Induction Motor Contribution to a Bus Fault

Initial fault current that running induction motors feed into a nearby bus fault from their total rating, locked-rotor current ratio and the decay over a few cycles.

Method: Motor contribution approximated by locked-rotor current with exponential decay (definitions; Chapman, Electric Machinery Fundamentals, 5th ed. (McGraw-Hill, 2012))

Input parameters

Unit system: SI

Parameter	Value	Unit
Total running motor power	2,000.0	kW
Bus line voltage	415.00	V
Efficiency × power factor	80.000	%
Locked-rotor current ratio	6.0000	
Decay time constant	0.030000	s
Time after fault	0.020000	s

Calculated results

Parameter	Value	Unit
Total rated current	3,478.0	A
Initial motor contribution	20.868	kA
Contribution at t	10.714	kA

Notes for this case

- Induction motors contribute roughly their locked-rotor current for the first cycle, decaying within a few cycles as their flux collapses. Include them in breaker making and busbar duties.

Formula and method

$$I_r = \frac{P}{\sqrt{3}\,V\eta\cos\phi}, \quad I_m(t) = \frac{I_{LR}}{I_r} I_r e^{-t/\tau}$$

Variables

P	Total running motor power	W
V	Bus line voltage	V
$\eta\cos\phi$	Efficiency × power factor	-
I_{LR}/I_r	Locked-rotor current ratio	-
τ	Decay time constant	s
t	Time after fault	s
I_r	Total rated current	A
$I_m(0)$	Initial motor contribution	A
$I_m(t)$	Contribution at t	A

Method and standards

Locked-rotor approximation.

Assumptions and limits

- Running motors only. The symmetrical AC envelope only: the DC offset that adds to the peak (making duty) is not included.
- τ is the motor's open-circuit subtransient decay, X″/(ωR_r) from the maker; typically a few cycles for LV motors, longer for large HV motors.

References

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Report details

Report reference	FCC-T5Q5-XQKE (the same inputs always give the same reference)
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Release checks	2 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/electrical/protection/motor-fault-contribution

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.