



FIRE Cost Estimate

Methodology and Summary

Bob Simmons & Phil Heitzenroeder



Methodology

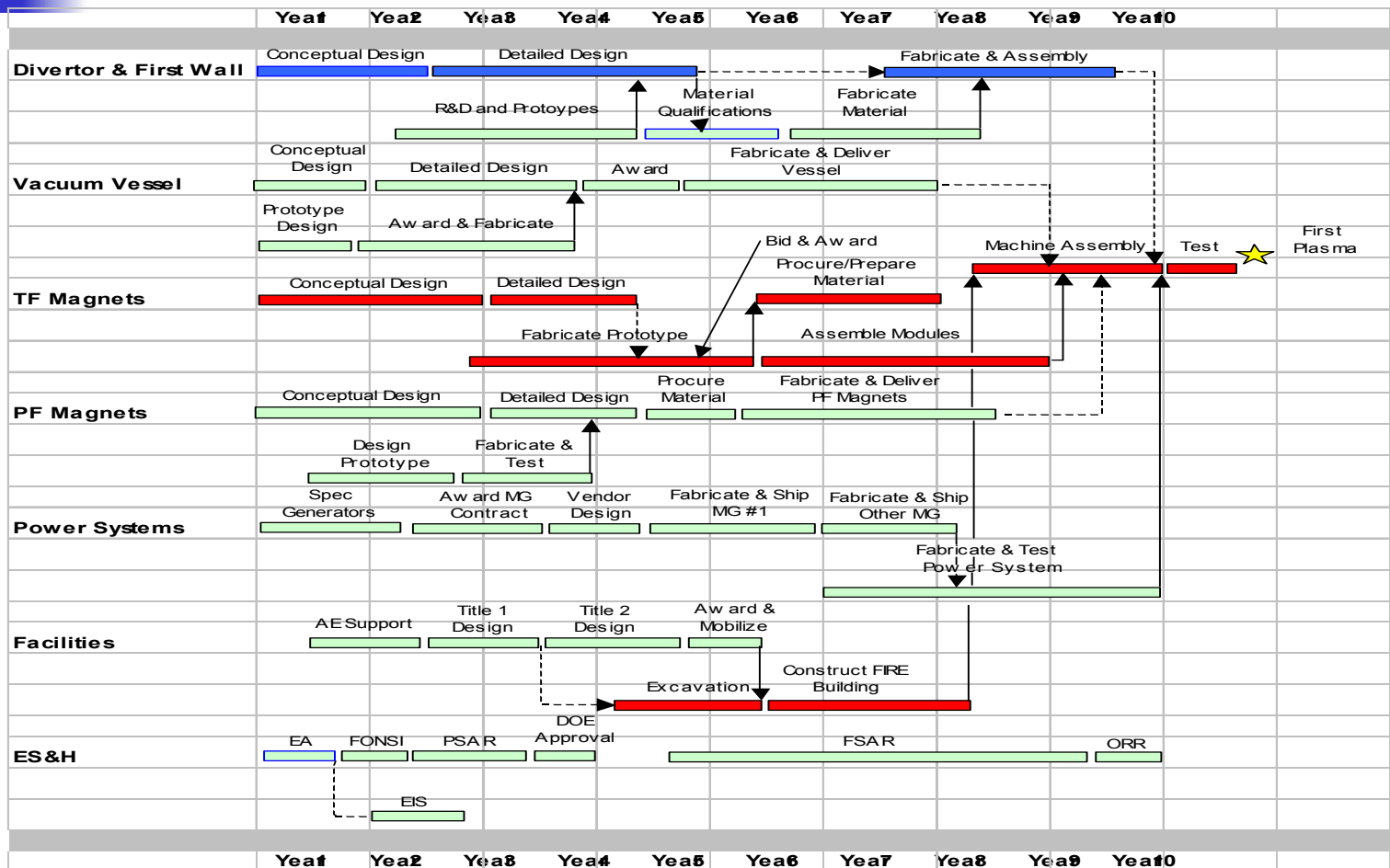
- FIRE assumed to be built on a “green field” site
- Estimate expressed in manhours and a “standard” fusion lab rate applied to cost
- Travel, Material, and Subcontracts fully loaded with all markups included
- Contingency estimated at the WBS 4 (3-digit) level based on standard guidelines as a starting point



Methodology

- Costs expressed in FY1999 \$
- Estimates developed for labor, M&S, and contingency
- Type of funding not crucial at this point of the design (pre-conceptual)
- Rely heavily on previous experiments and similar design

Schedule



June 5, 2001



Cost Summary

WBS Element	Cost (FY99M\$)	Contingency (FY99M\$)	Total (FY99M\$)
1 – Fusion Core Systems	\$266.3M	\$78.5M	\$343.8M
2 – Auxiliary Systems	\$135.6M	\$42.5M	\$178.1M
3 – Diagnostic Systems	\$22.0M	\$4.9M	\$26.9M
4 – Power Systems	\$177.3M	\$42.0M	\$219.3M
5 – Central I&C Systems	\$18.9M	\$2.5M	\$21.4M
6 – Site & Facilities	\$151.4M	\$33.8M	\$185.2M
7 – Assembly & Remote Maintenance	\$77.0M	\$18.0M	\$95.0M
8 – Project Support & Oversight	\$88.8M	\$13.3M	\$102.2M
9 – Preparation for Operations	\$16.2M	\$2.4M	\$18.6M
Total	\$953.6M	\$237.8M	\$1,190.4M



Fusion Core Systems Estimate

WBS Element	Cost (FY99M\$)	Contingency (FY99M\$)	Total (FY99M\$)
11 – Plasma Facing Systems	\$71.9M	\$19.2M	\$91.1M
12 – Vacuum Vessel & In-Vessel Structures	\$36.4M	\$11.6M	\$48.0M
13 – TF Magnets & Structures	\$117.9M	\$38.0M	\$155.9M
14 – PF Magnets & Structures	\$29.2M	\$7.2M	\$35.4M
15 – Cryostat	\$1.9M	\$0.6M	\$2.5M
16 – Tokamak Support Structure	\$9.0M	\$1.8M	\$10.9M
Total Fusion Core Systems	\$266.3M	\$78.5M	\$343.8M



R&D Summary – Fusion Core Systems

WBS	FY99M\$ (w/o Contingency)
WBS 11 - PFCs	\$8.7M
WBS 12 – Vacuum Vessel	\$1.4M
WBS 13 – TF Coils	\$3.3M
WBS 14 – PF Coils	\$1.0M
WBS 15 - Cryostat	\$0.0M
WBS 1.6 – Tokamak Support Structure	\$0.8M
Subtotal Fusion Core Systems	~\$15.2M



R&D Summary – Other Systems

WBS	FY99M\$ (w/o Contingency)
WBS 2.1 – Gas & Pellet Fueling Systems	\$0.1M
WBS 2.2 – Vacuum Pumping Systems	\$1.1M
WBS 2.4 – RF Heating & Current Drive	\$5.9M
WBS 7.5 – Remote Handling Systems	\$19.7M
WBS 7.6 – Hot Cell Facility Remote Handling	\$3.2M
Subtotal Other Systems	~\$30.0M
<i>TOTAL R&D</i>	<i>~\$45.2M</i>



Summary

- A great deal of effort has gone into developing this pre-conceptual cost estimate
- Wide reliance on previous devices and industrial input, especially for Fusion Core Systems
- FIRE ready to proceed with next phase and Conceptual Design

**FIRE Pre-Conceptual Cost Estimate
(May 24, 2001)**

WBS No.	Title	Level of Estimate		Est. Cost		Recommended Contingency		Total w/ Contingency		Comments
		Summary	Detail	FY-99 \$K	%	FY-99 \$K	%	FY-99 \$K	FY-99 \$K	
1 - Fusion Core Systems						\$266,322.4K	29.48%	\$78,507.0K	\$343,814.3K	
1.1	Plasma Facing Components - Ulrickson / Dreimeyer			\$71,902.2K		26.76%	\$19,241.1K	\$91,143.3K		
1.1.1	First Wall		X	\$15,067.9K		21.42%	\$3,227.0K	\$18,294.9K		
1.1.2	Outer Divertor Modules		X	\$26,663.9K		20.99%	\$5,596.0K	\$32,259.9K		
1.1.3	Baffle Structures		X	\$9,409.8K		59.47%	\$5,596.0K	\$15,005.8K		
1.1.4	Inner Divertor Plates		X	\$5,675.3K		21.39%	\$1,213.8K	\$6,889.1K		
1.1.5	Limiters & Armor		X	\$1,971.9K		21.45%	\$423.0K	\$2,394.9K		
1.1.6	Wall Conditioning Systems		X	\$4,413.4K		20.92%	\$923.4K	\$5,336.8K		
1.1.7	Plasma Facing Components Cooling Water (Inside Cryostat)									Already in Above Numbers
1.1.8	PF R&D		X	\$8,700.0K		26.00%	\$2,262.0K	\$10,962.0K		
1.2 Vacuum Vessel & In-Vessel Structures - Nelson						\$36,384.6K	31.92%	\$11,614.5K	\$47,999.1K	
1.2.1	Primary VV shell		X	\$18,860.1K		34.00%	\$6,412.4K	\$25,272.5K		Are Internal Control Coils Included?
1.2.2	VV Port Extensions & Duct Shielding		X	\$9,639.3K		28.00%	\$2,699.0K	\$12,338.3K		
1.2.3	VV Port Closure Systems & Penetration Shielding		X	\$5,315.4K		28.00%	\$1,488.3K	\$6,803.7K		
1.2.4	VV Heating & Cooling Systems (Inside Cryostat)		X	\$639.0K		36.00%	\$230.0K	\$869.0K		
1.2.5	VV Supports		X	\$1,494.5K		42.00%	\$627.7K	\$2,122.2K		
1.2.6	Local I&C and Sensors		X	\$436.3K		36.00%	\$157.1K	\$593.4K		
1.3 Toroidal Field Magnets and Structures						\$117,901.0K	32.27%	\$38,041.7K	\$155,942.7K	
1.3.1	TF Winding Pack		X	\$91,277.4K		34.00%	\$31,034.3K	\$122,311.7K		
1.3.2	TF Cases & Support Structure		X	\$5,503.4K		30.00%	\$1,651.0K	\$7,154.4K		
1.3.3	TF Magnet Assembly (Winding Pack into Cases)		X	\$2,416.9K		30.00%	\$725.1K	\$3,142.0K		
1.3.4	TF Power & Cryogen Interfaces		X	\$1,800.0K		20.70%	\$372.6K	\$2,172.6K		
1.3.5	TF Magnets Engineering Design/Support		X	\$13,620.3K		25.00%	\$3,405.1K	\$17,025.4K		
1.3.6	TF Coil R&D		X	\$3,283.0K		26.00%	\$853.6K	\$4,136.6K		
1.4 Poloidal Field Magnets and Structures						\$29,242.8K	24.66%	\$7,211.5K	\$35,359.3K	
1.4.1	Central Solenoid and Inner Ring Coils (PF1/2 Upper & Lower)		X	\$6,606.3K		33.14%	\$2,189.2K	\$8,795.5K		
1.4.1.1	CS/Inner Ring Coils Winding Packs			\$5,183.3K		34.00%	\$1,762.3K	\$6,945.6K		
1.4.1.2	CS/Inner Ring Coils Cases and Support Structure			\$883.0K		30.00%	\$264.9K	\$1,147.9K		
1.4.1.3	CS/Inner Ring Coils Assembly (Winding Pack into Cases)			\$540.0K		30.00%	\$162.0K	\$702.0K		
1.4.2	Outer Ring Coils (PF3/4 Upper & Lower)		X	\$12,524.6K		21.67%	\$2,713.6K	\$15,238.1K		
1.4.2.1	Outer Ring Coils Winding Packs			\$7,283.3K		16.00%	\$1,165.3K	\$8,448.6K		
1.4.2.2	Outer Ring Coils Cases and Support Structures			\$241.3K		20.00%	\$48.3K	\$289.6K		
1.4.2.3	Outer Ring Coils Shrouds & Assembly			\$5,000.0K		30.00%	\$1,500.0K	\$6,500.0K		Place Holder of \$5M for Ring Coils Shrouds/Assembly
1.4.3	PF Power and Cryogen Interfaces			\$1,250.0K		20.00%	\$250.0K	\$1,500.0K		
1.4.4	Field Error Correction Coils		X	\$1,761.4K		18.00%	\$317.1K	\$2,078.5K		Scaled from TPX Design
1.4.5	Resistive Wall Mode Coils									Future Upgrade - WBS Placeholder Only
1.4.6	PF Magnets Engineering Design/Support		X	\$6,148.6K		26.00%	\$1,598.6K	\$7,747.2K		
1.4.7	PF Coil R&D		X	\$952.0K		26.00%	\$247.5K	\$1,199.5K		
1.5 Cryostat - Nelson						\$1,917.2K	28.62%	\$556.3K	\$2,473.5K	
1.5.1	Cryostat Shell & Structure		X	\$1,730.4K		28.00%	\$484.5K	\$2,214.9K		
1.5.2	Vacuum & Fluid Systems		X	\$114.5K		40.00%	\$45.8K	\$160.3K		
1.5.5	Local I&C and Sensors		X	\$72.3K		36.00%	\$26.0K	\$98.3K		
1.6 Tokamak Support Structure - Titus \ Heitzenroeder \ Waganer						\$8,974.7K	20.52%	\$1,841.9K	\$10,896.5K	
1.6.1	Main Assembly Support Ring & Central Column Supports			\$1,472.0K		20.00%	\$294.4K	\$1,739.3K		
1.6.1.1	Central Column Supports		X	\$938.0K		20.00%	\$187.6K	\$1,107.8K		
1.6.1.2	Main Assembly Support Ring		X	\$534.0K		20.00%	\$106.8K	\$631.5K		
1.6.2	Gravity Supports		X	\$1,028.0K		20.00%	\$205.6K	\$1,214.8K		
1.6.3	TF Coil Radial Compression		X	\$5,692.0K		20.00%	\$1,138.4K	\$6,727.6K		
1.6.3.1	Compression Rings		X	\$3,293.0K		20.00%	\$658.6K	\$3,892.0K		
1.6.3.2	Radial Compression Mechanism & Interface Elements		X	\$2,399.0K		20.00%	\$479.8K	\$2,835.6K		
1.6.4	Central Tie Rod Assembly			\$0.0K		20.00%	\$0.0K	\$0.0K		NO LONGER REQUIRED
1.6.4.1	Tierod Coumns		X			20.00%				
1.6.4.2	Tierod End Supports		X			20.00%				
1.6.5	Ring Preload Mechanism R&D		X	\$782.7K		26.00%	\$203.5K	\$1,214.8K		

**FIRE Pre-Conceptual Cost Estimate
(May 24, 2001)**

WBS No.	Title	Level of Estimate		Est. Cost		Recommended Contingency		Total w/ Contingency		Comments
		Summary	Detail	FY-99 \$K	%	FY-99 \$K	%	FY-99 \$K	FY-99 \$K	
2 - Auxiliary Systems				\$135,610.9K	31.32%	\$42,479.8K		\$178,090.7K		
2.1	Gas & Pellet Injection Fueling Systems - M. Gouge			\$7,145.0K	20.00%	\$1,429.0K		\$8,574.0K		RATE ADJUSTMENT NEEDED
2.1.1	Fuel Storage System		X	\$831.0K	20.00%	\$166.2K		\$997.2K		
2.1.2	Pellet Injector Fueling System		X	\$3,587.0K	20.00%	\$717.4K		\$4,304.4K		
2.1.3	Gas Fueling System		X	\$1,687.0K	20.00%	\$337.4K		\$2,024.4K		
2.1.4	Disruption Control Systems		X	\$1,040.0K	20.00%	\$208.0K		\$1,248.0K		
2.2	Vacuum Pumping System - M. Gouge		X	\$9,585.9K	35.08%	\$3,362.5K		\$12,948.4K		
2.2.1	High Vacuum Pumping Systems			\$6,084.4K	38.00%	\$2,312.1K		\$8,396.5K		
2.2.2	Roughing & Backing Pumping Systems			\$1,941.9K	30.00%	\$582.6K		\$2,524.5K		
2.2.3	Diagnostic Roughing & Backing Systems			\$1,559.6K	30.00%	\$467.9K		\$2,027.4K		
2.3	Fuel Recovery and Processing Systems - C. Gentile		X	\$7,000.0K	15.00%	\$1,050.0K		\$8,050.0K		
2.3.1	Fuel Recovery & Processing System			\$7,000.0K	15.00%	\$1,050.0K		\$8,050.0K		
2.3.2	Radiation Monitoring Systems									
2.4	RF Heating/Current Drive Systems - Swain			\$111,880.0K	32.75%	\$36,638.3K		\$148,518.3K		
2.4.1	ICRF Systems			\$111,880.0K	32.75%	\$36,638.3K		\$148,518.3K		
2.4.1.1	Antennas		X	\$13,176.0K	54.00%	\$7,115.0K		\$20,291.0K		
2.4.1.2	Tuning & Matching Systems		X	\$4,038.0K	12.00%	\$484.6K		\$4,522.6K		
2.4.1.3	Transmission Lines		X	\$5,360.0K	12.00%	\$643.2K		\$6,003.2K		
2.4.1.4	RF Sources		X	\$55,766.0K	38.00%	\$21,191.1K		\$76,957.1K		
2.4.1.5	DC Power Supplies		X	\$21,047.0K	14.00%	\$2,946.6K		\$23,993.6K		
2.4.1.6	Local I&C and Sensors		X	\$6,221.0K	14.00%	\$870.9K		\$7,091.9K		
2.4.1.7	R&D		X	\$6,272.0K	54.00%	\$3,386.9K		\$9,658.9K		
2.4.2	ECRF Systems (Later Upgrade)									NOT IN BASELINE => LATER UPGRADE
2.4.3	Lower Hybrid Systems (Later Upgrade)									NOT IN BASELINE => LATER UPGRADE
2.5	Neutral Beam Injection System - Swain									
	(Upgrade - Later)									
3 - Diagnostic Systems				\$22,048.6K	22.00%	\$4,850.7K		\$26,899.3K		PHASE I ONLY
3.1	Startup Diagnostics (Phase I) - Young / Ellis			\$22,048.6K	22.00%	\$4,850.7K		\$26,899.3K		
3.1.1	Phase I Magnetic Diagnostics			\$4,962.7K	22.00%	\$1,091.8K		\$6,054.5K		
3.1.1.1	Rogowski Coils		X	\$876.5K	22.00%	\$192.8K		\$1,069.3K		
3.1.1.2	Flux/voltage Loops		X	\$604.7K	22.00%	\$133.0K		\$737.7K		
3.1.1.3	Magnetic Field Probes		X	\$672.6K	22.00%	\$148.0K		\$820.6K		
3.1.1.4	Saddle/ Locked-Mode Coils		X	\$435.7K	22.00%	\$95.9K		\$531.6K		
3.1.1.5	Mirnov Coils		X	\$765.3K	22.00%	\$168.4K		\$933.7K		
3.1.1.6	Diamagnetic Loops		X	\$779.2K	22.00%	\$171.4K		\$950.6K		
3.1.1.1	Vessel Structure Current Monitors		X	\$828.7K	22.00%	\$182.3K		\$1,011.0K		
3.1.2	Phase I Control and Machine Diagnostics			\$3,241.2K	22.00%	\$713.1K		\$3,954.3K		
3.1.2.1	Single-Channel Interferometer		X	\$624.3K	22.00%	\$137.3K		\$761.6K		
3.1.2.2	Hard X-Ray Detector/Monitor		X	\$277.2K	22.00%	\$61.0K		\$338.2K		
3.1.2.3	Survey Plasma/IR TV		X	\$632.9K	22.00%	\$139.2K		\$772.1K		
3.1.2.4	PFC and Divertor Thermocouples		X	\$893.4K	22.00%	\$196.5K		\$1,089.9K		
3.1.2.5	Fixed Edge Probes		X	\$813.4K	22.00%	\$178.9K		\$992.3K		
3.1.3	Phase I Vacuum Diagnostics			\$2,156.4K	22.00%	\$474.4K		\$2,630.8K		
3.1.3.1	Torus Ion Gauges		X	\$547.5K	22.00%	\$120.5K		\$668.0K		
3.1.3.2	Residual Gas Analyzers		X	\$314.5K	22.00%	\$69.2K		\$383.7K		
3.1.3.3	Glow Discharge Probes		X	\$677.4K	22.00%	\$149.0K		\$826.4K		
3.1.3.4	Fast Neutral Pressure Gauges		X	\$617.0K	22.00%	\$135.7K		\$752.7K		
3.1.4	Phase I Passive Visible/IR Diagnostics			\$1,253.9K	22.00%	\$275.9K		\$1,529.8K		
3.1.4.1	Single Bolometer Array		X	\$805.9K	22.00%	\$177.3K		\$983.2K		
3.1.4.2	Visible/VUV Survey Spectrometer		X	\$448.0K	22.00%	\$98.6K		\$546.6K		
3.1.5	Phase I Microwave Diagnostics			\$892.0K	22.00%	\$196.2K		\$1,088.2K		
3.1.5.1	ECE Heterodyne Radiometer		X	\$892.0K	22.00%	\$196.2K		\$1,088.2K		
3.1.6	Phase I Diagnostics Interface and Integration		X	\$9,542.4K	22.00%	\$2,099.3K		\$11,641.7K		
3.2	ICRF/Divertor Check (Phase II) Diagnostics - Young/Ellis									NOT IN BASELINE => LATER UPGRADE
3.3	Full Physics DD (Phase III) Diagnostics - Young/Ellis									NOT IN BASELINE => LATER UPGRADE
3.4	Full Physics DT (Phase IV) Diagnostics - Young/Ellis									NOT IN BASELINE => LATER UPGRADE

FIRE Pre-Conceptual Cost Estimate
(May 24, 2001)

WBS No.	Title	Level of Estimate		Est. Cost		Recommended Contingency		Total w/ Contingency		Comments
		Summary	Detail	FY-99 \$K	%	FY-99 \$K	%	FY-99 \$K	FY-99 \$K	
4 - Power Systems										
4.1	Site Power Supplies - Woolley / Neumeier		X	\$177,300.0K	23.69%	\$41,996.0K		\$219,296.0K		Assumes All Power Supplied by Grid => +-\$39.4M if MG
4.1.1	Substations & Utilities Interfaces									
4.1.2	AC Distribution Systems			\$13,900.0K	20.00%	\$2,780.0K		\$16,680.0K		
4.1.3	Emergency Power Supply Systems									
4.2	Experimental Magnet Power Supply Systems - Woolley / Neumeier		X	\$163,400.0K	24.00%	\$39,216.0K		\$202,616.0K		
4.2.1	TF Coil Power Supplies									
4.2.2	PF Coils Power Supplies									
4.2.3	FEC Coil Power Supplies									
4.2.4	RWM Coil Power Supplies (Upgrade)									
4.2.5	IC Coil Power Supplies									
4.2.6	Common Magnet Electrical Power Equipment									
5 - Central Instrumentation & Controls										
5.1	Instrumentation and Control Systems -Oliaro		X	\$18,845.8K	13.30%	\$2,506.1K		\$21,351.9K		
5.2	Data Acquisition Systems - Oliaro		X	\$7,521.6K	14.00%	\$1,053.0K		\$8,574.6K		
5.3	Network Infrastructure and Distribution - Oliaro		X	\$6,778.4K	4.00%	\$271.1K		\$7,049.5K		
			X	\$4,545.8K	26.00%	\$1,181.9K		\$5,727.7K		
6 - Site and Facilities										
6.1	Facility Modifications - Dilling			\$151,382.5K	22.32%	\$33,792.8K		\$185,175.2K		
6.1.1	Site & Facility Improvements			\$19,476.0K	14.56%	\$2,926.6K		\$22,402.6K		
6.1.1	Site & Facility Improvements		X	\$16,976.0K	14.00%	\$2,376.6K		\$19,352.6K		
6.1.2	Interfaces with Offsite Service Providers		X	\$2,500.0K	22.00%	\$550.0K		\$3,050.0K		
6.2	Building and Structures - Dilling			\$99,214.7K	26.42%	\$26,210.7K		\$125,425.4K		
6.2.1	Safety Related Buildings and Structures			\$66,041.4K	27.20%	\$17,962.5K		\$84,003.9K		
6.2.1.1	Tokamak & Hot Cell Building		X	\$55,357.8K	28.00%	\$15,500.2K		\$70,858.0K		
6.2.1.2	Radioactive Systems Support Building		X	\$3,876.1K	26.00%	\$1,007.8K		\$4,883.8K		
6.2.1.3	Tritium & Vacuum Pumping Building		X	\$0.0K	0.00%	\$0.0K		\$0.0K		Deleted
6.2.1.4	Radwaste Systems Building		X	\$4,651.3K	22.00%	\$1,023.3K		\$5,674.6K		
6.2.1.5	Emergency Power Supply Building		X	\$2,156.2K	20.00%	\$431.2K		\$2,587.5K		
6.2.2	Non-Safety Related Buildings & Structures			\$33,173.3K	24.86%	\$8,248.2K		\$41,421.5K		
6.2.2.1	Assembly & Mockup Building		X	\$9,901.1K	30.00%	\$2,970.3K		\$12,871.4K		
6.2.2.2	Magnet Power Conversion Building		X	\$5,767.0K	24.00%	\$1,384.1K		\$7,151.1K		
6.2.2.3	Cooling System/Heat Rejection Building		X	\$533.1K	22.00%	\$117.3K		\$650.4K		
6.2.2.4	Cryogenics Systems Building		X	\$607.3K	22.00%	\$133.6K		\$741.0K		
6.2.2.5	ICRF Power Supply Building		X	\$2,133.8K	24.00%	\$512.1K		\$2,645.9K		
6.2.2.6	Laboratory Office Building		X	\$12,206.4K	22.00%	\$2,685.4K		\$14,891.8K		
6.2.2.7	Operations and Control Building		X	\$1,265.3K	22.00%	\$278.4K		\$1,543.7K		
6.2.2.8	Plant Utilities Building		X	\$759.2K	22.00%	\$167.0K		\$926.2K		
6.3	Water Cooling Systems - Dilling			\$7,389.5K	10.98%	\$811.1K		\$8,200.6K		
6.3.1	PFC Cooling Water Systems (Outside Cryostat)	??		\$1,370.0K	14.00%	\$191.8K		\$1,561.8K		
6.3.2	VV Heating & Cooling Water Systems (Outside Cryostat)	??		\$433.7K	14.00%	\$60.7K		\$494.4K		
6.3.3	Secondary Component Cooling & Chilled Water Systems			\$4,107.5K	10.00%	\$410.7K		\$4,518.2K		
6.3.4	Plant Heat Rejection System			\$1,478.4K	10.00%	\$147.8K		\$1,626.2K		
6.4	Cryogenic Cooling Systems - Dilling			\$1,505.8K	22.49%	\$338.6K		\$1,844.4K		
6.4.1	Liquid Nitrogen Cooling Piping and Hardware		X	\$881.5K	20.00%	\$176.3K		\$1,057.8K		Includes Assembly & Installation Costs -- Also in WBS 7.2
6.4.2	Liquid Helium Cooling Piping and Hardware	??	X	\$624.3K	26.00%	\$162.3K		\$786.6K		
6.5	Waste Handling and Treatment Systems			\$8,604.3K	21.17%	\$1,821.3K		\$10,425.6K		
6.5.1	Liquid Radioactive Waste Treatment System		X	\$1,678.8K	18.00%	\$302.2K		\$1,980.9K		
6.5.2	Water De-Tritiation System		X	\$5,547.8K	22.00%	\$1,220.5K		\$6,768.3K		
6.5.3	High Level Solid Waste Processing System		X	\$697.1K	22.00%	\$153.4K		\$850.5K		
6.5.4	Low Level Solid Waste Treatment System		X	\$111.3K	18.00%	\$20.0K		\$131.4K		
6.5.5	Toxic Material Treatment System		X	\$569.3K	22.00%	\$125.2K		\$694.5K		
6.6	Utility Systems			\$15,192.2K	11.09%	\$1,684.3K		\$16,876.5K		
6.6.1	Inert Gas Distribution System		X	\$689.7K	12.00%	\$82.8K		\$772.5K		
6.6.2	Breathing Air System		X	\$775.9K	12.00%	\$93.1K		\$869.0K		
6.6.3	Compressed Air System		X	\$3,876.8K	12.00%	\$465.2K		\$4,342.0K		
6.6.4	Potable Water Treatment System		X	\$2,914.0K	12.00%	\$349.7K		\$3,263.7K		
6.6.5	Demineralized Water Treatment System		X	\$791.8K	10.00%	\$79.2K		\$871.0K		
6.6.6	Sanitary Drainage System		X	\$1,615.0K	10.00%	\$161.5K		\$1,776.5K		
6.6.7	Industrial Drainage System		X	\$1,615.0K	10.00%	\$161.5K		\$1,776.5K		
6.6.8	Fire Protection System		X	\$2,914.0K	10.00%	\$291.4K		\$3,205.4K		

**FIRE Pre-Conceptual Cost Estimate
(May 24, 2001)**

WBS No.	Title	Level of Estimate		Est. Cost		Recommended Contingency		Total w/ Contingency		Comments
		Summary	Detail	FY-99 \$K	%	FY-99 \$K	%	FY-99 \$K	FY-99 \$K	
7 - Machine Assembly and Remote Maintenance										
				\$77,030.0K	23.32%	\$17,960.2K		\$94,990.2K		
7.1	Torus Systems Assembly and Installation - Heitzenroeder		X	\$5,515.4K	15.00%	\$827.3K		\$6,342.7K		
7.2	Ancillary Systems Assembly and Installation - Heitzenroeder		X	\$2,078.6K	15.00%	\$311.8K		\$2,390.4K		
7.3	Special Machine Assembly Tools & Equip.- Heitzenroeder		X	\$2,142.0K	15.00%	\$321.3K		\$2,463.3K		
7.4	In-Vessel Measurement Systems - Nelson			\$629.0K	12.47%	\$78.4K		\$707.4K		TOTAL
7.4.1	Magnetic Field Measurement System		X	\$148.0K	14.00%	\$20.7K		\$168.7K		
	7.4.1.1 Magnetic Surfaces Measurement Systems									
	7.4.1.2 Other Magnetic Field Measurement Systems									
7.4.2	Mechanical Position Measurement/Metrology Systems		X	\$481.0K	12.00%	\$57.7K		\$538.7K		Based on one laser tracker and two Faro arms
7.4.3	Measurement Systems R&D		X	\$0.0K	0.00%	\$0.0K		\$0.0K		None Anticipated
7.5	Remote Handling Systems - Burgess			\$49,331.0K	25.77%	\$12,714.3K		\$62,045.3K		
7.5.1	In-Vessel Transporters		X	\$12,366.8K	28.00%	\$3,462.7K		\$15,829.5K		
	7.5.1.1 Articulated Booms			\$4,487.2K	28.00%	\$1,256.4K		\$5,743.6K		Details Not Broken Out
	7.5.1.2 End-Effectors			\$7,879.6K	28.00%	\$2,206.3K		\$10,085.9K		Details Not Broken Out
7.5.2	In-Vessel Inspection Systems		X	\$2,545.0K	12.00%	\$305.4K		\$2,850.4K		
	7.5.2.1 In-Vessel Metrology System		X	\$2,060.0K	12.00%	\$247.2K		\$2,307.2K		
	7.5.2.2 In-Vessel Viewing System		X	\$485.0K	12.00%	\$58.2K		\$543.2K		
7.5.3	Port Assembly Handling Systems		X	\$14,805.2K	28.00%	\$4,145.5K		\$18,950.7K		
	7.5.3.1 Midplane Port Handling Vehicle			\$7,098.8K	28.00%	\$1,987.7K		\$9,086.5K		
	7.5.3.2 Auxiliary Port Handling Vehicle			\$6,206.4K	28.00%	\$1,737.8K		\$7,944.2K		
	7.5.3.3 Dexterous Manipulators			\$1,500.0K	28.00%	\$420.0K		\$1,920.0K		
7.5.4	Remote Handling Tools		X	\$6,300.0K	28.00%	\$1,764.0K		\$8,064.0K		
	7.5.4.1 Pipe Cutting, Welding & Inspection Tools			\$6,150.0K	28.00%	\$1,722.0K		\$7,872.0K		
	7.5.4.2 Lip-Seal Cutting, Welding & Inspection Tools			\$0.0K	28.00%	\$0.0K		\$0.0K		Combined with 7.5.4.1
	7.5.4.3 Power Wrenches for Port Assembly Attachments			\$150.0K	28.00%	\$42.0K		\$192.0K		
7.5.5	Containment and Transport Systems		X	\$8,994.0K	28.00%	\$2,518.3K		\$11,512.3K		
	7.5.5.1 Transfer Casks			\$5,040.0K	28.00%	\$1,411.2K		\$6,451.2K		
	7.5.5.2 Cask Docking Interfaces			\$330.0K	28.00%	\$92.4K		\$422.4K		
	7.5.5.3 Cask Transport Air Cushion Vehicles			\$2,974.0K	28.00%	\$832.7K		\$3,806.7K		Rate \$124/hr vs. \$110
	7.5.5.4 Midplane Port Shielded Enclosure			\$650.0K	28.00%	\$182.0K		\$832.0K		
7.5.6	Remote Handling Control Room & Test Stand		X	\$4,320.0K	12.00%	\$518.4K		\$4,838.4K		
	7.5.6.1 Remote Handling Control Room Equipment			\$720.0K	12.00%	\$86.4K		\$806.4K		
	7.5.6.2 Test Stand Group Labor			\$3,600.0K	12.00%	\$432.0K		\$4,032.0K		
7.6	Hot Cell Facility Remote Handling Systems - Burgess			\$17,334.0K	21.39%	\$3,707.1K		\$21,041.1K		
7.6.1	Hot Cell Bridge Crane Systems		X	\$1,600.0K	16.00%	\$256.0K		\$1,856.0K		
7.6.2	Hot Cell Bridge Mounted Manipulator Systems		X	\$4,000.0K	16.00%	\$640.0K		\$4,640.0K		
7.6.3	Hot Cell Shielded Window Workstations		X	\$3,895.0K	12.00%	\$467.4K		\$4,362.4K		
7.6.4	Hot Cell Viewing Systems		X	\$1,030.0K	16.00%	\$164.8K		\$1,194.8K		
7.6.5	Hot Cell Component Repair Stations			\$6,180.0K	32.00%	\$1,977.6K		\$8,157.6K		
	7.6.5.1 Port Assembly Repair Station		X	\$2,810.0K	32.00%	\$899.2K		\$3,709.2K		
	7.6.5.2 Divertor Repair Station		X	\$2,975.0K	32.00%	\$952.0K		\$3,927.0K		
	7.6.5.1 Cryopump Repair Station		X	\$395.0K	32.00%	\$126.4K		\$521.4K		
7.6.6	Hot Cell Component Handling Fixtures			\$629.0K	32.00%	\$201.3K		\$830.3K		
	7.6.6.1 Divertor Module Handling Fixtures		X	\$236.0K	32.00%	\$75.5K		\$311.5K		
	7.6.6.2 Port Assembly Handling Fixtures		X	\$261.0K	32.00%	\$83.5K		\$344.5K		
	7.6.6.1 Limiter Module Handling Fixtures		X	\$66.0K	32.00%	\$21.1K		\$87.1K		
	7.6.6.1 First Wall Module Handling Fixtures		X	\$66.0K	32.00%	\$21.1K		\$87.1K		
8 - Project Support & Oversight										
				\$88,829.3K	15.00%	\$13,324.4K		\$102,153.7K		
8.1	Project Management & Control - Simmons		X	\$9,979.0K	15.00%	\$1,496.9K		\$11,475.9K		Need Review and Comment
8.2	Systems Engineering - Heitzenroeder			\$21,162.0K	15.00%	\$3,174.3K		\$24,336.3K		Need Review and Comment
	8.2.1 Design Integration		X	\$17,864.1K	15.00%	\$2,679.6K		\$20,543.7K		
	8.2.2 Configuration Management & Control		X	\$2,983.8K	15.00%	\$447.6K		\$3,431.4K		
8.3	Environmental and Safety Management - Petti/Simmons		X	\$2,841.4K	15.00%	\$426.2K		\$3,267.6K		D. Petti concurs
8.4	Construction Management - Dilling / Heitzenroeder		X	\$46,506.0K	15.00%	\$6,975.9K		\$53,481.9K		Revised estimate w/o Title III or Property Taxes
8.5	Project Physics - Meade		X	\$8,340.9K	15.00%	\$1,251.1K		\$9,592.0K		Rev 1 per Dale

FIRE Pre-Conceptual Cost Estimate
(May 24, 2001)

WBS No.	Title	Level of Estimate		Est. Cost		Recommended Contingency		Total w/ Contingency		Comments
		Summary	Detail	FY-99 \$K	%	FY-99 \$K	FY-99 \$K	FY-99 \$K		
9 - Preparations for Operations										
				\$16,212.1K	15.00%	\$2,431.8K		\$18,643.9K		
9.1	Pre-Operational Planning - Simmons		X	\$1,418.6K	15.00%	\$212.8K		\$1,631.4K		
9.2	Pre-Operational and Integrated Systems Testing - Heitzenroeder		X	\$1,071.0K	15.00%	\$160.7K		\$1,231.7K		
9.3	Operational Spares - Simmons		X	\$13,722.5K	15.00%	\$2,058.4K		\$15,780.9K		
TOTALS				\$953,581.5K	24.94%	\$237,848.7K		\$1,190,415.1K		