File No. 223/36/2018-R & D Coord (QC)

Ministry of New & Renewable Energy
(Standards & Quality Control Division)

Block 14, CGO Complex
Lodi Road, New Delhi-110003

9.04.2019

Subject: Guidelines for series approval of SPV Inverters for conducting testing in test labs for Implementation of Quality Control Order on SPV Systems, Devices and Components, Goods 2017

Ministry of New & Renewable Energy (MNRE) on 5/9/2017 under the BIS Act had notified the Solar Photovoltaics Systems, Devices and Components Goods (Requirements for Compulsory Registration) Order 2017 for quality control in SPV Power Projects. Implementation of the above mentioned order commenced on 16.04.2018 vide notification dated 16.04.2018 published in Gazette of India. It includes SPV modules, inverters and battery storage. As per the order, no person shall manufacture or store for sale, import, sell or distribute goods, which do not conform to Indian Standards specified in the Order.

2. The specified standards for inverters are IS 16221 (Part 2): 2015 (Safety of Power Converters for use in Solar Photovoltaic Power Systems) and IS 16169:2014(Test Procedure of Islanding Prevention Measures for Utility–Interconnected Photovoltaic Inverters). Manufacturers of these products are required to apply for registration from Bureau of Indian Standards (BIS), New Delhi after getting their products tested from BIS recognised test labs.

2. As the inverters are of varying sizes, ratings, varieties, etc. the inverters in each category are to be grouped for submitting samples to test labs, and shall be granted series approval for series of products based on testing of representatives models. Accordingly, draft guidelines for series approval of Inverters for conducting testing in test labs has been prepared in consultation with experts from test labs, solar inverters industry and Bureau of Indian Standards, New Delhi. Enclosed is the said draft guidelines for comments of public and related stakeholders. The comments may please be provided by 19th April, 2019 at the following address:

Encl: a/a

(Dr. B. S. Negi)
Adviser/Scientist-G
Email: negi@nic.in
Telefax: 24368581

9th April 2019

Ministry of New & Renewable Energy
(Standards & Quality Control Division)

Guidelines for series approval of Solar PV Inverters for conducting testing in test Labs for implementation of Solar Photovoltaics Systems, Devices and Component Goods Order 2017.

The guidelines are issued to facilitate labs/manufacturers in formation of series of products for approval of product family including change in design, materials, etc. for the testing of Solar Inverters in the test labs for compulsory registration with BIS for implementation of the Solar Photovoltaics Systems, Devices and Component Goods Order 2017. These guidelines are applicable for SPV based Off Grid, Grid-Tie and Hybrid Inverters of capacities up-to 150KW. The following series guidelines will be followed for conducting tests on Solar Inverters as per standards included in the said order by the test labs.

1. Definition of Product Family

A product family can be defined by the maximum configuration of components/sub-assemblies plus a description of how the models are constructed from the maximum configuration using these component and sub-assemblies. All models which are included in the family typically have same Hardware and same Firmware essential to ensure conformity with applicable requirements.

2. Process of Testing and Certification

The manufacturer will have to submit a declaration about the series of their product while submitting the samples of a particular series for testing to test lab. Out of the entire range of models intended to be covered under registration, the highest rated model shall be tested to cover the entire range of family. The lab will be required to charge the cost of testing only for the highest rated Inverter size model and test report can be issued to all such sets of lower wattage. Product label of each series model shall be placed in the test report. If there is a change in construction, material/components in the family then the product will be submitted to test Labs for fresh testing. The Firmware/software can have different limit setting as per the rating of the model in a given series, however the overall Firmware functionality should remain same.

Series Guidelines

The series guidelines are based on the following design and construction considerations:

(i) The Inverters having PV voltage rated 1000/1100Vdc max and AC voltage 415V ac Nominal

(ii) Both Hardware and Firmware are the same as declared by the Inverter Manufacturer. The Firmware can have different limit settings as per the model rating in the series.
(iii) Products having different Hardware Architecture and Firmware functionality shall be tested separately. Within the Family the components with different ratings (Power/current) can be allowed provided the Inverter with max rated component (such as EMC filters, Capacitors, Transformers, Inductors, IGBT/Mosfets, etc.) is tested.
(iv) All the models under one family shall have same rated Input/Output voltage, Same frequency and No. of Phases at output, Same PCB design and layout, same power stage topology, same insulation class (low or high frequency transformer or transformerless), same control algorithm/firmware, Same cabinet design and class of construction. If the cabinet design architecture is changing between various models in the family(keeping the same Internal Hardware like PCB layout between various models in the family), then all the different cabinet designs are to be tested or verified for Ingress Protection by either testing it at NABL approved laboratories or test reports shall be submitted from ISO/IEC 17025/ILAC accredited laboratories.
(v) The Maximum rated Inverter within the family shall be considered as the representative test sample for all the models in that family for safety tests.
(vi) Inverters having PV voltages rated 1100Vdc shall be tested at 1000V
(vii) Inverters having PV voltages rated greater than 1000Vdc and greater than 415Vac are not covered in these guidelines.

Documentation

The following information should also be provided with the samples;

(i) Product Datasheet
(ii) Complete Bill of Materials list with components.
(iii) IEC or any other equivalent international standards, where IEC is not available, safety certificates for critical components.
(iv) Schematics/Single Line diagram with working principle
(v) Enclosure openings/drawings
(vi) PCB wiring diagram/layouts with voltage markings and components layout diagrams on the PCB.
(vii) Actual PCB boards (Only PCBs without components) for spacing measurements
(viii) 1 set of additional PCB boards with components for the destructive safety tests
(ix) User Manual/Instruction/Operation Manual
(x) Any internal test reports.
(xi) Accessories like mounting & grounding hardware, spare cable with connectors one end open
(xii) Firmware Details like Version Name.

The Test laboratory should not accept the Inverters for testing without above detail. However, in case the samples have already been submitted to Test Lab or are in the process of submission, the concerned manufacturers will be required to submit an undertaking for compliance of the instructions contained in these guidelines to BIS for

granting registration. The testing sequence and the pass criterion should be strictly followed in accordance with the test standards. These guidelines will come into force from the date of MNRE notification.

Note: Confidentiality of the documents submitted shall be maintained by the concerned test laboratory.

Marking:

All the Inverters should contain the following clear and indelible Marking Label & Warning Label as per IS16221 Part II, clause 5.

The equipment shall, as a minimum, be permanently marked with:

a) The name or trade mark of the manufacturer or supplier;
b) A model number, name or other means to identify the equipment,
c) A serial number, code or other marking allowing identification of manufacturing location and the manufacturing batch or date within a three-month time period.
d) Input voltage, type of voltage (a.c. or d.c.), frequency, and maximum continuous current
e) for each input.
f) Output voltage, type of voltage (a.c. or d.c.), frequency, maximum continuous current, and
g) for a.c. outputs, either the power or power factor for each output
h) The Ingress Protection (IP) rating

Marking shall be located adjacent to each fuse or fuse holder, or on the fuse holder, or in another location provided that it is obvious to which fuse the marking applies, giving the fuse current rating and voltage rating for fuses that may be changed at the installed site.

Guidelines for Quantitative Selection of Samples

IS 16221 (Part 2):2015 / IEC 62109-2:2011 Safety of Power Converters for use in Photovoltaic Power Systems Part 2 (Particular Requirements for Inverters) and IS 16169:2014 / IEC 62116:2008 Test Procedure of Islanding Prevention Measures for Utility – Interconnected Photovoltaic Inverters

Two samples in the family should be submitted (2 no Max rated model) for testing where 1no Maximum rated model will undergo testing. The inverters shall have been manufactured from specified materials and components in accordance with the relevant drawings and process sheets and have been subjected to the manufacturer's normal quality control and production acceptance procedures. The inverters shall be complete in every detail and shall be accompanied by the manufacturer's handling, mounting and connection instructions, including the maximum permissible system voltage.

All the applicable tests referred in the relevant standards will be carried out. In the case of IS16221 Part 2, the tests referred in the said standard including IS16221 Part 1 will be carried out. The detailed testing will be carried out as per procedures and guidelines given in the above mentioned standards. IS16169 is not applicable for the Standalone/Off grid

Inverters and hence IS16169 shall not be tested for the Standalone/Off grid inverters. The sequence of testing is given in Annexure I.

Note: Most of the tests concerning safety of solar power converters referred in IS 16221(Part 2): 2015 are to be done as per IS 16221(Part 1) :2016. Due to the Inverter safety testing complications or for the components understanding, the lab shall carry out tests after having conversation with the manufacturer or Manufacturer to be present in verifying the test setup prior to testing for the critical tests as given in table in Annexure-II. (This is subject to the approval of BIS)

Retesting guidelines for any test failures:

If any test fails in sequence 1, then a new sample is to be submitted by the manufacturer and only the tests in the sequence 1 will be repeated after components & construction review and IS 16169.

Similarly, if any test fails in sequence 2, then a new sample is to be submitted by the manufacturer and only the tests in the sequence 2 will be repeated after the components & construction review. IS16169 can be omitted for a failure in sequence 2 unless the critical internal components are not changed.

In both the above case (failures in sequence 1 or 2), repetition for IS16169 testing shall only be done on 3 Balanced conditions and any 2 Imbalance conditions. Appropriate retesting fee will be charge by test labs for all those repeat tests. The retesting sequence should start from beginning in order to document the changes made in the components & construction and to ensure the compliance for IS 16169 is not disturbed.

A total of only one failure is permitted in each testing sequence and a second failure in that particular sequence will be considered as a total failure.

Pass criteria

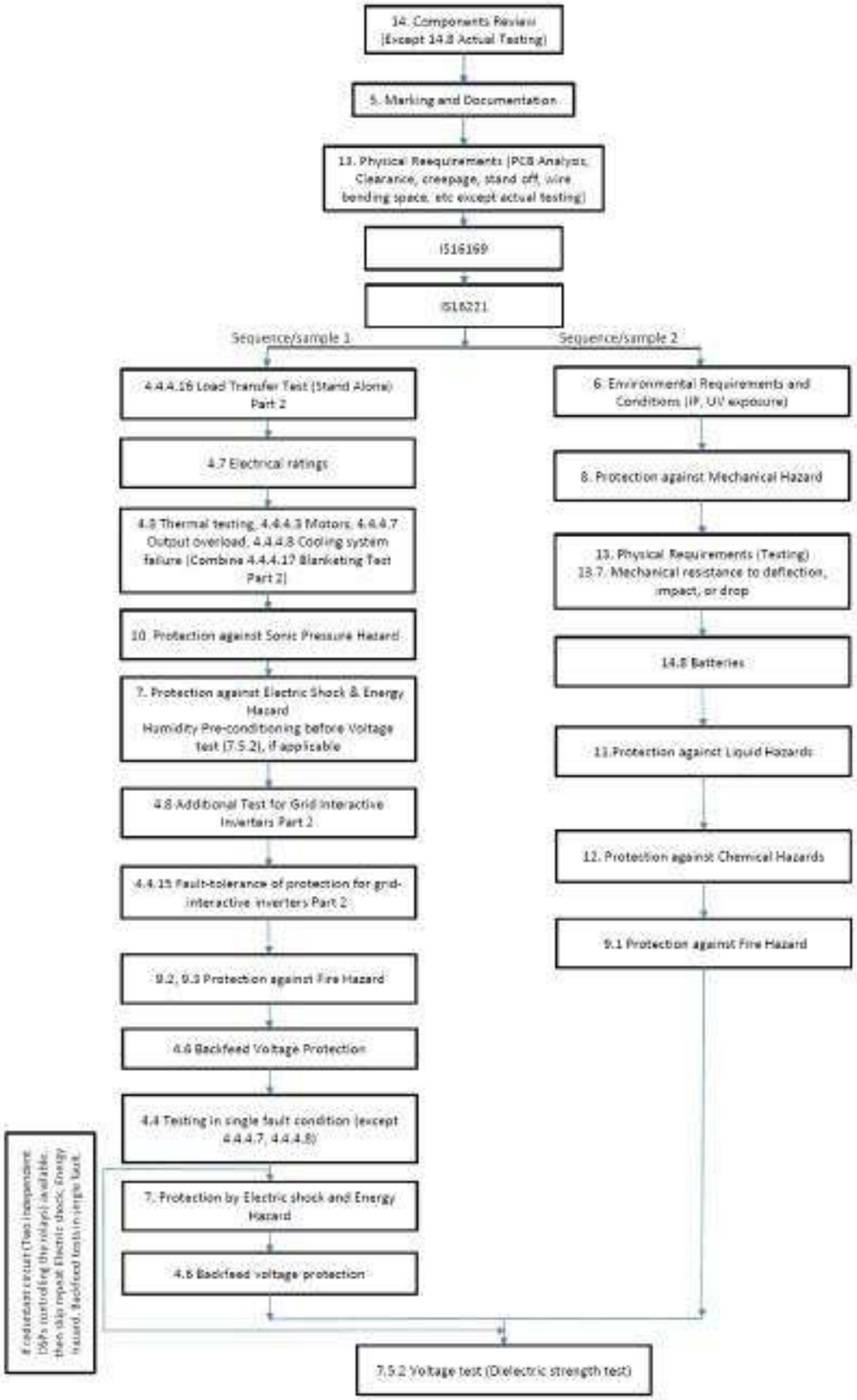
Pass criteria for Solar Inverters should be as per IS 16169 and IS 16221 Part II, wherever applicable.

Brands

All brands with respective model numbers should be listed in the test report. Test samples of all brands are not required to be submitted. However, product labels for respective brands must be placed in the test report. Lab may also include statement about coverage of this brand and respective model numbers to be covered based on the representative model tested and the declaration submitted by the manufacturer about multiple brands and respective model numbers. The products manufactured in two different locations shall be tested separately.

Please refer to "Process for Registration" under Registration Scheme available at BIS website www.crsbis.in.

Testing/Documentation Sequence:



Annexure - II

Table 1

Clause (IS 16221 (Part 1):2016)	**List of Tests**	**Assistance of manufacturers for technical and operational issue of components**
7.3.2.6	Working voltage and DVC	To tap out points and connect oscilloscopes at various internal auxiliary and Gate drive/control power supplies
7.3.9	Protection against shock hazard due to stored energy	To tap out point across the total bus capacitors and connect oscilloscope
9.2.2	Limited power source tests	To overload the auxiliary, Gate drive/control power supplies with loads to check the maximum VA power
7.5.2	Voltage test (dielectric strength test)	To remove some components like MOVs, X/Y capacitors or branch circuits which is connected across the ground
4.4.4.6	Backfeed current test for equipment with more than one source of supply	To put current probes after the DC fuses in the input side and before the contactor/relay in the AC output side of the inverter.
4.6	Backfeed voltage protection	To tap out point to connect voltage probes after the DC fuses in the input side and before the contactor/relay in the AC output side of the inverter.
4.3.2.1	Maximum temperatures - General	To put thermocouples in the all the critical components without damaging the inverter functioning
4.4.4 Method 1	Single Fault conditions to be applied	To open or short the critical components which is identified as its failure may lead to shock or Fire hazard. Example: DC bus capacitor short, IGBT D-S short (C-E), IGBT G-D short (G-E), IGBT open gate (Disable the IGBT by shorting the G -E), output current measurement (open any one phase) , output voltage measurement (open any one phase), control circuit failure (remove power from control circuit)