

# Fermilab Computing Division

## Physical Infrastructure Requirements for Computers FY04 – 07

(1/4/05)

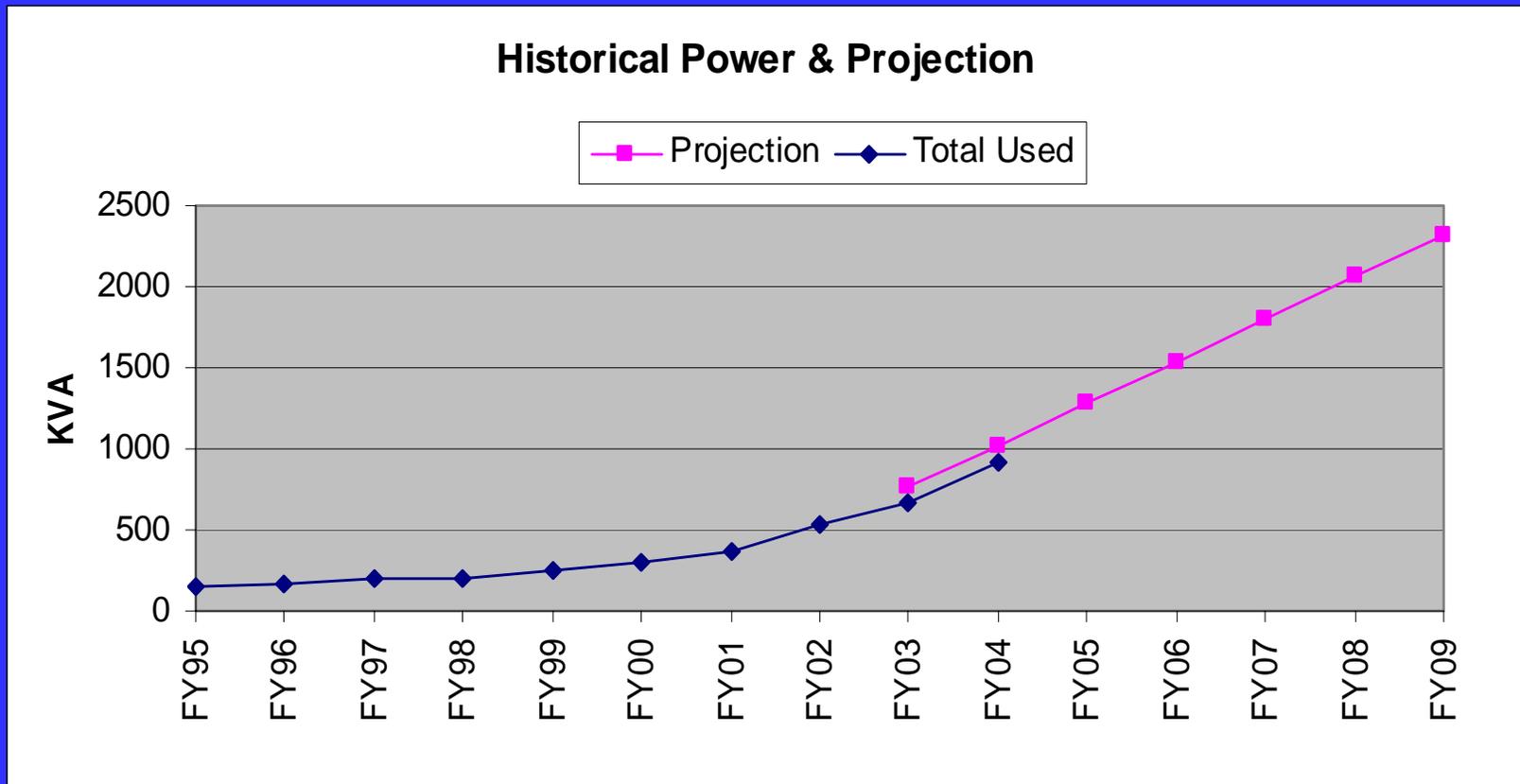
# Mission

- CDO/Operations provides requirements and management of computer infrastructure, i.e., space, power & cooling
- Computer rooms located in FCC, LCC and GCC
- Stakeholders: CDF, D0, CMS, SDSS, Minos, BTeV, BSS, FESS, PPD, among others

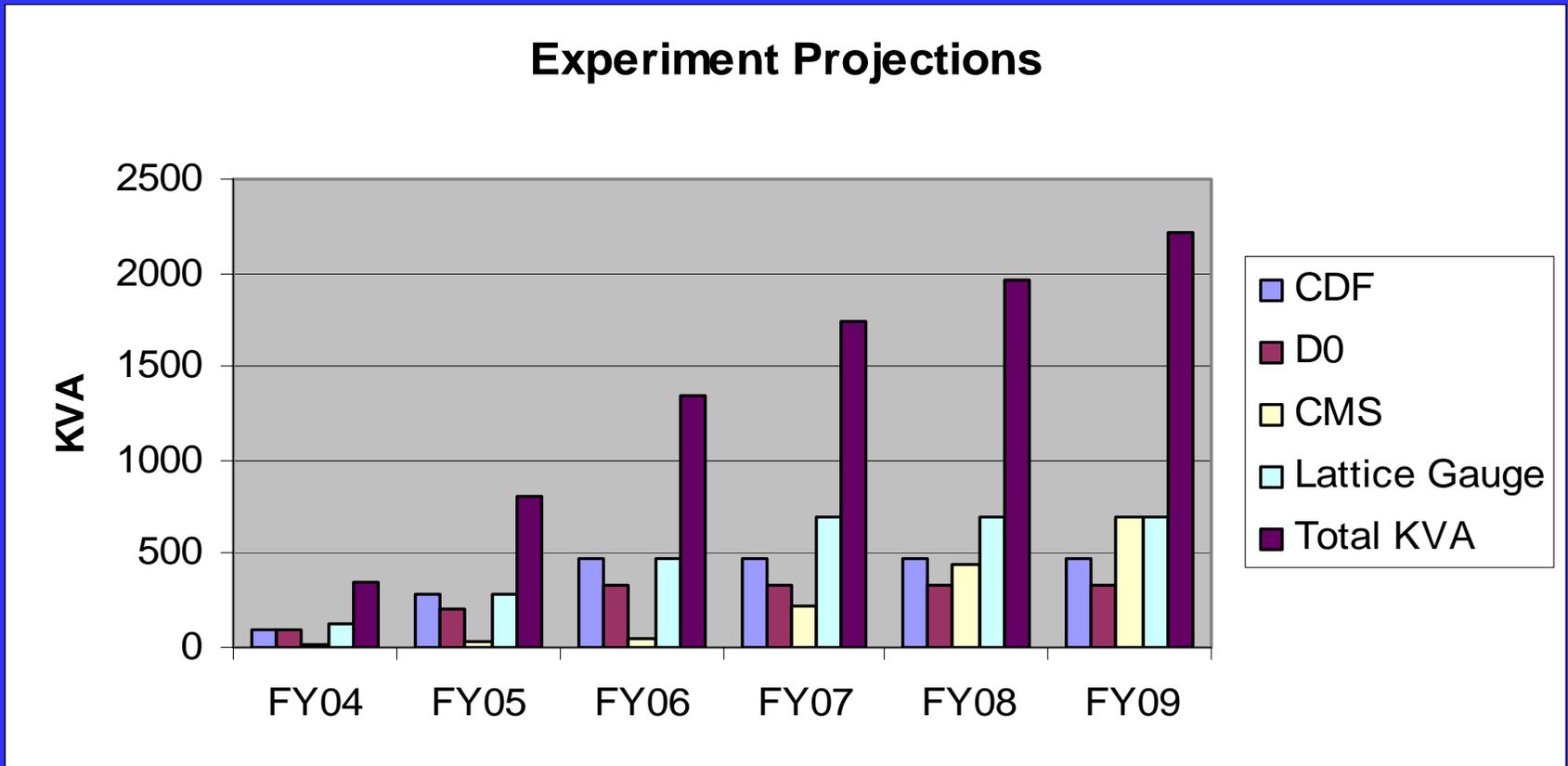
# What is happening?

- Commodity computers – more computing bang for the buck
- More computers are purchased (~1,000/yr)
- Power required per computer increasing yearly
- Rapidly increasing power and cooling requirements (+45%/FY02, +25%/FY03, +40%/FY04)
- More computers per sq. ft. of floor space (40 computers in 6 sq. ft., 10 – 13 KW)
- High power & cooling density (HDCF)

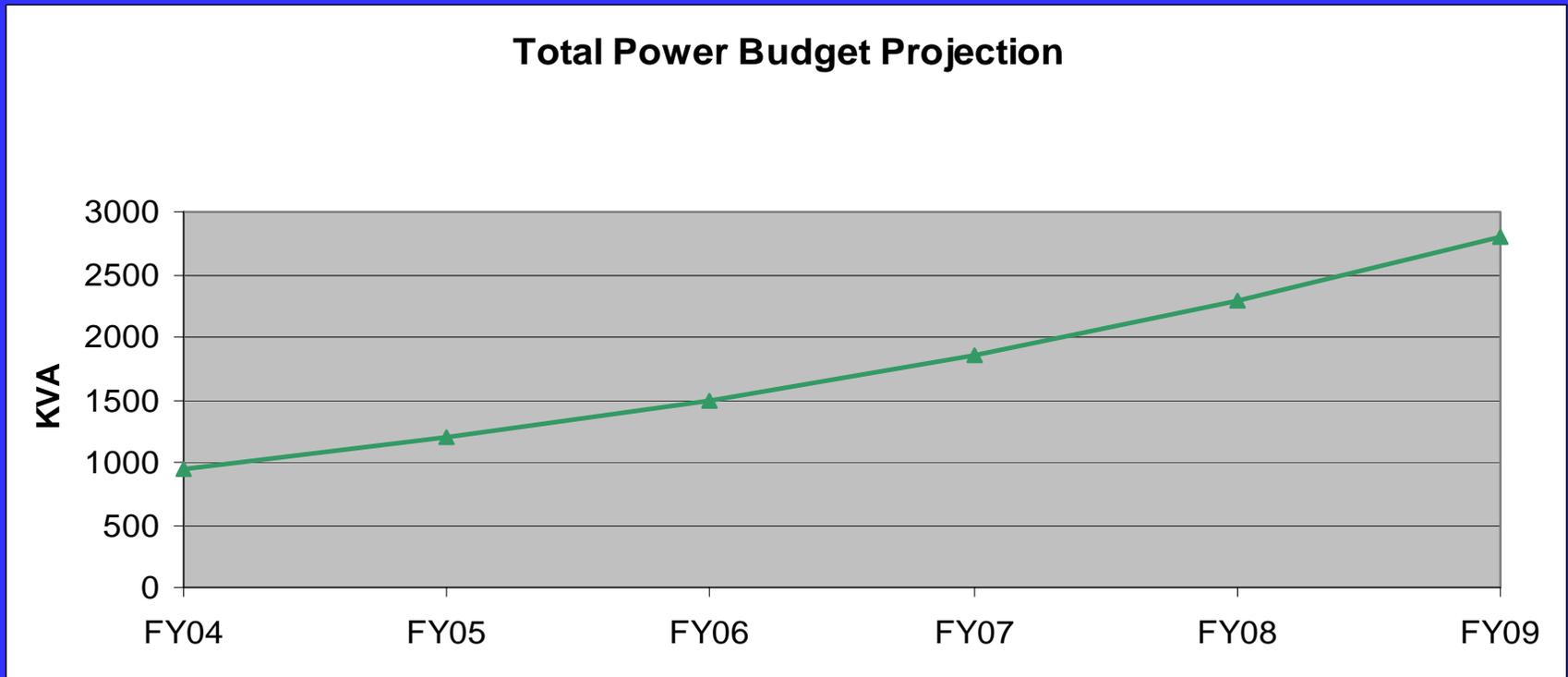
# Historical Power Growth + Projection



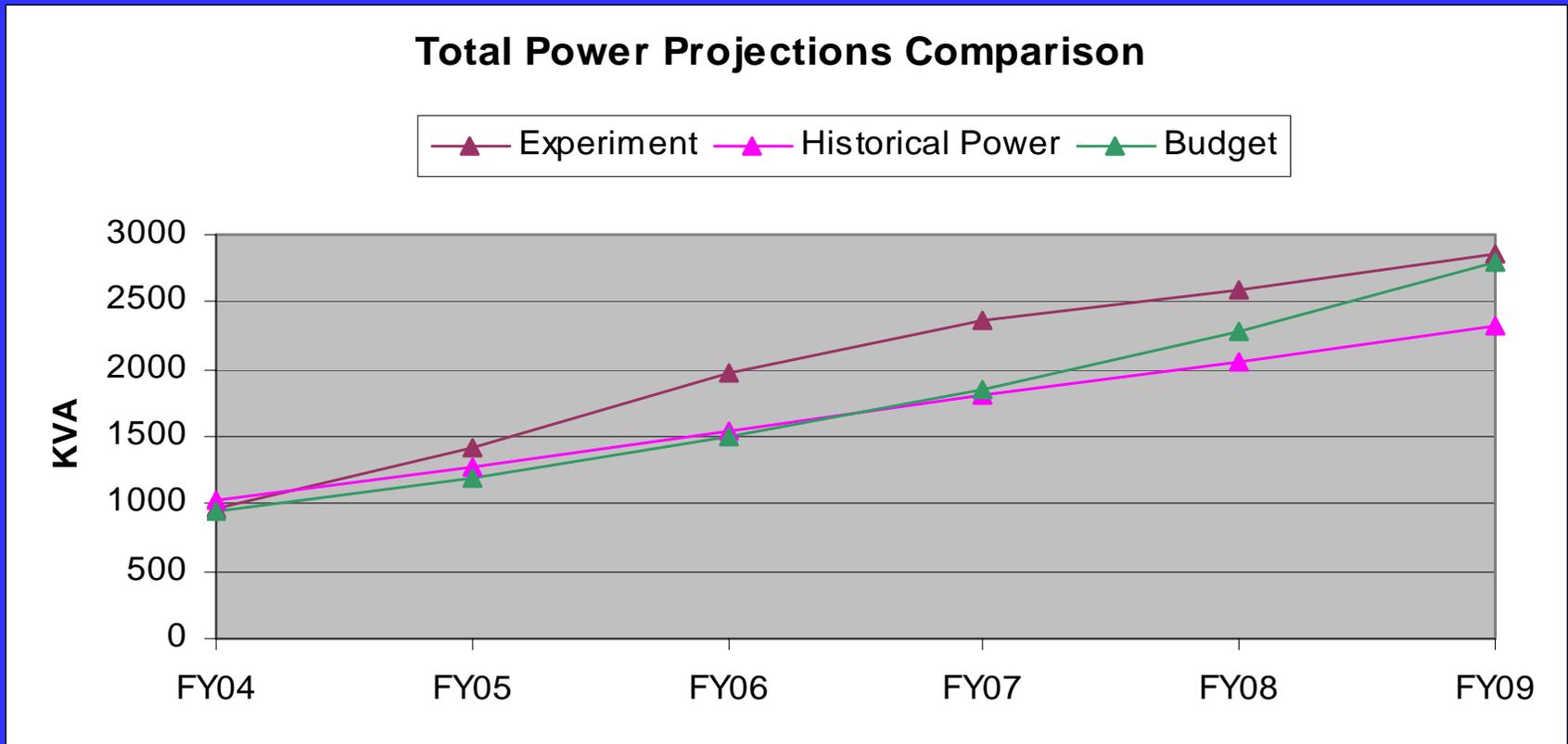
# Additional Power based on Experiment Projections in FY03



# Total Power Projection (\$2M/yr Computer Purchases)



# FY03 Total Power Projections Summary



# FCC Facts

- FCC reached it's maximum power and cooling capacity in FY03
  - FCC did not have sufficient utility space for added power and cooling equipment
  - Would have required a building addition, new feeder, upsizing of ICW, cooling pipes, ...
  - Would have caused major service outages

# Challenge

- Had to look outside FCC
- Needed to develop short (4 yr) & long term (10 yr) plans
- Plans needed to be phased. No longer can build a complete computer facility for 10 year life.
- Plans had to be adaptable to rapidly changing technology
- Concentrated on next 4 years

# 4 Year Response

- 4,000 computers, 4,000 sq. ft., 1600 KVA
- Wide Band offered the best in footprint for FY04/05 and electric power FY04-07
- Developed plan for adaptive reuse
- Directorate granted GPP funds for FY04 construction of 2,000 sq. ft., 800 KVA

# FY04/05

- GCC (Wide Band) computer room #1 completed Sept. 2004 (2,000 sq. ft. computer room, 800 KVA)
- Already running 760 computers @ 200 KVA = 1/3 FCC
- Planning to move ~500 systems (125 KVA) from FCC to GCC to accommodate new CDF, D0, CMS servers
- CDF, D0, CMS estimate total of 1,000 new computers in FY05
- Expecting 80% GCC utilization by end of FY05
- Also adding 1<sup>st</sup> half of 2<sup>nd</sup> computer room at LCC for Lattice Gauge (500 sq. ft., 250 KVA – CD funded). QCD is adding 512 computers in FY05 for a total of 768.

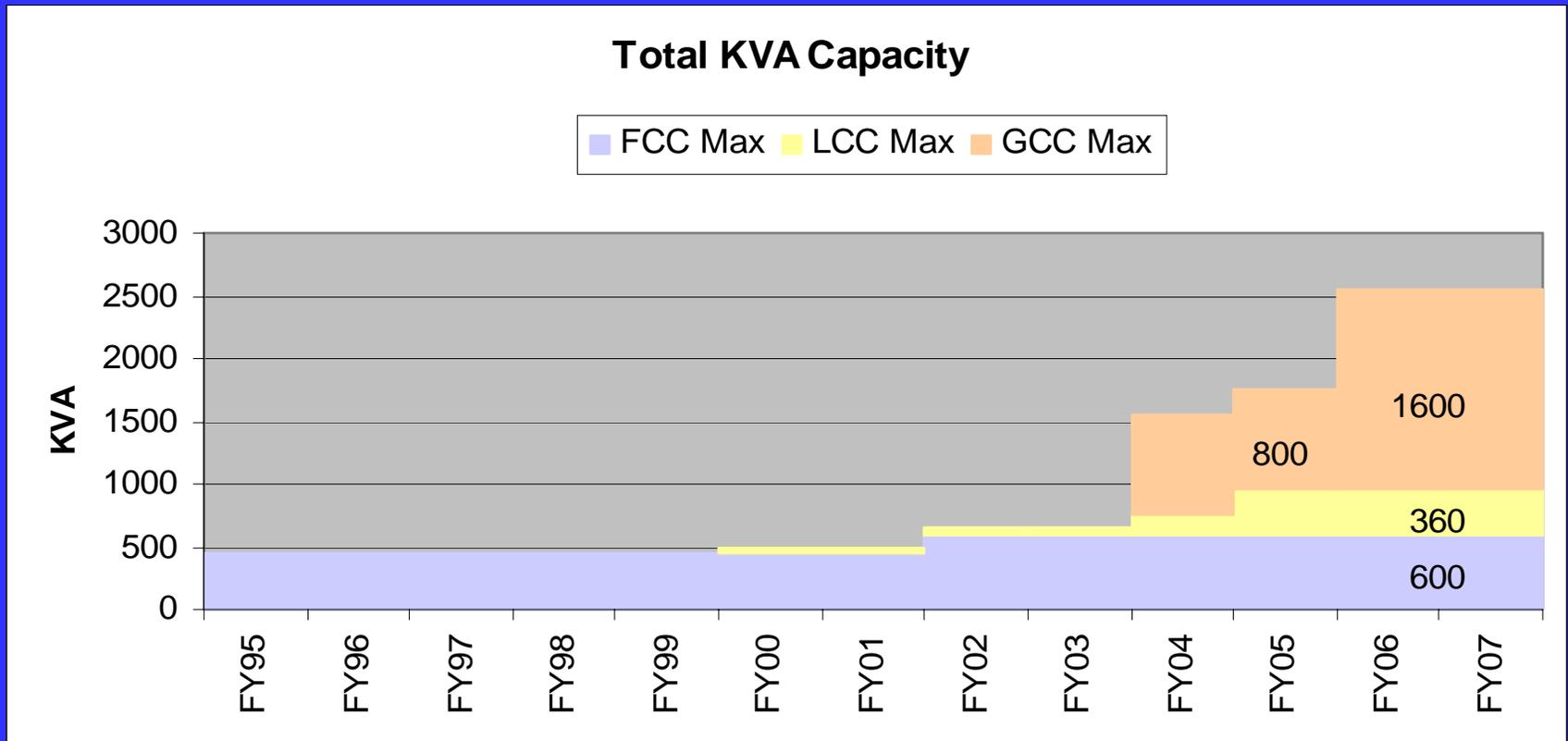
# FY05/06

- GCC north room: tape robots for distributed experiment data
- Finish out computer room #1 (2AC's)
- South building addition for computer room #2 (same size & power of room #1)

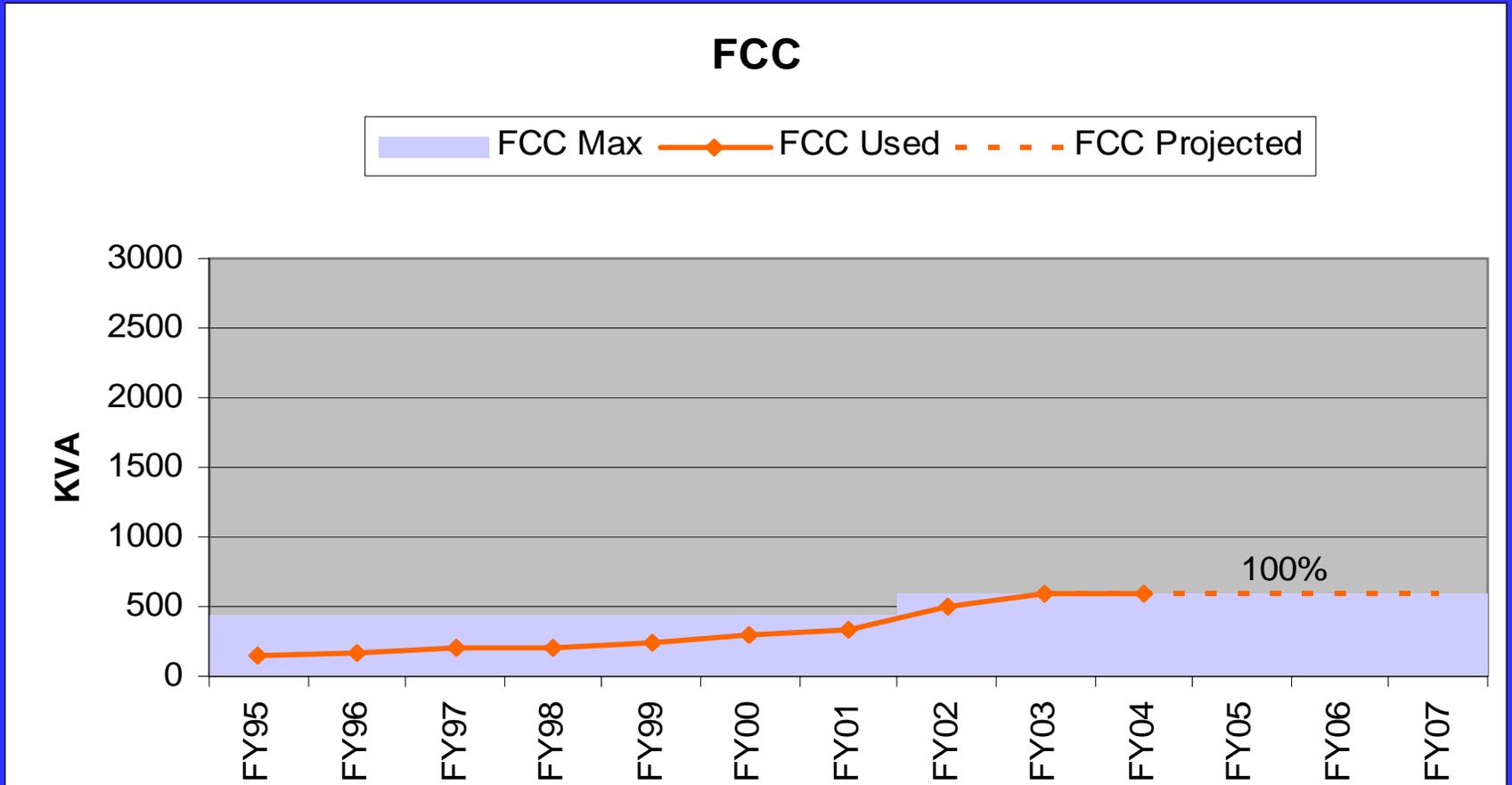
# Planned Capacities by FY07

- FCC - 600 KVA
- GCC - 1600 KVA
- LCC - 360 KVA
- Total – 2560 KVA
- Projections for FY07: 1800 - 2400 KVA

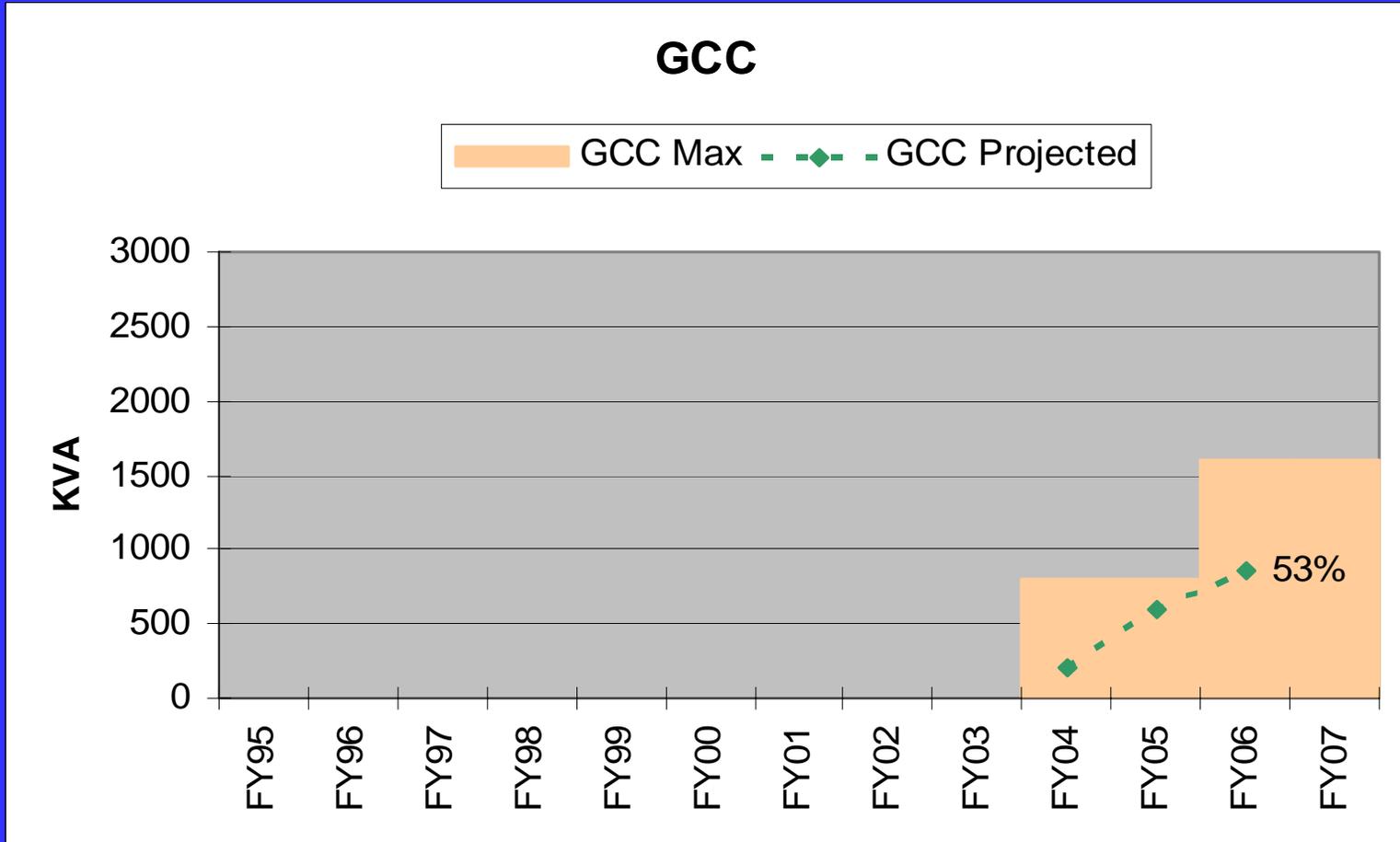
# Relative Capacities



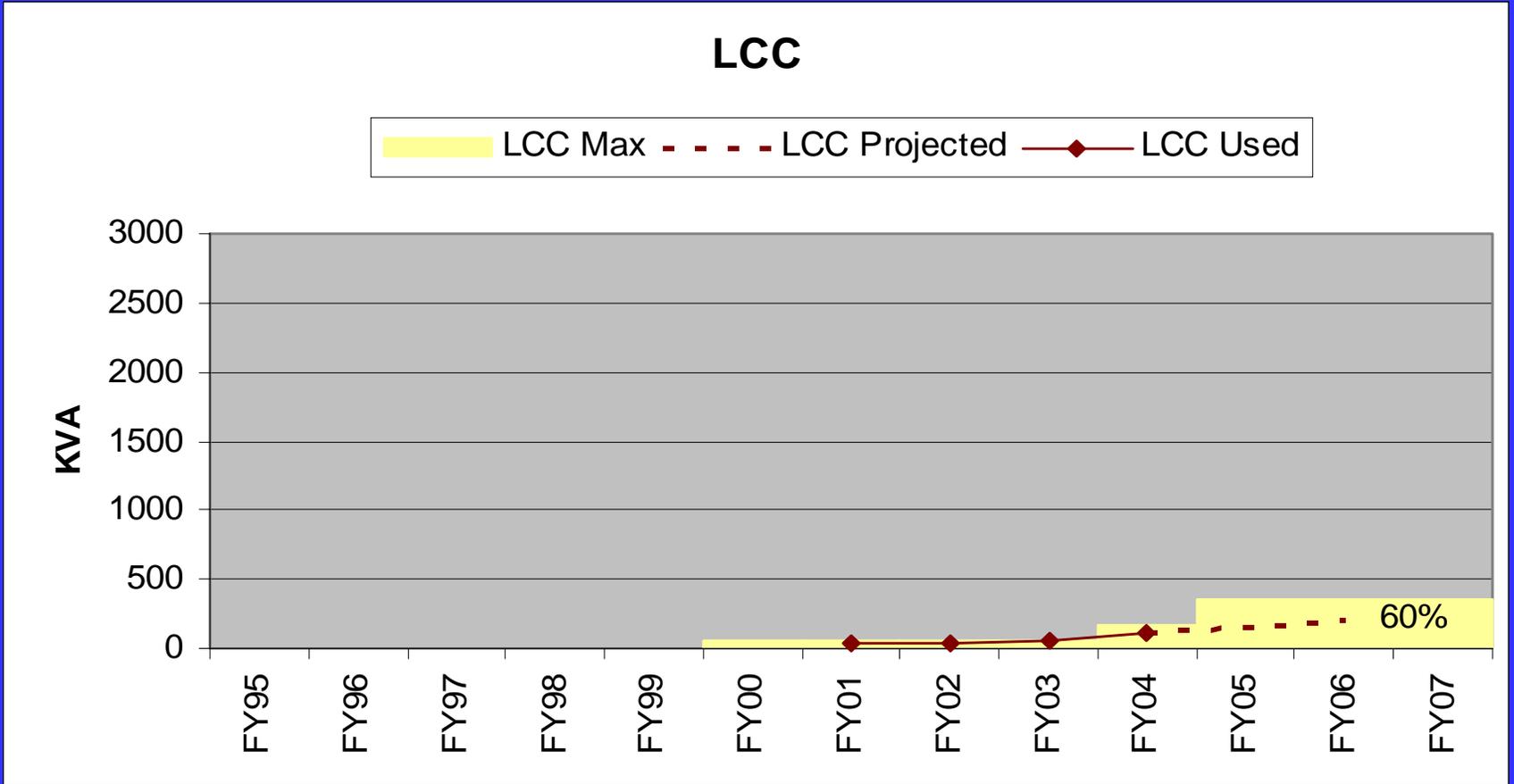
# FCC



# GCC

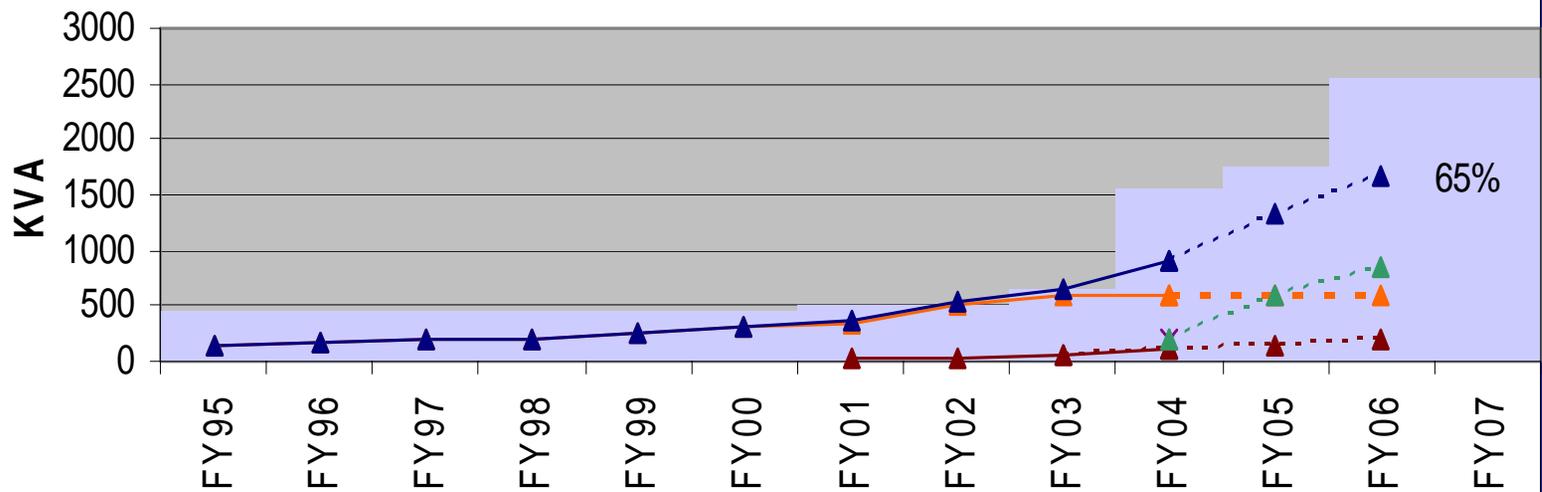
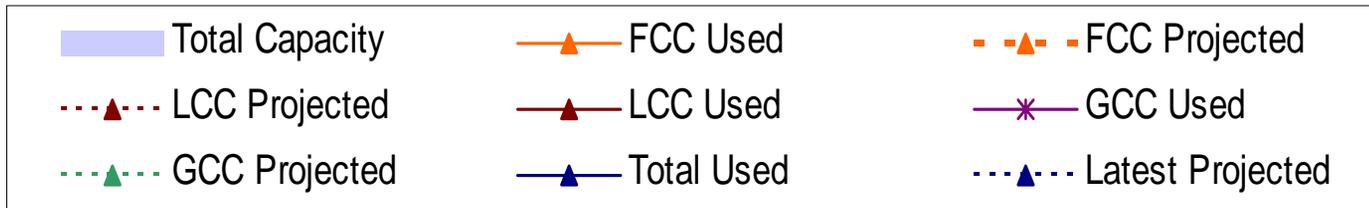


# LCC



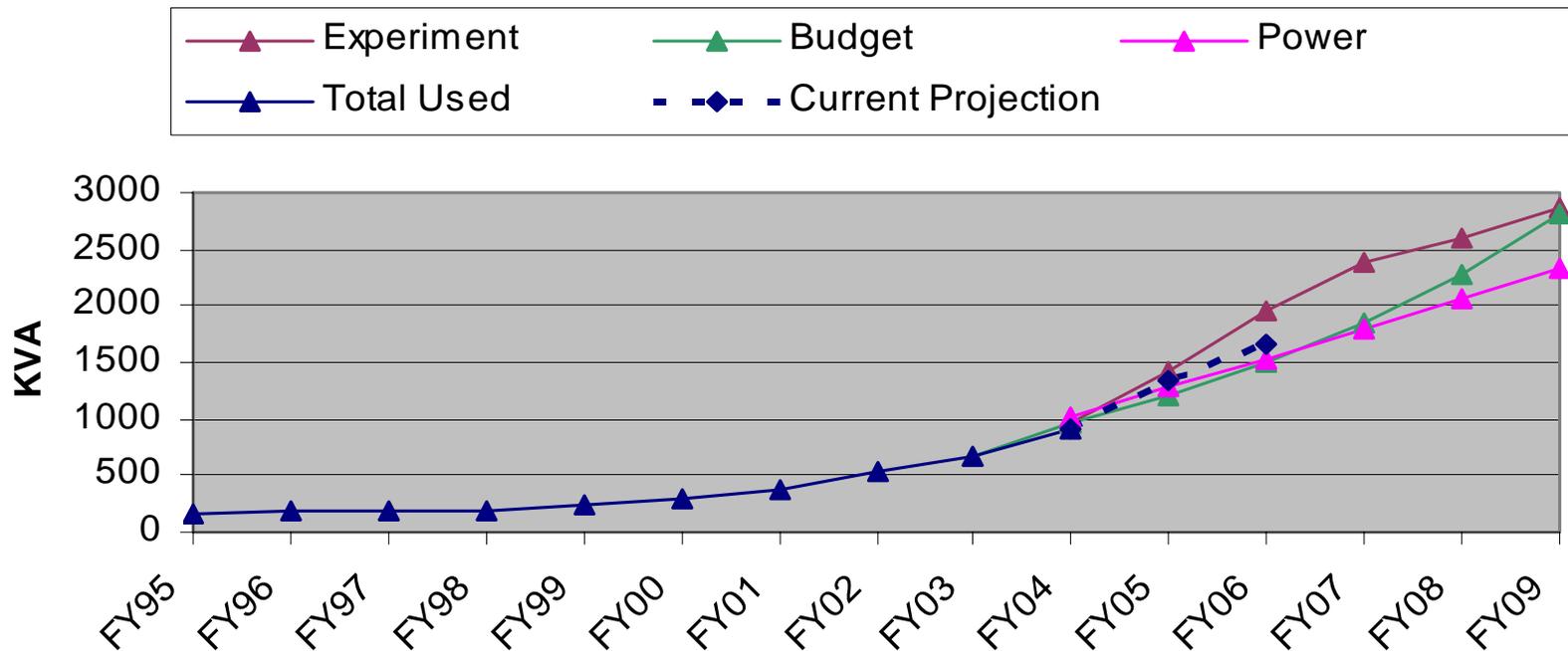
# All Facilities

## All Facilities Installed, Used & Projected



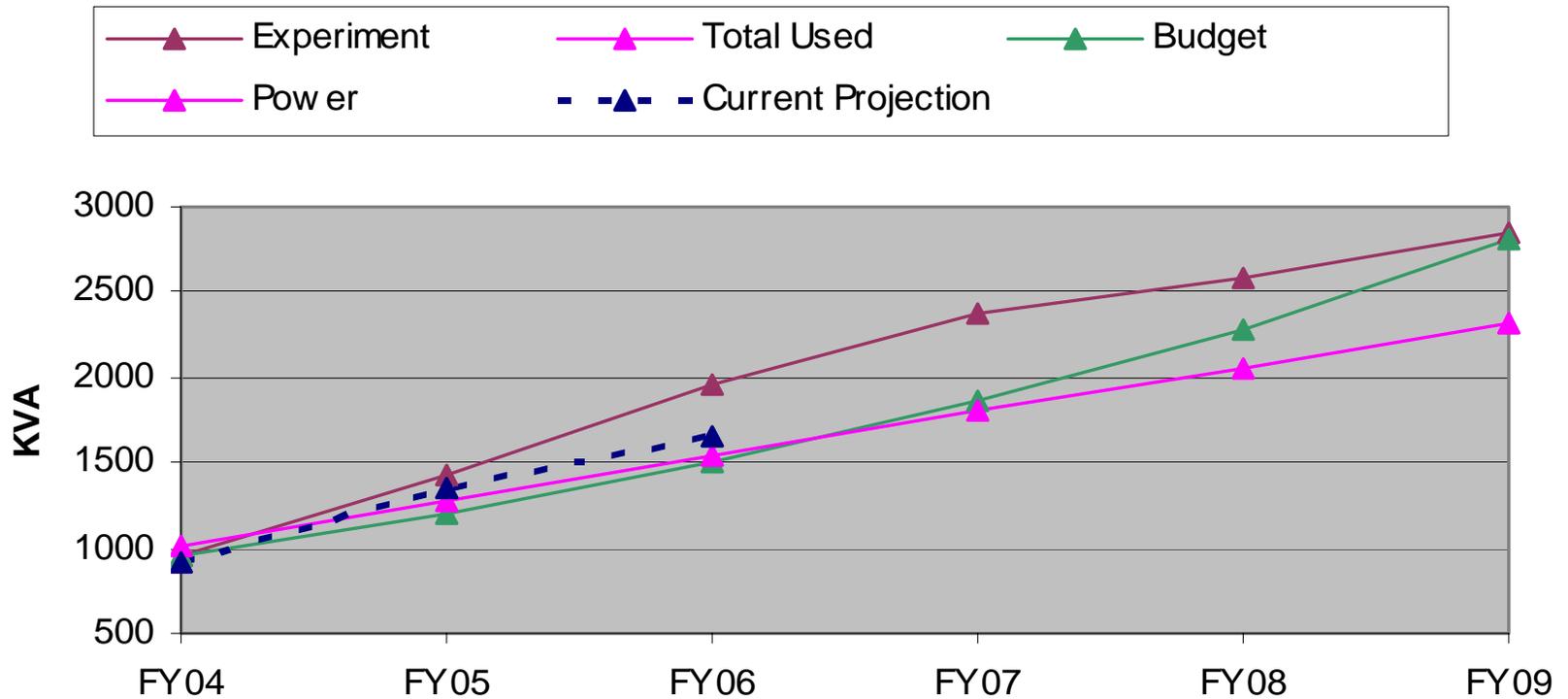
# Historical & Projections Comparison

## Total Power Projections Comparison



# Growth vs Projections

## Total Power Projections Comparison



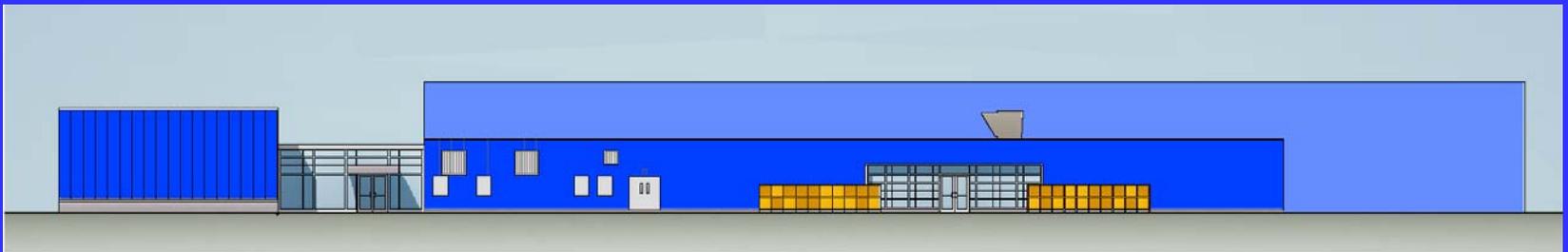
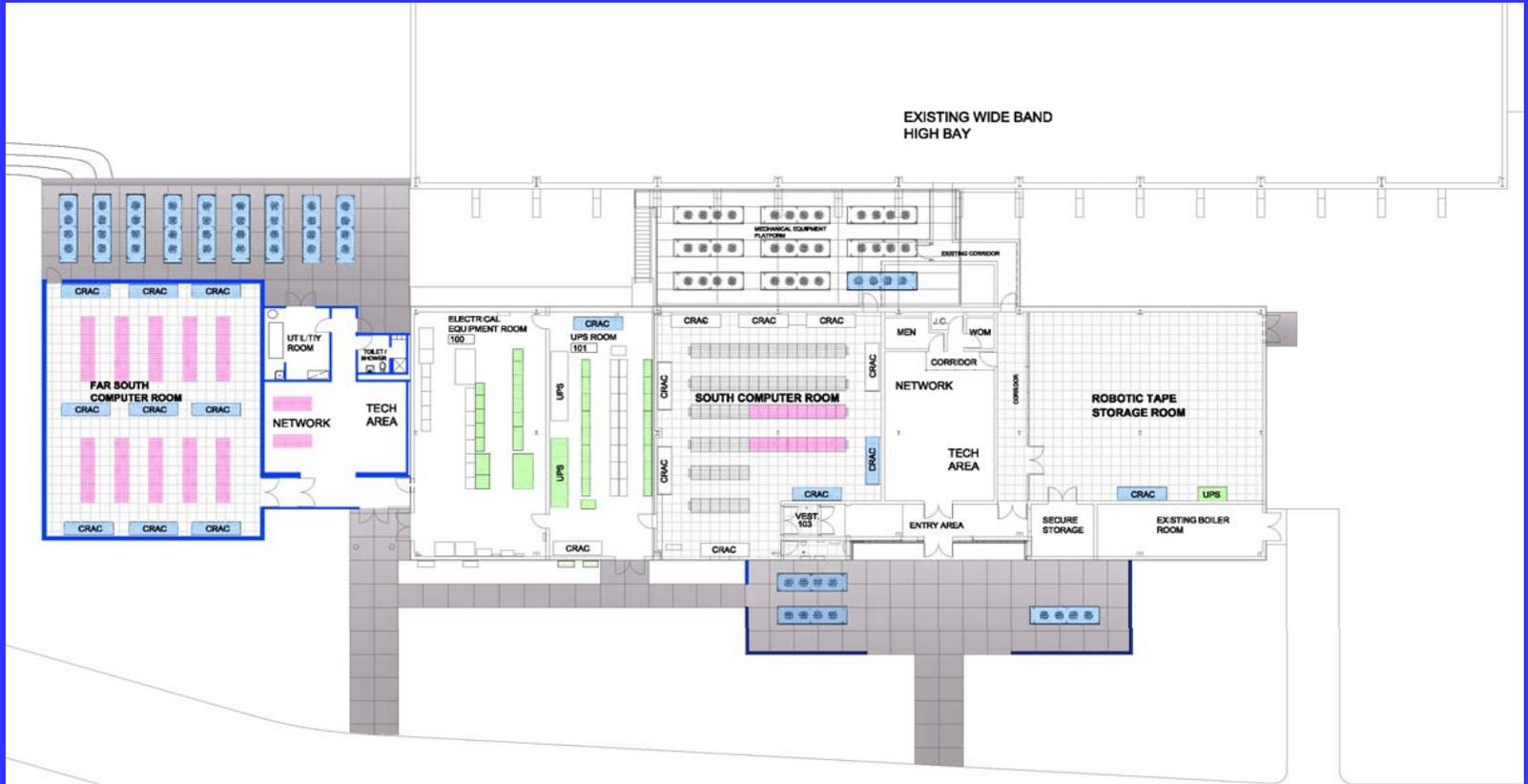
# FY08 & Beyond

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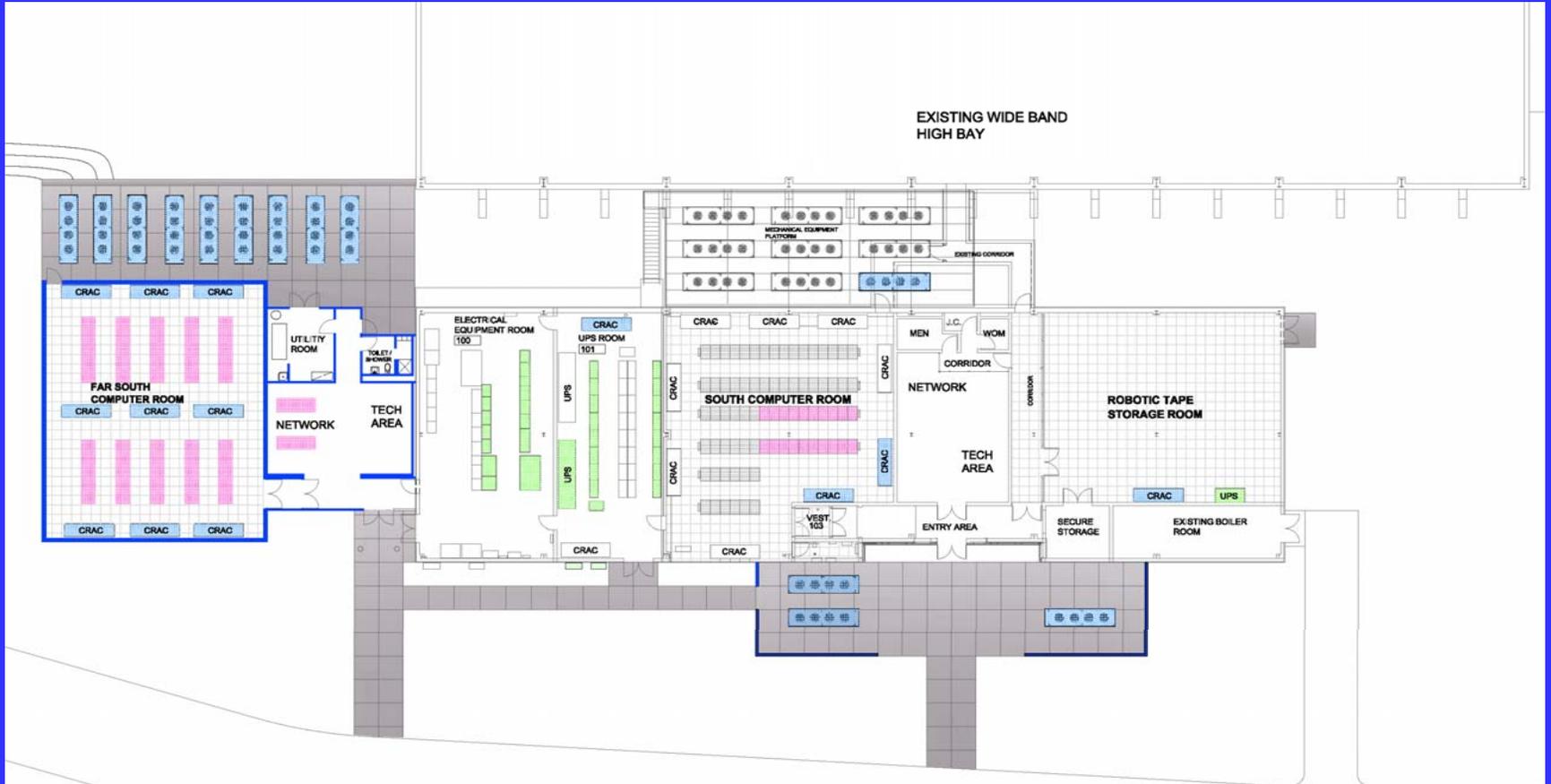
# FY05/FY06 Plans

- \$4.530m FY05/FY06 GPP Project
- Robotic Tape Storage Room (NCR)
  - 20 kVA UPS
  - 30 Tons of Cooling
  - 60 Tons of Cooling to SCR
  - 30 Tons of Cooling to UPS Room
- Substation Upgrades
  - (2)-1500 kVA Transformers
  - (4) Air Switches
  - Replace ~1,100 LF of Feeder Cable
- 2,400 SF Computer Room Addition
  - 1000 kVA/900 kW UPS system
  - 300 Tons of Cooling

# FY05/FY06



# FY05/FY06 Plan



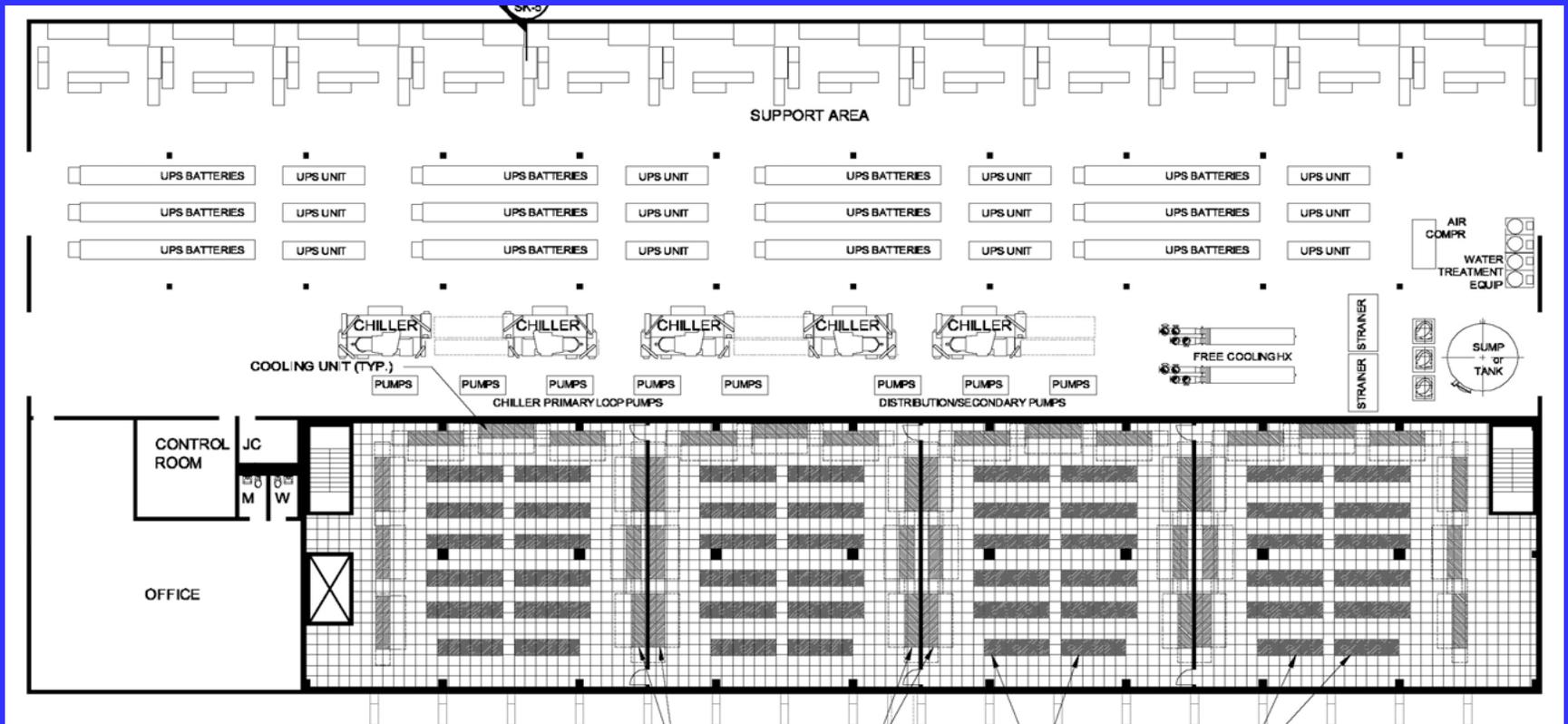
# FY05/FY06 Schedule

		M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20
Package #1	Title 2																				
	Procurement																				
	Title 3																				
Package #2	Title 2																				
	Procurement																				
	Title 3																				
Package #3	Title 2																				
	Procurement																				
	Title 3																				

# Future Facilities Options

- High Bay Expansion - 3 Floors
- High Bay Expansion - 1 Floor
- New Building
- Adaptive Reuse of Existing Building

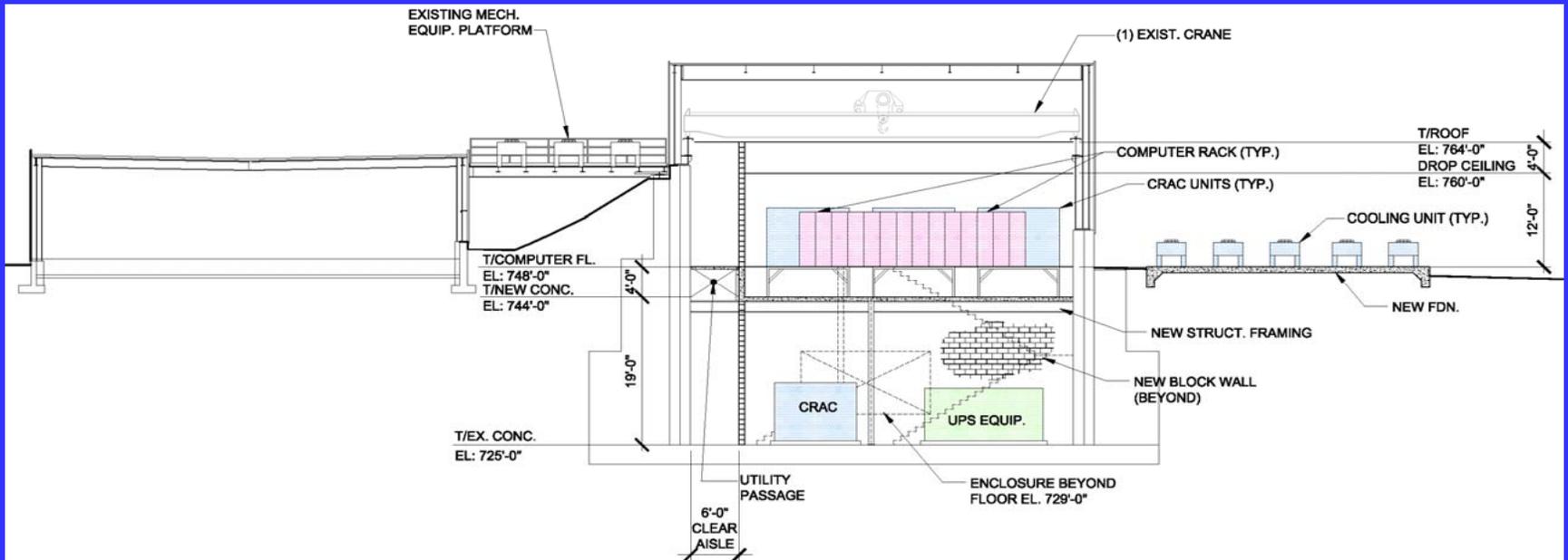
# High Bay Expansion – 3 Floors



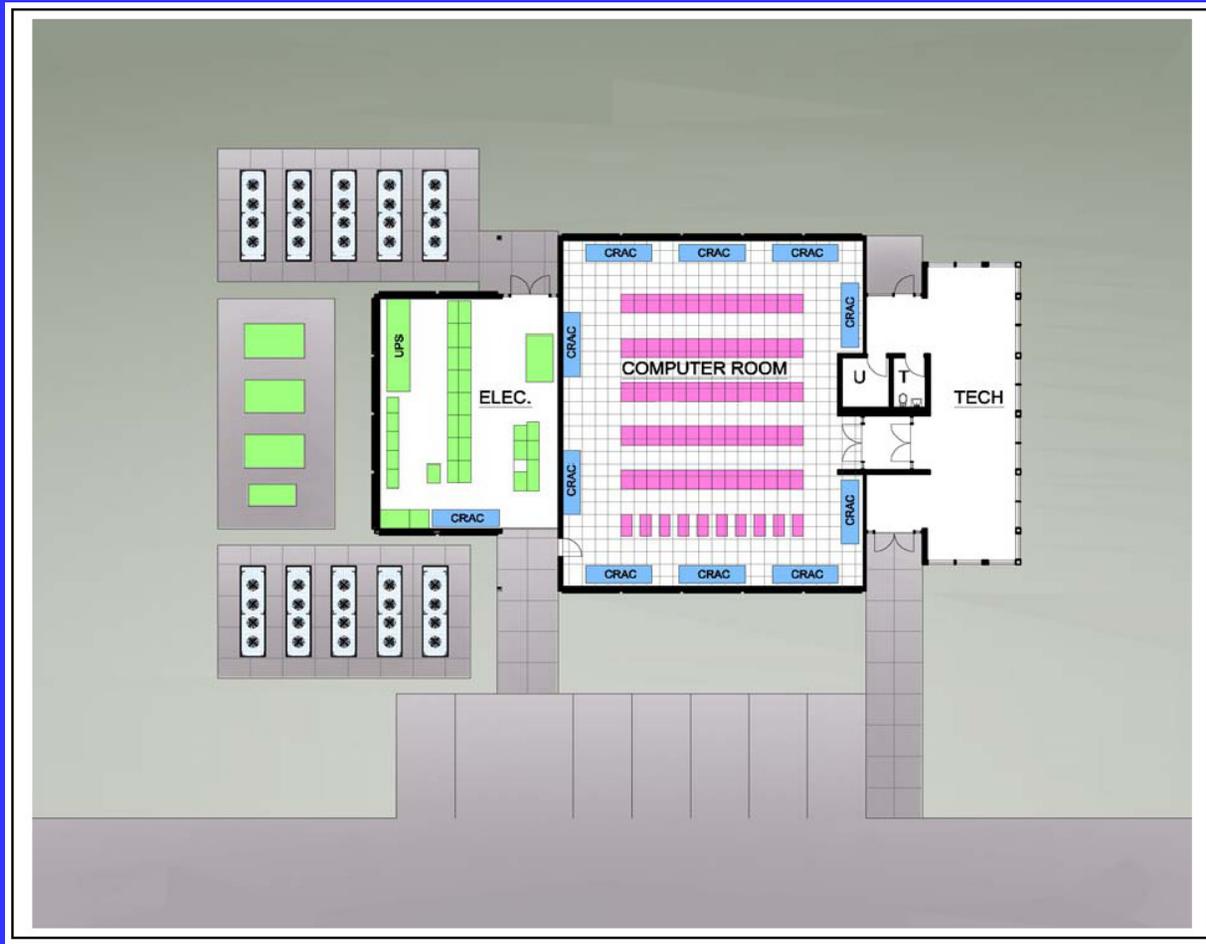
# High Bay Expansion – 1 Floor



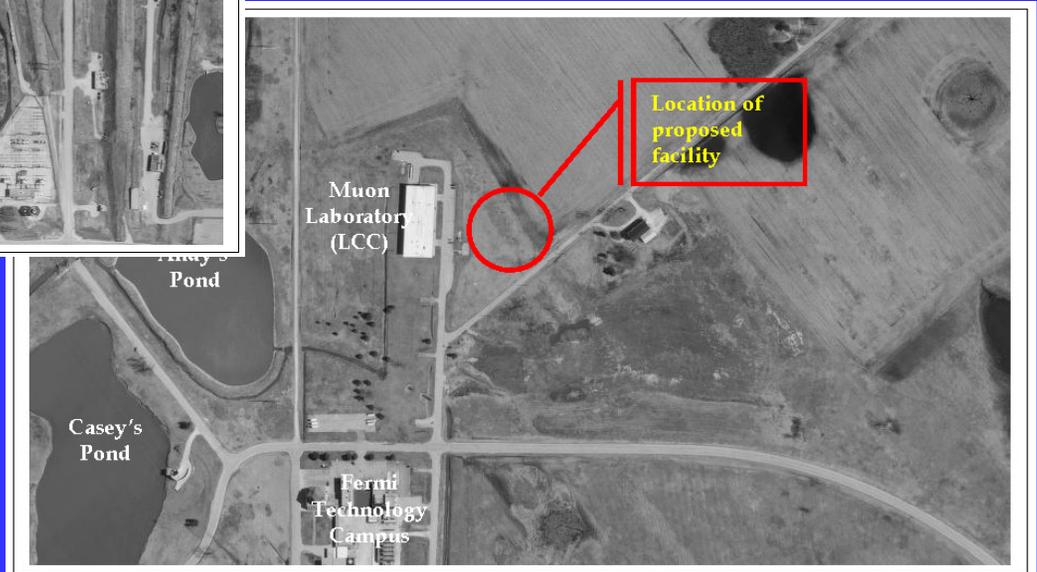
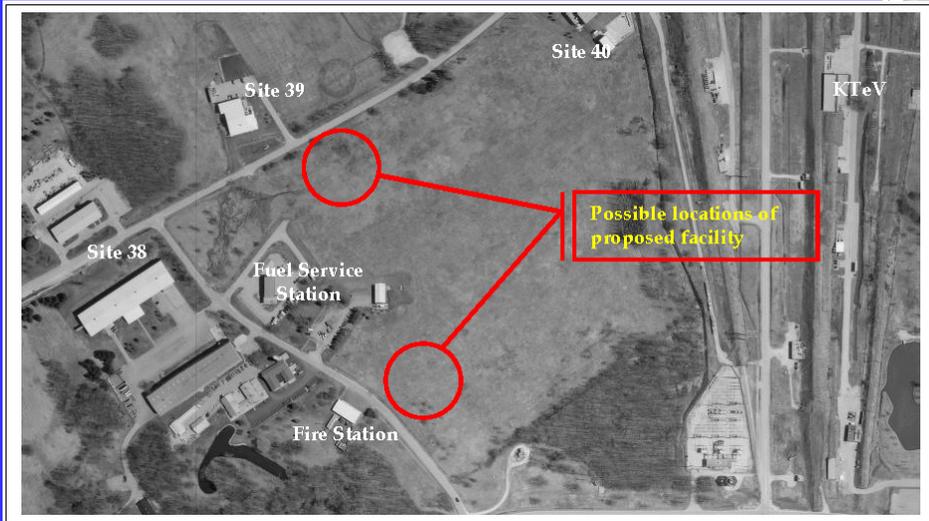
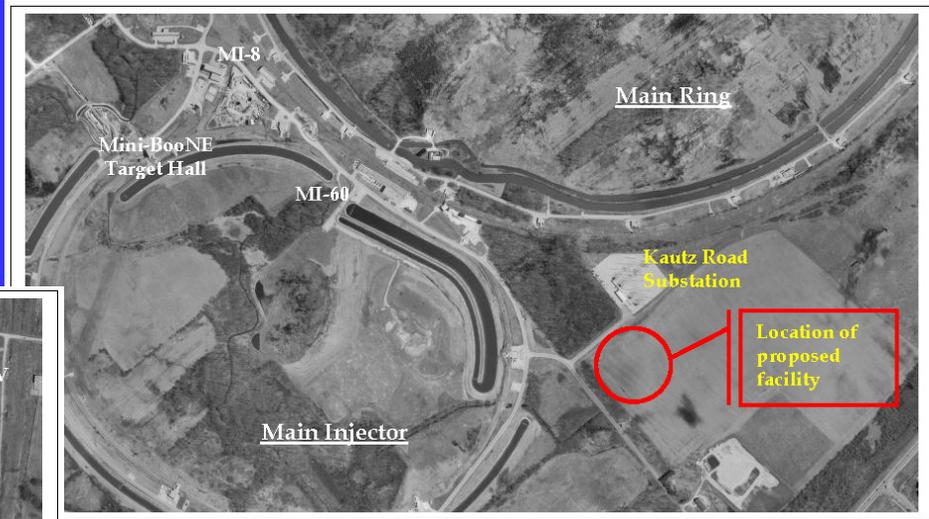
# High Bay Expansion – 1 Floor



# New Building



# New Building



# Adaptive Reuse

- January 2005 Project Definition Report
- Conversion of an existing building:
  - Computer Room (70 racks @ 40 nodes/rack=2,800 nodes)
  - 1000 kVA/900 kW of UPS Power
  - 300 tons of cooling
- Candidate Buildings:
  - Near existing utilities (elect, water, ICW)
  - 3,900 SF of 14' high space
- ~\$2.7m

# Summary

