NHP

TECHNICAL NEWS

Issue 5

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Quarterly Technical Newsletter of Australia's leading supplier of low-voltage motor control and switchgear.

IN THIS ISSUE

SET THE PROTECTION

The risk of circuit faults arising at initial "switch on" of an installation can be quite high. Failure to pre-set adjustable trip units can result in unnecessary damage occurring. The "try it and see" approach is a bit like checking a parachute on the way down. Simple procedures beforehand can prevent a major mishap.

The majority of moulded case circuit breakers (MCCBs) available offer some form of adjustment to the tripping characteristics. The flexibility of the adjustment is dependent on the style of "TRIP UNIT" fitted. Trip units offered are as follows.

Thermal magnetic

This style of trip unit provides adjustment for the pick-up current of the thermal or overload characteristics in a similar fashion to a motor overload relay.

"Failure to pre-set adjustable trip units can result in unnecessary damage occurring"

The adjustment range can be infinitely variable from 63 per cent to 100 per cent of the nominal rating of the circuit breaker. Adjustment of the magnetic or short circuit protection is also provided in larger frame sizes. Here the adjustment is typically from 5 to 10 times the nominal rating of the trip unit.

Electronic trip units

Electronics provides the maximum flexibility for adjustment. Current pick-up and time functions may be adjustable for overload and short circuit protection. (See Figure 1.)

MCCB fitted with electronic trip unit.

The flexibility of these adjustments enable the protection to be tailored to suit the load and upstream protection devices.

Magnetic only

Magnetic trip units offer short circuit protection only. Not having any form of overload protection, this trip unit has limited applications and can only be used in back-up situations where overload protection is provided by another device.

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The main application is in motor control units. These trip units are chosen to avoid premature tripping of the circuit breaker during "run-up" of the motor due to the high starting current.
In this application overload protection is provided by the motor overload relay.

Other protection

It is also quite common to include other forms of protection relays and these include phase failure, earth fault, phase reversal and reverse power. Many of these relays will also have adjustable settings and need to be correctly set.

If a consultant has been involved in the specification of the installation he should have detailed the settings required for all devices. In all cases, however, somebody must be accountable for the installation and the specification of setting requirements. Some of the factors to be considered in setting the specification are :-

1. Protection considerations

1.1 Upstream protection

It is normal to expect that a fault on a branch circuit will not cause the upstream protection to operate. In some installations this causes little concern, but if power to a computer or essential services is lost the consequences can be severe. It is not sufficient to select circuit breakers of a different thermal rating, as at high fault levels they may have the same trip time.

1.2 Cable protection

In simple installations the prime purpose of the circuit breaker is to only protect the wiring. To do this, the over current protection must match the cable rating. The cable rating is determined by the temperature rise and this will vary depending on the method of installation. If the cable is surrounded by thermal insulation, or bundled with other cables, the rating can be much lower than when installed in free air.

1.3 Motor protection

The full load current of the motor must be known so that the overload relay can be set.

Fig 1. Electronic adjustment range. ▶

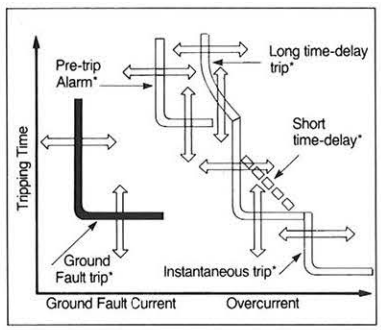
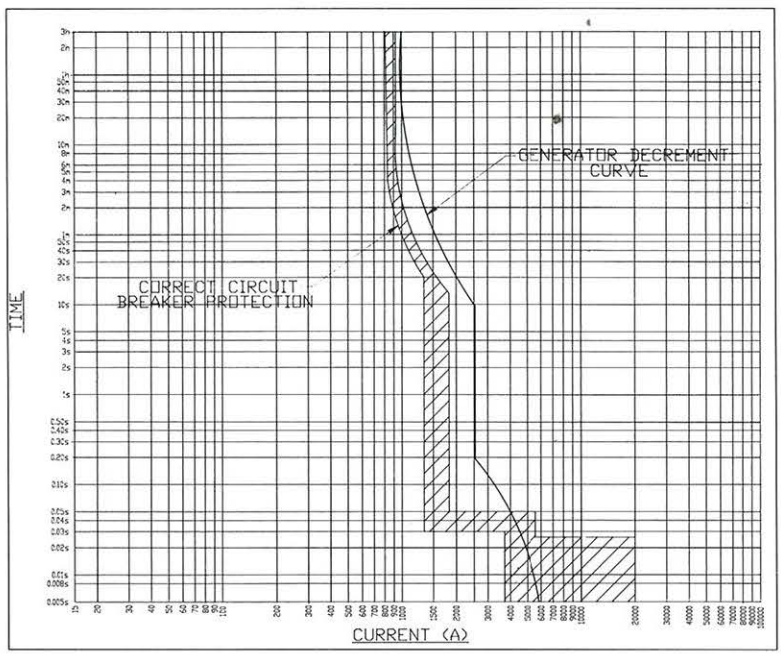


Fig 2. Generator decrement curve. ▼



The peak current during starting should also be known so that any adjustable instantaneous trip units in the circuit breaker can be set close to, but not below this current.

1.4 Generator protection

The use of generators provides an added burden on the protective device. Systems that derive power from the supply utility usually only need to consider protection of what is connected down stream, as there is always another protective device upstream. In the case of, say, a standby generator, this is not the situation and the circuit breaker must also provide upstream protection for the generator itself.

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The generator performance during a fault is significantly different to that of a normal transformer supply, as it will be non linear. This can mean that a generator might only be capable of delivering a short circuit current of, say, four times its full load rating and this may be below the instantaneous setting of the circuit breaker. The generator may be damaged before the circuit breaker trips.

The characteristic of the generator under overload/fault conditions should be available in the form of a decrement curve. The protective device should be set to ensure that it operates in the region under this curve. An example is shown in Figure 2.

1.5 Setting the protection

The supplier of protective elements may have been consulted on the correct device selection and settings for a project, but it should never be assumed the devices have been delivered pre-set to any particular setting. It is essential that every adjustable element is checked just prior to turning the installation on. The ideal situation is to have all settings clearly marked on the drawings, but all too often the settings are left to the last minute.

If settings have not been specified, the following needs to be checked :-

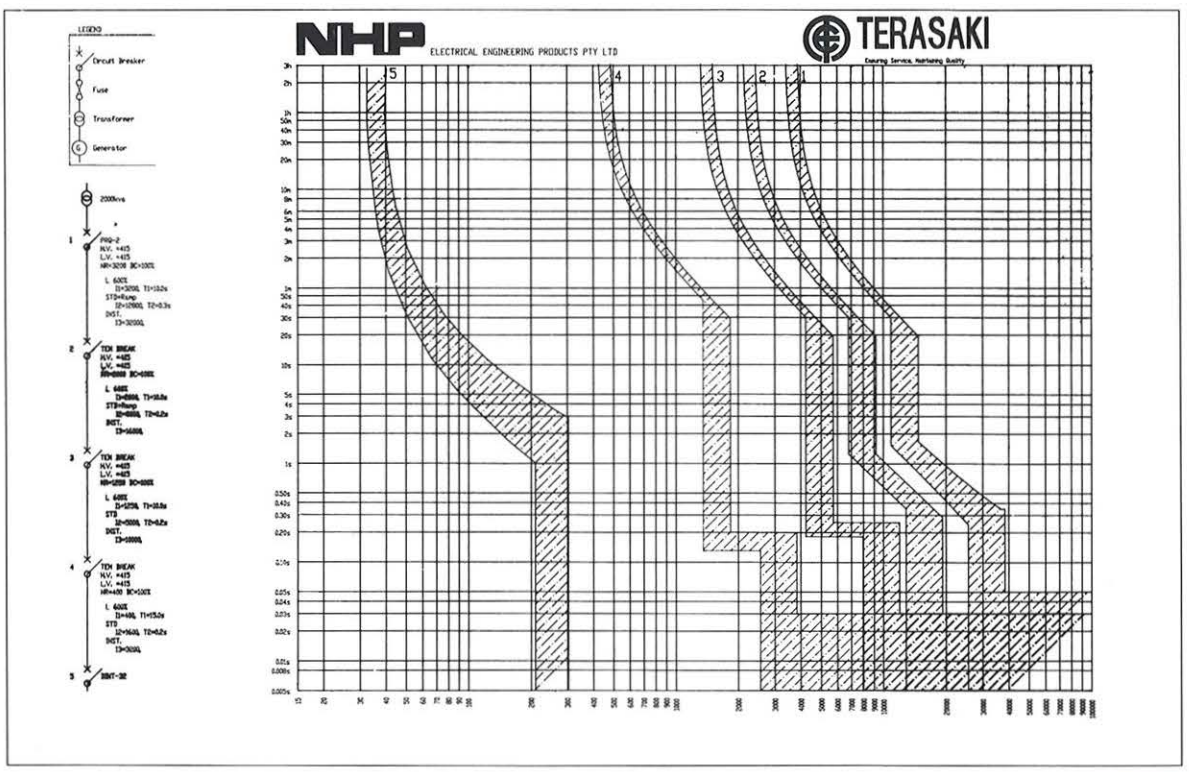
(a) Overcurrent pick-up settings need to match the thermal rating of the protected circuit.

(b) If the connected load is a motor, check that the motor overload protection matches the motor full load current and, if the relay provides adjustable time settings, that these match the expected run-up time.

(c) If the electric supply is from a generator, the protection must be set below the generator decrement curve.

(d) The grading between all protective elements can be checked by plotting the time current characteristics on the same graph paper. For thermal magnetic trip units there is little that can be done if the initial device selection was wrong. For fully adjustable electronic units the wide range of possible settings makes it very important to check the grading.

Fig 3. Grading exercise using TemCurve. ▼



Case study

A large generator burnt out due to a short circuit.

Cause - circuit breaker protection was not matched to the generator characteristics.

The generator had a maximum short circuit current output of eight times the rated current and a limited overload versus time output.

The circuit breaker had been installed with the instantaneous or short circuit protection set at 12 times the rated current. With the output of the generator limited to eight times, clearly the protection would never trip on short circuit protection. The long time delay or overload characteristics was set with a 20 second delay. The setting should have been two seconds.

The result - lack of generator backup and the high cost of replacing the generator. A phone call, fax. and a few minutes work would have prevented this damage.

Computer aided grading

In the past the preparation of grading schemes has been time consuming, hand drawing circuit breaker curves and re-drawing until the desired result was achieved. Computer based programmes now make this task less time consuming.

The graphics capability of computers enable the user to select devices and change settings, then print or plot the results in a fraction of the time, with a smaller margin of error than hand drawn schemes.

TemCurve

To assist in the preparation and checking of grading schemes NHP has available the TemCurve programme. This stand alone programme allows grading studies to be made on protection schemes incorporating many of the common protection components on the Australian market. (See Figure 3.)

TemCurve is designed to operate on IBM compatible PCs and is available by contacting your nearest NHP office.

Summary

The modern circuit breaker is a very sophisticated protective device, too often taken for granted. They offer high interrupting capacities and flexibility of adjustment and protection features never seen before. However, with all the functions available, safeguarding of the distribution system can only be assured if the protection functions are set to match the requirements. Installation "as supplied" cannot guarantee protection.

Contact NHP for all your switchgear requirements from the one source

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