

## Section 8

# Fault Finding

### 8.01 GENERAL INFORMATION

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There are, in general, set logical steps to be applied when fault finding. They are:

- **SYSTEM ANALYSIS:** this involves logging and advising of a fault occurrence
- **FAULT:** this should cover the inspection of equipment associated with the fault occurrence identifying the actual fault
- **POSSIBLE CAUSE:** tracing and identifying the cause of the fault
- **RECOMMENDED CORRECTION:** correcting the fault involving repair, replacement, resetting etc.
- **SETTING TO WORK:** recommissioning if necessary

If a fault or breakdown occurs then it must immediately be established whether the fault or breakdown is a supply failure or plant/equipment failure. A decision must be taken on whether the matter is urgent or not. The fault may need attention but it may not be urgent.

When a breakdown occurs, action must be taken immediately to render the plant safe. The procedures for shutting down the boiler plant and switching off pumps must be followed before any other action is carried out. Try to establish the cause of a breakdown prior to rectifying the fault.

Careful and complete details should be recorded of faults and breakdowns in a log book. Date of occurrence, particular item of equipment, details of the breakdown, any immediately previous maintenance work carried out, previous warnings or evidence of trouble which may have gone unheeded (or may have been acted upon), how the plant generally was operating, any special circumstances or relevant details, or similar information, should all be accurately and fully recorded, together with full details of action taken. Such records are not only useful to the operating staff, but invaluable to outside specialists and service engineers.

When investigating faults, do not overlook the obvious:

- ✓ Is the unit switched ON?
- ✓ Is the control system holding off operating the item?
- ✓ Is the local isolator switched on?
- ✓ Is the gas/oil fuel available?
- ✓ Is the isolating valve open/closed as necessary?

Do not take anything for granted, do not leave any component out of a fault finding checking sequence even if the item is new.

Electrical faults on mechanical plant are usually more complicated than mechanical faults. Electrical components and wiring are exposed to vibration, heat, damp and corrosive conditions. Always check connections for corrosion and/or loose fixings. Assuming the earthing is satisfactory electrical faults will usually be due to a component failure or wiring failure. A blown fuse indicates a short-circuit from a bare wire connection or contact. Always establish the cause of a blown fuse.

## 8.02 SYSTEM ANALYSIS

Firstly determine what has happened and what condition has occurred to justify investigating a fault. Listed below is a useful table of questions which has been prepared by BSRIA (TN 12/86) and is reproduced with their permission.

### SYMPTOM ANALYSIS

#### ACTION

#### KEY QUESTION

#### SUBSIDIARY QUESTIONS

Question available personnel

*What happened?*

*When did it happen? Under what circumstance? How long has the condition existed?*

*How long had the equipment been running?*

*Had it just been switched on? Had it been on/off for a long period?*

*Did you note anything unusual?*

*Any mains trip? Any audible or visual alarm? Erratic operation? Bang, flash, spark or smoke?*

*Were controls operated normally?*

*Anything abnormal about sequence of operation? Any particular difficulty in operating controls?*

#### Observation

*Anything unusual to be seen?*

*Any obvious signs of tampering? Any panels removed, cubicles open? Any hoses disconnected or oil leakage? Any fouling of moving parts? Any cables broken, frayed or burnt?*

**Inspect control and monitoring devices**

*All indications normal?*

*Power on? Tank level? Pressure? Filters? Alarms and interlocks? Printouts and displays? Control settings?*

*Run the equipment*

*What happens/does not happen?*

*Permanent condition? Intermittent condition? Fast/slow? What does it indicate? Can it be reproduced? Effect on output? Hazardous? Likely to cause damage? All conditions of operation?*

**EQUIPMENT INSPECTION**

**ACTION**

**COMMENTARY/RELEVANT QUESTIONS**

**Inspect the equipment using the natural senses**

*Continue the observation process*

*Look for:*

*Disconnected plugs/sockets. Incorrect control settings. Motor/pump running. Signs of arcing/burning. Valve heaters glowing/not glowing. Tripped circuit breakers. Missing components (eg bulbs)*

*Touch for:*

*Overheated components. Indications of mechanical movements. Warm oil lines. Vibration.*

*Listen for:*

*Any unusual sounds. Sounds of motion. Audio outputs. Relay operation.*

*Sniff for:*

*Smells of burning, gas leaks, fluid leaks.*

**Evaluate findings**

*Do they eliminate/substantiate possible faults? Do they provide useful points to the fault area? Do they reinforce/contradict?*

### 8.03 ELECTRICAL SUPPLY FAILURE

If a total mains failure occurs then quite obviously ALL power is lost. Upon failure of main supply affecting any section of distribution, all equipment served by the affected supply which could constitute a hazard to personnel or a fire hazard if re-energised when unattended must be switched OFF.

Upon failure of main supply automatic operation of the emergency luminaires will provide sufficient illumination for means of exit. It is essential therefore that the equipment is properly maintained. The Electricity Board should be notified of any failure of service and when supply is restored, reverse the switching arrangements to return the installation to normal operation.

Upon restoration of supply following a fault or failure, reset all equipment circuit breakers and starters which 'drop-out' or 'fail safe' due to under voltage and require manual resetting.

**WARNING:**

NO ELECTRICAL CONDUCTOR SHOULD BE REGARDED AS 'DEAD' UNLESS IT HAS BEEN PROVED TO BE SO.

#### EMERGENCY PROCEDURES

Should an abnormal condition arise, either in the switchgear or its associated equipment and cables, then the following procedure must be adopted:

- a) Immediately isolate from the supply any area of fault.
- b) Should a fault have occurred in or adjacent to an incoming transformer panel, the associated HV circuit breaker must also be tripped.
- c) In case of fire, the mains and standby supplies must be isolated
- d) Do not, under any circumstances, use water to put out a fire in or around electrical equipment.
- e) For personal injury or electric shock, follow such instructions as laid down by the British Safety Councils' Publication: 'Treatment for Asphyxia including Electric Shock' and seek immediate medical advice and attention.
- f) After a fault and prior to reinstatement, equipment must always be checked by a competent person, to ascertain the cause and any remedial action taken. As soon as possible thereafter the routine maintenance programme should be carried out. Work on HV equipment must always be carried out by authorised personnel only.

**ELECTRICITY EMERGENCY TELEPHONE NUMBER: ☎**

081 519 4525 during office hours

071 733 2161 Mon - Fri 5pm - 8.30am, Weekends and Pub. Holidays

The electrical installation includes an emergency diesel generator which cuts in automatically on mains power failure and powers the 'maintained' circuits.

There is very little that can be achieved until the mains power is restored. However, the following should be considered to be implemented to assist plant start-up on restoration of the electrical supply.

Advise all personnel that existing plant selection switches are not to be adjusted, and that they are switched OFF. It is necessary to prevent surge loads on the system on the reinstatement of the power supply. Since all systems will try to start at the same time, overloading the control circuit fuse may occur. Once power is resumed to the plant control panel, then (in stages), main items of equipment can be switched onto line again, minimising the load on the control circuit.

Check to confirm that the emergency lighting facilities are fully operational and working.

- If a power circuit fails, then the breakdown is localised and normally one can easily identify which circuit has failed. Obviously familiarisation with these electrical distribution circuits will be of benefit.
- If a particular item of plant breaks down it may be that the electrical circuit has failed and the circuit's fuse/circuit breaker requires inspection.
- If an item of plant has its own control panel/box then it may also have a 'power-on' indicator light.
- If the item of plant is not working, check this out first.

If the electrical failure occurs during the winter months and there is possibility of freezing of external pipework, tanks or plant, then shut OFF the valves to these areas and drain down the circuits concerned. Place suitable notices advising what action has been taken and remember to refill the circuits after restoration of the electrical supply.

**CAUTION:**

**TAKE ALL PRECAUTIONS AGAINST ELECTRIC SHOCK BY SWITCHING OFF BETWEEN ALL TESTS AND ENSURING LOOSE WIRES ARE NOT IN CONTACT WITH ANY METALWORK OR IN DANGEROUS POSITIONS.**

**8.04 WATER SUPPLY FAILURE**

If a total mains water supply failure occurs there is very little that can be achieved until the supply is restored. Check the stored water capacity in ALL tanks and advise all personnel to conserve water usage and NOT to drink from tank-fed taps. The Water Authorities recommend that once the water supply is restored water outlets, in particular those used for drinking, are run to waste for about 5 minutes.

If you are concerned about the supply then contact the Water Authority. Reasonable complaints will usually be handled free of charge at the discretion of the authority.

**WATER EMERGENCY TELEPHONE NUMBER: ☎  
071 837 3300**

**NOTE:** High velocities in water pipes can cause noise.

Once the mains water supply has been re-established check all break tanks and storage tanks to ensure correct operation of the ball valves. If the water supply is localised check out the associated break/storage tank, pump set (booster), water heater, etc. Locate the fault and rectify. The system has been designed and commissioned to give a velocity of less than 3 m/s. At 7 or 8 m/s cavitation occurs which causes noise, severe corrosion and pitting of the pipework.

**WATER QUALITY:** The "International Standards for Drinking Water" produced by the World Health Organisation define the toxic limits for substances frequently found in water supplies. Chemically pure water has no free ions; its hydrogen ion concentration, usually known as pH value, is equivalent to the hydroxyl ion concentration and on the pH scale has a value of 7 which represents neutrality. Water with a pH higher than 7 is alkaline; pH levels under 7 are acid.

The fireman's switch if in the OFF/STOP position or on a pre-determined position e.g., EXTRACT, will hold off the operation of numerous items of plant. Make sure this switch is in its correct position for plant operation.