MISCELLANEOUS SAFETY VOLUMES

FIST VOLUMES 5-3 THROUGH 5-11

Internet Version of This Manual Created
August 2000

Engineering Division Facilities
Engineering Branch
Denver Office

The Appearance of the Internet Version of This Manual May Differ From the Original, but the Contents Do Not

UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION

Back to Main Index

MISCELLANEOUS SAFETY VOLUMES

CONTENTS

BUREAU OF RECLAMATION

FACILITIES INSTRUCTIONS, STANDARDS & TECHNIQUES

Volume 5-3

HIGH PRESSURE SYSTEMS

High Pressure Systems

There is a potential danger inherent in high-pressure pneumatic and hydraulic equipment at power facilities. Personnel should be familiar with protecting, securing, and identifying high-pressure pipelines. Equipment is considered to be "high-pressure" if any part of it operates at 1400 kPa (200 lb/in$^{2)}$ or above. A large segment of the high-pressure systems are associated with air operated power circuit breakers. The power circuit breakers normally have two to four different pressure stages. These pressure stages, the pipe sizes, and the construction materials vary with each manufacturer. Repair must be made in accordance with each power circuit breaker manufacturer's specifications using properly rated fittings, valves, piping, and special components. Underrated materials cannot be safely used, even for temporary or emergency repairs.

One example of a violent failure of a high-pressure system involved an 18000-kPa (2600-1b/in^2) air pipe which worked out of a fitting. The loose pipe was directed toward the ground and blew a hole 0.6 m (2 ft) deep into the ground. Yard rock and sandy soil were blown around and could have easily injured or killed anyone in the vicinity. High-pressure systems therefore should be considered as potentially dangerous as high-voltage electricity, and should be treated with equal caution. Operation and maintenance personnel should therefore be familiar with hazards of high-pressure pneumatic and hydraulic systems, and with the common-sense practices associated with them. All damaged or faulty high-pressure pipelines should be reported immediately and repaired as soon as possible. Work on any high-pressure system should be scheduled in conjunction with other work on major equipment and compressors. The following general practices should be used for inspecting, protecting, securing, and identifying high-pressure systems.

1. PERMANENT LINES

PROTECT. - Exposed high-pressure pipelines that could be easily damaged must be protected. The exact method of protecting and securing these pipelines depends on the installation. Protecting pipelines against extremes such as rifle fire is not economically feasible; however, they should be protected against normal stresses such as impact and bending. Any high-pressure pipe or equipment which could possibly be hit by a vehicle should be protected by strong posts or other barricades. Protect pipelines with angle steel welded or bolted to the power circuit breaker support structure, or other strong supports. Where possible keep the pipe within the angle of the steel.

DO NOT WELD ANY PIPE OR HIGH PRESSURE TANK. - This could weaken the strength of the pipe or tank. Fabricate protective covers from standard 50-mm (2-in) square mesh welded wire fabric. These covers should be used whenever possible, to shield groups of exposed high-pressure pipes or valves. Open-mesh covers are preferred over solid covers, because they let most of the high pressure force dissipate but retain the solid pieces. A solid cover which cannot dissipate the full force, could itself be propelled through the air.

SECURE. - Where impractical to cover long, exposed, high-pressure pipelines, secure them to sturdy members at intervals (see table) to limit any whipping action that might occur if a pipe failed. Strap pipelines to strong supports close to fittings, bends, and on either side of couplings. Place a piece of rubber or neoprene gasket material between the strap and the high-pressure pipe to help prevent failure from wear due to vibration or hammer caused by motion of the high-pressure fluid. Suggested support intervals are given in Table 1. High-pressure air hose in overhead gutters should be secured at least every 0.9 m (3 ft). Gutters should be either without cover or with welded mesh fabric covers.

Table I - Suggested Intervals for Pipe Supports												
Pipe size		**3/4**	**1**	**1 1/4**	**1 ½**	**2**	**2 ½**	**3**	**3 ½**	**4**	**5**	**6**
Interval (maximum)	**(ft)**	**10**	**10**	**15**	**15**	**15**	**20**	**20**	**25**	**25**	**25**	**30**
	(m)	**3**	**3**	**4.5**	**4.5**	**4.5**	**6**	**6**	**7.5**	**7.5**	**7.5**	**9**

IDENTIFY. - After high-pressure pipe has been protected, paint all exposed pipe yellow. If further identification is desired, stencil the information onto the pipe in black letters, or wire permanent metal tags to the pipe. For example the labels should read:

COMPRESSED AIR ______ kPa
(______lb/in^2), or

HIGH PRESSURE _______ kPa
(_______lb/in^2).

2. TEMPORARY HOSES

Temporary high-pressure air hoses are usually used during maintenance, or during emergency breakdown of a compressor. Normally the hose is laid on the ground from a compressor to the power circuit breaker high-pressure storage tank.

PROTECT. - if hose has to be laid across a roadway, protect it from vehicular traffic. Construct a protective conduit from materials such as 2-by-4's with a narrow sheet of plywood nailed to the bottom, and lay it on the ground the complete width of the roadway, and lay the hose between the 2-by-4's. Thus, vehicle tires will not hurt the hose or force it into the rough road bed. Generally protect the hose from all sharp rock.

SECURE. - Tie the ends of the hose, and at regular intervals along the hose, to heavy stationary equipment and yard structures with rope. Where the hose is laid on the ground, place sand bags or equivalent on the hose at about 3-m (10-ft) intervals.

IDENTIFY. - If the hose is to be placed for 3 days or more, place the following warning sign at every high-traffic route for both foot and vehicular traffic:

COMPRESSED AIR _______kPa
(_____lb/in^2).

BUREAU OF RECLAMATION

FACILITIES INSTRUCTIONS, STANDARDS & TECHNIQUES

Volume 5-4

CHLORINE GAS SAFETY PROGRAM

Chlorine Gas System Safety Program

There is a need to emphasize major precautions to be observed while working with chlorine, which is a very dangerous gas. The following outlines a program governing the moving, storage, and maintenance procedures to be used for handling chlorine gas. Consult the Safety Engineer for procedures to be followed in an emergency, and the type of first aid treatment to be rendered to persons exposed to chlorine fumes.

1. MOVING CYLINDERS

a. Never move a chlorine gas cylinder unless the cylinder valve cap is in place.

b. Do not drop a cylinder or allow an object to strike the container with extreme force.

c. Never apply heat to chlorine cylinders or valves.

d. Any handtruck used for moving cylinders shall have a clamp support at least two-thirds of the way up the cylinder.

e. When lifting a cylinder using a crane or hoist, a special cradle or carrier should be used. Never use a rope sling, chain, or magnetic device.

f. Never lift a cylinder by the valve cap or neck.

2. STORING CYLINDERS

a. One extra, full or empty, container may be racked and stored in the chlorine room. All other containers should be stored outside of attended power or pumping plants. The storage area should be cool and dry, and protected from all heat sources including the sun.

b. Never store containers near turpentine, ether, anhydrous ammonia, finely divided metals, hydrocarbons, oxygen cylinders, acetylene cylinders, or any flammable materials.

c. The storage area should be clean, well vented to atmosphere, and remote from elevators, gangways, ventilating systems, or any other type of area that would allow leaking gas to disperse rapidly throughout the building.

d. Cylinder valve caps should always be screwed securely in place during storage.

e. Cylinders should always be stored vertically and never stacked or laid horizontally. The storage room should never contain other stored material.

3. GENERAL PRECAUTIONS

a. Never tamper with the fusible plug safety device on containers.

b. Never alter or repair a container or valve. Tell the chlorine supplier if any damage is found.

c. Never place a container in hot water, or apply direct heat to increase the flow rate, or for any other reason.

d. A flexible copper tube connection should be used between the container and the piping system. Copper tubing shall be type K or L and sized for a minimum of 3500-kPa (500-lb/In$^{2)}$ working pressure. A type L9.5 mm (3/8-1n) o.d. flexible copper tube is recommended.

e. Never perform maintenance work on a system unless the tank valves are closed.

f. When a container is empty the valve should be closed, lines disconnected, and the valve tested for leakage. An outlet pipe cap should be promptly attached and the cylinder valve cap secured. If the valve does not seat immediately, open and close it lightly until it seats. Never impact the valve or cylinder with anything, with the mistaken idea it would help make a tight valve closure.

g. To detect a chlorine gas leak, attach a cloth to the end of a stick, soak it with ammonia, and hold it close to the suspected area. A white cloud of ammonia chloride will result if there is a chlorine leak. Commercial 26 ^{O} Be ammonia must be used; household ammonia is not strong enough.

DO NOT GET ANY AMMONIA ON THE BRASS.

h. Do not enter a chlorine contaminated area without wearing a self-contained breathing apparatus, which is available at all Bureau plants. Canister-type chlorine masks do not protect against chlorine concentration over 1 percent when the oxygen concentration is below 16 percent.

i. If a leak develops in a chlorine system, shut off the cylinder valves and ventilate the area to the outdoors prior to repairing the leak. Should a major leak develop which can not be controlled, clear the area of personnel, and exhaust the fumes to the outdoors.

j. If a cylinder valve leaks, tighten the packing nut with the special wrench. Should it continue to leak, replace the outlet pipe cap and remove the cylinder to the outdoors.

k. If a cylinder leaks, tilt the cylinder to permit gas instead of liquid to escape. Less equivalent leakage can flow through a crack as gas than as liquid.

l. Do not use water on a chlorine leak.

m. In case of fire all cylinders should be removed from the fire zone Immediately.

BUREAU OF RECLAMATION

FACILITIES INSTRUCTIONS, STANDARDS & TECHNIQUES

Volume 5-5

HANDLING FAILED PCB-FILLED CAPACITOR CELLS

Handling Failed PCB-Filled Capacitor Cells

The purpose of this chapter is to establish the procedure for handling, storing and transporting of failed capacitor cells to minimize electrical, explosive, and environmental hazards associated with failed capacitor cells. A procedure is outlined to be used to dispose of failed capacitor cells.

ELECTRICAL HAZARDS

Failed capacitor cells can have a charge on them due to an opened discharge resistor. This charge can be eliminated by placing a shorting wire across the terminals.

All new AC capacitor cells are tested at the factory in accordance with ANSI Standards. ANSI requires the manufacturer to install a discharge resistor which reduces the capacitor cell voltage to 50 volts or less within 5 minutes after being disconnected from a voltage source.

EXPLOSIVE HAZARD

Capacitor cells which have failed in service but have not ruptured may have a built-up Internal pressure from the fault. Cells that have extreme bulging are dangerous to handle until the pressure is relieved. Internal pressure is relieved by puncturing as outlined under **"HANDLING PROCEDURES".**

Askaral, under arcing conditions, produces gases which consist predominately of hydrogen, chloride, HCl, smaller percentages of carbon dioxide, CO2, and smaller percentages of combustible gases such as carbon monoxide, CO; and oxygen 02. The amount and type of gas generated depends upon the type of askarel. Therefore, a faulted askarel-filled capacitor cell should be considered as potentially combustible when a bulged can is punctured.

HANDLING PROCEDURES FOR FAILED CAPACITOR CELLS

Removal from Rack

The following is the recommended procedure to follow when removing failed capacitor cells from the rack, after an outage is obtained:

1. Ground the neutral bus as close as possible to its connection to the ground mat. Series capacitors do not have a neutral bus, but the work platform must be grounded.

2. Short each capacitor cell in the area of work.

3. DO NOT PUNCTURE unruptured failed capacitor cells unless bulging is extreme. If extreme bulging has occurred, the following procedure should be followed:

a. Puncture only cells which have extreme bulging before they are removed from the rack.

"CAUTION": Personnel must exercise due caution when puncturing failed cells to prevent direct contact with the escaping gas. Also, no smoking or source of flame nearby when puncturing. The gas contains high percentages of Hydrogen Chloride (HCl). Minute concentrations of HCl are very unpleasant and irritating, giving warning of its presence. After puncturing, step into fresh air until the gas escapes and dissipates into the atmosphere, then continue. A tool using a spring-loaded pointed plunger should be used to puncture failed cells. If any askarel leaks from the can follow the procedure listed under <u>"Ruptured Cell Cleanup."</u>

(1) Vertically mounted cell. Puncture the cell as close to the top as possible. Puncturing at the top results in a smaller potential loss of askarel.

(2) Horizontally mounted cell. Puncture close to the top of the end of the cell facing outward. When the cell is removed, store the cell with the puncture up.

b. All punctured cells must be treated as leakers. PCB-filled cells must be shipped to PCB disposal sites.

4. Use a sheet metal screw to plug the puncture hole and minimize askarel leakage.

5. Remove failed capacitor cells from the rack.

6. Install a wire shorting the cell terminals to the can. Use any scrap copper wire #18 AWG or larger.

7. Wrap ruptured or leaking failed capacitor cells in a double thickness of vinyl plastic sheeting for temporary storage or transport.

8. Non-leaking failed cells must be stored and transported in an upright position.

Ruptured Cell Cleanup

When a capacitor cell ruptures, askarel is splattered onto the adjoining cells, racks and yard rock. When a rupture occurs in a capacitor house, splattered askarel tends to collect in the bottom of the house. Rags or oil sorbent sheets used in the askarel cleanup must be disposed of by the same method as the ruptured cells. Place the rags with the ruptured cell and wrap in plastic. The cleanup should proceed In accordance with existing EPA rules and regulations for PCB's. Workmen should use rubber gloves and protective clothing to avoid contact with the PCB's.

1. Capacitor Racks. Wipe down the adjoining splattered capacitor cans and rack with solvent. It is recommended to pour the solvent onto the rags when cleaning to prevent PCB contamination of the solvent. PCB contaminated materials should be disposed of in 55 gallon drums in accordance with EPA rules and regulations.

2. Capacitor Houses. Soak up askarel found in the bottom of the house with rags or commercial oil sorbents. Wipe down splattered adjoining cells and nonporous materials with solvent soaked rags. Porous building material should be tested after cleanup to determine if the PCB contamination has been reduced to an acceptable level according to the existing EPA rules and regulations.

3. Yard rock. All yard rock contaminated with PCB's must be removed and disposed of in accordance with EPA rules and regulations.

STORAGE OF CAPACITOR CELLS

The status of all individual capacitor cells must be indicated as to whether they are new, used, or failed. Used and failed cells should be labeled, "used and date" or "failed and date," with a marking pen. Capacitor cells should be stored in the following manner:

1. New Capacitor Cells. New, unused individual capacitor cells do not require a shorting wire across the cell terminals. The discharge resistor will short out any static charge that might occur. The cells must be stored in a location that will contain any askarel leaks that could occur.

2. Used Capacitor Cells. All used Individual capacitor cells must be stored with a wire shorting the cell terminals to the can. The cells must be stored in a location that will contain any askarel leaks that could occur.

3. Failed Capacitor Cells.

a. All failed individual capacitor cells must be stored with a shorting wire across the cell terminals to the can.

b. All ruptured or leaking capacitor cells must be placed in non-leaking PCB containers that contain sufficient absorbent materials to absorb any liquid PCB's that remain in the capacitors and stored in accordance with EPA rules and regulations for PCB's in a qualified storage facility.

c. Non-leaking PCB large high-voltage capacitors are not required to be stored in a qualified PCB storage facility. Store non-leaking failed capacitor cells in an upright position on a shipping pallet. Tie or otherwise secure the cells to they will not tip over during storage and shipment.

TRANSPORTING FAILED CAPACITOR CELLS:

Ruptured and Leaking Capacitor Cells

Ruptured and leaking capacitor cells must be in an approved container to be transported. The container must be labeled with the appropriate PCB label and the transporting vehicle must be marked in compliance with Department of Transportation rules and regulations.

Non-leaking Cells

Transport non-leaking failed capacitor cells in an upright position on a shipping pallet. Secure cells so they will not tip over. Vehicles transporting PCB materials must be marked in compliance with Department of Transportation rules and regulations.

DISPOSAL OF FAILED CAPACITOR CELLS:

Failed capacitor cells must be disposed of at an approved PCB disposal site within one year of the time they are removed from service.

BUREAU OF RECLAMATION

FACILITIES INSTRUCTIONS, STANDARDS & TECHNIQUES

Volume 5-6

INSPECTION AND MAINTENANCE OF PCB CONTAINING EQUIPMENT

Inspection and Maintenance of PCB Containing Equipment

(This information is from the Federal Register of August 25, 1982, pages 37342 through 37360.)

Title 40 of the Code of Federal Regulations, Part 761, which regulates PCB's (polychlorinated biphenyls) in concentrations greater than 50 p/m has been amended effective September 24, 1982. This final rule contains several changes that affect Bureau equipment and operation. The final rule:

1. Authorizes the use of all PCB Transformers that do not pose an exposure risk to food or feed for the remainder of their useful lives, and requires a quarterly inspection of this equipment for leaks of dielectric fluid.

2. Authorizes the use of large (more than three pounds of PCB's) PCB capacitors that are located in restricted access electrical substations for the remainder of their useful lives.

3. Authorizes the use of large PCB capacitors that are located in contained and restricted-access Indoor installations for the remainder of their useful lives.

4. Prohibits the use of all other large PCB capacitors after October 1, 1988.

5. Eliminates the proposed inspection requirements for all large PCB capacitors.

6. Authorizes the use of all PCB-containing, mineral oil-filled, electrical equipment for its remaining useful life.

7. Allows oil-filled cable to be assumed to contain less than 50 p/m PCB's if the actual PCB concentration is unknown.

8. Allows storage for disposal of nonleaking PCB large high-voltage capacitors and PCB-contaminated electrical equipment outside of qualified storage facilities after January 1, 1983.

9. Requires records of inspection and maintenance histories to be maintained for at least 3 years after disposing of PCB Transformers.

Use of PCB Transformers (transformers containing more than 500 p/m PCB's) Is subject to the following conditions:

1. A visual inspection of each PCB Transformer in use or stored for reuse shall be performed at least once every 3 months. These inspections may take place any time during the 3 month periods: January through March, April through June, July through September, and October through December, as long as there is a minimum of 30 days between inspections. The visual Inspection must include investigation for any leak of dielectric fluid on or around the transformer. The extent of the visual inspections will depend on the physical constraints of each transformer installation and should not require an electrical shutdown of the transformer being Inspected.

2. If a PCB Transformer is found to have a leak which results in any quantity of PCB's running off or about to run off the external surface of the transformer, the transformer must be repaired or replaced to eliminate the source of the leak. Cleanup of the released PCB's must be initiated as soon as possible, but in no case later than 48 hours of its discovery. Until appropriate action is completed, any active leak of PCB's must be contained to prevent exposure of humans or the environment and inspected daily to verify containment of the leak. Trenches, dikes, buckets, and pans are examples of proper containment measures.

3. Records of inspection and maintenance history shall be maintained at least 3 years after disposing of the transformer, and shall be made available for inspection, upon request, by EPA (Environmental Protection Agency). The records shall contain the following information for each PCB transformer.

a. Location

b. The date of each visual inspection and the date that a leak was discovered, if different from the inspection date

c. The person performing the inspection

d. The location of any leaks

e. An estimate of the amount of dielectric fluid released from any leak

f. The date of any cleanup, containment, or repair performed

g. A description of any cleanup, containment, or repair performed

h. The results of any containment and daily inspection required for uncorrected active leaks

4. A reduced visual inspection frequency of at least once every 12 months applies to PCB Transformers that utilize either of the following risk reduction measures. These inspections may take place any time during the calendar year as long as there is a minimum of 180 days between inspections.

a. PCB Transformer which has impervious, undrained, secondary containment capacity of at least 100 percent of the total dielectric fluid volume of all transformers so contained, or

b. A PCB Transformer which has been tested and found to contain less than 60,000 p/m PCB's (after 3 months of in-service use if the transformer has been serviced for purposes of reducing the PCB concentration.)

5. The use and storage for reuse of PCB Transformers that pose an exposure risk to food or feed is prohibited after October 1, 1985, and an increased visual inspection frequency of at least once every week is required.

Figure 1 is a sample "Inspection and Servicing Record" sheet to illustrate the inspection data required, and figure 2 is a blank inspection sheet that may be reproduced for use in the inspection program. Transformers classified as PCB-contaminated (between 50 and 500 p/m PCB's) may be serviced including rebuilding. Any servicing of PCB transformers (over 500 p/m PCB's) that requires removal of the transformer coil from the casing is prohibited.

PCB Transformers may be converted to either PCB-contaminated or non-PCB transformers and PCB-contaminated transformers may be reclassified as non-PCB transformers by draining, refilling, and/or otherwise servicing the transformer. In order to reclassify, the transformer's dielectric fluid must still contain less then 500 p/m PCB for conversion to a PCB-contaminated transformer or less than 50 p/m for conversion to a non-PCB transformer after a minimum of 3 months of inservice use subsequent to the last servicing conducted for the purpose of reducing the PCB concentration in the transformer. Inservice means that the transformer is used electrically under loaded conditions that raise the temperature of the dielectric fluid to at least 50 ^{o}C.

A specific operating procedure including a hazard analysis will be developed at each site where PCB equipment is located to analyze potential hazards in servicing PCB units. The specific operational procedure, including appropriate protective equipment that must be available for use, will be approved by the project, area, or regional safety professional.

EQUIPMENT Transformer Bank KSA

PROJECT Colorado- Big Thompson LOCATION Estes Powerplant

INSPECTION AND SERVICING RECORD

DATE	EMPLOYEE	INSPECTION RESULTS	SERVICING PERFORMED
7-10-81	R. L. Smith	No leaks observed	
10-2-81	R. L. Smith	Leak at drain valve area-moist only-not a moderate leak	
12-10-81	B.C. Jones	Moderate leak in drain valve area - several drops observed below valve	
12-11-81	R. L. Smith		Repaired defective drain valve and cleaned transformer
1-19-82	B.C. Jones		Askarel sample taken for dielectric strength test
3-3-82	R. L. Smith	No leaks observed	
5-20-82	R. L. Smith	Leak observed at gasket on left side of transformer-seep only-not a moderate leak	
6-10-82	B.C. Jones		Replaced defective gasket on left side of transformer and cleaned transformer
8-10-82	R. L. Smith	No leaks observed	
11-3-82	R. L. Smith	No leaks observed	

Sample Log Sheet

FIGURE 1 - SAMPLE INSPECTION AND SERVICING RECORD

EQUIPMENT ____________________

PROJECT ____________________ LOCATION ____________________

INSPECTION AND SERVICING RECORD

DATE	EMPLOYEE	INSPECTION RESULTS	SERVICING PERFORMED

FIGURE 2 - INSPECTION AND SERVICING RECORD

BUREAU OF RECLAMATION

FACILITIES INSTRUCTIONS, STANDARDS & TECHNIQUES

Volume 5-7

PCB TRANSFORMER PROTECTION AND MARKING REQUIREMENTS

PCB Transformer Protection and Marking Requirements

(This information is from the Federal Register of July 17, 1985, pages 29170 through 29101)

Title 40 of the Code of Federal Regulations, Part 761, which regulates PCB's (polychlorinated biphenyls) in concentrations greater than 50 p/m has been amended effective August 16, 1985. This final rule contains several changes that affect Bureau equipment and operation. This final rule prohibits.

1. The continued use of higher secondary voltage network PCB Transformers (network PCB Transformers with secondary voltages at or above 480 volts, including 480/277 volt systems) in or near commercial buildings beyond October 1, 1990. As the EPA definition of commercial buildings is nonindustrial, non-substation buildings, our power and pumping plants would normally not be considered commercial buildings. However, facilities that have a large number of visitors due to tourism or other reasons should be considered as commercial buildings.

2. The further installation of PCB Transformers (which have been placed into storage for reuse) in or near commercial buildings.

The final rule requires the following:

1. The installation, by October 1, 1990, of enhanced electrical protection on lower secondary voltage network PCB Transformers and on higher secondary voltage radial PCB Transformers (radial PCB Transformers with secondary voltages at or above 480 volts, including 480/277 volt systems) used in or near commercial buildings. The enhanced electrical protection requirements consist of the installation of high current fault protection on all commercial PCB Transformers and low current fault protection on higher secondary voltage commercial PCB Transformers.

2. The registration, by December 1, 1985, of all PCB Transformers with fire departments or fire brigades with primary response function, and the registration, by December 1, 1985, of all PCB Transformers located in or near buildings with building owners.

3. The marking by December 1, 1985, of the exterior of all PCB Transformer locations (the marking should be on the vault door, machinery room door, or other means of access, excluding grates and manhole covers).

4. The removal, by December 1, 1985, of combustible materials stored within a PCB Transformer enclosure, within 5 meters of a PCB Transformer, or within 5 meters of an unenclosed PCB Transformer,

The final rule also requires immediate notification of the National Response Center (24-hour toll free line -- 800-424-8802) in the event of a PCB Transformer fire-related incident; and, that PCB Transformer owners take measures as soon as practically and safely possible to contain any potential water releases associated with a PCB Transformer fire-related incident. These measures include, but are not limited to, blocking of floor drains, containment of water runoff, and control and treatment of cleanup water prior to discharge. Appropriate documents or instructions at plant sites should be revised to reflect the notification requirements and actions required by the amended final rule.

The rules listed in this volume are in addition to the inspection, record keeping, and servicing requirements contained in the FIST Volume 5-6, as a result of the August 25, 1982 electrical Equipment Rule issued by EPA.

BUREAU OF RECLAMATION

FACILITIES INSTRUCTIONS, STANDARDS & TECHNIQUES

Volume 5-8

SAFETY PROCEDURES FOR HIGH VOLTAGE TESTING

Safety Procedures for High-voltage Testing

High voltage testing mishaps can result in serious injury or death. Careful planning and adequate safety procedures can help prevent injury both to personnel performing tests and to others who might otherwise Inadvertently come into contact with equipment under test. The following safety procedures should be followed for all high-voltage testing performed by Reclamation personnel:

1. Only qualified, trained personnel should conduct tests. On-the-job high-voltage-test training should not be performed unless under the supervision of an experienced professional.

2. A hazard analysis of the test to be performed should be made in accordance with Appendix A of the Reclamation Operation and Maintenance Safety Standards.

3. A thorough inspection of the test site and the equipment to be tested must be performed prior to testing to Identify areas where access should be restricted during testing, and to identify any accessory equipment which must be disconnected during testing. Warning signs should be posted or sentries assigned to restrict access, and a check should be made to determine that the accessory equipment to be excluded from the test is disconnected.

4. The area around the test unit should be roped off and only authorized personnel allowed within these limits.

5. Upon completion of the test, the equipment must be grounded in accordance with the procedures described in FIST Volume 3-1, or the applicable IEEE testing standards and the ground should be maintained long enough to assure that the accumulated charges have drained sufficiently to permit reconnecting work on the equipment to proceed safely.

Training in high-voltage-testing techniques may be obtained from the Denver Office, Research and Laboratory Services Division, Electric Power Branch, Code D-3770. Requests for this treining should be directed to the Program Services Division, Project Operation Services Staff, Code D-5140, Denver Office, for coordination.

BUREAU OF RECLAMATION

FACILITIES INSTRUCTIONS, STANDARDS & TECHNIQUES

Volume 5-10

VOLTAGE HAZARD ASSOCIATED WITH USE OF CIRCUIT BREAKERS HAVING GRADING CAPACITORS

Voltage Hazard Associated With Use of Circuit Breakers Having Grading Capacitors

It is possible to develop substantial sustained voltages on a bus which has connected potential transformers and is disconnected from the external system through an open air circuit breaker having grading capacitors. A sustained voltage of about one-half rated magnitude and one third normal frequency has been observed on a supposedly deenergized bus. We are not aware of any equipment failures that have resulted from this phenomenon, but safety is a concern due to the hot bus and shock hazard. This reemphasizes the necessity for strict adherance to approved grounding procedures in the Reclamation Operation and Maintenance Safety Standards when approaching and working on circuits and Instrumentation. The voltages observed in this phenomenon were caused by a ferro-resonant circuit consisting of the grading capacitors in the air circuit breaker and the magnetizing impedance of the potential transformers. The resonance can be suppressed through application of resistors or through use of capacitor potential devices instead of potential transformers. Where observed voltages are found to be objectionable, recommendations for corrective action should be obtained from the Program Services Division, Project Operation Services Staff, Code D-5140, Denver Office.

BUREAU OF RECLAMATION

FACILITIES INSTRUCTIONS, STANDARDS & TECHNIQUES

Volume 5-11

POTENTIAL HAZARD FROM MESSWANDLER-BAU INSTRUMENT TRANSFORMERS

Potential Hazard from Messwandler - Bau Instrument Transformers

During a four year period in the late 1960's and early 1970's, Reclamation experienced five destructive explosions of Messwandler-Bau (MWB) 230-kV and 345-kV current transformers. MWB agreed to rebuild 42 JK-196 units because of a high percent of combustible gas (ranging from 4 to 32 percent), high gas pressure (ranging from 8 to over 30 psi-g), and high power factor (ranging from 0.5 percent to 3.41 percent). This experience leads us to be concerned over future explosive failures affecting the safety of our personnel and the security of nearby power equipment.

Types JK-196 and JTS-345 MWB current transformers manufactured after 1964 are the units that are most prone to failure. It is suspected that the explosive failures are the result of internal corona action which causes buildup of excessive Internal gas pressure or leakage paths and ultimate flashover across major insulation.

It is recommended that the following actions be taken on all MWB current transformer Types JK-196, JK-230, JTS-196, and JTS-345; and potential transformer Types UT-196, UT-230, and JOS-196 to prevent additional explosive failures:

1. Install a pressure gage as shown on the attached Drawing No. 1046-ES-131 to provide for convenient periodic monitoring and recording of the internal gas pressure during routine inspections. Gas pressure in excess of that shown in table 1 should be considered as indication that the instrument transformer may be abnormal and should be tested more frequently or removed from service; however, if the pressure exceeds 15 psi-g, the transformer shall be removed from service Immediately.

2. When gas pressure exceeds 10 psi-g, a combustible gas test should be performed immediately. A combustible gas content of over 4 percent indicates that the transformer may be abnormal and should be tested more frequently or removed from service.

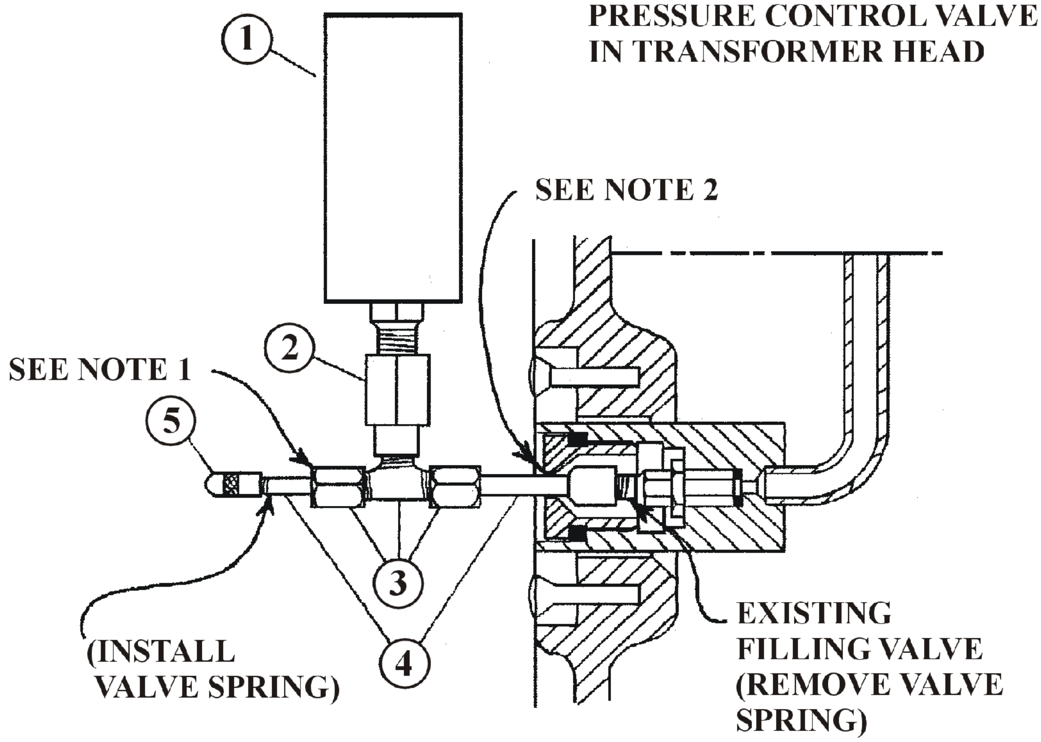
3. Perform weekly or periodic visual examination of the units for detecting oil leakage, discoloration or other abnormalities during routine inspections.

4. Establish a periodic Doble test schedule of 2 years for normal MWB units and perform more frequent testing on questionable units. Power factor readings exceeding that permitted by the manufacturer's instruction book (1.0 percent at 20 EC for Types UT-196 and UT-230 and 0.5 percent at 20 EC for all other types listed above) should be considered as an indication that the current transformer is abnormal and should be tested more frequently or removed from service.

Table 1
Normal Operating Pressures

Oil temperature degrees C	Gas pressure psi-g
25	5.3
30	5.6
35	6.0
40	6.4
45	7.0

NITROGEN FILLING AND PRESSURE CONTROL VALVE IN TRANSFORMER HEAD



REFERENCE DETAILS	
NO.	DESCRIPTION
1	PRESSURE GUAGE (0 TO 30 LBS)
2	BRONZE REDUCER
3	FLARED-TYPE BRASS TEE CONNECTORS
4	TIRE EXTENSION VALVE STEM. CUT AND REMOVE MIDDLE PORTION FOR DESIRED LENGTH
5	VALVE WITH ROUNDED HEAD

NOTES

1. FOR 345-KV ROUND OFF ALL SHARP EDGES ON FITTINGS TO REDUCE CORONA

2. DRILL HOLE THROUGH EXISTING CAP-NUT, INSERT VALVE STEM EXTENSION AND SEAL WITH MASTIC.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
PACIFIC NW. - PACIFIC SW. INTERTIE

MEAD SUBSTATION

PRESSURE GUAGE FOR
MESSWANDLER-BOU CURRENT TRANSFORMERS

DESIGNED C. Dvorak SUBMITTED [illegible]
DRAWN C. Dvorak RECOMMENDED [illegible]
CHECKED [illegible] APPROVED

DENVER, COLO JULY 20, 1972 | 104-ES-131