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Basic Application Profile for Fault Location, Isolation, and Service Restoration in a Looped Single Line Feeder

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Contents

1 Functional Description 1
2 Description of Use Case and Associated Roles/Actors 4
2.1 List of Roles/Actors 4
2.2 Use Case 4
2.3 Sequence Diagram of Typical Interactions 4
3 Logical Architecture 5
4 Allocation Variants (Conditional) 6
5 Functional Variants 6
6 Performance Requirements 6
7 Description of Data Model per Actor 6
7.1 LLN0 Required Data Objects 6
7.2 LPHD Required Data Objects 7
7.3 PIOC Required Data Objects 7
7.4 PDIR Required Data Objects 7
7.5 PTRC Required Data Objects 7
8 Communication Services 8
9 Device-Related Requirements (Conditional)—Test Behavior 8
10 Engineering Tool-Related Requirements 8
11 Naming Rules 8
12 Capabilities for Testing 8
A.1 Glossary 9

Figures

Figure 1 First Event, Fault Active 1
Figure 2 Fault Between Vault 3 and Vault 4 2
Figure 3 Vaults 2 and 3 Send Blocking Signal in Opposite Direction of Fault 2
Figure 4 Vault 3 Does Not Receive Blocking Signal and It Trips on Directional Overcurrent 3
Figure 5 Vault 3 Sends Transfer Trip Signal to Vault 4 3
Figure 6 Vault 4 Sends a Close Signal to Breaker D; System Enters Restoration Blocked Mode 4
Figure 7 Sequence Diagram for the Basic Application Profile 5

Tables

Table 2-1 List of Actors 4

Foreword

A Basic Application Profile (BAP) is based on system/subsystem specific basic application function descriptions. The term “basic” means here that an elementary application function/subfunction is the chosen context for defining the profile. The level of what is perceived as elementary is application dependent and may include, for example, many Logical Node (LN) instances of many LN classes, when using IEC 61850.

A BAP is a user/user group agreed-upon selection and interpretation of relevant parts of the applicable standards and specifications and is intended to be used as building blocks for interoperable user/project specifications.

The key ideas of BAPs are:

- BAPs are elements in a modular framework for specific application systems/subsystems.
- Combinations of different BAPs can be used in real projects as building blocks.
- Project-specific refinement additional to the BAP might be necessary to meet specific requirements for implementation in projects. These additional requirements should be frequently fed back into the User Group and may lead to a new or revised BAP based on user experiences and group decisions.

BAPs shall represent a user-agreed common denominator of a recommended implementation or a proven best practice implementation of an application function in the domain of substation automation, but are not aimed to cover all possible implementation options.

BAPs shall not have options; all selected criteria are therefore mandatory in the interest of interoperability. If variants of BAPs for an application function are needed, different BAPs for the same application function shall be defined to facilitate interoperability in a modular way.

Intelligent electric devices might contain more options as requested by BAPs to achieve more flexibility to satisfy the needs of the global market, but it is considered to be useful if the BAP-specific definitions can be selected easily (e.g., by some settable BAP identifier).

BAPs are built on the basis of international standards and also may have an influence in the further development of standards by possible feedback and implementation of lessons learned.[1]

This document follows the format of the Basic Application Profile in IEC 61850-7-6.

Feedback

In the preparation of this technical publication, the input of users and other interested parties has been sought and evaluated. Inquiries, comments, interpretation requests, and proposed or recommended revisions should be submitted to the concerned NEMA product section by contacting:

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1 IEC TR 61850-7-6:2019.

This standard was developed by NEMA's Distribution Automation Section and at the time of publishing was composed of the following members:

ABB Inc.
Eaton
G&W Electric Company
Hitachi Energy USA Inc.
Hubbell Power Systems
Itron, Inc.
Mitsubishi Electric Power Products, Inc.
S&C Electric Company
Schneider Electric
Siemens Industry, Inc.
TESLA, Inc.

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1 Functional Description

Fault location, isolation, and service restoration (FLISR) includes automatic sectionalizing and restoration, and automatic circuit reconfiguration. These applications accomplish distribution automation operations by coordinating operation of field devices, software, and dedicated communication networks to automatically determine the location of a fault, and rapidly reconfigure the flow of electricity so that some or all of the customers can avoid experiencing outages. Because FLISR operations rely on rerouting power, they typically require feeder configurations that contain multiple paths to single or multiple other substations. This creates redundancies in power supply for customers located downstream or upstream of a downed power line, fault, or other grid disturbance.

The example below is for a three-phase lockout/isolation of a fault between vault 3 and vault 4.[2]

An example of a cable fault shows how this system-based test approach was used. First, a fault is placed on a cable between V3P and V4P (between vault 3 and vault 4) as shown in Figure 1 below. It is expected that the breakers feeding the cable isolate the fault. After successful isolation, the normally open breaker closes in and restores the supply. As the power system was already entered, the only thing necessary to define this test case is to place the fault on the cable segment (see Figure 1). Figures 2 through 6 show simplified progression of how the fault is isolated.

All breakers on each vault are fault interrupters. A capacity check is not performed because both feeders can support the full load of the loop.

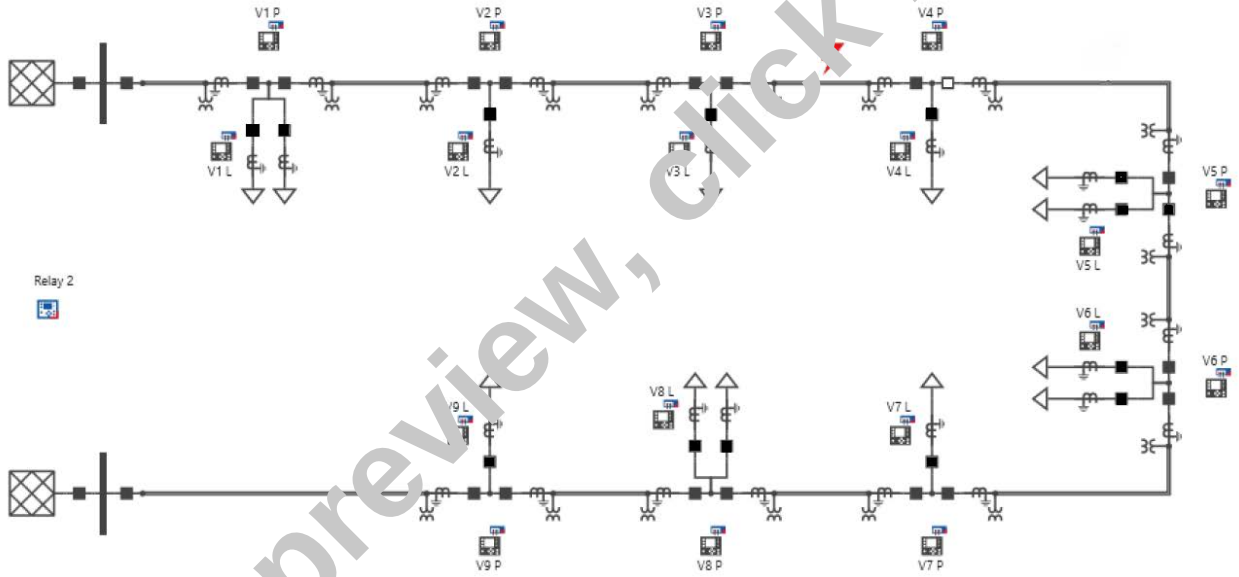

Figure 1
First Event, Fault Active

[2] Use cases from Duke Raleigh and provided by G&W Electric.