15. Use of VRLA battery

15.1 Select the Capacity

VRLA battery's rated capacity is 10 hour rate discharge capacity. If battery discharge current is too large, then it can not reach the rated capacity. Therefore, it should be based on the device’s load, voltage, size and other factors to select the appropriate battery capacity. The total capacity of the battery should comply to YD5040-97 "Communication Power Equipment Installation Design" provisions configuration, calculated as follows:

$$Q \geqslant \frac{KIT}{\eta[1+\alpha(t-25)]}$$

Q---Battery capacity（Ah）; K--- Safety Coefficient 1.25; I--- Load current（A）;

T--- Time of discharge（h）;

η--- Discharge capacity Coefficient;

t --- lowest ambient temperature values of actual battery location. Take 15 ℃ for location with heating equipment ; Take 5 ℃ for location without heating equipment

- Battery temperature coefficient (1 / ℃). Take α = 0.006 when Discharge hour rate ≥10; Taking α = 0.008 when 10> Discharge hour rate ≥1; Taking α = 0.01 when the discharge hour rate <1,

Calcualtion may refer to the selecting system:

15.1.1 Telecom system

Telecommunication sysyem included 48V and 24V battery systems, which mostly is 48V.

15.1.1.1 Calculation factor

$V_{总}$——Total float voltage（V） V_f——single cell float voltage（V）

$V_{低}$——lowest total voltage（V） I——Total current load（A）

T——Discharge duration（h） t——Ambient temperature（℃）

K_{it}——Capacity conversion Coefficient (C_t/C_{10})

K_a——Aging coefficient (0.6~1.0)

K——Reliability coefficient (1.0~1.4)

K_t——Temperature correction coefficient (0.006)

15.1.1.2 Calculation step

——Calculate the number of battery cells：$n= V_{total}/ V_f$

——Calculate single cell termination voltage：$V_{end}=V_l/n$

——Calculate theoretical capacity：$C_e=IT$

——Calculate the 10 hour rate capacity：$C_{10}= C_e/ K_{it}$

——Calculate the actual capacity：$C=KC_{10}/\{K_a[1-K_t(25-t)]\}$

15.1.1.3 Conclusion of Calculation

According to the calculation of the actual capacity; and select the appropriate type of battery.

15.1.1.4 Examples of calculation

In a mobile company communications room, no air conditioning, and with heating supply in winter, operating temperature range of 5 ~ 30 ℃, the load current is 973A, 48V system system, bacvk up time is 2 hours, the system minimum operating voltage of 42V, which battery models is more appropriate? Answer: n = 48/2 = 24 pcs

$V_f=V_l/n=42/24=1.75V$

$C_e=IT=973\times2=1946Ah$

$C_{10}= C_e/ Kit=1946/61\%=3190.16Ah$ (2 hours rate discharge battery can emit 61% of rated capacity, ie Kit = 61%)

In the case of 5 ℃, take K = 1.2, * = 0.8, the actual capacity is

$C=KC_{10}/\{K_a[1-K_t(25-t)]\}$

$=1.2\ C_{10}/\{0.8[1-0.006(25-5)]\}$

$=1.2\ C_{10}/(0.8\times0.88)=5437.77Ah$。

According to the battery specification table, you can choose two or three groups 2000AH/48V group 3000AH/48V or four or six groups 1000AH/48V GFM-1500/48V batteries in parallel. Specific installation space according to the environment, ease of maintenance, cooling effect is good or bad and other factors.

15.1.2 Caculation for UPS selection

UPS battery includes 380V and 220V, 48V and 12V and other systems, which mostly use 380V battery .

15.1.2.1 Calculation factor

V_T——Float total voltage（V） V_f——single cell float voltage（V）

V_l——lowest total voltage（V） P_T——total power load（W）

T——Discharge duration（h） t——Ambient temperature（℃）

K_a——Aging coefficient (0.6~1.0) K——Reliability coefficient (1.0~1.4)

K_t——Temperature correction factor (0.006)

15.1.2.2 Calculation step

——Calculate the number of battery cells：$n= V_T/ V_f$

——Calculate single cell termination voltage：$V_{end}=V_l/n$

——Calculate single cell power：$P=P_{end}/n$

——According to the discharge time, the termination voltage and power, check Constant Power Discharge Data Sheet, select the theoretical capacity (C10) of the battery.

——Calculate the actual capacity：$C=KC_{10}/\{K_a[1-K_t(25-t)]\}$

15.1.2.3 Conclusion onCalculation

According to the calculation of the actual capacity to locate; and select the appropriate type of battery.

15.1.2.4 Examples of calculation

An UPS projects with the power P = 6KW, system voltage 220V, requires back up time of 30 minutes. What kind of battery model is more suitable?

Answer: P = P total / n = 6000/18 = 333W (220V system wih12V battery 18 pcs)

Discharge time requiredT=30min，V_{end}=1.75V/ single cell。

Discharge power（404W），Theoretical capacity C_{10}=40Ah。

Actual capacity: In the case of 25 ℃, take K = 1.2, Ka = 0.8, the actual capacity is:

$C=KC_{10}/\{K_a[1-K_t(25-t)]\}$

$= KC_{10}/K_a$

$=1.2\times 40/0.8$

$=60Ah$

It can determine the most appropriate battery choice is 12V65AH, using a total of 18 series, constitute a group 65Ah/220V system.

15.1.3 Caculation for power Selection

Power battery includes 380V, 220V, 110 V and 48V systems, in which mostly is 220V

15.1.3.1 Calculation factor

V_T——Total float voltage（V） V_f——single cell float voltage（V）

I_{touch}——Closing current（A） I_n——Each phase fault current(A）

T_n——The duration of each stage discharge incident（h）

t——Ambient temperature（℃）

K_{it}——Capacity conversion coefficient Ct/C_{10})

K_a——Aging coefficient (0.6~1.0)

K—— Reliability coefficient (1.0~1.4)

K_t——Temperature correction coefficient (0.006)

Cn——Capacity of each stage C_{10}——10h rate capacity

C——Actual capacity

15.1.3.2 calculation step

——Calculate the number of battery cells connected in series：$n= V_T/ V_f$

——Calculated single cell termination voltage：$V_{end}=V_l/n$

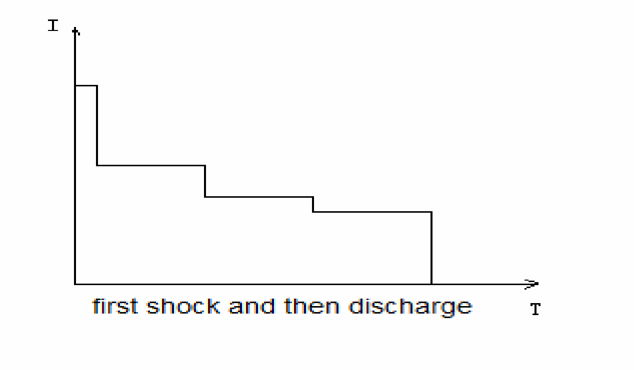
——Discharge time calculated for each phase：$T=T_n-T_{n-1}$， based on Shock time calculated = 5s

——Calculate the required 10 hours accident rate discharge capacity: $C_{10}=C_1+C_2+\text{----}+C_n$ $C_n=(I_n-I_{n-1})T/K_{IT}$

Note: After the first discharge and then shock, capacity is the total of each stage class; If first shock and then discharge, it need higher capacity, if insufficient capacity, then have to replenish.

——Calculate the actual capacity

$C=KC_{10}/\{K_a[1-K_t(25-t)]\}$



15.1.3.3 Conclusion on Calculation

According to the calculation of the actual capacity ; and select the appropriate type of battery.

15.1.3.4 Examples of calculation

a power plant project of 2 × 300MW unit, each battery DC load Parameters required refer toTable 15-1 - To calculate the battery capacity of each group.

Parameters required

	Rated Voltage	end Voltage	Discharge Time	Discharge current（A）				
				0-1min	1-30min	30-60min	60-180min	Random
Battery bank 1	220V	1.85V	3h	890.27	466.91	340.01	20.00	20.00
Battery bank 2	110V	1.80V	1h	215.36	179.36	179.36	0	10.00

Calculation:

a. Battery bank 1

Battery bank 1 -Battery capacity calculation of each stages

	Rated Voltage	end Voltage	Discharge Time	Discharge current（A）				
				0-1min	1-30min	30-60min	60-180min	Random
bank 1	220V	1.85V	3h	890.27	466.91	340.01	20.00	20.00
Discharge capacity				Impulse discharge	233.455	170.01	40	

(Ah)								
Capacity Coefficient	Compared with 10hr capacity				35%	35%	61%	
10hr capacity	Total	1218.3Ah			667	485.74	65.6	

As Impulse discharge capacity is small, it need to calculate the discharge capacity of each stage, Take temperature is 25 ℃, from the table view, the increase the capacity of the C10 = 1218.3Ah, Ka - aging factor (0.6 ~ 1.0), K - reliability factor (1.0 to 1.4), I f choosing Ka = 0.8, K = 1.2

Then C = KC10 / {Ka [1-Kt (25-t)]}

= KC10/Ka

= 1.2 × 1218.3/0.8

= 1827.5Ah

Therefore, the safest option is to choose 1000AH/220V/2 set of batteries, each bank of 104 pcs

b. Battery bank 2

Battery bank 2 -Battery capacity calculation of each stages

	Rated Voltage	End Voltage	Discharge Time	Discharge current（A）				
				0-1min	1-30min	30-60min	60-180min	Random
Battery Bank 2	110V	1.80V	1h	215.36	179.36	179.36	0	10.00
Discharge capacity (Ah)				Impulse discharge	89.68	89..68		
Capacity Coefficient	Compared with 10hr capacity				35%	35%		
10hr capacity	Total	512.46			256.23	256.23		

As Impulse discharge capacity is small, it need to calculate the discharge capacity of each stage, Taking temperature is 25 ℃, from the table view, the increase is the capacity of the C10 = 512.46Ah, Ka - aging factor (0.6 ~ 1.0), K - reliability factor (1.0 to 1.4), if choosing Ka = 0.8, K = 1.2

Then C = KC10 / {Ka [1-Kt (25-t)]}

= KC10/Ka

= 1.2 × 512.46/0.8

= 768.69Ah

Therefore, the safest option is to choose 800AH/110V batteries, each bank of 52.pcs

15.2 Charger selection

Since in float use and not monitored, requires the charging device for f VRLA battery has The following features:

1) Automatic Voltage Regulator (2) automatic steady flow (3) constant voltage limiting current

(4) high temperature alarm (5) ripple coefficient of less than 5%

(6) failure alarm (7) Float / Equalize automatically converted (8) Temperature