ETM

Mobile Substations

Overview

Mobile Substations (ETMs) are provided on an auto-transportation module basis, however it is also feasible to provide modular skid mounted units.

For primary voltages up to 140 kV and 20 MVA with ONAN/ONAF cooling system, it is possible to build them in modules able to circulate freely through state and national highways.

ETMs above 20 MVA, are mainly provided in modules on special trailers, capable of circulating with licenses granted by the corresponding authorities, including a power transformer with ODAF cooling system (forced/directed oil + forced air) and using heat exchangers.

From the transportation point of view, the restrictions with this type of ETMs are generally weight, width and length; so the final design of an ETM is always a commitment between the physical characteristics (weight and dimensions) and the desired electrical performance.

When specifying an ETM, Tadeo Czerweny S.A. has qualified personnel which can advise properly in the definition of all necessary aspects for the correct election of its parameters.

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MANAGEMENT SYSTEM CERTIFICATION
DNV·GL
ISO 9001 = ISO 14001
OHSAS 18001

FT 2159 Rev. 2

Tadeo Czerweny

ETM

Mobile Substations

Electrical Transmission and Distribution Companies, competing in a non-regulated market, face every day the challenge of offering a safe and reliable service while keeping very strict quality standards. In order to preserve service quality, many of them have chosen to duplicate the number of power transformers in each station. This solution obviously represents very high and unacceptable financial costs.

The challenge for Management in this century will be the Quality in investment decisions, so these companies will have to consider the minimization of the capital costs as a key factor in their decisions.

Electric power distribution business means strong capital investment, for this reason it must be reduced although maintaining service quality. The transformers stock must be optimized, without neglecting the growth and the risks that may lead to economic penalties from the Regulating Bodies, and even worse, from the customers themselves.

In this context, Tadeo Czerweny S.A. has put itself at the forefront of the suppliers of the Electric Power Transmission and Distribution Companies, bringing specific projects for the minimization of the Capital Expenditures: the Mobile Substations (ETM).

The incorporation of ETMs in the technical stock of these Electric Companies, strategically distributed in the energy supplying area, considerably reduces the capital investment and maintenance costs. As a reference, the estimated time required to put an ETM into service is three to four hours; this period does not include mobilization time.

At Tadeo Czerweny S.A. we know how to interpret the specific needs of each of our customers, allowing us to develop unique and innovative technological answers.

ETM

Guidelines to specify an ETM

PRODUCT TYPE ALTERNATIVES:

Type I:
- High-Voltage module
- Power Transformer module
- Distribution-Voltage module

Type II:
- Compact HV Mobile Substation
- Distribution-Voltage module

Type III:
- Compact Mobile Substation

Type IV:
- Compact Mobile Transformer

POWER TRANSFORMER:

For power above 15 MVA, it is not recommended to ask either the tertiary winding or transformer losses capitalization considering the same formulas applied to transformers targeted to conventional stations type.

ETMs are designed to deal with emergencies, and therefore the amount of equal hours for both load and no-load losses is totally different.

Defining the copper maximum overtemperature in 65 °C and the oil maximum overtemperature in 60 °C is also advisable.

To obtain major power modules, we must consider the use of NOMEX insulation material type for all windings.

Combining all the above mentioned hints, will lead to reductions of up to 30% in the transformer weight, and consequently to a significant reduction in its dimensions.

CURRENT TRANSFORMERS:

Toroidal "bushing" type transformers are preferred to the conventional ones. Conventional ones are heavier and occupy much more room. The manufacturer must choose the features, since defining exaggeratedly high benefits is not necessary due to the proximity of the protection elements to which they are connected. Higher rates of protection lead to greater dimensions and weights in the power transformer.

BASIC IMPULSE LEVEL (BIL):

The lowest levels specified by the Standards for each class of voltage must be considered. This finally results in smaller dimensions and weights.

VOLTAGE TRANSFORMERS, DISCHARGERS:

Tadeo Czerweny S.A. recommends those elements manufactured with insulation columns covered with silicone rubber instead of ceramic. Silicone rubber polymers have shown a very good behaviour under the most severe atmospheric conditions, and an excellent solution when the aims are to reduce weights, to improve the transportation security and to prevent vandalism.

The levels of protection offered by the available Ozn dischargers, make protection against temporary overvoltages, even with the minimum levels of insulation, very safe.

COOLING SYSTEM:

The manufacturer will select the best and more advisable cooling system for a specific power of the ETM, thus obtaining the best economic/technical solution for the refrigeration design of the power transformer and saving space in the ETM transformer module.

SWITCHES, ISOLATING SWITCHES FOR MEDIUM/HIGH VOLTAGE AND RECLOSERS:

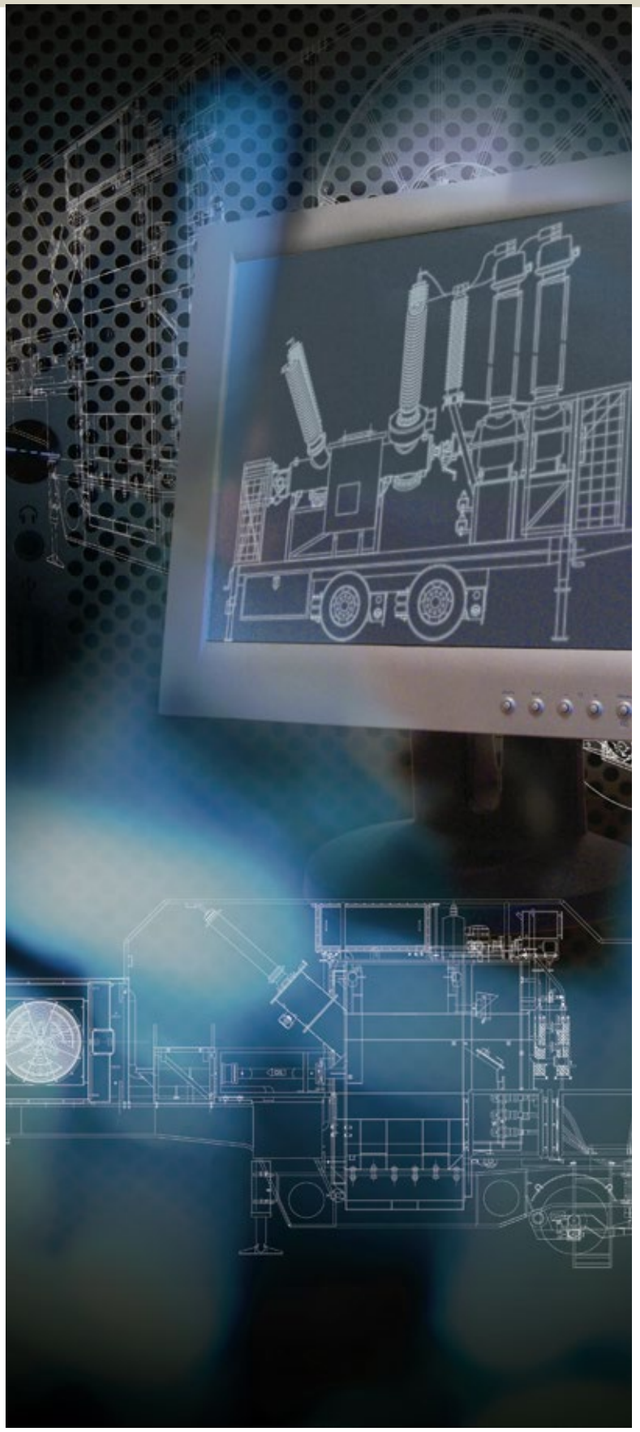
At present, there are reclosers with built-in protections against overcurrent. They are a highly recommended alternative and an excellent solution for medium-voltage fields (10 to 40 kV approx.), made up by cells with switches and line isolating switches.

AUXILIARY SERVICES:

Where DC auxiliary services are requested, command voltages and power capacities election must be left to the manufacturer discretion. It is advisable that the DC auxiliary services, under normal operation, are provided by the rectifying system of the batteries charger from the AC auxiliary services.

Do not specify auxiliary services capacities to feed external loads to the ETM, such as lighting of premises, external battery chargers, etc. These considerations lead to smaller dimensions and weights for the auxiliary services compartment.

Black start: If there is no external provision of power generation to feed the auxiliary services in order to be able to operate the high-voltage and isolating switches, we recommend the addition of an appropriate diesel generator.



ALARM CIRCUITS, PROTECTION:

Select those of the lowest internal consumption (equal benefit) to optimize the necessary power for the auxiliary services.

BARS BUS:

If possible, and whenever necessary, specify aluminum bars to connect the medium-voltage outputs. They are lighter and show an excellent conductivity.

CABLE REELS FOR DISTRIBUTION VOLTAGE OUTPUTS:

As far as possible the incorporation of these reels is not recommended, since it significantly increases the physical dimensions of the ETM.

GENERAL ASPECTS:

Specifying for an ETM, the same technical features corresponding to a typical Transformer Station often makes the ETM design not viable or, at best, dramatically reduces its transportability conditions.

Maximum dimensions and weights of transportation:

The following maximum dimensions and weights have to be considered and checked to meet state and federal highway requirements:

A/ Vehicle, truck, trailer type, and others
B/ Maximum width
C/ Maximum length
D/ Maximum height:
E/ Maximum weight with two individual axes and wheels
F/ Maximum weight with two dual axes and wheels
G/ Maximum weight with three dual axes and wheels
H/ Other local regulations/restrictions

ADDITIONAL ADVANTAGES OF ETM:

- Meeting extra energy demands at low cost.
- Reducing maintenance costs of the tradicional Transformer Stations.
- Temporary power supply, allows to replace existing equipment during regularly scheduled maintenance.
- Quickly restore electrical service following an outage caused by a storm or other disaster.
- Temporary new service while permanent facilities are being constructed.
- General Emergency Services.

ETM

ETM - TYPE I - developed for EDESUR - Argentina

Equipment made up of three units or independent modules. They can work all together, making a conventional transformer station. Also, each module can operate independently.

Main features:
Power: 35 MVA
Voltages: 132 and13,86 kV

Power Transformer Module:

Power: 35MVA
Voltages: 132 (± 11 x 1.4273%) /13, 86 kV (OLTC on HV side).
Vector Group (IEC standard): YNyn0
Cooling system: ODAF - Forced and directed oil & Forced air.
Main components:

- Fire fighting system.
- Pumping equipment for fire fighting system.
- Cooling oil equipment.
- Reels for distribution cables, mechanically operated
- Protection and measuring instruments (overcurrent, differential type).
- Telecontrol.
- Appropriate IP Cabinet for: protection, measurement and telecontrol instruments.
- Interconnection cabinet (to facilitate connection with other modules).
- Lighting system.
- Grounding system.

High-Voltage module:

Provided with all the necessary components for protection, measurement and operation on a 132 kV line. It is mounted on a specially designed trailer.
This module consists of the following main equipment:

- 145 kV on-load break switch.
- Voltage transformer.
- Ozn dischargers.
- Protection and measuring instruments.
- Telecontrol.
- Appropriate IP Cabinet for: protection, measurement and telecontrol instruments.
- Interconnection cabinet (to facilitate connection with other modules).
- Lighting system.
- Grounding system.

Distribution-Voltage module:

Equipped with a CD made up of six metallic inner cells (mounted within a Shelter) with all the necessary components for protection, measurement and operation on a 13.2 kV line. This module consists of the following main equipment:

- Metallic Shelter for cells.
- Three-phase battery charger.
- Input primary cell 2000 A-13.2 kV (quantity: 1 (one)).
- Output primary cell 800 A-13.2 kV (quantity: 4 (four)).
- Measuring cell.
- Protection and measuring instrument (overcurrent, arc protection, etc).
- Auxiliary Services transformer.
- Telecontrol.
- Appropriate IP Cabinet for: protection, measurement and telecontrol instruments.
- Interconnection cabinet (to facilitate connection with other modules).
- Lighting system.
- Grounding system.

ETM

ETM – TYPE III - developed for EDEERSA - Argentina

EDEERSA – 7 MVA – Voltages: 33 kV (+ 8; -12 x 1,25%) / 13,86 kV

EDEERSA -15/15/15 MVA - ONAN / ONAF -132 (+8; -12 x 1.25%) / 34.5(+/-2x2,5%) / 13.86 kV

Power transformer

15/15/15 MVA - 132/34,5/13,86kV.

BILs 550-170-95 kVcr.

ONAN-ONAF cooling system with Automatic Command or Manual Switch.

OLTC (On Load Tap Changer) on 132 kV side.

NLTC (Off Load Tap Changer) on 33 kV side.

Fire detectors.

IP66 cabinets for 33 kV and 13.2 kV outlets.

132 kV Voltage Field

Voltage transformers.

Overvoltage dischargers.

Operating field.

P.A.T. line rotating isolating switch.

Switch in SF6.

Current transformer.

On site command from Shelter.

Distribution-Voltage Field

Increased Security Cells.

Internal arc protection cabinet.

Vacuum circuit breaker.

SF6 Insulation.

P.A.T. and bars rotating isolating switch.

Telecontrol.

Incorporated Cable Reels system

60 meters of single-phase wire for 33 kV and 13,2 kV fields.

Total or partial winding / unwinding.

Suitable materials to avoid magnetic losses.

Electrically operated.

ETM – TYPE III - developed for ENELCO - Venezuela

ENELCO - Venezuela: 30 MVA - ODAF - 138 (+/-8x1,25%) / 25 kV & 115 (+/-8x1,25%) / 34,5 -13,8 kV

Power transformer

30 MVA -138/25 kV & 115/34.5-13.8 kV.

BIL: 650-200 kV.

ODAF cooling system with heat exchangers.

OLTC (On Load Tap Changer) on 138/115 kV side.

NLTC (Off Load Tap Changer) on 33/25 kV side.

Working possibilities: 115/34.5-13.8 kV and 138/25 kV.

138 kV Field

Overvoltage dischargers.

Measurement and protection current transformers.

Operation field.

Line rotating isolating switch.

P.A.T. rotating isolating switch.

Switch in SF6.

On site command from cabinet.

Auxiliary Services Module

40 kVA auxiliary services transformer.

Voltages: 8,439-6,9/0,215 kV.

Silicone base isolation fluid.

Terminals protecting cover.

NLTC (off load) tap changer.

Alternative HV selection, through an on-load switch.

Bay-o-net type fuses.

Cooling system

Heat exchanger consisting of:

Pumps for oil flow.

Oil cooling fans.

Flow detector at interchanger pipes.