ENGINEERING STANDARISATION PROCESS FOR SEVEN UTILITIES

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1. INTRODUCTION

In this document we describe the conditions in which Grupo Endesa (GE)-Distribution started a new management framework from seven companies in September 1997. The first signs of the new legislation that would considerably affect the Spanish Electric Industry were taken into account..

The strategy followed by GE-Distribution so as to optimise the programming, engineering and operation processes for the distribution system is also described; particular emphasis is placed on engineering, applied benchmarking techniques and the office automation that support the process.

2. GE-DISTRIBUTION DATA.

In September 1997, seven Spanish companies made up the Distribution Business range for the ENDESA Group: five came from the Peninsula (ENHER, ERZ, FECSA, SEVILLANA and VIESGO) and two were insular (GESA and UNELCO). Table 1 shows the most significant data for each company and their global data. Figure 1 shows the geographical distribution of these companies, which shows they are dispersed throughout the country.

Table 1

COMPANY	CUSTOMERS	AREA (KM^2)	ENERGY (GWH)
(1) ENHER	1.523.043	16.304	16.285
(2) ERZ	679.162	46.206	5.256
(3) FECSA	1.877.500	23.504	18.072
(4) GESA	536.490	4.950	3.375
(5) SEVILLANA	3.570.715	98.780	24.398
(6) UNELCO	788.870	7.478	5.019
(7) VIESGO	469.037	16.125	3.988
TOTAL	**9.444.817**	**213.347**	**76.393**

The legislative situation also has to be considered. The political division of Spain in self-governing regions meant that GE-Distribution had to meet not only the national regulations but also the requirements of nine different self-governing regions (Andalucia, Asturias, Baleares, Cantabria, Canarias, Catalonia, Extremadura and Galicia).

Finally, the impending liberalisation of the electric industry in Spain also had to be taken into account, with the separation of the production, distribution and marketing business lines and the appearance of new agents (system operator, market operator and transmission utilities) and new regulations concerning the quality of the service (continuity and wave quality) with their corresponding economic sanctions and investment obligations.

Figure 1

In the following pages we will refer exclusively to the distribution activity/business, including the HV/MV, MV/MV and MV/LV installations. Table 2 shows the different HV and MV voltage levels present in each GE-Distribution company; this is due to the fact that some of these companies are the result of smaller companies merging during this century.

Table 2

U_n (kV)	COMPANY						
	1	**2**	**3**	**4**	**5**	**6**	**7**
220	x	x	x	x	x	x	x
132	x	x	x	x	x		x
110	x		x				
66	x	x		x	x	x	
55							x
45		x					
30		x		x		x	x
25	x	x	x		x		
20		x			x	x	x
15		x		x	x	x	
13,2		x					
12							x
11	x		x				
10		x					

3. ESTRATEGY

Table 3-1 shows, for each company, the extension of the MV and LV lines, the number of MV/LV Transformation Centres (TC) and the number of areas in which the regions were divided. Table 3-2 shows how many different systems in the technical cycle of distribution were considered basic and had to be standardised.

Table 3-1

COMPANY	TC	KM MV	KM LV	AREAS
ENHER	18456	16422	25290	6
ERZ	10778	10608	9563	4
FECSA	19409	21012	27955	5
GESA	9053	5516	6845	3
SEVILLANA	51442	42079	62278	9
UNELCO	7013	5748	11931	5
VIESGO	9201	8460	15054	3
TOTAL	**125352**	**109845**	**158916**	**35**

Table 3-2

SYSTEMS / APPLICATIONS
BD INSTALLATIONS
BD EXPLOITATION
OPERATIÓN
WORKS MANAGEMENT
MAINTENANCE
NEW SUPPLIES
INCIDENT MANAGEMENT
DESCHARGE MANAGEMENT
SUPPLY QUALITY
OPERATIONAL PLANNING
PLANNING
MAPPING
ENERGY BALANCE
METER MANAGEMENT
CONSTRUCTIVE UNITS
STANDARDS
TRANSFORMER MANAGEMENT

This situation was also characterised by the close ties existing between each company and its implementation territory, and by its good relations with the corresponding local government. Thus, the two companies located in Catalonia (i.e., FECSA and ENHER) initiated the functional integration process. Therefore, the number of management units decreased from 7 to 6.

Management homogenisation was achieved with *benchmarking* techniques and a global view (local-national-international) which identified the present and future requirements and adopted the most satisfactory solution. It was preferable that this solution already existed in one of the companies, with a recent design and easily implemented in all the companies. The Distribution Technical Office was created in Madrid, near the GE decision centres, in order to lead these activities. The Office was formed by three subdepartments called *Competence Centres* and located in the regions where the presence of GE-Distribution was higher: (Barcelona, in Catalonia, and Seville in Andalucia) which together have 80% of the supplied market.

4. THE COMPETENCE CENTRES

At the same time, the companies adjusted the internal organisation of their technical cycles of distribution, implementing an organisation chart identical to that of the Distribution Technical Office. Thus, each competence centre not only had to lead the working groups created for the homogenising and standardising activities but from then on also had to co-ordinate all the activities performed by the same units belonging to different companies. Figure 2-1 shows the structure of the three Competence Centres and the staff assigned to each activity line. Figure 2-2 shows the typical structures adopted by the companies for their Technical Cycle of Distribution and for their interaction with the Competence Centres.

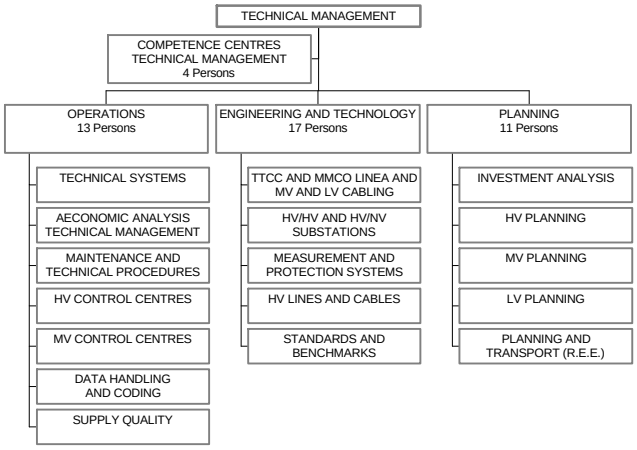

Figure 2-1

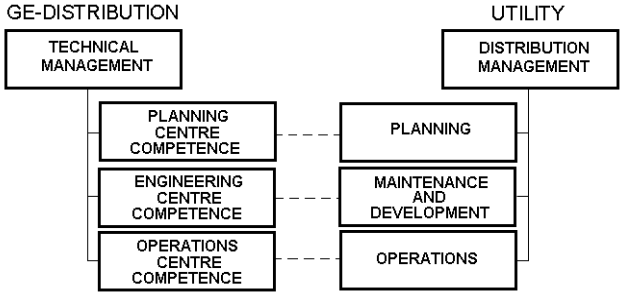

Figure 2-2

In 1998, the Competence Centres have worked very hard in those activities assigned to them and have had the highest collaboration and dedication from the companies' experts. During this period of time, about 30 working groups have been created in order to face the different activities. We have to take into account that often the same engineer has been involved in several working groups at the same time. Usually, the following methodology has been used:

1. The Competence Centre makes a list of the issues that have to be homogenised and sends it to its equivalent unit in the other companies, so that they designate the experts that are going to take part in the working group.

2. The Competence Centre gathers information from the different companies, studies it and makes a proposal.

3. The Competence Centre sends this proposal to the members of the working groups, together with the notice for the first group meeting which will take place in 2-3 weeks' time. Members from other GE-Distribution Services will also assist, when necessary.

4. The proposal is discussed *face to face* until the members reach a consensus on a draft of the final proposal. The draft is then sent to the members of the working group and the other GE-Distribution Services that are interested in that issue for their final

comments. In some cases, the final proposal is also sent to the possible manufacturers.

5. The Competence Centre sends the final document to the Distribution Technical Office in order to be signed. It is then distributed internally in the GE-Distribution as a GE-Regulation which will replace the regulations in each company, if there are any.

Each issue has needed one or two general meetings and some activity consisting of bilateral contacts and mailing, basically by e-mail and video conference. When the task was more complex or voluminous, we decided to divide it in different parts. The competence centre was still in charge of global co-ordination, but a person was chosen as the responsible for each part and the Computer Forum was widely used in order to decrease the number of general meetings.

After one year of intensive work, we have been able to prepare regulations, proceedings, technical tools and strategic criteria which, in fact, will allow GE-Distribution to function as one company. The following sections describe in detail the activities of the Technological Competence Centre; as for the Planning and Operations Competence Centres, their most important activities were:

Planning Competence Centre

Criteria for MV Planning
Criteria for LV Planning
Criteria for Investment Decisions
Sole contact with the System Operator (REE)

Operations Competence Centres

Exploitation Database (BDE) exclusive for distribution; which includes the alphanumeric, orthogonal and cartographic views of the installations and linked to the marketing system, the economical system and the following technical systems:

- Energy Management System (EMS)
- Distribution Management System (DMS)
- Maintenance Proceedings and Strategies
- Regulations on Line Operation
- Work and Maintenance Management
- Disturbances and Quality Supply Management

Maintenance strategies and procedures
Network operating standards.

5. THE TECHNOLOGICAL COMPETENCE CENTRE

The methodology used by the Technological Competence Centre was not different to that described in the previous section. However, it will be interesting to describe the process, since it is precisely in the engineering area where the biggest differences between the methods used by the different companies can be seen. Despite being very small, these differences are very important because the world of distribution consists of thousands and thousands of identical or very similar installations, where a minimal optimisation of the design can lead to important technical and/or economical benefits.

It is easy to agree with what is stated above. Nevertheless, the professional workers of each company often are rightly proud of the design of their installations, thus overrating the advantages of their own design and seeing faults in other designs. Although understandable, this attitude is a serious difficulty when the main aim is to agree one unique design for seven companies.

This attitude, which the sociologists have called “unwillingness to change”, was left behind a few months later. The task of the working groups was made easier by the conviction that the adoption of identical solutions would necessarily reduce the costs in engineering, supply, assembly and maintenance of the installation, by the progressive acceptance of the GE-Distribution reality, where each company is part of a whole, and by frequent personal meetings by the experts. Thus, the proposed aims were achieved with progressively less tension and more cordiality.

A clear leadership is needed in this kind of processes. However, this leadership has to be carried out without imposing itself, encourage participation, moderate conflicting situations and try to satisfy all parties. Nobody must feel a stranger in the working group and all suggestions have to be taken into account, even those contradicting the proposal. Once a good environment is achieved, it is possible to reach solutions which were initially thought unattainable. For example, a working group had to decide what was the best solution for wire identification between the other elements in a substation cupboard. The decision did not seem to be an easy one: some companies labelled the wires in both ends, others in the source component, others in the destination component, and amazingly, only one company had decided many years ago not to label the wires any more. After this company had explained the reasons for this, the working group chose this solution unanimously.

5.1. Structure and functions

Figure 2.1 shows the structure and the staff of the Technological Competence Centre. The activities that had to be carried out have been divided into four large technological areas whose limits and assigned staff have not been clearly established on purpose. These can vary depending on the needs at the time. The Competence Centre has no assistance staff: these and other similar activities (writing of documents, preparation of files, etc...) are performed externally.

The technical *know-how* of transmission and distribution resides in the Technological Competence Centre.

Therefore, the Competence Centre determines the materials, the equipment and the construction solutions for the GE-Distribution installations following criteria for efficiency, security, environmental safety and reduction of costs, while also supervising their correct application. Thus, it has to keep in close contact with the following:

- The Planning and Operations Competence Centres
- The distribution managers of the GE-Distribution companies
- The marketing managers of GE-Distribution and the companies
- The supply and environment managers of GE.

Frequent meetings with the manufacturers are also necessary in order to know which new technologies are available and their possible application in the design of the GE-Distribution installations. Spain is a special country when it comes to environmental aspects; therefore, the design of the installations may have certain variations depending on the region (but always considering the efficiency criteria). Figure 3 is a map with the risk of forest fires; this and other similar maps are included in the Technical Library of Distribution, which is described in detail in the following section.

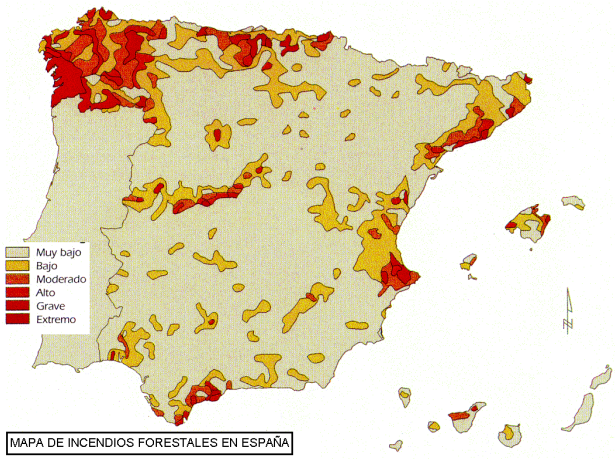

Figure 3

Every year, the person responsible for each technological area writes a list with the main issues. The list is revised by the Distribution Technical Office and by the distribution managers of the companies, in order to give higher priority to the most important issues or to suggest other issues which, although related to specific needs, will be of general interest in a medium term. The issue list is revised and controlled every month.

The issues are studied monographically or are grouped together when they are not very complex and they are related to each other. In any case, a meeting is held when the proposal by the Competence Centre is sufficiently prepared; these meetings may last 1 or 2 days, depending on the issues to be debated.

The final result is always a document. Now the only thing left to do is to solve the *little problem* of how to manage a huge and diverse amount of documents in an environment as dispersed as GE-Distribution (see figure 1).

5.2. The Technical Library of Distribution

The Technical Library of Distribution is the application that supports all the documentation related to the design of the distribution installations and which is accessible for all the technicians of GE-Distribution in the corporation's Intranet. It was created from an application designed by one of the companies.

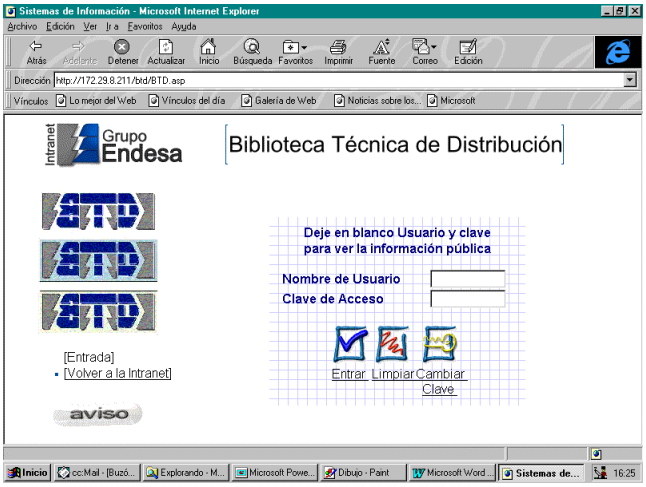

Figure 4

Every document included in the Technical Library usually belongs to one of the following classes:

a. Regulations or technical specifications for the equipment
b. Guides or technical criteria for application
c. Instructions or procedures
d. Articles and technical studies

Classes (a, b and c) belong to the WHAT, WHEN and HOW issues; while class (d) belongs to the WHY issue and contains the corporate knowledge of GE-Distribution. Each document has a person responsible for its content, so that the users know who they have to get in touch with for any questions (doubts, mistakes) regarding the document.

Figure 4 shows the home page of the Technical Library, where the user has to identify him or herself and introduce his/her password. Figure 5 shows the main page with the four options: "Navigation", "Looking for a document", "What's new" and "My Folders".

The management of the documentation contained in the Technical Library is the sole responsibility of the Technological Competence Centre. Thanks to a batch

process, the Technical Library is updated daily; therefore, the users that access the Technical Library are absolutely sure that they have the appropriate documentation.

Figure 5

Each document is independent, but it will usually be assigned to a higher level: the Installation model where it can be applied. For example: the document "Regulation GE LNE001 bare wires for HV aerial lines higher than 30 kV" may be consulted individually or by searching several Installation models. (220 kV aerial lines; 132 kV aerial lines; 66 kV aerial lines, HV/MV substations, etc.).

The user consults the documentation in two different ways:

a. finding a specific document (figure 6).
b. searching in the Installation model tree (figure 7).

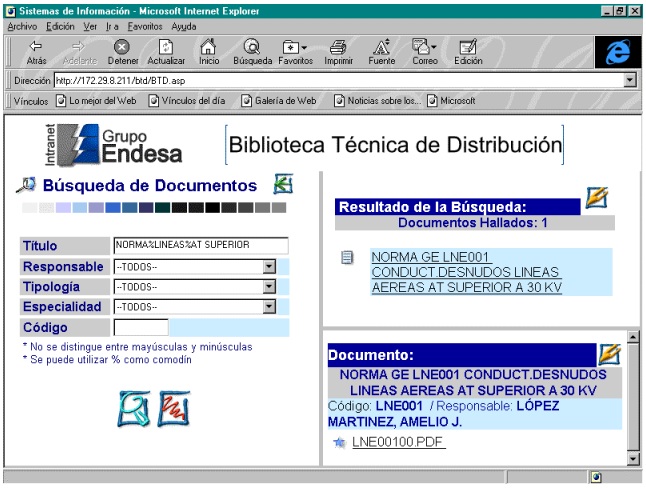

Figure 6

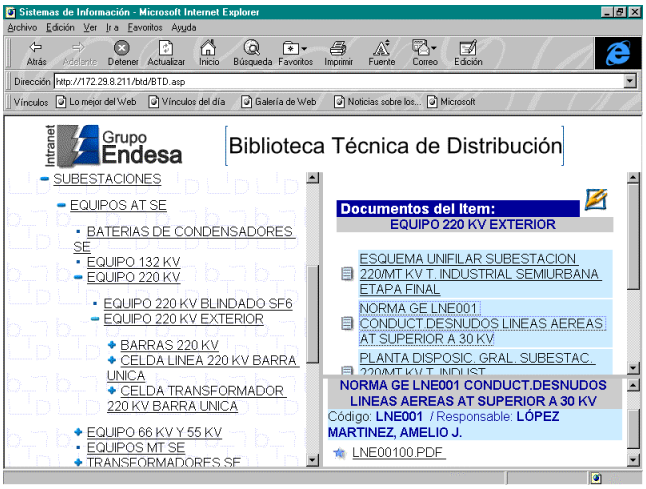

Figure 7

For option (a) it is necessary to know the number or the title of the document. A help guide has been included for this option. For example, the document mentioned in the previous paragraph could be found by writing: "NORMA%LINEAS%AT". The programme will search in the Technical Library and will show the user the title of all the documents which have been found. Once a document is displayed on the screen, the user may:

a. read the document (figure 8)
b. print all or part of the document
c. record all or part of the document in a diskette
d. copy the document in a private file.

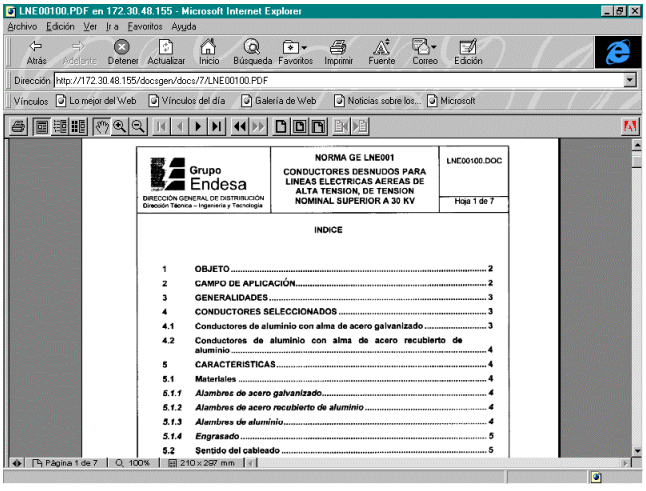

Figure 8

Options (b and c) are usually used for giving the information to third parties (Figure 9), while option (a) is used to solve one specific doubt.

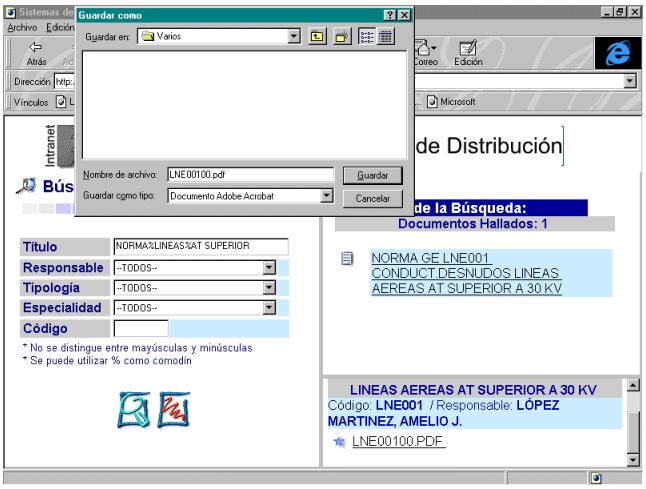

Figure 9

Option (d) allows those users that only work in a specific area (e.g.: MV Underground Lines) to create a customised Technical Library which only contains what they need. At the beginning of the working session, the user can consult "New". Thus, the user that prefers to keep a printed copy of the documents he/she needs or who has created his own private folders may know which documents of the area he is interested in have been entered, deleted or modified.

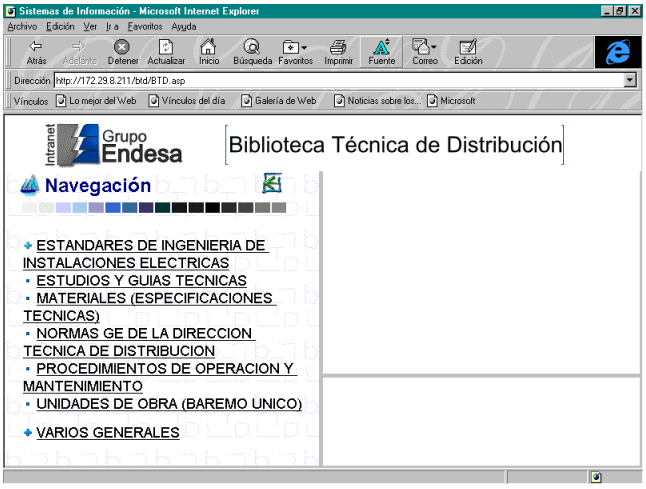

Figure 10

At the moment of publication of this document, the Technical Library has around 2000 documents (figure 10), classified in the following sections:

Engineering standards
Regulations or technical specifications for the equipment
Guides or technical criteria for application
Instructions or procedures
Articles and technical studies

As for the Installation model, the following Engineering standards have been completed (figure 11):

HV/MV substations
Aerial and underground MV lines
Internal and external transformation centres
Optic Fibre Installations

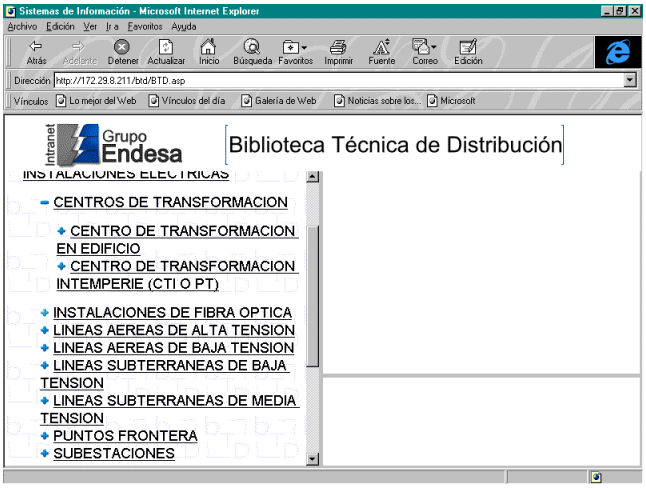

Figure 11

6. CONCLUSIONS

Thanks to following *benchmarking* techniques supported by a perfectly designed leadership, in little more than a year it has been possible to standardise most materials and installations of GE-Distribution. Furthermore, the organisations have been made suitable and new tools have been implemented to facilitate the interaction between the Technological Competence Centre and the engineering and operative areas departments of the GE-Distribution companies. Economically, standardisation accounts for approximately 85% of the cost of acquisition of equipment and services in the construction of new GE-Distribution installations, with significant annual savings.