Controlled STAR Note #0279A

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PROGRAM PROJECT-JOB

STAR Project

TITLE

STAR Electrical Power Requirements

REV. A	1/15/99	The total power has decreased, primarily due to measurement of the actual power used by the magnet and the reduction in the EMC electronics. Also, some typographical errors have been fixed.

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STAR Electrical Power Requirements

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Controlled STAR Note # 279A

Abstract: This note describes the necessary electric power that RHIC needs to provide to STAR. In addition, the heat loads produced by STAR are calculated.

Issued: January 14, 1997
Version A: January 15, 1999—This revision reflects changes made to STAR since this note was issued. Some typographical errors have been fixed. The total power has decreased. This is primarily due to measurement of the actual power used by the magnet and the reduction in the EMC electronics.

We can separate the electrical power system for STAR to three distinct systems: Magnet Power, Conventional Power and Clean Power. We define them in the following manner:

- Magnet Power -- All electrical power needed to operate the magnet. This number includes all power supplies for the magnet.
- Conventional Power -- This power is used for utilities in the Assembly Hall, utility rooms (on the East Side of the Assembly Hall), WAH, DAQ room, Control room and the new trailer. Power is provided to convenience outlets, air heating and cooling systems, water chillers, and mechanical equipment such as detector air conditioners and water pumps. The new trailer will only use conventional power
- Clean Power -- This is used for STAR electronics. It will be provided in the Assembly Hall, WAH, DAQ and Operations building.

Because the detectors in STAR will be phased in time, we will separate the power requirements between the "Baseline" and "Full Detector". The Baseline detector is defined as the Magnet, TPC, Trigger, CTB, Slow Controls, DAQ, and Online system. The Full Detector adds the SVT, EMC, TOF, FTPC and Trigger and DAQ upgrades.

Power Summary:

A summary of STAR's requirements is shown in the table below. These numbers contain no contingency. Explanations for how these numbers are obtained are described later in this document. Power for items such as lights, cooling (both water and air), and heating are not included in this table. WAH power can be used in either the WAH or the Assembly Hall. It will be used only in one place at a time.

Power	**Baseline - kVA**	**Full Detector - kVA**
Magnet - WAH (operating)	3500	3500
Clean	249	452
Conventional - WAH	22	41
Conventional - Trailer	23	23
TOTAL STAR Power	***3794***	***4016***
Uninterruptible	12.3	12.3

The shaded items are special power items. These items have already been included in STAR's total power.

Magnet Power:

The Magnet Group has calculated the power needed to run the STAR magnet from the tuned currents that were measured in the magnet field mapping. This number is in the expected operation column. Their results can be summarize in the following table:

	Without Power Supply Efficiency	Operation with Power Supply Efficiency
Main Supply -- 13.8 kV	2.8 MVA	
Trim Supplies -- 480V	0.25 MVA	
Space Trim	0.04 MVA	
Total	3.1 MVA	3.5 MVA

The power supply efficiency is estimated to be 85%. When the magnet is being operated, the cooling system needs to run. The power for the cooling system will be provided by RHIC and is not included in this STAR note. The total magnet power needed for normal operation is 3.5 MVA.

Clean Power:

The STAR detector needs to be electrically isolated from as many electrical-noise sources as possible. We define clean power as the power supplied to the detector in the WAH or Assembly Hall, DAQ room and Control room. All power to the detector is supplied from the platform. We determine the power requirements by estimating the power needed for each rack in each of these three rooms. Detailed information can be found in Appendix 1 and 2. We convert from kW to kVA by assuming a power factor of 0.8. There is no contingency in these numbers.

		Baseline - kVA	Full Detector- kVA
WAH	South 1	41	122
	South 2	70	159
	South 3	16	32
	Total	127	313
DAQ		105	123
Control		17	17
Total		249	453

In general there are two types of racks -- VME and miscellaneous. VME racks contain three crates. We assume that each VME crate will nominally use 1.5 kW out of 1.8 kW maximum. The other racks use nominally 3 kW. Clean power is not needed for the trailer.

Conventional Power:

The detector power includes all conventional power located on the platform. Power for lights, cooling (water and air), and heating are not included in this table.

	Base line kVA	Full Detector kVA
WAH	22	41
Trailer (workstations only)	23	23

Uninterruptible Power:

Because of safety and other considerations, it is important to put some devices on uninterruptible power. STAR Note #221A describes the STAR units that require uninterruptible power. The necessary loads are summarized below:

Sub-system	**Item**	**Location**	**kVA**
TPC	TPC Gas System	Assembly Building - Gas House	4.5
Slow Controls	Terminal Server	South Platform	1.5
Online	Network Switch	South Platform	1
Trigger	Workstation	Control Room	1.4
Slow Controls	Workstation	Control Room	1.5
Online	Ethernet Switch	DAQ Room	1
DAQ	File Server	DAQ Room	1.4
Total			**12.3**

Electronic Heat Loads to Environment:

To properly size the air conditioning, we need to calculate the amount of heat generated by STAR. The most important time to monitor temperatures is when the STAR detector is in the WAH. The sources of heat in the WAH come from the magnet, platform electronics and cables. Because of the difficulty of fully sealing racks, we take the fact that 15% of the power produced in a rack will escape. All racks on the South Platform will be water-cooled. In the DAQ room, only racks in row DA will be water-cooled. The heat from the computers, workstations and transformers will be dissipated into the air. Appendix 1 and 2 shows the details of the heat load calculation. The magnet heat comes from a document authored by Bill Christie.

	Location	Baseline - kW	Full Detector - kW
Magnet	WAH	8	8
Clean - Platform	WAH	10	24
Clean - Transformers	WAH	13	26
Conventional - Platform	WAH	18	33
Cables	WAH	5	45
EMC Barrel	WAH		23
EMC Endcap	WAH		9
Total WAH		**54**	**168**
Electronics	DAQ	34	47
Electronics	Control	16	16
Total DAQ and Control		**50**	**63**
Total		**104**	**231**

We assume that all power to the TPC FEE and SVT and FTPC electronics is removed by the water system and that the heat out does not go into the outside air. In addition, we assume that all of the heat generated by the power cables goes into the air as does heat generated in the EMC electronics.

Electronic Heat Loads to Water System:

Using the information from Appendixes 1 and 2, we can estimate the heat removed by the water system.

		Baseline - kW	Full Detector - kW
South - Floor 1	Platform	31	86
South - Floor 2	Platform	32	73
TPC	Detector	39	42
TOF	Detector		22
SVT	Detector		2
FTPC	Detector		2
Total WAH	WAH	102	227
DAQ Racks	DAQ	38	61
Total STAR		140	288

The magnet water-cooling is not included in the above table.

Electrical Equipment in DAQ , Control Building, Trailer

4-Jan-99

Clean Power

		#	Name	Total kVA	Base Line Total kVA	Current Total (amps)	Volt.	Current /unit (amps)	Power /unit (watts)	# of Heat Exch / rack	# of Heat Exch	Base Line # of Heat Exch	Heat Exch. Power (kW)	Base Line Heat Exch. Power (kW)	Total HEAT to Air (kW)	Base line HEAT to Air (kW)	Name	Sub-system	Description
DAQ	DA1-2	2	rack	7.5		50.0	120.0	25.0	3000	3	6		6.0		0.9		Integration Reserve	Integration	Reserve
	DA3	1	rack	5.0	5.0	19.3	208.0	19.3	4020	3	3	3	4.0	4.0	0.6	0.6	DAQ receivers - SVT	DAQ	3 - 9u VME Crates/rack
	DA4	1	rack	5.0	5.0	19.3	208.0	19.3	4020	3	3	3	4.0	4.0	0.6	0.6	DAQ receivers - SVT	DAQ	3 - 9u VME Crates/rack
	DA5	1	rack	5.0	5.0	19.3	208.0	19.3	4020	3	3	3	4.0	4.0	0.6	0.6	DAQ receivers - TPC	DAQ	3 - 9u VME Crates/rack
	DA6	1	rack	5.0	5.0	19.3	208.0	19.3	4020	3	3	3	4.0	4.0	0.6	0.6	DAQ receivers - TPC	DAQ	3 - 9u VME Crates/rack
	DA7	1	rack	4.6	4.6	17.7	208.0	17.7	3680	3	3	3	3.7		0.6	0.6	DAQ receivers - TPC	DAQ	Trigger crate here
	DA8	1	rack	3.8	2.5	14.4	208.0	14.4	3000	2	2	1	3.0	1.5	0.5	0.3	DAQ Taping	DAQ	1 crate added in upgrade
	DA9	1	rack	5.0	5.0	19.3	208.0	19.3	4020	3	3	3	4.0	4.0	0.6	0.6	DAQ receivers - TPC	DAQ	3 - 9u VME Crates/rack
	DA10	1	rack	5.0	5.0	19.3	208.0	19.3	4020	3	3	3	4.0	4.0	0.6	0.6	DAQ receivers - TPC	DAQ	3 - 9u VME Crates/rack
	DA11	1	rack	5.0	5.0	19.3	208.0	19.3	4020	3	3	3	4.0	4.0	0.6	0.6	DAQ receivers - TPC	DAQ	3 - 9u VME Crates/rack
	DA12	1	rack	5.0	5.0	19.3	208.0	19.3	4020	3	3	3	4.0	4.0	0.6	0.6	DAQ receivers - FTPC	DAQ	3 - 9u VME Crates/rack
	DA13	1	rack	5.0	5.0	19.3	208.0	19.3	4020	3	3	3	4.0	4.0	0.6	0.6	DAQ receivers - FTPC	DAQ	3 - 9u VME Crates/rack
	DA14-16	3	rack	15.1		58.0	208.0	19.3	4020	3	9		12.1		1.8		DAQ receivers -Future	DAQ	3 - 9u VME Crates/rack
		16		76.2	52.3	kVA					47	31	60.9	37.7	9.1	6.3			
	DB	10	workstations	5.0		33.3	120.0	3.3	400						4.0		Third lavel trigger - not well defined		
	DC1	1	rack	1.9	1.9	12.5	120.0	12.5	1500						1.5	1.5	RHIC Control Rack	RHIC	
	DC2	1	rack	1.9	1.9	12.5	120.0	12.5	1500						1.5	1.5	Communication/Slow Control	Slow Controls	
	DC3	1	rack	2.5	1.3	9.6	208.0	9.6	2000						2.0	2.0	Misc Items	Integration	Reserve
	DC4	1	rack	2.5		16.7	120.0	16.7	2000						2.0		Integration Reserve	Integration	Reserve
	DC5	1	rack	2.5	16.7	16.7	120.0	16.7	2000						2.0		Global Interlocks	Convent. Sys.	
		5		11.3	21.7	kVA					0	0	0.0	0.0	9.0	5.0	kW		
DAQ	**RackTotal**	21		92	74	kVA					47	31	61	38	22	11	kW		
		1	Transformer - T5	8.0	8.0	13.3	480.0	13.3	6400						6.4	4.3	480V Transformer	Convent. Sys.	39"x29" 48" high
		1	compute serv. 1	6.2	6.2	24.0	208.0	24.0	4992						5.0	5.0	IBM SP1	Computer	
		1	compute serv. 2	4.2	4.2	16.0	208.0	16.0	3328						3.3	3.3	Large SGI (rsgi00)	Computer	
		1	online taping	1.0	1.0	6.7	120.0	6.7	800						0.8	0.8	Tapes online data	DAQ	(48" x 30 ") footprint
		1	net. switch	0.8	0.8	5.5	120.0	5.5	660						0.7	0.7	Network Switch Cabinet	Computer	(This is a pure quess.)
		1	File Server	0.5	0.5	3.7	120.0	3.7	440						0.4	0.4	File Server	Computer	
		2	disk rack	1.6	1.6	11.0	120.0	5.5	660						1.3	1.3	Racks for file server disks	Computer	
		1	File Server	0.5	0.5	3.7	120.0	3.7	440						0.4	0.4	File Server	DAQ	
		1	disk rack	0.8	0.8	5.5	120.0	5.5	660						0.7	0.7	Racks for file server disks	DAQ	
		1	reserve	6.0	6.0	40.0	120.0	40.0	4800						4.8	4.8	Integration reserve	Integration	
		1	workstation	1.1	1.1	7.3	120.0	7.3	880						0.9	0.9	Workstation with disks	Computer	
				30.9	30.9	kVA									24.7	22.6	kW		
Control		12	workstation	8.5	8.5	56.4	120.0	4.7	564						6.8	6.8	for use of collaboration	Computer	
		1	reserve	5.6	5.6	37.5	120.0	37.5	4500						4.5	4.5	Integration reserve	Integration	
		1	Laserprinter	1.2	1.2	8.2	120.0	8.2	984						1.0	1.0	Laserprinter	Computer	
		5	TV monitors	1.3	1.3	8.3	120.0	1.7	200						1.0	1.0	Various visual monitors	Integration	
		12	people						200						2.4	2.4	people on shift		
				16.6	16.6	kVA									15.7	15.7	kW		

Conventional Power

Trailer	25	workstation	17.6	17.6	117.5	120.0	4.7	564	14.1	14.1	for use of collaboration
	1	misc. items	2.5	2.5	16.7	120.0	16.7	2000	2.0	2.0	misc. items
	2	Laserprinter	2.5	2.5	16.4	120.0	8.2	984	2.0	2.0	Laserprinter
	25	people						200	5.0	5.0	meetings in trailer
			22.6	22.6	kVA				23.1	23.1	kW

Total	**Baseline**		
123.3	104.9	kVA	Total DAQ
16.6	16.6	kVA	Total Control
139.9	**121.5**	**kVA**	**Total DAQ+Control**

Watts	**A**	**Workstation**
264	2.2	Monitor
300	2.5	CPU
564	**4.7**	**Total**

Power Factor	0.8	Correction from watts to kVA - phase difference
Fraction of power that escapes into air	0.15	

46.9	33.9	kW	Total DAQ HVAC Cooling needed
15.7	15.7	kW	Total Control HVAC Cooling
62.5	**49.5**	**kW**	**Total DAQ+HVAC Cooling (lights not included)**

Total	**Baseline**	
76	52	DAQ Row A
5	0	DAQ Row B
11	22	DAQ Row C
23	23	DAQ Computing Hardware (Transformer removed)
17	17	Control Room

Baseline Rack Assignment for STAR Platform

4-Jan-99

Plat-form	Floor	Row Pos	Racks	Total (kVA)	Base Line (kVA)	Equiv. Current Total (amps)	Base Line Equiv. Current Total (amps)	Equiv. Current /rack (amps)	Power /rack (watts)	HEAT Power /rack (watts)	Total Heat Exch.	Base Line Heat Exch	Total HEAT Prod. (kW)	Base Line Total HEAT Prod. (kW)	Rack Name	Sub-system	Description	Comments
South	1	A 1	1	3.8		25.0		25.0	3000	3000	3		3.0		Integration Reserve	Integration	Reserve	
	1	A 2	1	5.6	5.6	37.5	37.5	37.5	4500	4500	3	3	4.5	4.5	Trigger	Trigger	Level 0 and Level 1 Trigger	3 - 9u VME Crates/rack
	1	A 3	1	5.6	5.6	37.5	37.5	37.5	4500	4500	3	3	4.5	4.5	Trigger	Trigger	Level 0 and Level 1 Trigger	3 - 9u VME Crates/rack
	1	A 4	1	5.6		37.5		37.5	4500	4500	3		4.5		Trigger -VPD/VTX	Trigger	VPD and VTX electronics	
	1	A 5	1	1.9	1.9	12.5	12.5	12.5	1500	1500	3	3	1.5	1.5	MWC Trigger/TOF Control	Trigger	TPC Endcap Trigger	3 - 9u VME Crates
	1	A 6	1	1.9	0.6	12.5	4.2	12.5	1500	1500	3	2	1.5	1.5	CTB/TOF VME	CTB/TOF	VME Receiver Crates	1 for CTB
	1	A 7	1	5.6		37.5		37.5	4500	4500	3		4.5		EMC Trigger	CTB/TOF		
	1	A 8	1	5.6		37.5		37.5	4500	4500	3		4.5		EMC Transistions	EMC	EMC Level 1 Trigger input	
Floor	1	A 9	1	2.1	2.1	14.0	14.0	14.0	1680	1680	2	2	1.7	1.7	TPC Laser	TPC	Laser Optics Control for TPC Laser	
41	1	A 10	1	3.8		25.0		25.0	3000	3000	3		3.0		Integration Reserve	Integration	Reserve	
	1	B 1	1	3.8		25.0		25.0	3000	3000	3		3.0		Integration Reserve	Integration		Future use
	1	B 2	1	3.8		25.0		25.0	3000	3000	3		3.0		Integration Reserve	Integration		Future use
	1	B 3	1	3.8	3.8	25.0	25.0	25.0	3000	3000	2	2	3.0	3.0	TOF Low Voltage	Trigger		
	1	B 4	1	3.8	3.8	25.0	25.0	25.0	3000	3000	2	2	3.0	3.0	CTB HV/MWC LV	Trigger		
	1	B 5	1	5.6	5.6	37.5	37.5	37.5	4500	3600	4	4	3.6	3.6	FTPC HV and Pulser	FTPC		
	1	B 6	1	6.0	6.0	50.0	50.0	50.0	6000	4100	2	2	4.1	4.1	FTPC - FEE LV	FTPC	Low Voltage Power Supplies	power factor=1
Floor	1	B 7	1	6.0	6.0	50.0	50.0	50.0	6000	4100	2	2	4.1	4.1	FTPC - FEE LV	FTPC	Low Voltage Power Supplies	power factor=1
kVA	1	B 8	1	3.8		25.0		25.0	3000	3000	3		3.0		Integration Reserve	Integration		Future use
40	1	B 9	1	3.8		25.0		25.0	3000	3000	3		3.0		Integration Reserve	Integration		Future use
	1	C 1	1	2.5		16.7		16.7	2000	2000	1		2.0		SVT control	SVT	Control -Cross connects	
	1	C 2	1	2.5		16.7		16.7	2000	2000	1		2.0		SVT-VME	SVT	vme, calibration	
	1	C 3	1	7.2		60.0		60.0	7200	3240	4		3.2		SVT-LV	SVT	Low Voltage Supplies	pf=1.0
	1	C 4	1	7.2		60.0		60.0	7200	3240	4		3.2		SVT-LV	SVT	Low Voltage Supplies	pf=1.0
Floor	1	C 5	1	4.0		26.7		26.7	3200	3200	2		3.2		SVT-HV	SVT	High voltage supplies	
Floor	1	C 6	1	9.0		60.0		60.0	7200	3240	2		3.2		SSD-LV	SVT	Power Supplies	
kVA	1	C 7	1	3.8		25.0		25.0	3000	3000	3		3.0		Integration Reserve	Integration	Reserve	
40	1	C 8	1	3.8		25.0		25.0	3000	3000	3		3.0		Integration Reserve	Integration	Reserve	
122			27	122	41	854	293				73	25	86	31	kW			
	2	A 1	1	1.9	1.9	12.5	12.5	12.5	1500	1500	1		1.5	1.5	STAR Interlocks	Conventional		
	2	A 2	1	1.9	1.9	12.5		12.5	1500	1500	2		1.5	1.5	Conv. Systems	Conventional		
	2	A 3	1	2.5	2.5	16.7	16.7	16.7	2000	2000	2	1	2.0	2.0	Field Cage HV	TPC	includes TPC controls	2-VME, Nim and HV supply
	2	A 4	1	2.5	2.5	16.7	16.7	16.7	2000	2000	1	1	2.0	2.0	TPC Controls/Workstatior	TPC	Workstation, Communication	
	2	A 5	1	1.3	1.3	8.3	8.3	8.3	1000	1000	2	1	1.0	1.0	Ground Plane Pulser	TPC	GPP system	3-Nim, Camac,
	2	A 6	1	3.1	3.1	20.8	20.8	20.8	2500	2500	3	2	2.5	2.5	TPC Gated Grid	TPC	Gated Grid	
	2	A 7	1	2.5	2.5	16.7	16.7	16.7	2000	2000	2	2	2.0	2.0	Anode HV	TPC	2 -Lecroy 1440's + VME	
Floor	2	A 8	1	2.5	2.5	16.7	16.7	16.7	2000	2000	1	1	2.0	2.0	Slow Controls	Slow Controls	Main STAR Control System	
kVA	2	A 9	1	3.8	3.8	25.0	25.0	25.0	3000	3000	3	3	3.0	3.0	Slow Controls	Slow Controls	Main STAR Control System	
26	2	A 10	1	3.8		25.0		25.0	3000	3000	3		3.0		Integration Reserve	Integration	future use	
Floor																		
kVA	2	B 1-9	9	48.6	48.6	405.0	405.0	45.0	5400	1600	9	9	14.4	14.4	TPC LV	FEE	LV Power Supplies - pf=1.0	6 Power supply units + spare
52	2	B 10	1	3.8		25.0		25.0	3000	3000	3		3.0		Integration Reserve	Integration	future use	(1 heat exchanger/rack + one for VME Crate)

	2	C 1	1	3.8		25.0		25.0	3000	3000	3		3.0		Integration Reserve	Integration	
	2	C 2	1	5.6		37.5		37.5	4500	4500	3		4.5		EMC - Controls	EMC	monitoring
Floor	2	C 3	1	5.6		37.5		37.5	4500	4500	3		4.5		EMC - EMC Reserve	EMC	
Floor	2	C 4	1	5.6		37.5		37.5	4500	4500	3		4.5		EMC - EMC Reserve	EMC	
kVA	2	C 5	1	38.0		253.3		253.3	30400				0.0		EMC -AC Power	EMC	38 lines at 800 watts
81	2	C 6-10	6	22.5		150.0		25.0	3000	3000	3		18.0		Integration Reserve	Integration	
159			31.0	159.1	70.5	1141.7	538.3				47	20	72.4	31.9 kW			

No reserve power added for each rack
Equivalent current calculation is based on 120 V single phase power.
Power factor is nominally 0.8

Third Floor and Conventional Power

4-Jan-99

Plat-form	Floor	Row	Pos	Racks	Total Power (kVA)	Base Line Power (kVA)	Current Total - assuming 120 V (amps)	Base Line Current Total (amps)	Current /rack (amps)	Power /rack (watts)	HEAT Power /rack (watts)	Total HEAT Prod. (kW)	Base Line Total HEAT Prod. (kW)	Rack Name	Sub-system	Description	Comments	Foot-print sqr. ft.
North	*Clean Power*																	
	3			1	8.0	8.0	53.3	53.3	53.3	6400	6400	6.4	6.4	480V Transformer	Convent. Sys.		39"x29" 48" high	18
	3			1	8.0	8.0	53.3	53.3	53.3	6400	6400	6.4	6.4	480V Transformer	Convent. Sys.		39"x29" 48" high	18
	3			1	8.0		53.3		53.3	6400	6400	6.4		480V Transformer	Convent. Sys.	(future use)	39"x29" 48" high	18
	3			1	8.0		53.3		53.3	6400	6400	6.4		480V Transformer	Convent. Sys.	(future use)	39"x29" 48" high	18
					32.0	16.0	213.3	106.7	amp			25.6	12.8 kW					
North 1	*Conventional Power*																	
	3			1	4.0	4.0	26.7	26.7	26.7	3200	3200	3.2	3.2	480V Trans.	Convent. Sys.	(may be smaller)	3'x6'	18
	3			2	3.8		25.0		12.5	1500	1500	3.0		TOF/EMC Laser	TOF/EMC		4'x2'	8
					7.8	4.0	51.7	26.7	amp			6.2	3.2 kW			**Total Space**		98
North	*Conventional Power*																	
	2	A	1-2	2	4.3	4.3	28.3	28.3	14.2	1700	1700	3.4	3.4	Magnet Controls	Magnet	Racks for mag. control system	2'x2 1/2 '	20
	2			1	1.3	1.3	8.3	8.3	8.3	1000	1000	1.0	1.0	Detector Fans		408V		
	1			2	9.0	9.0	60.0	60.0	15	3600	3600	7.2	7.2	TPC Laser	TPC	208V single phase	located - off platform	
	2			2	5.0		33.3		16.7	2000	2000	4.0		SVT-Water system	SVT	208V (pump & chiller)	3'x3'	9
	2			2	8.8		58.3		29.2	3500	3500	7.0		SVT-Air System	SVT	208V (blower & compressor)	2'x2'	2
	2			1	1.3		8.3		8.3	1000	1000	1.0		SVT-Vacuum pump	SVT	208V	1'x2'	4
	2			1	3.8	3.8	25.0	25.0	25.0	3000	3000	3.0	3.0	TPC- IFC Air Conditioner	TPC	408V May merge with SVT	2'x2'	4
					33.3	18.3	221.7	121.7	amps (for 120 V)			26.6	14.6 kW	**Total Space**				39

Heat from this page

Full	**Baseline**	
25.6	12.8	Heat -North Clean
6.2	3.2	Heat -North 1 Conventional
26.6	14.6	Heat - North Conventional
58.4	30.6	**Total conventional + other clean Electronics Heat to Air- WAH/AH**

Lights not included in conventional power
Maximum Height for third floor including rack and cooling is 4'

Summary

4-Jan-99

Total	Baseline		
280.6	111.5	kVA	Total power for first and second floor
158.3	63.4	kW	Total Heat produced in first and second floor racks

Heat Exchanter Water Cooling on Detector

Full STAR	Base Line STAR		
42	38.8	kW	TPC (SVT heats up the TPC)
22		kW	TOF
2		kW	SVT
2		kW	FTPC
68	39	kW	Total to detector

EMC Power consumption

30.4	total	
0	rack	(goes to water)
7.6	cables	(goes to air)
22.8	to Detector	

Power dissipated by cables

kW	Full STAR watts /ft /side	Base Line STAR watts /ft /side	
3.5	18	18	FEE-TPC Power Densities /end/ft
7.6	159		EMC- Barrel and End Cap
7.52	38	6	TOF/CTB
1.68	8		FEE-FTPC
0.68	3		SVT
21	225	24	Total power/ft/side
	45	**5**	**kW kW (Total power/ft/side x 2 x 100' converted to kW)**

4-Jan-99

Full STAR	Base Line STAR		
41.0	22.3	kVA	Total Conventional Power - Platform
312.6	127.5	kVA	Total Clean Power - Platform
353.6	149.7	kVA	Total Platform Power
139.9	121.5	kVA	Clean from DAQ - Control
493.5	**271.2**	**kVA**	**Total Detector Power**
452.5	248.9		Total Clean Power
158.3	63.4	kW	Platform Heat needed to be removed by water (only first and second floor - south)
0	0	kW	Heat Exchanger water cooling needed in DAQ House
158.3	63.4	kW	Subtotal Heat Exchanger water Cooling for electronics
68	38.8	kW	Total heat exchanger water on Detector
226.3	**102.2**	**kW**	**Total heat exchanger water needed for everything but magnet**
0.15	0.15		Fraction of Rack power going into heat
120	45		Number of Platform Heat Exchangers
0	0		Number of DAQ Heat Exchangers
120	**45**		**Total Number of Heat Exchangers**
58			Racks on Platform
5			Racks in DAQ
2			Magnet Racks
65			**Total Racks**

Heat to Air

Full - kW	Base-line kW		
8	*8*	Magnet	1 ton of air conditioning cools 3.3 kW
24	10	Heat Produced on First and Second Floor South Platform	1 kW equals 3413 BTU/hr
58	31	Other Electronics Heat (includes transformer and conventional platform)	
23		EMC Barral Crate Heat	
9		EMC Endcap Crate Heat	
45	5	Cable Heat (Assume all detector heat removed by water system)	
167	**53**	**WAH/AH Electronic Heat**	
47	**34**	**DAQ Electronic Heat**	
16	**16**	**Control Electronic Heat**	

This is used in the STAR Note

	Base	*Full*	
Power Summary			
	3500	3500	Magnet - Maximum Power needed
	249	452	Clean
	22	41	Conventional - WAH
	23	23	Conventional Trailer
	3794	**4016**	**Total**
Clean Power			
	41	122	WAH - South 1
	70	159	WAH - South 2
	16	32	WAH - North 3
	127	**313**	**Total**
	105	123	DAQ
	17	17	Control
	249	**452**	**Total**
Conventional Power			
	22	41	WAH
	23	23	Trailer
Heat to Air			
	8	8	Magnet
	10	24	Clean-Platform
	13	26	Clean-Transformers
	18	33	Conventional Platform
		23	EMC Barral Crate Heat
		9	EMC Endcap Crate Heat
	5	45	Cables
	53	**167**	**Total WAH**
	34	47	DAQ
	16	16	Control
	50	**63**	**Total Daq+Control**