



Document No.	GIS 12-051
Applicability	Group
Date	05 September, 2003

Guidance on Industry Standard for Power Transformers and Reactors (IEC)

GIS 12-051

BP GROUP
ENGINEERING TECHNICAL PRACTICES

Foreword

This is the first issue of Engineering Technical Practice (ETP) GIS 12-051. This Guidance on Industry Standard (GIS) is based on the following heritage documents from merged BP companies:

BP RPSE

GS 112-5

Guidance for Specification GS 112-5 Transformers and Reactors

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1. Scope

This GIS document provides guidance on industry standard for design, materials, fabrication, inspection, testing, documentation, and preparation for shipment of IEC power transformers and reactors.

2. Normative references

The following normative documents contain requirements that, through reference in this text, constitute requirements of this technical practice. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this technical practice are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

IEC International Electrotechnical Commission

IEC 60034	Rotating electrical machines
IEC 60076-1	Power transformers – Part 1: General
IEC 60076-3	Power transformers – Part 3: Insulation levels, dielectric tests and external clearances in air.
IEC 60076-5	Power transformers – Part 5: Ability to withstand short circuit
IEC 60076-8	Power transformers – Part 8: Application guide
IEC 60076-10	Power transformers – Part 10: Determination of sound levels
IEC 60137	Insulated bushings for alternating voltages above 1000 V
IEC 60214	On-load tap-changers
IEC 60289	Reactors
IEC 60296	Specification for unused mineral insulating oils for transformers and switchgear
IEC 60354	Loading guide for oil-immersed power transformers.
IEC 60529	Degrees of protection provided by enclosures
IEC 60542	Application guide for on-load tap-changers
IEC 60616	Terminal and tapping markings for power transformers

3. Design, materials and fabrication

3.1. General

- a. Performance guarantees shall be provided on:
 1. No load losses.
 2. Full load losses.
 3. Percent impedance, both positive and zero-sequence between various windings.
 4. Percentage regulation at 100% and 80% power factor.
- b. Oil-immersed distribution transformers shall be fabricated in accordance with relevant parts of IEC 60076.
- c. Reactors shall be fabricated in accordance with relevant parts of IEC 60289.
- d. Polychlorinated Biphenyl (PCB) contamination of insulating liquid shall not exceed one part per million (PPM). PCB PPM shall be recorded on permanent nameplate.



3.2. Design considerations

- a. Temperature rise shall comply with IEC 60076-2.
- b. Insulation levels shall comply with IEC 60076-3 table 2.

The short duration power frequency withstand voltage is a single figure related to the maximum expected system voltage of the winding (U_m). Because industrial systems are generally connected via underground cables, the lightning withstand voltage can be selected as the lower of the two options given in IEC 60076-3. However where fed via overhead lines, the higher of the two values should be chosen.

- c. Short circuit withstand shall comply with IEC 60076-5.
- d. Liquid immersed transformers shall be rated with cyclic duty capacity as specified in IEC 60354.
- e. Transformer and reactor control cabinets shall be IP55, in accordance with IEC 60529.
- f. If data sheets specify a load rejection overvoltage, the transformer shall be designed to safely withstand the resulting conditions without damage or causing mal-operation. Manufacturer shall specify a transformer secondary voltage that is expected following a load rejection condition.

Note that some expected overvoltages for load rejection on unit connected generator transformers can be severe. Protection arrangements also need to be taken into consideration (fifth harmonic restraint). The voltage appearing at the secondary terminals of the transformer can also impinge onto standard distribution transformer primary windings and these should be assessed. Hence the manufacturer is required to assess the transformer secondary voltage under conditions of load rejection.

4. Materials and fabrication**4.1. Mechanical handling**

- a. Transformers and reactors shall be designed to facilitate skid movement in any direction without use of rollers, planes or rails.
- b. Lifting and jacking points shall be mounted on tanks and arranged to prevent damaging stresses during lifting and jacking operations.
- c. Tank covers shall not distort when lifted.
- d. An informational plate shall be mounted on the tank, when spreader bars are required for lifting all or part of the tank.

4.2. Tank and radiators

- a. Liquid immersed transformers and reactors shall be fitted with filling and draining orifices.
- b. Tank drain-off orifice of conservator transformers shall be fitted with a valve.
- c. Devices fixed to the tank or tank lid above insulating liquid level shall have a stand-off lip to prevent water tracking to the interior of tank.
- d. Covers of sealed tank transformers shall be welded to tank.
- e. Gasketed joints, with the exception of pressure relief devices, shall be below cold liquid levels.
- f. Filling and draining orifices shall be sealed with screwed plugs.

