INTRODUCTION

Since 1995, the Fonds d’Amortissement des Charges d’Électrification (FACE) supports operations aiming at using alternative technical solutions to the extensions and the reinforcements of low tension (LT) network, since these solutions are economically profitable.

For alternative solutions to the reinforcement, the idea is either to adapt the network to the existing request, but to modify form of the request on network so that the quality of supply of electricity is brought back at the necessary level. The modifications possibly necessary on uses of electricity are always done with an at least equal, and frequently improved quality of service.

The first operations of “micro” Demand Side Management (DSM), aiming at setting up alternative solutions to LT reinforcements were carried out since 1995. The initiated projects included actions on the network (voltage adapter slipper for example) and among customers. They led to the development of a method of diagnosis of a LT departure.

Another type of operations was also carried out, with the objective to differ investments on the distribution network on a territory scale (primary electrification trade union, homogeneous habitat, etc). This approach is called the “macro” DSM.

The operations which used DSM approach give good results and generated substantial financial economies, because they made it possible to improve the rendered electric service, while avoiding expensive reinforcements of network.

These operations are thus doubly gaining, because they make it possible to improve at the same time quality of supply on network and conditions of use of the equipment among customers.

All the operations carried out made it possible to develop and validate tools, and to define the conditions under which DSM is a valid alternative solution. The experience feedback indicates thus that today, the installation of a "quasi-industrial" treatment of departures in constraint by DSM is possible. For that, it is advisable to well know the existing adapted solutions and to select the departures for which technical effectiveness and economic profitability of these solutions have great chances to be assured.

“Micro” DSM: simple objective; multiple interests

The correct operation of a LT departure is limited by three distinct physical phenomena:
- constraints of voltage drop
- saturation of feeder
- heating of cables

The constraints of voltage drops appear when lengths of cable are too significant taking into consideration their section and the intensity which they must transport. A LT departure is in constraint as soon as a customer of this departure sees his tension going down below 207V (that is to say 230V less 10%). It is by far the most frequent cause of needs for reinforcement, and it is on this criterion that DSM operations concentrate.

The principal objective of a micro DSM operation is of raising constraints on a LT departure by presenting an economic assessment more advantageous than a traditional reinforcement. This makes it possible in certain cases to restore quality of supply of electricity for underprivileged customers requiring a high cost of reinforcement (and, consequently, undergoing long withdrawal periods).

Advantages of a micro DSM operation, compared to a traditional reinforcement of the network, are multiple:
- To perpetuate station HV/LV when DSM action implies a reduction of synchronous peak level on the departure.
- To make customers sensitive to the control of energy; to diffuse powerful uses; to allow economies to users.
- To carry out a step of proximity towards the customers, which often makes it possible to improve their comfort (elimination of disjunctions thanks to the power cut, tiresome managements of the heating thanks to the programming...).
- To increase the security of supply (with solutions such as inverter + batteries).

The care taken to the choice of departures to treat by DSM is essential for the success of the operations. The major criterion of selection is cost of estimated reinforcement per customer of the departure. A high cost indeed makes it possible to have recourse to a greater choice of technical solutions of DSM and to optimise economic profitability of it.

All the thresholds suggested in the figure 1, hereafter, direct the treatment of a departure towards such or such
solution result from experience feedback of the operations carried out. They can be adjusted according to possible local specificities.

The pre-diagnosis aims to direct as soon as possible the treatment of departure towards one of the four following possibilities ·-

- simple solutions networks (off-peak hours and balancing of the phases),
- solutions like voltage adapter slipper and tri/mono converters,
- complete DSM diagnosis,
- reinforcement.

A visit on site with installation of measurements allows at this stage: ·-

- to ensure themselves that the departure is well in constraint, and to know the level of this constraint,
- to know schedules of appearance of the constraint,
- to apprehend level of imbalance between phases during the voltage drop,
- to detect the presence of customers having a specific occupation (often badly simulated by the digital models).

Complete DSM diagnosis is reserved for departures complying with the criteria of selection and for which a solution relating to only the network could not be found. It aims at defining a technical solution or a whole of technical solutions making it possible to raise the constraints and to establish the balance sheet of it.

From some simple observations on the appearance of the constraints, a first orientation towards the types of solutions best adapted is proposed (see table 1). This orientation remains indicative; indeed, the choice of solutions is a function of uses and modes of use but also of periods of appearance of the constraints on network and there thus does not exist of standard remedy which could be applied whatever LT departure. Moreover, constraints on a network are seldom raised by only one solution : it is generally a whole of actions adapted to the context which makes it possible to solve a problem of quality of supply on the network.

| Unbalanced departure | * |
| 2 customers in constraint | * |
| Micro-cuts | * |
| Short constraints (<2 min) | * *
| Long Constraints | * *
| Week end | *
| Morning 6h-9h | *
| Day Professional uses | *
| 12-14 h et 18 h-20 h domestic uses | *
| 22 h-23 off-peak hours | *

Table 1 : solution adapted to the types of constraints met

**Micro DSM operation in Maine et Loire**

4 departures feeding 27 customers undergoing of strong constraints were treated by multiple DSM actions ·-

- Intervention on network and balancing 1balancing on the network
  1 Reinforcement of small dipole (100 m)
  5 Balancing among customers
  4 tri/mono converters
- Programming 3 Shifts, in period off-peak hours, of electric household appliances and water-heater
- Electronics of power 3 Inverters
- Powerful materials 3 electronic speed- starters
- Multi-energy 90 Low Consumption Lamps
- Decentralized production 1 Boiler drink very powerful
- Decentralized production 4 portable Groups for the intermittent and very disturbing materials
  Group EJP 40 kVka on a porcine breeding

CIRED2005
Session No 5
### Table 1: Number of events before and after DMS

<table>
<thead>
<tr>
<th>Name of departure</th>
<th>Number of events *</th>
<th>Gains %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before DMS</td>
<td>After DMS</td>
<td></td>
</tr>
<tr>
<td>La jumelière</td>
<td>11313</td>
<td>699</td>
</tr>
<tr>
<td>Coron</td>
<td>1469</td>
<td>544</td>
</tr>
<tr>
<td>Chanteloup</td>
<td>3049</td>
<td>81</td>
</tr>
<tr>
<td>Gennes</td>
<td>1054</td>
<td>41</td>
</tr>
</tbody>
</table>

* Disturbances out off quality standard: micro cuts, short cuts, tension apart from the beach (230 V -10%; 230 V +6%). Sampling rate: 10 milliseconds (ms). All events with a duration longer than 10 ms are analysed and stored. Measurements were carried out during seven days consecutive.

### Economic assessment in € (including all taxes)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of the avoided reinforcements</td>
<td>158 818</td>
</tr>
<tr>
<td>Cost of work</td>
<td>71040</td>
</tr>
<tr>
<td>Carry forward of reinforcement</td>
<td>7 to 10 years</td>
</tr>
<tr>
<td>Benefit</td>
<td>7978</td>
</tr>
</tbody>
</table>

### "Macro DSM" Operation: to optimise work on distribution network on a territory scale

"Macro DSM" operations aim, like micro operations, to optimise the investments on the distribution network of electricity. Whereas the micro operation implies an approach departure by departure and well adapted solutions ("over measure"), macro operation consists in defining DSM solutions adapted on average to the consumers of a given territory ("loan-with-to carry"). A geostatistic analysis of the data on consumption of energies by sectors and uses on the territory, coupled to an analysis of the data on network (exits for example of the GDO), makes it possible to define actions which are characterized by:

- family of solution-type adapted on average to local consumers;
- low cost of diffusion of these solutions on a targeted territory.

All customers are not met within the framework of a macro operation; its success thus depends strongly on the accompaniment which is set up to organize the realization of work. The axes of communication to be developed and possible supports to set up for work strongly depend on the type of solution considered and the type of "target" customers. These elements must be detailed during the development of the solutions. This type of operations, generally aiming to prevent the appearance of constraints and to differ reinforcements on the distribution network from a territory, can also answer other problems like:

- to differ construction from an additional line of transport, to optimise the purchases for a distributor, to optimise the investments of production (case of the networks not interconnected like those of the overseas departments for example).

This approach can also be used in dense agglomerated urban zone, where costs of reinforcement of network are also very high.

Several macro DSM operations were carried out or are in progress in France:

- actions on the electric heating in the Canton of Lanmeur;
- experimental operation on 2 primary trade unions of electrification of Oise;
- alternative solution to the project of a new line 225 KV aiming at making safe the power supply of the Annéciens basin;
- solution complementary to a reinforcement limited of the existing infrastructure, bound in particular to constraints of landscape integrations, on the line of transport Boutre - Carros feeding Nice and its area.

The macro DSM thus meets well aims of planning in the medium and long term while bringing tools to a reflexion on the local infrastructures (distribution networks) and regional, even national (transport).

### Prospects

An average department in Metropolitan France has 4 000 km of LV rural lines serving some 75 000 customers. In many departments, the needs for reinforcement remain very definitely higher than financial capacity of annual absorption of the badly fed departures. This leaves a significant place to the DSM which then makes it possible to satisfy more customers in their bringing quality of supply to which they have right. Indeed, the DSM does not have the role to replace all the reinforcements but to increase well effectiveness of various work of improvement of power supply.
List of low tension network departures

**NO**

Control by measurement

All departure must be reinforced

- Number of customers on the departure ≤ 10
  - Number of customers on the line ≤ 5
    - Reinforcement cost ≤ 5000 €
      - Voltage adapter slipper tr/mono converter ≤ 2
        - Nb of customers with bad supply > 2
          - Correct and cost-effective solution
        - DSM study
      - DSM actions
    - DSM actions
  - Voltage adapter slipper tr/mono converter > 2
    - DSM study
  - DSM actions
- Reinforcement cost by customer > 5000 €
  - Nb of customers with bad supply > 2
    - Correct and cost-effective solution
  - DSM study
  - DSM actions

**YES**

Network actions

Reinforcement