

ABB

ABB CHALLENGE

## Automatic backup feed start

### Introduction

The assignment deals with issue of automatic backup feed start, which is used in systems with two isolated feed lines connected to two sections and also to each other by a protection element (circuit breaker). Your task is to design a logic system and control program for PLC of an automatic backup feed start (2 supplies and 1 mutual connection – circuit breaker). The simplified simulation and scheme will not considerate time parameters of particular operation statuses and parallel operation of transformers.

The used protection elements are air-insulated Emax series circuit breakers. Air-insulated circuit breakers are used as general protection elements (factories, electric lines etc.) and as protection elements of electric machines (generators, drives, transformers, capacitors).

They are used in all types of operations (housing, industry, service sector) and also in boats, mines, transformer stations and generally in primary and secondary distribution of electric power.

In second part your team is tasked to integrate the automatic backup feed start into an industrial enterprise (a factory) with a section, that can't encounter an outage longer than a time necessary for automatic backup feed start, and two sections, which are required to be fed 10 minutes after the outage (failure of both feeds) to safely shutdown the technological unit.

The third task is the creation of a visualization, that presents and simulates the function of the assignment.

## Required theoretical basis

We strongly recommend you to acknowledge yourself with the topic of controlling via PLC using internet and provided literature before you begin solving the tasks. To understand the way circuit breakers are controlled and monitored we recommend you to read the Emax series air-insulated circuit breakers catalogue.

## The principle of an automatic backup feed start

As regular operational status we consider state, when circuit breakers of both transformers are "On" and the connection circuit breaker is "Off". Each section is fed from own transformer. In case the control system is in manual operation mode, the operators are able to arbitrarily switch on/off particular circuit breakers except switching on all three (parallel operation of transformers is forbidden). Parallel operation of transformers is also forbidden at the moment when control system is switched to automatic operation mode. At the moment when outage of one of the transformers occurs the system firstly switches off the transformer circuit breaker, where the outage occurred, and then connects following section to the other transformer using connecting circuit breaker. At the moment the feed is restored the system will do so-called reverse automatic backup feed start. That means, firstly disconnects the connection between two transformers and then switches on the circuit breaker of transformer, where feed was restored.

### Basic operational statuses:

Breaker Q1	Connecting breaker	Breaker Q2
0	0	0
1	0	0
0	1	0
0	0	1
1	0	1
1	1	0
0	1	1

Logic 1: circuit breaker "On"

Logic 0: circuit breaker "Off"

## Operational statuses monitoring and control signals

The system is connected to substation and control elements by binary signals 24 V DC.

### Operational statuses monitoring:

- Measuring by undervoltage relays (voltage ok: L, undervoltage (no voltage): H)
- circuit breakers states: On / Off / trip / breaker position (In / Out)
- monitoring statuses of control buttons and switchers: On / Off; Automatic / Manual mode; reverse start Allowed / Forbidden

### Control signals:

- Signals of coils switching circuit breakers on
- Signals of coils switching circuit breakers off

## Assignment

- Create configuration of PLC in CoDeSys with optimal number I/O modules
- Declare variables representing I/O signals
- Design logic of control program according to assignment
- Simulate function of control automatic backup feed start in CoDeSys

### Assignment for integration automatic backup feed / feeds start into a industrial enterprise is following list of behavioural requirements:

- The factory is fed from two independent and isolated lines (transformers 2× 1600 kVA). Both feed lines are connected with a circuit breaker (junction), which allows connect particular sections in case of outage before one of the transformers. There is also a backup generator, which is connected only in case of outage at both transformers at the same time. Sections 1 and 2 feed unspecified number of protected circuits (outputs). One of the output feeds a technology unit, that can't be disconnected longer than it is required to start the automatic backup feed, and two outputs, which are required to be fed at least 10 minutes after an outage in order to shut down the technology unit safely. For circuit breakers consider only signals On / Off / Trip.

- At the moment, when any circuit breaker reaches the "Trip" status, manual confirmation of operator is required
- Visualization should present particular operational statuses of circuit breakers using a function scheme
- It has to enable change of operational statuses of elements in order to simulate the operation of the system
- Sections which are fed and which are not fed should be distinguished by colour.

## Schedule

- 08:00 – 08:15 Oficiální zahájení
- 08:30 – 08:45 Zadání kategorie Team Design
- 08:45 – 16:30 Vypracovávání řešení
- 16:45 – 17:00 Příprava na prezentaci vypracovaného řešení
- 17:00 – 18:00 Prezentace vypracovaných řešení
- 18:30 – 19:00 Vyhlášení výsledků soutěže
- 19:00 – 19:15 Oficiální ukončení