INSTRUCTIONS

AC POWER CAPACITORS

CAUTION: THE EQUIPMENT COVERED BY THIS INSTRUCTION SHOULD BE INSTALLED AND SERVICED ONLY BY COMPETENT PERSONNEL FAMILIAR WITH GOOD SAFETY PRACTICES. THIS INSTRUCTION IS WRITTEN FOR SUCH PERSONNEL AND IS NOT INTENDED AS A SUBSTITUTE FOR ADEQUATE TRAINING AND EXPERIENCE IN SAFE PROCEDURES FOR THIS TYPE OF EQUIPMENT.

GENERAL SAFETY INSTRUCTIONS

The objective of these instructions is to help make capacitor users aware of application and handling practices which will aid them in the use of power capacitors. The instructions cover recommended practices in receiving, handling, installation, fusing, field testing and disposal of power capacitors. The instructions do not address themselves to the requirements of national and/or local codes, nor to requirements of insurance underwriters, which may be applicable to any given capacitor application. Compliance with codes and insurance underwriters' requirements demand individual consideration on the part of capacitor users for each particular situation and should not be assumed to have been achieved simply by complying with the suggestions contained in these instructions.

Consult the Material Safety Data Sheet for specific environmental, health and safety information prior to use.

PROTECTION AGAINST SHOCK

WARNING: DISCONNECT CAPACITORS OR EQUIPMENT FROM POWER BEFORE DOING ANY WORK. CHECK FOR AN OPEN CIRCUIT TO BE CERTAIN THAT THE CAPACITORS ARE DISCONNECTED FROM THE POWER SOURCE. WAIT 5 MINUTES AFTER DE-ENERGIZATION FOR SELF-DISCHARGE AND THEN SHORT-CIRCUIT AND GROUND THE CAPACITORS BEFORE HANDLING.

Capacitors for shunt or series application on power systems have internal discharge resistors (so indicated on the nameplate) which are designed to reduce the voltage, after the power is switched off in **five minutes** for those rated over 600 volts, and in **one minute** for those rated 600 volts or less. After the indicated time, the capacitor or equipment should be shorted and grounded by using a shorting stick with an insultated handle. Then, by using a shorting wire, the capacitor terminals should be connected together and to the case **before handling.**

EXPLOSION HAZARD

The correct application of capacitor fuses will greatly minimize the possibility of case rupture; but since considerable stored energy may be available upon the occurrence of a fault inside a capacitor, it is possible to get explosive case rupture in any application, even with proper fusing. For three-phase capacitors fused only on two terminals or single-phase two-bushing capacitors fused on only one terminal, and applied on delta or ungrounded wye systems, an internal ground fault from the unfused phase to case might result in case rupture. These remote possibilities must be considered when locating the capacitors or equipment.

If capacitors or equipment are not supplied with fuses, follow the fusing guides recommended in NEMA Standard CP1; ANSI / IEEE Standard 18; or refer to the nearest General Electric Sales Office.

HANDLING OF FAILED CAPACITORS

Some failed capacitors may be found considerably bulged due to internal pressure from gassing prior to circuit clearing. Such capacitors should be handled very carefully. A failed capacitor should be short-circuited before handling (see Protection Against Shock). It is further recommended that a bulged capacitor be permitted to cool before handling. This will lower the internal pressure, reducing the possibility of case rupture.

Consult the Material Safety Data Sheet for information on further precautions in handling failed capacitors.

COMBUSTIBLE IMPREGNANT FIRE HAZARD

Capacitors contain a Class IIIB combustible liquid which could possibly ignite if there is a case puncture or rupture in the presence of an electrical arc. Capacitors containing these materials should be suitably protected from mechanical damage and located where a possible fire could be contained and would result in minimum damage and hazard to the surrounding area.

DISPOSAL OF CAPACITORS OR IMPREGNANT

The capacitor and the liquid it contains should be disposed of in a manner consistent with the applicable local, state and federal regulations. Loss of the liquid into the environment should be avoided or minimized. Consult the Material Safety Data Sheet for further informaion.

APPLICATION

The General Electric power capacitor is designed for use on power systems to supply leading kilovars. These leading kilovars reduce line thermal loading and system losses and raise the voltage level at the point of application. The capacitors may be mounted indoors or outdoors, either singly or in banks.

RECEIVING

Check the capacitor when received to make sure that no damage occurred during shipment. Minor damage such as small dents will not harm the capacitor's performance, but capacitors with large dents, leaks or broken bushings should not be installed. In case of major damage, file a claim against the carrier and also notify the nearest Sales Office of the General Electric Company for instructions regarding the disposition of the capacitor.

Check the capacitor's nameplate to make certain that the voltage rating is the same as the applied voltage. According to NEMA Standard CP-1 the recommended maximum continuous-working voltage to be applied to the capacitor shall be 110 percent of the nameplate rating. The peak continuous working voltage, including all harmonics, shall be 1.1 X $\sqrt{2}$ X the nameplate voltage rating. Any lower voltage is permissible.

INSTALLATION

Capacitors may be installed indoors or outdoors. Capacitors may be stored in any position, but when installing them, the large case sides should be vertical, the bushings should be either vertical or horizontal and the minimum spacing between large sides of adjacent capacitors should be 1-1/2 inches to provide for efficient heat dissipation.

When capacitors are mounted in hangers, it is recommended that both the capacitor case and the hanger (if it is metal) be grounded to eliminate the minor shock which may be obtained from the small charging current between the line terminals and the case. Stainless-steel cases have an unpainted surface under the mounting bracket so that contact is made between the capacitor case and hanger, thus facilitating grounding by means of a single conductor to the hanger.

Two-bushing capacitors are generally furnished with parallel groove connectors and associated Belleville washers. Single-bushing capacitors are generally furnished with one Belleville washer plus a nut for use with bus bars. The parallel groove connectors will accommodate from one No. 10 Awg solid to two No. 2 Awg stranded-copper conductors, as well as equivalent sizes of aluminum. When attaching conductors to the connectors, back off the nut to the top of the terminal stud; then, slip the conductors in from the side. There is room to do this for combinations of all except two conductors of the largest size, where it will be necessary to remove the nut (unless the second conductor terminates at the terminal and can be slipped in from the end). Bus bars may be used for interconnecting capacitors. To attach bus bars, all that is required is one Belleville washer and the nut placed over the bus bar.

The connectors are plated to keep corrosion to a minimum. However, when aluminum conductors are used, especially in a salt or corrosive atmosphere, the slow galvanic action caused by the contact of different metals can be avoided if an oxidation preventative such as Penotrox A (Burndy Co.) or No-ox-id (Dearborn Chemical Co.) is used to coat the aluminum conductor at the point of connection.

When tightening the terminal nuts, it is necessary only to flatten the Belleville washers. This provides visual indication of sufficient tightening and results in follow-up pressure on the conductors of approximately 1000 pounds. Tightening to more than 25 foot-pounds is not required or recommended (Note: Those with copper terminals which should not exceed 15 foot-pounds are stamped 15 foot-pounds maximum).

AMBIENT TEMPERATURE

High operating temperatures will reduce the life of a capacitor. For single-tier, open installations outdoors with unrestricted air circulation, maximum permissible ambient temperature is 46°C (115°F). Installing capacitors in tiers, one above another, reduces the maximum permissible ambient by 3°C (6°F) per tier.

AMBIENT TEMPERATURE (continued)

For capacitors mounted indoors, the maximum permissible ambient temperature is 46°C (115°F). Capacitors should be located so as to minimize the transfer of heat from adjacent equipment and to provide free circulation of air around the capacitors.

Capacitors may operate continuously at any low temperature. However, if the internal temperature of an unenergized capacitor drops to less than -40°C (-40°F), the capacitor should not be energized. The capacitor then must be brought to -40°C (-40°F) before it may be energized without possibility of damage. For this reason, if extremely low temperatures are anticipated, it is advisable to switch capacitors onto the line to keep their internal temperature above the critical point.

For applications outside these ranges, capacitors need to be designed accordingly.

FUSING AND LIGHTNING PROTECTION

Capacitors should be fused either individually or in groups to isolate failed capacitors from the system and to minimize occurrence of case rupture in the event of capacitor failure. Types of fuses and ratings for specific applications may be obtained at any General Electric Sales Office.

Cutouts used for switching should be opened as rapidly as possible to minimize arcing.

It is recommended that capacitors be protected by suitable lightning arresters connected to the terminal with as short a lead as possible and with all grounds connected together. As a general rule, arrester protective level with 1.2 X 50 wave should be less than two-thirds the BIL rating of the capacitor. Ratings of recommended arresters may be obtained at any General Electric Sales Office.

MAINTENANCE

Under normal service conditions, once a capacitor is installed no further maintenance is required during the life of the capacitor. Repainting of the case may be desired for appearance, and periodic cleaning of the bushings may be necessary in contaminated atmospheres to prevent arc-over.

Capacitors may be inspected periodically to see that they are operating. If indicating protective devices are not used, the capacitor can be checked most easily by de-energizing (see Protection Against Shock) and checking the capacitance (see Testing).

If a leak occurs in the capacitor, contact the nearest General Electric Sales Office for recommendations regarding disposition.

Capacitors with large dents may be checked for operation as described under "Testing." If such testing is impossible or if results are unsatisfactory, contact the nearest General Electric Sales Office regarding the possibility of factory test and repair.

TESTING

A low voltage capacitance measurement may be made to evaluate the condition of the capacitor. For further tests or details, see NEMA Standard Publication No. CP1.

WARRANTY

The following basic information must be provided with respect to warranty claims:

Serial number, date in service, date failed, type of installation (1.e. pole type, stack rack), fixed or switched, conditions at the time of failure. Do not scrap an in-warranty capacitor unless authorized by Product Service, GE Capacitor and Power Protection, Fort Edward, NY.

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