Turbine Governor Speed Regulation (Droop) and Load Sharing

Speed regulation of a turbine governor from no-load and full-load speeds, and how two units in parallel share a load change after a frequency change.

Input parameters

Unit system: SI

Parameter	Value	Unit
Rated frequency	50.000	Hz
Unit 1 droop (speed regulation)	4.0000	%
Unit 1 rating	60.000	MW
Unit 2 droop	5.0000	%
Unit 2 rating	40.000	MW
Load increase on the pair	10.000	MW
Rated speed (for no-load and full-load speeds)	3,000.0	rpm

Calculated results

Parameter	Value	Unit
Frequency change	-0.21739	Hz
Unit 1 load change	6.5217	MW
Unit 2 load change	3.4783	MW
Unit 1 no-load speed	3,120.0	rpm
Combined stiffness	23.000	

Notes for this case

• Droop R = (N₀ − N)/N_r: the speed (frequency) falls by R of rated speed as load goes from zero to full. In parallel, units pick up a load change in proportion to rating divided by droop; equal droops share in proportion to rating. Secondary (frequency) control then restores the frequency.

Formula and method

$$R = \frac{N_0 - N}{N_r}, \quad \Delta P_i = \frac{P_{r,i}}{R_i f_n}(-\Delta f), \quad \Delta f = -\frac{\Delta P_L}{\sum_i P_{r,i}/(R_i f_n)}$$

Variables

f_n	Rated frequency	1/s
R_1	Unit 1 droop (speed regulation)	-
P_{r1}	Unit 1 rating	W
R_2	Unit 2 droop	-
P_{r2}	Unit 2 rating	W
ΔP_L	Load increase on the pair	W
N_r	Rated speed (for no-load and full-load speeds)	rad/s
Δf	Frequency change	1/s
ΔP_1	Unit 1 load change	W
ΔP_2	Unit 2 load change	W
N_0	Unit 1 no-load speed	rad/s
β	Combined stiffness	-

Method and standards

Linear governor droop characteristics.

Assumptions and limits

- Linear droop; no load frequency sensitivity; steady state.

Report details

Report reference	FCC-9X00-JECB (the same inputs always give the same reference)
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Calculator	Turbine Governor Speed Regulation (Droop) and Load Sharing
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/boilers-power-plant/steam-turbines/turbine-governor-droop-load-sharing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.