蓝河电气
LANHE ELECTRIC

DDX1 Series of Fault Current Limiter

www.sxlhdq.com

陕西蓝河电气工程有限公司

Shaanxi Lanhe Electrical Engineering Co., Ltd.

蓝河电气
LANHE ELECTRIC

DDX1 Series of Fault Current Limiter

SHAANXI LANHE ELECTRICAL ENGINEERING CO., LTD.

Contents

Application Characteristics

- High-capacity switchgear with world-leading breaking speed
- There are nearly a thousand sets of production have been used in power distribution systems at home and abroad，the function and reliability of the productions have been verified.
- Reduce the cost of substation.
- Protect the frail power equipment
- Solve the problem of short circuit current exceeding standard after new power supply is connected.
- Optimize operation mode of the system.
- In many cases, provide the only reasonable technical solution
- The actual current will be much lower than the peak of prospective current.
- Current limiting very early at the first half wave.
- The ideal plan to energy saving and loss reduction for the current limiting reactor.

1 Principle and Characteristics

1.1 The Basic Parts of DDX1

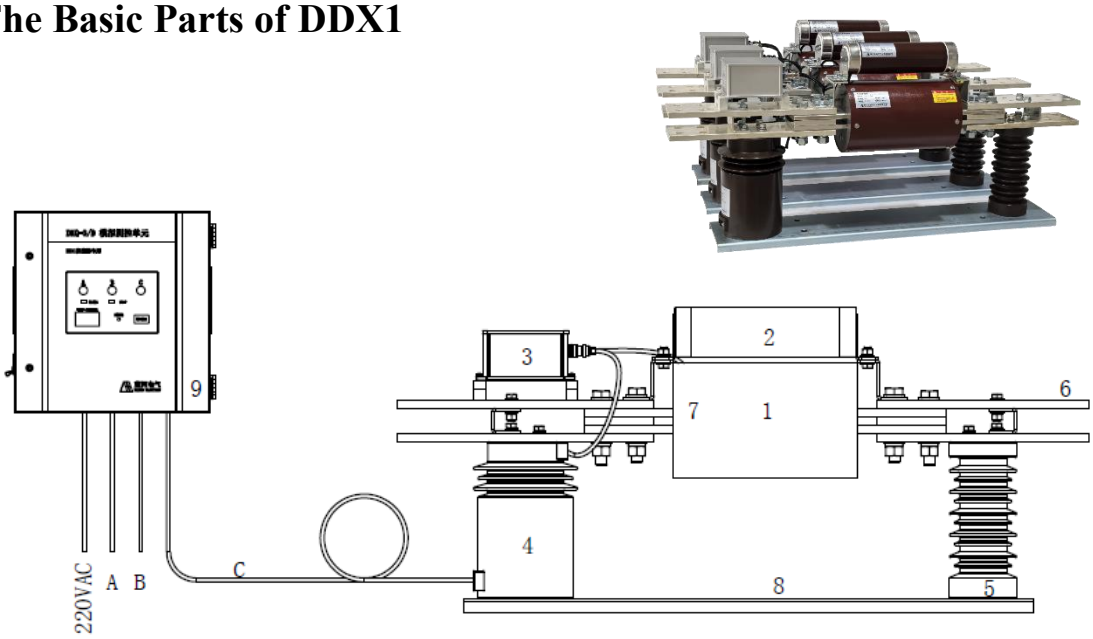


Fig1 The Basic Parts of DDX1

1 Rapid isolator
2 Special High-Voltage Current Limiting Fuse
3 Electrical Controller
4 High-Voltage Isolated Transformer
5 Insulator
6 Main Bus
7 Current Transducer （Inside Rapid isolator）
8 Mounting channel
9 Analog measurement and control unit

The Basic Parts of DDX1 are show in Fig1。Rapid isolator 1、the fuse 2 and the electrical controller 3 are the key parts of DDX1。The main passage of current is the parallel loop made up by the Rapid isolator 1 and the fuse 2。The cutting action of the Rapid isolator 1 is controlled by the electrical controller 3。The Analog measurement and control unit 9 is used to indicate the operating conditions of DDX1， also is the power supply of DDX1。

1.2 Description of the Principle

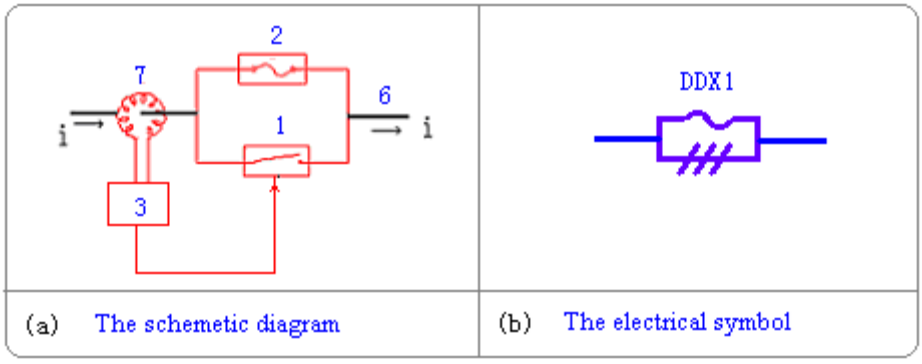


Fig2 The schematic diagram and the electrical symbol

In fig1 and fig2 Analog measurement and control unit9 supply power for the electrical controller 3 through the isolated transformer 4, and indicate the operating conditions of DDX1 by LED、LCD、the contacts of relays or counter etc. The main passage of current is the parallel loop made up by the Rapid isolator 1 and the fuse 2 are in parallel and form the main passage of DDX1 current。But because the resistance of Rapid isolator 1 is in micro-ohm and the fuse 2 is in milli-ohm, so almost all the current in main loop is flow through the Rapid isolator 1 in normal situation。The current signal is transmitted to the controller 3 by current transducer 7 sealed in Rapid isolator 1, When a fault occurs, and it will be analyzed in controller 3。The controller 3 will output a powerful trigger pulse to Rapid isolator 1, when the fault current signal exceeds its settings, and this result the demolish cutting in Rapid isolator 1,the current passage in Rapid isolator 1 is opened in several hundred millisecond， then the fault current is transfer to fuse 2 and be broken in several microsecond。

Fig3 is the sketch-map of the time sequence of DDX1's current breaking process：

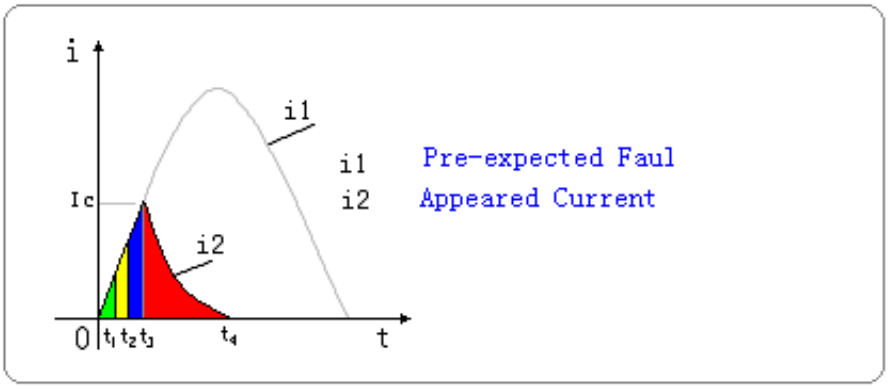


Fig3 The sketch map of DDX1's breaking process

t=0 the short-circuit occurs;

$t=t_1$ the response time of the electrical controller which is related with the value of the pre-expected

fault current, the settings of the controller and the phase angle between current and voltage when short occurs, normally longer than 600 milliseconds, During this time, the controller will found the fault and fire the trigger pulse;

$t=t_2$ the Rapid isolator is open， and the current is transferred to the fuse。 t_2-t_1 is the response time of the demolish-cutting, normally in 200 milliseconds。

$t=t_3$ the fuse is arcing Ic is named cut-off current。t_3- t_2 is the melting duration (pre-arcing time) of the fuse, normally in a microsecond。

$t=t_4$ the arc in the fuse is extinguished， the fault current has been broken。t_4- t_3 is the arcing duration of the fuse， normally shorter than 5 microsecond。t_4-t_1 is named the total breaking duration of DDX1， shorter than 10 microseconds。

The Typical fault current waveform in power system， also the comparison in breaking feature between DDX1 and normal circuit-breaker are shown in fig4。We can see, DDX1 just need several microseconds and have obvious current-limiting feature to break a fault current, but above a hundred microseconds for normal circuit breaker because of its relay-protection and its operating mechanism with no current-limiting feature。

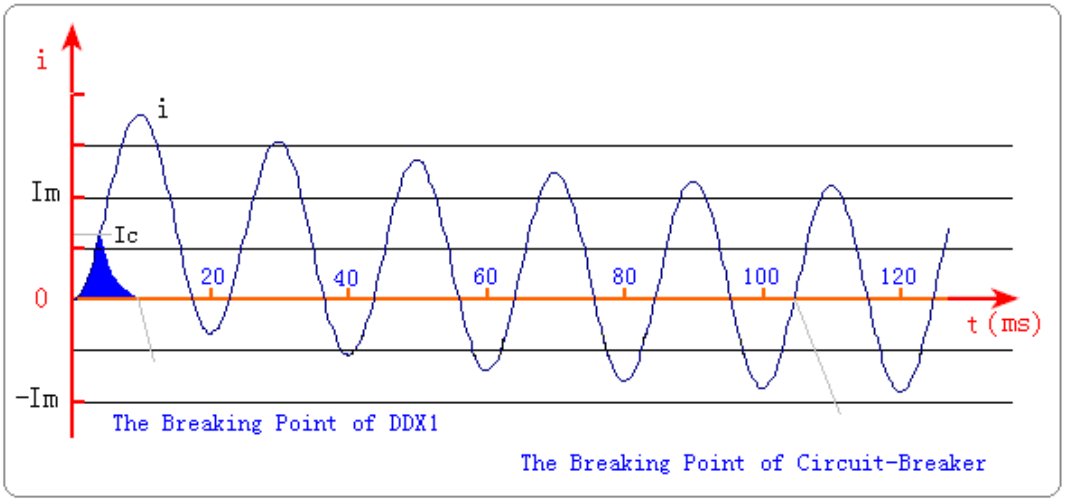


Fig4 The Typical current waveform in power system and the comparison sketch map in breaking feature between DDX1 and normal circuit-breaker

Through fig3 and fig4,we can see： DDX1 can break the fault current at the first current rise before peak value of the pre-expected short-current is arrived。The cut-off current Ic which flow through the electrical apparatus actually is about (15~50) % of the peak value of the pre-expected short-current。

The total breaking duration is less than 10ms， this result a deep reduction of the fault current energy $\int i^2 dt$ （about 1/200 of the value of a nmal circuit-breaker） and be more efficient to the protection of main electrical apparatus。

According to the feature of the fault current in power system, two settings for controller been recommended are the instantaneous value of current i and the instantaneous value of current variation di/dt。the controller can output the ignition pulse only when the two settings meet its demands simultaneously， thus enhance the ability to resist interference and ensure the fast operation of DDX1。The internal dissected structure pictures of the Rapid isolator and the fuse are show in fig 5。

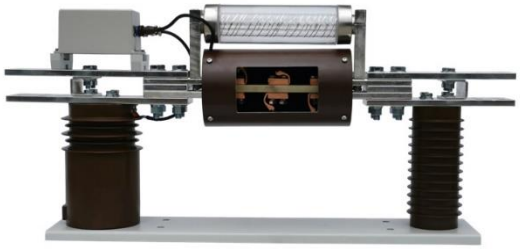


Fig5 The photo after DDX1 is done

1.3 Description of the Characteristics

- High ability to break a fault current: 50kA~200kA
- High breaking speed (Full open time) :<10 ms
- Obvious current-limiting feature can limit the fault current to （15~50)% of its pre-expected value
- Rated current: 630A~6300A
- Rated voltage: 3.6kV~40.5kV
- The Rapid isolator and the fuse are sealed fully，less noise、high reliability and can be used indoor or outdoor
- The operation behavior can be set by i and di/dt
- The current transducer is sealed inside the Rapid isolator achieve a simplest structure
- The world’s fastest switching device
- Patent technology
- The military high-technology: demolish cutting technology under control More efficient to protect the power system and the main equipment

- The powerful weapon to treat fault current new apparatus to avoid energy loss

2 Main Technical Data

2.1 Table1 Main Technical Data of DDX1

Number	Items		Units	Technical Data
1	Rated current		A	630/2000/4000/6300
2	Rated voltage		kV	3.6/7.2/12/20/40.5
3	Rated frequency		Hz	50/60
4	Rated short-circuit breaking current		kA	50/63/100/150/200
5	The total breaking duration		ms	<10
6	Rated Insulation Level (power frequency/lighting)	3.6	kV	/
		7.2	kV	23/60
		12	kV	42/75
		17.5	kV	38/95
		20	kV	50/125
		40.5	kV	95/185
7	Cut-off Current/ the peak Value of Pre-expected Fault Current		%	15~50
8	DC resistance of main loop		μΩ	<40
9	The range of settings		kA	5~60
10	Rated short-circuit breaking current of the type HV current-limiting fuse		kA	63/100/150/200
11	Rated Short-time withstand current of main loop		kA/s	40/3
12	Rated peak value withstand current of main loop		kA	100
13	Net distance between phases and to the earth(indoor)		㎜	100/125/180/300
14	The unit Creeping distance		㎜/ kV	＞25（3 级污区）
15	Destroy mechanical load on insulator		kN	＞12

Table2 The Structure Dimensions (For reference only)

Rate Voltage (kV)	Rate Current (A)	A (mm)	B (mm)	CIndoor/Outdoor (mm)	D (mm)	E (mm)	F (mm)	G (mm)	Φ_1 (mm)	Φ_2 (mm)	Weight (kg)
3.6	800	1024	849	180	420	409	190	90	125	88	45
	1250~5000	1024	849		434	409			175		54/67
	8000	1125	905		445	460			205		75
7.2	630	1044	869	285/310	525	429	190	90	125	88	48
	1250~4500	1044	869		534	429			175		61/77
	7000	1145	970		545	525			205		87
12	630	1139	964	285/310	525	524	190	90	125	88	56
	1250~4000	1139	964		534	524			175		70/77
	6300	1240	1020		545	575			205		87
20	1250~3150	1316	1141	380/-	629	714	190	90	175	120	73/80
	5000	1417	1197		640	752	190	90	205		90
40.5	1500	1464	1289	390/430	668	849	220	110	175	120	82
	3150	1464	1289		686	849	220	110			92

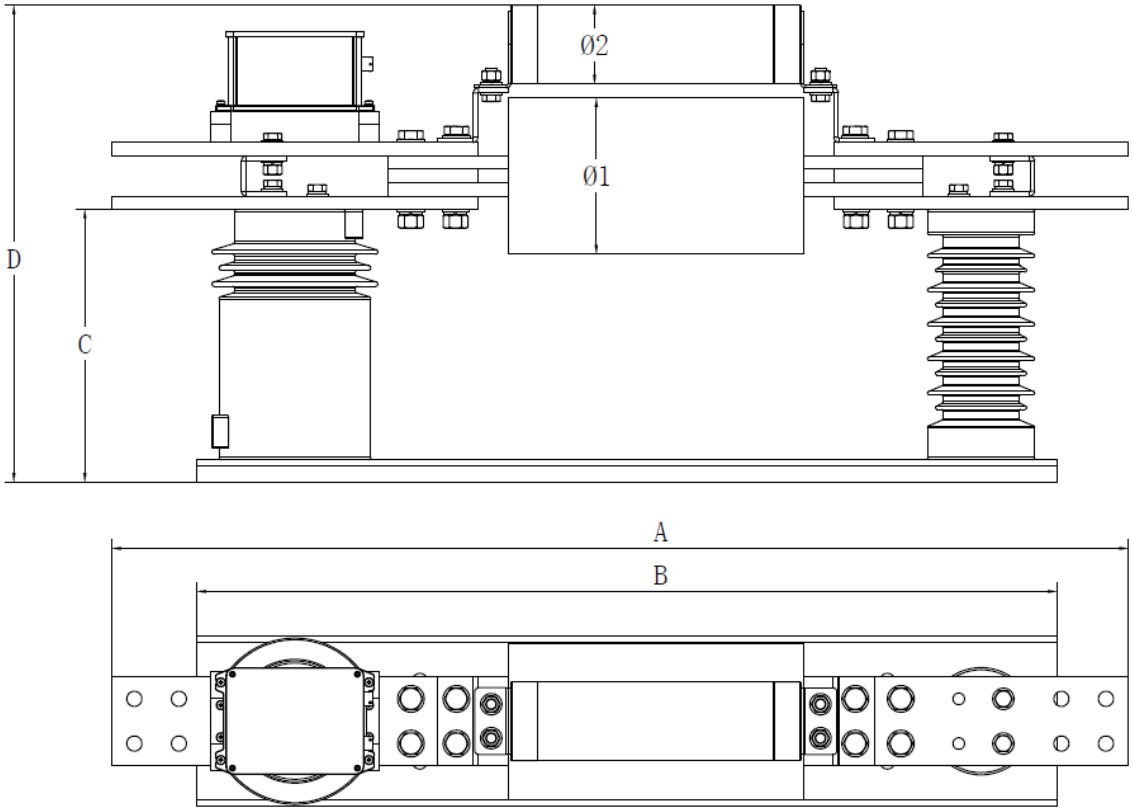


Fig6 The sketch map of Structure Dimensions

3 The Typical Structure and The Project Examples

3.2 Examples of Single-phase Application

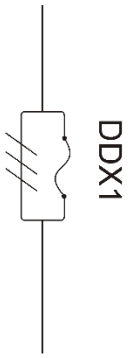
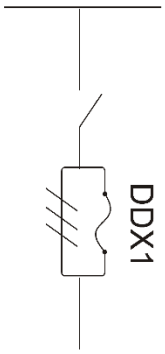
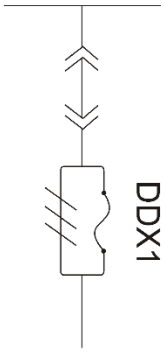
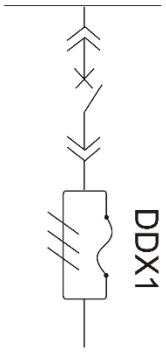
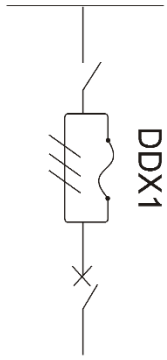
(a) outdoor usage

(b) indoor usage

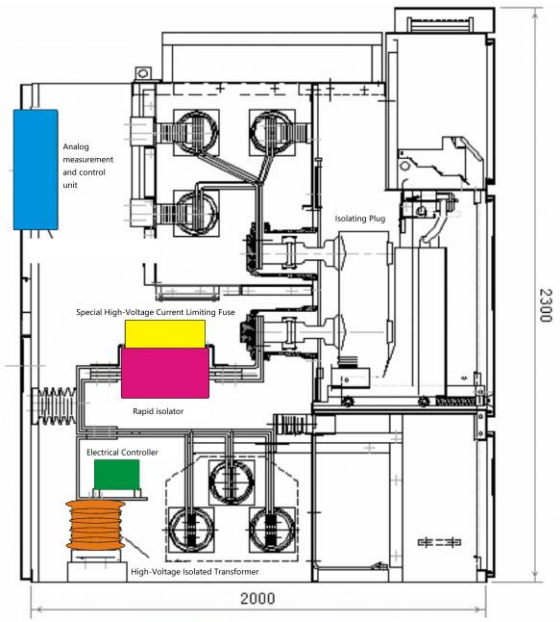
Fig6 DDX1 single-phase application (Reactor bypass)

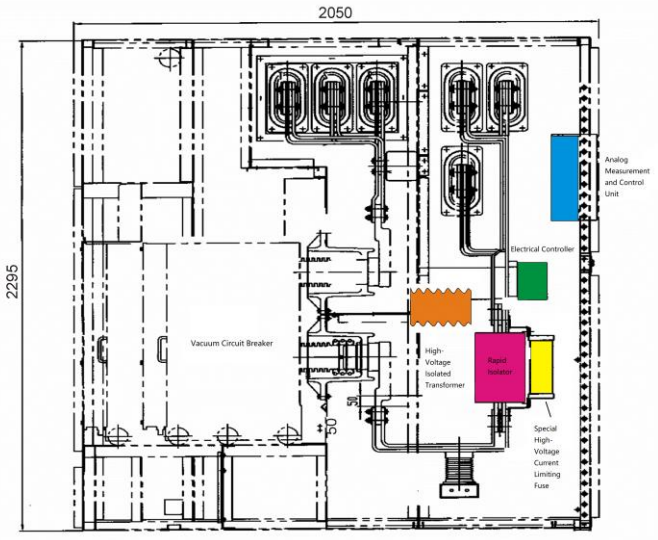
3.2 The Schemes to Form a Cubic and Some Examples

3.2.1 The Single Line Diagram of The Schemes

Example 1	Example 2	Example 3	Example 4	Example 5
				

3.2.2 The Examples of Typical Structure





Example 1

(b) Some photos

Fig7 The examples of typical cubic structure

4 The Typical Applications

4.1 DDX1 used in current-limiting reactor bypass

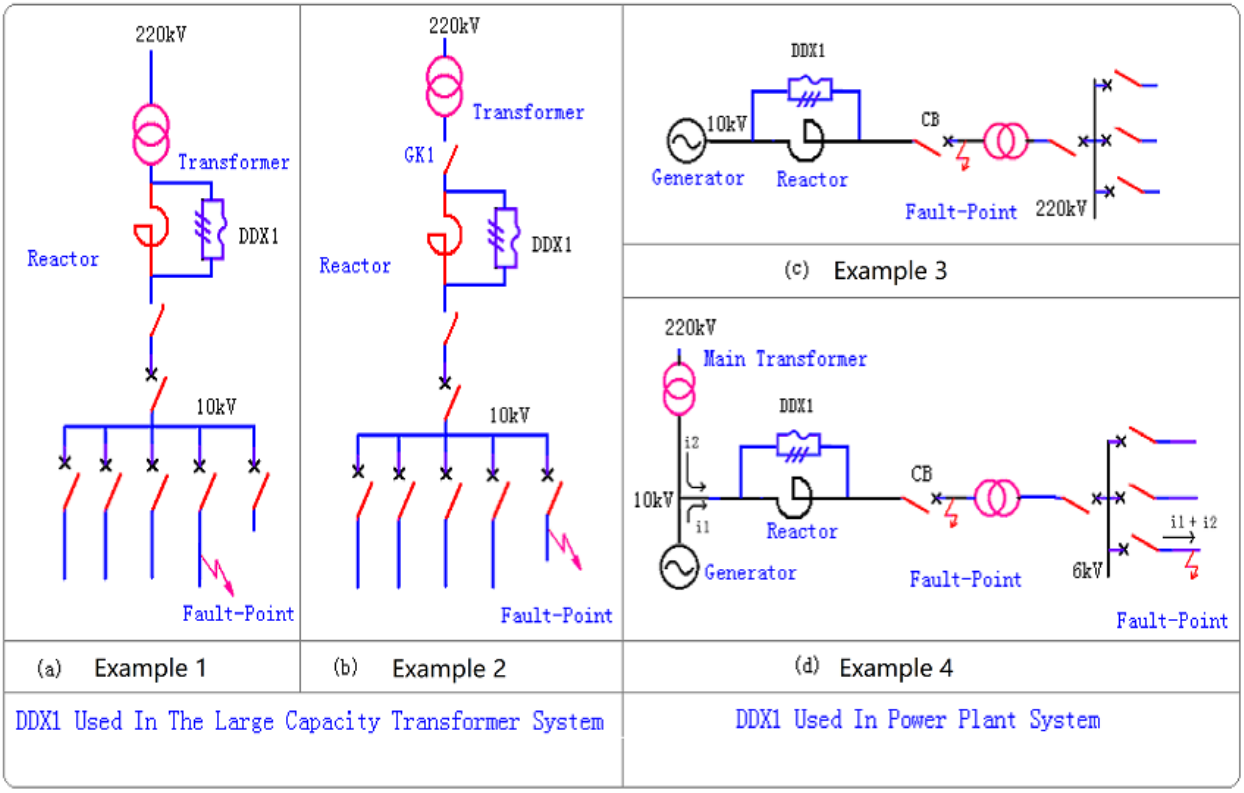
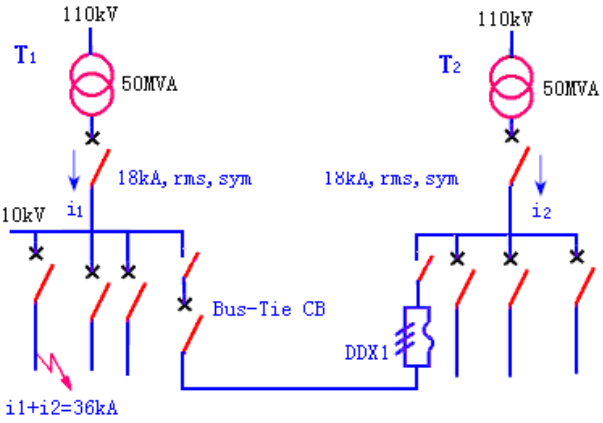


Fig 8

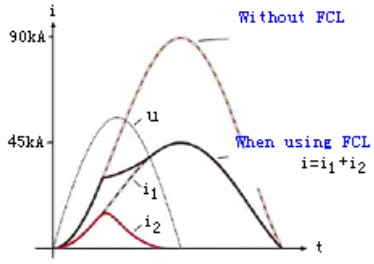
DDX1 in reactor bypass，advantages：

- ■ Avoid coppers loses of reactor
- ■ Avoid voltage drop of reactor
- ■ Avoid electromagnetic field on the reactor

4.2 DDX1 used in busbar system



The single line diagram of a busbar system



The waveform of fault current flow through fault-piont
$i=i_1+i_2$

The sketchmap of the fault current waveform

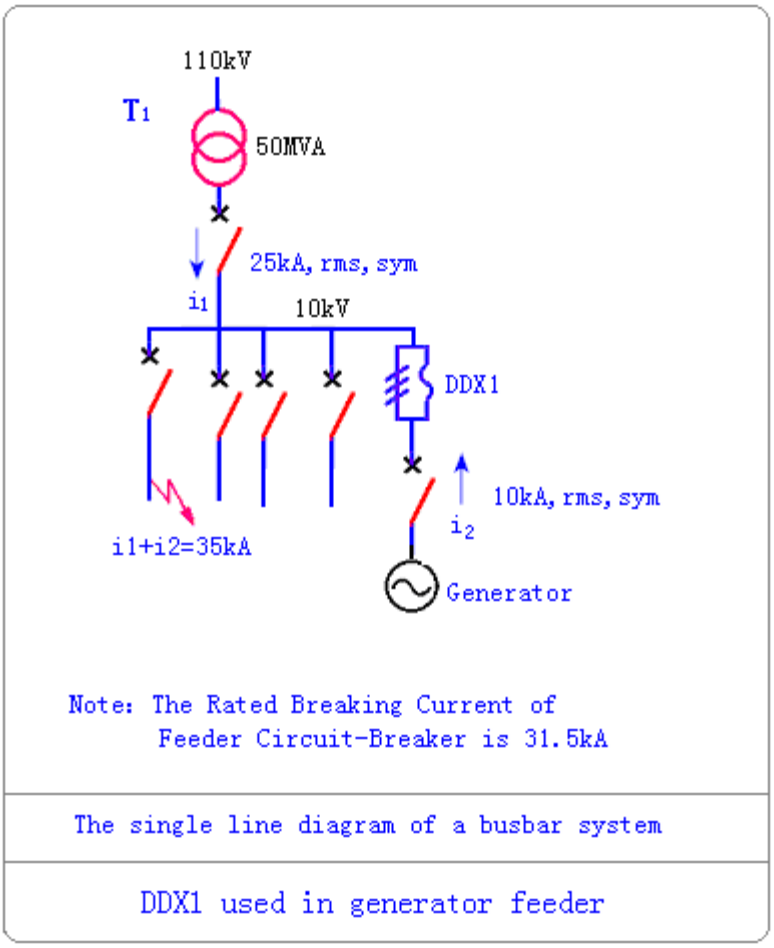
DDX1 used in busbar system

Fig 9

DDX1 installed in bus-tie，Advantages：

- Improving power quality
- Increasing the reliability of the system
- Reduction of the network-impedance
- Optimal load flow
- Existing bus bar system has not to be changed
- strengthen the operation flexibility

4.3 DDX1 used in generator feeder



The single line diagram of a busbar system

DDX1 used in generator feeder

Fig 10

DDX1 used in generator feeder Advantages:

■ Generator can be connected independent on the short-circuit capability of the system

■ No need of expensive generator breaker

■ Existing bus bar system has not to be changed

4.4 DDX1 used in power plant system or large capacity transformer system

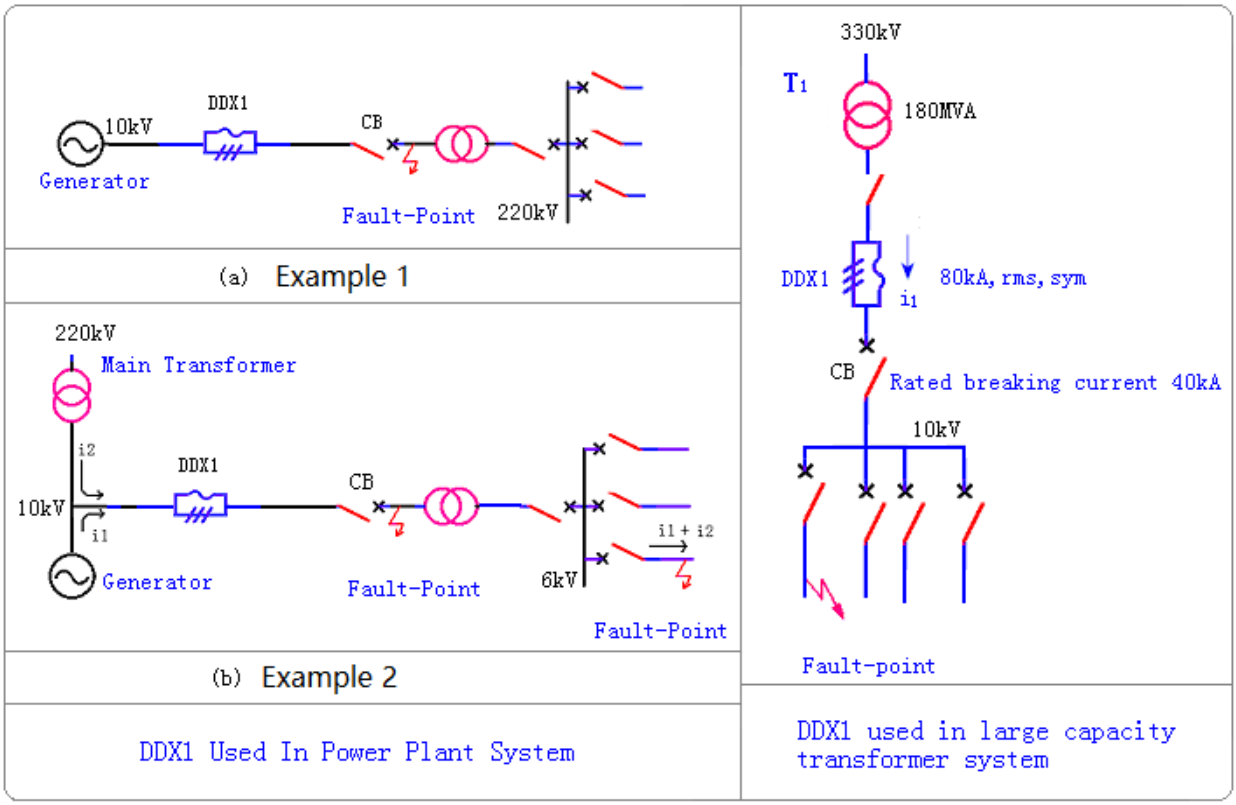


Fig11

Advantages of this application:

- No need of expensive generator breaker
- No need of expensive isolated busbar
- No need of reactor
- By cooperated with CB, to give a more efficient protection to system and main equipment

陕西蓝河电气工程有限公司

Shaanxi Lanhe Electrical Engineering Co., Ltd.

Tel：+86-29-84251056 Email：info@lanhecn.com

Add：Block B,2/F,Building 3,Shengyuan Science and Technology Park,190 XiBuDaDao, Xi'an High-tech Zone, Shaanxi Province, China

Web：www.sxlhdq.com/en