FAULT PASSAGE INDICATOR FOR MEDIUM VOLTAGE UNDERGROUND NETWORKS
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1. SCOPE

This technical description (TD) covers the general requirements of design, manufacturing, testing, supply, delivery and performance of Fault Passage Indicators (FPIS), suitable for locating phase and earth faults in Medium Voltage (MV) distribution underground networks. The FPIS shall provide fast fault location indication, enabling reduction in outage times, enhanced service to customers and reduction of wear of circuit breakers, as unnecessary operations to locate faults can be avoided.

2. APPLICABLE STANDARDS

This TD is based on the following standards:

IEC International Electrotechnical Commission

- IEC 60529: Degrees of protection provided by enclosures (IP code)
- IEC 60255-27: Measuring relays and protection equipment - Part 27: Product safety requirements
- IEC 60255-21-1: Electrical relays - Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment - Section One: Vibration tests (sinusoidal)
- IEC 60255-21-2: Electrical relays - Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment - Section Two: Shock and bump tests
- IEC 60255-21-3: Electrical relays - Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment - Section 3: Seismic tests
- IEC 60068-2-1: Environmental testing – Part 2-1: Tests – Test A: Cold
- IEC 60068-2-2: Environmental testing – Part 2-2: Tests – Test B: Dry heat
- IEC 60068-2-30: Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12h + 12h cycle)
- IEC 61000-4-2: Electrostatic discharge immunity test (Level 3)
- IEC 61000-4-3: Radiated, radio-frequency, electromagnetic field immunity test (Level 3)
- IEC 61000-4-4: Electrical fast transient / burst immunity test (Level 4)
- IEC 61000-4-5: Surge immunity test
- IEC 61000-4-6: Immunity to conducted disturbances, induced by Radio frequency fields (Level 3)
- IEC 61000-4-8: Power frequency magnetic field immunity test (Level 4)
- IEC 61000-4-9: Electromagnetic compatibility (EMC) – Part 4-9: Testing and measurement techniques – Impulse magnetic field immunity test
- IEC 61000-4-11: Voltage dips, short interruptions and voltage variations immunity test
- IEC 61000-4-12: Ring waves immunity test (2,5kV common mode, 1kV differential mode)
- IEC 61000-4-18: Electromagnetic compatibility (EMC) - Part 4-18: Testing and measurement techniques - Damped oscillatory wave immunity test
- IEC 61131-2: Programmable controllers – Part 2: Equipment requirements and tests
- IEC 61869-2: Instrument transformers – Part 2: Additional requirements for current transformers

ISO International Organization for Standardization

Note: Regarding the above standards, their most recent version shall be valid.

Where any provision of this technical description differs from those of the standards listed above, the provision of this technical description shall apply. In case of conflict, the order of precedence shall be:
- This technical description
- IEC standards,
- Other standards (ANSI, ISO, PPC etc.)

3. OPERATING CONDITIONS

3.1 Environmental conditions

The substations that will accommodate the equipment described herein have the following environmental conditions:
- Ambient air temperature: -10°C to +55°C
- Relative humidity: 5% to 95% non-condensing

The supplied equipment shall be suitable for long-term trouble-free operation indoors, inside the above mentioned limits and must follow the requirements specified with IEC 60068-2 standard and proven by the type tests of par. 5.1.1 part 5.

3.2 Distribution system characteristics

The products are intended to be used in a three phase three wire distribution network, grounded at the sending end (MV node of HV/MV Transformer), through a resistance limiting the single phase earth fault current to 1000 A. The MV network shall have the following characteristics:
- Nominal system voltage: 15 kV 20 kV
- Maximum system voltage: 17,5 kV 24 kV
- Rated frequency: 50 Hz 50 Hz
- Short circuit level: 250 MVA 250 MVA
- Symmetrical three phase fault level (1sec): 9,6 kA 7,2 kA
- Low voltage (LV) network: 230 V AC ± 10%
4. FPI FEATURES

4.1 General

The FPI shall primarily consist of the following units:

- The Current Sensors
- The Control Unit (Controller)

The Control Unit and Current Sensors shall be installed inside the indoor 20 or 15/0,4 kV Distribution Substation. The Control Unit shall comprise an independent unit. The current sensors shall be installed onto MV cables.

The sensors and the controller shall be independent of one another and they shall be connected with appropriate cables provided by the Supplier. The cables connecting the Control Unit with the Current Sensors shall be of a minimum length of 6 m. There shall be the means to disconnect and safely isolate the cable connections to the Current Sensors, without having to power-down the MV feeders. Such a need may arise during equipment maintenance, detector board replacement e.t.c.

4.2 Current Sensors

The Current Sensors (CSs) shall be installed on MV cable. Three (3) CSs shall be provided, which, with the appropriate connection and software shall be able to detect phase and earth faults.

The core of the CSs shall be of split core type or other similar type, such that the installation on the cable can be done easily without disconnecting cables or interrupting cable’s continuity and in any case without power interruption. The core and the coil shall be protected by a specific waterproof covering.

The MV cables on which the CSs shall be installed are paper insulated armored cables or synthetic insulation (X-LPE) cables, of a maximum total diameter of 100 mm and a maximum pole diameter of 45 mm. The CSs’ diameter shall be at least 20% bigger than cable or pole diameter respectively.

The CSs shall not require external or auxiliary supply of AC or DC power. They shall also be either CTs of a low remanence type according to IEC 61869-2 i.e. the remanent flux shall not exceed 10% of the saturation flux (Remanence factor: $K_r<10\%$) or Rogowski coils. This will ensure the correct measurement and fault detection after an initial fault with major DC component occurred.

HEDNO is particularly aware of the long term loosening of the clamping latch mechanism which eventually leads to costly and time consuming replacement of the sensors. The Bidder shall display in detail how this is avoided in the proposed solution.

4.3 Control Unit

4.3.1 General

The Control Unit is the logic device and it shall have the capability to detect phase and earth faults in MV distribution underground networks, together with its enclosure.

The Control Unit shall detect phase and earth faults with the following settings:

- Phase faults threshold: Adjustable from 300 A to 500 A (in the primary) during the initial installation or during operation
- Earth faults threshold: Adjustable from 50 A to 80 A (in the primary) during the initial installation or during operation

It shall not be activated by inrush currents. The restrain time (response delay) shall be adjustable from 40 up to 160ms. The Bidder shall display in detail how this is achieved in the proposed solution.

The reset of FPI’s activation status shall be achieved:
- Automatically after the reset time has elapsed. The reset time shall be configurable from 1 up to 4 hours after the fault has occurred
- Automatically after the restoration of the voltage in the detectable MV line. A ten (10) seconds delay is required to avoid false resets resulting from short term circuit re-energization during fault switching. The maximum reset time after the restoration of the voltage shall be 15 sec.
- Manually by means of an appropriate button on the enclosure (see par. 4.3.2)

The Control Unit shall have dry contacts for connection with a Communication Unit for remote indication of the fault passage and monitoring of the unit. Specifically, it shall have three (3) dry contacts for:
- Indication of phase fault
- Indication of earth fault
- Indication of Control Unit’s 230V AC power supply loss (with a time delay for activation) and indication of low level of battery’s voltage, in order to provide the operators with all useful information for preventive maintenance. This alarm may arise when the battery is in the deep discharging phase or it have reached end-of-life status or have malfunctioned (see par. 4.3.4).

4.3.2 Enclosure

All the electronic equipment of the Control Unit shall be incorporated in an external plastic enclosure having a minimum degree of protection IP 54. Non-connected connector ports and used or unused cable glands shall conform at least to the enclosure’s IP rating.

The enclosure shall be designed for the service conditions specified in par. 3.1 and shall be wall-mounted.

Its dimensions and weight shall not exceed the values indicated in the following table:

<table>
<thead>
<tr>
<th>Max dimensions</th>
<th>Values</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width (mm)</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Depth (mm)</td>
<td>100</td>
<td>Extensions that protrude from the main body (i.e. hinges, glands) shall be taken into account</td>
</tr>
<tr>
<td>Height (mm)</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Max weight (kg)</td>
<td>3</td>
<td>Battery weight excluded</td>
</tr>
</tbody>
</table>

The enclosure shall be appropriately designed for the extraction of the thermal loads induced therein, namely from the Control Unit itself and the Battery, while operating at the upper temperature limit (see par. 3.1).

The enclosure shall include adequate openings, secured with appropriate (IP rating equal or exceeding the respective enclosure’s rating) cable glands. All incoming cabling from CSs and other external devices shall be routed through these openings, shall be firmly installed and shall not reduce the IP rating of the external enclosure.

The incoming wires shall be connected to the Control Unit’s terminal blocks via plug-in type terminal strips, which shall be clearly marked and easily accessible. This will make possible the easy disconnection for testing purposes.
The Control Unit shall be equipped externally with:
- a button for manual reset of trip status and test activation of the Control Unit (reset/test button)
- Indicators (LEDs) for the operation of the unit and monitoring of the equipment’s status. They shall indicate the operational status of the power supply and earth and phase fault, so that the user may assess the situation locally at a glance.

4.3.3 Earthing

If there are exposed metal, provision shall be made to ensure the electrical continuity of all of them. An earthing terminal shall be provided for connecting the Control Unit’s mounting frame (if it is metal) to the substation’s earthing system. The earthing terminal shall be suitable for accommodating a 16 mm² Cu conductor.

4.3.4 Power supply

The Control Unit shall be powered by the substation’s LV network (230V / 50Hz). In case of network power failure a back-up battery shall provide energy for the operation of the Control Unit.

The battery shall be delivered pre-installed into the cabinet, but with the terminals not connected. The terminals shall be covered and electrically insulated to prevent accidental shorting.

It shall be hermetically sealed and must be maintenance free. It shall have a design life expectancy of at least 10 years at 20°C operating temperature. The battery shall be certified by the manufacturer to operate over a temperature range of −25 °C to +74 °C. It shall be accessible, easily replaceable without using tools for the detachment of its connectors and it shall be testable. It shall be available in the Greek market.

The Bidder shall provide detailed documentation from the manufacturer of the battery to prove the above-mentioned design life. The Bidder shall also include in the offer the proof of its compliance with these requirements (according to the battery manufacturer specifications), giving with enough detail how the necessary capacity of the battery was chosen. Tables showing both the nominal and the maximum consumption of the Control Unit shall be provided.

The battery type provided shall have such external dimensions and electrical characteristics, as of batteries commercially available and not be of a proprietary design.

All DC circuits shall be protected against reverse polarity input.

5. TESTS

5.1 Type tests

The following type tests of paragraphs 5.1.1 and 5.1.2 shall be carried out at the beginning of the execution of the contract, before the series production of equipment and prior to the delivery of the first lot (and also prior to lot acceptance tests).

The type tests shall be carried out by a test laboratory accredited by a recognized independent private or public laboratory accreditation body. The test laboratory, the tests time schedule as well as the number of samples shall be proposed from the Supplier to be approved by HEDNO’s Inspection Service within two (2) weeks from the effective date of contract. Simultaneously within this same time period, the Supplier shall have available samples of the equipment ready to be shipped to the test laboratory.
HEDNO will request the execution of the below mentioned type tests to the test laboratory which will then send the results of the type tests directly to HEDNO. In case of failure of the type tests the Supplier must first analyze and report to HEDNO the reasons of the failure. After making the necessary changes, the Supplier may submit new samples within one (1) month from the announcement of the materials failure to him, for the repetition of the tests. In case of a failure on the new samples HEDNO will terminate the Contract due to Supplier’s fault.

The cost of the tests shall be borne by HEDNO in case the results are successful while in case of a failure their cost shall be borne by the Supplier. The costs for the samples as well as their transport to the test laboratory will be charged to the Supplier in both cases of results (failure or success of the tests).

During the period of the validity of the contract, no modification to the study, planning and construction of the equipment is permitted. In case of any modifications detected, HEDNO will terminate the Contract due to Supplier’s fault.

5.1.1 Type tests for the Control Unit

1. AC 2kV rms / 50Hz / 1min insulation breakdown voltage test in accordance with IEC 60255-27
2. DC 5kV (1,2/50μs, 0,5J) impulse voltage withstand test in accordance with IEC 60255-27
3. EMC Immunity tests
   (a) 2 kV surge test (common mode) in accordance with IEC 61000-4-5
   (b) 8 kV in contact/15 kV in air discharge mode, electrostatic discharge test in accordance with IEC 61000-4-2
   (c) 10 V/m radiated electromagnetic field test in accordance with IEC 61000-4-3
4. Vibration endurance tests as per IEC 60255-21-1, Class 1
5. Environmental tests
   (a) Cold test as per IEC 60068-2-1, section 3, test Ad, continuous operation at -20°C for 16 hrs
   (b) Dry heat test as per IEC 60068-2-2, section 4, test Bd, continuous operation at 55°C for 16 hrs
   (c) Cyclic humidity test as per IEC 60068-2-30, test Db, upper temperature 55°C, number of cycles 2
6. Degree of protection (IP) test in accordance with IEC 60529

5.1.2 Type tests for the Current Sensors

All Type tests for CTs in accordance with IEC 61869-2

5.2 Routine tests

Routine tests shall be carried out at manufacturer’s premises and the relevant test protocols shall be provided to the assigned inspector. The routine tests are the following:
1. Insulation breakdown voltage test (2 kV / 50 μsec / 50Hz)
2. Enclosure inspection to verify that the construction is according to the contract and the enclosure ready for installation (modem, earthling devices e.tc)
3. Functionality tests of all Control Units (as of paragraph 4.3)
4. Design and visual checks in accordance with the requirements of the present TD
5. All Routine tests for CTs in accordance with IEC 61869-2

5.3 Sample tests (Factory Acceptance Tests – FAT)

These tests shall be performed in presence of HEDNO’s personnel at the manufacturer’s premises, prior to delivery, after successful routine testing performed on each specimen of the batch done by the Supplier.

The assigned HEDNO’s inspector shall select a random sample from any lot under delivery based on IEC 410 plans, simple or double sampling, normal inspection, inspection level II, AQL=2.5%, on which all the tests described in the paragraph 5.2 above shall be successfully carried out.

Also a full operation check must be carried out to ensure that the equipment operates according to the present TD. Operational checking must be done using simulation techniques at the premises of the Supplier.

The Supplier has to propose the procedure and duration of such tests. HEDNO has the right to modify these procedures, up to 30 days prior to the inspection period.

5.4 Validity of the contractual delivery time

The contractual time of equipment delivery will begin on the issuing date of the results of successful type tests of paragraph 5.1 by the test Laboratory. It is clarified that the time required for testing, issue of the relevant test reports and tests evaluation, will be excluded from the delivery schedule, i.e. the delivery time will be extended equally to the time required for the testing. The extension of the delivery time concerning the time required for the tests, concerns all the partial deliveries and not only the first one.

The above contractual delivery time is valid only if the Supplier respects the contractual time concerning its proposal for the execution of the type tests of paragraph 5.1 (Test Laboratory, tests time schedule, number of samples) and the sample’s availability, namely two (2) weeks from the effective date of contract for the first samples plus one (1) month for the improved sample in case the first sample has been rejected (see attached Figure 1). In case of delay in the submittal of the aforementioned data the issuing date of the results of successful type tests by the test Laboratory shall not be considered a starting point of the contractual delivery time but a previous date for a time period equal to the delay of the aforementioned samples and data.

6. FUNCTION SIMULATING DEVICES

Portable simulator equipment shall be provided for the purpose of testing the configuration of the Control Unit. The Simulators shall simulate the passage of a fault (phase and earth fault) in order to activate the FPIs.

The simulator equipment will also allow HEDNO personnel to perform all tests required to ensure that the Control Unit are properly configured, prior to the FPI installation.

7. SPARE PARTS
The Bidders shall attach to their technical and economic Bid a complete list of spare parts for the equipment offered. Spare parts list shall be divided in two sections.

The first section shall include the spare FPIs that shall accompany the main provision. The unit price of the spare FPIs must be included only in the economic Bid. They shall be the same FPIs as of the main Bid, except from the battery.

The second section shall include a list of spare parts, with CSs and everything inside the Control Unit except from the enclosure and battery (CPU, modules, cabling e.tc). The prices of these spare parts must be included only in the economic Bid and shall be taken into consideration for the economic evaluation of the Bids, according to the quantities mentioned in the Call of Tender.

The Bidder shall commit for at least 10 years availability period of all spare parts. During this time, any additional items required, shall be purchased according to the prices of these lists.

8. SPECIAL INFORMATION THAT MUST BE GIVEN WITH THE BID – REFERENCES

Every Bid in order to be evaluated as technically accepted must be followed with the underneath information:

a) Declaration of the type of the offered units and informative leaflet of the manufacturer.

b) In addition to those mentioned in Annex 10 of the Inquiry, regarding the column «REFERENCE» of the Table of this Annex, the following will be taken into consideration. In this column the Bidder will deliver all the evidence, proof, indication, explanation, to show that / how the TD’s requirements are met, even with the cost of repeating certain information. Any discrepancies shall be clearly and thoroughly reported. Offers repeating the wording of this TD or providing only promotion leaflets will not be considered for evaluation and the offer will be rejected. In this requirement HEDNO gives particular importance in order to secure easier comprehension and evaluation of the offer, in short time given (without doubts and misunderstanding), without posing too much burden on the work of the Technical Evaluation Committee. Failure to do so, will result to the Bid’s rejection.

c) Typical drawings, leaflets e.tc that show characteristics of the offered units, their dimensions and proposed installation layouts with instructions.

d) Certificates to ensure that equipment comply with the IEC standards mentioned in this TD.

e) A declaration of conformity of the equipment offered with the requirements of the present TD. Any discrepancies shall be clearly and thoroughly reported.

f) Type tests Reports or Reports of Performance for the offered units, issued by a test laboratory accredited by a recognized independent private or public laboratory accreditation body.

The Reports for the offered unit shall concern the tests of paragraph 5.1 of the present TD.

The Reports submitted shall concern equipment of the exact offered design. The Type tests Reports or Reports of Performance submitted, shall state that the equipment tested are strictly in accordance with the relevant requirements of the corresponding IEC standard. The test results shall verify the ratings assigned by the manufacturer.
The Bidder shall certify the Type Tests Reports, Reports of Performance or the detailed Type test Certificates as true copies of the original. It is explicitly stated that after the signing of the contract any tests of paragraph 5.1 of the present TD for the equipment shall be carried out by a test laboratory accredited by a recognized independent private or public laboratory accreditation body, in accordance with tests of par. 5.1, as it is clearly mentioned in this paragraph.

g) A statement that upon receipt of the equipment, any the labels of the Control Unit (Button, LEDs) shall be written in Greek language.

h) Declaration of the factory/ies where the products are manufactured, with analytical information (full address, number of employees, a brief description of the installations, testing capabilities e.tc). The factory shall possess the following certifications and capabilities and provide the relevant certificates:
   - ISO 9001 certification of the manufacturer covering the production field of the offered materials. The certificate shall be guaranteed by the manufacturer, which shall also provide communication data for the Certification Body together with its accreditation certificate as well as any other relevant data requested during the stage of the technical evaluation of the offer, facilitating the examination of the soundness of the certificate. ISO 9001 certificate shall be in effect on the date of the offer. In addition a declaration shall be submitted that during any Contract resulting from the Inquiry, the ISO 9001 certification of the factory of the manufacture shall be in effect.
   - Adequacy of the testing equipment for routine and lot acceptance testing and competency in quality control equipment.

HEDNO reserves the right to examine on site the factory’s capabilities in manufacturing the offered materials, during a possible Contract.

i) The manufacturer must have references from Electric Utilities or Network Operators (name of the Utility or Operator, address, phone number, fax number, e-mail e.tc) for the offered type equipment. In each reference letter, the buyer, the type of device, the quantity, the date of delivery, the country of installation, the manufacturer and the type of cooperated equipment shall be mentioned as well as, whatever information is deemed to be useful for proving the long term successful operation of the material. The units must be installed and operate successfully in the network for at least the last 3 years. The number of the units must be at least equal to the half of the number of the tender. As proof original or true copies of Appreciation letters are preferred but copies of sales contract are also accepted (price units are not necessary to be visible). In case of orders awarded by Electric Utilities or Network Operators to Third Parties, such as in the case of indirect order to the FPI manufacturer, as proof of experience will be submitted true copies of the contract between the Electric Utility or Network Operator and the Third Parties as well as that between the Third Parties and the manufacturer.

j) Sales record of the offered equipment (FPI) or equipment similar to the offered (namely wall-mounted FPIs suitable for locating phase and earth faults in MV distribution underground networks with the same specifications as the offered), which has been sold to Electric Utilities or Network Operators. The sales list shall include the following:
   - The type of the equipment
   - The name of the Electric Utility or Network Operator along with its full communication details.
• The quantity of the equipment purchased of each order and in total.

The above-referred Certificates / References / Reports shall:
• Be either original or certified true photocopies of the original
• Include the full details of the Electric Utility / Network Operator / Company / Organization issuing the certificate / reference (including at least the following: name, logo, address, phone number)
• Be signed. The signature shall be accompanied with the full communication details of the signatory (including at least the following: name, address, phone number, e-mail and job position)

Inappropriate submission and not early filing of all the requested Certificates / References / Reports constitutes a reason for exclusion of the Supplier from the Tender. HEDNO reserves the right to check and to confirm the validity and authenticity of the Certificates / References / Reports. If any of them found to be inaccurate or falsified, the Supplier will be excluded from the Tender and his Bid will be rejected automatically and with no right of objection.

Note: Tests reports, reference letters, copies of contracts e.tc shall refer to equipment manufactured in the factory where the equipment offered will be manufactured.

9. DOCUMENTATION

The Supplier must provide, for approval by HEDNO within 30 days from the effective date of the contract, six (6) complete sets of the documentation for all units, in hardcopy and in electronic form.

The documentation must include:
• Description of the offered units
• Description of the operation of the offered units
• The drawing of the electronic parts of the Control Units, which will describe in every detail the internal wiring of the enclosure with its terminal blocks and connectors
• Installation, operation and maintenance instructions for the units offered

10. TRAINING

The Supplier will provide for HEDNO four (4) courses of training, each one lasting three (3) days, at four (4) different geographical sites in Greece (Athens, Thessalonica, Patras and Lamia) and not necessarily in sequential time intervals. Additionally, after the end of the 4th training course, one more training course shall be scheduled, lasting two (2) days for each one of the 4 locations mentioned above, in order to resolve any outstanding issues and problems encountered.

HEDNO and the Supplier will agree on the most convenient time for the courses. One FPI, the necessary Simulator and documentation will be used for this training.

The training shall include, at least, the following:
- The FPI HW components piece by piece
- The Control Unit’s firmware main functions
- The function of the FPI as a unit
- Maintenance of the equipment
- Operation of the equipment
- Programming and use of the simulating devices
- Installation techniques and considerations

11. INSTALLATION AND COMMISSIONING OF THE FIRST TWENTY (20) UNITS

The installation and commissioning of the first twenty (20) FPIs will be done by personnel of the Supplier, in presence of the staff of HEDNO who will watch the procedure. This procedure will serve as an additional hands-on/on-site training. Specifically four (4) units will be installed on each of the following Regional Departments of HEDNO:

- Regional Department of Attica,
- Regional Department of Macedonia-Thrace,
- Regional Department of Peloponnese - Epirus,
- Regional Department of Central Greece and
- Regional Department of the Islands.

Programming of the Control Units of the above 20 items will be implemented together with their installation.

The aforementioned work will be accomplished within two (2) months following the first (1st) partial delivery of equipment to the Central reception Warehouse of HEDNO. The work will be ensured by the relevant Section of the Network Department in collaboration with staff of the relevant Departments of HEDNO (Regional Departments) and the Supplier.

After the successful installation and operation of the 20 units and the successful functional tests, a SAD (Site Acceptance Document) will be signed between the Supplier and HEDNO.

The Supplier will have to cover the expenses of its personnel during this period.

12. GUARANTEE

The guarantee period will be three (3) years at maximum for all units supplied. The guarantee period will start from the date of installation and shall not exceed five (5) years from the date of delivery. According to the above mentioned, the warranty period shall expire five years after receipt of the equipment, or three years after its installation on the network, whichever comes first. The serial number regarding the equipment's installation shall be delivered by HEDNO to the Supplier each semester. On this file the serial number, the date and the location of equipment's installation shall be referred.

The Supplier must be fully responsible for the proper operation of all the units for the guaranteed period. During the guarantee time period the Supplier, free of charge will:

- Correct any Software or Hardware fault which will be found on any type of equipment.
- Correct any communication problems that may arise (due to the equipment supplied)
- Correct any error or omission which will be found in the documentation
- Respond to any information required by HEDNO
- Make any modification requested, which will improve the equipment's compliance to the specifications

In the case of Control Unit firmware malfunctions, HEDNO's personnel has performed all checks, according to the training and documents received, in order to solve the problem.
If the fault reasons are not identified or solved, then an onsite intervention of the Supplier shall be required.

Regarding the interventions to correct any equipment software fault the following will apply:

- Maximum time for answering to HEDNO (notice of a problem) to the telephone, FAX or e-mail: 2 h, from 8 a.m. to 3 p.m. from Monday to Friday, except official holidays, as they apply to Greece
- Maximum time between acknowledging the problem reported above by HEDNO until the arrival to HEDNO's Local Unit in order to visit the site escort by HEDNO's personnel: 2 working days
- Maximum time between on-site intervention and resolution of the problem (return to repair conditions): 15 working days (in case the intervention has to be supplied to all locations shall be concluded within 4 months)

Failure to provide support within the above-mentioned times, will incur a fine of 240,00€ per day of delay. For intermediate delays (i.e. hour) the fine will be determined by linear interpolation. In case of simultaneous events the Supplier shall proceed to interventions and corrective actions in a sequentially manner. The Supplier won’t be responsible for any delays regarding compliance with the maximum times mentioned above, if those delays result from force majeure cases. The Supplier shall notify HEDNO, by registered letter, in the advent of any situations mentioned in the previous clause immediately or in any case within 15 days from the occurrence date, if all other means were tried to avoid or minimize the delay in the promised obligations.

The Supplier has the sole responsibility of employing its personnel according to all the legal requirements and providing all personal and health insurance for them. HEDNO could not be held liable for any injuries or compensation to the personnel of the Supplier.

In case of equipment failure (CPU, Power supply e.t.c) on the network or in HEDNO's warehouses, HEDNO shall replace it with equipment that will get from the stock of spare parts, which will be delivered with the 1rst partial delivery of the Tender’s materials (see Chapter 7). The equipment which was failed on the network shall be carried by HEDNO’s crews to HEDNO’s Regional Warehouses to be checked for finding the causes of failure. The failure will be announced immediately to the Supplier (i.e. the place where the equipment had operated, the warehouse where has transferred e.t.c) regardless of the results of the check performed by HEDNO to ascertain the causes of failure (1rst failure announcement, regardless of the causes of failure). The check of the causes of the failure shall be performed by HEDNO within 1 month from the date of the 1rst announcement of failure to the Supplier. If the check reveals that the failure is due to the Supplier, this will be announced to the Supplier, within this period of 1 month (2nd failure announcement, failure due to the Supplier's fault).

Regardless of the causes of the failure, the Supplier must make the provision to replace within three months from the date of the 1rst failure announcement all the materials used, for replacing of damaged from the stock of HEDNO's spare parts, with new ones. For each month that delays the timely replacement of the materials used by the stock of HEDNO's spare parts, the price of materials will be retained by the letter of guarantee. For intermediate delays (days) the fine will be determined by linear interpolation. The delivery of these materials by the Supplier must be made with packaging similar to that provided by this TD.

Within two months from the date of the announcement of the failure due to the Supplier (2nd failure announcement, failure due to the Supplier), the Supplier has the right to demand in writing the presence of his representative during reexamination of the causes of failure. This reexamination must take place within this period of two months. In case that
the Supplier within the aforementioned period of two months does not make any request to be present during the reexamination of the causes of failure, or does not attend despite his relevant declaration, it shall be considered as a fact that he unreservedly acknowledges himself as responsible to for this failure. Furthermore if the Supplier within this period of two months does not throw any doubt concerning the failure of the equipment it shall be considered as a fact that he unreservedly acknowledges himself as responsible to for this failure.

During reexamination of the causes of failure a relevant Control Report shall be drawn in duplicate and signed by both Supplier and HEDNO. This report shall state the cause of the failure that was ascertained and the Supplier will declare that he acknowledges it. In cases of disagreement the matter shall be referred for further judgment by a Committee consisting of the Head of Technical Division Section of HEDNO's Network Department or his substitute, the Head of Inspection Section of the HEDNO's Material, Purchasing & Transportation Department or his substitute, as well as of the Head of the Supplier's Study Office or other representative of him. In cases of disagreement and until the Committee comes to a decision, the Supplier is deemed responsible for the failure. The acknowledgement from the part of the Supplier of the equipment failure ceases to have any legal effect from the moment the Committee judges that the failure in question is not due to the Supplier's responsibility.

In case that the equipment failure is due to the Supplier's responsibility:

- The cost of the materials to be supplied by the Supplier to replace the materials taken from the stock of spare parts, for replacing of damaged, shall be borne entirely by the Supplier.
- The Supplier is obliged to accept the failed equipment from HEDNO's Regional Warehouse, within two (2) months from the date of recognition, as above, by the Supplier that the failure is due to him, and to transfer it to his factory or to a factory of his choice. The cost of this transportation shall be borne entirely by the Supplier. In case of delay beyond of 2 months, HEDNO is entitled to send the equipment failed in the Supplier's factory, and the transportation cost shall burden the Supplier.
- All replacements, transportation and loading/uploading costs of the damaged equipment from HEDNO's workshops to HEDNO's Regional Warehouse as well as the transportation and loading/uploading cost from HEDNO's Regional Warehouse to the Supplier's factory, if these are carried out by HEDNO, shall be borne by the Supplier entirely and shall be retained by the letter of guarantee. Replacement, transportation and loading/uploading costs of the damaged equipment, for replacing of the damaged equipment from another one, are calculated in accordance with HEDNO's Contracts that were signed with Contractors involved in the construction of distribution networks or upon final account.
- In case of transportation of the damaged equipment from the HEDNO's Regional Warehouse to the Supplier's factory, transportation costs shall be calculated in accordance with applicable decisions of the Ministers of Commerce and Transportations being in force or upon final account.
- These costs shall be notified to the Supplier immediately after he has received the damaged equipment or after it is sent at his factory by HEDNO.

In case that the equipment failure is not due to the Supplier's responsibility:

- The cost of the materials to be supplied by the Supplier to replace the materials taken from the stock of spare parts, for replacing of damaged, shall be borne entirely by HEDNO, according to Contract's spare parts price list.
• All replacement, transportation and loading/uploading costs of the damaged equipment from HEDNO's workshops will be borne entirely by HEDNO.

At the end of the guarantee period, HEDNO and the Supplier will sign a protocol on the equipment's behavior for the release of the Letter of Guarantee.

13. NAMEPLATES AND MARKING

The FPI shall carry a nameplate, suitable to withstand the environmental conditions, at a position visible at normal operation position, with engraved letters.

The FPI's nameplate shall include at least the following data:
• Name or trademark, address and phone of the manufacturer
• Date of manufacture, product type and serial number
• Contract number
• Rated input voltage (V)
• Rated continuous current (A)
• Rated frequency (Hz)
• Rated battery type, max capacity (Ah or Wh) and voltage (V)
• Weight (battery included) (kg)

The exact details of the nameplate shall be decided during the sample approval period.

14. PACKING

The equipment shall be packed in durable wooden cases of suitable dimensions, with all sides totally closed. The cases shall withstand external environmental conditions, like rain, humidity, ambient temperatures etc.

Packaging shall include all appropriate hardware for fixing the Control Unit onto concrete wall.

The packing shall ensure that the equipment shall be protected against damages during transportation, loading and unloading. The wooden cases shall be packed together on EU type pallets and the total weight of pallet one shall not exceed 550 Kg.

On two opposite sides of each case the following data shall be marked in a clear and indelible way:
• Manufacturer / Year of manufacture / Contract Number
• Description, type and serial number of contents
• HEDNO material code number
• Gross weight in kg

Attached:
- Figure No 1: Time schedule from effective date of contract until start of production.
**Figure 1**
Time schedule from effective date of contract until start of production