ABB

MS 3.1.1.9-2E

Maintenance and Surveillance

Low-Voltage Switchgear Equipment

K-Line® Switchgear

IB 3.1.1.7-2

Type K-225 thru 2000 and K-600S thru 2000S

IB 6.1.2.7-1

Type K-3000, 4000, K-3000S and 4000S

IB 6.1.2.7-2

RECOMMENDED MAINTENANCE & SURVEILLANCE LOW VOLTAGE SWITCHGEAR EQUIPMENT

EQUIPMENT MAINTENANCE PROGRAM

This Bulletin augments the information and instructions provided in Instruction Bulletin 3.1.1.7-2, 6.1.2.7-2 and 6.1.2.7-1.

Switchgear installations which require exceptional dependability due to serious safety or economic consequences of operating problems should be given comprehensive maintenance and surveillance attention. This program recommendation has been developed specifically for use in Nuclear Power Generating Stations but it is applicable to any installation where exceptional reliability is desired and a preventive maintenance program is to be implemented.

Some maintenance activities are considered essential, therefore ACTIVITIES WHICH ARE MOST IMPORTANT TO ASSURE AVOIDANCE OF PREDICTABLE PROBLEMS ARE UNDERLINED.

FREQUENCY OF MAINTENANCE

Suggested time frames in the program are not absolute, they represent the best generalized advice of the manufacturer for equipment installed in a clean, uncontaminated environment such as may be found in a power generating station. If equipment is in an area where corrosive or conductive contaminents are present, or if large amounts of airborne contaminants will be experienced, the shortest interval of the range shown in the equipment maintenance program should be used. Further, in highly contaminated areas, as described, circuit breaker servicing should be accomplished at a maximum of two year intervals.

If it becomes apparent after several maintenance cycles that certain activities are not needed as frequently as suggested, or that increased frequency would be prudent, the program should be adjusted to meet the specific needs of the installation.

RECORDS

Records are a key factor in a preventive maintenance program and can provide vital data for evaluating equipment condition, when necessary, if the recording system is consistent, thorough and available when needed. As a minimum the records should contain the data and, for circuit breakers, the number of operations at last maintenance in addition to results of testing. If observations of equipment condition are recorded, a realistic basis for adjusting maintenance frequency will be available.

SPARE PARTS

A major factor in overall availability is down-time-per-failure or mean-time-to-repair and, although, switchgear and associated components enjoy favorable reliability expectations, random failure of a component can cause down-time or reduced capability if inadequate attention is given to the spare parts inventory. A spare parts recommendation for the switchgear equipment can be provided to assist in selection of appropriate parts. Storage of spares should be in a clean, dry area. Part access and identification should permit prompt availability, when needed.

1. GENERAL

CAUTION: BE SURE THAT ALL ELECTRICAL SUPPLIES ARE OFF BEFORE PERFORMING ANY MAINTENANCE INSIDE EQUIPMENT.

a. The following lubricants are recommended:

LUBRICANTS	
Mechanisms (anti-friction)	ANDEROL 757 Tenneco Chem. Inc.
Electrical Contact Compound	NO-OX-ID "A Special" Sanchem Chem. Co.

Use of other lubricants risks incompatibility with original materials or unproven performance.

b. In tightening bolted conductor connections, use of a torque wrench is recommended. The following torque levels will assure good connections:

DRY THREAD TORQUE	
BOLT DIA.	TORQUE
3/8"	15-25 ft. lb.
1/2"	30-45 ft. lb.
5/8"	50-75 ft. lb.

c. A clean and dry environment should be a continuing goal of the maintenance program for all electrical equipment.

d. Operating and maintenance personnel should be alert for unusual sounds (sizzling or crackling) and smells (ozone or burning) when in the vicinity of electrical equipment.

2. RECEIPT AND STORAGE

Environmental conditions during transit and storage can have a substantial effect on equipment reliability. Extended periods of storage with original shipping covers in place must be avoided.

a. Upon receipt, equipment should be put into a ventilated storage area protected from the weather. Temperature should be maintained between 40°F and 120°F, humidity should be maintained at 50% relative* or below and/or boxes should be removed.

*If relative humidity above 50% is anticipated, localized heat sources should be provided to maintain equipment temperature above the dew point. One means of accomplishing this is to energize internal equipment space heaters and store circuit breakers within the equipment enclosures.

b. Under all conditions of transport and storage, equipment should be protected from direct impingement of water, flooding and heavy contamination, such as construction dust/dirt.

3. AT INSTALLATION (Repetition of some factory activity is suggested due to uncertainties of shipping, handling, etc.)

CAUTION: TURN OFF ALL POWER BEFORE WORKING INSIDE.

a. Equipment mounting should be on level rails embedded flush with the finished floor per installation dwgs.

b. Removal of all shipping supports and installation of all bus conductors (main ground) across shipping splits should be verified.

c. Check all bolted bus connections for proper torque.

d. Check circuit breaker connection wipe by applying NO-OX-ID compound to stationary connection stubs and racking breaker into connected position, then out. Contact lines in compound verify contact.

e. Exercise each circuit breaker (close and trip twice.)

f. Inspect primary conductor insulation system, remove contamination accumulated in storage and installation.

g. Check primary cable connections for tight hardware and proper stress relief. Check all primary connections to other electrical equipment.

h. Check control wire connections - See 6c.

i. Check trip/racking interlock to verify not racking with breaker closed and no closing unless breaker is latched in position.

j. Millivolt drop measurements on each circuit breaker provide useful preoperation checks and valuable comparative data for future use.

k. Set and check calibration of trip units per I.B.** On solid state trip units, verify that color coded sensor leads agree with the wiring diagram (WD) identified on the circuit breaker nameplate.

4. TWELVE TO EIGHTEEN MONTH INTERVALS

CAUTION: TURN OFF ALL POWER BEFORE WORKING INSIDE

a. Identify and service circuit breakers which are due. See CIRCUIT BREAKER SERVICING section, page 5 of this Bulletin.

** Electro-Mechanical Trip - I.B. 6.1.2.7-1
Solid State Trip - I.B. 6.1.2.7-4

b. Exercise all circuit breakers which are not due for service.

c. Inspect primary interface connections with other equipment for signs of excessive heat (Cable and bus connections, usually in the rear of the equipment.) Discoloration or embrittlement of adjacent insulating materials and conductor corrosion or discoloration may indicate a hot joint. See HOT JOINT MAINTENANCE & JOINT COVERS, below.

d. Inspect primary cables for chafing at conduits or supports.

e. Exercise the racking mechanism.

5. ONE TO THREE YEAR INTERVALS (Nuclear - Alternate refueling shutdowns.)

CAUTION: TURN OFF ALL POWER BEFORE WORKING INSIDE.

a. Clean contamination from all primary insulation with vacuum, distilled water or a solvent approved by NIOSH or local authority, as necessary. Inspect for discoloration or other evidence of excessive heat. If found, preceed per HOT JOINT MAINTENANCE, below.

b. Inspect control wiring bundles for discoloration due to heat, chafing or other damage to insulation.

c. Clean stationary breaker connection stubs in the enclosure with a solvent approved by NIOSH or local authority. Inspect for evidence of contact galling, excessive heat, arcing or corrosion. If found, proceed per HOT JOINT MAINTENANCE below. Reapply NO-OX-ID compound prior to reconnecting circuit breaker.

NOTE: Protective relays should typically be checked for accuracy of calibration at two to five year intervals, see manufacturers instructions for details.

6. TEN YEAR MAXIMUM INTERVAL

CAUTION: TURN OFF ALL POWER BEFORE WORKING INSIDE.

CIRCUIT BREAKER REFURBISHMENT

a. Disassemble, inspect, clean, relubricate, readjust and recalibrate breaker mechanisms which have not been fully refurbished in ten years.

b. All primary conductor connection bolts should be torqued to recommended values. (An alternative to retorquing may be use of infrared heat sensor (thermographic) techniques. These procedures are specialized, however, and require plans to overcome loading and safety difficulties.)

c. Tighten all secondary control wire connections while checking for loose lug crimps and broken wire strands.

HOT JOINT MAINTENANCE - For primary joints which show evidence of excessive heat: (1) Open joint and inspect connection surfaces. (2) If surfaces appear reasonably smooth, with only minor pitting or corrosion, clean and dress contact surfaces minimizing removal of plating. (3) If surfaces are heavily pitted or corroded, or if there has been any melting of conductor material, the affected parts must be replaced. (4) Replace contact finger springs if breaker disconnects have been exposed to excessive heat. (5) Contact surfaces should be protected with NO-OX-ID before reassembly. (6) Use recommended torque values in tightening bolted connections. (7) Before and after millivolt drop testing can provide some confidence that the problem has been corrected.

CIRCUIT BREAKER SERVICING

Circuit breakers require inspection and servicing periodically to assure operability. Servicing should be accomplished based on number of operations since last serviced, with an elapsed time limit. The appropriate frequency of servicing depends on the duty of the circuit breakers. As experience warrants, the recommended frequency of servicing shown below should be adjusted on specific breakers to account for more/ less severe duty than initially expected, based on the breaker condition when serviced.

Recommended service frequency is shown for three general categories of duty:

LOAD CURRENT SWITCHING, UP TO RATED CONTINUOUS CURRENT ENVIRONMENT NORMAL, MINIMAL CONTAMINATION.

Service breaker every five (5) years or upon accumulating the number of operations shown below since last serviced, whichever comes first.

K-600/800 _____ 1750 Ops.
K-1600 _____ 500 Ops.
K-3000/4000 _____ 250 Ops.

MOTOR START, CAPACITOR & REACTOR SWITCHING OR ANY DUTY IN A CONTAMINATED ENVIRONMENT.

Service breaker every two (2) years or upon accumulating the number of operations shown below since last serviced, whichever comes first.

K-600/800 _____ 1000 Ops.
K-1600 _____ 300 Ops.

FAULT INTERRUPTION

Service a breaker which has interrupted short circuit current as soon as possible.

This service program qualifies a circuit breaker for the total number of operations shown below before replacement or factory refurbishment is required. The limit is suggested to provide margin.

A.C. CIRCUIT BREAKERS

K-600/800 - Total Operations - 12,500
Suggested Limit - 11,250
K-1600 - Total Operations - 4,000
Suggested Limit - 3,600
K-3000/4000 - Total Operations - 1,500
Suggested Limit - 1,350

D.C. CIRCUIT BREAKERS

K-600/800 - Total Operations - 11,450
Suggested Limit - 10,305
K-1600 - Total Operations - 3,700
Suggested Limit - 3,330
K-3000/4000 - Total Operations - 1,350
Suggested Limit - 1,215

The following should be accomplished at each service interval:

CLEAN, INSPECT & LUBRICATE PRIMARY DISCONNECTS.

CONTACT & INSULATION CLEANING.

ARC CHUTE INSPECTION

OPERATION CHECK

CONTACT PRESSURE CHECK*

Instructions follow which clarify the above.

In addition, the hardware (bolts, nuts, screws and pin retainers) should be checked with a thorough inspection to be sure that they are in place and secure.

There are other activities which may be required as shown:

CONTACT PRESSURE ADJUSTMENT*

Required if contact pressure check indicates a problem.

MECHANISM ADJUSTMENT & LUBRICATION*

Required if breaker misoperation occurs (such as not latching closed or high control voltage required for operation).

TRIP DEVICE CALIBRATION CHECK.**

Recommended at alternate service intervals to verify coordination, as needed.

LUBRICATION

The K-Line circuit breakers are lubricated during factory assembly as follows:

All mating surfaces of moving current-carrying joints have been lubricated with NO-OX-ID Special Grade "A" grease.

All other mechanism parts, bearings, pins, etc. have been lubricated with ANDEROL-757.

The circuit breaker mechanism does not ordinarily require lubrication in the usual moderate service environment expected. However, if operating difficulties are experienced, if grease becomes contaminated or if parts are replaced, relubrication with ANDEROL grease may be required. Extensive disassembly is required to properly relubricate the mechanism. Contact the nearest ABB Power Distribution Inc. district office for field assistance or factory refurbishment.

Primary disconnect fingers should be cleaned with a solvent approved by NIOSH or local authority, inspected for corrosion or evidence of arcing and relubricated with NO-OX-ID grease at each servicing.

NOTES:

Do not use No-OX-ID grease on main or arcing contact parting surfaces.

Do not use light oil to lubricate mechanism parts.

The spring charging motor is sealed, lubrication is not recommended.

*Consult the Circuit Breaker Instruction Bulletin for guidance in making the contact pressure check and adjustments, and mechanism adjustments. K-225 to K-2000 - I.B. 6.1.2.7-1, K-3000 & K-4000 - I.B. 6.1.2.7-2.

**Consult the following Instruction Bulletins for details of trip device testing:

Electro-Mechanical Trip - I.B. 6.1.2.7-1
Solid State Trip - I.B. 6.1.2.7-4

CONTACT AND INSULATION CLEANING

Any dirt, soot or grease should be removed from the circuit breaker contacts and surface of entire current carrying structure, as well as all insulation surfaces, with a cloth saturated with an approved solvent. Cleaning of the insulation is important because contamination can accumulate and, with moisture, can place the circuit breaker in jeopardy, dielectrically.

A degree of burning and pitting on the circuit breaker arcing contacts is to be expected from normal operation; on highly inductive or capacitive circuits and after major interruptions, some pitting may occur on the main contacts. When necessary to dress the contacts, follow the contour of the contacts with a fine file. Do not attempt to eliminate pitting entirely. After this maintenance, the contact pressure should be made, if indicated.

NOTE: Replacement of contact need only be considered when after repeated dressing of contacts, less than 50% of the original contact material thickness is left, the tips of the stationary arcing contacts have been eroded away, or any contact has been broken, cracked or burned through.

CAUTION: FOR SAFETY, KEEP CLEAR OF ALL MOVING PARTS.

ARC CHUTE INSPECTION

Removal:

1. If circuit breaker has a solid state overcurrent trip device, it is necessary to remove two 1/4" diameter screws fastening the solid state control assembly. Move the assembly access to the arc chute retaining screws.
2. Loosen the retaining screw and remove the screw and arc chute retainer.
3. Pull the arc chute forward slightly then lift to remove.

Inspection:

1. Discoloration or slight eroding is not harmful
2. Arc runners or cooling plates that are seriously burned or eroded and moldings that are cracked or broken require replacement of the arc chute.

Replacement:

1. Properly position the arc chute in the upper molding.
2. Position retainer and insert and tighten screw.

OPERATION CHECK

During servicing it is desirable to verify breaker operability. On electrically operated breakers this should be done at minimum expected control voltage level (typically 80% of nominal).

CONTACT PRESSURE CHECK

See circuit breaker Instruction Bulletin for detailed checking procedures.

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