

# Technology Working Group/ ITER Advocate Session Clarification of Costs

**July 10, 2002**

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**The Boeing Company**

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**Snowmass Summer Study**

## Purpose of Cost Assessment

**Assemble relevant cost data and estimate bases  
for each burning plasma experiment option**

- **Direct Capital Costs** (Fusion Power Core, Auxiliary Equipment, Remote Handling Systems, Site Facilities, and Allowance for Indeterminates) (**Land and Land Rights are not included**)
- **Indirect Capital Costs** (R&D during Construction, Project Support and Oversight during Construction)
- **Commissioning** (Preparation for Operations)
- **Annual Operating Costs** (Permanent Staff, Energy and Utility Costs, Fuel and Replacement Parts, Supplies and Support Services)
- **Decommissioning Costs** (Personnel, Hardware, and Services)

# Used a Common Cost Breakdown Structure (CBS) to Enable Comparison

- Developed a Common CBS that would encompass the experiments' CBS elements
- Sent common CBS to advocates for concurrence
- Analyzed cost elements for consistent assignment to common CBS
  - Escalation to current dollars, 2002\$ (US)
  - Contingency
  - Design Support
  - R&D Support during Construction
  - Spares and Deferred Costs
  - Allowance for Indeterminates

## Cost Bases Used

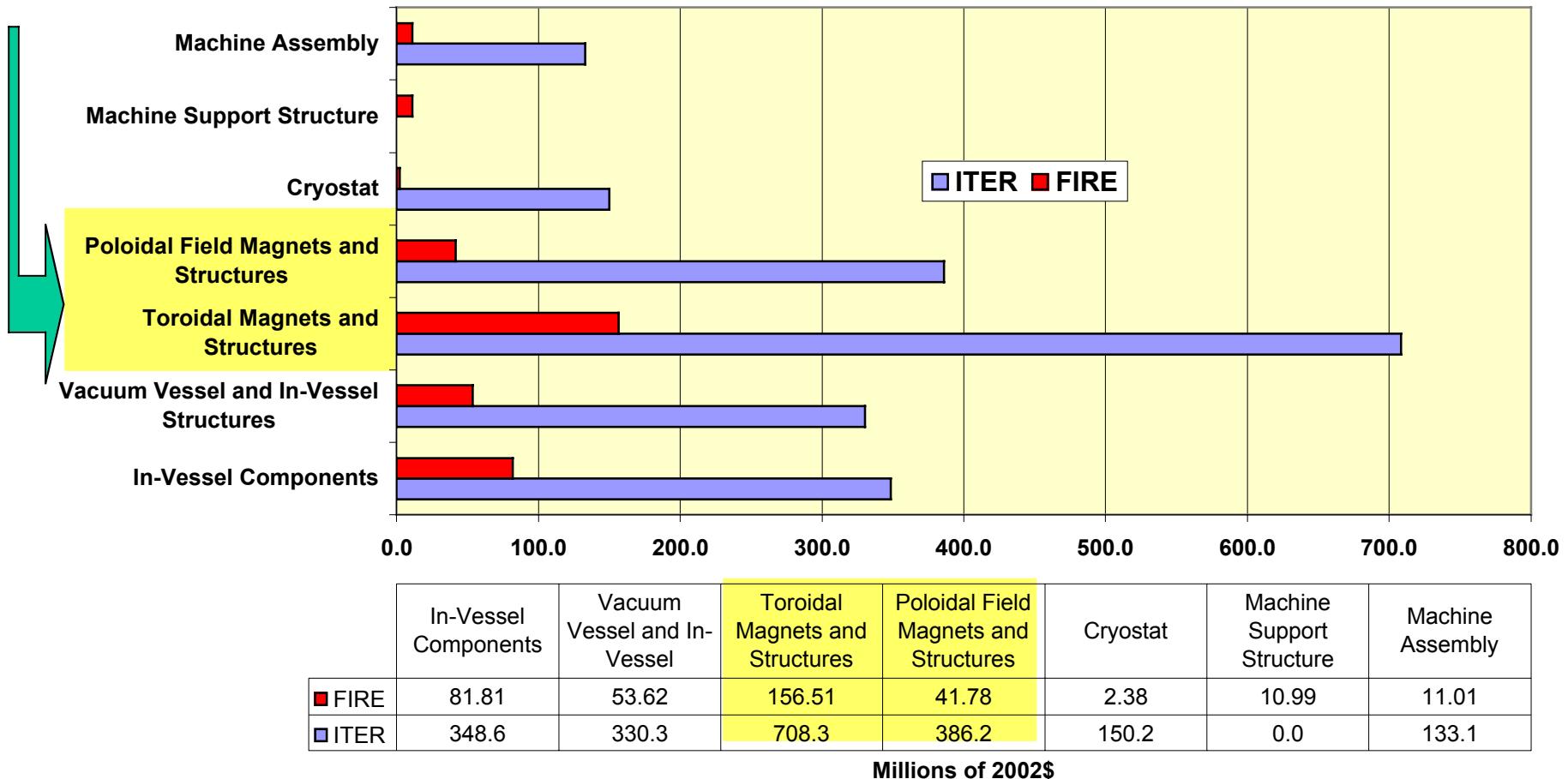
- **ITER Plant Description Document, Technical Basis, G A0 FDR 1 01-07-13 R1.0, Chapter 7, “Resources”, Table 7.1.5-1 in 1989 kIUA**
- **FIRE cost basis for 2.0 m radius machine dated July 8, 2001 in FY1999\$ is detailed basis. Updated cost basis for 2.14 m radius machine developed by FIRE team inputs and FIRE SALE code in 2002\$**
- **The IGNITOR cost basis has not been provided.**

## Examine Two Systems in this Session

- **TF and PF Systems**
- **Remote Handling Systems**

# Comparison of Fusion Power Core Elements

## Examine ITER TF and PF Costs



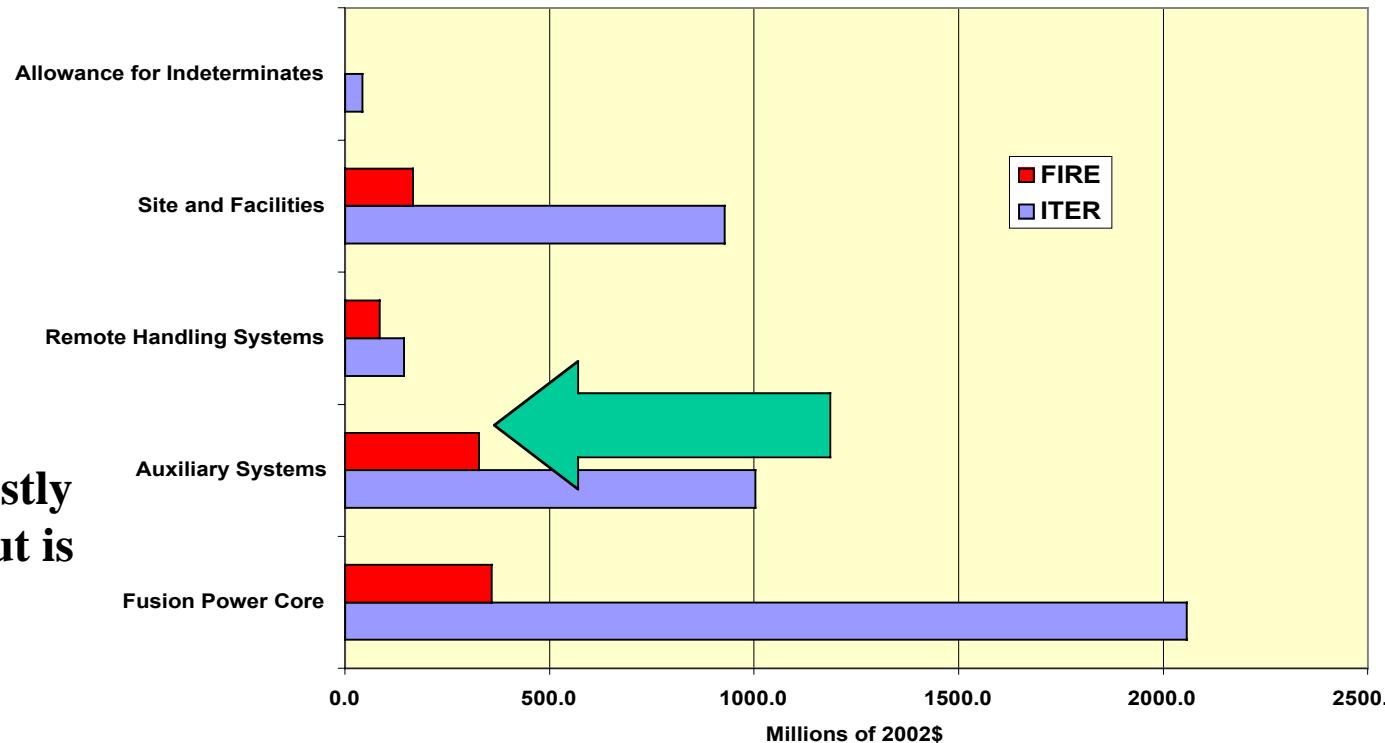
# Comparison of Magnet Subsystems

<u>Capital Cost Account</u>		<u>ITER</u>	<u>FIRE</u>
<b>1.3</b>	<b>Toroidal Magnets and Structures</b>	<b>708.3</b>	<b>156.51</b>
1.3.1	TF Winding Pack	267.6	52.5% of #1.1.6 conductor
1.3.2	TF Cases and Supports	241.7	#1.1.2 TF Mag Str
1.3.3	TF Pack and Case Assembly	168.0	#1.1.1 TF Coil Winding
1.3.4	Power and Cryogen Interfaces	30.92	52.5% of #1.1.5 feeders
1.3.5	Local I&C and Sensors		
1.3.6	TF Magnets Engr Design Support		16.38
<b>1.4</b>	<b>Poloidal Field Magnets and Structures</b>	<b>386.2</b>	<b>41.78</b>
1.4.1	Central Solenoid		
1.4.1.1	CS Winding Pack	70.4	13.8% of #1.1.6 conductor
1.4.1.2	CS Case and Supports	44.7	#1.1.4 CS coil
1.4.1.3	CS Assembly		0.84
1.4.2	Poloidal Field Magnets	71.4	#1.4.3 PF & CC
1.4.2.1	PF Winding Pack	171.8	33.7% of #1.1.6 conductor
1.4.2.2	PF Cases and Support		10.27
1.4.2.3	PF Assembly		0.35
1.4.3	Field Correction Coils	In 1.4.2	7.76
1.4.3.1	FC Winding Pack	in 1.4.2.1	2.21
1.4.3.2	FC Case and Supports		#1.4.4
1.4.3.3	FC Assembly		
1.4.4	Power and Cryogen Interfaces	27.98	47.5% of #1.1.5 feeder CS,PF CC
1.4.5	Local I&C and Sensors		1.40
1.4.6	PF Magnet Engr Design Support		9.30

**Question: Is the allocation of Conductors and Feeders into TF, PF, and CS subsystems per ITER IDR still appropriate?**

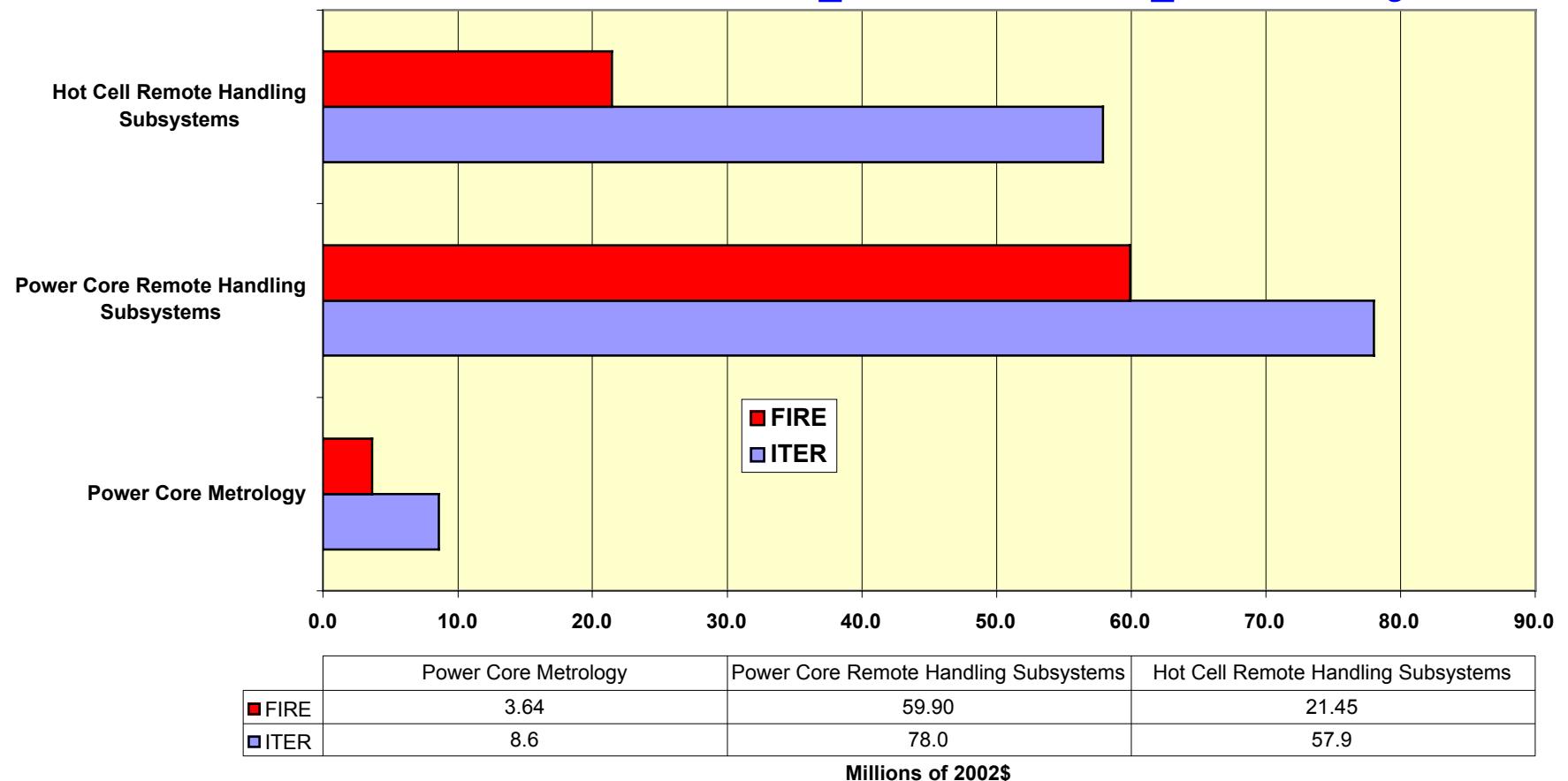
# Given The Size and Complexity of the ITER Remote Handling, The Ratio of System Costs Do Not Seem Appropriate

**ITER is only  
60% more costly  
than FIRE but is  
much more  
capable**



See next pages for detailed breakdown

# Hot Cell and Core Metrology Costs Seem Reasonable, But ITER Core RH May Be Insufficient For Proposed Capability



# Comparison of Site Facility Costs

<u>Capital Cost Account</u>		<u>ITER</u>	<u>FIRE</u>
3	<u>Remote Handling Systems</u>	<b>144.5</b>	<b>84.99</b>
3.1	<b>Power Core Metrology</b>	<b>8.6</b>	<b>3.64</b>
3.1.1	Magnetic Field Measurement	0.19	#7.4.1
3.1.2	Positional Measurement	0.54	#7.4.2
3.1.3	Viewing System	0.55	#7.5.2.2
3.1.4	In-vessel Metrology System	2.36	#7.5.2.1
3.2	<b>Power Core Remote Handling Subsystems</b>	<b>78.0</b>	<b>59.90</b>
3.2.1	In-Vessel Transporter/Boom and End Effectors	38.9	#2.3.1 Bkt RM Equip
3.2.2	Port Transporters/Handling System	16.8	#2.3.2 In-Vssl Div Equip
3.2.3	Divertor Transporters/Handling System	0.9	#2.3.5 Neutr B RH Equip
3.2.4	Neutral Beam Transporter/Handling	Incl in 3.5.7	
3.2.5	Vacuum Pump Transporter/Handling	21.4	#2.3.3 Trnsfr Cask Sys w/Dfrd
3.2.6	Containment and Transfer Systems		11.56
3.2.7	Special Remote Handling Tools/Robots		7.66
3.2.8	Power Core RH Control Room		4.68
3.2.9	Power Core RH Equipment Design Support		Not separated yet
3.3	<b>Hot Cell Remote Handling Subsystems</b>	<b>57.9</b>	<b>21.45</b>
3.3.1	Hot Cell Bridge Crane Systems	1.99	#7.6.1
3.3.2	Hot Cell Bridge Crane Manipulators	4.92	#7.6.2
3.3.3	Hot Cell Workstands	4.65	#7.6.3
3.3.4	Hot Cell Viewing Systems	1.27	#7.6.4
3.3.5	Hot Cell Component Repair Stations	7.83	#7.6.5
3.3.6	Special Remote Handling Tools/Robots		
3.3.7	Special Handling Fixtures	0.80	#7.6.6
3.3.8	Hot Cell RH Control Room	Incl in 3.5.8	Incl in 3.5.8
3.3.9	Hot Cell RH Systems Design Support		Incl in 3.5.9

## Other Cost Uncertainties (Answer off-line?)

- Does ITER VV costs include shielding, heating and cooling, support structures, and I&C
- Is the Machine Support Structure included in Magnet Systems?
- ITER identifies Torus Assembly costs but does not identify costs associated with Ancillary Systems assembly and installation
- ITER only provided a “rough estimate” for Central Instrumentation and Control. Is there a detailed estimate?
- Waste Handling and Treatment at \$11.8M (8.2 kIUA) seems low. FIRE is at \$10.55M
- ITER does not provide any Utility Systems (inert gas, breathing air, compressed air, water, communication, lighting, etc.

# Backup Slides

# Cost Risk and/or Uncertainty Table

Areas judged to have some cost risk and/or uncertainty

Capital Cost Accounts		ITER FEAT	FIRE 2.14 m radius	DCC only
<b>1 Fusion Power Core</b>		<b>2056.70</b>	<b>358.10</b>	
<b>1.1 In-Vessel Components</b>		<b>348.60</b>	<b>81.81</b>	
1.1.1 First Wall	In 1.1.1	219.90	20.68	
1.1.2 Blanket/Reflector		109.10	38.24	
1.1.3 Divertor		0.00	14.15	
1.1.4 Baffle		8.80	2.71	
1.1.5 Limiter/armor		8.60	0.00	
1.1.6 Manifolding and Filler Shields		2.20	0.00	
1.1.7 Shielding	In 1.1.2	0.00	6.03	
1.1.8 Wall Conditioning		0.00	0.00	
1.1.9 Local I&C and Sensors		0.00	0.00	
1.1.10 In-Vessel Components Engr Design Support		0.00	0.00	
<b>1.2 Vacuum Vessel and In-Vessel Structures</b>		<b>330.30</b>	<b>53.62</b>	
1.2.1 Primary Vacuum Vessel		222.60	28.16	
1.2.2 Port/Duct Assemblies		107.70	13.84	
1.2.3 Port Closure Systems		0.00	7.64	
1.2.4 Penetration/Port Shielding		0.00	Incl in 1.2.3	
1.2.5 Heating/Cooling System		0.00	0.97	
1.2.6 Support Structures		0.00	2.35	
1.2.7 Local I&C and Sensors		0.00	0.66	
1.2.8 VV Engr Design Support		0.00	0.00	

# Cost Risk and/or Uncertainty Table

Capital Cost Accounts		ITER FEAT	FIRE 2.14 m radius
1.3	<b>1.3 Toroidal Magnets and Structures</b>	<b>708.27</b>	<b>156.51</b>
1.3.1	TF Winding Pack	267.65	127.62
1.3.2	TF Cases and Supports	241.70	7.16
1.3.3	TF Pack and Case Assembly	168.00	3.15
1.3.4	Power and Cryogen Interfaces	30.92	2.20
1.3.5	Local I&C and Sensors	0.00	0.00
1.3.6	TF Magnets Engr Design Support	0.00	16.38
1.4	<b>1.4 Poloidal Field Magnets and Structures</b>	<b>386.23</b>	<b>41.78</b>
1.4.1	Central Solenoid	0.00	0.00
1.4.1.1	CS Winding Pack	70.35	8.27
1.4.1.2	CS Case and Supports	44.70	1.38
1.4.1.3	CS Assembly	0.00	0.84
1.4.2	Poloidal Field Magnets	71.40	0.00
1.4.2.1	PF Winding Pack	171.80	10.27
1.4.2.2	PF Cases and Support	0.00	0.35
1.4.2.3	PF Assembly	0.00	7.76
1.4.3	Field Correction Coils	In 1.4.2	2.21
1.4.3.1	FC Winding Pack	in 1.4.2.1	0.00
1.4.3.2	FC Case and Supports	0.00	0.00
1.4.3.3	FC Assembly	0.00	0.00
1.4.4	Power and Cryogen Interfaces	27.98	1.40
1.4.5	Local I&C and Sensors	0.00	0.00
1.4.6	PF Magnet Engr Design Support	0.00	9.30

# Cost Risk and/or Uncertainty Table

Capital Cost Accounts		ITER FEAT	FIRE 2.14 m radius
<b>1.5 Cryostat</b>		<b>150.20</b>	<b>2.38</b>
1.5.1	Cryostat Shell	108.80	2.14
1.5.2	Support Structures	0.00	Incl'd in 1.5.1
1.5.3	Thermal Shield	41.40	0.00
1.5.4	Local I&C and Sensors	0.00	0.24
1.5.5	Cryostat Engr Design Support	0.00	0.00
<b>1.6 Machine Support Structure</b>		<b>0.00</b>	<b>10.99</b>
1.6.1	Main Support Structure	In 1.3 & 1.4 ?	1.85
1.6.2	Radial Compression System	0.00	7.85
1.6.3	Machine to Pedestal Supports	In 1.3 & 1.4 ?	1.29
1.6.4	Pedestal Structure	0.00	0.00
1.6.5	Auxiliary System Supports	0.00	0.00
1.6.6	Local I&C and Sensors	0.00	0.00
1.6.7	Machine Support Structure Engr Design Support	0.00	
<b>1.7 Machine Assembly</b>		<b>133.10</b>	<b>11.01</b>
1.7.1	Torus Assembly Operations	72.20	6.68
1.7.2	Ancillary System Assembly Operations	0.00	1.95
1.7.3	Assembly Tooling	60.90	2.39

# Cost Risk and/or Uncertainty Table

Capital Cost Accounts		ITER FEAT	FIRE 2.14 m radius
2 Auxiliary Systems		1002.10	327.59
2.1 Fueling System		9.80	5.56
2.1.1	Gas Fueling Subsystem	6.20	1.15
2.1.2	Pellet Injector Fueling Subsystem	3.60	2.44
2.1.3	Disruption Control (Pellet Injection) Subsystem	0.00	1.41
2.1.4	Fuel Storage, Local	0.00	0.57
2.1.5	Local I&C and Sensors	0.00	0.00
2.1.6	Fueling Engr Design Support	0.00	0.00
2.2 Vacuum Pumping System		37.20	16.34
2.2.1	High Vacuum Pumping Subsystem	16.60	10.57
2.2.2	Roughing and Backing Subsystem	13.40	3.21
2.2.3	Diagnostic and Roughing Subsystem	7.20	2.57
2.2.4	Vacuum I&C and Sensors	0.00	0.00
2.2.5	Vacuum Engr Design Support	0.00	0.00
2.3 Fuel Processing and Handling System		103.50	4.60
2.3.1	Exhaust Processing System	16.90	0.00
2.3.2	Storage and Delivery, Long Term Storage	17.10	0.00
2.3.3	HDT Isotope Separation	8.00	0.00
2.3.4	Atmospheric Detritiation	39.50	0.00
2.3.5	Water Detritiation	19.00	0.00
2.3.6	Tritium Plant Analytical System	1.40	0.00
2.3.7	Tritium Plant Automatic Control System and Sensors	1.60	0.00
2.3.8	Fuel Processing Engr Design Support	0.00	0.00

# Cost Risk and/or Uncertainty Table

Capital Cost Accounts		ITER FEAT	FIRE 2.14 m radius
<b>2.4 RF Heating/Current Drive Systems</b>		<b>157.70</b>	<b>86.10</b>
2.4.1	ICRF Heating/Current Drive Subsystem	46.30	86.10
2.4.1.1	Antennas	6.50	12.22
2.4.1.2	Tuning and Matching	6.90	2.84
2.4.1.3	Transmission Lines	In 2.4.1.1	3.77
2.4.1.4	RF Sources	23.00	46.99
2.4.1.5	DC Power Supplies	9.90	15.04
2.4.1.6	ICRF I&C and Local Sensors	In 2.4.1.4	5.23
2.4.1.7	ICRF Engr Design Support	0.00	0.00
<b>2.4.2 ECRF Heating/Current Subsystem</b>		<b>111.40</b>	<b>0.00</b>
2.4.2.1	Antennas/Launcher	23.30	Later
2.4.2.2	Tuning and Matching	0.00	Upgrade
2.4.2.3	Transmission Lines	25.70	0.00
2.4.2.4	RF Sources	42.40	0.00
2.4.2.5	DC Power Supplies	20.00	0.00
2.4.2.6	ECRF I&C and Local Sensors	In 2.4.2.4	0.00
2.4.2.7	ECRF Engr Design Support	0.00	0.00
<b>2.4.3 LHH Heating/Current Subsystem</b>		<b>0.00</b>	<b>0.00</b>
2.4.3.1	Windows	Not Used	Later
2.4.3.2	Waveguides		Upgrade
2.4.3.3	Transmission Lines	0.00	0.00
2.4.3.4	Amplifiers	0.00	0.00
2.4.3.5	DC Power Supplies	0.00	0.00
2.4.3.6	LHH I&C and Local Sensors	0.00	0.00
2.4.3.7	LHH Engr Design Support	0.00	0.00

# Cost Risk and/or Uncertainty Table

Capital Cost Accounts		ITER FEAT	FIRE 2.14 m radius
<b>2.5 Neutral Beam Heating/Current Drive System</b>		<b>137.90</b>	<b>0.00</b>
2.5.1	Beam Source and HV Bushing	13.60	Later
2.5.2	Beamlne Components	5.60	Upgrade
2.5.3	Pressure Vessel, Drift Duct and Shielding	17.10	
2.5.4	Correction/Compensation Coils	6.30	
2.5.5	Assembly and Testing	5.50	
2.5.6	DC Power Supplies	89.80	
2.5.7	NB I&C and Local Sensors	0.00	
2.5.8	NB Engr Design Support	0.00	
<b>2.6 Device Instrumentation and Diagnostics</b>		<b>214.10</b>	<b>25.39</b>
2.6.1	Magnetic	4.70	In 2.6
2.6.2	Neutron	13.20	
2.6.3	Optical	33.60	In 2.6
2.6.4	Bolometry	9.60	
2.6.5	Spectroscopic	29.40	
2.6.6	Microwave	23.10	In 2.6
2.6.7	Vacuum	0.00	In 2.6
2.6.8	Diagnostic Neutral Beamlne & Power Supply	32.60	
2.6.9	Operational Systems	15.80	
2.6.10	Standard Diagnostics	52.10	In 2.6
2.6.11	Other Instrumentation/Diagnostics		0.00
2.6.12	Device Instrumentation and Diagnostics Design Support	0.00	In 2.6

# Cost Risk and/or Uncertainty Table

Capital Cost Accounts		ITER FEAT	FIRE 2.14 m radius
<b>2.7 Central Instrumentation and Control</b>		<b>71.80</b>	<b>20.37</b>
2.7.1	Instrumentation and Control	Rough Estimate	8.18
2.7.2	Data Acquisition		6.82
2.7.3	Network Infrastructure and Distribution	0.00	5.38
2.7.4	Central Computer	0.00	0.00
2.7.5	Data Storage and Retrieval	0.00	0.00
2.7.6	Central Instrumentation and Control Design Support	0.00	0.00
<b>2.8 Power Supplies (Magnet Only)</b>		<b>270.10</b>	<b>169.23</b>
2.8.1	AC/DC Convertors, ReactivePwr Cnvtrs, Harm Filtrs	116.60 In 2.8	
2.8.2	Switching Networks, Dschg Circuits, DC Dstrb, I&C	96.50 In 2.8	
2.8.3	Steady State Electrical Power Network	57.00 In 2.8	
2.8.4	TF Power Supplies	0.00 Incl	
2.8.5	PF Power Supplies	0.00 Incl	
2.8.6	Field Error Correction Power Supplies	0.00 Incl	
2.8.7	Resistive Wall Mode Power Supplies	0.00 Upgrade	
2.8.8	IC Coil Power Supplies	0.00 Incl	
2.8.9	Common Electrical Power Supplies	0.00 Incl	
2.8.10	Power Supplies Design Support	0.00 Incl	

# Cost Risk and/or Uncertainty Table

Capital Cost Accounts		ITER FEAT	FIRE 2.14 m radius
<b>3 Remote Handling Systems</b>		<b>144.50</b>	<b>84.99</b>
<b>3.1 Power Core Metrology</b>		<b>8.60</b>	<b>3.64</b>
3.1.1 Magnetic Field Measurement		0.00	0.19
3.1.2 Positional Measurement		0.00	0.54
3.1.3 Viewing System		0.00	0.55
3.1.4 In-vessel Metrology System		0.00	2.36
<b>3.2 Power Core Remote Handling Subsystems</b>		<b>78.00</b>	<b>59.90</b>
3.2.1 In-Vessel Transporter/Boom and End Effectors		38.90	16.07
3.2.2 Port Transporters/Handling System		0.00	19.94
3.2.3 Divertor Transporters/Handling System		16.80	0.00
3.2.4 Neutral Beam Transporter/Handling		0.90	0.00
3.2.5 Vacuum Pump Transporter/Handling	Incl in 3.5.7		0.00
3.2.6 Containment and Transfer Systems		21.40	11.56
3.2.7 Special Remote Handling Tools/Robots		0.00	7.66
3.2.8 Power Core RH Control Room		0.00	4.68
3.2.9 Power Core RH Equipment Design Support		0.00	0.00
<b>3.3 Hot Cell Remote Handling Subsystems</b>		<b>57.90</b>	<b>21.45</b>
3.3.1 Hot Cell Bridge Crane Systems		0.00	1.99
3.3.2 Hot Cell Bridge Crane Manipulators		0.00	4.92
3.3.3 Hot Cell Workstands		0.00	4.65
3.3.4 Hot Cell Viewing Systems		0.00	1.27
3.3.5 Hot Cell Component Repair Stations		0.00	7.83
3.3.6 Special Remote Handling Tools/Robots		0.00	0.00
3.3.7 Special Handling Fixtures		0.00	0.80
3.3.8 Hot Cell RH Control Room	Incl in 3.5.8	Incl in 3.5.8	
3.3.9 Hot Cell RH Systems Design Support		0.00	Incl in 3.5.9

# Cost Risk and/or Uncertainty Table

Capital Cost Accounts		ITER FEAT	FIRE 2.14 m radius
<b>4 Site and Facilities</b>		<b>927.60</b>	<b>165.73</b>
<b>4.1 Land and Land Rights</b>		<b>No Cost</b>	<b>No Cost</b>
4.1.1	Land and Privilege Acquisition	0.00	0.00
4.1.2	Relocation of Building, Utilities, Highways, etc	0.00	0.00
4.1.3	Facility Improvements (roads, sewers, access)	0.00	0.00
<b>4.2 Buildings and Structures, Safety Related</b>		<b>447.30</b>	<b>72.58</b>
4.2.1	Tokamak Building and Hot Cell (if integral)	0.00	60.98
4.2.2	Hot Cell Building	0.00	In 4.2.1
4.2.3	Radioactive Systems Support/Storage Building	0.00	4.21
4.2.4	Radioactive Waste Handling Building	0.00	5.13
4.2.5	Fuel Processing and Storage Building	0.00	0.00
4.2.6	Power Supplies Building	0.00	0.00
4.2.7	Emergency Power Supply Building	0.00	2.25
<b>4.3 Buildings and Structures, Non-Safety Related</b>		<b>98.80</b>	<b>41.65</b>
4.3.1	Administrative and Control Building	0.00	1.34
4.3.2	Assembly and Mockup Building	0.00	13.37
4.3.3	Laboratory Building	0.00	12.50
4.3.4a	Power Supplies Building (non-safety related)	0.00	5.41
4.3.4b	Power Supplies Building (non-safety related)	0.00	7.13
4.3.5	Cryogenics Building	0.00	0.54
4.3.6	Cooling Services/Heat Rejection Building	0.00	0.57
4.3.7	Plant Utilities Building	0.00	0.80
<b>4.4 Water Cooling Systems</b>		<b>198.10</b>	<b>7.26</b>
4.4.1	In-Vessel Cooling	102.00	1.32
4.4.2	Vacuum Vessel Cooling/Heating	in 4.4.1	0.42
4.4.3	Auxiliary Systems Cooling, Chilled Water	33.20	3.84
4.4.4	Heat Rejection System	62.90	1.68

# Cost Risk and/or Uncertainty Table

Capital Cost Accounts		ITER FEAT	FIRE 2.14 m radius
<b>4.5 Cryogenic Systems</b>		<b>127.70</b>	<b>1.71</b>
4.5.1	Liquid Nitrogen Subsystems and Piping	0.00	0.99
4.5.2	Liquid Helium Subsystems and Piping	0.00	0.73
4.5.3	Cryolant	86.90	0.00
4.5.4	Cryolines	17.50	0.00
4.5.5	Cryogenic Containers	23.30	0.00
<b>4.6 Waste Handling and Treatment</b>		<b>11.80</b>	<b>10.55</b>
4.6.1	Atmospheric Detritiation	0.00	
4.6.2	Water Detritiation	0.00	6.89
4.6.3	Gaseous Waste Processing	0.00	0.00
4.6.4	Liquid Radioactive Waste Treatment	0.00	1.92
4.6.5	High-Level Solid Waste Processing	0.00	0.91
4.6.6	Low-Level Solid WasteProcessing	0.00	0.14
4.6.7	Toxic Material Processing	0.00	0.69
<b>4.7 Utility Systems</b>		<b>0.00</b>	<b>17.43</b>
4.7.1	Inert Gas Storage and Distribution	Not Provd	0.79
4.7.2	Breathing Air	0.00	0.89
4.7.3	Compressed Air	0.00	4.44
4.7.4	Potable Water	0.00	3.44
4.7.5	Demineralized Water	0.00	0.92
4.7.6	Sanitary Drainage	0.00	1.80
4.7.7	Industrial Drainage	0.00	1.80
4.7.8	Communication	0.00	0.00
4.7.9	Furnishing and Fixtures (if not in buildings)	0.00	0.00
4.7.10	Electrical Power	0.00	0.00
4.7.11	Lighting	0.00	0.00
4.7.12	Fire Protection	0.00	3.35

# Cost Risk and/or Uncertainty Table

Capital Cost Accounts		ITER FEAT	FIRE 2.14 m radius
<b>4.8 Site Electrical Power</b>		<b>38.20</b>	<b>14.56</b>
4.8.1	HV Substations and Utility Interfaces	38.20	In 4.8
4.8.2	AC Distribution	In 4.8.1	In 4.8
4.8.3	Emergency Power Supply/UPS	0.00	In 4.8
<b>4.9 Plant Safety Systems</b>		<b>5.70</b>	<b>0.00</b>
4.9.1	Fire Protection		
4.9.2	Chemical Protection		
4.9.3	Radiological Protection	5.70	
<b>5 Allowance for Indeterminates</b>		<b>43.10</b>	<b>0.00</b>
<b>Total Direct Capital Costs</b>		<b>4174.00</b>	<b>936.42</b>