DESIGN DATA SHEET
DEPARTMENT OF THE NAVY
NAVAL SHIP ENGINEERING CENTER

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DDS9620-1

FAULT CURRENT CALCULATIONS FOR DIRECT CURRENT SYSTEMS

Supersedes DDS6205-2, dated 21 January 1955

9620-1-a. Scope

This design data sheet covers a method of making fault current (short circuit current) calculations on direct current systems.

9620-1-b. General

The d.c. short circuit current analysis is required to determine the interrupting rating needed for each circuit breaker or fuse. In determining the maximum current that the protective devices must be capable of interrupting, it is necessary to account for both the maximum generator contribution and the maximum motor contribution, to the fault.

9620-1-c. Definitions of terms

In connection with the formulae presented herein, the following definitions of symbols are applicable:

E_g = rated voltage of the generator (positive terminal to negative terminal), volts.

I_g = rated full load current of generator, amperes.

I_m = sum of the rated full connected load currents or the maximum number of motors assumed to be connected to the system at the instant of fault, amperes.

I'_s = maximum available short circuit current of generator in amperes.

I_{max} = maximum available short circuit current, in amperes, including the contribution of all generators and motors connected to the system at instant of fault.

I_{min} = minimum available short circuit current, amperes.

R_f = total circuit resistance of the faulted feeder in ohms, from the switchboard bus to the point of fault including all significant resistances; i.e., cable, circuit breakers, etc.*

R = total system resistance from source of current to point of fault, in ohms.

9620-1-d. Determination of fault currents

The following paragraphs outline the purpose of the fault currents mentioned in paragraph 9620-1-c and the method that can be used in determining the magnitude of the fault current. For purposes of this analysis only zero impedance faults need be considered.

(1) *The maximum available short circuit current of the ship service generators.*—This value of current determines the maximum contribution of each generator to any fault.

This value is generally limited by commutator flashover and varies with the design of the machine and the condition of the commutator. The maximum available short circuit current of each generator should be determined as follows:

*Values of resistance for cables may be obtained from DDS9620-2, Electric Cable Voltage Drop Calculations.

For generators over 60 kilowatts:

$$I'_g = 10I_g$$

For generators under 60 kilowatts:

$$I'_g = 12I_g$$

(2) *The maximum available short circuit current at the point of application of each circuit breaker, fuse, or switch.*—This current is required to determine the interrupting rating of each circuit breaker or fuse. For protective devices in series the analysis need be carried only as far as is necessary to determine the adequacy of all devices for the service. The maximum available current should be determined on the basis of the contribution of maximum expected parallel generator capacity, plus the contribution of the maximum number of motors assumed to be operating at the time of fault. The calculation should be made as follows:

$$I_{max} = \frac{5I_g}{1 + \frac{5E_gR_l}{E_g}} + \frac{E_g}{R}$$

(3) *Minimum available short circuit current.*—This current should be determined on the basis of no rotating motor load on the system and only one generator contributing. The generator with largest total circuit resistance to fault should be used. For this condition the current can be determined as follows:

$$I_{min} = \frac{E_g}{R}$$

If the contribution of any generator, calculated on the basis of this equation exceeds the value of $5I_g$, the latter value should be considered as the minimum available short circuit current.

TABLE 1.—RESISTANCE OF TYPE ACB, TYPE AQB, AND 50-AMPERE FRAME SIZE TYPE ALB CIRCUIT BREAKERS

Overcurrent coil rating (amperes)	Ohms per pole		
	Type ACB	Type AQB	50A frame size Type ALB
10			0.01422
15		0.00780	
25		.00660	.00501
35			.00281
50		.00157	.00161
75		.00094	
100	0.00075	.00064	
125	.00058	.00050	
150	.00047	.00034	
175	.00039	.00030	
225	.00028	.00023	
250	.00024	.00018	
300	.00019	.00014	
350	.00016		
400	.00013	.00011	
500	.00010	.00010	
600	.00008	.00009	
800—1,200	.00005		
1,200—4,000	.00004		

*If the contribution of any generator, calculated on the basis of this equation, exceeds the value of I'_g the latter value should be used in calculating the contribution of that generator to the maximum available short circuit current.