	Collaboration Efforts	J Osborne
12:00	0:30	Closing Overview	V Kuchler
12:30	1:30	Working Lunch	
14:00	1:30	CesrTA, e-cloud	M Palmer
15:30	0:30	Break	
16:00	1:00	FLASH	J Carwardine
17:00	2:00	Executive Session	

April 19, 2009

8:30	1:00	Executive Session	
9:30	0:10	Introduction	A Yamamoto
9:40	0:35	R&D to improve the gradient	L Lilje
10:15	0:15	Decision process	A Yamamoto
10:30	0:30	Break	
11:00	0:30	Cavity integration	H Hayano
11:30	0:30	Cryomodule	N Ohuchi
12:00	0:20	Role of Plug compatibility	J Kerby
12:20	0:10	Cryogenics	T Peterson
12:30	1:30	Working Lunch	
14:00	0:20	HLRF	S Fukuda
14:20	0:20	MLI beam dynamics and quadrupoles	C Adolphsen
14:40	0:20	STF at KEK	H Hayano
15:00	0:20	NMF at FNAL	M Champion
15:20	0:10	Summary and Discussion	
15:30	0:30	Break	
16:00	1:00	ATF2	A Seryi
17:00	2:00	Executive Session	
19:00		End	

April 20, 2009

8:30	1:00	Executive Session	
9:30	1:00	Minumum Machine	E Paterson
10:30	0:30	Break	
11:00	0:20	Electron Source	A Brachmann
11:20	0:30	RTML	N Solyak
11:50	0:30	BDS / MDI	A Seryi
12:20	0:15	Simulation (beam dynamics)	K Kubo

12:35	1:55	Working Lunch	
14:30	0:30	Damping Rings	S Guiducci
15:00	0:30	Positron Source	J Clarke
15:30	0:30	Break	
16:00	1:00	Project Manager Outlook	M Ross, N Walker
17:00	1:00	Executive Session	
18:00	0:30	Closeout with B Barish	

Appendix

Introduction to Meeting

Context Document

AAP Review at TILC'09

The Accelerator Advisory Panel (AAP) will carry out its first review of the ILC during the April 2009 TILC in Japan. This document describes the scope of this review in rather general terms and is meant to help prepare the meeting.

After completion of the Reference Design Report (RDR) in 2007 the ILC has entered the Technical Design Phase which is subdivided into phase 1 (till summer 2010) and phase 2 till the end of 2012. A Project Management Team has been installed that executes the Technical Design Plan (TDP) during this time and regularly updates the goals and verifies consistency of the overall approach. The basis for the activities is the RDR from which the project is expected to evolve.

The AAP is an advisory panels to the ILC director. It is composed of members of the ILC GDE and external members drawn from other projects. It complements the activities of the Project Advisory Committee (PAC) which consists solely of external members. As a panel with access to inside information the AAP is supposed to carry out in-depth technical reviews of the project aligned with the goals of the Technical Design Phase but not necessarily entirely confined to those goals.

To allow for an efficient preparation of the review the AAP has defined an overall context and goals that set the frame for discussion during the first review. These goals have been stated in the attached document. It is hoped that the technical background can be provided that will answer the incurred technical challenges. The topics have been developed in tight consultation with the ILC Executive Committee.

The first review will concentrate on TDP 1 which emphasizes certain focus points and defers the assessment of a more concentrated design effort for other topics to a later date. The focus points are

- Superconducting RF (SRF)
- e-cloud understanding
- Conventional Facilities and Siting (CFS)
- Test Facilities

The AAP will emphasize these topics in the review. The AAP has defined a context to structure the review in a separate document. That outline should serve to develop the detailed agenda and to guide the provision and selection of technical information.

Accelerator systems not mentioned in the focus list have received less financial support during TDP 1. Still, it is important that these areas are sufficiently well understood not to pose technical hurdles when the project is approved and funding is obtained. The AAP has thus defined the review for the accelerator systems such that major hurdles can be discussed and be brought to the attention of the management. In simple terms: there should be no show stopper for rapid start of construction should the project be approved.

On the other hand all reasonable efforts have to be made to simplify the design of the ILC and reduce the cost. There are many possible options which have been summarized under the term "Minimum Machine". The Minimum Machine has immediate consequences for the tunnel layout and affects many accelerator systems at the same time. The AAP wishes to see the options for the Minimum Machine discussed. Starting from the RDR the respective areas should indicate possibles benefits of a design change and indicate a process that may lead to the change of the design. It should always be attempted to maintain a complete machine design, by default the RDR.

Along with the technical areas, the AAP will also look into the management of the project to understand whether the stated goals of the TDP are efficiently reached and the ILC is ready for construction when the political environment may be. Finally, the overall strategy for realizing a linear collider will be addressed.

Topic	Category

- **Management**
  - ***Are the current management structures adequate to achieve technical readiness for the ILC in 2012?*** — ***Context***
    - use of international resources
    - topical emphasis
    - timing
    - Minimum Machine Overview (details in technical areas)
      - Simplification and rationalization
      - Cost savings
  - ***Does the current process involve the community such that it is prepared to engage when the decision for construction will be taken?*** — ***Context***
    - LHC results become available
    - Energy reach and window will be known
- **CFS**
  - ***Characterization of the process towards final ILC layout*** — ***Context***
    - Tunnel and Depth configurations
      - Cost implication
      - Optimization of power distribution
      - Operational aspects
    - Goals of TDP phase I and II for CFS
      - Completeness of Design?
      - Assessment of effort after TDP.
- **e-cloud**
  - ***Will e-clouds impose an operation limitation for the ILC?*** — ***Context***
    - Is the theoretical understanding sound?
    - What are the uncertainties in extrapolation for the ILC?
    - What are the mitigation techniques?
    - Which aspects of the theory and of the mitigation techniques have been tested experimentally and independently in positron and proton rings?
    - Damping ring test facilities
      - CesrTA
        - e-cloud
        - impedance limitations
      - PEP II
      - KEK B
        - high curent operation
        - future options
      - DaΦne
    - Is there a DR design for the ILC for safe operation wrt e-cloud?
      - What is the design and how has it been verified?
      - What are the remaining uncertainties and how are they covered in the design proposal?
      - What are the side effects: impedance, acceptance, emittance, bunch, etc…
    - What is the operation margin?
      - bunch charge
      - shorter bunches
      - smaller rings
- **SCRF**
  - ***What is the path to finalizing the gradient choice?*** — ***Context***
    - Current experimental status
      - Established standards

Topic	Category

- Extrapolation of results
- Time limitations
- Decision process
- Role of plug compatibility in this process
- ***What is the path towards industrialization?*** — ***Context***
  - Current experimental status
    - Established standards
    - Extrapolation of results
    - Internationalization of efforts
  - Outline tendering process
  - Role of Plug compatibilty
- ***Lessons expected from systems tests*** — ***Context***
  - FLASH
    - Operational limitations of ILC cavities
      - ILC like mode
        - *–- Long bunch*
        - *— High charge*
        - *— High gradient*
      - Experience and characterization of implications for ILC
  - Other facilities foreseen
    - Timelines
    - Benefits

- **ATF/ATF-2**
  - ***Overall goals of the Test Facility Program*** — ***Context***
    - International involvement
  - ***Demonstration of final focussing*** — ***Context***
    - stability
  - ***Demonstration of 2 pm emittance*** — ***Context***
    - reproducibility

- **Accelerator systems**

  Comprises:
  – e- source
  – e+ source
  – DR injectors
  – DR
  – Bunch compressor
  – Main linac
  – Beam delivery and final focus
  – Dumps
  – Operations and Controls
  - ***Current baseline layout?*** — ***Review***
    - Challenges
    - Alternatives
      - Decision process for alternatives
  - ***What are the technical limitations known today and implications on project timing?*** — ***Review***

    Suppose funding were available today to address the engineering work. Are there any technical hurdles that require research and investigations before engineering could start? Those issues might delay the realization of the project and should be clarified early if on the critical time line.

Topic	**Category**
• **Strategy**	
• ***TD Phases 1 & 2***	***Context***
• ***Beyond TD***	***Context***