BENEFIT (TECHNICAL) CRITERIA

Long Life, light weight propulsion materials and structures

* A Criteria which may be a good discriminator for top level conceptual evaluation work.

Design Criteria		Relative Weight		Percent of Total Criteria	Cum Percent, All Criteria	Percent of * Criteria	Cum Percent, * Criteria	Comments
1)	# of active systems required to maintain a safe vehicle (-)	603		2.72%				Unknown.
2)	# of different propulsion systems (-)	582	*	2.62%	5.34%	5.19%		Not Applicable.
3)	# of systems with BIT BITE (+)	542		2.45%	7.79%			In this area there is no difference between this and any other technology.
4)	# of components with demonstrated high reliability (+)	541		2.44%	10.23%			The use of new materials should increase the reliability of many components.
5)	# of hands on activities req'd (-)	534		2.41%	12.63%			The use of new materials should decrease the need for the number of hands on activities.
6)	# of active components required to function including flight operations (-)	527	*	2.38%	15.01%	4.70%	9.89%	Not Applicable.
7)	# of potential leakage / connection sources (-)	527		2.37%	17.39%			Possibly reduced compared to materials because of ability to form more complex single parts.
8)	# of systems requiring monitoring due to hazards (-)	523		2.36%	19.74%			In this area there is no difference between this and any other technology.
9)	System margin (+)	508	*	2.29%	22.03%	4.53%	14.42%	The increased engine T/W improves margin.
10)	# of toxic fluids (-)	495	*	2.23%	24.27%	4.41%	18.83%	Not Applicable.
11)	% of propulsion system automated (+)	488	*	2.20%	26.47%	4.35%	23.18%	In this area there is no difference between this and any other technology.
12)	# of unique stages (flight and ground) (-)	483	*	2.18%	28.64%	4.31%	27.49%	Not Applicable.
13)	% of propulsion subsystems monitored to change from hazard to safe (+)	470		2.12%	30.76%			In this area there is no difference between this and any other technology.
14)	# of in-space support sys. req'd for propulsion sys. (-)	465		2.10%	32.86%			None.
15)	Design Variability (-)	464	*	2.09%	34.95%	4.14%	31.63%	Greatly reduced because of higher margins and flat material property curves.
16)	# of active on-board space sys. req'd for propulsion (-)	454	*	2.05%	37.00%	4.05%	35.68%	Not Applicable.
17)	On-board Propellant Storage & Management Difficulty in Space (-)	453	*	2.04%	39.04%	4.04%	39.72%	Not Applicable.

BENEFIT (TECHNICAL) CRITERIA

18)	# of purges required (flight and ground) (-)	428		1.93%	40.97%			In this area there is no difference between this and any other technology.
19)	# of confined spaces on vehicles (-)	427		1.92%	42.89%			In this area there is no difference between this and any other technology.
20)	Technology readiness levels (+)	425	*	1.92%	44.81%	3.79%	43.51%	TRLs vary between 3 and 4.
21)	# of active ground systems required for servicing (-)	420		1.89%	46.71%			In this area there is no difference between this and any other technology.
22)	# of different fluids in system (-)	404	*	1.82%	48.53%	3.60%	47.11%	Not Applicable.
23)	# of checkouts required (-)	403		1.82%	50.34%			Could be reduced because of more complex single parts.
24)	# of propulsion sub-systems with fault tolerance (+)	398	*	1.79%	52.14%	3.55%	50.66%	In this area there is no difference between this and any other technology.
25)	# of inspection points (-)	390		1.76%	53.90%			Could be reduced because of more complex single parts.
26)	Mass Fraction required (-)	387	*	1.75%	55.64%	3.45%	54.11%	Greatly improved over conventional materials.
27)	Hours for turnaround (between launches or commit to new mission) (-)	374		1.69%	57.33%			Could be reduces because of more complex single parts and higher margins which could be used to improve reliability.
28)	ISP Propellant transfer operation difficulty (resupply) (-)	371		1.68%	59.01%			Not Applicable.
29)	# pollutive or toxic materials (-)	350		1.58%	60.59%			Not Applicable.
30)	# of expendables (fluid, parts, software) (-)	348		1.57%	62.15%			Not Applicable.
31)	Minimum Impulse bit (+)	332		1.50%	63.65%			Not Applicable.
32)	# of criticality 1 failure modes (-)	329		1.48%	65.13%			Reduced from current designs.
33)	# of element to element interfaces requiring engineering control (-)	320		1.44%	66.57%			Could be fewer because of more complex single parts.
34)	Ave. Isp on refer. trajectory (+)	310	*	1.40%	67.97%	2.76%	56.87%	Not Applicable.
35)	# of parts (different, backup, complex) (-)	296		1.33%	69.31%			Much lower than current systems.
36)	# of umbs. req'd to Launch Vehicle (-)	276	*	1.25%	70.55%	2.46%	59.33%	Not Applicable.
37)	# of engines (-)	274	*	1.24%	71.79%	2.44%	61.77%	Architecture dependent based on abort considerations. Technology supports as few as one or as many as wanted.
38)	Resistance to Space Environment (+)	268	*	1.21%	73.00%	2.39%	64.16%	Could be different than current materials.
39)	# of physically difficult to access areas (-)	265		1.19%	74.19%			In this area there is no difference between this and any other technology.

BENEFIT (TECHNICAL) CRITERIA

40)	# of active engine systems required to function (-)	247	*	1.11%	75.30%	2.20%	66.36%	Not Applicable.
41)	Integral structure with propulsion sys. (+)	239	*	1.08%	76.38%	2.13%	68.49%	New materials could make this more feasible.
42)	Hours to refurbish propulsion system (-)	237		1.07%	77.45%			Could be reduced because of higher reliability and more complex single parts.
43)	# of manhours (c/o, handle, assemble etc) on system between on and off cycles (Low Cycle Fatigue) or use (High Cycle Fatigue) (-)	229		1.03%	78.48%			Could be reduced because of higher reliability and more complex single parts.
44)	# of modes or cycles (-)	227	*	1.02%	79.50%	2.02%	70.51%	Not Applicable.
45)	# of ground power systems (-)	226	*	1.02%	80.52%	2.02%	72.53%	In this area there is no difference between this and any other technology.
46)	Mean time between major overhaul (+)	221		1.00%	81.52%			Could be increased by the use of new materials.
47)	Amount of energy release from unplanned reaction of propellant (-)	219	*	0.99%	82.51%	1.95%	74.48%	Not Applicable.
48)	Margin, mass fraction (+)	215	*	0.97%	83.48%	1.92%	76.40%	Greatly improved over use of current materials.
49)	Margin, thrust level / engine chamber press(+)	211	*	0.95%	84.43%	1.88%	78.28%	The high T/W allows this to be increased.
50)	Transportation trip time (-)	211	*	0.95%	85.38%	1.88%	80.16%	Not Applicable.
51)	# of engine restarts required (-)	201	*	0.91%	86.29%	1.79%	81.95%	Not Applicable.
52)	Margin, ave. specific impulse (+)	193	*	0.87%	87.16%	1.72%	83.67%	Not Applicable.
53)	Power required as % of total veh. power (-)	183	*	0.82%	87.98%	1.63%	85.30%	Not Applicable.
54)	lbs. Intg.wet & dry mass of propulsion sys. (-)	163	*	0.74%	88.72%	1.45%	86.75%	Greatly reduced compared to the use of current materials.
55)	Impacts to Payload compat.(EMI,Thermal,& Exhaust) (-)	161	*	0.73%	89.44%	1.44%	88.19%	In this area there is no difference between this and any other technology.
56)	# of aero-control surfaces (-)	157	*	0.71%	90.15%	1.40%	89.59%	Not Applicable.
57)	lbs. of airborne support sys. req'd (-)	155	*	0.70%	90.85%	1.38%	90.97%	Not Applicable.
58)	# of manufacturing, test and operations facilites (recurring) (-)	154		0.69%	91.54%			In this area there is no difference between this and any other technology.
59)	# of hours to refurbish launch site between each launch (-)	145		0.65%	92.19%			In this area there is no difference between this and any other technology.
60)	Thrust control range (+)	139	*	0.63%	92.82%	1.24%	92.21%	Could allow some improvement.

BENEFIT (TECHNICAL) CRITERIA

61)	# of alternate dedicated emergency abort sites required (-)	136	*	0.61%	93.43%	1.21%	93.42%	Not Applicable.
62)	# of major systems required to ferry or return to launch site (plus logistics support) (-)	135	*	0.61%	94.04%	1.20%	94.62%	Not Applicable.
63)	Req'd propulsion sys. volume (-)	131	*	0.59%	94.63%	1.17%	95.79%	Could be lower because of increased engine thrust/weight.
64)	# of hazardous processes (-)	118		0.53%	95.16%			In this area there is no difference between this and any other technology.
65)	# of cleanliness requirements (-)	115		0.52%	95.68%			In this area there is no difference between this and any other technology.
66)	% of trajectory time available for abort (+)	104	*	0.47%	96.15%	0.93%	96.72%	Not Applicable.
67)	Ideal delta-V on ref. trajectory (-)	102	*	0.46%	96.61%	0.91%	97.63%	Not Applicable.
68)	# of processing steps to manufacture (-)	101		0.46%	97.07%			Lowered.
69)	# of keepout zones (-)	95		0.43%	97.50%			In this area there is no difference between this and any other technology.
70)	Amount of response time to initiate safe abort (-)	92	*	0.41%	97.91%	0.83%	98.46%	In this area there is no difference between this and any other technology.
71)	Amount of real time inspection or repair (-)	79		0.36%	98.27%			Could be lower because of increased reliability and more complex single parts.
72)	# of tools required (-)	79		0.36%	98.63%			Could be increased.
73)	Hardware cost (-)	64	*	0.29%	98.91%	0.58%	99.04%	Could be lowered because of less assembly due to more complex single parts.
74)	Facility capitalization cost (-)	62		0.28%	99.19%			Could be slightly higher.
75)	% of payload margin (+)	52	*	0.24%	99.43%	0.47%	99.51%	Could be greatly increased due to higher engine thrust/weight.
76)	cost of transportation / requirements (-)	40		0.18%	99.61%			Not Applicable.
77)	# acres permanently affected (-)	34		0.15%	99.76%			In this area there is no difference between this and any other technology.
78)	# of attainable destinations (+)	33	*	0.15%	99.91%	0.30%	99.81%	Could be increased because of higher engine thrust/weight.
79)	# new unique approaches (+)	20	*	0.09%	100.00%	0.19%	100.00%	None.