BABAR
DISASSEMBLY AND DISPOSAL
SAFETY PLAN

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Revision Record

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1 Introduction to BaBar D&D

All D&D activities will adhere to SLAC ES&H policy; this plan supplements existing ES&H programs. This is an evolving document and the appendices, in particular the Summary Hazard Analysis will continue to be developed as necessary.

1.1 Description of the BaBar Detector

The BaBar Detector is a general purpose detector for detection and reconstruction of events produced in e^+e^- interactions at the SLAC National Accelerator Laboratory PEPII storage rings. This approximately 1200 ton detector, with readout electronics, was assembled in the late 1990s, and conducted data taking operations from 1999 through early 2008.

The detector is a hexagonal prism whose longitudinal axis is aligned along the beam line. The core of the detector is about 22 feet tall, and stretches 21 feet along the beam line. The detector consists of several subsystems that provide tracking of charged particles, detection of neutral energy, and identification of both charged and neutral particles.

In order to reconstruct the path and momentum of charged particles, three subsystems are used. The innermost, the Silicon Vertex Tracker (SVT), is composed of 5 layers of double sided silicon which contains two orthogonal sets of strips (~150000 strips). As charged particles pass through the silicon, ionization is produced and detected on the orthogonal strips, providing, at optimal angle, an approximately 15 micron measurement of position in the strips in each dimension. The SVT is a high resolution detector capable of detecting detached vertices with at resolution of about 180 microns when tagging events. This was crucial to the experiment's ability to measure CP violation parameters, its central goal.

The second subsystem involved in charged particle tracking is the Drift Chamber (DCH), which is located radially outward of the SVT. It consists of a gas volume (He: isobutane::80:20) contained by an inner and outer cylinder and two endplates, instrumented with about 29,000 wires strung between the endplates which form 7104 small drift cells arranged in 40 layers radially; 24 of these layers are stereo. As the charged particles traverse the gas volume, the gas is ionized. The ionization products drift under the influence of the electrostatic field maintained in the cells, with amplification provided by the field. The sense wires with their electronics measure both the drift time of the ionization and the total ionization for position measurement and particle identification respectively. The position measurments can be combined to trace the charged particle trajectory through the DCH.
A uniform magnetic field is applied to the tracking volume in order to measure the momentum of the charged particles as they curve in the field. The 1.5 Tesla magnetic field is provided by a superconducting coil located in a cryostat immediately inside the steel return yolk (Instrumented Flux Return (IFR) steel).

Neutral particles are measured primarily via their energy deposition in the Electromagnetic Calorimeter (EMC). The EMC consists of 6580 CsI crystals doped with approximately 1 part per 1000 of Tl. These crystals weigh on average about six pounds each. The barrel portion of the EMC contains 5760 crystals in 120 rows azimuthally. The forward endcap contains 820 crystals in 8 nested rings; the outermost ring abuts the forward barrel crystals. Gamma rays interact totally in the EMC. The CsI(Tl) materials scintillates. The light emitted in a set of crystals is sampled by photodiodes, yielding a precise measurement of the total energy of the

gamma ray. In addition, neutrons and K_L mesons often interact in the crystals, and though they do not deposit all their energy, the energy measured can be used to infer their presence via the pattern of energy deposition in the crystals.

Particle identification is the work of several subsystems. The SVT and DCH provide charged particle energy loss information. The EMC provides electron/charged hadron separation by pattern of energy deposition. The Cherenkov light particle identification system, the DIRC, provides most of particle identification for charged particles, separating e, μ, π, K, p over a large momentum range. The system consists of 144 quartz bars contained in 12 bar boxes arrayed in a cylinder between the DCH and EMC. As a charged particle traverses the quartz bar, light is emitted if the particle is traveling faster than the speed of light in quartz. This UV light is totally internally reflected down the quartz bars to an array of almost 11000 phototubes laid out on the back surface of a water filled toroidal tank. The rings of Cherenkov light are detected by the phototubes.

The remaining subsystem contributing to particle identification is the IFR. It consists of the flux return steel, which has 17 gaps in the barrel and endcap, with sensing elements installed in the gaps. During upgrades in 2002, 2004, 2006, the absorber material was thickened by the addition of 5 layers of brass in the barrel (~70 tons) and 6 layers in the forward endcap (~35 tons) in place of sensor layers; additional steel was added to the outside of the forward endcap, with additional sensor layers interspersed. The sensors currently in the barrel are Limited Streamer Tubes(LSTs), installed in 2004 and 2006. The sensors in the forward endcap are Resistive Plate Chambers (RPCs), installed in 2002. The backward endcap, which covers a limited center-of-mass solid angle, has the original RPCs.

These detector systems are read out with a very large electronics plant. The electronics is located in three places. The front end electronics is positioned as close to the detector as is possible, constrained by reliability and repairability considerations. Frequently the location is on the subsystem itself; in other cases it is located on the outside of the detector, but inside the Accelerator Housing. The system read-out-boards are located in the Electronics Hut (EH), which is itself located outside the shield wall. The intelligent part of the monitoring electronics, as well as many low voltage and bias voltage power supplies for the subsystems are also located in the EH. The Event Trigger is also located here: the Level 1 specialized electronics, and the Level 3 Compute Farm. The Event Builder switches are also in the EH. The EH has extensive power distribution into the 40 racks that it contains, as well as a chilled water cooling system in the racks. Completely assembled events are then shipped to the third location, the Computer Alcove that is located in the Control Room. A fraction of the data is processed for the shift takers who are in the Control Room to review. The Control Room also has stations for the monitoring of hardware conditions.

1.2 Identification of Assets with Long Term Value

The technical management of BaBar, including the subsystem managers, in conjunction with SLAC PPA Directorate personnel, have reviewed the detector components for re-use potential. The outcome for the major subsystems follows. Detector components with high reuse potential will be protected in the disassembly process, and mothballed after their removal from the detector.

The heart of the SVT is the silicon sensors. Other items in the system include: front end cards in the Support Tube with the structure supporting the silicon sensors; cables to the next stage of electronics, which are located atop the detector and at the north end of the accelerator housing; cables to the EH connecting to the final readout stage and high voltage power supplies; the readout boards and high voltage boards and crates. The silicon sensors have been exposed to a decade of beam operations; in particular, the sensors have been heavily irradiated in the plane of the accelerator. Radiation damage has been observed in all modules; portions of the modules and readout chips that intercept the accelerator plane are very heavily damaged. The portions of the SVT located inside the Support Tube have no reuse potential in a future experiment. However, studies of the detector elements can yield increased understanding of damage mechanisms under irradiation. The future of the detector is seen to be public display of each of the two halves in science museums. Care will be needed in disassembly to achieve this goal. The electronics located on and near the detector has no reuse value. The readout modules in the EH are decade old technology, and have no reuse value. The high voltage boards and crates still have reuse potential, though this is diminishing as the commercial manufacturers drop support for these older systems.

The core of the DCH is the chamber itself. Some areas in the chamber have been damaged over the years of operation. Deposits slowly form on the wires themselves, limiting effective operation. The first stage electronics, located on the aft face of the DCH, is designed specifically for this drift chamber to function at the interaction rates produced at the PEPII accelerator, and consequently had little reuse potential. The DCH is seen as a good candidate for display in a science museum. As in the case of the SVT, the readout modules are decade old technology, and have no reuse value. The low voltage power supply can be reused as a magnet power supply. The high voltage power supplies have reuse potential subject to the caveat of diminishing manufacture support.

The DIRC quartz bars are a unique resource. Production of these bars, in this quantity, provided a very significant challenge to industry. The bar boxes which contain the quartz bars provide a safe environment for the preservation of these bars for future reuse. The structure that supports the bars is worth retaining for reuse. The stand-off box, on which the phototubes are mounted, is not expected to be reused: DIRC readout technology improvements will allow more compact readout not affected by backgrounds as severely as the water filled stand-off box (SOB). The phototubes sensing elements have aged due to the high rate environment in which they have lived; some of the phototube envelopes have been damaged by the ultrapure water environment in which their faces are contained. Nevertheless, the phototubes have value for those with the patience to remove them from the SOB structure into which they have been glued. The front end readout electronics is very specialized to BaBar, consequently it may not have reuse potential. The readout modules are decade old technology and have no reuse value. The high voltage supplies have reuse potential subject to the caveat that manufacturer's support is diminishing.

The DIRC quartz bars, their bar boxes, and the support structure have an identified potential reuse. A proposal for a very high luminosity B factory, SuperB, outside Rome, Italy is in the development stage. These DIRC components have been identified as useful in the detector at this proposed accelerator.

The EMC CsI(Tl) scintillating crystals represent an ~ $20M investment in late 1990s funds. The machined shape of these crystals has been designed specifically for the offset interaction point of the PEPII storage rings, somewhat limiting their general usefulness. It may be necessary to re-machine these crystals for reuse outside the mechanical structures in which

they are housed. This is an expensive process that accounts for about half the initial cost of the crystals. All the crystals in the EMC have been damaged by exposure to radiation in the BaBar-PEPII operating environment. In the barrel portion of the calorimeter, this damage is low enough to allow reuse of the crystals. The endcap has seen a substantially higher dose that depends on distance from the beam-line. The outermost rings have seen doses comparable to those seen in the barrel; consequently, they have reuse value. Color centers have formed in the inner rings, lowering their light output. These crystals have much more limited value; best use may be to scrap them for their salt value. The photodiodes and preamps at the back of each crystal may be reused with the crystals. The analogue-to-digital converters have some reuse potential, though they have design flaws that make their reuse less than ideal. The balance of the readout electronics are decade old technology and have no reuse value. The high voltage supplies have reuse potential subject to the caveat that manufacturer's support is diminishing. An extensive low voltage plant exists that is specific to this application. It is unlikely to have a reuse.

The EMC barrel crystals, photodiodes, preamps and barrel structure have an identified potential reuse at SuperB. Lightly damaged forward endcap crystals may also have some potential reuse there.

The magnet system has several components. The superconducting coil in its cryostat, with its valve box interface, has good reuse potential. The cryogenic systems which provided working fluids to the coil have just passed the halfway point of their service life; consequently, they have reuse potential. Reuse of the steel is less clear. If no reuse has been identified, it is a candidate for salvaging, subject to the Metals Moratorium and Suspension.

The cryostat and its valve box interface have an identified potential reuse at SuperB. The cryogenic systems could also be reused for this application. Interest has been expressed for reuse of the steel; it may be that some or all of it can find a home there.

The RPCs and LSTs are the sensor portion of the IFR. The RPCs in the backward endcap have no reuse value. They were poorly manufactured (bad Q/A), and have aged badly under accelerator backgrounds. The forward endcap RPCs were replaced in 2002. The effects of backgrounds are greater here than in the backward direction. Some of these properly constructed chambers have been damaged. The forward RPCs have limited reuse value, and will likely be discarded. The associated front end electronics have no identified reuse. The LSTs were installed in the barrel flux return steel in 2004 and 2006. Backgrounds at their location are low. They are essentially healthy chambers. Their construction is in small modules. Reuse potential is high. These devices will be stored on removal from the barrel steel. No request for these detectors has yet been received. The front end electronics is specialized to the LSTs; their design is more modern. They may have some reuse value.

Most of the contents of the Electronics House have been accounted for in the earlier discussion. The Level 1 Trigger boards have been designed for the BaBar-PEPII environment. They have no identified reuse, and unknown, if any, reuse potential. The Level 3 Trigger computer farm consists of state-of-the-art machines installed in the last two years. They have been used since the past summer as a Monte Carlo event production farm for BaBar data analysis. The Cisco event builder switches are of recent vintage, and are reusable.

The Electronics House itself has 40 water cooled racks with a heat exchanger that has significant excess capacity. The power distribution to the racks is robust. Use of this structure, with updates for more distributed power and better in-rack heat exchangers, will

allow reuse of this structure as a substantially larger compute farm than is currently installed, with the compute capacity of up to three Sun Black Boxes with the most extensive updating of services. It is expected that when the EH is rolled back into a corner of the IR2 Hall, it will be adapted to this use, saving the cost of demolishing the structure.

The computers, switches, and mass storage devices in the Computing Alcove in the Control Room can all be reused. Computer equipment in the Control Room proper is approaching the end of its service life, but will be reused where possible.

1.3 Preservation of Assets with Long Term Value: the Minimal Maintenance State

The goal of the Minimal Maintenance State is to safely preserve assets for reuse at the lowest cost during the preparations for, and execution of, detector disassembly. Each of the subsystems has a different set of needs based on reuse potential and the nature of the detector.

For the SVT, the front-end electronics will remain off. All power supplies will remain off. During the time that water continues to circulate in the PEP-II final focus magnet system which is located in the support tube with the SVT, dry air flow will be maintained for SVT to ameliorate the effects of condensation due to the chilled magnet water, limiting effects on the SVT structure. The SVT's own negative pressure cooling system will be drained.

For the DCH, low voltage power for the front end electronics as well as high voltage power for the wires in the chamber will be off and disconnected. Dry air will flow through the DCH central volume and bulkhead volumes, mitigating oxygen deficiency issues in the DCH access tunnel at the back of the detector. Cooling will be off and the system drained.

For the DIRC, low and high voltage power will be off. Dry boil-off nitrogen will flow through the bar boxes to assure that there is no possibility for condensation on the bars. It will also flow through the Stand Off Box, drained of its water, to provide a dry buffer for the bar boxes, as well as provide a stable environment for the phototubes. The cooling system will remain off and drained.

For the EMC, low voltage and photodiode bias voltage will be off. In order to reduce stress on the photodiode-crystal glue joint, the temperature must be kept approximately constant. The Fluorinert cooling system will remain on to provide this stability, as it did during the operating phase of the experiment. In addition, in order to protect the mildly hygroscopic CsI (Tl) crystals, dry boil-off nitrogen will flow through the crystal containing volumes of the barrel and endcap portions of the EMC. The source calibration system, which uses Fluorinert as the work fluid, as well as the water chiller system used to remove heat from the barrel front end electronics, will be off and drained.

For the RPCs, both low voltage and high voltage electronics will be off. The chambers will be opened to air. The water cooling system will be turned off and drained. For the LSTs, low and high voltage electronics will be off. Nitrogen has replaced the working gas mixture during the MMS.

The state of the detector systems during the MMS will be monitored. For the DCH, only pressure is recorded. For both the DIRC and EMC a more extensive set of measurements will

be recorded, including humidity, temperatures and chiller status (EMC). In order to increase monitoring reliability while reducing upkeep costs, a new MMS monitoring system with fewer dependencies will replace the full detector monitoring system provided by the online computing system during BaBar beam operations.

The magnet power supply will be off and disconnected. Vacuum will be maintained for the magnet cryostat until the superconducting coil warms to room temperature. The cryostat will be backfilled with nitrogen to keep the cryostat interior dry for reuse.

The Minimal Maintenance State was established for all subsystems except the magnet in early September 2008. At time of the writing of this document, the superconducting coil is close to room temperature and the cryostat has been backfilled with nitrogen.

1.4 Settling Detector Ownership

The BaBar Collaboration has averaged between 500 and 600 members from initial collaboration formation through the completion of data-taking. At the time of collaboration formation these members came from approximately 70 institutions in nine countries. The membership split was ~50% U.S., ~50% non-U.S. The bulk of the funding for the subsystems of the detector was provided by DOE for the U.S., INFN for Italy, IN2P3 and CEA for France, PPARC for the U.K., BMBF for Germany, and NSERC for Canada. The detector elements were provided under Memoranda of Understanding between SLAC and the individual funding agencies for specific components of the detector, and the Multilateral Agreement Concerning Participation in the Collaboration Common Fund for the BaBar Detector. As agreed in the MOAs, the experiment was performed under the "General Conditions for Experiments at SLAC".

Different subsystems have components from different funding agencies, following the interests of the experimenters. Responsibility for the SVT construction was taken on by the U.S. and Italy. For the DCH, the effort was shared between U.S., Canada, France, and Italy. For DIRC the effort was split between the U.S. and France. For the EMC, the effort was covered mostly by the U.S., with large contributions from Germany and the U.K. The RPCs were predominantly provided by Italy; the LSTs by the U.S. and Italy with some contributions via the Common Fund from the other funding agencies. Finally, the magnet, a part of the data acquisition electronics, online computing, and detector assembly were provided by the Common Fund, a pool of funding managed by the funding agencies jointly in the International Finance Committee (IFC).

Two provisions of the General Conditions for Collaborative Experiments Performed at SLAC bear on the D&D process. Funding agencies retain ownership of the equipment that they have provided for the experiment, though ownership of the equipment no longer required by the Collaboration can, under formal mutual agreement, be transferred to SLAC, should it be mutually advantageous to do so. The Collaborating Institutions are collectively responsible for the installation and dismantling of the equipment that they supply.

Discussions of ownership and dismantling issues have taken place at the last three International Finance Committee meetings. These discussions have focused on transfer of ownership of detector components from collaborating funding agencies to the U.S. The U.S. would then take on responsibility for the dismantling of the experiment. Discussions are

complicated by potential reuse of components. Most reuse scenarios center on components being used in a SuperB factory effort, where substantial in-kind credit might be claimed if the SuperB project moves forward: funding agencies have been reluctant to move forward on the transfer until the fate of SuperB is more clear. Expectations are that clarity is likely to be achieved before the end of calendar year 2009. Consideration of the disassembly schedule indicates that the roll-out of the barrel portion of the BaBar Detector for dismantling will not occur before the end of CY2009. The IFC settled on the end of CY2009 as the time for ownership transfer of the core detector elements to SLAC/DOE at the January 2009 meeting.

In Autumn 2008, the BaBar experimenters declared an end to the data taking phase of the experiment. This was subsequently endorsed by the IFC, opening the possibility for the national groups to recover 'small parts', those items located in the Electronics House and on the detector that they feel have some reuse potential. Lists of such items were provided. The recovery of these items will be completed before the end of CY2009 transfer of ownership of the detector to SLAC, with the bulk of the retrieval expected to be complete in the first half of CY09 at the expense of the national groups. This is expected to entail the involvement of technicians from these collaborating institutions working in IR2. Their effort will be governed by this Safety Plan.

1.5 BaBar Decommissioning and Dismantling Tasks

The BaBar D&D Program consists of five interwoven components. They are Program Management, Engineering and Tooling Refurbishment, Peripherals Disassembly, Core Detector Disassembly, and Subsystem Disassembly.

Program Management covers program planning, safety, material disposition planning/tracking; a preliminary budget estimate for this is ~$4.6M.Note that cost estimates include healthy contingency. The component extends through the entire program.

Engineering and Tooling Refurbishment includes engineering and technician effort required to plan the removal of subsystems, to design (or qualify) tooling needed for these tasks, technician and machinist effort to refurbish existing tooling and fabricate additional new tooling. This component stretches over the first ~2 years of the D&D Program with a preliminary budget estimate of ~$4.4M.

Peripherals Disassembly covers removal of shield wall; clearing, disconnecting and moving the Electronics Hut; removal of walkways, platforms, utilities, cabling, cableways and on-detector electronics (where appropriate). This phase of the program, with a preliminary budget estimate of ~$1.8M, lasts through 4 years.

Core Detector Disassembly deals with removal of the larger detector elements, many with reuse value, from the flux return steel structure. It includes disassembly of the four detector end-doors, removal of SVT, DCH, DIRC, EMC and IFR components of the detector. This activity, whose preliminary budget estimate is ~$2M, begins in FY2009 and is estimated to last for about two and a quarter years. Cost estimates do not include disposal, if possible, of the components.

Subsystem Disassembly deals with the breakdown of the subsystems with long-term value into their component parts. The subsystems that fall into this category are the EMC

(breakdown to the level of crystals) and the DIRC (breakdown to the level of quartz bar boxes). This effort commences when the subsystems are removed from the magnet steel in FY2010, assuming that re-use for the full systems does not materialize. The engineering estimate for the cost of disassembly is $2.25M. The duration of this phase of the program is estimated to be two years. Cost estimates do not include disposal of the materials.

In early July 2008 two presentations were made to the DOE Annual Program Review for the PPA Directorate. These talks are provided in Appendix I. One of these talks provided the overall D&D strategy and a summary of the D&D issues for each detector subsystem. This talk contains a large number of photos of the detector components, photos from the initial installation of subsystems in the detector a decade ago, photos from the three campaigns of detector upgrade in 2002, 2004 and 2006, and photos taken at other times during operations. This talk also contains more details of the disassembly task that can be used in conjunction with the D&D schedule milestones, discussed in Section 5.1, and contained in Appendix J.

1.6 Materials Disposition

The disassembly and removal of the BaBar Detector from the IR-2 operating area will result in a considerable amount of material that will require proper handling and storage. Several areas have been identified for storage of materials as they are removed from the IR2 hall. One such area, the IR12 hall, is reserved for detector systems such as the EMC, DIRC bar box support cylinder with bar boxes, and the coil in its cryostat, that require systems that provide dry atmosphere and that maintain constant temperature. (IR12 also provides a site for disassembly of these systems, in the final stage of the project, if anticipated reuses do not come to pass, as well as prep area for tooling.) At IR2, multiple shipping containers have been acquired for storage of smaller items (e.g., LSTs in crates inherited from LCLS). IR8 has two storage areas: one fenced area inside the experimental hall for mid-sized components (e.g. DCH, DIRC Stand Off Box) which need only be kept out of the weather, and a fenced area on the outside this building. An outdoor fenced area has been set up outside the North SLC Arc Entry near IR12. This area will be used to store metal bearing components from inside the accelerator housing. The entry tunnel provides storage for general use items (e.g. chillers) that were removed from the IR2 Apron. An area on the north side of the Klystron Gallery at Sector 12 will be used for interim storage of the shield wall blocks, as well as an additional fenced area to supplement the North SLAC Arc Entry. Finally, negotiations for space on the CEH pit floor for interim storage of the end door structures are in progress.

Detector components can be broadly separated into two categories: those that spent time inside the accelerator housing; and those that did not. It is possible that materials removed from the accelerator housing may have become activated due to the radiation environment in the housing; these materials must be surveyed for radioactivity and documented. In addition, the material could be subject to the metals suspension, a DOE directive which prohibits unrestricted release for recycling of scrap metals from radiation areas within DOE facilities. More will be said about the metals suspension later in this section. When a material has no reuse, then it is determined to be waste. An item can be normal waste (which is sent to SLAC salvage for recycling), hazardous waste, low level radioactive waste, or mixed waste. Any of these can be metals suspension waste as well. For all materials leaving the accelerator housing, source location and storage location will be recorded in the BaBar Oracle Equipment Database. A bar code will be attached to each larger item; miscellaneous small items, such as nuts, bolts, and washers, will be collected in drums and bar coded. Cables will

be collected in standard steel bins for long term storage; the bin will be bar coded and its contents tracked.

RPFO has developed a Material Classification and Control Plan which is contained in Appendix G, and Material Disposition Flow Chart, contained in Appendix L. Also contained in Appendix L is a "Hold Material" label. This plan outlines the process for classifying materials, performing radiological surveys, creating a database, and marking materials. All materials will be bar coded and will be labeled with a redundant paint stencil where practical. All cable containers will be stenciled. Large items will be stacked in storage areas so that bar codes and stencils will be viewable. Materials will be stored inside buildings where possible. At the completion of all D&D activities ownership of DOE suspension and moratorium materials and the tracking database will be transferred to the SLAC Salvage Department.

Examples of hazardous materials include circuit boards, capacitors, mercury containing fluorescent bulbs, and batteries. Metals will be tested for lead in the paint. We expect that only old, pre-1985 steel plate recycled from earlier PEP I experiments might have that problem, so this material is limited. Similarly, we expect there to be little, if any, low level radioactive waste or mixed waste.

Hazardous waste presents its own special concerns due to the fact that we want to keep different kinds of hazardous waste separate as much as reasonable. This reduces the costs of the disposal of the waste. For example it will be important to keep items containing mercury separate from waste containing lead, or from oily rags. Care needs to be taken to keep items from 'accidentally' moving from the correct bin to an incorrect bin. Standardized labels on the bins describing the nature of their contents will be used.

The generation of hazardous waste during the D&D activities will be minimized by actively engaging the Waste Management team for advice and direction. All Universal Waste (fluorescent bulbs, batteries, HIDs, incandescent lamps, thermometers, mercury switches, and mercury thermostats) will be disposed of by Waste Management to an approved recycling facility. Any non-hazardous waste, from areas not covered under the Metals Moratorium (e.g. copper/metal wires, metal sheet, etc.) will be recycled as scrap metal. All waste generated by the BaBar D&D activities will be surveyed and released by RFPO prior to pick-up by Waste Management. All Class II regulated wastes (concrete/asphalt/soil, saw cutting slurry, non-friable asbestos, treated wood) that may be generated will be disposed of by Waste Management to A SLAC approved disposal facility." The custodian of the hazardous waste containers will be current on Class 105 and/or 105R training and will be responsible for inspecting the containers following the appropriate guidelines.

As mentioned earlier, a DOE directive currently in force suspends the unrestricted release of scrap metals from radiation areas within DOE facilities. Material that falls under that directive is called Metals Moratorium and Suspension Material. Following the spirit of the directive has led to a large inventory of scrap metal being stored onsite at SLAC; the steel of the BaBar detector may add to that burden. The only alternative is to ship the material to a suitable disposal facility at large expense.

CERN has dealt with a similar problem when dismantling LEP in preparation for the installation of the LHC. French legislation required an extensive theoretical study to establish the possible activation paths in the accelerator and in the four experiments installed around the LEP accelerator ring. The purpose was to define which areas might potentially contain activated material and which ones would be completely free of activation. The potential

sources of induced radioactivity for the experiments were e^+e^- annihilation events and beam related radiation. Calculations were done via Monte Carlo modeling and compared with measurements made during the disassembly of the experimental areas; the measurements confirmed the calculations.

A study is underway, carried out by Radiation Physics, based upon using the known properties of the PEP-II beams to calculate the activation of the BaBar detector components and to compare that with measurements taken during the detector disassembly. A coarse description of the BaBar detector is being entered into FLUKA. Annihilation events from the BaBar Monte Carlo and beam gas events from the Machine Detector Interface group will be used to represent the sources. The critical energy for the synchrotron radiation created in the IP region is about 40 Kev, so synchrotron radiation is not a source that will activate beam line components. The hope is that it will be possible to demonstrate via the calculations and the measurements that the metal components beyond a certain minimum radius from the beamline could not have been radioactively contaminated during the BaBar detector's operation in the PEP-II beams. It is important to plan well so that the appropriate measurements are made that constitute the most sensitive test of the calculations. The measurements will check for induced radioactivity, with complementary gamma-spectrometry measurements to be made on sample of the various materials.

The next step would be to gather the data and prepare a package suitable for presentation to the DOE as supporting evidence for an exemption from the Metals Moratorium. The time scale for this process is uncertain. Hence large items, such as the BaBar flux return steel, will be packaged suitably for long term storage. Smaller items with no reuse potential could be sent to a suitable disposal site.

Flow charts for the materials disposition process appear in Appendix L.

2 Introduction to BaBar D&D Safety Plan

All D&D activities will adhere to SLAC ES&H policy; this plan supplements existing ES&H programs. This is an evolving document and the appendices in particular the Summary Hazard Analysis will continue to be developed as necessary.

The BaBar Safety Analysis Document developed during the initial design and construction of the detector contains detailed functional descriptions, physical descriptions, and descriptions of the hazards and hazard controls for each detector system. The link to this document is provided below.
https://www-internal.slac.stanford.edu/ad/addo/toc/010-3X_Safety_Current/[023-302TP-000_BABARSAD]/[023-302TP-000_BABARSAD]Text_R000.pdf

2.1 Purpose

This Safety Plan describes the systematic approach to integrating safety into the Disassembly and Disposal (D&D) of the BaBar Detector. The purpose of this plan is accident prevention.

2.2 Scope of Safety Plan

The D&D activity will entail a substantial level of effort over a period of years. A detailed schedule of D&D tasks has been developed that provides an overall scope. This safety plan will cover all activities associated with the BaBar D&D. There is some uncertainty pertaining to the International Finance Committee (IFC) determination of ownership of detector systems, the possible reuse of certain systems in a proposed B-Factory in Italy, and the disposition of materials due to the current moratorium of materials from accelerator housings. These issues will impact this D&D Program and may require a change in scope to include the commitment of additional resources. This D&D Safety Plan is a living document and will be modified and updated as necessary.

In general, the D&D is a complicated reversal of the assembly process. The detector was assembled from the outside in and will be disassembled from the inside out. Substantial work is required before the first detector system will be removed. Some of this work includes: removal of radiation shield walls, chillers, PEP magnets and beam lines, platforms and walkways, cables, plumbing, calibration systems, and relocation of the Electronics House.

2.3 Objective/Goal

Continue the safety success story that we have worked so hard to achieve thus far. Strive to have zero TRC/DART incidents for the duration of the entire D&D Program.

3. Safety Challenges/Lessons Learned

"The safety challenges listed here are what we believe will need the most attention. A comprehensive list of all hazards is listed in Appendix E, "BaBar D&D Summary Hazard Analysis". In this section is also a brief look back at safety challenges from past major upgrades."

During past major interventions, the safety challenges that were identified as the most significant are listed below:

1. Potential for Chaos: This was due to the simultaneous operation of many different work groups in a very congested space. Teams of US and foreign collaborators, graduate and undergraduate students, contractors, as well as a multitude of SLAC work groups participated. In order to control this potential for chaos, detailed planning, daily coordination/safety meetings, IR-2 specific safety orientation, and continuous oversight by a safety team was required.
2. Fatigue: Some of the summer interventions involved extremely aggressive schedules with corresponding demanding work loads. Six day work weeks involving day and swing shifts, and occasionally the graveyard shift, was the routine over an extended period of time and created increased physical demands on workers. In addition, the hall crew, which was required to perform hard physical labor, included multiple people that returned from retirement to participate. Continuous monitoring, discussion of this issue with workers individually and at daily meetings, and oversight was required.

3. Rigging Operations: Rigging operations that required complex load transfers, unusual lifting fixtures, load monitoring, and elaborate procedures were also part of past summer interventions. Incorporating safety into the design, as well as the formal safety reviews of plans, procedures, tooling, and fixtures, was an essential part of assuring the success of these operations.

The safety challenges for the D&D Program are somewhat different when compared with the past interventions.

1. Falls: This will need special attention because in this disassembly process walkways, railings, stairways, and eventually anchorage points that people are accustomed to using will be removed.
2. D&D vs. Demolition: This is not a demolition activity but a controlled disassembly. Demolition is one of the high risk activities in industry. The fact that items removed may not be used again may cause some workers to view some operations as demolition.
3. Focus/Distraction: There is an ongoing period of major transition at SLAC including new and improved business practices and processes. The B-Factory is no longer the central program at SLAC. The BaBar D&D is a beta test site for the new WPC process. The new demands to formally document the planning process before performing work will improve safety and performance. As we implement some of these changes, there is a potential for resistance and confusion especially for some of the long-term employees. As we implement these changes during this transition period it will be important that people clearly understand the need for these changes and implement them in a way that is efficient and adds value.
4. Control of Hazardous Energy (COHE): Control of electrical, flammable gas, cryogenics, vacuum and cooling systems will be a challenge due to the complexity of some systems. All work on electrical apparatus will be conducted in accordance with the SLAC ES&H Manual, Chapter 8, Electrical Safety, and the new COHE Chapter. Exposure to > 50 volts will be prohibited for all D&D activities.
5. Potential for Chaos: There will be a limited number of different groups involved. The core group of personnel that will perform the majority of D&D activities is the IR-2 hall crew. This crew is knowledgeable and experienced. Some of the members of this crew participated in the construction of the detector. Depending on the determination of ownership of subsystems, foreign collaborators may be involved with the disassembly of certain subsystems. Different cultures have varying respect for safety rules and regulations. This has been a challenge in the past and has contributed to the potential for chaos.
6. Fatigue: Multiple shifts are not anticipated but due to the small size of the hall crew fatigue will be an issue. Unlike the past interventions, there will not be urgent deadlines to get the detector back together and online.

We recognize that these are important safety issues for this D&D activity. This safety plan identifies the extra steps we will take to control the identified risk to an acceptable level. The responsibility for implementing this plan is the task of all parties involved.

Appendix A contains a compilation of the lessons learned from the major interventions from 2004 to the present. This material will be used in the D&D safety briefing and will be reviewed from time to time in appropriate meetings. Lessons Learned and near misses will be discussed at Weekly Meeting, Daily Meetings, and Tailgate Meetings. LL that are applicable to the current D&D activity will be identified and discussed with the pertinent workers. The

following links will be utilized to identify appropriate LL: https://ll.hss.doe.gov, and https://slacspace.slac.stanford.edu/sites/esh/cgs/ll/default.aspx

Section 4, 5, and 6, describe the D&D Organization, Roles and Responsibilities, Management Processes, Safety Team, Work Planning and Control, and the approach to developing the Summary Hazard Analysis.

4. D&D Organization, Management, Roles and Responsibilities

The BaBar D&D Program is organizationally located in the PPA Directorate at SLAC. A functional organization chart for the D&D is provided in Appendix K. All personnel participating in the D&D activity have the authority and will be responsible for stopping any activity that appears to pose an imminent danger

4.1 D&D Program Manager

The D&D Program Manager has the overall responsibility for ensuring that safety is incorporated into the D&D Program. The D&D Program Manager will implement the SLAC safety policy and objectives by:

- Ensuring that safety is integrated throughout the D&D Program.
- Ensuring that risk is identified and eliminated or controlled to acceptable levels.
- Ensuring that D&D activities are performed in accordance with SLAC safety policy and requirements.
- Ensuring WPC is accomplished by chairing the Weekly Planning Meetings and the Daily Coordination/Safety Meetings and formally approving work under the lab wide WPC process.
- Providing direct oversight of activities by performing walkthrough inspections and actively reinforcing positive safe behavior.

4.2 D&D Engineering Manager (Chief Engineer)

The D&D Engineering Manager is responsible for ensuring adequate engineering practices are in place to safely accomplish the tasks associated with the D&D activities. The D&D Engineering Manager will implement the SLAC safety policy and objectives by:

- Develop the program schedule and update as necessary.
- Participating in and approving work in the Weekly Planning Meetings, Daily Coordination/Safety Meetings and the when necessary the Tailgate Authorization Meetings in accordance with the lab wide WPC process.
- Develop WIPs and assist with the development of JSAs as necessary.
- Ensuring adequate drawings, specifications, and procedures are developed and ensuring these meet the requirements of SLAC safety policy and requirements.
- Ensuring all support equipment and tooling meets SLAC requirements.
- Providing specific direction to supervisors and workers as required to accomplish work activities.
- Providing direct oversight of activities by performing walkthrough inspections and actively reinforcing positive safe behavior.

4.3 D&D Floor Supervisors

The D&D work group supervisor is directly responsible for the safety of his/her workers. The D&D work group supervisors will implement the SLAC safety policy and objectives by:

- Attending the Weekly Planning Meetings and the Daily Coordination/Safety Meetings
- Completing and maintaining Job Safety Analysis (JSA) in accordance with the lab wide WPC process.
- Conducting tailgate meetings in accordance with the lab wide WPC process.
- Authorizing workers to perform tasks only after assuring that workers understand all hazards and hazard control associated with the tasks.
- Developing procedures and providing instruction, direction, and guidance for daily tasks as required.
- Providing direct oversight of activities and actively reinforcing positive safe behavior.
- Actively discouraging unsafe actions and halting activities where safety is compromised for any reason.

4.4 D&D Team Members

Employees are responsible for understanding the hazards associated with their work, the systems and methods in place to control those hazards, and to perform their work in a safe and responsible manner as addressed by the WIPs, JSAs, and their routine and non-routine JHAM. The D&D Team will implement the SLAC safety policy and objectives by:

- In accordance with the WPC process actively participate in the daily meetings and the tailgate meetings as required
- Review WIPs, JSAs, JHAMs, permits, and procedures as required
- Reinforcing the positive safe behaviors of fellow workers
- Taking a team approach to safety by always remaining vigilant and looking out for the other guy
- Bringing concerns to supervisors and the D&D Safety Team members where there are uncertainties or questions
- Participating in the hazard analysis process where appropriate, this includes: the identification of hazards, establishing hazard controls, assessing risk, and implementing the hazard controls

4.5 D&D Safety Team

The D&D Safety Team is responsible for directly supporting: management, engineers, supervisors, and workers to assure safety is integrated into the D&D processes and operation. The D&D Safety Team will implement the SLAC safety policy and objectives by:

- Developing the D&D Safety Plan
- Generating a D&D Summary Hazard Analysis
- Participating in the Weekly Planning Meetings, Daily Coordination/Safety Meeting, and Tailgate Meetings. In these meetings safety team members will maintain an awareness of issues pertaining to the overall D&D activity and bring to the attention of these groups relevant safety issues or problems
- Providing safety briefings specific to the hazards associated with the BaBar D&D.
- Providing daily safety oversight of D&D activities

- Directly supporting supervisors by assisting with lessons learned, coordinating SME support, assisting with JSAs and the generation of additional hazard analysis where deemed necessary
- Document safety issues where required to bring to the attention of supervisors and management
- Conducting Safety Reviews of documents including: drawings, procedures, plans, analysis, as necessary
- Anticipating the unique D&D safety challenges and recommending to management actions to resolve them

The Safety Team Leader is Sandy Pierson. The team members are Frank O'Neill, Joe Kenny, Don Dains, and Jim Healy. Additional members may be required to support the daily oversight of activities and these may be requested from the ES&H Division or other Directorates. In order for the team to be effective they must be willing to get involved to a level that allows sufficient understanding of the D&D activities. They must also have the confidence to engage and interact tactfully with people in the hall in difficult situations. This may not always be an easy task and new members of the team will need the right combination of skills, knowledge, and willingness to provide this safety support.

4.6 D&D Safety Behavior

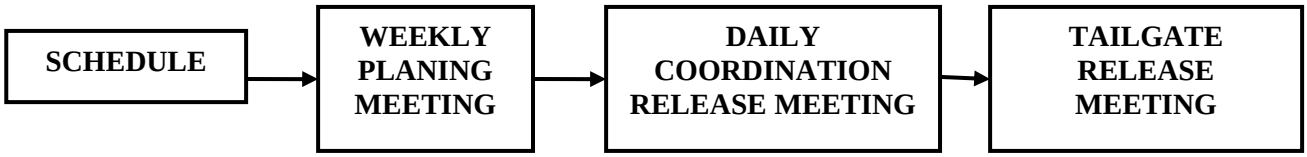
Positive reinforcement of safe behaviors is the responsibility of all personnel in positions of authority from the first line supervisor for this D&D up to the Director of PPA and the Director of the SLAC . This is the best approach to convince workers that safety is one of our core values. Also necessary, but hopefully on a much less frequent basis, is the need to demonstrate that we will not tolerate violation of safety rules and regulations or unsafe behavior. As in the past, we will advertise and enforce the three strikes and you're out policy at IR-2. This is a general scheme and more serious problems may need immediate attention by management. This policy first provides a verbal warning, second the involvement of the supervisor, and third the exclusion of the person from the IR-2 facility. Reentry into the IR-2 facility is only allowed when the worker and their supervisor have convinced the D&D Program Manager and the Safety Team Leader that negative safety behavior will not be repeated. This policy was implemented in the past due to the mixed nature of the work force and the problems associated with the different safety culture people were accustomed to in their home institutions. People that physically worked on the detector included: US and foreign collaborators including physicists, engineers, technicians, graduate students, undergraduate students and postdocs. Working hand in hand with these people were a wide variety of SLAC groups including: MFD, Vacuum, Cryogenics, Metrology, Accelerator Dept, Rigging, Carpenters, Electricians, Plumbers, subcontractors, etc. One person disregarding the safety rules had the potential to become a problem for everyone. Implementing and enforcing this policy helped create the expectation that negative safety behavior would not be tolerated at the IR-2 facility.

5. Work Planning and Control

The BaBar D&D Program is implementing the new lab-wide Work Planning and Control (WPC) process developed by the ES&H Division. We anticipate adjustments will be necessary to the D&D Program as the WPC program evolves. This section of the D&D Safety Plan describes how D&D WPC will be accomplished in accordance with the new

WPC requirements. Although some tasks in this D&D activity will be repetitive, most days the crews will be performing a different set of tasks every day.

The work planning and control for the D&D activities will be accomplished by first developing a global schedule with a set of milestones. The next step will be to conduct a Weekly Planning Meeting. The third step is the Daily Coordination/Safety Meeting, and the final step is the Tailgate Meeting. This process adheres to the ISMS core functions by assuring that:



- Work is scoped in increasing detail throughout the process
- Hazards and hazard controls are developed and reviewed in a staged process from the general to the specific
- Work is performed in accordance with clearly communicated instruction and supporting oversight
- Work accomplished is reviewed at multiple levels to understand what went right, what went wrong, and how to proceed with future work in order to optimize safety and efficiency

This is a systematic process that integrates safety into each step. The schedule defines and scopes the work globally. Further scoping of the work occurs at each subsequent stage of the process. Hazard identification and the development of hazard controls become better defined through each step of the process. Work is performed in accordance with clearly communicated instruction, authorization and supporting oversight. Feedback and improvement is a part of each meeting in that the status of work accomplished is discussed with the intent of understanding what went right, what went wrong, and how to proceed in a manner that optimizes the safety and efficiency of future work.

Discussion is not only encouraged, but required to assure people understand and proceed in accordance with JSAs, procedures or agreements at Coordination/Safety or Tailgate meetings. The essential parts of this process are identified and discussed below.

5.1 Program Schedule

A comprehensive project schedule, with a set of milestones, breaks down the activities and tasks with estimated time durations necessary for each. The schedule was created in outline form by the Engineering Manager and it is updated and redistributed to project team members on a weekly basis. Each schedule item also includes a Hazard Category to determine if it has a High, Medium, Low, or Very Low potential for mishap. This is not a risk assessment (no severity or probability assigned) but simply a general determination of this potential. This is the initial step that will highlight the need for further review of hazards and hazard controls. Each schedule item also includes estimated start and finish dates, task predecessors and successors, and the person responsible for the completion of the task. The person responsible may either perform the task himself or assign the task to others under his/her direction. The high level D&D project schedule appears in Appendix J. The detailed

set of tasks including their hazard potential and duration is also provided there via a clickable figure.

5.1.1 Schedule Methodology

The sequence, estimated time durations, Hazard Categories, and personnel assignments are based primarily on experience with the original 1997 to 1999 installation and the three IFR Upgrade campaigns that occurred in 2002, 2004, and 2006.

The disassembly sequence is approximately a reverse of the original installation. The personnel assigned to the project were selected based on previous experience in these campaigns as well as a proven history of safe operation. Unfortunately, very few personnel that were involved in the original installation are available for this endeavor. However, the Program Manager, Engineering Manager and Safety Team Leader have all been involved with BaBar since 1994 and have experience in the design, system assembly, detector installation, and detector operation. Much of the schedule task sequencing and estimated time durations is based on the institutional knowledge of these individuals.

The schedule assumes the reuse of the original installation tooling for the disassembly process. Much of the original tooling exists in various stages of condition and it is anticipated that much of this tooling will need refurbishment or replacement. The tooling refurbishment is represented in the schedule as a level 2 sub-Program. The task time estimates for Tooling Refurbishment is based on experience designing the original installation equipment.

The schedule assumes retrieval of subject matter experts as available. For instance, it is assumed that LCLS engineers such as Stuart Metcalfe and Richard F. Boyce will accept responsibility for disassembly of the systems that they originally installed (i.e., the PEP Near IR Rafts and Support Tube, the Drift Chamber, etc.).

The schedule is also based on experience from the IFR upgrade completed in Fall 2006. This upgrade took place over three campaigns: IFR Forward Endcap Resistive Plate Chambers in 2002, 1st third of IFR Barrel Limited Streamer Tubes (LSTs) in 2004, balance of IFR Barrel sextants with LSTs in 2006. The Barrel IFR Upgrade required uncabling of the forward end of the SVT and the forward end of the EMC, a load transfer of the EMC, removal of most of the corner blocks fore and aft, removal of flux bars, releasing some of the cryostat restraints, and pulling the forward doors to the walls. Many of these tasks will be repeated during the disassembly process.

The schedule assumes continuation of the safety and administrative requirements that were instrumental in the safe operation of the 2006 Barrel IFR Upgrade.

The schedule assumes the availability of approximately 8000 square feet of indoor controlled storage space. 4000 square feet of this is expected to be available to the Program no later than June 1 of 2009. The remaining 4000 square feet is assumed to become available in September, 2010 at IR-2 as the final disassembly of the detector occurs and frees space.

The schedule assumes that all ownership issues associated with detector components and/or systems with potential reuse are settled no later than the end of calendar year 2009. It is also assumed that the Italian SuperB decision will also be made in this time frame.

The schedule assumes an educated fudge factor in the task durations associated with the new Work Planning and Control Program that will be implemented at SLAC. The BaBar Disassembly and Disposal Program has been selected as a Beta Test site for this new program during the past several months. The schedule assumes inefficiencies during the implementation period of this program for training, development of forms and procedures, and iterations as the process improves with experience.

The BaBar D&D Project is dominated by hoisting and rigging activities. All hoisting & rigging activities shall be performed by SLAC personnel in accordance with SLAC ES&H Manual Chapter 41, “Hoisting & Rigging” and JSA-BBR-001 "General Hoisting and Rigging". There are no "Pre-engineered Production Lifts" or "Critical Lifts" known at the writing of this document. Hence, all of the lifts known at this time are "Ordinary Lifts". These "Ordinary Lifts" range in complexity from very simple to more complex operations that require intricate load transfers.

Risk control is accomplished through the use of technical experts plus oversight. Only designated crane operators and rigging support personnel will be authorized to perform hoisting and rigging activities for the BaBar D&D Project. In addition, the complex "Ordinary Lifts" will have an internal requirement to use "Critical Lift Controls" including formal lift planning documentation, use of proof certified slings and rigging accessories, the use of the SLAC Riggers with Floor Supervision, Safety Oversight, and Field Engineering Oversight. The Person-in-Charge for these lifts shall be the BaBar D&D Chief Engineer or designee.

5.1.2 Potential Schedule Risks

There is great potential of schedule risk associated with the disposal of materials removed from IR-2. Presently, the schedule assumes that all items removed are considered trash with no restrictions on disposal. The metals moratorium issue will most certainly adversely affect the schedule. Creation of the controlled storage areas and transportation of materials to these areas were not in the original schedule. These types of tasks are added to the schedule as they are understood. The time and effort associated with survey and tracking of materials, such as bar coding and entering information into a tracking database are not well understood; consequently are not presently represented in the schedule.

There are also instances where some detector components can not be removed in a reverse process of the installation. The Barrel IFR Brass Absorber Plates are an example of this. In these instances, new tooling and processes will need to be developed and may adversely affect the scheduled durations.

Unanticipated events such as extended illnesses, non-SLAC related injuries, lab closures, power outages, striking bargaining unit work force, etc. will adversely affect the program schedule. The schedule may also slip because of “Surprises” during the disassembly process. Perhaps the equipment does not match the engineering drawings, there is an unknown component is in the way of the item to be removed, etc.

Also, there exists little documentation of the original installation. Therefore, the schedule relies heavily on the institutional knowledge of a handful of key personnel. The Program Manager and the Engineering Manager are essential to maintain program efficiency. A loss of either of these individuals would result in severe schedule slippage. Also, the program team is very lean. A staff reduction would adversely affect the schedule duration. Also, the laboratory could divert essential resources to other critical needs. Such an occurrence could

delay, or even stop, the program. The schedule may be adversely affected by unanticipated and changing SLAC and DOE bureaucracy and safety requirements.
The ownership issues and the decision to build the Italian SuperB may not be settled as indicated in the program schedule. This would adversely affect the schedule.

The indoor controlled storage space may not be available as scheduled for detector components and/or systems with potential reuse. This scenario could delay, or even stop, the program.

The schedule may also be adversely affected by a lower-than-expected budget profile. It is also unknown the effect of the Continuing Resolution at this time. Such events could delay tasks and increase overall cost.

5.2 Weekly Planning Meeting

The purpose of the Weekly Planning Meeting is to status the work accomplished; plan and review work for the future two weeks; identify tasks necessary to prepare for the upcoming work; review the hazards for upcoming work and determine the appropriate control; and discuss issues and problems. This is an intentionally iterative process given it is a weekly meeting looking forward two weeks.

The Weekly Meetings will have an attendee list as follows:

1. Program Manager – Chair
2. Chief Engineer (alternate Chair)
3. Operations Manager (alternate Chair)
4. Hall Crew Supervisor
5. Safety Team Leader
6. Other: System Manager, PEP Representative, Specialty Engineer, Accelerator Physicist, etc. as required

The standing agenda for the Weekly Meeting will be:

1. Status of work accomplished to date (what are we doing right/wrong and how can we improve)
2. Schedule Status – identify tasks for next two weeks (longer term where necessary)
3. Preparation and coordination required for upcoming work
4. Procedures, Drawings, special tooling, expertise, or equipment required
5. Hazard identification and development of mitigation required
6. Safety Discussion–Issues, Problems, Lessons Learned
7. Completion of the "SLAC Work Integration Plan (WIP)" form as required (see Appendix B)
8. Action item list

The tasks identified, action item list, safety discussion, and all pertinent associated information and decisions will be documented utilizing the BaBar hypernews, this will then be referenced and summarized in the WIP form when required. The hypernews log will be the official approval by BaBar management of the work for the two week period identified. It is anticipated that the WIP form will be completed for summary task level activities (Level 3 in the schedule) where multiple work groups are involved. Examples of this include removal of the DIRC Standoff Box, or removal of the forward raft or removal of the support tube. The WIP forms will be compiled in a binder in the BaBar Control Room in Bldg. 621.

5.3 Daily Coordination/Release Meetings

The purpose of the Daily Coordination/Safety Meeting is to review the status of the work accomplished on the previous shift; discuss what went right and what went wrong with the intent to optimize the safety and efficiency of future activities; review and discuss all activities planned for the day; coordinate the activities of the different work groups working in the hall; review the hazards and the hazard controls for these activities; and release the activities as discussed. The outcome of this meeting is the approval by the Program manager of the reviewed activities for this specific shift.

In order for this to happen, the supervisors for each work group are required to be present at this daily meeting. The supervisor will be required to review or reference the procedure or JSA (see appendix C) that applies to all work he/she has authorized to be accomplished for this day/shift. All necessary supporting documentation such as procedures, drawings, plans, permits, COHE and ELP should also be available for review. The discussion and review of the JSAs or procedures will be open to all present.

All workers may attend and if appropriate may be required to attend by the Program Manager. If a worker is not present in the Daily meeting they are required to attend a Tailgate Release Meeting with their supervisor. Open discussion of issues by program management, engineers, supervisors, safety oversight personnel and workers is an essential part of this coordination/planning process. The chair of the meeting will go around the table and ask each individual in the room for their input.

The daily meeting will have an attendee list as follows:

1. Program Manager – Chair
2. Chief Engineer (alternate Chair)
3. Operations Manager (alternate Chair)
4. System Experts – may be required
5. Hall Crew Supervisor
6. Hall Crew Members – may be required
7. Other work crew supervisor
8. Other work crew members – may be required
9. Safety Team Member
10. Others as necessary (collaborating physicists, foreign technicians, facilities personnel, etc.)

The standing agenda for the daily meeting will be:

1. Status of work accomplished previous day/shift (what are we doing right/wrong and how can we improve)
2. Discuss objectives for upcoming day/shift
3. Discuss what could go wrong and how to avoid it
4. Coordinate activities if required
5. JSA: supervisor - review or reference as appropriate for each activity (see Appendix C), list permits and plans
6. Discuss hold points, safety issues, problems, lessons learned
7. Roll call - questions and input, open discussion
8. Assign, approved and release tasks for the day/shift including review of WIPs as appropriate

The tasks assigned and personnel responsible as well as other pertinent information will be logged in the BaBar daily hypernews log by the Chair of the meeting. The hypernews log will be the official approval & release by BaBar management for the work to be performed for that day/shift this will then be referenced and summarized in the WIPs and JSAs as required. The WIPs, JSAs and procedures will be compiled in a binder in the BaBar Control Room in Bldg. 621.

BaBar experiment collaborators, including subsystem specialists that will work in the IR-Hall will be assigned to a supervisor. All of these personnel will be required to attend the Daily Coordination/Safety Meeting. They will also be required to attend a separate Tailgate Meeting if their JSAs or procedures were not covered in the daily meeting. All work in the hall shall be approved & released by the Program Manager or designee and authorized by a supervisor as described below.

5.4 Tailgate Release Meeting

The purpose of the Tailgate Meeting is to formally assign & release each authorized worker their tasks for the day/shift, and provide all necessary information to accomplish the tasks. This is the responsibility of the first line supervisor. The WPC "Job Site/Tailgate Meeting Checklist & Attendance" (see Appendix D) will be utilized for this meeting.

For the IR-2 Hall Crews this meeting may take place as part of the Daily Coordination/Safety Meeting with the crews attending or it may be held separately.

For the IR-2 Hall crew, the supervisor will describe to each worker the specific tasks for the day/shift; provide supporting instruction and guidance when necessary; review hazards and hazard controls associated with each task; and require discussion to assure the appropriate level of understanding exists. The supervisor will include in the discussion lessons learned with the intent of optimizing the safety and performance of the activity. The supervisor will then acquire agreement from each worker to perform the tasks in accordance with the direction provided.

D&D Tailgate Meeting will have an attendee list as follows:

1. Worker/Crew Supervisor – Chair
2. All Hall Worker/Crew Members
3. Safety Team Member
4. Other as required such as: engineers, System Managers, specialists, etc.

The standing agenda for the meeting will be:

1. Step through the WPC "Job Site/Tailgate Meeting Checklist & Attendance" (see Appendix D)
2. Review the work accomplished on the previous day/shift - this will include the identification and discussion of what went right, what went wrong, and how safety and efficiency may be optimized for today's tasks
3. Describe the work tasks for the day/shift - this may include the review of procedures, drawings, equipment required, other support documentation, and discussion with system managers or engineers, etc.
4. Review the JSA or procedure for this day/shift's activity

Other Workers: Facilities workers, contractors, and all other personnel that will work in the IR-Hall will be required to be represented by their supervisor (UTR in some cases) at the Daily Coordination/Safety Meeting. These supervisors will then conduct Tailgate Meeting for their direct employees. All work in the hall shall be approved & released by the Program Manger at the Daily Meeting and further released by a supervisor in a Tailgate Meeting. All workers must be authorized as documented in a signed JSA or procedure signed by their supervisor.

Representative WPC forms are in the Appendices. The most recent forms may be found on the WPC website:
https://www-internal.slac.stanford.edu/user/eshdev/draft-wpc/

6 Summary Hazard Analysis

A summary *Disassembly and Disposal Hazard Analysis* will be developed and attached as Appendix E. The Analysis looks afresh at salient portions of previously-issued safety documents like the *BaBar Safety Assessment Document*, the *BaBar Fire Hazard Analysis*, and safety plans for earlier major upgrades, interventions and maintenance periods. This analysis will cover both conventional and unique hazards specific to the planned D&D activities. In addition the BaBar Safety web page will be updated to remain applicable. All of these documents as well as other useful safety related material is contained or linked at this page.

Intended to cover the safety of the detector design and operation, the role of the BaBar Safety Assessment Document (https://www-internal.slac.stanford.edu/ad/addo/toc/010-3X_Safety_Current/[023-302TP-000_BABARSAD]/[023-302TP-000_BABARSAD]Text_R000.pdf) and Fire Hazard Analysis (https://www-internal.slac.stanford.edu/ad/addo/toc/010-3X_Safety_Current/[023-302TP-000_BABARSAD]/[023-302TP-000_BABARSAD]FHA_R000.pdf) are nonetheless important references to any work occurring in IR-2. Safety issues addressed in these documents include cryogenic, magnetic, electrical, and flammable gas systems and their associated hazards that must be systematically decommissioned before other tasks can begin. Fire detection and prevention systems like the extant Very Early Smoke Detection Apparatus (VESDA) will remain operative as long as possible during disassembly.

A list of hazardous materials with estimated quantities will be developed as part of the Summary Hazard Analysis in Appendix E.

7 D&D Specific Safety Training

7.1 BaBar Specific Training

As we have done during all major interventions we will provide safety briefings that are applicable to the unique issues relevant to this D&D activity. These safety briefings are mandatory for anyone planning on performing work in IR-2, as in the past translators will be provided for foreign collaborators if needed. Appendix G contains an outline for this briefing.

7.2 Safety Team Members

An indoctrination session for new Safety Team Members will be provided as required. Subjects covered will include: an overview of the detector construction and safety systems, a review of this safety plan, a discussion of the safety problems we have had in the past, a tour of the IR-Hall, and an introduction to BaBar Management. Also covered will be the time commitment, scheduling logistics, the preferred method to communicate issues, and the expectation regarding the system to discipline personnel.

8 Access Control

Omnilocks have been installed on all doors to the exterior of the IR-2 facility including tunnel entrances. Security has only provided access codes to those people with a need to access this area. The D&D Program Manager and Safety Team Leader are in control of this list.

9 Management Inspections

9.1 PPA Associate Laboratory Director

PPA conducts Line-management and ES&H Compliance Assessments of BaBar at least annually as required in the *SLAC ES&H Manual* Chapter 33, "Line Management Self Assessment." Additionally, PPA conducts ALD walkthroughs, building manager inspections and AHA reviews at least annually or before changes in operation. A PPA safety coordinator documents all walkthroughs in SMART and records findings in CATS. It is planned that the PPA ALD will inspect the D&D operations on a routine and regular basis.

9.2 ES&H Division

It is anticipated that all groups in the ES&H Division will be called upon to support this program. The ES&H division has assigned a liaison to BaBar D&D and has provided and will continue to provide oversight assistance for crucial activities. ES&H subject matter experts will also be utilized on a routine basis to assist with specialized hazards such as beryllium.

9.3 DOE Site Office

A DOE Stanford Site Office liaison frequently visits D&D activities and Daily Coordination/Safety Meetings. Furthermore, the Site Office has committed to a formal inspection of the IR Hall biannually.

9.4 BaBar D&D Program Manager

The D&D Program Manager conducts the Daily Coordination/Safety Meetings and routinely and regularly walks the IR Hall with the Building Manager, Engineering Manager, and Safety Team Leader.

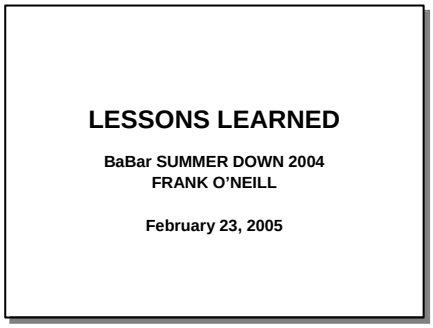
10 Incident Reporting

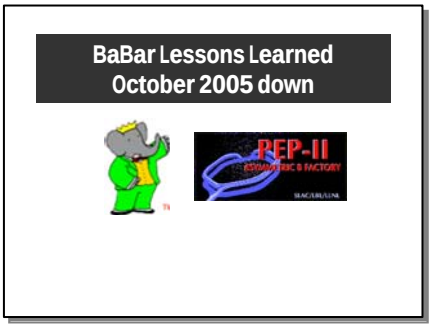
PPA formally participates in the SLAC-wide Lessons-learned program by regularly reviewing the SLAC Lessons-learned database (see https://slacspace.slac.stanford.edu/sites/esh/cgs/ll/default.aspx) for extent-of-need inside the Directorate. A PPA safety coordinator forwards applicable lessons to personnel responsible for similar systems, activities, or work environments. Responses from the PPA Directorate to each lesson are recorded in the Database.

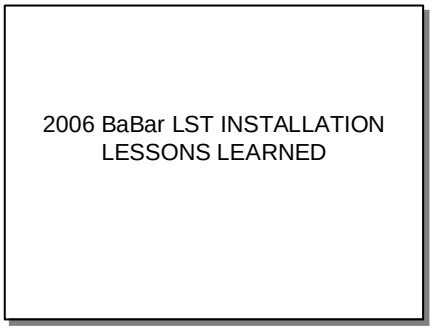
The Directorate also formally participates in the SLAC Close-call Reporting Process to collect and share information on incidents that could have resulted in an injury, property damage, or release to the environment, thus allowing SLAC to identify and trend conditions that aid in the prevention of similar occurrences. See http://www-group.slac.stanford.edu/esh/concerns/close_calls/ for more information of the Close-call Program.

APPENDIX A - LESSONS LEARNED

This appendix contains a compilation of the lessons learned power point presentations for the major interventions from 2004, 2005, and 2006. This material will be used in the D&D safety briefing and will be reviewed from time to time in appropriate meetings.







Presentations available at the following hyperlinks:

2004 Lessons Learned

http://www.slac.stanford.edu/BFROOT/www/Organization/Babar_Safety/D&D_Documents/LESSONS_LEARNED_2004.pdf

Oct2005 Lessons Learned

http://www.slac.stanford.edu/BFROOT/www/Organization/Babar_Safety/D&D_Documents/Oct2005_LessonsLearned.pdf

2006 Babar 1 LST Installation Lessons Learned

http://www.slac.stanford.edu/BFROOT/www/Organization/Babar_Safety/D&D_Documents/2006%20BaBar%201%20LST_INSTALLATION_LESSONS_LEARNED.pdf

APPENDIX B – WPC: WIP FORMS

WIP FORM

Part 1: Scope of Work

Activity Title:_____ _____ Date Submitted: _____
Location: _____ WPC/SOW #:_____ Dept Tracking No. _____
Requestor: _____ Phone No: _____ Organization: _____
Proposed Start Date: _____ Required Completion Date: _____
Responsible Line Manager: _____Phone No: _____
Activity Planner: _____Phone No: _____
System Affected: _____
Work Scope: _____
_____
General Comments/Potential Safety Issues: _____
_____

Part 2: Work Planning Review & Concurrence, Hold Points

Reviewed			*Review Completed & Date*	*Check If Hold*
Y	*N/A*			*Points*
Identified				
☐	☐		_____	☐
☐	☐		_____	☐
☐	☐	ESH Review	_____	☐
☐	☐	Quality Assurance	_____	☐
☐	☐	Area Manager	_____	☐
☐	☐	Other (specify)	_____	☐

Part 3: Supporting / Executing Individuals/Groups

Part 4: Permits , Plans & Safety Controls

Reviewed			*Review Completed & Date*	*Check if Hold*
Y	*N/A*			*Points Identified*
☐	☐		_____	☐
☐	☐		_____	☐
☐	☐		_____	☐
☐	☐		_____	☐
☐	☐		_____	☐
☐	☐	Other (specify)	_____	☐

Part 5: Work Authorization

Authorization to Proceed: _____ Date: _____
(Responsible Line Manager)

ACTIVITY TITLE: _____

Basis for Planning:
This supporting information identifies hazards, associated mitigation actions and defines the sequential work steps necessary to complete this task. All staff involved in this task are to completely review this checklist prior to performing any work. If there are questions immediately contact your supervisor. If any activity can not be performed as detailed by this checklist, stop the activity and report to your supervisor.

Part 6: Job Hazards, Hold Points

Reviewed			*Review Completed & Date*	*Check if Hold*
Y	*N/A*			*Points Identified*
☐	☐	Vacuum	_____	☐
☐	☐	High Voltage	_____	☐
☐	☐	Pneumatics	_____	☐
☐	☐	LCW	_____	☐
☐	☐		_____	☐
☐	☐		_____	☐
☐	☐	Other (specify)	_____	☐

Part 7: Procedure Details / Attach signed JSA or procedure authorizing hands-on work

1.0 **Equipment:**

2.0 **Job Site Preparation:**

3.0 **Procedure:**

Part 8: Lessons Learned & Closeout

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Work Accepted: _____ Date: _____
(Responsible Line Manager)

Supporting information

Hazards to consider

Hazards Requiring Permits / Special Authorization
○ Asbestos/Man-Made Mineral Fibers Class I: asbestos operations and activities involving the removal of friable asbestos, thermal systems installation (TSI) and surfacing ACM and PACM Class II: asbestos operations and activities involving the removal of ACM which is not friable asbestos, TSI or surfacing material, such as floor tiles, wallboard, and transite board Class III: construction, repair and maintenance activities where ACM is likely to be disturbed Class IV: maintenance and custodial activities during which personnel contact ACM and PACM
○ Beryllium (In the form of copper alloy, as beryllium oxide ceramics, in pure form, in mixed metal alloy. Note any operation that may result in beryllium dust)
○ Confined Space
○ Electrical Work
○ Excavation/penetration (includes trenching & shoring)
○ Hoisting and Rigging
○ Lead
○ Radiological Work
○ Welding/burning/hot work
○ Waste Storage or Disposal

Physical Hazards
○ Atmospheric issues – Oxygen (enriched – deficient)
○ Boiler. Pressure Vessels, Relief Valves
○ Compressed Gas
○ Cryogenic Work
○ Elevated Work: Ladders, Scaffolds, Stairways

○ Ergonomic Conditions (Contact, Stress, Vibration, Repetitive Motion
○ Flammables
○ Lasers
○ Low Clearance
○ Magnets
○ Manual Lifting
○ Noise
○ Non Ionizing Radiation
○ Obstructed Access/Egress
○ Power Equipment
○ Thermal Sources
○ Unguarded Equipment
○ Mobile Equipment & Cranes

Chemical Hazards
○ Chemicals
○ Hazardous Waste

Biological Hazards
○ Cooling tower and Legionella
○ Insects/ animals/ wildlife/ parasites
Other Hazards
○ _____
○ _____
○ _____
○ _____
○ _____

Hazards & Controls (Reference E-Tool for required permits and plans)

Hazard	Controls to consider
○ Asbestos/Man-Made Mineral Fibers ☐ Class I: asbestos operations and activities involving the removal of friable asbestos, thermal systems installation (TSI) and surfacing ACM and PACM ☐ Class II: asbestos operations and activities involving the removal of ACM which is not friable asbestos, TSI or surfacing material, such as floor tiles, wallboard, and transite board ☐ Class III: construction, repair and maintenance activities where ACM is likely to be disturbed ☐ Class IV: maintenance and custodial activities during which personnel contact ACM and PACM	Asbestos/Man-Made Mineral Fibers ☐ Class I: SLAC personnel are prohibited from performing Class I work & from entering any area where Class I work is being performed. Only asbestos subcontractors may perform this work. ☐ Class II: May only be performed by trained & qualified SLAC personnel or asbestos subcontractors, under supervision of the asbestos program manager (APM). If there is potential for exposure above 0.1 fibers/cc, work must be performed by asbestos subcontractors. SLAC personnel must have JSA approved by APM. ☐ Class III/IV: SLAC personnel must have a JSA approved by their supervisor & a Class II supervisor. ☐ Notify CGS due to potential for regulatory notifications
○ Beryllium (In the form of copper alloy, as beryllium oxide ceramics, in pure form, in mixed metal alloy. Note any operation that may result in beryllium dust)	Beryllium ☐ IH approval required [Address as appropriate, warnings, surveys, PPE, Med Surveillance, Waste]

○ Confined Space	Confined Space ☐

○ Electrical Work	Electrical Work ☐ Lockout/Tagout ☐
○ Excavation/penetration (includes trenching & shoring)	Excavation/Penetration ☐ Covers for open pits/ Traffic Plates/ Access ladders/Barriers ☐ Signs or Markings ☐
○ Hoisting and Rigging	Hoisting & Rigging ☐ Traffic Control ☐
○ Lead	Lead ☐
○ Radiological Work	Radiological ☐
○ Welding/burning/hot work	Hot Work ☐
○ Waste Storage or Disposal	Waste Disposal ☐

Physical Hazards	Potential Controls (may not be all-inclusive)
◯ Atmospheric issues – Oxygen (enriched – deficient)	☐ Atmospheric monitoring ☐ Non-sparking tools and equipment ☐ Respiratory protection ☐ Ventilation
◯ Boiler. Pressure Vessels, Relief Valves	☐ Design to ASME code ☐ Inspection of vessels ☐ Labeling and other markings
◯ Compressed Gas	☐ Regular inspection (flammable of toxic gases) ☐ Securing cylinders ☐ Secondary containment ☐ Segregation of incompatible gases ☐ Transportation of cylinders
◯ Cryogenic Work	☐ Engineering controls ☐ Face shield ☐ Gloves ☐ Guard against air (oxygen) collection in cryogenic reservoirs
◯ Elevated Work • Ladders • Scaffolds • Stairways	☐ Engineering controls ☐ Face shield ☐ Gloves ☐ Fall Protection Plan

◯ Ergonomic Conditions (Contact, Stress, Vibration, Repetitive Motion	☐ Diversify activities ☐ Evaluation of work posture /positioning ☐ PPE ☐ Stretch breaks/ exercises ☐ Special Tools (Lifts, etc.)
◯ Flammables	☐ Approved storage units ☐ Compatibility of flammable compounds ☐ Fire extinguisher ☐ Grounding for transfers
◯ Lasers	☐ PPE ☐ Interlocks ☐ Barriers/Curtains/Beam Stops ☐ Laser Safety Officer
◯ Low Clearance	☐ Engineering controls (guards) ☐ Signs or other markings
◯ Magnets	☐ Signs or other markings
◯ Manual Lifting	☐ Lifting aids ☐ 2-Person Lift/ proper lifting techniques ☐ Diversity of activities
◯ Noise	☐ Dampening ☐ Engineering controls ☐ Hearing protection (plugs or muffs) ☐ Medical testing ☐ Workplace monitoring
◯ Non Ionizing Radiation	☐ Signs or other markings

◯ Obstructed Access/Egress	☐ Alternative exits ☐ Signs or Markings
◯ Power Equipment	☐ Engineering controls ☐ Face shield ☐ Gloves
◯ Thermal Sources	☐ Signs or Markings
◯ Unguarded Equipment	☐ Add Guarding ☐ Other physical barriers ☐ Signs or Markings
◯ Mobile Equipment & Cranes	☐ Roll-over protection ☐ Anti-Two-blocking

Chemcial Hazards	**Potential Controls** (may not be all-inclusive)
◯ Chemicals	☐ Physical controls • Gloves • Respiratory protection • Face shields • Aprons/ lab coats • Safety glasses / Chemical goggles • Suitable shoes ☐ Administrative controls • Work place monitoring • Medical monitoring • Eyewash/safety shower ☐ Engineering Controls • Ventilation
◯ Hazardous Waste	☐ Chemical substitutions ☐ PPE

	☐ Workplace monitoring

Biological Hazards	Potential Controls (may not be all-inclusive)
○ Cooling tower and Legionella	☐ Physical controls • Gloves • Respiratory protection • Safety glasses / Chemical goggles • Suitable shoes ☐ Administrative controls • Work place monitoring • Medical monitoring
○ Insects/ animals/ wildlife/ parasites	☐ Insect spray ☐ PPE

Other Hazards	Potential Controls
○ _____a	☐ Additional Controls (Specify) •
○ _____a	☐ Additional Controls (Specify) •

APPENDIX C – WPC: JSA FORMS

Job Safety Analysis

JOB/ACTIVITY TITLE: Page of			DATE: New Revised
DEPARTMENT/GROUP NAME	BLDG LOCATION(s):	PREPARED BY:	JSA DURATION IN DAYS, WEEKS OR MONTHS: (NOT TO EXCEED 12 MONTHS)
Scope of Work (Activity Description), including boundary conditions as appropriate			
REQUIRED PERSONAL PROTECTIVE EQUIPMENT			

Basic Job Steps	Potential Hazards	Controls (engineering, procedural or PPE)

Job Safety Analysis (continued)

Basic Job Steps	Potential Hazards	Controls (engineering, procedural or PPE)

Worker Name (please print)	Signature	Date

I have reviewed the steps, hazards & controls described in this JSA with all workers listed above.

Supervisor Name	**Signature**	**Date**

Workers authorized as outlined below to perform Job/Activity as described; all ESH training must be up-to-date:

1. in your regular work area without additional coordination, or
2. outside your regular area with Bldg/Area Mgr notification & subsequent Release To Proceed, or
3. in support of a project outside your regular area and after you or your supervisor/team lead attend routine field level meetings and receive Release To Proceed for the duration agreed to at the meeting.

APPENDIX D – WPC, Tailgate/Coordination Meeting Checklist

WPC, Tailgate/Coord. Meet cklist

- ☐ Record personnel attending Meeting

Each UTR, supervisor or group lead:

- ☐ Discuss the overall objectives and technical goals of the activity and identify number of workers for each task
- ☐ Discuss what could go wrong, and how to avoid such issues. Include activity and area specific hazards, controls, preventative measures and bounding conditions for each task
- ☐ Specify hold points, sign-offs, or notifications and approvals that are required
- ☐ Discuss coordination requirements between
  - Other work groups in the area – identify if their activities create a hazard for your work crew, and visa versa.
  - Subject matter experts who may be required to monitor, collect samples, etc.
  - Other work groups providing outside services for a subtask (for example: coordinate with riggers to lower material into the tunnel, contact electricians to show zero voltage verification, request Fire Marshall to inspect and approve hot work permit)

Meeting Leader:

- ☐ Discuss lessons learned from previous similar work
- ☐ Confirm all permits, plans, procedures, and authorizations are complete
- ☐ Ask the attendees if they see any issues that were not identified
- ☐ Ask the attendees if they understand their assignments, have any concerns or questions.
- ☐ Specify the requirements for new people to "join the work crew"
- ☐ Remind attendees that any significant change in scope of work must be thoroughly evaluated prior to continuing.
- ☐ Remind attendees of their right to stop any work they feel is unsafe.
- ☐ Remind attendees of emergency response requirements:
  - Call 911 to report life-threatening injuries, smoke, fire or large hazardous material releases.
  - Contact UTR, supervisor, or SLAC sponsor for non-life-threatening injuries or facilities/ equipment damage
- ☐ Complete contact information sheet and post at job site, or appropriate common location
- ☐ Grant "Release to Proceed"

_____

Meeting Leader Date

Contact Information

Contact information for today's activity-level work

Person in Charge (Print Name)

_____

Phone _____ **Pager** _____ **Email** _____

Area or Building Manager (Print Name)

_____

Phone _____ **Pager** _____ **Email** _____

Work Group Supervisor (Print Name)

_____

Phone _____ **Pager** _____ **Email** _____

Work Group Supervisor (Print Name)

_____

Phone _____ **Pager** _____ **Email** _____

Work Group Supervisor (Print Name)

_____

Phone _____ **Pager** _____ **Email** _____

Work Group Supervisor (Print Name)

_____

Phone _____ **Pager** _____ **Email** _____

APPENDIX E – BaBar D&D SUMMARY HAZARD ANALYSIS

BaBar Disassembly and Disposal Summary Hazard Analysis

1 INTRODUCTION

This Hazard Analysis concerns the disassembly and disposal (D&D) of the BaBar Detector. It addresses hazards anticipated in the baseline operation schedule extant at the time of writing. The hazards listed in this analysis will be modified and updated as activities and circumstances progress.

The BaBar Detector is a high-energy physics experiment located on the PEP-II ring in SLAC's IR-2 building. The major systems include: a Silicon Vertex Tracker (SVT), a Drift Chamber (DCH), a particle identification system – Detector Internally Reflected Cherenkov light (DIRC), a CsI electromagnetic calorimeter (EMC), a magnet with an Instrumented Flux Return (IFR), and associated data collection systems. Detailed description of these systems and the associated hazards and controls are contained it the BaBar Safety Assessment Document. Detector operations ceased in Spring 2008. See http://www-public.slac.stanford.edu/babar/ for more information on BaBar.

It is expected that BaBar will be decommissioned and disassembled over a three-year period beginning fall of 2008 by SLAC Particle Physics and Astrophysics (PPA) personnel and workers from external institutions having responsibility for the various subsystems. Work will commence under the direction of a Program Manager, Chief Engineer, and mechanical and systems engineers, many of whom were involved in constructing the experiment.

1.1 Purpose and Scope

The purpose of this Hazard Analysis is to evaluate activities for hazards encountered during the various phases of D&D and to evaluate adequacy of general operational and support procedures used to eliminate, control, or abate identified hazards. Hazards capable of causing injury to personnel, damage to the environment, or damage to critical hardware have been considered in this analysis. In addition, the Work Planning and Control process, including Work Integration Plans and Job Safety Analyses (see Appendices B and C) will be used to assess and abate hazards identified at the worker level during the D&D process itself, and to assess risk and establish controls for hazards associated with activities peripheral to D&D such as material disposition and transport offsite.

The Hazard Analysis will identify and evaluate hazards resulting from the implementation of general D&D operations or tasks considering the following criteria:

1. Planned configuration and/or state of the Detector, PEP components, and IR Hall at each major phase

2. Facility interfaces

3. Planned D&D environments

4. Supporting tools and other peripheral equipment;

5. The general task sequence

6. Applicable personnel safety and health requirements

7. Potential for untoward events such as fire or earthquake

The Hazard Analysis will identify the safety requirements needed to eliminate or control identified hazards or to reduce the associated risk to an acceptable level. The analysis identifies the following:

1. Conventional hazards generally associated with heavy industrial operations

2. Unique hazards associated with the detector, the IR hall, and the support systems

3. Requirements for safety devices and equipment, including personal protective equipment

4. Warnings, cautions, and special emergency procedures such as access, egress, fire watches, and rescue

5. Requirements for packaging, handling, storage, transportation, maintenance, and disposal of hazardous materials

6. Requirements for safety training and personnel certification

1.2 System Safety

The methodology of System Safety Engineering will continue to be applied in this final phase of the BaBar Program. System Safety is the application of engineering and management principles, criteria, and techniques to optimize all aspects of safety within the constraints of operational effectiveness, time, and cost throughout all phases of the system lifecycle.

2 HAZARDS AND ANALYSIS

The general hazards associated with BaBar D&D are listed below:

Hazards Conventional:

- Slips/trips/falls
- Falls from height
- Drop or collision of equipment

- Struck/crushed by object
- Electric shock and arc flash
- Fire
- Exposure to hazardous material
- Extreme noise exposure
- Earthquake

Hazards Unique BaBar D&D:

- Cryogenics
- Flammable Gases
- Hazardous Material – Thallium doped Cesium Iodide, Beryllium,
- Complex Rigging – load transfer operations
- Magnetic Field
- Seismic
- Pressure
- Oxygen deficiency
- EMC CsI-crystal degradation by exposure to water

3 MAJOR D&D ACTIVITIES

In general, BaBar D&D entails removal of the BaBar Detector and associated equipment from IR-2 and its immediate environs. Phases of this task include (not necessarily in this sequence):

- Removal of external BaBar electronics; roll back of the entire Electronics House
- Removal of muon shield and associated supports
- LST, RPC, and brass removal from the flux return steel
- Support-tube/SVT decoupling from PEP-II and removal
- Removal of forward magnets, supports and raft
- Removal of backward-end raft and magnets
- Removal of the forward- and backward-end detector doors
- Removal of personnel walkways and stairs on and around the detector
- Removal of solenoid cryogenics systems
- Detector rollout to its “assembly” position on the east side of the Hall
- Drift Chamber removal
- Removal of the DIRC and quartz bar assembly and possible preservation for reuse
- Solenoid removal and preservation
- EMC Barrel and Endcap removal and preservation for possible reuse
- Disassembly and removal of IFR and structural steel and preservation for possible reuse

A detailed schedule for all work is maintained by the D&D chief engineer.

4 HAZARD ANALYSIS

Hazard Assessment Process

The hazard assessment process is a principal factor in the understanding and management of technical risk. Hazards are identified and resultant risks are assessed by considering probability of occurrence and severity of consequence. The risk assessments identified in the hazard matrix assume the hazard controls/mitigations are in place."

Hazard Severity Categories
Severity is the assessment of the worst potential consequences, defined by degree of injury or property damage, which could occur. There are four categories of hazard severity: Class I, Catastrophic; Class II, Critical; Class III, Marginal; and Class IV, Negligible. The table below depicts these categories and provides a general description of the characteristics that define the worst case potential injury or system damage if the identified hazard were to result in an accident. These categories are derived from MIL-STD-882D, Standard Practices for System Safety.

Hazard Probability Categories
Probability is the likelihood that an identified hazard will result in a mishap, based on an assessment of such factors as location, exposure in terms of cycles or hours of operation, and affected population. There are five levels of probability: Level A, Frequent; Level B, Probable; Level C, Occasional; Level D, Remote; and Level E, Improbable. The table below depicts these levels and provides a general definition for each probability level. These levels are derived from MIL-STS-882D, Standard Practice for System Safety.

Hazard Severity and Probability Categories

Hazard Severity Classification

CLASS	DESCRIPTION	POTENTIAL CONSEQUENCE
I	Catastrophic	Serious impact on- or off-site, causing deaths, major environmental impact, or complete loss of laboratory operation.
II	Critical	Major on-site impact or minor off-site impact. May cause death, severe injury, or severe occupational illness to personnel, major damage to a facility, or minor environmental impact.
III	Marginal	Minor on-site with no off-site impact. May cause minor injury, minor occupational illness, or minor impact on the environment.
IV	Negligible	Will not result in a significant injury or occupational illness, or provide significant impact on the environment.

Hazard Probability Levels

LEVEL	FREQUENCY OF OCCURRENCE	DEFINITION
A	Frequent	Likely to occur frequently. ($X > 10^{-1}$)
B	Probable	Will occur several times in the life of an item. ($10^{-1} \geq X > 10^{-2}$)
C	Occasional	Likely to occur some time in the life of an item. ($10^{-2} \geq X\ 10^{-3}$)
D	Remote	Unlikely, but possible to occur in the life of an item. ($10^{-3} \geq X > 10^{-6}$)
E	Improbable	So unlikely, it can be assumed occurrence may not be experienced.

Mishap Risk Assessment Matrix

SEVERITY PROBABILITY	Catastrophic	Critical	Marginal	Negligible
Frequent	1	3	7	13
Probable	2	5	9	16
Occasional	4	6	11	18
Remote	8	10	14	19
Improbable	12	15	17	20

MIL-STD-882D

Sections 1 – 5 (red): *Unacceptable*
Sections 6 – 9 (yellow): *Acceptable with written senior-management approval*
Sections 10 - 17 (gray): *Acceptable*
Sections 18 – 20 (green): *Acceptable*

Hazard	Causes	Control/Mitigation	Impact	Consequence	Probability	Risk
Fire	Design failure, equipment failure, human error, leaking flammable gas in combination with an ignition source and sufficient oxygen resulting in an explosion and/or fire, electrical short/arcing igniting combustible material, human error resulting in an explosive gas mixture inside the drift chamber, combined with an ignition source, hot work in or near the detector including: welding, brazing, or soldering	Design, fire prevention, detection, automatic response. (See BaBar SAD and FHA) Decommissioning and impairment of fire protection systems (detection/suppression) will only be allowed with approval of the Fire Marshall or his designee. All hot work will require permits in accordance with SLAC ES&H Manual Chapter 12.	Injury, death, materiel damage	Critical	Remote	10
Electrical shock or arc flash	Design failure, equipment failure, human error, failure to follow Control of Hazardous Energy (CoHE) procedures, failure to warn of high voltages	Design safety features and warnings, safety systems, training (See BaBar SAD), comprehensive pre-work system deenergization	Injury, death, materiel damage	Critical	Remote	10
Asphyxiation	Design failure, equipment failure resulting in leaking asphyxiant, personnel error resulting in leaking asphyxiant	Proper design, leak tests, identification of plumbed asphyxiants, use of ODMs/alarms, procedures for disassembly, ventilation, use of SLAC PRCS entry program for work inside the detector, and personnel training. (See BaBar SAD.) Comprehensive pre-work replacement of system gases with air.	Injury, death	Critical	Remote	10
Cryogenics	Design failure, equipment failure, human error, structural failure, overpressurization, or damage to the supply dewars, cryostat, or transfer lines could result in a release of liquid helium.	Comprehensive pre-work removal of cryogens	Injury	Marginal	Improbable	17
Hazardous materials	Design failure, equipment failure, human error	Design safety features, safety systems, training, minimize/eliminate the use of hazardous materials, develop procedures, provide training, comply with the requirements of SLAC HazCom.	Injury	Marginal	Remote	14

Radiation	Design failure, equipment failure, human error, overpressurization of the circulation system, or leakage of the system due to the use of incompatible materials (Teflon pipe joint sealing compound), unauthorized removal and loss of control of radiation source	Design safety features, safety systems, training, provide appropriate design safety factors for the circulation system, provide appropriate pressure relief for the circulation system, establish procedures and pressure monitoring systems as appropriate, leak test the circulation system, establish source security measures, comply with SLAC Rad Safety Program, comply with the SLAC ALARA program. (See BaBar SAD.) Comprehensive pre-work removal of all radioactive materials.	Injury	Marginal	Remote	14
Pressure	Design failure, equipment failure, human error resulting in overpressurization of systems or components	Design safety features, safety systems, training, establish appropriate safety factors for each pressure system, provide appropriate pressure relief for each pressure system, establish procedures and pressure monitoring systems as appropriate. (See BaBar SAD.) Comprehensive pre-work bleeding of pressure systems.	Injury	Marginal	Remote	14
Severe earthquake	Failure of the design to survive the anticipated earthquake, equipment failure, human error, e.g., failure to bolt doors to the barrel or to earthquake brace doors when parked open, earthquake occurring during “higher-risk” time window, e.g., during process of opening doors.	Implement design safety features, safety systems, procedures, and training for earthquake response. Minimize number of personnel in work areas.	Injury, death, materiel damage	Critical	Remote	10
Slips, trips, falls. Falls from height.	Design failure, equipment failure, human error	Design and operate equipment as per SLAC, DOE, OSHA, and manufacturers' requirements, require personnel follow safety rules in SLAC ES&H Manual	Injury, death	Critical	Remote	10

Material handling, including hoisting and rigging	Design failure, equipment failure, human error	Design safety features, safety systems, procedures, training (including H&R Certification, Forklift Driver Certification). Have SLAC Rigging Department perform complex lifts under approved Lift Plans.	Injury, death, materiel damage	Critical	Remote	10
General occupational hazards: cuts, lacerations, sprains, hearing damage	Design failure, equipment failure, human error	Design and operate equipment as per SLAC, DOE, OSHA, and manufacturers' requirements, develop procedures, provide training, require personnel follow safety and PPE rules in SLAC ES&H Manual.	Injury	Marginal	Improbable	17

5 Specific Controls and Mitigations

5.1 Fire (Conventional Hazard)

The detector is equipped with a Very Early Smoke Detection Apparatus (VESDA) that automatically actuates fire alert and controls systems. The SLAC Fire Protection Technicians are responsible for impairment. Deliberate VESDA impairment may be necessary during welding, cutting, and other hot work; the VESDA system itself will be disengaged from the detector as BaBar is disassembled. PPA safety coordinators and the chief engineer will reevaluate and request VESDA impairments as needs arise. All welding and plasma cutting activities are performed under the eye of a fire watch.

PPA safety coordinators will provide briefings for Palo Alto Fire Department personnel that include a tour of the Hall.

5.2 Electrical Shock and Arc Flash

The numerous electrical systems associated with the detector will be deenergized to the extent possible to allow safe work around the systems. Please see the BaBar D&D Utilities Isolation Plan for details.

5.3 Asphyxiation (Unique D&D Hazard)

The BaBar DIRC tunnel is a confined space fit for Alternate Entry as defined in the SLAC ES&H Manual Chapter 6 (See http://www-group.slac.stanford.edu/esh/hazardous_activities/confinedspace/policies.htm.) Entry requirements include training, air sampling, attendant personnel, documentation, and work procedures. All hazardous and non-life-supporting gas systems will be disconnected from the detector before work begins in the tunnel.

5.4 Cryogenics (Unique D&D Hazard)

Cryogenic technicians will disconnect the cryogenics systems feeding the detector solenoid as one of the first steps of decommissioning. No cryogenics will be used during disassembly activities.

5.5 Hazardous Materials

Planned D&D activities will expose workers to a minimum of toxic or reactive materials. The small amounts of nontoxic Fluorinert and mildly toxic antifreeze in chiller systems will need further review as systems such as the EMC will need almost continuous use of coolants. Contact with the thallium doped cesium iodide internal to the EMC should not be possible because the calorimeter will remain sealed. The potential for damage to the beryllium surfaces on the support tube and inner DCH cylinder will need to be assessed.

Open-air exposure of the EMC Crystals. Since these thallium-doped cesium iodide crystals are mildly hygroscopic, and the EMC may be redeployed at another laboratory, exposure to the atmosphere will be controlled to prevent this type of degradation.

Previous damage to the Drift Chamber inner cylinder. This beryllium cylinder was cracked during SVT removal in 2000, prompting costly and time-consuming repair and cleanup operations to prevent human exposure to the highly toxic metal.

5.6 Noise

Some power-tool and material-handling equipment used in the IR Hall is expected to expose workers to high noise levels. Personal protective equipment will be issued to workers as needed to protect worker hearing.

5.7 Radiation

SLAC Radiation Protection personnel do not expect activation of material in the Detector components. A BaBar D&D Material Classification and Control Plan has been developed in order to assure all materials is properly surveyed, classified (hold material, salvage, other) and stored in accordance with pertinent requirements.

5.8 Slips, Trips, and Falls

Good housekeeping and reminders to workers to keep their eyes on where they step will help prevent slips, trips, and falls.

5.9 Falls From Height

Fall protection may be challenging during disassembly since parts of the detector once used as fall-arrest anchor points may be removed or rendered ineffective. PPA will, however, provide fall restraint or arrest for all workers exposed to falls greater than four feet. To meet the ES&H manual requirements for fall protection, a PPA safety coordinator has received certification as a competent person for fall protection who will complete and Elevated Surface Work Plan before such tasks begin. All elevated workers will be trained as Fall Protection *Authorized*.

Until such time as the SLAC ES&H Division provides safety training in use of scissor lifts, all those who operate such lifts are required to read the lift manufacturer's operation manual, show operational proficiency, and have a JHAM (routine or non-routine) for lift operation.

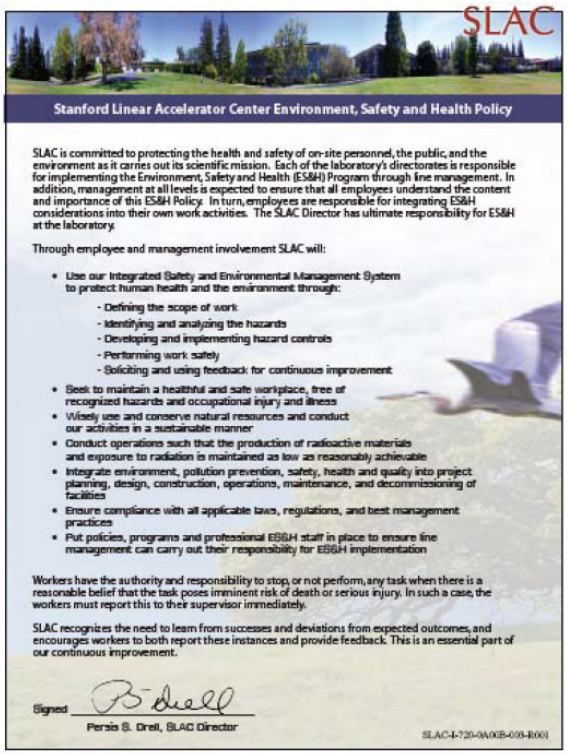
APPENDIX F – BaBar D&D SAFETY ORIENTATION

IR-2 D&D SAFETY ORIENTATION

Sandy Pierson x2686
Joe Kenny ext.-2201

SLAC ES&H Policy

- Use ISEMS
- Healthful & safe workplace
- Sustainable operations
- ALARA
- Integration of ES&H concepts into all phases of operation
- Compliance and Best Management Practices
- Line Management of ES&H
- Identify & stop unsafe activities
- **Learn from successes and deviations from expected outcomes**, and encourages workers to both report these instances and provide feedback



SLAC

Stanford Linear Accelerator Center Environment, Safety and Health Policy

SLAC is committed to protecting the health and safety of on-site personnel, the public, and the environment as it carries out its scientific mission. Each of the laboratory's directorates is responsible for implementing the Environment, Safety and Health (ES&H) Program through line management. In addition, management at all levels is expected to ensure that all employees understand the content and importance of this ES&H Policy. In turn, employees are responsible for integrating ES&H considerations into their own work activities. The SLAC Director has ultimate responsibility for ES&H at the laboratory.

Through employee and management involvement SLAC will:

- Use our Integrated Safety and Environmental Management System to protect human health and the environment through:
  - Defining the scope of work
  - Identifying and analyzing the hazards
  - Developing and implementing hazard controls
  - Performing work safely
  - Soliciting and using feedback for continuous improvement
- Seek to maintain a healthful and safe workplace, free of recognized hazards and occupational injury and illness
- Wisely use and conserve natural resources and conduct our activities in a sustainable manner
- Conduct operations such that the production of radioactive materials and exposure to radiation is maintained as low as reasonably achievable
- Integrate environment, pollution prevention, safety, health and quality into project planning, design, construction, operations, maintenance, and decommissioning of facilities
- Ensure compliance with all applicable laws, regulations, and best management practices
- Put policies, programs and professional ES&H staff in place to ensure line management can carry out their responsibility for ES&H implementation

Workers have the authority and responsibility to stop, or not perform, any task when there is a reasonable belief that the task poses imminent risk of death or serious injury. In such a case, the workers must report this to their supervisor immediately.

SLAC recognizes the need to learn from successes and deviations from expected outcomes, and encourages workers to both report these instances and provide feedback. This is an essential part of our continuous improvement.

Signed _____
Persis S. Drell, SLAC Director

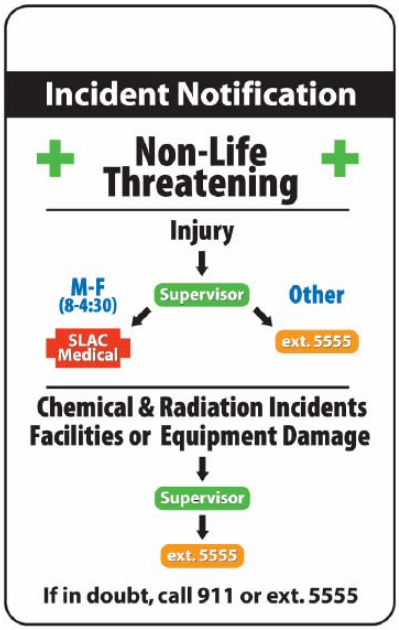
SLAC-I-720-0A00B-000-R001

Incident Notification - Life Threat

- For life threatening incidents, always call 911
  - Examples include: incidents involving severe injuries, significant amounts of smoke, a fire, an explosion or a large release of hazardous materials, dangerous law enforcement situations
- Calling Sequence
  1. 911 will roll emergency responders (Fire & EMS)
  2. ext. 5555 will activate internal response and notification
     - Via mobile phone: 650-926-5555
  3. Your supervisor
- Call from safe location; provide detailed information and where you will meet responders

Incident Notification – Non-Life Threat

- For all Non-Life Threatening incidents:
  - Inform your supervisor first
- For Injuries/Illnesses:
  - During SLAC Clinic hours (8 AM-4:30 PM), report to clinic for treatment
  - After SLAC Clinic hours, call ext. 5555 for instructions from Security on what clinic to go to
- For Non-Life Threatening Chemical or Radiation incidents and Facilities or Equipment Damage:
  - Call ext. 5555; needed to activate internal response, reporting and investigation processes
- **Whenever in doubt call 911 or Security at extension 5555**



4

Access

For safety and anti-theft purposes, all doors to the hall are Omni-locked.

- *If you feel you need an Omni-lock passcode, ask Sandy Pierson, x2686.*
- *Keep passcode to youself*

Work Authorization

SHIFT MEETING ATTENDANCE

*If you supervise work in the Hall, you **must** attend the 0800 (day shift) pre-shift meeting*

Why Work Authorization?

- Informs all of the status of safety provisions (including JSAs & WIPs) extended over multiple shifts
- Tells all of safety (and other) lessons learned
- Allows all working groups to see how their work might impinge on others
- Allows all to see how others' work might affect themselves
- Useful for allocating scarce resources

Work Authorization

JSAs and WIPS

WORK AUTHORIZATION DOCUMENTS

All work will be performed under a

Job Safety Analysis (single group)

or

Work Integration Plan (multiple groups)

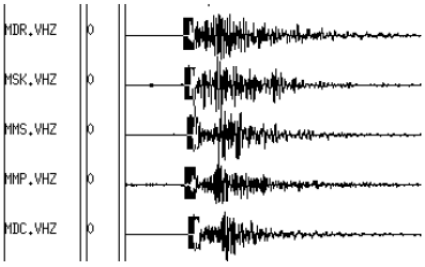
Work Authorization

WORK AUTHORIZATION DOCUMENTS

- *Discuss WIPs and JSAs for your work at the Shift Meeting*
- *Get necessary signatures*
- *File documents in JSA binder in Conference Room*
- *Talk to Sandy, Joe, Frank, or for more details*

Fire

- If you see smoke or hear an alarm, evacuate immediately from nearest exit
- *Only trained people may use fire extinguishers. See me if you would like training.*
- Meet in IR-2 parking lot
- Dial 911 from a SLAC phone, report fire, answer all questions and let them hang up first



Earthquake

- Remain calm
- Move away from windows and falling equipment
- Get under a sturdy desk or table
- If quake was strong enough to knock objects off shelves, then evacuate carefully only after shaking stops
- Report to the IR-2 parking lot
- Do not re-enter building until authorized to do so by BAT or PAFD

Medical Emergency

- Remain calm
- If victim is in contact with energized electrical conductor, DO NOT TOUCH HIM. Disconnect power source.
- Dial 911 from a SLAC phone, report illness/injury, answer all questions and let them hang up first
- You may administer first aid if trained to do so
- Do not alter accident scene
- Send someone to parking lot to help EMTs find victim

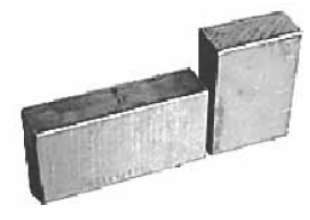
Personal protective equipment

- YOU *MUST* WEAR:
  - Hard hats (provided at most entrances to the IR hall)
  - Steel-toed shoes
  - Safety glasses while grinding, sawing, or soldering
  - Safety vests while working in auto/truck traffic




Personal protective equipment

- Wear gloves while handling sharp or rough metal objects. (Leather is best.)
- See Sandy or Joe if you plan to operate a laser, service lead-acid batteries, use a respirator, or feel you need hearing protection



Lead (Pb)

- If you plan to handle metallic lead (and are not yet trained to do so) contact me at x2201 or 415-596-8137.

FALL PROTECTION

If you plan work within 6 feet of an unprotected edge from which a fall of more than four feet is possible, you must have and *Elevated Surface Work Plan* which will include…

- ***Training***
- ***Documentation***
- ***Work rules***
- ***Inspections***
- ***Protective gear***
- ***Buddy system***
- ***Rescue plan***

Contact Sandy Pierson or Joe Kenny

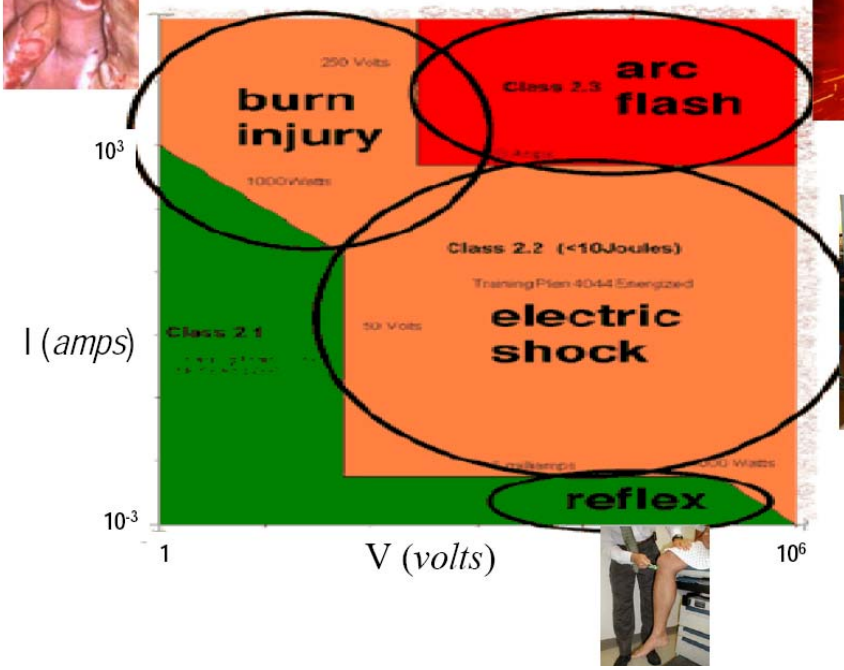
Fall Protection

- Must successfully complete Fall Protection training
- Must complete an ESWP with Joe Kenny (-2201)
- Must attach copy of EWSP to your JSA (and WIP if you have one)

Crane use

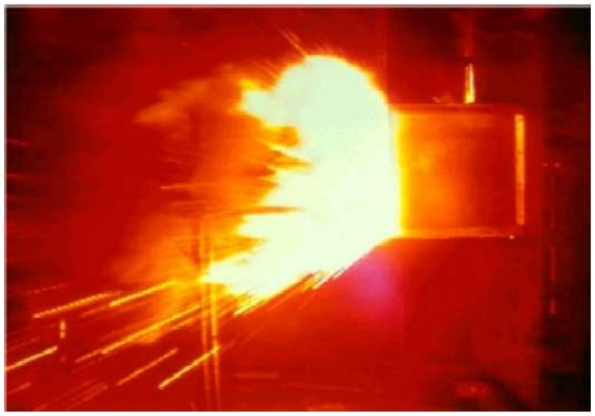
- ***<u>Only explicitly-qualified workers are to use cranes</u>***
- This means **you** are **not** (chances are)

Electrical hazards by I:V



Electrical work controls

- Training
- Approach distances
- PPE
- ELPs
- Locks w/tags
- Barriers



- **In short: Lets the electricians do wall-current work!**

Storage

Do not store items

- In exitways
- In stairwells
- In front of electrical panels

Refrigerator is for food only.

Radiation Surveys

- All material inside the shielded portion of IR-2 will be processed in accordance with the BaBar D&D Material Classification and Control Plan I
- This includes RPFO survey, ID/bar coding, secure storage, salvage where allowed, etc.

DIRC tunnel access

- You must have PRCS Training
- You must have Lockout/Tagout Training
- See me to sign up for both courses

Three strikes

- BaBar Safety Team member or any D&D worker will stop activities where life or health are in imminent danger
- Negative safety behavior will not be tolerated at IR-2
  - 1st offense: **verbal warning**
  - 2nd offense: **Supervisor/D&D Management meeting**
  - 3rd offense: ***exclusion from the IR-2 facility***
- 4 workers were dismissed from IR-2 in 2004 for repeatedly disregarding the rules

The BaBar Safety Team for D&D

Sandy Pierson
-2686

Joe Kenny
-2201

Frank O'Neill
-5300

Don Dains
-4324

Jim Healy
-4989

APPENDIX G – BaBar D&D MATERIAL CLASSIFICATION AND CONTROL PLAN

SLAC MEMORANDUM

RP-RPFO-081028-MEM-01

DATE: 10/28/08

TO: BaBar dismantling group

FROM: Jim Allan, Ray Russ, Amanda Sabourov
Joachim Vollaire, James Liu RP
Leslie Normandin, Property Control

Via Sayed Rokni

SUBJECT: **Babar D and D Material Classification and Control Plan**

Attachment: Drawing

The following is an outline summary of the process controls for the BaBar dismantling project at IR-2. Processes should be planned, locations identified and prepared for storage, and controls in place **before** material is removed from the BaBar IR-2 accelerator housing.

Material identified as DOE moratorium material ("Hold Material") needs to be managed separately from non-hold materials in anticipation that they can be processed out of SLAC in the future with DOE approval. Therefore, it will be important to identify each item, conduct appropriate and complete radiological surveys, and have an item database. In addition, to assist in processing materials when and if they are cleared from DOE moratorium controls, complete records and secured storage locations for "Hold" materials will be necessary.

I. There are 2 main material origin locations from the Babar dismantling:

- **A)** Those materials originating from **outside** the accelerator housing of IR-2 (not designated as a Radiological Area) such as the electronics house (not subject to DOE metal suspension policy), and
- **B)** Those materials originating from **inside** the accelerator housing (a Radiological Area) which technically includes areas behind the concrete wall shielding blocks thus, may be subject to DOE metal suspension policy).

II. The subcategories of non Radioactive materials from location **A** and the process controls are:

1) Items for **reuse at SLAC**
   a) No RP or Property Control involvement unless item has a PC#.
   b) May relocate at will
2) Items for **reuse outside of SLAC**

a) No RP involvement
b) Property Control transfer and export controls possible
c) May store for future shipping outside of SLAC

3) Items whose status is **undetermined**
   a) No RP or Property Control involvement
   b) May relocate

4) Items deemed unusable at SLAC for Property Control **Salvage (not "Hold Material")**
   a) Require Salvage Form completed by originator
   b) RPFO survey and completion of salvage form (except for electronics, computers and furniture which can skip this step)
   c) Transfer to Property Control, (salvage).
   d) Property Control may process outside of SLAC

5) Trash (non-metals and non-hazardous) for **disposal**
   a) No RP or Property Control involvement
   b) May place in trash

6) Items which are **hazardous**
   a) Contact hazardous waste for processing.

III. The subcategories of location **B (Accelerator Housing)** and processing controls are:

1) Items (metal and non-metal) for **reuse at SLAC**
   a) Requires RPFO survey upon removal
   b) Place in designated storage location

2) Items (non-metal and metal) for **reuse** at facilities **outside of SLAC**
   a) Requires a RPFO survey upon removal and documents on standard survey form.
   b) Place in designated storage location.
   c) Suspension metals materials controls ("Hold Materials") prior to transfer:
      1. Material owned by others may be returned.
      2. Material owned by DOE on loan requires a memo of understanding regarding the suspension of materials controls from BaBar and RP.
      3. Material transferred to others from DOE requires a memo of understanding regarding suspension of materials controls from BaBar and RP.
   d) Property Control needs to process any transfers outside of SLAC

3) Items (metal and non-metal) whose status is **undetermined**
   a) Require RPFO survey upon removal
   b) Place in designated storage area
   c) Assign identification number to item and record number
   d) Mark ID number on item

4) Items (metal) for Property Control **Salvage ("Hold Materials")**
   a) Require RPFO survey
   b) Place in designated secured storage location
   c) Assign identification number to item and record number

d) Mark ID number on item in green to signify 'hold'

5) Items (non-metal) for **disposal**
   a) Require RPFO survey
   b) Place garbage in trash
   c) Transfer equipment and materials to Property Control

6) Items which are **hazardous or radioactive materials** (of this part II and III)
   a) Require RPFO survey
   b) Require waste management forms and proper storage
   c) Radioactive material will be relocated to a RAM storage area or transferred to RAMSY once declared as radioactive waste.

IV. The following areas and locations should be established prior to removing materials from the accelerator housing.

1) Large metal items whose status is undetermined
   a) Locate a large area at North Adit for staging
   b) For items needing protection from the elements, inside North Adit

2) Large metal items for Property Control ("Hold Material")
   a) A separate area at North Adit, fenced

3) Small metal items (i.e., bolts) that are Hold Material
   a) Stage 55-gallon drums at IR-2 which will be moved to North Adit when full
   b) Have location at North Adit to place full drums

4) Wire, cables, etc that are Hold Material
   a) Stage grey bins
   b) Have location at North Adit to stage full Bins

5) Radioactive materials
   a) Case by case basis, no predesignated area needs to be established.

V. How to process material originating from Accelerator housing

As material leaves the accelerator housing, the originator shall have a radiological survey conducted by RPFO. RPFO shall survey material with a Ludlum Model 18 with a 1 inch NaI detector and GM detector, such as the TBM model 15 survey meter.

If material is a small metal item or wires, it may go into a staged 55-gallon drum or grey bin located outside of IR-2 marked as "Hold Material."

Non-metal items will be relocated as directed by BBR personnel.

Larger metal items will be assigned an identification number (BBR YRMMDD-###). The item will be entered into a log. The log will have a signature space for RP to sign stating the item is not radioactive based on survey results. Drums and

bins may receive an identification number when full prior to relocation. Any large hold metals not stored in bins or drums should be marked in green.

RP will mark items "OK" YRMMDD" and surveyor's initials/ signature or labeled as not radioactive with surveyors initials/ signature if not radioactive. The item may be relocated to the North Adit after marking.

RP will mark items with **yellow paint** "RAM YRMMDD" and surveyor's initials or labeled with a radioactive material label if radioactive. The item may be relocated to a RAM storage area or RAMSY after marking.

Results of RP surveys may be documented on the BaBar database log with RP surveyors signature and survey results.

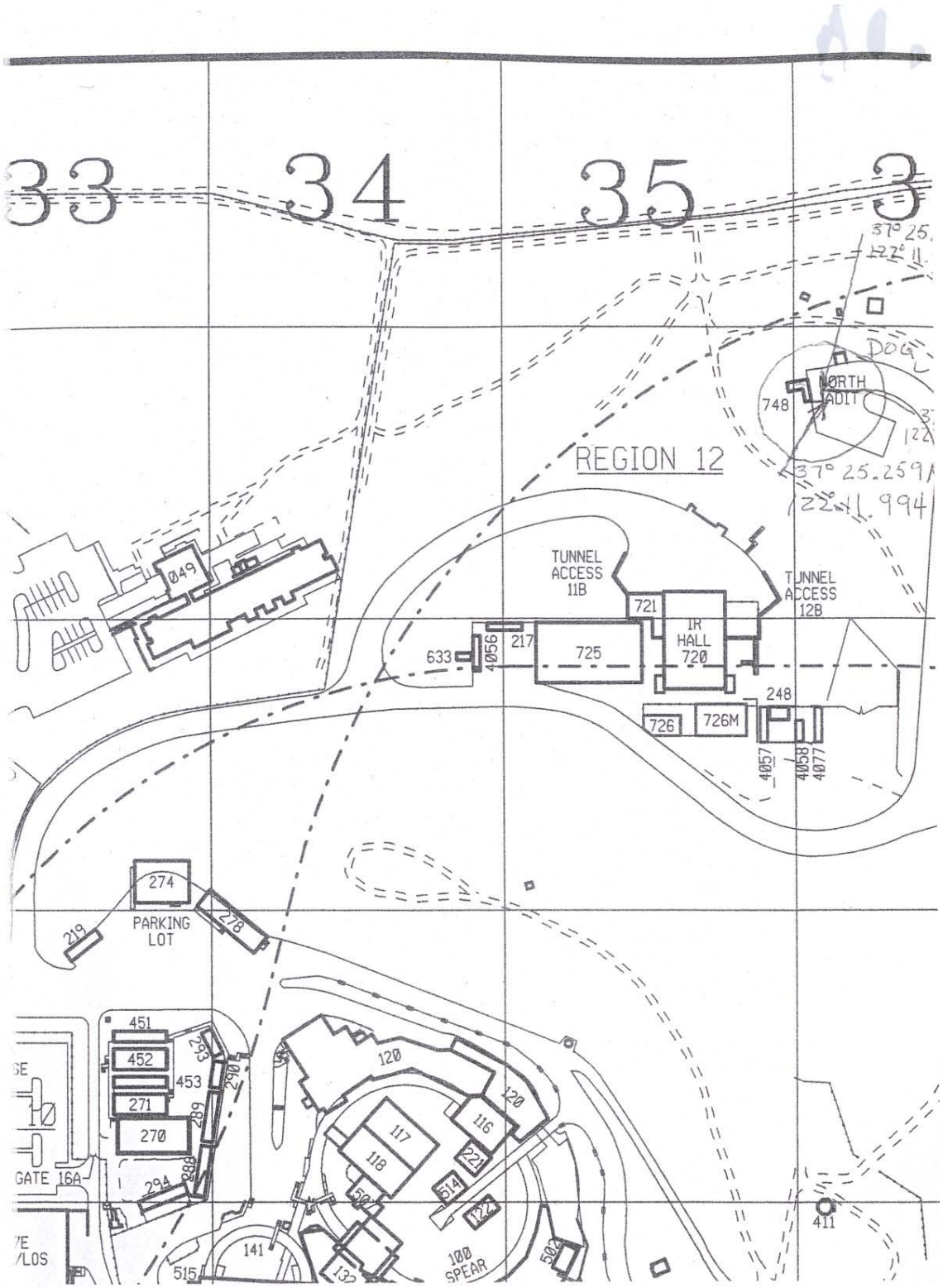
VI. RP Surveys

All items removed from Accelerator housing shall be surveyed on all surfaces using NaI and GM detectors. Items may need to be surveyed away from the Accelerator housing, possibly outside of IR-2 hall but prior to delivery to the storage area. Temporary Radioactive Material Areas may need to be established in a location near IR-2 for material awaiting a RP survey. Large items, if possible, may need to be broken down to smaller parts to perform direct surveys; however, as long as all surfaces are surveyed, this may not need to be performed frequently.

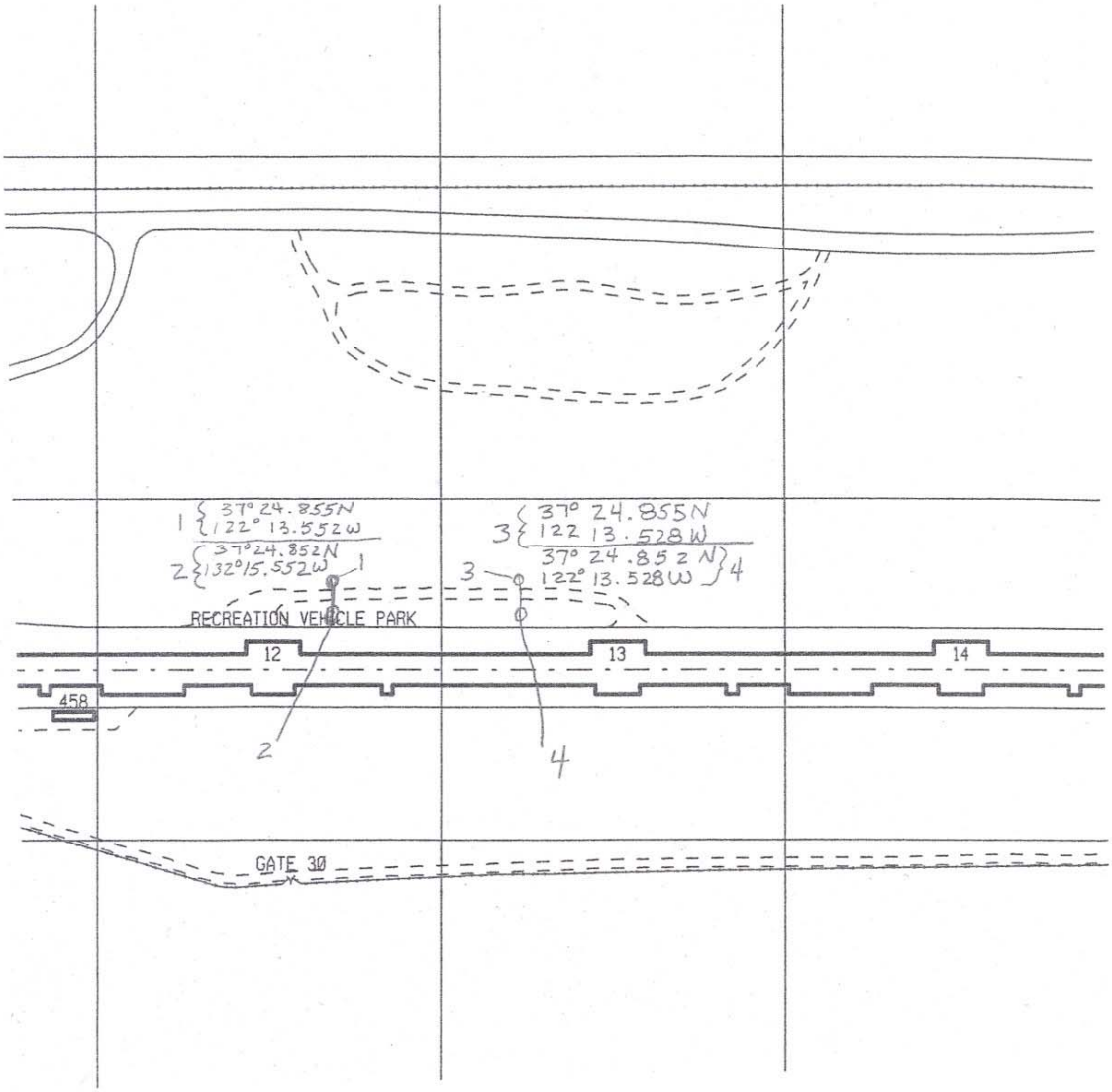
In addition to the surveys mentioned above, RP will acquire samples of critical items for analysis in the RP Radioanalysis Laboratory.

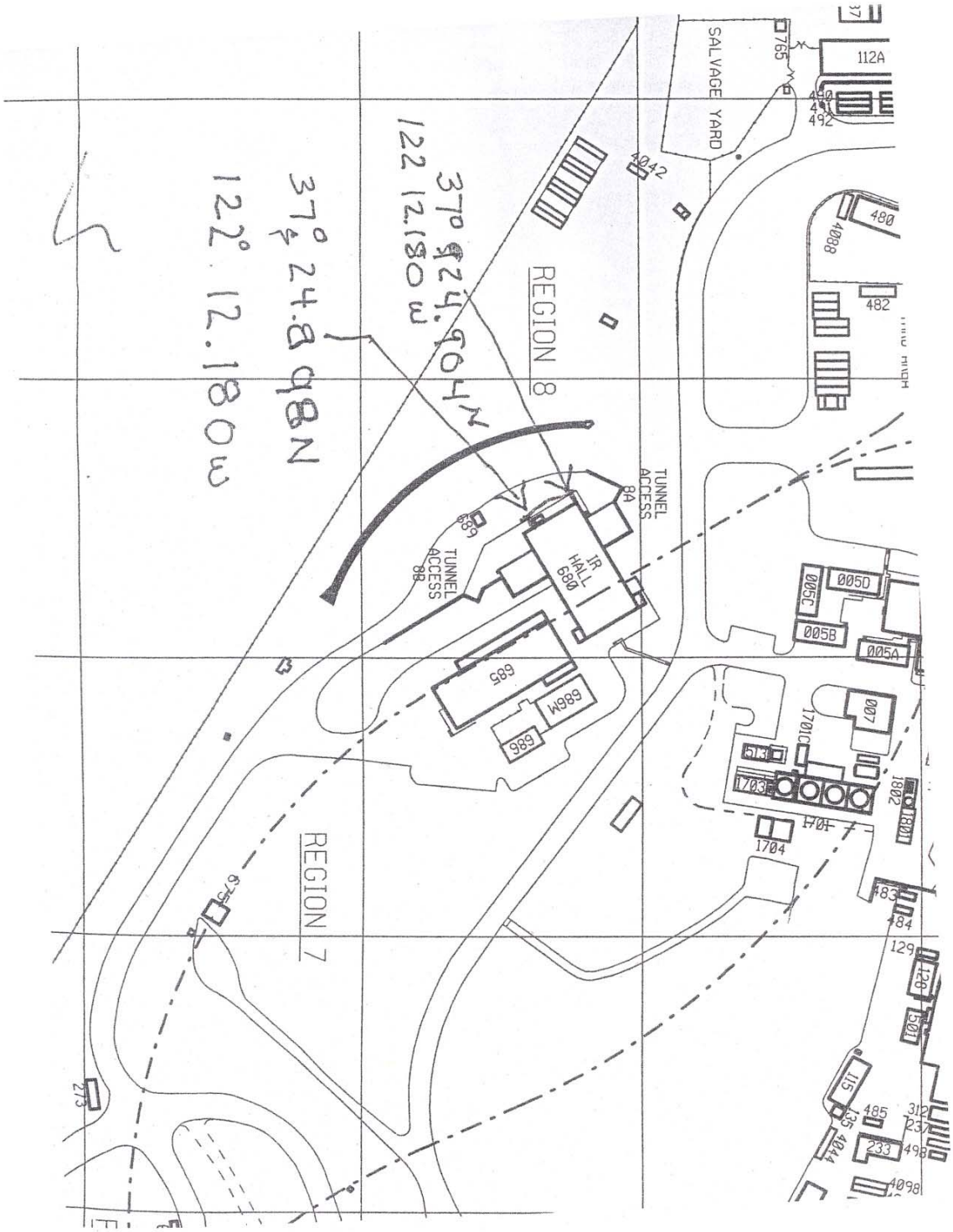
RP will also acquire swipe samples on pre-determined critical items for analysis of Fe-55 isotopes during the course of dismantling.

APPENDIX H – BaBar D&D MATERIAL STORAGE LOCATION MAPS


33
34
35
REGION 12
NORTH ADIT
748
TUNNEL ACCESS 11B
TUNNEL ACCESS 12B
721
IR HALL 720
725
633
4056
217
248
726
726M
4057
4058
4077
049
274
PARKING LOT
219
278
451
452
453
271
270
293
290
289
288
294
120
116
117
118
221
514
122
50
141
515
132
100 SPEAR
502
411
GATE 16A

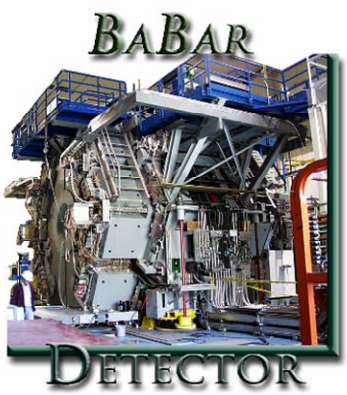
			Office for Sewer Treatment Plant	N OF BLDG. #838
MIDDLE OF BLDG. #188 - SPEAR	217	35-C	Van Group D	W OF BLDG. #725 - IR
MIDDLE OF BLDG. #188 - SPEAR	219	33-D	SSRL IBM Office Trailer	NW OF BLDG. #128
N OF BLDG. #188 - SPEAR	221	34-D	East Pit Control Room	MIDDLE OF BLDG. #188
E OF BLDG. #962 - ESB	222	35-G	ARDB Offices	S OF BLDG. #184
MIDDLE OF BLDG. #188 - SPEAR	223	35-G	ARDB Offices/Shops	S OF BLDG. #184
S OF BLDG. #944 - TEST LAB	224	35-F	Office Area for Bldg #121	W OF BLDG. #121
SW OF BLDG. #127	225	34-F	Ardb Lab	NE OF BLDG. #962 - ES
SW OF BLDG. #835 - PMU	228	31-E	Mechanical Design Offices	W OF BLDG. #214
E OF BLDG. #483	229	31-E	Accelerator Physics Offices	W OF BLDG. #214
S OF BLDG. #962 - ESB	231	34-G	ARDB HV Test Lab	E OF BLDG. #962 - ESB
S OF BLDG. #962 - ESB	233	34-G	Va/Vra Trailer	E OF BLDG. #962 - ESB
E OF BLDG. #148	234	31-E	Cal Tech Office Trailer	W OF BLDG. #214
S OF BLDG. #188 - SPEAR	237	34-F	EFD Trailer	E OF BLDG. #962 - ESB
INSIDE BLDG. #188 - WEST SIDE	238	38-D	SLC Office Trailer	NE OF BLDG. #825 - IR
NE OF BLDG. #962 - ESB	239	31-F	MFD Office Trailer	S OF BLDG. #831 - VAC
E OF BLDG. #962 - SECTOR 30	240	29-E	MFD Office Trailer	E OF BLDG. #838
E OF BLDG. #137W - SSRL LOS	241	27-E	SEM Office Trailer East	S OF BLDG. #835 - PMU
E OF BLDG. #858 - SCS	242	27-E	SEM Office Trailer West	S OF BLDG. #835 - PMU




37° 24.904N
122 12.180 W
37° 24.848N
122° 12.180W
REGION 8
REGION 7
SALVAGE YARD
TUNNEL ACCESS 8A
TUNNEL ACCESS 8B
JR HALL 680
685
686M
686
689
005D
005C
005B
005A
007
1701C
1703
1704
1802
1801
112A
765
4042
480
4088
482
483
484
129
128
105
115
485
233
404
312
237
498
4098
275
675

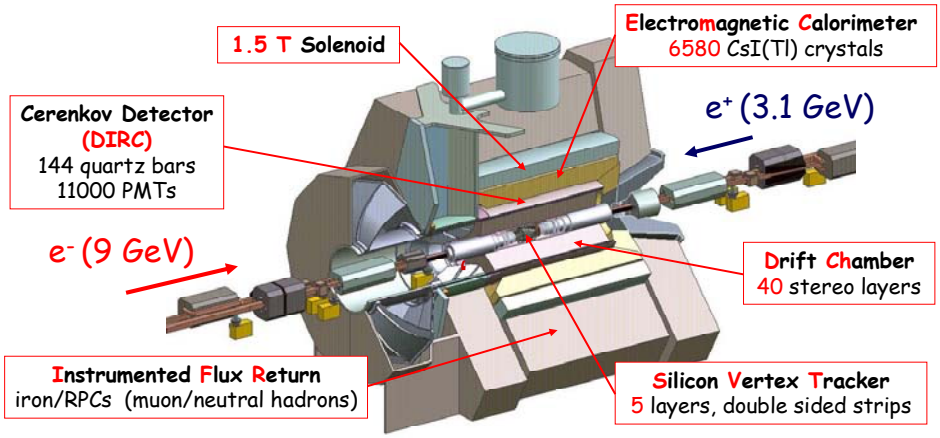
APPENDIX I – Slides from the July 7-9, 2008 DOE PPA Program Review

BaBar Overall D&D Strategy



- Identify the assets
  - Look at reuse potential
- Preserve the assets
  - Minimal maintenance state
- Settle ownership
- Plan & execute the D&D
  - Scope and schedule:
    - Phases and milestones
  - Cost & manpower:
    - Line up the staff

BaBar Detector



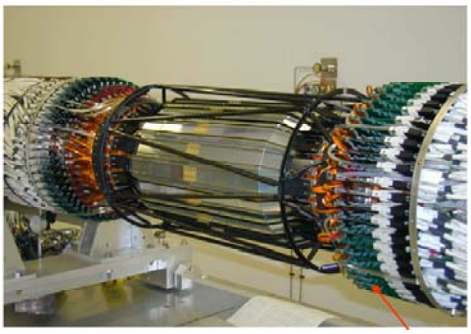
'Ideal'

BaBar Detector Assets

- Identification of assets:
  - Subsystem managers were involved in identifying detector components with long term value.
  - Assets with high value to preserve in the disassembly process, if they have not already been spoken for:
    - Quartz bars from the DIRC.
    - CsI (Tl) crystals from the EMC.
    - Superconducting magnet coil, cryostat and current leads.
- Look at detector disassembly by system from the IP.

BaBar Detector Subsystems: SVT

- SVT located in the support tube that carries the beam line elements closest to IP. Have detailed project plan from removal during the 2002 upgrade campaign. Improved tooling exists.
- Radiation damage sufficient to limit usefulness
- Expected disposition: tests, display.



BaBar Detector Subsystems: DCH

- DCH is supported by the DIRC: remove while the detector is on the beamline. Tooling exists.
  - Expected disposition: display.

BaBar Detector Subsystems: DIRC

- Radiator is synthetic fused silica in long, thin rectangular bars. The material was chosen for its resistance to radiation, long attenuation length, large index of refraction, excellent optical properties. The 144 bars are collected together in groups of 12 in hermetically sealed bar boxes. The bars are a unique resource. If no reuse will store the bars in their bar boxes.
- The Cherenkov photons emerge from the bars into a water filled expansion region, the Stand-Off Box. The SOB is instrumented with ~11000 phototubes whose faces are exposed to water.
- Potential reuse: SuperB
  - Quartz bars and support structure
  - Phototubes and SOB do not have an identified reuse

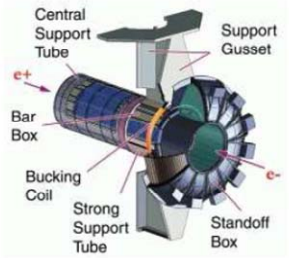
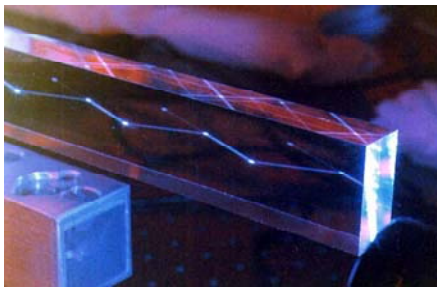
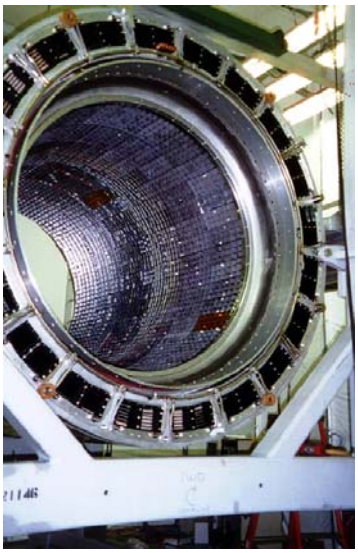


Figure 49. Exploded view of the DIRC mechanical support structure. The steel magnetic shield is not shown.



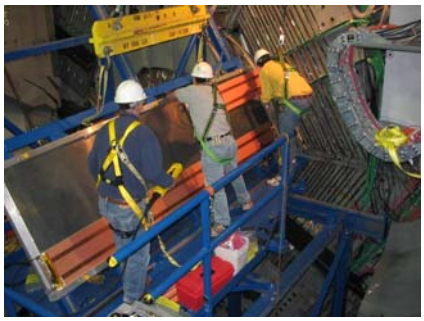
BaBar Detector Subsystems: EMC

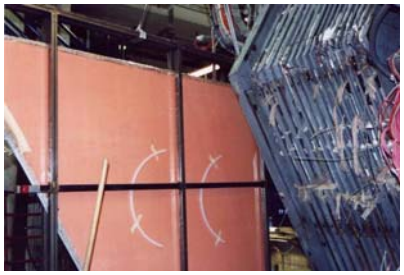
- Consists of 6580 ~4kg CsI(Tl) crystals read out with two photodiodes each. CsI(Tl) is mildly hygroscopic. Crystals are suspended in carbon-fiber support structures mounted in the calorimeter support structures. ~$20-30M asset. Will require dry room construction to store crystals
- Calorimeter is in two parts: barrel portion (most of crystals) and forward endcap. Barrel supports endcap, and is supported off magnet return steel.
- Potential Barrel reuse: SuperB
  - Some endcap crystals may have a home in SuperB. Others would be stored if radiation damage is low enough.



BaBar Detector Subsystems: IFR

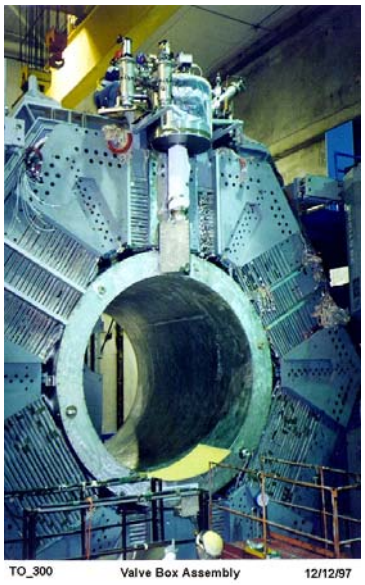
- LSTs: twelve layers of modules in 6 sextants. Six layers of brass installed in gaps formerly occupied by PRCs (increase interaction lengths). These detectors are expected to have minimal aging at the time of cessation of B-Factory operations. No reuse identified.
- RPCs: Forward endcap: 16 layers of chambers (192 gaps), 4 in double modules, with 5 layers of brass; these chambers are being aged by backgrounds—many are at the end of their service lifeBackward endcap: 18 layers of modules (216 gaps) from the initial construction of the detector; the majority of these chambers are in bad shape. Discard.





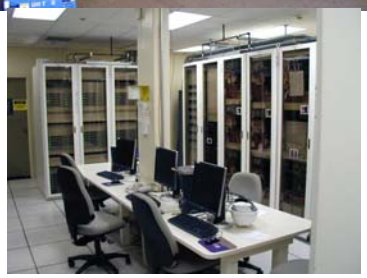
BaBar Superconducting Coil & Steel

- The magnet system is composed of:
  - Superconducting coil in its cryostat, with current leads. This is an asset with long term value.
  - Power supply for the magnet.
  - Cryogen system: pumps, liquifier, dewars and controls. Has long term value, though will be almost two decades old, half its expected service life.
  - Flux return steel (IFR). Has scrap value (pending metals suspension resolution)
  - Potential reuse: coil, cryogenic system, and perhaps steel, can be reused in SuperB



BaBar Electronics Hut

- Electronics hut and contents:
  - Readout electronics: special purpose for BaBar; single board computers are relatively aged, though may have some reuse.
  - Power supplies: some low voltage can be reused ('off the shelf'). HV: supplies are older models, but may be useful to other experiments reaching the end of their lives (and spares) (eg, RHIC experiments); generally useful.
  - Level 3 Trigger compute farm and event builder switches. First glance: move to SCCS.
  - EH not weatherproofed. First glance: discard.
  - BUT!
    - SCCS has power and cooling limitations
    - Reuse compute farm in situ as MC farm
      - Done!
    - Reuse racks and building in corner of IR2; couple provide equivalent of a Sun BlackBox at substantially less cost. This is being considered.



The Minimal Maintenance State

- The goal of the minimal maintenance state is to safely preserve assets for reuse at the lowest cost in preparation for detector disassembly
- A stand-alone version of the monitoring system will be used to track the state of the detector in the MMS. This is in lieu of using the detector full monitoring system, which would require substantial computing professional effort.
  - Most of the steps to the MMS are reversible. However, once the smaller set of channels to be monitored are transferred to the MMS monitoring system, it will be very difficult to return to a state where calibrations, etc., can be run.

The Minimal Maintenance State

2007: expectation

2008: evolution

System	Front-end electronics	Power supplies	Gas	Cooling	Other utilities
SVT	Off	Off	dry air	off, drained	
DCH	Off	Off	dry nitrogen	off	
DRC	Off	Off	dry nitrogen	off, empty	SOB drained, purification system off
EMC	Off	Off	dry nitrogen	fluorinert circulating	water system drained and dried; source system drained
IFR-RPC	Off	Off	dry nitrogen	off, drained	
IFR-LST	Off	Off	dry nitrogen	off, drained	
Trigger	Off	Off	n/a	n/a	
DAQ	Off	Off	n/a	n/a	
Online farm	Off	Off	n/a	n/a	
Safety systems/monitoring/UPS	On	On	n/a	EH cooling on	UPS maintained
Infrastructure	n/a	n/a	n/a	EH cooling on	UPS maintained
Magnet	On	Off	n/a	n/a	vacuum pumps on
IR2 complex	n/a	On	On	On	gas shack limited use

Dry air

Off

On: MonteCarlo farm

Pumps off, Backfill N2

Decommission: remove hazards

Detector Status

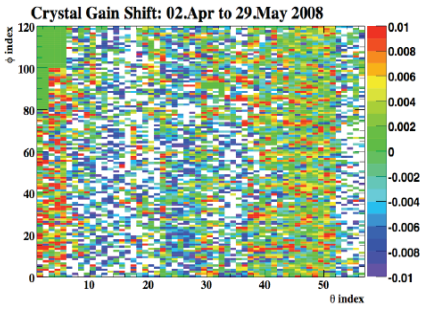
- End run April 7
  - Collaboration decision to maintain the detector in a 'warm ready' state for ~3 months.
    - Purpose:
      - be able to take final calibrations;
      - be able to take data if warranted by results of analysis of Run 7 data
    - Progress toward MMS is impacted by this decision.

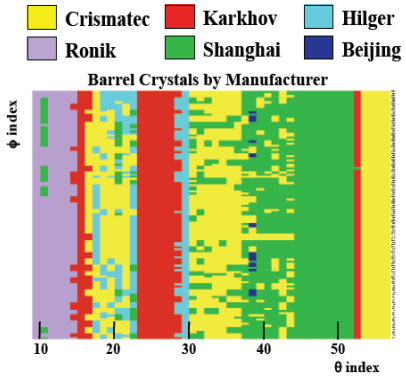
Detector Status

- Progress to MMS
  - SVT: final calibrations done during first two weeks; cooling systems off and drained; dry air flow maintained; quantities for MMS monitoring defined.
  - DCH: final calibrations done during first week; nitrogen flowing into chamber; this week front end electronics will be turned off and water drained from the system & dry air will replace nitrogen.
  - DIRC: final calibrations done in first two weeks; electronics and chiller system off; chiller system drained; SOB will be drained before the end of the month and SOB and phototube faces dried. Water purification system running closed loop.
  - EMC: source calibrations continue. Expect last one to be done in ~two weeks (see next transparency). Water to be drained from barrel cooling channels to avoid corrosion on Al structure. Fluorinert flow for barrel and endcap cooling continues till disassembly to keep stress off photodiode-crystal glue joint.

Crystal light yield recovery

- EMC source calibrations taken during startups show that certain crystal groups light yield increase from their values at the end of running periods.
  - Mainly crystals manufactured by Crismatec (yellow on right plot)
- After running was complete, goal is to take a series of source calibrations to track and understand the recovery process of the crystals.
  - Calibrations taken approximately every 3 ± 1 weeks.





Detector Status

- Progress to MMS
  - IFR-RPC: final plateau runs taken in the week following end of data taking; gas off for both avalanche and streamer mode chambers. Chambers open to air.
  - IFR-LST: final plateau runs taken in the week following end of data taking; nitrogen flowing through tubes now.
  - Magnet and Cryo-sytems: magnet off; cooling for magnet off; liquifier/compressor system repaired/regenerated before most of cryogenics staff left – now mothballed; magnet above 210K.
  - Access control: omnilocks (code for each user, entry recorded) installed on entries into IR2; omnilocks also installed on EH and Computing Alcove.
  - Level 3 Trigger farm adapted for Monte Carlo production.

Detector Status

- Progress to MMS: Monitoring System
  - Defined items to monitor at collaboration meeting early June
  - Progress on monitoring system:

* installed MMS application server
 - Dell 2950 purchased Sep 2007
 - stand-alone RedHat 5
  - non-taylored - update via RedHat subscription
  - minimum dependencies on SLAC core services
 - internal RAID with 500 GB for archive data + 80 GB for applications

* installed control software
 - EPICS version 3.14.7 (BaBar Production version) ported to RedHat5
 - standard EPICS Channel Archiver
 - will provide access to live + archived data through "StripTool","DM" display manager and JAVA archiver viewer
 - no dependencies on BaBar releases or packages

* IOC
 - one installed
 - most recent hardware used by BaBar
  - mvme5500 running Linux
 - driver support for VSAM, SIAM and CANBUS
  - covers all sensors we want to monitor

* software ready

Next Steps:

* putting the MMS core infrastructure hardware in place

* moving sensors to the MMS

Transition to the MMS monitoring system will be complete in September (schedule dependent on availability of key personnel: may be earlier)

Detector Ownership: existing agreements

- From the 1996 General Conditions for Collaborative Experiments Performed at SLAC, signed by all BABAR national partners [BABAR.FRC.95.007.04]
  - Section 6.6: Ownership Status
    - The delivery of items to the SLAC site, or the handling of such items there, will not affect rights of property relevant to those items, unless otherwise formally agreed with the owner. On the other hand, the ownership of equipment no longer required by the Collaboration can, under formal mutual agreement, be transferred to SLAC, should it be mutually advantageous to do so.
  - Section 6.7: Installation and Dismantling of Equipment
    - The Collaborating Institutions are collectively responsible for the installation and dismantling of the equipment supplied by the Collaborating Institutions, the contribution of SLAC as Host being limited in principle to the assistance detailed in paragraph 5.2.b.3 above.

Discussion to date on ownership & disposal

- Responsibilities discussed in July 2007 and February 2008 with BABAR International Finance Committee
  - Equipment ownership formally turned over to SLAC
  - SLAC and DOE take on responsibility for partial and/or complete dismantling, and storage or disposal
  - Decisions about requests for re-use of equipment will be made on a strategic basis with advice from agencies/collaboration as appropriate
    - SuperB is most likely case for strategic redeployment
  - If there are proceeds from the disposal of the magnet or coil (common fund items) after costs of dismantling, they will be disbursed to the original participating agencies
    - Salvage proceeds from other equipment will be used to offset SLAC costs for DND

Ownership Transition

- Collaboration was concerned about control over strategic re-use of BaBar systems
  - Strong desire by a large part of BaBar community to see re-use as part of a SuperB project
- Proposed solution was to delay ownership transfer, with collaboration to retain responsibility for BABAR transition and maintenance until the end of CY2010
  - Future of SuperB should be clear on that time scale
  - In this scenario, expect IFC members would continue to contribute to BaBar OCF through end of MMS
  - Collaboration manages transition to MMS and monitoring of BaBar while MMS is maintained

Ownership Transition

- In light of comments at the February IFC meeting, the proposal which will be discussed later this month at the IFC meeting will be to transfer ownership of the detector later this year. It is expected that a plan for prioritized release of assets will also be discussed. This plan will reflect the proposal for release of accelerator assets. It is expected to weigh reuse proposals by usefulness to the lab program on site; usefulness to the lab program at other sites; usefulness to the US community; usefulness to the global community.

D&D Planning History

- First round of planning for D&D of the BaBar detector was prepared for review August '07.
- Elements of the plan:
  - FY09: BaBar transitions to the MMS in the quarter following the end of data taking.
  - FY10-FY14: keep the detector in the MMS to preserve equipment. Lookd to possibility of reuse of components (for example: offshore SuperB Factory).
  - About FY15: Dismantle and dispose of the detector if strategic reuse does not materialize.
  - Identify components with long term value.
  - Schedule: 45 months to fully disassemble the detector (sequential process)(some steps are crane limited). Requires the use of 2 IR halls.
  - Preliminary cost estimate was $9.4M, no disposal costs.
  - Next steps were seen as: identifying project team, refine the cost estimate, preserving and documenting tooling, develop detailed plan including disposal.

D&D Planning History

- Key recommedations from the review:
  - Database of all equipment, how it is to be handled, future potential for reuse…
  - Duration of the MMS, cost consequences, eliminate it….
  - Planning for demolition and disposal should begin in FY2008, even if it would begin in 2015.
  - Best if disassembly starts as soon as possible by the physicists and engineers who have detailed knowledge of the detector before they are attracted to other projects.
  - Activities timeline and spending profile to be developed.
  - Bottoms-up cost estimate.
  - Detailed consideration of metals moratorium, activated equipment handling, materials disposal.

D&D Planning

- Reactions to the recommendations:
  - Database of all equipment, how it is to be handled, future potential for reuse…
    - Databases of electronics parts (following slides) and cables exist, though they need augmentation. Have discussed database for tooling (photos, design drawings, load testing sheets, procedures, jhams, location, etc) with database experts: effort in the works. Meanwhile, collecting data (see binder).
  - Duration of the MMS, cost consequences, eliminate it….
    - MMS is, for the detector, a means of preserving the assets. Some systems will continue in the MMS even as other systems around them are disassembled. However, the plan for D&D for the review has been advanced to an earlier start.

Database

522 rows found.

Manufacturer Name	Module Type	Model	Description	Location Detector System	Status	Count
ACROMAG	AVME9440-I-L		Input / Output Register	BBR	Good	1
ACROMAG	AVME9440-I-L		Input / Output Register	DCH	Good	4
ATI	24 PORT HUB	TS24TR	24 Port Hub	BBR	Good	1
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board	BBR	Bad	6
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board	BBR	Good	78
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board	EMC	Good	1
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board	IFR	Bad	1
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board	IFR	Good	4
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board	N/A	Bad	5
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board	N/A	Good	7
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board		Good	3
BI RA SYSTEMS	VME SIAM I/O BOARD	BiRa 7551	VME SIAM I/O VME Crate board	BBR	Good	4
BI RA SYSTEMS	VME SIAM I/O BOARD	BiRa 7551	VME SIAM I/O VME Crate board	CEN	Good	1
BI RA SYSTEMS	VME SIAM I/O BOARD	BiRa 7551	VME SIAM I/O VME Crate board	EMC	Good	4
BI RA SYSTEMS	VME SIAM I/O BOARD	BiRa 7551	VME SIAM I/O VME Crate board	N/A	Good	3
BI RA SYSTEMS	VME SIAM I/O BOARD	BiRa 7551	VME SIAM I/O VME Crate board		Good	7
BI RA SYSTEMS	VSAM		VME Smart Analog Module	BBR	Good	17
BI RA SYSTEMS	VSAM		VME Smart Analog Module	CEN	Good	3
BI RA SYSTEMS	VSAM		VME Smart Analog Module	DCH	Good	2
BI RA SYSTEMS	VSAM		VME Smart Analog Module	IFR	Good	3

Database

522 rows found.

Manufacturer Name	Module Type	Model	Description	Location Detector System	Status	Count
ACROMAG	AVME9440-I-L		Input / Output Register	BBR	Good	1
ACROMAG	AVME9440-I-L		Input / Output Register	DCH	Good	4
ATI	24 PORT HUB	TS24TR	24 Port Hub	BBR	Good	1
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board	BBR	Bad	6
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board	BBR	Good	78
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board	EMC	Good	1
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board	IFR	Bad	1
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board	IFR	Good	4
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board	N/A	Bad	5
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board	N/A	Good	7
BI RA SYSTEMS	VME SIAM	BiRa 7550	8 input interlock VME Crate board		Good	3
BI RA SYSTEMS	VME SIAM I/O BOARD	BiRa 7551	VME SIAM I/O VME Crate board	BBR	Good	4
BI RA SYSTEMS	VME SIAM I/O BOARD	BiRa 7551	VME SIAM I/O VME Crate board	CEN	Good	1
BI RA SYSTEMS	VME SIAM I/O BOARD	BiRa 7551	VME SIAM I/O VME Crate board	EMC	Good	4
BI RA SYSTEMS	VME SIAM I/O BOARD	BiRa 7551	VME SIAM I/O VME Crate board	N/A	Good	3
BI RA SYSTEMS	VME SIAM I/O BOARD	BiRa 7551	VME SIAM I/O VME Crate board		Good	7
BI RA SYSTEMS	VSAM		VME Smart Analog Module	BBR	Good	17
BI RA SYSTEMS	VSAM		VME Smart Analog Module	CEN	Good	3
BI RA SYSTEMS	VSAM		VME Smart Analog Module	DCH	Good	2
BI RA SYSTEMS	VSAM		VME Smart Analog Module	IFR	Good	3

Mod Type = 2101

87 rows found.

Barcode	Description	Loc Description	Status
20000597	Fast Control Partition Master	084 GLT lab	Good
20000597	Fast Control Partition Master	084 GLT lab	Good
20000597	Fast Control Partition Master	OFF SITE LBL TRIGGER GROUP	Good
20000597	Fast Control Partition Master	OFF SITE For unclassifiable locations	Good
20000597	Fast Control Partition Master	040 DCT test stand	Good
20000617	Fast Control Partition Master	OFFSITE INFN PISA --- A. Lusiani	Good
20000617	Fast Control Partition Master	Spare/Repair 621 Ray's test stand	Good
20000617	Fast Control Partition Master	084 EMC Teststand	Good
20000736	Fast Control Partition Master	OFF SITE D. Kirkby	Good
20000736	Fast Control Partition Master	620B R-24 E-7 Front S-13	Good
20000736	Fast Control Partition Master	OFF SITE LBL Vertex Group	Good
20000736	Fast Control Partition Master	620B R-24 E-7 Front S-16	Good
20000736	Fast Control Partition Master	620B R-24 E-7 Front S-11	Good
20001160	Fast Control Partition Master	Spare/Repair 621 Ray's test stand	Good
20001160	Fast Control Partition Master	620B R-24 E-7 Front S-14	Good
20001161	Fast Control Partition Master	620B R-24 E-7 Front S-13	Good
20001161	Fast Control Partition Master	UNKNOWN	Good
20001162	Fast Control Partition Master	040 Data Flow Lab	Good
20001162	Fast Control Partition Master	084 DCH test stand (Proto II)	Good
20001162	Fast Control Partition Master	620B R-24 E-7 Front S-15	Good
20001162	Fast Control Partition Master	040 Data Flow Lab	Good
20001163	Fast Control Partition Master	620B R-24 E-7 Front S-18	Bad
20001163	Fast Control Partition Master	040 Data Flow Lab	Bad
20001163	Fast Control Partition Master	Spare/Repair 621 621 2nd floor	Bad
20001163	Fast Control Partition Master	620B R-24 E-7 Front S-19	Bad
20001164	Fast Control Partition Master	620B R-24 E-7 Front S-12	Good

D&D Planning

- Reactions to the recommendations:
  - Planning for demolition and disposal should begin in FY2008, even if it would begin in 2015.
  - Best if disassembly starts as soon as possible by the physicists and engineers who have detailed knowledge of the detector before they are attracted to other projects.
    - Planning progress has been less than one might hope for several reasons. Key mechanical engineering personnel have been temporarily transferred to LCLS to meet pressing needs: we will have them back part time, half time, and full time in the new fiscal year. (Note that when the decisions about manpower assignment were made, Run 7 had not yet been curtailed.) Other personnel have focused on data-taking operations till early April. Nevertheless, planning effort has gone on to define the scope, develop a schedule, develop a budget, including the spread over the years of the disassembly.
    - Progress has been made in refurbishing tooling, documenting tooling and procedures, and load testing fixtures. Tooling has been located, and collected. Cleanup of unneeded equipment has taken place. Containers have been prepared for storage. A D&D Safety Plan, using experience from the IFR interventions in 2002, 2004, 2005, and 2006, is being developed.

D&D Safety Plan Outline

1. Introduction
   - 1.1 Purpose
   - 1.2 Scope
   - 1.3 Goal
2. Safety Challenges
3. Organization, Management, and Responsibilities
   - 3.1 D&D Project Manager
   - 3.2 D&D Chief Engineer
   - 3.3 D&D Team Members
   - 3.4 D&D Safety Team
4. Work Planning and Control
   - 4.1 Work Authorization Process
   - 4.2 Schedule
   - 4.3 Procedures
   - 4.4 Safety Reviews
   - 4.5 Weekly and Daily Meetings
5. Hazard Analysis
   - 5.1 SAD Addendum
   - 5.2 Subsystem Hazard Analysis
   - 5.3 Job Hazard Analysis
6. D&D Specific Safety Trainin
7. Access Control Security
8. Safety Milestones/Schedule
   - 8.1 D&D Safety Plan
   - 8.2 Hazard Analysis
   - 8.3 Safety Team
   - 8.4 Safety Reviews
9. Management Inspections
   - 9.1 PPA ALD
   - 9.2 PPA EPP
   - 9.3 ES&H
   - 9.4 SSO

Related Plans and Documents

Material Disposition Plan

CoHE Plans: Electrical, Cryogenic, Gas, Pressure/Vacuum

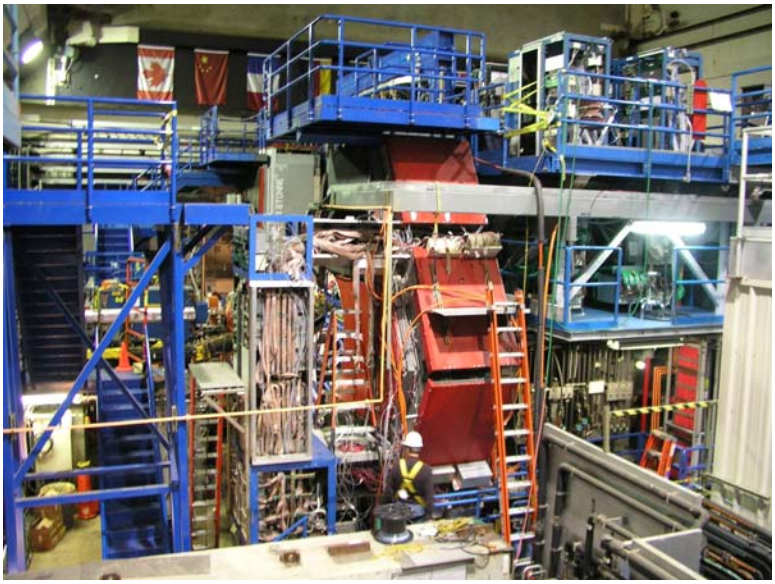
Radiation Survey Plan

Property Control Plan

D&D Planning

- Reactions to the recommendations:
  - Activities timeline and spending profile to be developed.
    - 5 main elements: Details in Jim Krebs talk.
      - Project Management
        - $4.63M; 51 months
        - Project planning, safety, and materials disposition plan
        - Costs not properly included in the August 2007 estimate
      - Engineering and tooling refurbishment
        - $4.42M; 22.3 months
        - Qualifying and refurbishing tooling for major system removal
        - Cost not fully included in August 2007 estimate
      - Peripherals Disassembly
        - $1.78M; 46.5 months
        - Remove shielding walls, electronics hut, walkways, platforms, ultilities, cabling, cableways.
      - Core Detector Disassembly
        - $2.04M; 27 months
        - Disassemble doors, remove SVT, DCH, DIRC, EMC, IFR
      - Subsystem Disassembly
        - $2.26M; 24 months
        - Breakdown of EMC and DIRC into components. Execution depends on whether systems are reused or disposed

BaBar Detector



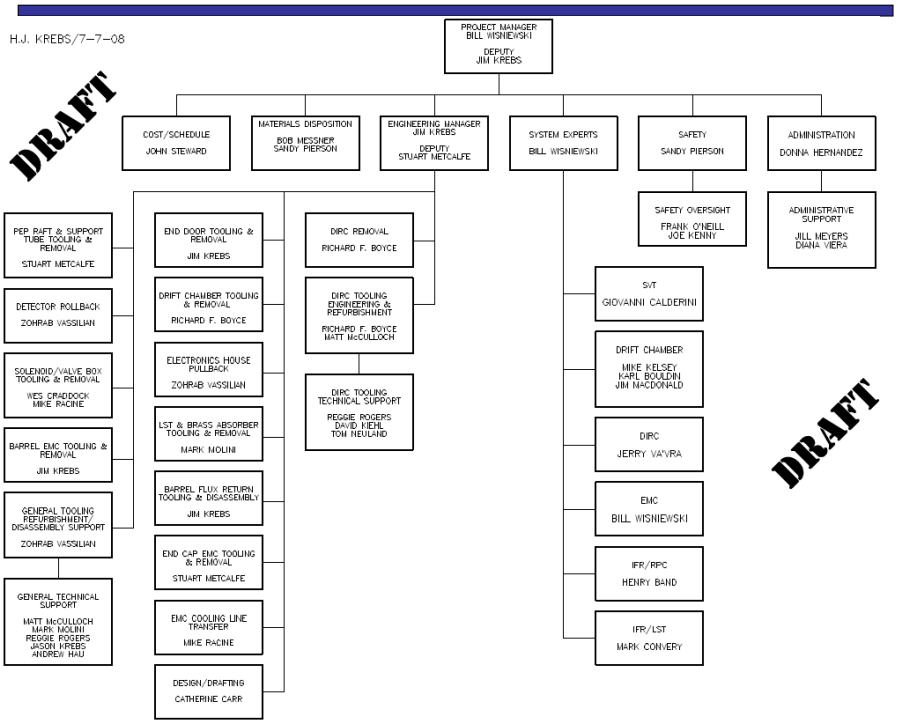
'Actual'

Shield wall removed

D&D Planning

- Reactions to the recommendations:
  - Bottoms-up cost estimate.
    - Engineering effort in FY09 to refine the estimates further.
    - The current cost estimate, $15.1M, incorporates ~30% contingency. This contingency reflects that planning is at an early stage.
    - Estimate does not include materials disposal costs, in particular, effects of the metals moratorium.
  - Detailed consideration of metals moratorium, activated equipment handling, materials disposal.
    - Meetings with ES&H division personnel have begun to deal with materials disposal. Interactions with site office personnel have started.
    - D&D organization includes people responsible for following up on the metals moratorium issues.

D&D Planning: Manpower



D&D Planning: Milestones

FY08 Milestones

9/30/08 D&D Safety Plan Created
9/30/08 IFR Background Shiled Wall and Supporting Structure Removed

FY09 Milestones

12/31/08 Electronicas House Emptied/Rolled Back
03/31/09 PEP Rafts and Support Tube Removed
03/31/09 Detailed Project Schedule Complete
03/31/09 Materials Disposition Plan Created ← Core Disassembly Readiness Review
04/30/09 End Cap Emc and Drift Chamber Removed
06/30/09 FWD East End Door Disassembled/Removed
09/31/09 FWD West, BWD East End Doors Disassembled/Removed

FY10 Milestones

11/30/09 DIRC SOB Removed
12/31/09 BWD West End Door Disassembled/Removed
03/31/10 Barrel Brass Absorber/LSTs Removed
04/15/10 Detector Rolled Out to Main Disassembly Area
05/15/10 DIRC Central Support Tube/Horsecollar Removed
06/15/10 Barrel EMC Removed
08/15/10 Solenoid/Valve Box Removed

FY11 Milestones

01/31/11 Barrel Flux Return Disassembled/Removed
04/30/11 DIRC System Disassembled
06/30/11 End Cap EMC Disassembled

FY12 Milestones

09/15/12 Barrel EMC Disassembled
09/31/12 Project Completion

Backup Slides

Detector Ownership: existing agreements

- Section 5.2.b.3: Supplies and installations at the experiment
  - Help with the installation and removal of the detector and its auxiliary equipment, including provision of crane and rigging services, geometrical survey and alignment, transport of equipment on the Laboratory site as well as inside the experimental areas. Such services will be charged to the Collaborating Institutions, according to the policies and practices currently in use at SLAC.
  - Assistance with basic infrastructure, such as counting houses, local air conditioning, and cryogenics as specified in the Memorandum of Agreement.
  - Assistance in establishing a local supply of electricity, water, compressed air and standard network lines connected to the SLAC communications network and the national scientific network.

Detector Ownership: existing agreements

- From "Multilateral Agreement Concerning Participation in the Collaboration Common Fund for the BABAR Detector" [BABAR.FRC.95.008.05]
  - Article 1, Section 1.7: Upon completion or termination of the experiment, DOE may abandon Common Fund items in place, at which point SLAC may dispose of same in a manner agreeable to the funding agencies. If Common Fund items are sold, the proceeds should be returned to the Common Fund participants in a proportion to their contribution to the item.

Common Fund at the time of the acquisition of the common

Detector Ownership: existing agreements

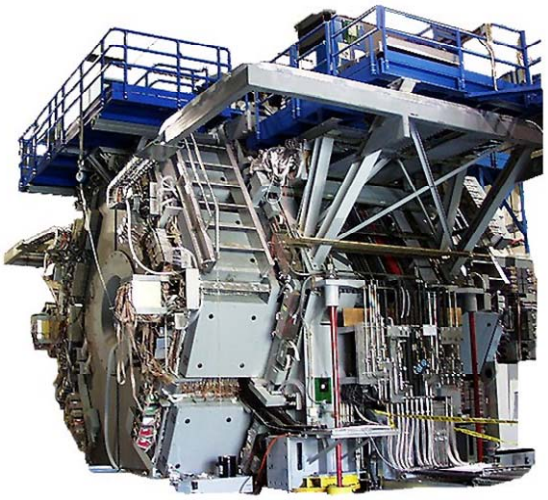
- From the 1996 General Conditions for Collaborative Experiments Performed at SLAC, signed by all BABAR national partners [BABAR.FRC.95.007.04]
  - Section 6.10: Release of Space
    - As soon as the experiment is declared complete, the space used by the Collaboration, including office and laboratory space and the space used for testing and running the experiment, will be made available to SLAC for reallocation. If requested by SLAC, the Collaboration agrees to restore the space to the condition in which it was received.

Common Fund Items

WBS	Description	Common Fund [k$]
1.6	Magnet	
1.6.0	Magnet engineering	385
1.6.1	Solenoid	1625
1.6.3	Cryogenics	1455
1.6.4	Cryogenics monitoring	152
1.6.6	Flux return	3440
1.6.7	Installation	263
1.7	Electronics	
1.7.B	Common systems	124
1.7.C	Infrastructure	202
1.8	Computing	1344
1.9	Management/Coordination	
1.9.5	Detector assembly	3397
	Contingency	413
	Reserve	500
Total		**13300**

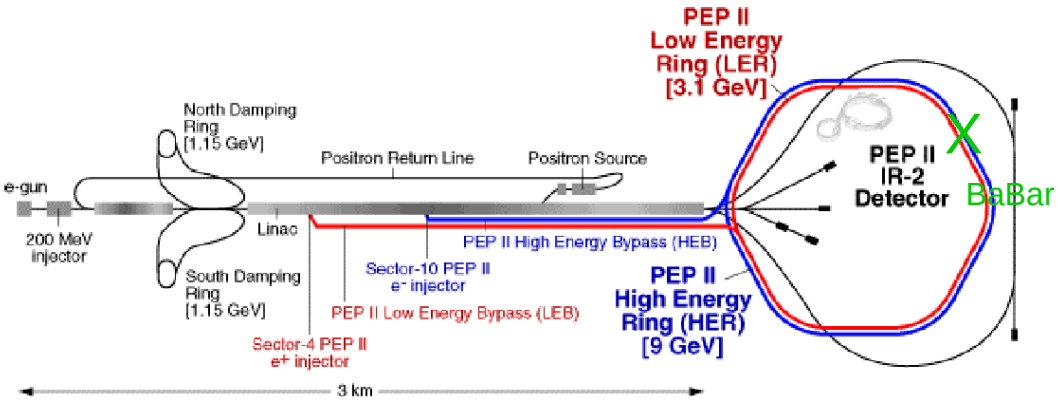
Canada NSERC	0.6%
France CEA	5.0%
France IN2P3	5.0%
Germany BMBF	5.8%
Italy INFN	12.2%
UK PPARC	7.4%
US DOE	62.3%
To be distributed	1.7%
Total	100.0%

BaBar Disassembly and Disposal Planning

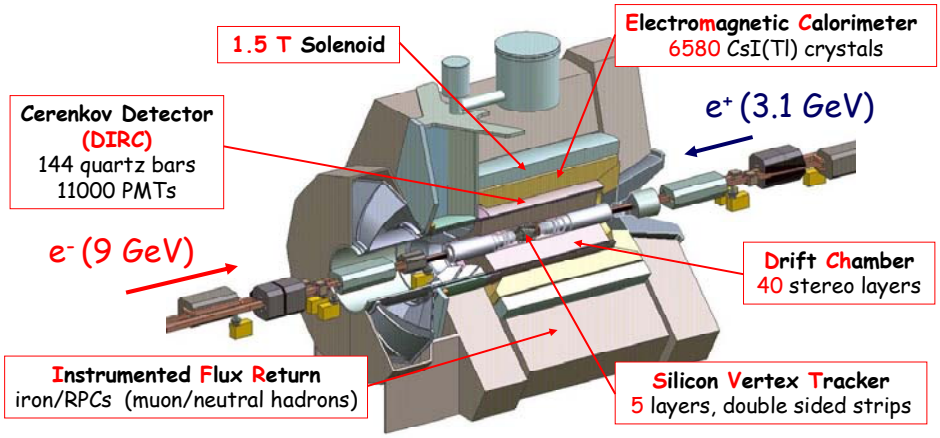


H. James Krebs
July 7, 2008

The B-Factory



BaBar Detector



SVT: 97% efficiency, 15 μm z hit resolution (inner layers, perp. tracks)

SVT+DCH: $\sigma(p_T)/p_T = 0.13\ \% \times p_T + 0.45\ \%$

DIRC: K-π separation 4.2σ @ 3.0 GeV/c → >3.0σ @ 4.0 GeV/c

EMC: $\sigma_E/E = 2.3\ \% \cdot E^{-1/4} \oplus 1.9\ \%$

BaBar Detector

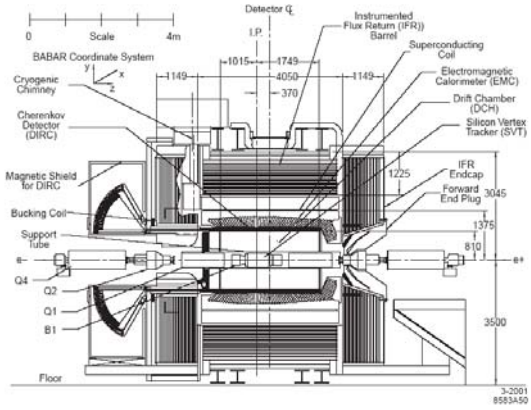


Figure 1. *BABAR* detector longitudinal section.

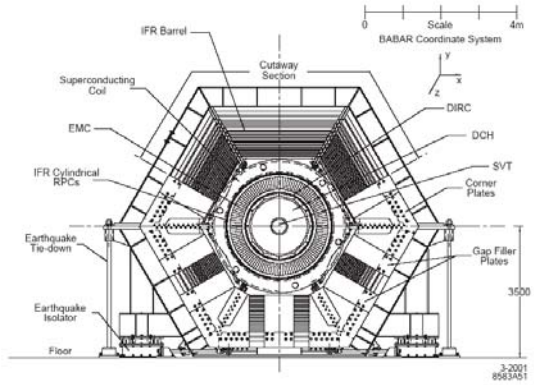
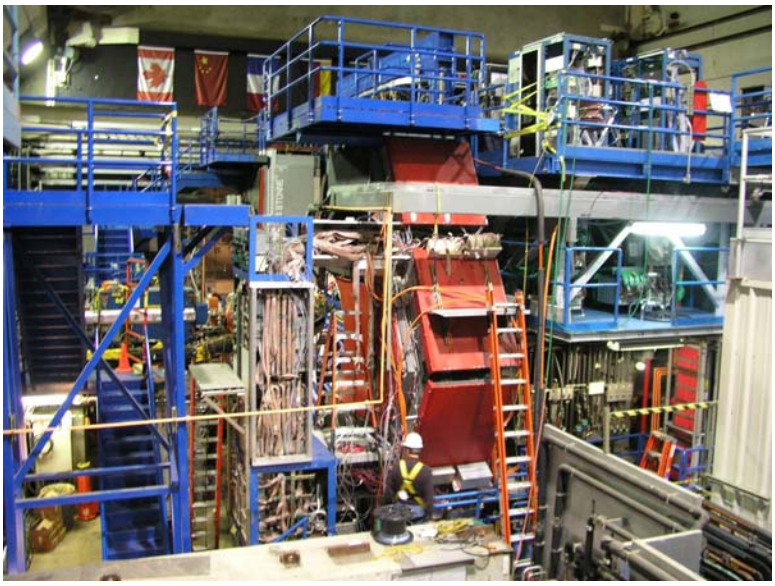


Figure 2. *BABAR* detector end view.

'Ideal'

BaBar Detector



'Actual'

Shield wall removed

Status of BABAR transition & DND planning

- In the midst of transition to "minimal maintenance state"
  - Put detector, IR-2, and environs into stable long-term state to preserve and secure assets that minimizes need for manpower
  - Collaboration managed process which should complete this summer
- Early stages of detailed DND planning underway
  - Incorporating advice from August 2007 DOE review, in particular the advantages of early start to the DND project, and change in timeframe due to curtailed run 7
  - Identifying project organization and main participants
  - Structuring main elements of plan and sequence of activities for a project beginning ~July, 2008
    - Safety planning incorporated from the start, based on extensive experience in 2004-2006 IFR upgrade project
    - Expect to preserve some components for re-use in other HEP projects
    - Discussing funding and funding profile with OHEP

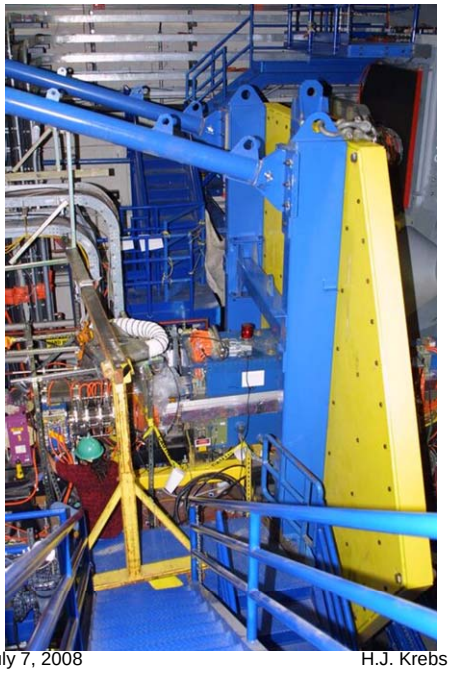
BaBar Detector Disassembly

- BaBar completed the IFR upgrade in Fall 2006. This upgrade took place over three campaigns: IFR Forward Endcap Resistive Plate Chambers in 2002, 1st third of IFR Barrel Limited Streamer Tubes in 2004, balance of IFR Barrel sextants with LSTs in 2006.
  - Barrel upgrade required cabling of forward end of SVT and forward end of EMC, load transfer of EMC, removal of most of the corner blocks fore and aft, removal of flux bars, releasing some of the cryostat restraints, pulling forward doors to walls.
  - Experience gained in these campaigns plus experience from the initial detector assembly provide excellent input for planning the detector disassembly process, estimating the required manpower (both labor and engineering), as well as M&S.

Project Schedule

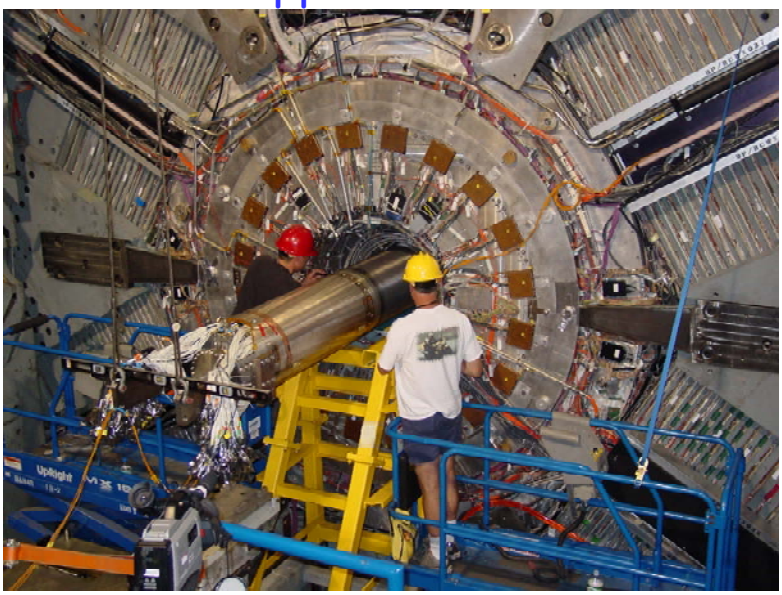
- 51 months duration
- Five Project Phases (Subprojects)
  - Project Management
  - Engineering and Tooling Refurbishment
  - Peripherals Disassembly
  - Core Disassembly
  - DIRC/EMC System Disassembly
    - May not be needed if major components are reused in a Super B Factory
- Assumptions
  - Project start date July 1, 2008
    - We have begun!
      - Planning, preliminary engineering, tooling refurbishment
  - Major components removed in designated loacations
    - Collision area – the present loaction of BaBar
    - Main disassembly area – 12.9 meters east of present location
      - Requires detector roll-out
  - Dismantling tasks performed sequentially
    - Tooling refurbishment performed in parallel at IR-12
    - Electronics house disassembly can be performed in parallel with PEP Support Tube and Rafts removal
    - Can be optimized with additional work crews
      - Included in present draft of Org Chart
    - Experienced supervision may not exist for multiple crews
  - Use of personnel knowledgeable in the disassembly of BaBar
  - Items hauled away are assumed to be trash
    - Ending location TBD
  - Metals are stored in Metals Moratorium Purgatory (MMP)
    - Location TBD
    - Awaiting formal Materials Disposition Plan

Concrete Radiation Shield Wall

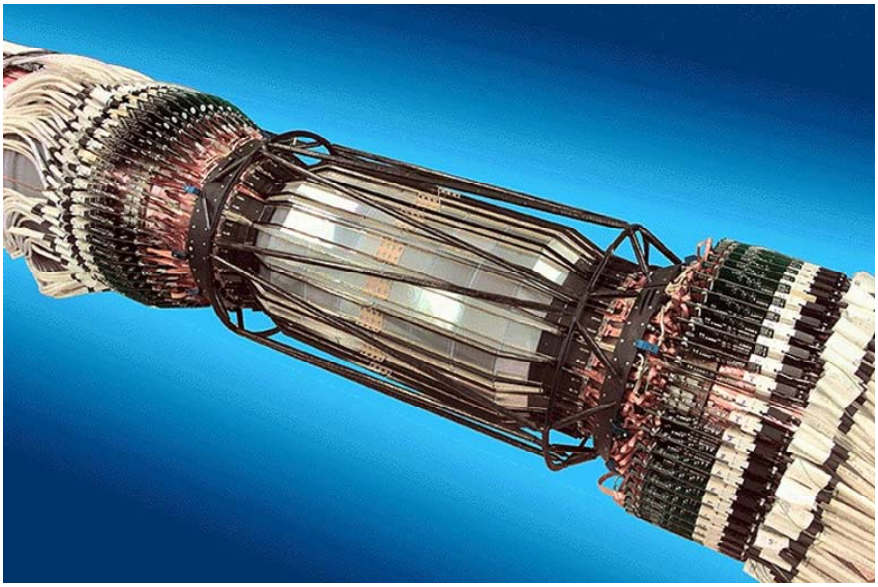


IFR Background Shield Wall (1st Affected Metals Moratorium Item)

SVT & PEP Support Tube Installation



Silican Vertex Tracker (SVT)

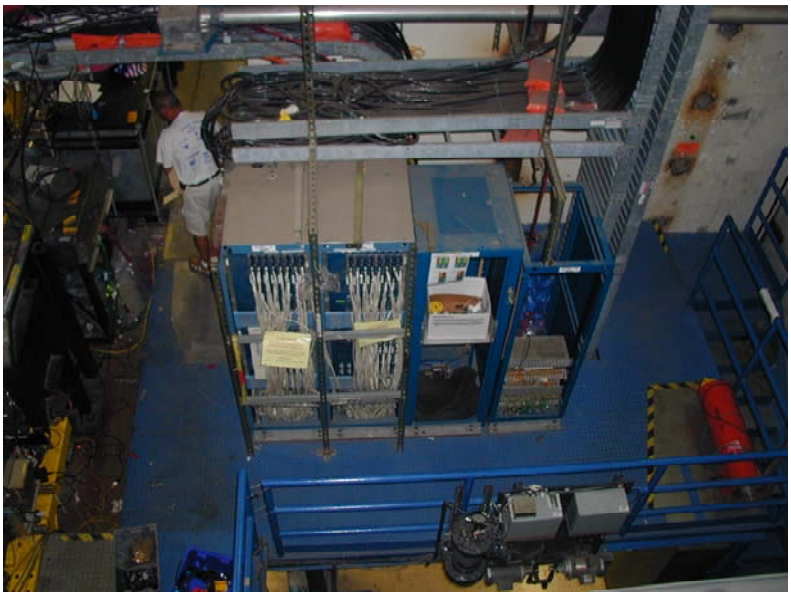


Silican Vertex Tracker (SVT)

- The SVT Detector and the PEP Support Tube are a married assembly
  - This system was extracted from BaBar in 2002
    - Removed from the forward end on beamline
    - A detailed project plan exists including schedule and resource estimates
    - Extraction/insertion tooling exists in good working condition
- It is assumed that the SVT detector will end up on display at a lab or university
- Reusable items
  - Very few – electronics racks

Forward SVT MUX Racks

Backward SVT MUX Racks



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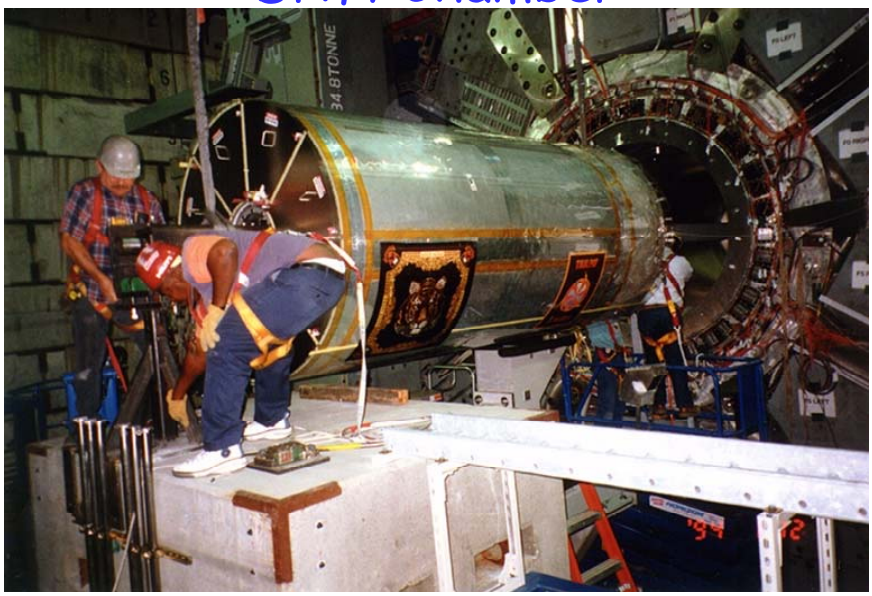
Drift Chamber



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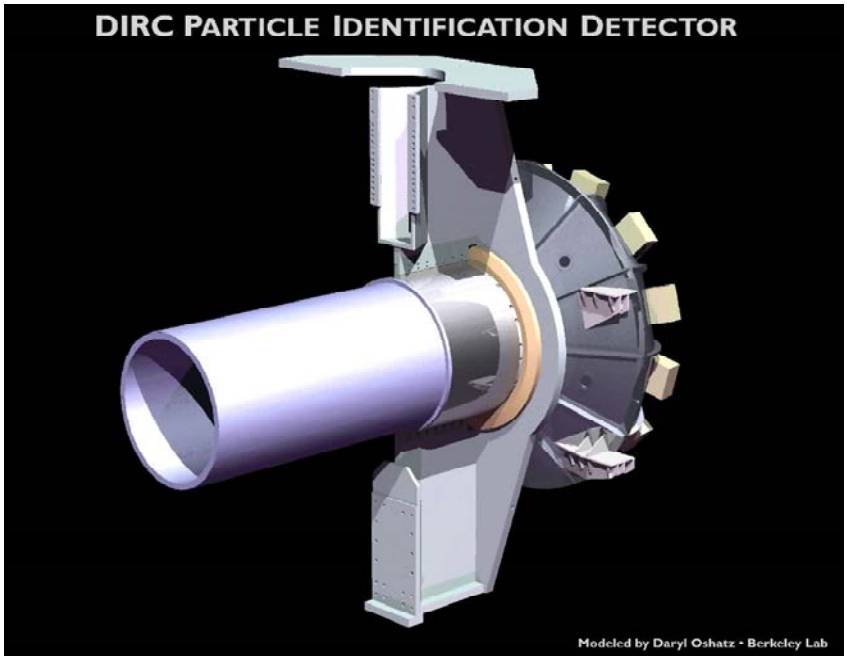
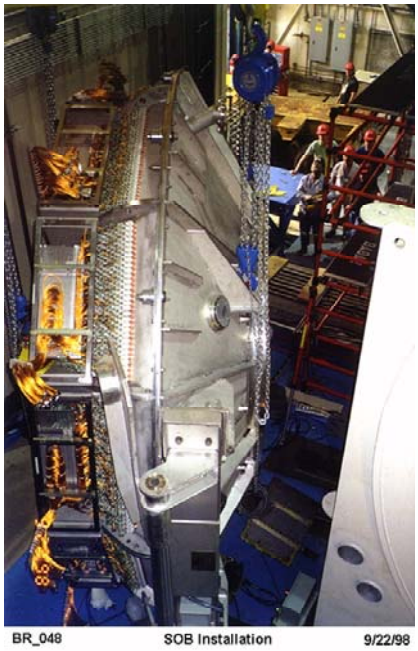
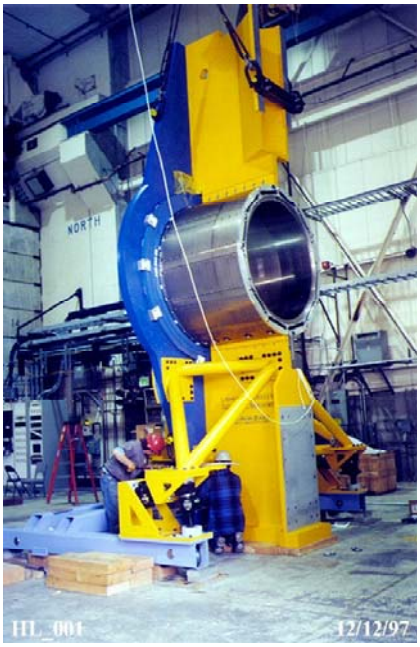
Drift Chamber

- Supported by the DIRC Central Support Tube
  - Removed from the forward end in main disassembly area
- It is assumed that the Drift Chamber will end up on display at a lab or university
- If disposed of:
  - Beryllium inner tube
  - Gold plated wires
- Gas system racks
  - Ship to Annecy and disassemble
- Reusable items
  - Most items considered obsolete
- Extraction tooling exists – Somewhat scattered
  - Good condition (stored inside)
  - Needs to be gathered to one location




DIRC Central/Strong
Support Tube Assembly


BR_048
SOB Installation
9/22/98

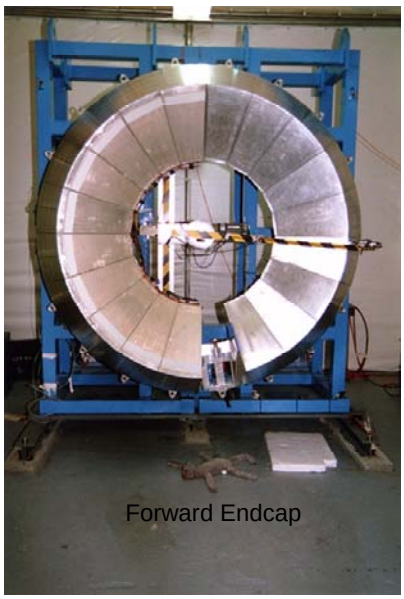

NORTH
HL_001
12/12/97

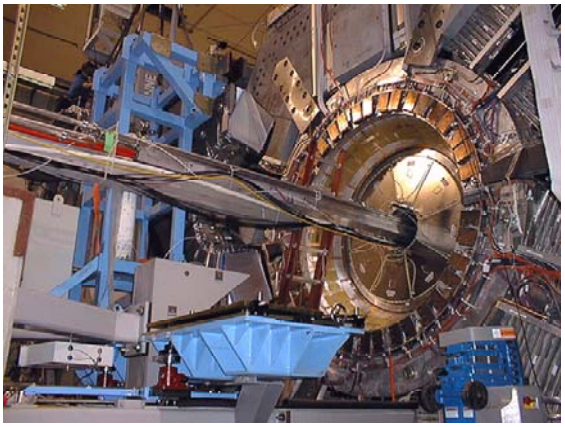
DIRC Magnetic Shield Cylinder

DIRC

- Major detector components
  - Stand off box with 11,000 phototubes
  - Quartz Bar Boxes
  - Central/Strong Support Tube with Horsecollar and Magnet Bucking Coil
  - DIRC Magnetic Shield
- All major components removed from backward end in main disassembly area
  - Ship to IR-12 for final disassembly
- Reusable items
  - Quartz bars will be stored
    - Store in existing bar boxes?
  - Magnet Bucking Coil
- Most extraction equipment exists
  - Good condition (stored inside)

End Cap Calorimeter

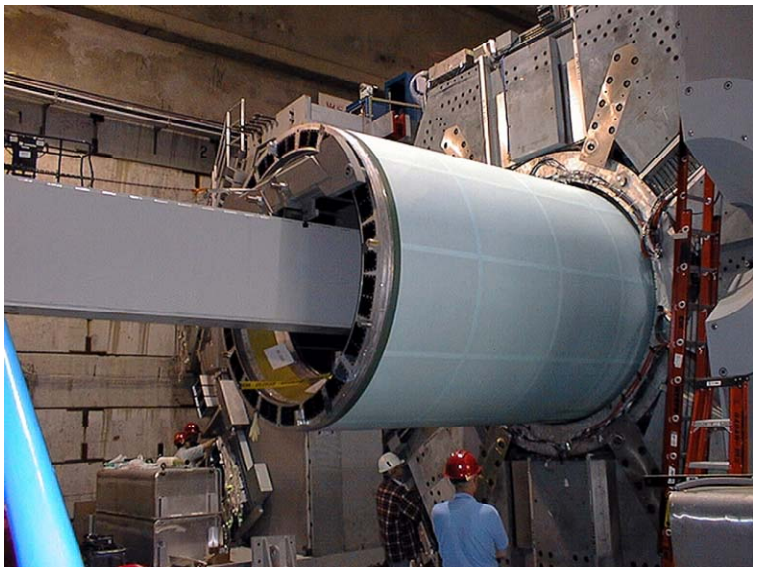




End Cap Calorimeter

- All major components removed from forward end in collision area
  - Ship to IR-12 for final disassembly
- Reusable items
  - Crystals
    - Stored in humidity control container
    - May have excessive damage
- Most extraction equipment exists
  - Good Condition
    - Items stored inside but somewhat scattered
  - Some items will need to be replaced
- We have experience in backing the end cap out of BaBar
  - Have not done this for a while (5 years?)

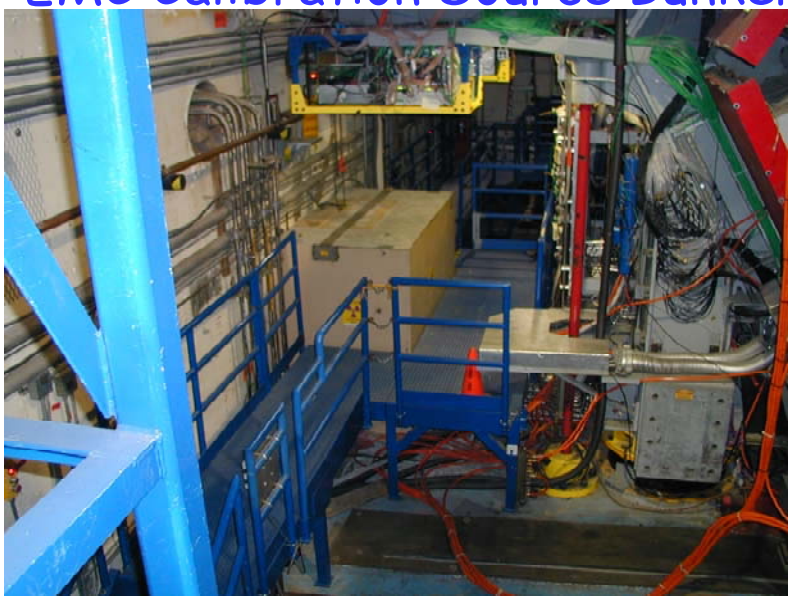
Barrel Electromagnetic Calorimeter



Barrel Electromagnetic Calorimeter

- Removed from forward end in main disassembly area
  - Ship to IR-12 for final disassembly
- Reusable items
  - Crystals
    - Store in a humidity control container
- Most extraction equipment exists
  - Condition varies
    - Some items stored inside
    - Large items stored outside
  - Items are somewhat scattered
  - Some items will need to be replaced
  - Load transfer members may be redesigned

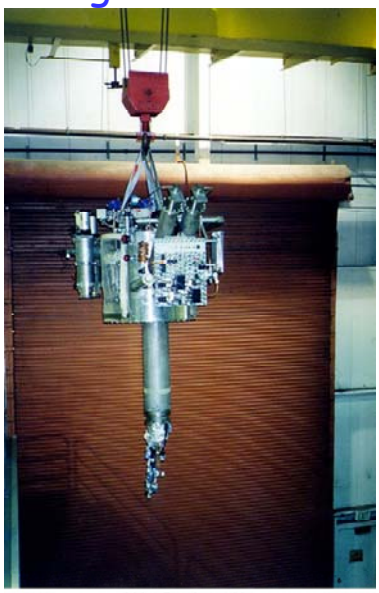
EMC Calibration Source Bunker



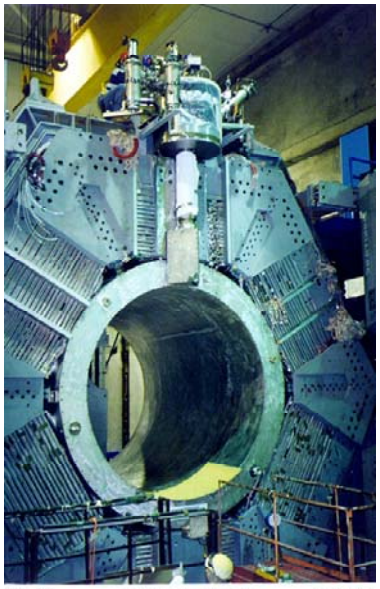
BaBar Magnet System

TO_293 Inserting the Solenoid into the Flux Return

Magnet Valve Box With Current Leads



TO_299 Valve Box Assembly 12/12/97



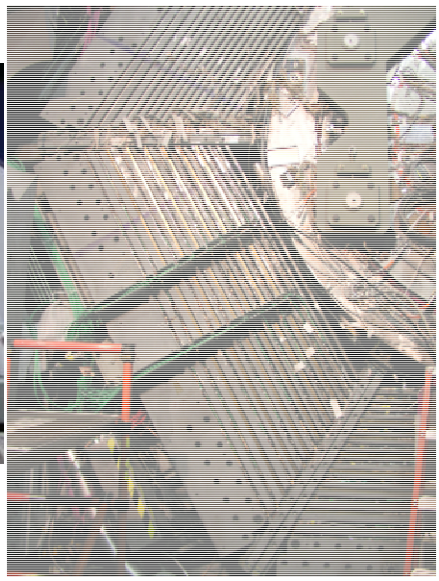
TO_300 Valve Box Assembly 12/12/97

IR-2 Helium Liquefier

BaBar Magnet System

- Solenoid is removed from backward side in main disassembly area
- Uses EMC extraction beam assembly with magnet-specific tooling
- Most extraction equipment exists
  - Stored outside
    - Needs refurbishment/replacement
- Reusable items
  - Solenoid and Valve Box
  - Power Supply plus spare
  - Helium Liquefier and controls
    - Could also be used to provide a source for LHe at SLAC
  - LN_2 Dewar

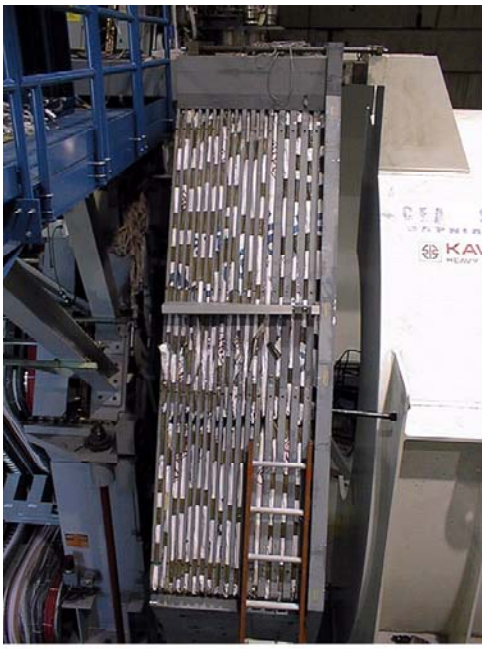
Instrumented Flux Return (LSTs) Barrel



Upper Barrel LST Removal

Instrumented Flux Return

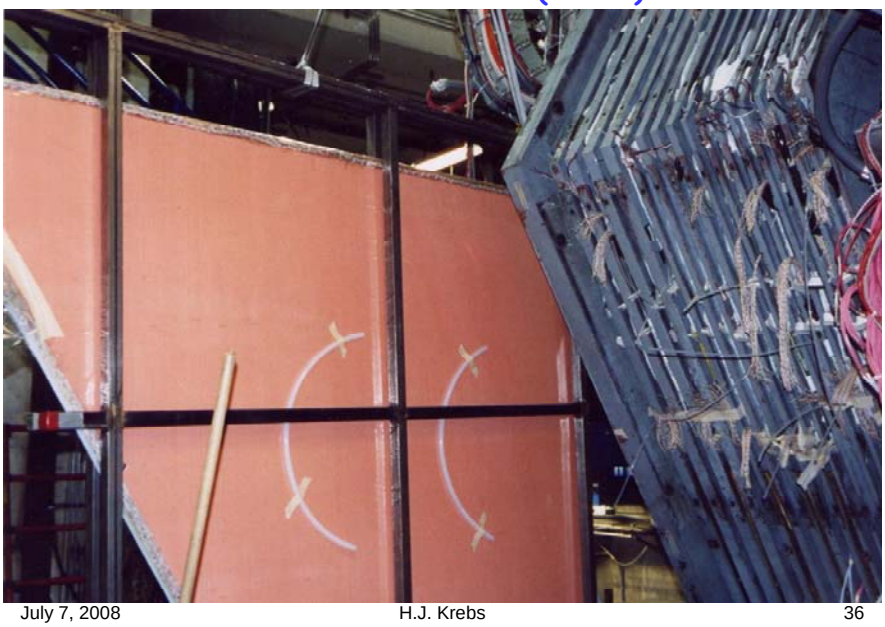
- Limited Streamer Tubes (LSTs)
  - Removed from detector in collision area
    - Most extraction equipment exists in good condition
    - Will be stored for possible future application
      - Storage crates available from LCLS
- 75 tons of brass absorber plates
  - Removed from detector in collision area
    - Most extraction equipment exists
      - Needs refurbishment
  - Affected by metals moratorium



SM_011 Back Door and Magnetic Shielding 06/30/98

Instrumented Flux Return Backward End Door RPCs

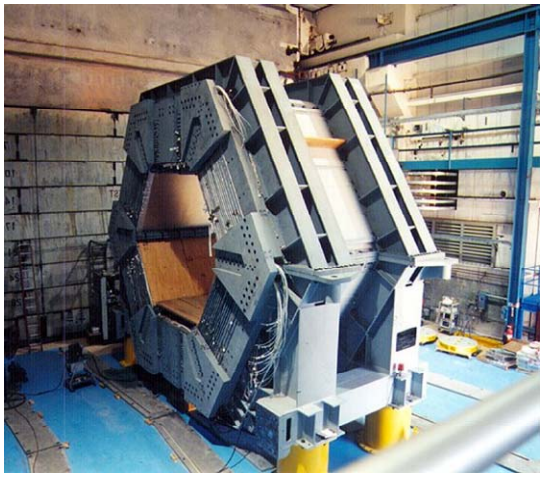
Instrumented Flux Return (RPCs) End Door



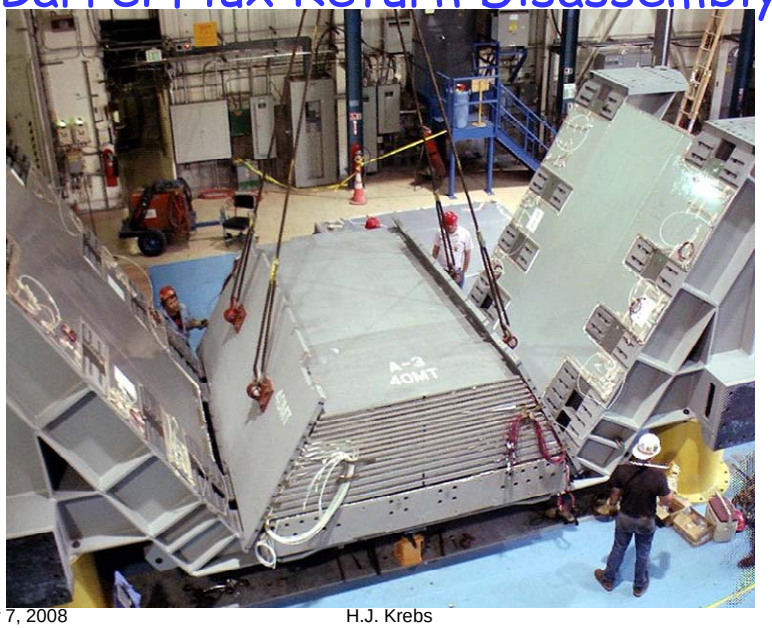
Instrumented Flux Return (RPCs)

- Resistive Plate Chambers (RPCs)
  - Barrel
    - 6 RPCs in Barrel (Layer 19)
      - Approx 250 lbs each
      - Must disassemble barrel steel and support structure to remove these chambers
  - Forward End Doors
    - 16 layers, 3 modules high, both east and west
      - 96 total chambers
        - » Approx. 150 lbs each
    - Removed from detector in collision area
    - RPCs shall be disposed of
  - Backward End Doors
    - 18 layers, 3 modules high, both east and west
      - 108 total chambers
        - » Approx. 150 lbs each
    - Removed from detector in collision area
  - Most extraction equipment exists
    - Needs some refurbishment
- 30 tons of brass absorber plates (FWD End Door)
  - Removed from detector in collision area
    - Most extraction equipment exists
      - Needs refurbishment
  - Affected by metals moratorium

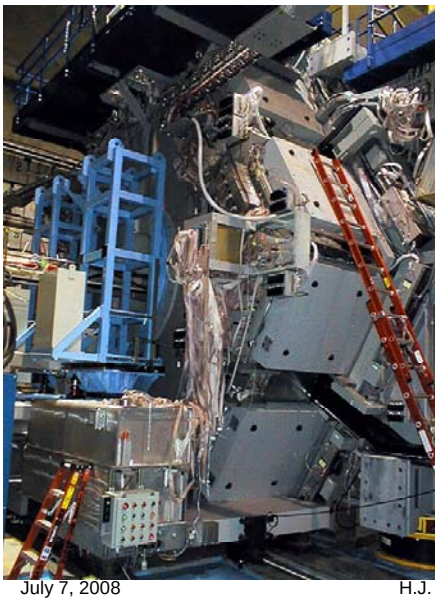
Barrel Flux Return



Barrel Flux Return Disassembly



End Door Flux Return

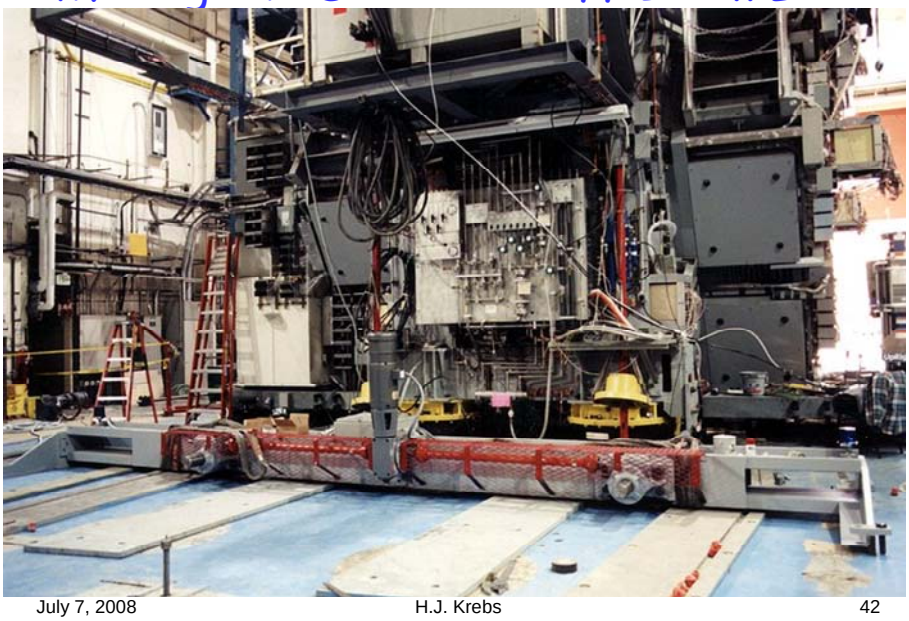


TO_298 Forward Door Assembly 12/12/97

Flux Return

- 962 tons of steel (not including end plugs)
  - Heaviest items 46.2 tons
- Disassembled in main disassembly area
- Most tooling exists
  - Needs refurbishment (stored outside)
  - Some new tooling needed for safety reasons
- Affected by metals moratorium

Moving the Detector Off Beam Line

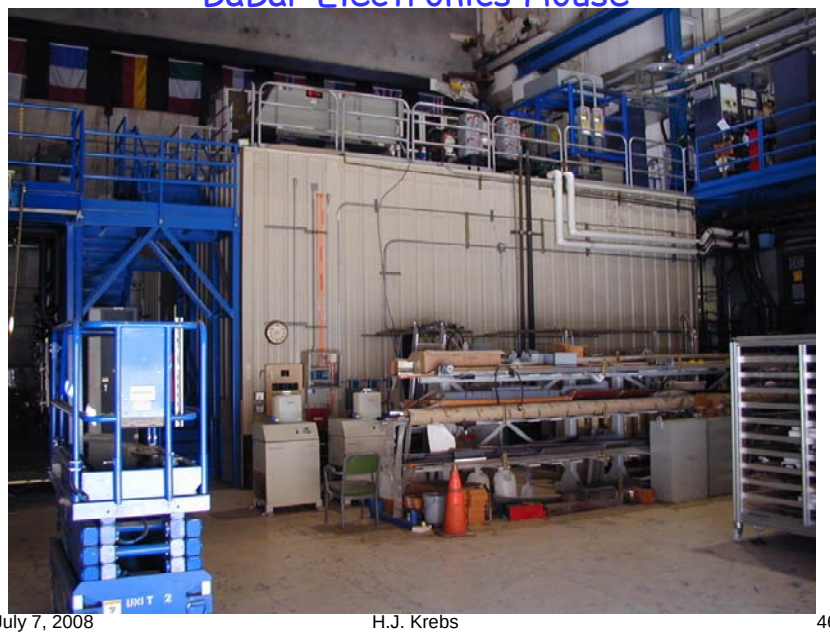


Miscellaneous Stairs & Walkways

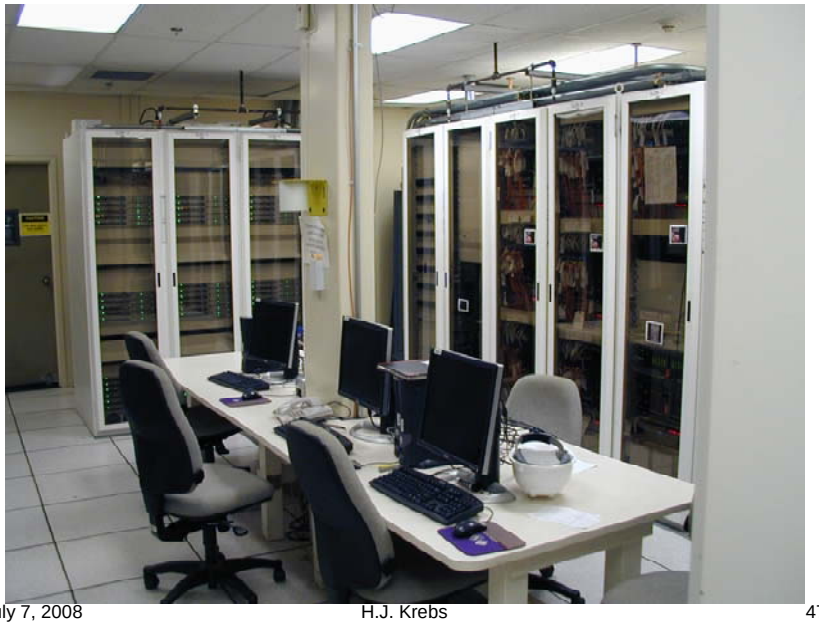
East Detector Platform Electronics Racks

West Detector Platform Electronics Racks

BaBar Electronics House



BaBar Electronics House – First Floor



BaBar Electronics House – Second Floor

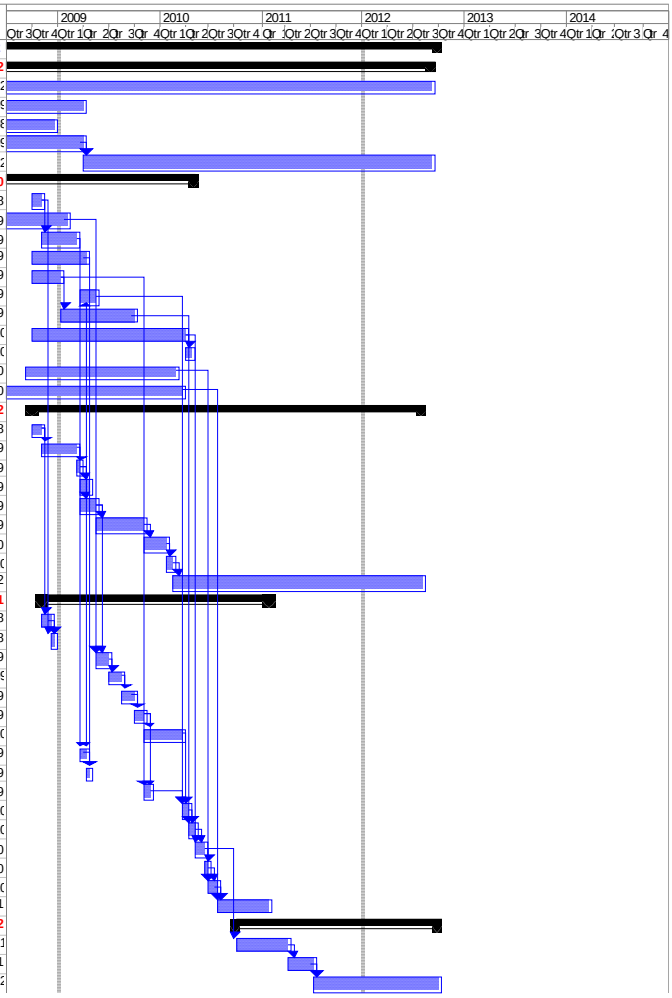
Building 621 Control Room

Building 636 (BaBar Gas Shack)

LN2 Dewar, Storage Container 439

Chiller Land

ID		Task Name	Duration	Start	Finish
1		**BABAR DISASSEMBLY AND DISPOSAL**	**51.7 mons**	**Tue 7/1/08**	**Wed 9/19/12**
2		**PROJECT MANAGEMENT**	**51 mons**	**Tue 7/1/08**	**Wed 8/29/12**
3		Project Management	51 mons	Tue 7/1/08	Wed 8/29/12
4		Create Detailed Project Schedule	9 mons	Tue 7/1/08	Fri 3/27/09
5		Develop Safety Plan/Safety Oversight	6 mons	Tue 7/1/08	Wed 12/17/08
6		Develop Materials Disposition Plan	9 mons	Tue 7/1/08	Fri 3/27/09
7		Materials Disposition	42 mons	Mon 3/30/09	Wed 8/29/12
8		**ENGINEERING AND TOOLING REFURBISHMENT**	**22.3 mons**	**Tue 7/1/08**	**Wed 4/28/10**
9		PEP Support Tube Tooling	1 mon	Wed 10/1/08	Tue 10/28/08
10		End Door Tooling	7 mons	Tue 7/1/08	Thu 1/29/09
11		End Cap EMC Tooling	4 mons	Wed 10/29/08	Mon 3/9/09
12		Drift Chamber Tooling	6 mons	Wed 10/1/08	Mon 4/6/09
13		DIRC SOB Tooling	3 mons	Wed 10/1/08	Thu 1/8/09
14		Detector Roll-Out Equipment	2 mons	Tue 3/24/09	Mon 5/18/09
15		DIRC Central Support Tube/Horsecollar	9 mons	Fri 1/9/09	Thu 9/24/09
16		Barrel EMC Tooling	18 mons	Wed 10/1/08	Wed 3/31/10
17		Cylindrical RPC Tooling	1 mon	Thu 4/1/10	Wed 4/28/10
18		S.C. Solenoid/Valve Box Tooling	18 mons	Mon 9/1/08	Mon 3/1/10
19		Barrel Flux Return Tooling	21 mons	Tue 7/1/08	Tue 3/23/10
20		**PERIPHERALS DISASSEMBLY**	**46.5 mons**	**Wed 10/1/08**	**Thu 7/26/12**
21		Remove Shielding	1 mon	Wed 10/1/08	Tue 10/28/08
22		Remove Electronics House Equipment	4 mons	Wed 10/29/08	Mon 3/9/09
23		Roll Back Electronics House	0.5 mons	Tue 3/10/09	Mon 3/23/09
24		Dismantle Electronics House	1 mon	Tue 3/24/09	Mon 4/20/09
25		Remove End Door Peripherals	2 mons	Tue 3/24/09	Mon 5/18/09
26		Remove Barrel Peripherals	6 mons	Tue 5/19/09	Thu 11/5/09
27		Remove Piping/Heat Exchangers	2 mons	Fri 11/6/09	Tue 1/19/10
28		Remove Walkways and Platforms	1 mon	Wed 1/20/10	Wed 2/17/10
29		Remove IR-2 Cabling and Cableways	30 mons	Thu 2/18/10	Thu 7/26/12
30		**CORE DISASSEMBLY**	**27 mons**	**Wed 10/29/08**	**Thu 1/27/11**
31		Remove PEP Rafts	1 mon	Wed 10/29/08	Thu 11/27/08
32		Remove PEP Support Tube/SVT	0.5 mons	Fri 11/28/08	Thu 12/11/08
33		Disassemble FWD East End Door	1.5 mons	Tue 5/19/09	Tue 6/30/09
34		Disassemble BWD East End Door	1.5 mons	Wed 7/1/09	Wed 8/12/09
35		Disassemble FWD West End Door	1.5 mons	Thu 8/13/09	Thu 9/24/09
36		Disassemble BWD West End Door	1.5 mons	Fri 9/25/09	Thu 11/5/09
37		Remove Barrel Brass/LSTs	4 mons	Fri 11/6/09	Wed 3/17/10
38		Remove End Cap EMC	0.5 mons	Tue 3/24/09	Mon 4/6/09
39		Remove Drift Chamber	0.5 mons	Tue 4/7/09	Mon 4/20/09
40		Remove DIRC SOB	0.5 mons	Fri 11/6/09	Mon 11/23/09
41		Roll Out Detector	1 mon	Thu 3/18/10	Wed 4/14/10
42		Remove DIRC Central Support Tube/Horsecollar	1 mon	Thu 4/15/10	Wed 5/12/10
43		Remove Barrel EMC	1 mon	Thu 5/13/10	Thu 6/10/10
44		Remove Cylindrical RPC	0.5 mons	Fri 6/11/10	Thu 6/24/10
45		Remove S.C. Solenoid/Valve Box	1 mon	Fri 6/25/10	Fri 7/23/10
46		Remove Barrel Flux Return	6 mons	Mon 7/26/10	Thu 1/27/11
47		**DIRC/EMC SYSTEM DISASSEMBLY**	**24 mons**	**Fri 10/1/10**	**Wed 9/19/12**
48		DIRC Disassembly	6 mons	Fri 10/1/10	Wed 4/6/11
49		End Cap EMC Disassembly	3 mons	Thu 4/7/11	Thu 6/30/11
50		Barrel EMC Disassembly	15 mons	Fri 7/1/11	Wed 9/19/12



Proposed Performance Measurement Milestones

- FY08 Milestones
  - 9/30/08 D&D Safety Plan Created
  - 9/30/08 IFR Background Shield Wall and Supporting Structure Removed
- FY09 Milestones
  - 12/31/08 Electronics House Rolled Back
  - 03/31/09 PEP Rafts and Support Tube Removed
  - 03/31/09 Detailed Project Schedule Complete
  - 03/31/09 Materials Disposition Plan Created
  - 04/30/09 End Cap EMC and Drift Chamber Removed
  - 06/30/09 FWD East End Door Disassembled/Removed
  - 09/31/09 FWD West, BWD East End Doors Disassembled/Removed
- FY10 Milestones
  - 11/30/09 DIRC SOB Removed
  - 12/31/09 BWD West End Door Disassembled/Removed
  - 03/31/10 Barrel Brass Absorber/LSTs Removed
  - 04/15/10 Detector Rolled Out to Main Disassembly Area 05/15/10 DIRC Central Support Tube/Horsecollar Removed
  - 06/15/10 Barrel EMC Removed
  - 08/15/10 Solenoid/Valve Box Removed
- FY11 Milestones
  - 01/31/11 Barrel Flux Return Disassembled/Removed
  - 04/30/11 DIRC System Disassembled
  - 06/30/11 End Cap EMC Disassembled
- FY12 Milestones
  - 09/15/12 Barrel EMC Disassembled
  - 09/31/12 Project Completion

Phase	ED&I ($K)	M&S ($K)	Labor ($K)	Cont ($K)	Total ($K)
Project Management	2627.09	1350	0	839.07	4816.16
FY08	350				350
FY09	758.33	200		183.75	1142.08
FY10	608.33	300		208.75	1117.08
FY11	539.59	400		228.44	1168.03
FY12	370.84	450		218.13	1038.97
Engineering and Tooling Refurbishment	2496.67	872.5	140	696.83	4206
FY08		12.5	12.5		25
FY09	675	175		170	1020
FY10	1087.5	335		284.5	1707
FY11	734.17	350	127.5	242.33	1454
Peripherals Disassembly	416.65	157	906.67	296.08	1776.4
FY09	208.33	150	481.67	168	1008
FY10	116.66		212.5	65.84	395
FY11	33.33	5	85	24.67	148
FY12	58.33	2	127.5	37.57	225.4
Core Disassembly	570.87	80	1074.99	340.14	2066
FY08		12.5	12.5		25
FY09	104.19	41	439.17	116.84	701.2
FY10	320.85	17.5	354.15	138.5	831
FY11	145.83	9	269.17	84.8	508.8
DIRC/EMC System Disassembly	550	240	1090.83	376.17	2257
FY11	233.33	40	410.83	136.84	821
FY12	316.67	200	680	239.33	1436

Budget Breakdown

- Breakdown by Project Phase
  - Project Management $4816K
  - Engineering and Tooling Refurbishment $4206K
  - Peripherals Disassembly $1776K
  - Core Disassembly $2066K
  - DIRC/EMC System Disassembly $2257K
- Breakdown by Fiscal Year
  - FY2008 $400K
  - FY2009 $3871
  - FY2010 $4050
  - FY2011 $4100
  - Fy2012 $2700
- Project Total $15,121K
  - EDIA $6661K
  - M&S $2700
  - Labor $3212
  - Contingency $2548 (16.9%)

Final Comments

- We have an experienced and dedicated team shown in our draft Org Chart
  - Some participants on loan to other projects
    - Informal personnel agreements are now in place for the key personnel
      - Need to formalize
- We are finalizing a set of performance measurement milestones to help us track progress
- Cost estimates do NOT include costs associated with disposal of materials
- We have a proven safety record
- We are ready to begin disassembly!
  - Need determination of ownership
  - Disassembly of the concrete radiation shield wall is scheduled to commence August 4, 2008

APPENDIX J – D&D Schedule Milestones & Detailed Task List

The first two figures in this appendix are a very high level snapshot of the D&D schedule.

The third figure provides a double-clickable link to the detailed list of tasks for the D&D project, including hazard category and duration.

H.J. Krebs — BaBar Detector Disassembly and Disposal Master Project Schedule (v17)

ID	Outline Number		Task Name	Hazard Category	Duration	Start	Finish
1	1		BABAR DISASSEMBLY AND DISPOSAL		207.6 wks	Tue 7/1/08	Mon 9/24/12
2	1.1		PROJECT PLANNING (Charge # 1423610)		204 wks	Tue 7/1/08	Tue 8/28/12
3	1.1.1		GENERAL PROJECT MANAGEMENT		204 wks	Tue 7/1/08	Tue 8/28/12
4	1.1.2		CREATE SAFETY/MATERIALS DISPOSITION PLAN		33 wks	Tue 7/1/08	Fri 3/6/09
10	1.1.3		MATERIALS TRACKING SYSTEM		34.4 wks	Tue 7/1/08	Wed 3/18/09
17	1.1.4		CREATE CONTROLLED MATERIALS STORAGE AREAS		35 wks	Tue 7/1/08	Mon 3/23/09
24	1.1.5	✓	WORK PLANNING AND CONTROL		19 wks	Mon 8/25/08	Wed 1/21/09
30	1.1.6		MASTER PROJECT SCHEDULE		82.6 wks	Tue 7/1/08	Mon 3/15/10
42	1.1.7		IFC SYSTEM APPROVAL MILESTONES		58.8 wks	Fri 10/31/08	Fri 1/29/10
67	1.1.8		DISASSEMBLY READINESS REVIEWS		58 wks	Wed 3/4/09	Fri 5/7/10
92	1.1.9	✓	OFFICE SPACE PLAN		22.8 wks	Mon 10/6/08	Thu 4/2/09
97	1.1.10		MATERIALS DISPOSITION - DETERMINE HOLD/STORAGE AREAS		73.8 wks	Tue 7/1/08	Fri 1/8/10
119	1.1.11	✓	Determine Final Electronics House Footprint	VL	1 wk	Mon 10/6/08	Fri 10/10/08
120	1.1.12	✓	Determine Detector Out Location Footprint	VL	1 wk	Mon 10/13/08	Fri 10/17/08
121	1.1.13		PROJECT STATUS REVIEWS		148.4 wks	Mon 3/23/09	Mon 4/2/12
129	1.1.14	✓	DISASSEMBLY WEB CAMERA		12 wks	Mon 11/3/08	Wed 2/11/09
134	1.1.15	✓	MISCELLANEOUS PROJECT MANGEMENT ISSUES		1 wk	Mon 12/8/08	Fri 12/12/08
136	1.2		ENGINEERING AND TOOLING DESIGN & REFURBISHMENT (Charge # 1423620)		99.6 wks	Tue 7/1/08	Wed 7/14/10
137	1.2.1		DETECTOR/ELECTRONICS HOUSE ROLL-OUT EQUIPMENT		67.6 wks	Tue 7/1/08	Tue 11/10/09
177	1.2.2	✓	ELECTRONICS HOUSE ROLL-OUT		16.2 wks	Mon 11/3/08	Mon 3/16/09
180	1.2.3		PEP SUPPORT TUBE/RAFTS		13 wks	Mon 2/2/09	Tue 5/5/09
200	1.2.4		FWD END CAP EMC		33 wks	Mon 10/27/08	Tue 7/7/09
228	1.2.5		END DOOR FLUX RETURN		19.8 wks	Tue 1/20/09	Wed 6/10/09
270	1.2.6		BARREL IFR LSTs & BRASS ABSORBER		19.2 wks	Mon 3/2/09	Thu 7/16/09
300	1.2.7		DRIFT CHAMBER		14 wks	Mon 2/2/09	Tue 5/12/09
318	1.2.8		DIRC STAND OFF BOX		14 wks	Wed 5/13/09	Thu 8/20/09
337	1.2.9		DIRC BAR BOXES		30 wks	Fri 8/21/09	Thu 4/8/10
356	1.2.10		DIRC CENTRAL SUPPORT TUBE/HORSECOLLAR		26 wks	Wed 12/2/09	Fri 6/18/10
379	1.2.11		CYLINDRICAL RPC		23 wks	Thu 10/1/09	Tue 3/30/10
396	1.2.12		BARREL EMC		53 wks	Mon 6/15/09	Wed 7/14/10
426	1.2.13		SUPERCONDUCTING SOLENOID & ASSOCIATED HARDWARE		69.4 wks	Mon 11/10/08	Thu 4/22/10
488	1.2.14		BARREL FLUX RETURN		50.2 wks	Thu 5/14/09	Mon 5/24/10
551	1.3		DETECTOR PERIPHERALS DISASSEMBLY (Charge #1423630)		110.45 wks	Tue 7/1/08	Thu 9/30/10
552	1.3.1		RADIATION SHIELDING	N/A	28.3 wks	Wed 8/6/08	Thu 3/12/09
555	1.3.2		IFR BACKGROUND RADIATION SHIELD WALL	'-BBR-003	1.25 wks	Thu 3/12/09	Fri 3/20/09
571	1.3.3		WALKWAYS, STAIRWAYS & PLATFORMS	'-BBR-020	79.5 wks	Thu 10/16/08	Thu 6/10/10
572	1.3.3.1		Removal Phase I		18.9 wks	Thu 10/16/08	Wed 3/18/09
587	1.3.3.2		Removal Phase II		0.2 wks	Thu 5/21/09	Fri 5/22/09
592	1.3.3.3		Removal Phase III		2.5 wks	Mon 5/24/10	Thu 6/10/10
612	1.3.4		ELECTRONICS HOUSE EQUIPMENT	WIP-BBR-	35 wks	Tue 7/1/08	Mon 3/23/09
623	1.3.5		CHILLERS AND HEAT EXCHANGERS	WIP-BBR-	31.8 wks	Mon 9/22/08	Thu 5/21/09

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ID	Outline Number	Task Name	Hazard Category	Duration	Start	Finish
682	1.3.6	PIPING AND HOSES	-BBR-021	78.35 wks	Thu 10/16/08	Wed 6/2/10
741	1.3.7	VALVE PANELS	-BBR-022	66.85 wks	Fri 5/22/09	Thu 9/30/10
749	1.3.8	END DOORS	-BBR-023	10.6 wks	Thu 2/26/09	Tue 5/12/09
786	1.3.9	BARREL DETECTOR	-BBR-024	20.5 wks	Mon 3/16/09	Fri 8/7/09
991	1.3.10	IR-12 WORK		8.21 wks	Mon 3/2/09	Wed 4/29/09
996	1.4	DETECTOR CORE DISASSEMBLY (Charge #1423640)		108.85 wks	Thu 1/8/09	Wed 3/30/11
997	1.4.1	OPEN DETECTOR	-BBR-025	0.7 wks	Mon 3/30/09	Thu 4/2/09
1009	1.4.2	PEP RAFTS & SUPPORT TUBE	-BBR-026	7.56 wks	Mon 4/6/09	Thu 5/28/09
1010	1.4.2.1	Remove Backward Raft		2.85 wks	Mon 4/6/09	Fri 4/24/09
1053	1.4.2.2	Remove Beamlines in Tunnel to -15m from IP		2.35 wks	Mon 4/6/09	Tue 4/21/09
1069	1.4.2.3	Remove Forward Raft		2.71 wks	Wed 4/8/09	Mon 4/27/09
1095	1.4.2.4	Remove Rafts & Support Tube		4.55 wks	Mon 4/27/09	Thu 5/28/09
1117	1.4.3	CLEAN OUT DIRC TUNNEL	-BBR-025	0.4 wks	Thu 5/28/09	Mon 6/1/09
1126	1.4.4	FWD END CAP EMC	-BBR-027	2.08 wks	Thu 5/28/09	Fri 6/12/09
1157	1.4.5	ROLL BACK ELECTRONICS HOUSE	-BBR-028	13.45 wks	Thu 1/8/09	Thu 4/16/09
1220	1.4.6	FWD EAST END DOOR	-BBR-029	9.45 wks	Fri 6/12/09	Wed 8/19/09
1305	1.4.7	FWD WEST END DOOR	-BBR-029	18.68 wks	Tue 6/16/09	Tue 10/27/09
1391	1.4.8	BWD EAST END DOOR	-BBR-029	8.15 wks	Wed 10/21/09	Mon 1/4/10
1455	1.4.9	BWD WEST END DOOR	-BBR-029	17.15 wks	Wed 10/21/09	Wed 3/10/10
1519	1.4.10	EAST DETECTOR PLATFORMS	-BBR-030	2.1 wks	Wed 3/10/10	Wed 3/24/10
1523	1.4.11	ROLL OUT DETECTOR	-BBR-031	8.65 wks	Fri 3/26/10	Wed 5/26/10
1577	1.4.12	DRIFT CHAMBER	-BBR-032	2.1 wks	Mon 5/24/10	Tue 6/8/10
1581	1.4.13	DIRC STAND OFF BOX	-BBR-033	1.3 wks	Tue 6/8/10	Wed 6/16/10
1585	1.4.14	DIRC BAR BOXES	-BBR-033	2.3 wks	Wed 6/16/10	Thu 7/1/10
1589	1.4.15	DIRC CENTRAL SUPPORT TUBE/HORSECOLLAR	-BBR-034	2.3 wks	Fri 7/2/10	Tue 7/20/10
1593	1.4.16	CYLINDRICAL RPC	-BBR-035	1.1 wks	Tue 7/20/10	Tue 7/27/10
1597	1.4.17	BARREL EMC	-BBR-036	3.1 wks	Wed 7/28/10	Wed 8/18/10
1601	1.4.18	DUMP RESISTOR	-BBR-037	1.1 wks	Wed 8/18/10	Wed 8/25/10
1605	1.4.19	VALVE BOX	-BBR-038	1.1 wks	Thu 8/26/10	Thu 9/2/10
1609	1.4.20	SUPERCONDUCTING SOLENOID	-BBR-039	2.3 wks	Thu 9/2/10	Mon 9/20/10
1613	1.4.21	WEST DETECTOR PLATFORM	-BBR-030	1.1 wks	Tue 9/21/10	Tue 9/28/10
1617	1.4.22	BARREL BRASS ABSORBER/LSTs	-BBR-040	14.15 wks	Tue 9/28/10	Thu 1/20/11
1857	1.4.23	BARREL FLUX RETURN	-BBR-041	9.8 wks	Wed 1/19/11	Wed 3/30/11
1953	1.5	SYSTEM DISASSEMBLY (Charge #1423650)		97 wks	Fri 10/1/10	Mon 9/24/12
1954	1.5.1	DIRC/EMC SYSTEM DISASSEMBLY		97 wks	Fri 10/1/10	Mon 9/24/12
1955	1.5.1.1	DIRC Disassembly	WIP	25 wks	Fri 10/1/10	Mon 4/11/11
1956	1.5.1.2	End Cap EMC Disassembly	WIP	12 wks	Tue 4/12/11	Wed 7/6/11
1957	1.5.1.3	Barrel EMC Disassembly	WIP	60 wks	Thu 7/7/11	Mon 9/24/12
1958	1.5.1.4	BaBar Disassembly Complete		0 wks	Mon 9/24/12	Mon 9/24/12

H.J. Krebs — BaBar Detector Disassembly and Disposal Master Project Schedule (v15)

ID	Outline Number		Task Name	Hazard Category	Duration
1	1		BABAR DISASSEMBLY AND DISPOSAL		207.8 wks
2	1.1		PROJECT PLANNING (Charge # 1423810)		204 wks
3	1.1.1		Project Management		204 wks
4	1.1.2		Create Safety/Materials Disposition Plan		31 wks
5	1.1.2.1	✓	Develop Safety Plan	VL	25.4 wks
6	1.1.2.2	✓	Develop Materials Disposition Plan	VL	25.4 wks
7	1.1.2.3	✓	Review Safety/Materials Disposition Plan	VL	0.2 wks
8	1.1.2.4		Approve Safety/Materials Disposition Plan	VL	5.2 wks
9	1.1.2.5		Safety/Materials Disposition Plan Approved		0 wks
10	1.1.3		Materials Tracking System		31.4 wks
11	1.1.3.1	✓	Select Database Product	VL	14 wks
12	1.1.3.2	✓	Purchase Bar Codes	VL	10.4 wks
13	1.1.3.3	✓	Develop Mechanical Materials Tracking Input Form	VL	3 wks
14	1.1.3.4		Train Hall Crew Supervisors	VL	8 wks
15	1.1.3.5		Create "Storage Locations" in Database	VL	2 wks
16	1.1.3.6		Materials Tracking System Ready		0 wks
17	1.1.4		Controlled Materials Storage		28 wks
18	1.1.4.1	✓	IR-8	L	22.4 wks
19	1.1.4.2	✓	North SLC Arc Addit	L	20.8 wks
20	1.1.4.3	✓	First Eight Storage Containers Received		0 wks
21	1.1.4.4	✓	Design Layout of Guantanamo	VL	0.2 wks
22	1.1.4.5		Move Concrete Shield Wall Blocks and Erect Guntanamo Controlled Storage Area	M	3 wks
23	1.1.4.6		Add Gate to Guantanamo	L	0.4 wks
24	1.1.5		Work Planning and Control		19 wks
25	1.1.5.1	✓	Develop Work Planning and Control Beta Test Forms	VL	3 wks
26	1.1.5.2	✓	Beta Test of Work Integration Planning	VL	13.6 wks
27	1.1.5.3	✓	Revise Work Planning and Control Forms (if needed)	VL	1 wk
28	1.1.5.4	✓	BaBar D&D Work Planning And Control Forms Ready		0 wks
29	1.1.5.5		Write General Purpose JSAs	VL	16 wks
30	1.1.6		Master Project Schedule		82.8 wks
31	1.1.6.1	✓	Create Detailed Project Schedule (to Detector Roll-Out)	VL	14 wks
32	1.1.6.2	✓	Working Version of Detailed Project Schedule Created (to Detector Roll-Out)		0 wks
33	1.1.6.3	✓	Update Working Version of Master Project Schedule (Excluding System Disassembly)	VL	8 wks
34	1.1.6.4	✓	Review Working Version of Master Project Schedule (Excluding System Disassembly)	VL	2 wks
35	1.1.6.5	✓	Working Project Schedule Created (Excluding System Disassembly)		0 wks
36	1.1.6.6		SuperB Use of BaBar Systems Decided		0 wks
37	1.1.6.7		Create First Draft of DIRC System Disassembly Schedule	VL	8 wks
38	1.1.6.8		Create First Draft of End Cap Calorimeter System Disassembly Schedule	VL	8 wks
39	1.1.6.9		Create First Draft of EMC System Disassembly	VL	8 wks
40	1.1.6.10		Review System Disassembly Schedules	VL	2 wks
41	1.1.6.11		System Disassembly Schedule Created		0 wks
42	1.1.7		IFC System Approval Milestones		59 wks
43	1.1.7.1	✓	Services Disconnection		27 wks
44	1.1.7.1.1	✓	IFR/RPCs		0 wks
45	1.1.7.1.2	✓	IFR/LSTs		0 wks
46	1.1.7.1.3	✓	Silicon Vertex Tracker		0 wks
47	1.1.7.1.4	✓	Drift Chamber		0 wks
48	1.1.7.1.5	✓	End Cap Calorimeter		0 wks
49	1.1.7.1.6	✓	Superconducting Solenoid/Valve Box/Dump Resistor		0 wks
50	1.1.7.1.7	✓	Helium Liquifier		0 wks

BaBar Disassembly Master Schedule
H.J. Krebs
Date: Thu 2/12/09

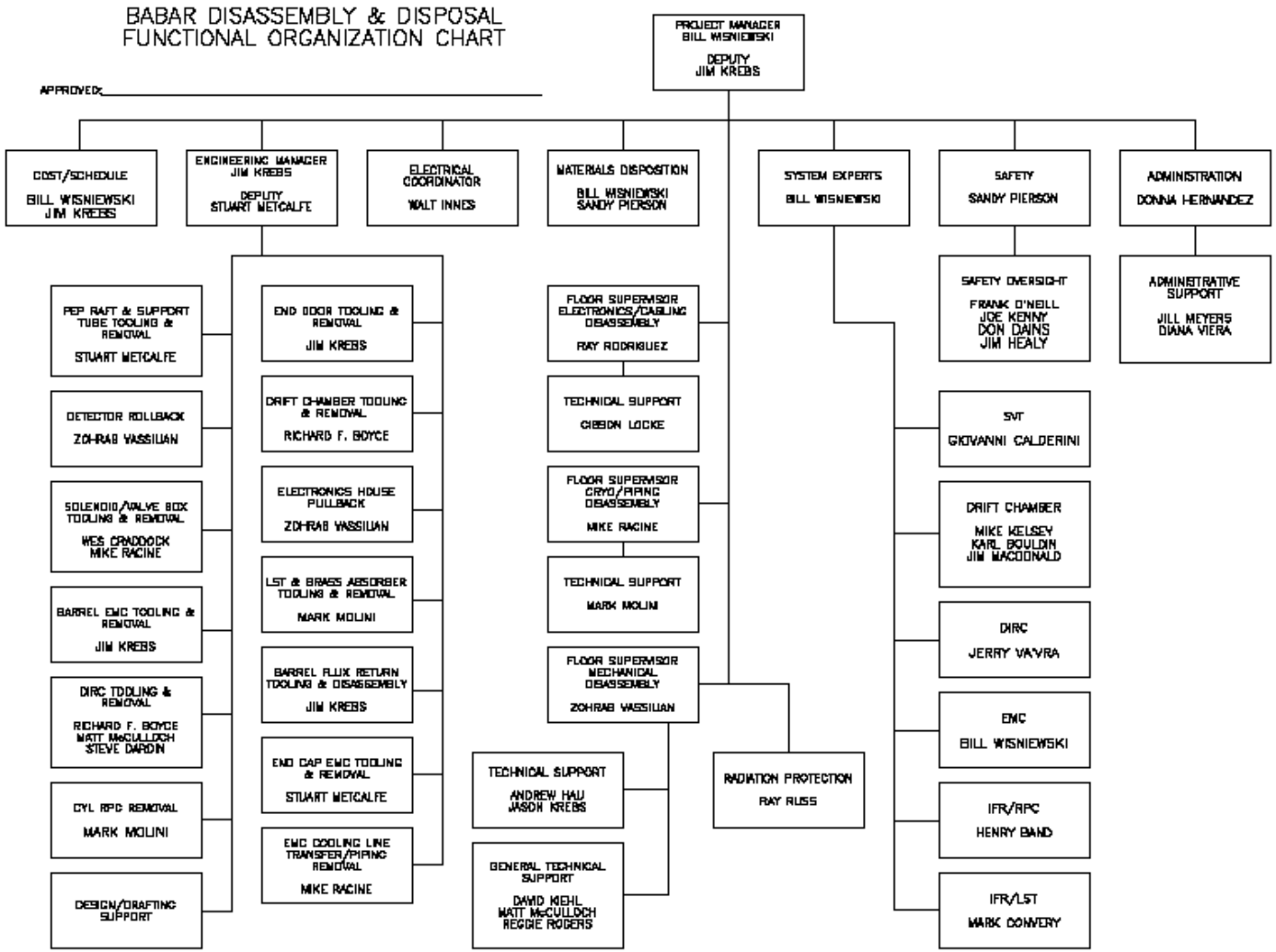
Task — Split — Progress — Milestone — Summary — Project Summary — External Tasks — External MileTask — Split

Page 1

APPENDIX K – BaBar D&D Functional Organization Chart

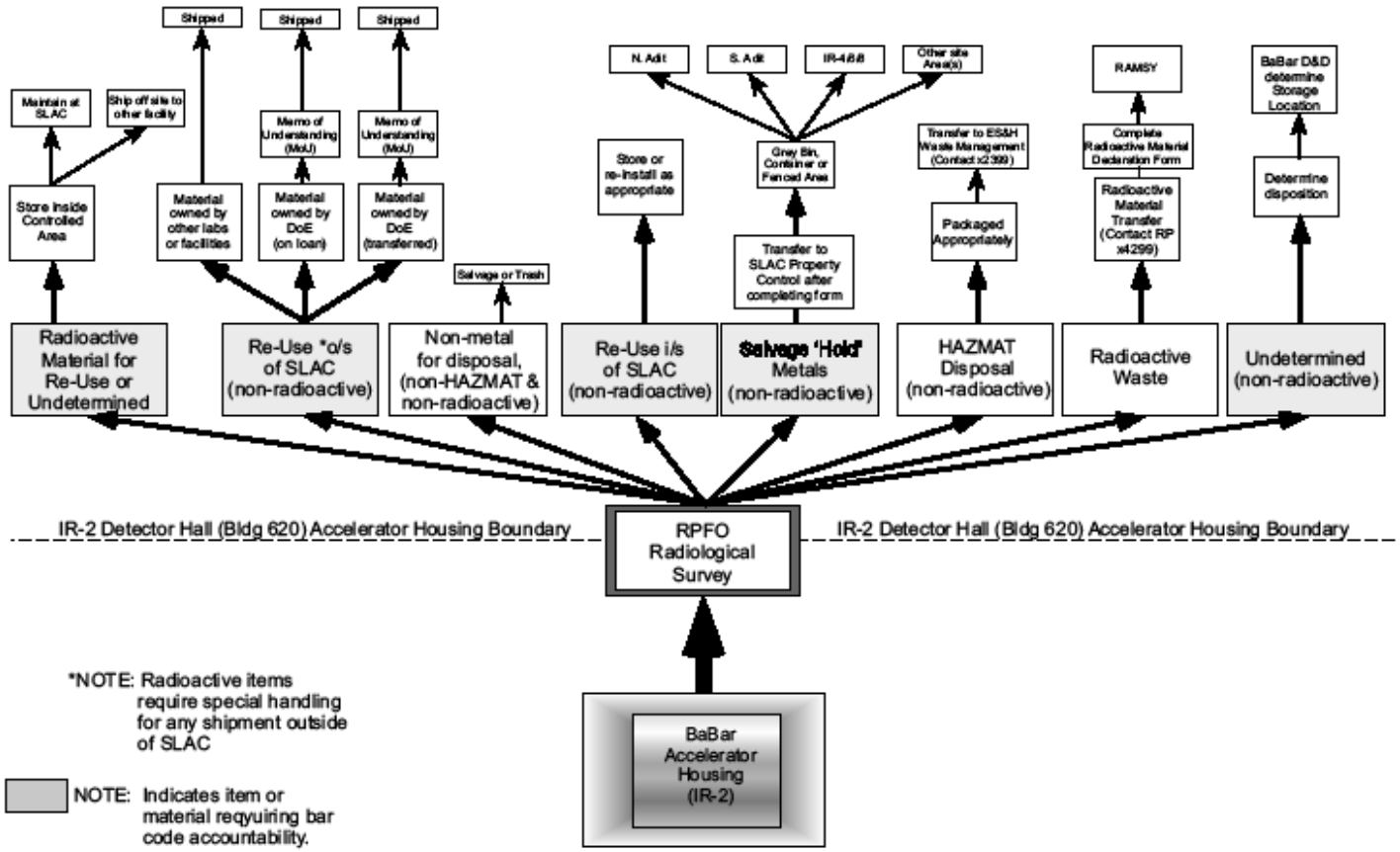
BABAR DISASSEMBLY & DISPOSAL FUNCTIONAL ORGANIZATION CHART

APPROVED:_____

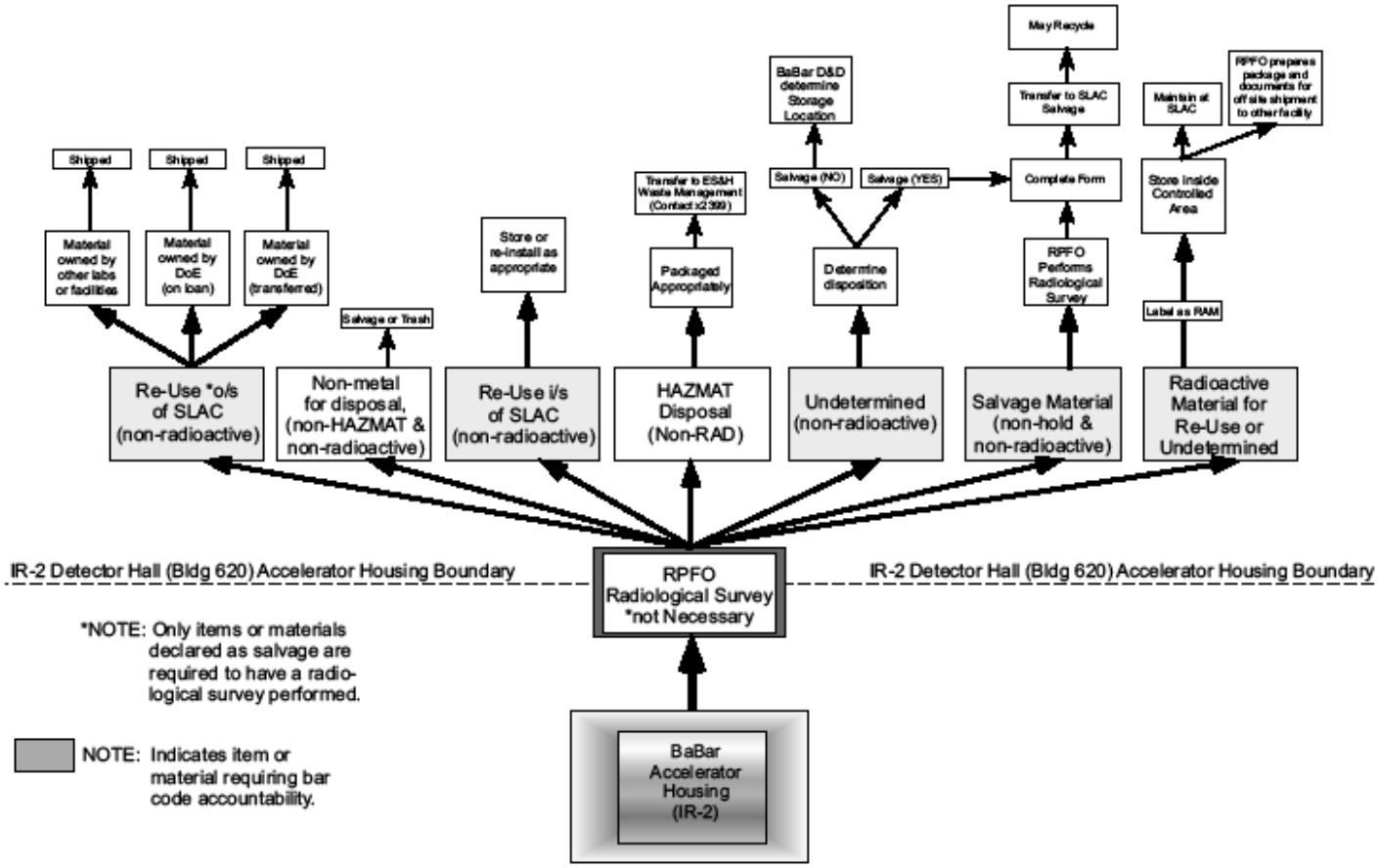


APPENDIX L – Materials Disposition Flowchart

Radiological Survey and Release/Hold for BaBar D&D Materials Removed From Accelerator Housing



Disposition of BaBar D&D Materials Removed From IR-2 RCA and Never Located Inside Accelerator Housing



SLAC

NATIONAL ACCELERATOR LABORATORY

Item Subject to DOE Suspension

DO NOT RECYCLE

DO NOT DISPOSE OF IN TRASH

Call (650) 926-2329 or (650) 926-4299
for Proper Disposal