

Sandia Large Rotor Design Scorecard (SNL100-01)

Design scorecard summary for updated SNL100-01 100-meter blade. Significant design changes from the baseline SNL100-00 blade (see report SAND2011-3779) include: (1) entire spar cap is replaced with carbon, (2) width of spar reduced by 50% with both principal shear webs moved accordingly, (3) root build-up was thinned, (4) trailing edge reinforcements were significantly reduced in thickness (50%) and width (50%), (5) shear web foam core reduced in all three webs (25% reduction), (6) parasitic resin thickness reduced from 5mm to 4 mm.

Table 1: Blade Parameters

Parameter	Value
Blade Designation (name)	SNL100-01
Design Wind Speed Class	IB
Blade Length (m)	100
Blade Weight (kg)	73,995
Span-wise CG location (m)	33.1
# shear webs	3
Maximum chord (m)	7.628 (19.5% span)
Lowest fixed base natural frequency (Hz)	0.49 Hz (NuMAD/ANSYS)
Control	Variable speed; collective pitch
Special notes:	Updated design with carbon spar cap starting with SNL100-00 baseline design; 7.2% of blade weight is parasitic/extra weight (resin)

Table 2. Blade Design Performance Metrics Summary

Analysis	Design Load Condition (DLC) designation	Metrics	Notes/method
Fatigue	Turbulent Inflow (NTM) (4 to 24 m/s)	202 years fatigue life at 50% span in spar 570 years fatigue life at 15% span in spar 1260 years fatigue life at 24% span in TE	MSU/DOE Database provided single cycle failure values and GL was referenced for slope values (10 for glass and 14 for carbon); Miner's Rule calculation
Ultimate	EWM50; 0 degree pitch with 15 degree yaw error	Max strain = 3525 micro-strain Allowable strain = 5139 micro-strain Max/allowable = 68.6%	At 2% span (near root); flap-wise; FAST
Deflection	ECD-R	Max (10.48 m) vs. allowable (13.67 m); Clearance = 3.19 m = 23.3%	FAST, NuMAD/ANSYS
Buckling	EWM50; 0 degree pitch with 15 degree yaw error	Min load factor (2.077) vs. allowable (2.042); near root to 10 meters span-wise)	Linear, ANSYS
Flutter	--	Flutter margin 1.84 (@ 13.7 RPM)	Sandia NuMAD-based Flutter Tool (BLAST); updated tool since SNL100-00 calculations

Table 3. Blade Design Bill of Materials

Material	Description	Mass (kg)	Percent Blade Mass
E-LT-5500	Uni-axial Fiberglass	10,924	14.8%
Saertex	Double Bias Fiberglass	9,368	12.7%
Carbon Prepreg	Conceptual Laminate	10,094	13.6%
EP-3	Epoxy Resin (total)	26,723	36.1%
Foam	Foam core	15,948	21.6%
Gelcoat	Coating	927	1.2%