Overview of Protocols for Release of Materials from PEP-II accelerator and BaBar Detector

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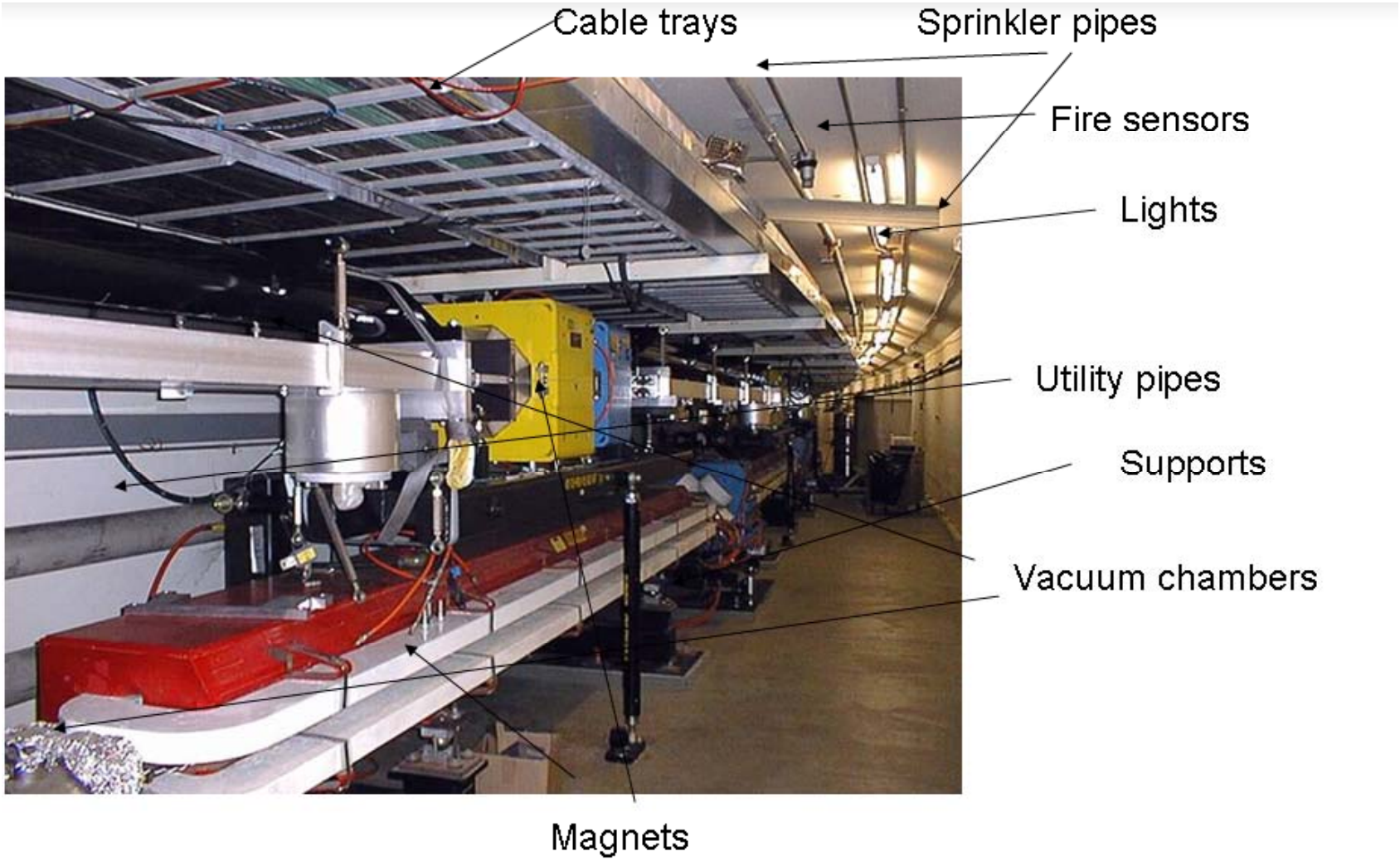
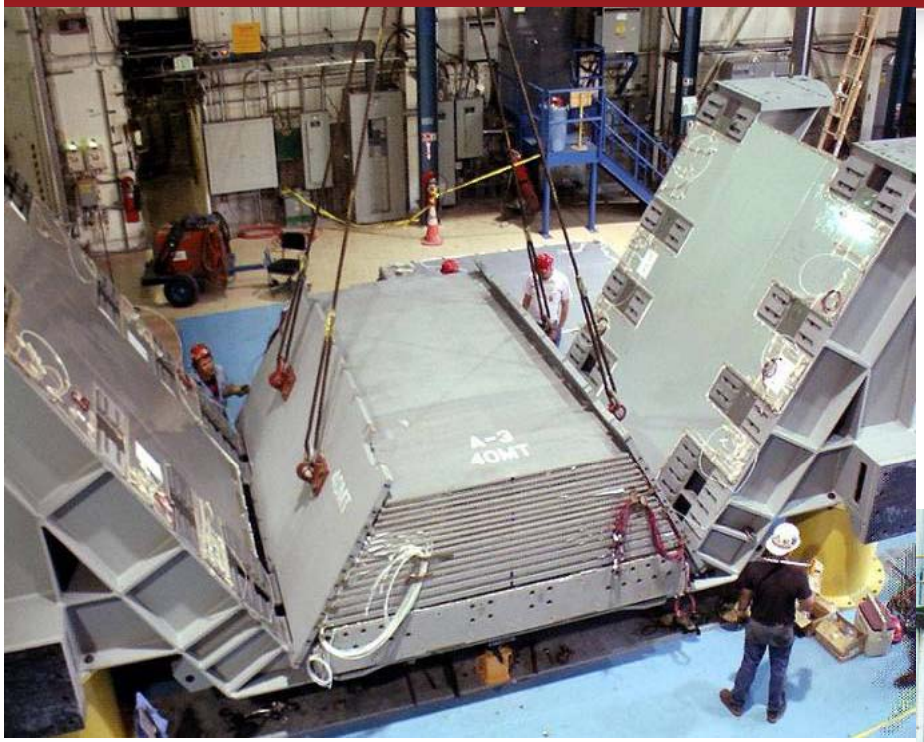
SLAC Metal Release: Time Line and Milestones

- DOE Review of B-Factory Decommissioning, SLAC, 2009
- DOE review of SC accelerator labs: SLAC, 2009
- NNSA/SC Joint Working Group: 2009-2010
- Radiological Clearance of Property Workshop, Las Vegas, Nevada, 2010
- Accelerator Safety Workshop, SLAC, 2010
- DOE-SC Letters from Malosh to SLAC Site Office (SSO) Manager, 2010
  - Letter from SSO to SLAC, 2010
- FY11 PEMP: Multi Year Material Disposition Plan
- Peer review of SLAC program and processes, documentation, July , 2011
- SSO V&V; August-September 2011
- SSO approval for release of PEP-II, BaBar materials, September 2011
- First release of metals from SLAC, September 2011
  - 8 tons of PEP-II Al cables, 1 ton of BaBar copper cables

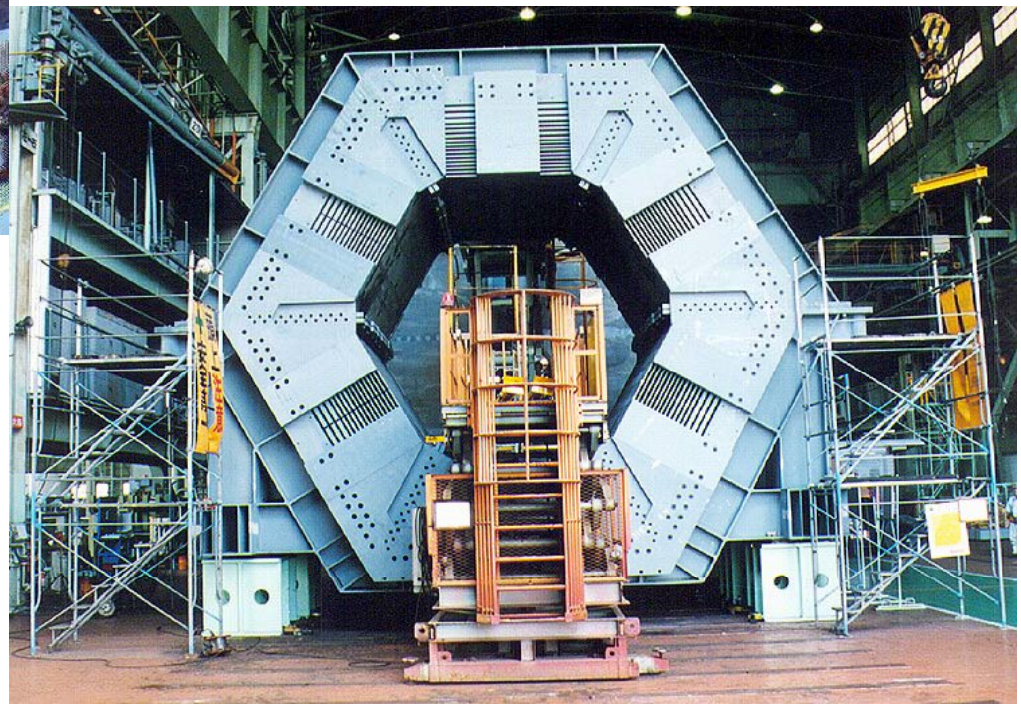
SLAC PEP-II Ring (2 km circumference)



Structures from BaBar Detector



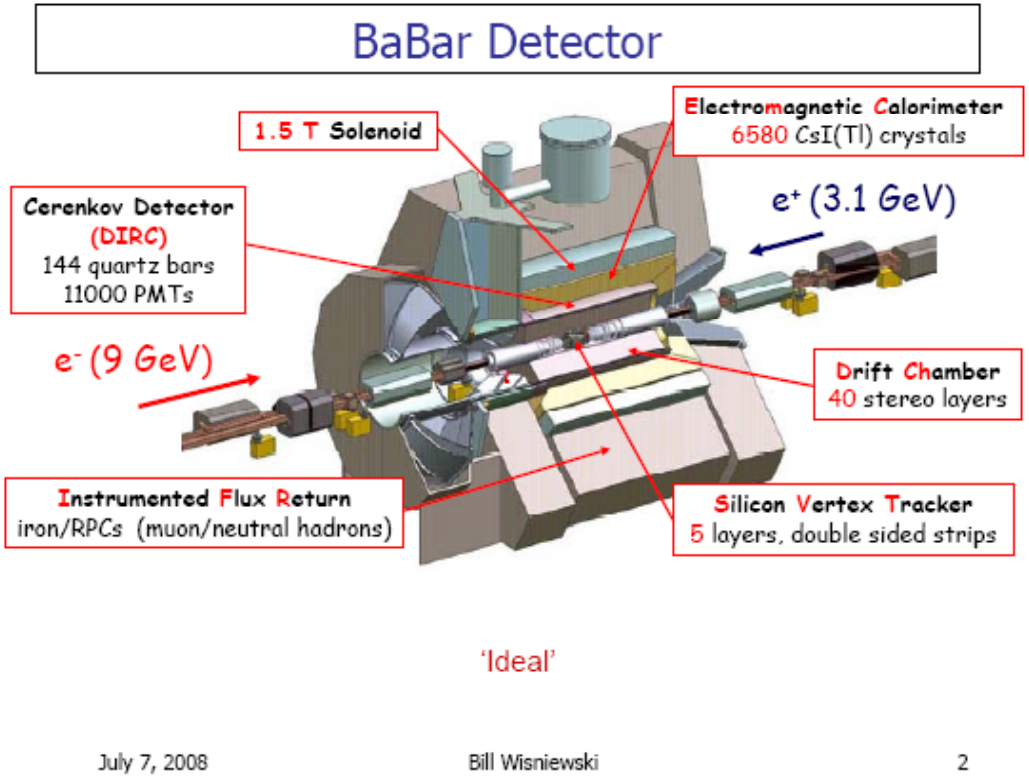
Magnet flux return (slabs of steel) and support girders



Activation Characteristics in Electron Accelerators

- No alpha emitters are produced
- Most radionuclides emit betas and gammas, which can be easily measured with common radiation instruments
- For material release purposes, in general, most abundant radioisotopes are those with a half-life of the order of the irradiation time (about 1 to 10 years)
- Induced activity in an object is volumetric and presents its maximum at the surface that faces beam loss points
  - This supports surface measurements
- Radioisotopes that are difficult to detect are generally accompanied by "proxy" radioisotopes that can be clearly measured
  - This supports measurements for proxy radioisotopes, instead of measurements for all potential radioisotopes that can be produced

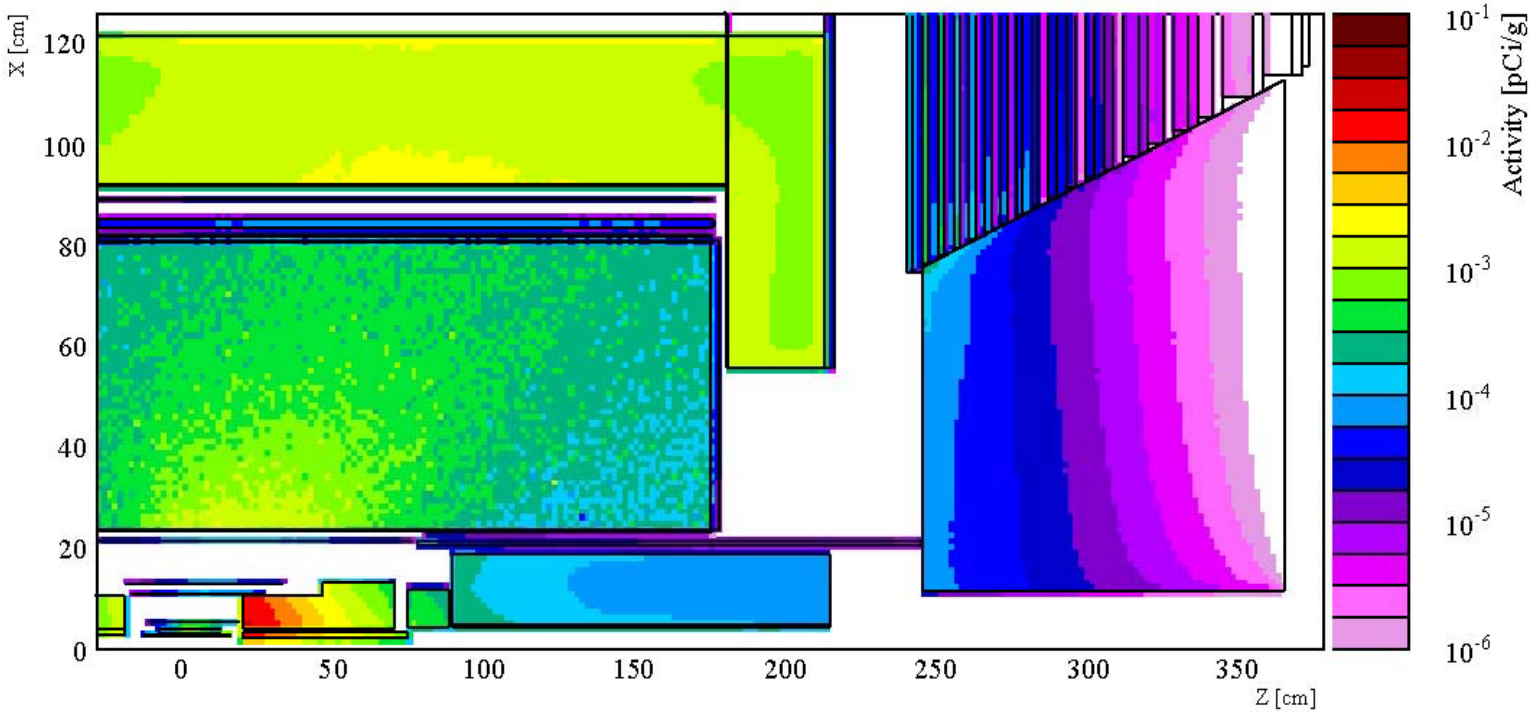
FLUKA Calculations of Induced Activity in BaBar



Three-Floor-High, Thousands Pieces

FLUKA is a Monte Carlo code that can calculate induced radioactivity in a 3-D geometry in accelerator facilities, well benchmarked by SLAC and CERN experiments

Calculated Volumetric Radioactivity Profile in BaBar



Notice how the radioactivity profile of each BaBar component has its maximum on the side that faces the source (i.e., e^+ and e^- collision point inside BaBar)

SALC RP Note 09-04, 2009

SLAC Material Release Program Release Protocols

- Release based on evaluation that includes both Process Knowledge and measurements
- Measurements characterize the materials as released from radiological controls when the instrument response or signal is indistinguishable from background (IFB)
  - Establishing IFB for the volumetric measurement protocols is accomplished at SLAC using practical and sensitive field survey instruments with sufficiently low detection limits and
  - supplemented by confirmatory measurements:
    - Field gamma spectrometry (a graded approach)
    - Portal gate monitor
    - Laboratory radioanalysis of representative samples
- SLAC measurement protocol for potential volumetric radioactivity has a detection limit capability that is about two order of magnitude lower than the ANSI N13.12 Screening Levels

SLAC Measurement Protocols and detection Thereshold for Volumetric Radioactivity

Type	Method	Equipment & Method to Detect Proxy Radioisotopes [references]	Detection Threshold
Basic Measurements	Field Surface Survey	Surface survey for gross beta-gamma counting rate using Ludlum 1”x1” NaI meter in scan or fixed point measurement mode [RPD2010a, RPD2009d]	1-10 (typical 3) pCi/g [RPD2011a]
Confirmatory Measurements	Field Gamma Spectrometry (graded approach)	Surface measurements using a portable gamma spectrometer for radioisotopes in the fixed point measurement mode [RPD2008f, RPD2011b, RDP2011c]	0.1-1 pCi/g
	Portal Gate Monitor (for large batch)	Thermal Fisher Scientific Radiation Portal Monitor TFS SGS-II (4 plastic scintillators, each 48x15x2 in^3, with NBR)	~0.1-1 pCi/g
	Laboratory HPGe Measurements (as warranted)	Representative samples collected and counted using low-background HPGe system with the environmental counting protocol [RPD2007b, RPD2007c, RPD2007d]	0.01-0.1 pCi/g

- ANSI N13.12 Screening Level (SL): 30 pCi/g for High-Dose category radioisotopes.
- Natural background levels: ~30 pCi/g of ^{40}K, ^{238}U and ^{234}Th series in soil.

Program Manual and TBDs

1. SLAC Material Release Program Manual
2. "Using the Ludlum-18 with a 44-2 detector to define and monitor radioactive materials," RPFO-042
3. "MCNP calculations of MDA and Detectable Region for the Ludlum-18 with a 44-2 Detector", RPD-008
4. "Technical basis document MDA for contamination," RPFO-031
5. "Use of ORTEC Transpec-100 with the ISOTOPIC program to quantify radioisotope activity concentration in homogeneous volumetric material" RPD-009
6. "Technical basis for measurements of induced radioactivity in concrete shield blocks",
7. *"Simulation of the induced radioactivity in the aluminum conductor cable of PEP-II due to beam collimation," RP Note ,2011*
8. *"Simulation of the induced radioactivity in the magnets and chambers of PEP-II," RP Note, 2011*
9. *"FLUKA calculations of the induced activity in the BaBar detector using B0B0 bar Events as a test case", RP Note RP-09-04.*

General and *Project-specific* Procedures

1. "Criteria for defining and monitoring for radioactive material," RPFO-018
2. "Contamination monitoring," RPFO-032
3. "Transpec-100 calibration and use procedure"
4. "SAM-935 calibration and use procedure" RE-023
5. "Use of ORTEC DigiDART to perform field measurements"
6. Radioanalysis Laboratory manual and HPGe/LSC procedures
7. *"PEP-II cable metal material release radiological survey plan and results," RPD-006*
8. *"PEP-II magnet and chamber material release radiological survey plan and results"*
9. *"BaBar radiological survey procedure," RPFO-043*
10. *"BaBar miscellaneous item bins release radiological survey plan and results," RPD-007*
11. *"Concrete shield blocks radiological survey plan and results," RPD-005*

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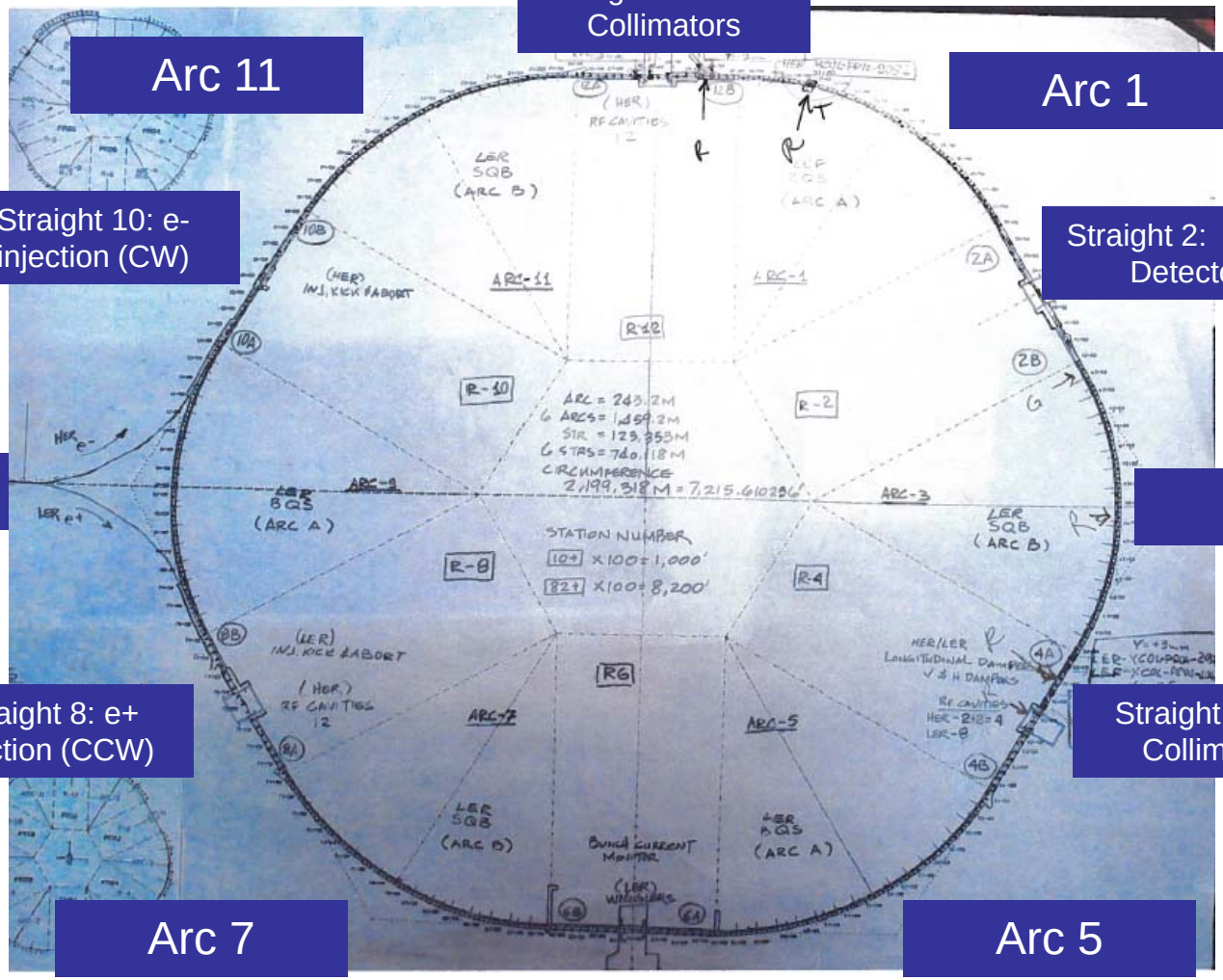
Documentation: BaBar, 30 Boxes, 240 Separate Measurements and Records

Initial Survey	30 Boxes Surveyed	30 Surveys Documented	30 Records	
Confirmatory Measurements	All Boxes - 4 Transpec Meas.	Boxes Zoned, Materials Segregated	27 Green, 3 Red Boxes	120 Records
Laboratory Gamma Spectroscopy	1 Sample per Box for all green Boxes	5 Samples per Box in 3 QA Boxes	42 Records	
QA Measurements	10% (3 Boxes) Resurveyed	Multiple Layers	45 Records	
Independent Lab analysis	1 Sample from each QA Box sent Offsite	3 Records		

PEP-II Overview, Segregation and Batching



Straight 12: HER Collimators

Arc 11

Arc 1

Straight 10: e- injection (CW)

Straight 2: BaBar Detector

Arc 9

Arc 3

Straight 8: e+ injection (CCW)

Straight 4: LER Collimators

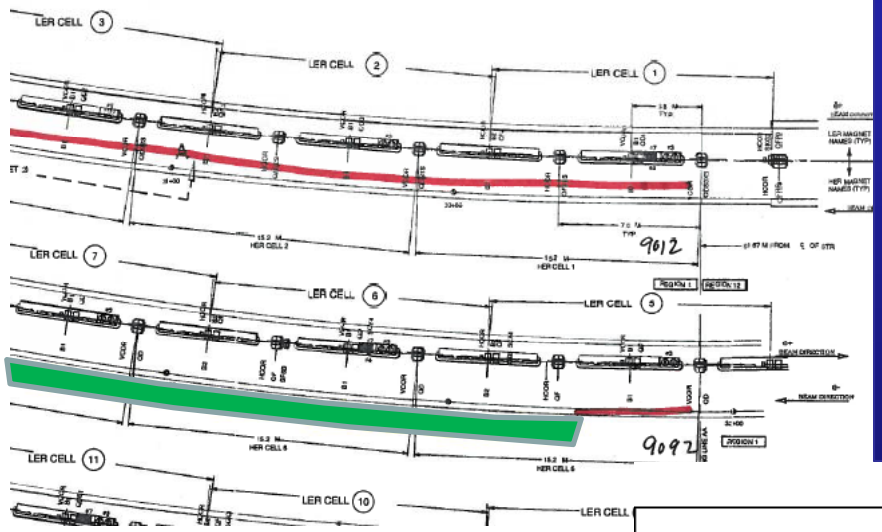
Arc 7

Arc 5

Straight 6

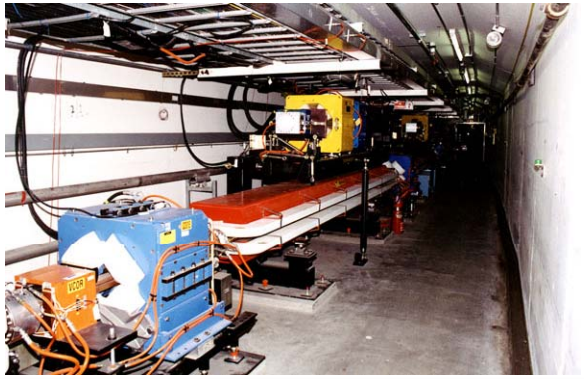
~420 Batches

Zoning in PEP-II Arc 1 (Accelerator Components)



Green: Radiological Survey shows no potential for radioactivity (fewer confirmatory measurements). PK and Simulations also considered in zoning
Red: Either method shows potential for radioactivity
Yellow: Conservative assignment when inconclusive, new data may be required.

Green: 70% of Arcs
Red and Yellow: 30% of Arcs



HER

Location (HER)	Component Reading L	Component Reading R	Piping Reading	Notes	Arc or Strait	Arc/St Number
R01-C01-PR12-9012	900	1200	4200	Red	Arc	1
R01-C01-PR12-9022	550	750	1100	Red	Arc	1
R01-C02-PR12-9032	1700	2400	2300	Red	Arc	1
R01-C02-PR12-9042	1000	1550	1800	Red	Arc	1
R01-C03-PR12-9052	450	760	700	Red	Arc	1
R01-C03-PR12-9062	280	300	2300	Red	Arc	1
R01-C04-PR12-9072	180	180	700	Red	Arc	1
R01-C04-PR12-9082	5100	164000	6500	Red	Arc	1
R01-C05-PR12-9092	480	1060	400	Red	Arc	1
R01-C05-PR12-9102	200	300	400	Green	Arc	1
R01-C06-PR12-9112	190	360	350	Green	Arc	1
R01-C06-PR12-9122	200	290	300	Green	Arc	1

August 8, 2011
BATCH
7-15-1

ORTEC
AMETEK

#923

#923