Afghan Panelboard Manufacturing

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Few panelboards and switchboards hand-constructed in Afghanistan are currently acceptable for USACE projects. Panelboards are disapproved because they are not built to an approved manufacturing standard, and are not adequately tested to ensure operator safety. Although the pictures presented in this report are from an inspection of one manufacturer's panelboard factory, the manufacturing processes are typical of most panelboard manufacturers in Afghanistan. The suggestions presented in this report can be used by any manufacturer in Afghanistan desiring to produce USACE contract compliant panelboards.

Manufacturing Process

Afghan-built panelboards are manufactured by taking sheets of steel and cutting/bending them into smaller sheets that are suitable for typical panelboard boxes. These sheets are tack-welded together to form the basic panelboard box.

After the box is tack-welded, the door and box are separately painted or powder coated, and then assembled with hinges, locks and seals to form the panelboard enclosure.

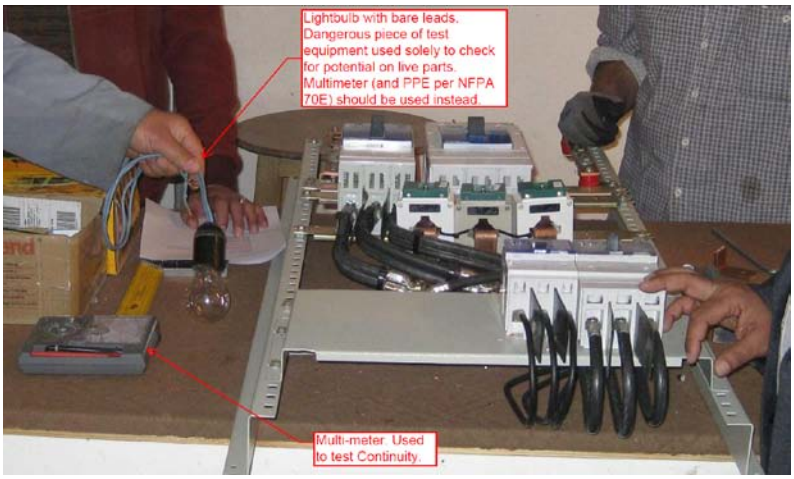
While the enclosure is being constructed, the panelboard interior is concurrently constructed. Quality breakers (Legrand, OEZ, Schneider, Moeller, or others) are mounted on steel channel, and interconnected with busbar, wire, or interconnecting strips. Smaller sized breakers are din-rail mounted.

Although panel interiors are constructed according to panel schedules shown on engineering plans, panels do not appear to conform with a panelboard manufacturing standard. Panelboard interiors (including live-part spacing, busbar sizes, etc.) are likely designed and constructed based on experience and intuition, and not based on established standards.

Panelboard Testing

After the panel interior is installed in the enclosure, the panel is tested. At the factory we visited, two tests are done on new panelboards:

- Continuity of Grounded Parts (and non-continuity of Phase-to-Ground) **DESIRABLE TEST (see Routine Tests Below)**
- Operational Test (powering the panelboard and checking for potential on each bus using a light bulb with a phase and ground lead) **NOTE THAT THIS TEST IS EXTREMELY DANGEROUS, AND SHOULD NOT BE CONDUCTED.**



Necessary Corrective Actions

Panelboards built in Afghanistan could be acceptable if the following actions are taken.

1. **Build Panels to IEC (BS EN) 60439.** Most locally-built panels currently appear to be built based on intuition, without referencing an applicable standard such as IEC 60439 or NEMA PB-1. IEC 60439 is the preferable panelboard standard for Afghanistan, since this standard is used throughout Europe. A typical example of non-compliance with IEC 60439 is the lack of a nameplate that includes items such as Manufacturer's Name, rated voltage, rated current, short-circuit withstand strength, etc. Another typical non-compliance is inadequate spacing between live and grounded parts within the panel. Manufacturers should train workers on the panelboard construction requirements of IEC 60439, and establish a quality control (QC) program to ensure compliance with IEC 60439.

2. **Establish Occupational Safety.** During our visit to one panelboard manufacturer, gross inadequacies in worker safety were witnessed. Panelboard tests expose workers to arc-flash hazards that could result in injury or death. Europe has not yet established arc-flash standards, so the default standard is NFPA 70E, "Standard for Electrical Safety in the Workplace." Afghan panelboard manufacturers should familiarize themselves with this standard, and provide workers with personal protective equipment (PPE) based on the task they are performing. Applicable PPE includes, but is not limited to: eye protection, flameproof clothing and coveralls, and hardhats.

3. **Perform Routine (Factory) Tests.** Routine, factory tests are required to ensure that each panelboard produced by a manufacturer is safe. These tests (described in detail in IEC 60439), are as follows:
    - **a.** Inspection of the Panelboard including inspection of wiring and electrical operation test.
    - **b.** Dielectric Test.
    - **c.** Checking of protective measures and of the electrical continuity of the protective circuits.

4. **Have Panelboard "Types" Tested by an Approved, 3rd-Party Laboratory.** A type-test is required for each typical box size constructed by the manufacturer. Typical panel(s) should be sent to an approved, 3rd-Party laboratory for the following tests:
    a. Verification of Temperature-rise Limits
    b. Verification of Dielectric properties
    c. Verification of Short-circuit withstand strength
    d. Verification of Effectiveness of Protective Circuit
    e. Verification of Clearances and Creepage
    f. Verification of Mechanical Operation
    g. Verification of Degree of Protection
    h. EMC Tests

    A successful type-test will validate manufacturing practices and confirm the routine tests. If a panelboard is being produced for a USACE project, both the routine test and type test results shall be submitted to the government for review.

Conclusion

Afghan panelboard manufacturers are producing panels that are nearly approvable for USACE projects. A panelboard manufactured to an approved standard (such as IEC 60439), produced in a factory with an established safety program, and type-tested for quality will likely be approved by AED-N Engineering. If USACE is able to approve Afghan-built panels, the resulting spike in production could create jobs and increase the amount of capital that remains in Afghanistan.