STAR Project

Parameters Notebook

December 22, 1992

STAR Note Number 66

1.0 INTRODUCTION

This document defines the STAR detector parameters for the Conceptual Design Report (CDR). The detector cost and schedule will be made in accordance with the parameters and drawings that follow.

1.1 BASELINE DETECTOR

The Phase 1 detector consists of a Time Projection Chamber (TPC) within a conventional solenoidal magnet (SOL) and the electronics, computing, electrical, mechanical, structural and safety systems required for the operation of these components. It also includes the management, integration, installation and testing effort required to design and construct the detector.

1.2 UPGRADE DETECTOR SYSTEMS

The following additional detector subsystems are currently considered to be upgrades to the Phase 1 detector. Each of these upgrades will include the detector subsystem and the incremental electronics, computing, electrical, mechanical, structural and safety systems required for the operation of that specific detector subsystem. They will also include the incremental installation and testing effort required. They will not include incremental management and integration effort because that is a quantum, rather than simple incremental, function of which and how many of the upgrades might be selected to be designed and constructed coincident with Phase 1.

Current upgrades to Phase 1:

Silicon Vertex Tracker (SVT)
Time of Flight System (TOF)
External Time Projection Chambers (XTP)
Electromagnetic Calorimeter (EMC)

2.0 STAR DETECTOR Phase 1 Parameter Summary

2.1 TIME PROJECTION CHAMBER

Tracking volume, m^3	50
B field, T	0.5

SECTORS, Number

Outer (1.25-2.0 m)	24
Inner (0.5-1.25 m)	24

PADS

	Outer		Inner
Size, mm	6.2xl9.5		2.85xll.5
Pitch, mm	6.7x2O		3.35x48
Number/sector	3940		1830
Total/TPC		138480	

GRIDS-Outer (inner) sector

	Gated	Ground	Anode/sense	Field
Voltage, V	-250	0	1200 (1100)	0
Diam., um	75	75	20	125
Material	Au/BeCu	Au/BeCu	Au/W	Au/BeCu
Pitch, mm	1	1	4	4
Height, mm	14 (12)	8 (6)	4 (2)	4 (2)
Number	1350	1350	338	338

GAS @ 1 atmosphere

CH_4	10%
Ar	90%

OUTER FIELD CAGE (OFC)

Maximum voltage, V	-30000
Electrode ring period, mm	11.5
Number inner electrode rings	365
Cu electrode thickness, mm	0.035
Kapton thickness, mm	0.075
Insulator	
Mylar (42), mm	3.200
GIue (43), mm	1.092
Support	
A1 skin (2), mm	4
Al honeycomb, mm	48

INNER FIELD CAGE (IFC)	
Maximum voltage, V	-30000
Electrode ring period, mm	11.5
Number inner electrode rings	365
Al electrode thickness, mm	0.025
Kapton thickness, mm	0.075
Support	
Kapton (2), mm	0.150
Rohacell, mm	6.350

2.2 SOLENOIDAL MAGNET (WBS 4.4)

Coil Inner Diameter	5.24 m
Coil Length	6.2 m
Ampere-Turns	2.47x10**6
DC Power	1.9 MW
Operating Voltage	376 V
Operating Current	5146 A
Magnetic Field Strength	.5 Tesla
Water Flow	1320 gpm
Water Pressure Drop	105 psi
Iron Weight	717 MT
Copper Coil Weight	160 MT

2.3 ELECTRONICS (WBS 4.7)

FRONT END ELECTRONICS (WBS 4.7.1)

TPC FRONT END ELECTRONICS

Front End Electronics Boards w/ spares.	5003
Boards per inner-outer sector	193
PASA (PreAmp-Shaper)	
Integrated Circuits per board	2
16 fold; PreAmp < 700 electrons noise; 180ns. 1/t Shaper	
SCA/ADC (Switched Capacitor Array / A-D-Converter)	
Integrated Circuits per board	2
16 fold; SCA 10 MHz sample rate 1024 time buckets;	
ADC 10-bit, 5 usec. conversion time	
pads per board	32

DATA ACQUISITION (WBS 4.7.2)

TPC DATA ACQUISITION

TPC Readout Boards on chamber	312
Total including 5% spares.	328
maximum number readout boards per inner-outer sector	13
maximum number front end boards per readout board	18
maximum number pads per readout board	576
transputers per readout board	1
TPC Transputer Links	312
fiber optic cables per transputer	4

TRIGGER (WBS 4.7.3)

Vertex Position Detector

radiators	48
phototubes	48
pmt bases,ADCs(10 bit),TDCs(10bit)	48

Central Trigger Barrel

radiators	240
phototubes	240
pmt bases,ADCs(10bit)	240

Endcap MWPC

preamp/shaper/ADC (10bit) boards	96

Veto Calorimeter

radiators	4
phototubes	4
pmt bases,ADCs (10bit)	4

Trigger Controller

Trigger Processor	1
ram-fpga boards (16 digital input, 2 digital output, 16x1kx16bit RAM)	26

CONTROLS (WBS 4.7.4)

Slow Controls is based on use of a low-cost Unix workstation running a software package called EPICS (Experimental Phyics and Industrial Control System). The interface to Slow Controls at each detector subsystem is a VME crate with a processor. EPICS provides subsystem control, alarming, and history logging in a single, centralized package.

2.4 COMPUTING (WBS 4.8)

CODE DEVELOPMENT SYSTEM		
Central Compute Server - Total CPU		60 Mflops
	Memory	256Mbytes
File Server -		
Total On-Line Storage		10 Gbytes
Tape System Exabyte 8mm		2 Drives
Laser Printer		1
Two User Workstations		6
Each	CPU	10 Mflop
	Memory32 Mbyte	
	Disk	2 Gbyte
SUBSYSTEM DEDICATED COMPUTERS (8)		
	TPC	6
	Magnet	1
	Trigger System	1
ON-LINE EVENT PROCESSOR		
	CPU total	250 Mflops
OFF-LINE PROCESSING FARM		
	Host Systems	3
	Node CPU's	300
	DAQ Compatible Tape Drives	3
	8mm Tape Drives	9
	2 Gbyte disk drives	24

2.5 Conventional Systems (WBS 4.9)

Mechanical Utilities (WBS 4.9.1)

Detector Mixed Chilled Water (WBS 4.9.1.1)

Heat load inside detector (electronics)	36 KW
Heat load around detector (PMT's)	62 KW
Heat load inside the electronics trolley	166 KW
Heat load in the computer/operation building	11 KW

Special HVAC (WBS 4.9.1.2)

Circulation inside the detector	150 CFM

Industrial Cooling Water (wbs 4.9.1.3)

TPC readout cards and TOF pmt's	30 KW

Electrical Utilities (WBS 4.9.2)

Filtered Utility Power

1. To computer/operations room,	40 KVA, @ 208 V
2. To clean room, and electrical shop	36 KVA, @ 208 V

Clean Power

1. To trolley	385 KVA, @ 208 V
2. Operations/control rooms	11 KVA, @ 208V

Uninterrupted power

1. To trolley	1 KVA @ 120 V
2. To Op/Comp room	5 KVA @ 120 V

Emergency power

1. To WAH	1 KVA, @ 120 V

Detector System Safety (WBS 4.9.3)

None

Electronics Cart System (WBS 4.9.4)

Enclosed structure moves on rollers	
Number of levels	2
First level dimensions	25 ft W X 20 ft L X 10 ft H
Second level dimension	25 ft W X 20 ft L X 9 ft H

Access Systems (WBS 4.9.5)

Detector Access (WBS 4.9.5.1)

General Access (WBS 4.9.5.2)

Area Shop Equipment (WBS 4.9.6)

Mechanical Shop (WBS 4.9.6.1)

Dimensions	15 ft W X 20 ft L X 12 ft H

Electrical Shop (WBS 4.9.6.2)

Dimensions	15 ft W X 20 ft L X 12 ft H

2.6 BEAM TEST PROGRAM (WBS 4.10)

2.7 INSTALLATION & TEST (WBS 4.11)

Technical Parameters are inappropriate for this WBS element since it is an activity.

2.8 PROJECT MANAGEMENT (WBS 4.12)

Technical Parameters are inappropriate for this WBS element since it is an activity.

2.9 SYSTEMS INTEGRATION (WBS 4.13)

Technical Parameters are inappropriate for this WBS element since it is an activity.

3.0 STAR DETECTOR SVT Upgrade Parameter Summary

3.1 SILICON VERTEX TRACKER (WBS 4.1) Rev 10/30/92

Layers		3
Layer 1		
	Radius	45.8 mm
	Nom detector area	0.08 m^2
	Faces & carriers	6
	Active length per face	282 mm
	Detectors	24
	Channels	10,752
Layer 2		
	Radius	81.4 mm
	Nom detector area	0.18 m^2
	Faces & carriers	10
	Active length per face	352.5 mm
	Detectors	50
	Channels	22,400
Layer 3		
	Radius	132.9 mm
	Nom detector area	0.41 m^2
	Faces & carriers	16
	Active length per face	493.5 mm
	Detectors	112
	Channels	50176
Total		
	Nom detector active area	0.67 m^2
	Faces & carriers	232
	Detectors	186
	Channels	83,328

3.2 SVT FRONT END ELECTRONICS (WBS 4.7.1.1)

Detectors per SVT	186
Channels per Detector	448
Channels per SVT	83328
Front End Electronics IC's (on wafer)	
w/ 5% spares	2730
Shaper I Cs per wafer	14

3.3 SVT DATA ACQUISITION (WBS 4.7.2.1)

SVT Readout Boards (WBS 4.7.2.1.1)	372
SCA/ADC-IC's per Board	28
16 Channels per IC	
SCA/ADC-Boards per wafer	2
224 Channels per Board	
SCA 40mhz sample rate	
256 time buckets	
ADC 10 bit, 5usec conv. time	
SVT Transputer Boards	186
Readout Boards per Transputer Board	2
Transputers per Transputer Board	1
SVT Transputer Links (4.7.2.1.2)	186
fiber optical cables per Transputer Board	4

3.4 COMPUTING (WBS 4.8.1.1 & 4.8.2.1)

3.5 INSTALLATION & TEST (WBS 4.11.1)

4.0 STAR DETECTOR TOF Upgrade Parameter Summary

4.1 TIME OF FLIGHT DETECTOR (WBS 4.3) - [Patch Upgrade]

Phototubes & Bases	300ea
Shingle Counters	300
Shingle Supports	300
Multiplicity Counters	0
Multiplicity Counter Supports	0
Module Trays	350
Module Tray Support Rails	216

4.2 FRONT END ELECTRONICS (WBS 4.7.1.3) - [Patch Upgrade]

Total Channels	300

4.3 DATA ACQUISITION (WBS 4.7.2.3)

4.4 COMPUTING (WBS 4.8.1.3 & 4.8.2.3)

4.5 INSTALLATION & TEST (WBS 4.11.3)

5.0 STAR DETECTOR EMC Upgrade Parameter Summary

5.1 ELECTROMAGNETIC CALORIMETER (WBS 4.5)

BARREL EM

Initial Tower Size (delta eta, delta phi)	.1 x .1
Upgrade Tower Size (delta eta, delta phi)	.05 x .1
Initial Towers in eta	20
Upgrade Towers in eta	40
Towers in phi	60
Tower Geometry	Pseudo-projective
Total Towers	1200
Initial Number of channels	1200
Upgrade Number of channels	2400
Layers per tower	21
Clad Lead Absorber (5mm)	21
Scintillator (3mm)	21
Total layers of lead (5mm)	1260
Total tiles of scintillator (3mm)	50400
Total Shower Max Scintillator Tiles	1200
Total Shower Max Channels per Tile	24
Total Shower Max Channels	28800

Readout Configuration

WLS fibers per Barrel Scintillator Tile	2
Total Barrel WLS Fibers	100800
WLS fibers per Shower Max channel	1
Total Shower Max Fibers	28800
Initial PMT's per Tower (single anode)	1
Initial readout for Shower Max	uninstrumented
Initial Total PMT's	1200
Total Weight	150 MT

EM ENDCAP UPGRADE

Weight per Endcap	30 MT

5.2 EMC FRONT END ELECTRONICS (WBS 4.7.1.5)

Total Channels	1,200

5.3 EMC DATA ACQUISITION (WBS 4.7.2.5)

5.4 COMPUTING (WBS 4.8.1.5 & 4.8.2.5)

5.5 INSTALLATION & TEST (WBS 4.11.1.5 & 4.11.2.5)

6.0 STAR DETECTOR XTP Upgrade Parameter Summary

6.1 EXTERNAL TIME PROJECTION CHAMBERS (WBS 4.6)

Rectangular geometry	
Modules (1.8m x 2.2m x 1.0m)	8
Readout Pad Rows	8
Readout Pads/Row	350
Total Channel Count	22,400

6.2 FRONT END ELECTRONICS (WBS 4.7.1.6)

Total Channels	22,400

6.3 DATA ACQUISITION (WBS 4.7.2.6)

6.4 COMPUTING (WBS 4.8.1.6 & 4.8.2.6)

6.5 INSTALLATION & TEST (WBS 4.11.1.6 & 4.11.2.6)