BENEFIT (TECHNICAL) CRITERIA

Long Life, High Thrust/Weight Lox/Hydrogen Engine

* 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%		Only one system is necessary. This technology can be used for main propulsion, OMS and RCS. Also there are no additional modes of operation (such as RAM, or turbine engines) needed.
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%			Because only one propulsion type and mode of operation is needed, the number of components with high reliability should be higher than for current systems or for combined cycle systems.
5) # of hands on activities req'd (-)	534		2.41%	12.63%			In this area there is no difference between this and any other technology.
6) # of active components required to function including flight operations (-)	527	*	2.38%	15.01%	4.70%	9.89%	Somewhat less than combined cycles.
7) # of potential leakage / connection sources (-)	527		2.37%	17.39%			Possibly reduced compared to other systems because of need of only one system.
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 high engine T/W improves margin.
10) # of toxic fluids (-)	495	*	2.23%	24.27%	4.41%	18.83%	None for the propulsion.
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%	Dependent on architecture. In this area there is no difference between this and any other technology.
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.

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15)	Design Variability (-)	464	*	2.09%	34.95%	4.14%	31.63%	The lowered design environments greatly reduce design variability.
16)	# of active on-board space sys. req'd for propulsion (-)	454	*	2.05%	37.00%	4.05%	35.68%	One.
17)	On-board Propellant Storage & Management Difficulty in Space (-)	453	*	2.04%	39.04%	4.04%	39.72%	Some method of providing a small amount of propellants with known conditions in zero-g must be provided (accumulators, screens, etc.). Only O_2 and H_2 must be provided, some other concepts could require more. However, this should not be a significant discriminator because all the technologies must perform this function.
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%	Very high compared to all other competing propulsion technologies.
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%	Less than turbine based cycles and than some RRCCs.
23)	# of checkouts required (-)	403		1.82%	50.34%			In this area there is no difference between this and any other technology.
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%			In this area there is no difference between this and any other technology.
26)	Mass Fraction required (-)	387	*	1.75%	55.64%	3.45%	54.11%	Improved over current rockets, highest of gen 3 propulsion systems considered.
27)	Hours for turnaround (between launches or commit to new mission) (-)	374		1.69%	57.33%			In this area there is no difference between this and any other technology.
28)	ISP Propellant transfer operation difficulty (resupply) (-)	371		1.68%	59.01%			None.
29)	# pollutive or toxic materials (-)	350		1.58%	60.59%			None in propulsion system.
30)	# of expendables (fluid, parts, software) (-)	348		1.57%	62.15%			None in propulsion system.
31)	Minimum Impulse bit (+)	332		1.50%	63.65%			In this area there is no difference between this and any other technology.

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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%			Fewer than combined cycles.
34)	Ave. Isp on refer. trajectory (+)	310	*	1.40%	67.97%	2.76%	56.87%	439.6
35)	# of parts (different, backup, complex) (-)	296		1.33%	69.31%			Much lower than current systems. Otherwise, in this area there is no difference between this and any other technology.
36)	# of umbs. req'd to Launch Vehicle (-)	276	*	1.25%	70.55%	2.46%	59.33%	Should be as low or lower than other propulsion approaches.
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%	Same as current engines.
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.
40)	# of active engine systems required to function (-)	247	*	1.11%	75.30%	2.20%	66.36%	Should be as low or lower than other propulsion approaches.
41)	Integral structure with propulsion sys. (+)	239	*	1.08%	76.38%	2.13%	68.49%	In this area there is no difference between this and any other technology.
42)	Hours to refurbish propulsion system (-)	237		1.07%	77.45%			In this area there is no difference between this and any other technology.
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%			In this area there is no difference between this and any other technology.
44)	# of modes or cycles (-)	227	*	1.02%	79.50%	2.02%	70.51%	Only one plus whatever throttling is wanted.
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%			>200. In this area there is no difference between this and any other technology.
47)	Amount of energy release from unplanned reaction of propellant (-)	219	*	0.99%	82.51%	1.95%	74.48%	More than combined cycles or pulsed detonation engines because of lower specific impulse.
48)	Margin, mass fraction (+)	215	*	0.97%	83.48%	1.92%	76.40%	Improved over current rockets, lowest of gen 3 propulsion systems considered.
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%	Very short compared to combined cycles.

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51)	# of engine restarts required (-)	201	*	0.91%	86.29%	1.79%	81.95%	None.
52)	Margin, ave. specific impulse (+)	193	*	0.87%	87.16%	1.72%	83.67%	Low.
53)	Power required as % of total veh. power (-)	183	*	0.82%	87.98%	1.63%	85.30%	Unknown.
54)	lbs. Intg.wet & dry mass of propulsion sys. (-)	163	*	0.74%	88.72%	1.45%	86.75%	More than combined cycles or pulsed detonation engines because of lower specific impulse.
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%	Because it uses a rocket earth to orbit trajectory, the number may well be less than most combined cycle concepts.
57)	lbs. of airborne support sys. req'd (-)	155	*	0.70%	90.85%	1.38%	90.97%	None.
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%	Can be designed as wanted at slight weight increase, but no life decrease.
61)	# of alternate dedicated emergency abort sites required (-)	136	*	0.61%	93.43%	1.21%	93.42%	Could be higher than combined cycles because vehicle designs tend to be lower L/D.
62)	# of major systems required to ferry or return to launch site (plus logistics support) (-)	135	*	0.61%	94.04%	1.20%	94.62%	All systems except turbine based combined cycles are the same.
63)	Req'd propulsion sys. volume (-)	131	*	0.59%	94.63%	1.17%	95.79%	More than combined cycles or pulsed detonation engines because of lower specific impulse.
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%	Unknown.
67)	Ideal delta-V on ref. trajectory (-)	102	*	0.46%	96.61%	0.91%	97.63%	Least of all systems.
68)	# of processing steps to manufacture (-)	101		0.46%	97.07%			Less that combined cycles, possibly more than pulsed detonation engines.
69)	# of keepout zones (-)	95		0.43%	97.50%			In this area there is no difference between this and any other technology.

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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%			In this area there is no difference between this and any other technology.
72)	# of tools required (-)	79		0.36%	98.63%			In this area there is no difference between this and any other technology.
73)	Hardware cost (-)	64	*	0.29%	98.91%	0.58%	99.04%	Probably lowest of all systems except (possibly) pulsed detonation engines.
74)	Facility capitalization cost (-)	62		0.28%	99.19%			Less than combined cycles.
75)	% of payload margin (+)	52	*	0.24%	99.43%	0.47%	99.51%	Improved over current engines.
76)	cost of transportation / requirements (-)	40		0.18%	99.61%			All systems except turbine based combined cycles are the same.
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%	In this area there is no difference between this and any other technology.
79)	# new unique approaches (+)	20	*	0.09%	100.00%	0.19%	100.00%	None.