THE EFFECT OF MICRO-OUTAGES AND DISTURBANCES IN THE ELECTRICITY SUPPLY ON MANUFACTURING PROCESSES IN THE CERAMIC INDUSTRY. CONCLUSIONS.

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Summary:

This paper shows the results applied to the ceramic industry, obtained in the Research and Study Project (PIE nº 132219) of Micro-outages in the Spanish Electricity Supply Network and Methods to Minimise their Effects. The project was carried out between 1991 and 1995 by IBERDROLA, in co-operation with UITESA and the GEDEE Research Group from the Department of Electrical Engineering at the Polytechnic University of Valencia. The project covered the origins, causes and effects of low voltage network conducted disturbances which mainly affect the quality of voltage wave in the electricity supply network and industrial facilities. Voltage dips and brief outages constitute disturbances whose features have brought them to the forefront of an analysis of repercussions on facilities in the ceramic industry.

A study was presented at QUALICER '92 summarising the project's partial results and experiences. This paper sets out the conclusions which may now be drawn from an analysis of features and behaviour of customer facilities and the Iberdrola supply network.

The quality of the electricity supply is subject to many criteria, and customer perception is fundamental if this is to be established. To this end, subsequent to analysis of the results of sampling carried out in a number of industries and on their power supplies, a list has been drawn up of several solutions and general recommendations applicable to distribution networks and internal customer facilities in a bid to mitigate the repercussions of voltage dips and brief interruptions.

After project research and an exhaustive analysis of regulations for gas-fuelled facilities, the Castellón Regional Industry and Energy Service was informed of the conclusions aimed at adjusting the regulations to the behaviour and features of the power supply. The project submitted a document, the Regulations Interpretation Sheet, entitled «Behaviour of Gas Regulating Control Devices in Single-Layer Roller Kilns for Ceramic Manufacturing relative to Power Failures in the Electricity Supply», which suggested specific solutions for the problem created by gas-regulating electrovalves in the ceramic industry.

This interpretation proposal has been dealt with by the Castellón Regional Industry Service and recently, on 21 November 1995, a decision was taken by the Department of Trade and Industry's Energy and Industry Board approving these operational criteria.

1. Introduction.

In 1990 the Spanish company Iberdrola, working alongside the UITESA company and the GEDEE research group from the Department of Electrical Engineering at the Polytechnic University of Valencia, began research on voltage wave disturbances in medium voltage networks in a bid to analyze the actual situation of the network and provide the quality electric power supply demanded by modern society. Research was financed by OCIDE (PIE No. 132219).

References [1], [2] and [3] cover the operational directives fundamental to this project. They set out the aims, specifying the disturbances to be assessed, evaluating all necessary data and resources and potential sources of information, indicating the documentation integration process, and reporting on objectives fulfilled to date. Subsequent phases have now been completed, yielding the results, mainly pertaining to the ceramic industry, with which this paper deals.

2. Project results

2.1. Sampling of disturbances.

The systematic sampling plan was drawn up in two stages:
The **first** stage, the aim of which was to gather background information regarding power lines and customers involved in the study, was carried out successfully (see reference [7]), and sets out first impressions on electrical disturbances found in some industrial processes.

The **second** stage was backed up by the above-mentioned first real contact, and could thus focus on achieving the following objectives:

Carrying out a survey of all incidences, changes in network configuration and anomalies arising in certain lines in the course of the investigation.

- Recording all traceable electrical disturbances at certain points on each line for a period of approximately three months.
- Relating these disturbances to their possible origins, causes and effects, and establishing classification criteria.
- Establishing sensitivity levels and nature of repercussions on equipment affected, and putting forward criteria for possible solutions.
- Analysis of the influence and scope of possible customer disturbance loading, and specific features of their facilities which may be deemed inadequate.
- Gathering information to be added to databases.

In accordance with an established programme, simultaneous monitoring has been carried out on two electrical power lines and on two customers for each line, using five high-performance recorders as follows:

- One medium voltage recorder at the head substation of the power line under investigation.

- One medium voltage recorder at each customer transformation centre.

- One low voltage recorder on these customers' actual premises.

For each specific case, sampling progress has advised in favour of or against changes to be made in the location of recorders, especially in the case of low voltage recorders.

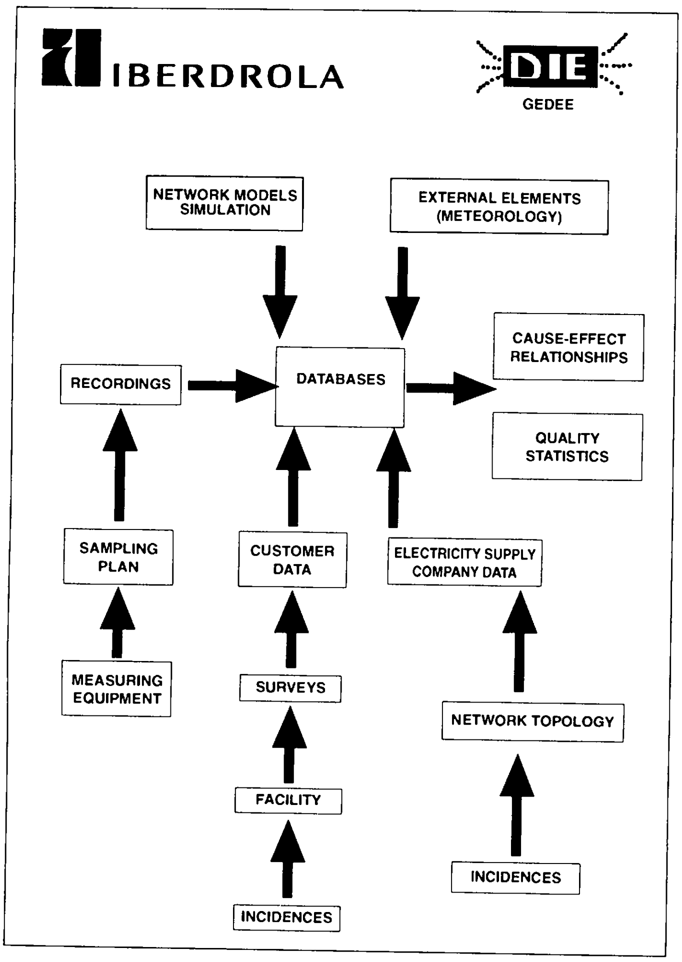


FIGURE 1

Selection of the two customers, also analyzed using medium voltage power supply, was decided in accordance with the following: their situation within the line configuration, whether or not they had a co- generation facility, the sensitivity recorded in their equipment, type of manufacturing process, non-linearity or distortion brought on by the load and, in particular, their actual willingness to co-operate during the sampling process.

In addition to the customers, other parties involved in the plan were:

For Iberdrola

➢ A coordinator for the various regional distribution units involved.

➢ The respective heads of regional distribution units on the lines under investigation, or their authorised representatives.

For GEDEE (University Department of Electrical Engineering):

➢ A plan coordinator.
➢ 2 X two-man data monitoring teams.

The monitoring teams dealt with interpretation of recordings and relevant enquiries to draw up a justifiable correlation with regard to origins, causes, effects and consequences.

Independently of the sampling plan focusing on a specific programme, using suitable shorter-time controls it has been deemed convenient to begin cause-effect research and possible mitigation, in centres with specific problems. Thus, a number of studies have been carried out to this end, involving separate analyses of certain industrial processes for various economic activities over periods of not more than three weeks.

2.2. Data analysis and monitoring.

Information obtained during the various stages covered by the sampling plan was pooled into the relevant databases for a reliable understanding of the behaviour of each line under investigation. Subsequently, an in- depth study was made of the various information packages, their contents were closely scrutinised, their meaning and possible relationship interpreted and the simulation models progressively checked (with the EMTP package). Thus a diagnosis could be carried out and recommendations put forward for the most suitable treatment to mitigate disturbances. These procedures are summarised in Figure 1.

Each investigation has been summarised in a separate report for each line, with a specific structure and a complete breakdown of suggested solutions for both customers and the power supply company.

As an insight into partial conclusions which are now being drawn, it may be said that:
Mean values, expressed as percentages, of disturbances recorded on the monitors located at the **head** of the lines under investigation have produced the following concepts and figures:

- ❖ Micro-outages or zero voltages, lasting less than 1 minute 2.90%
- ❖ Voltage dips with homopolar component 13.4%
- ❖ Voltage dips
  - two-phase with ΔU (fall in voltage) < 20 % 9.30%
  - two-phase with ΔU > 20% 3.80%
  - three-phase with ΔU < 20% 4.20%
  - three-phase with ΔU > 20% 3.20%
- ❖ Voltage waveform disturbances due to connection of substation condenser batteries 28.70%
- ❖ Voltage waveform disturbances with rapidly damped homopolar component 23,70%
- ❖ Other voltage waveform disturbances 10.00%
- ❖ Power failures > 1 minute 0.80%

Voltage waveform disturbances of current measured at the head have been of no significance in any case study.

We should emphasise, with a view to carrying out in-depth monitoring of each register,

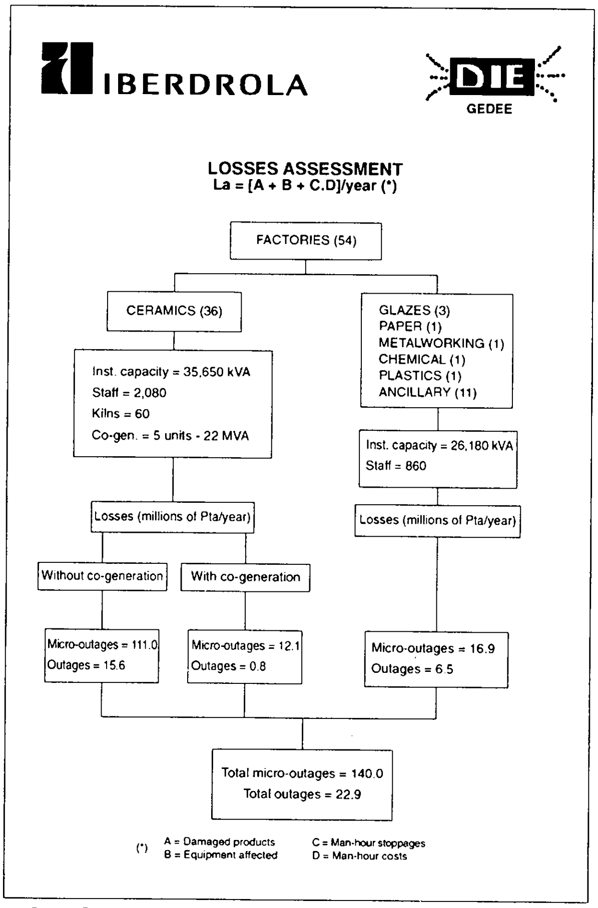


FIGURE 2

the almost inevitable need to know how both simple and compound waveforms behave in the three phases, and moreover the behaviour of the intensity wave in these phases.

The origins of previous disturbances have been related to the high voltage network in 12% of cases studied, and to the medium voltage supply or to customers' facilities in 68% of cases. It was not possible to ascertain the origins of the remaining 20%.

Furthermore, causes could only be satisfactorily ascertained in 55% of cases studied. The most frequent causes were storms and rainfall at 30%, ahead of substation condenser batteries connection, 20%, and lastly forest fires and breakdown of equipment either within the distribution network or in the customers' facilities, combining to account for 5%.

Repercussions on the manufacturing processes, monitored simultaneously with their power supply, also expressed as average percentages with regard to total number of disturbances, were the following:

➢ Sensitivity of customer with co-generation facility to continue operations while cut out from the mains	18%
✦ Micro-outages	2.9%
✦ Voltage dips with homopolar component	9.5%
✦ Two-phase dips, ΔU (fall in voltage) > 20%	2.5%
✦ Three-phase dips, ΔU > 20%	2.3%
✦ Power failure > 1 minute	0.8%
Total	18%
➢ Manufacturing process stoppages, non-cogeneration customers	8%
✦ Micro-outages	2.9%
✦ Homopolar voltage dips	1.2%

✦ Two-phase dips, ΔU > 20%		1.3%
✦ Three-phase dips, ΔU > 20%		1.6%
✦ Waveform disturbances		0.2%
✦ Power failure > 1 minute		0.8%
	Total	8%

Figure 2 shows the approximate average assessment of annual losses as a consequence of the repercussions of electrical disturbances at 54 plants connected to the medium voltage supply lines. It also shows type of activity and provides significant sample size measurements.

Medium voltage recordings on the customer transformation centres averaged 55% of occurrences undetected at the head of the line. Of these, at least 5% had originated from the customer's facilities, although they were causing no direct damage to these facilities.

It has also been observed that between 50% and 60% of recordings obtained in the low voltage customer facility were not detected at higher voltage levels. These were mainly impulses and disturbances in the voltage waveform, and to a lesser extent in the intensity waveform, which were attributable to the customer himself, and which have so far occasioned no appreciable disorders in the manufacturing facilities involved.

2.3. Solutions

Solutions put forward have either concentrated on reducing the frequency of the disturbances occurring, or preventing or mitigating repercussions in sensitive receivers.

In the case of the former, Figure 3 summarises a number of conditions for the electricity supply company and others to be borne in mind by customers. The latter, with reference to actual receiver operations, have been divided into two groups: solutions for the ceramic industry in Figure 4, and solutions for other branches with specific problems in Figures 5 and 6.

In the ceramic industry the equipment most sensitive to disturbances are the gas-fuelled kilns, due to closure of the general electrovalve regulating gas flow, subsequent stoppage and restart of process, relighting with the loss of materials affected.

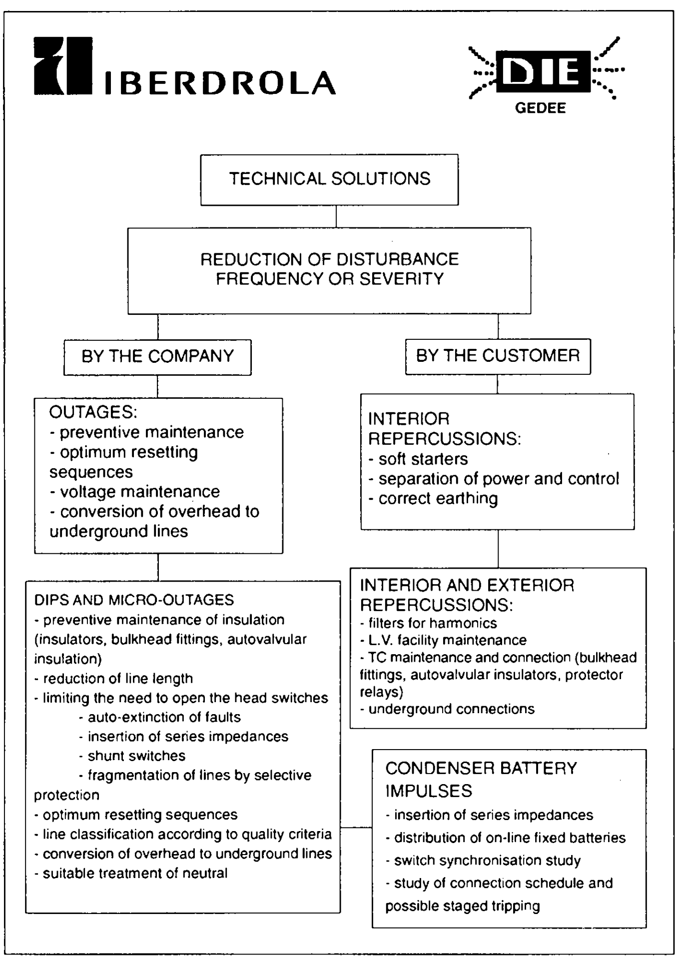
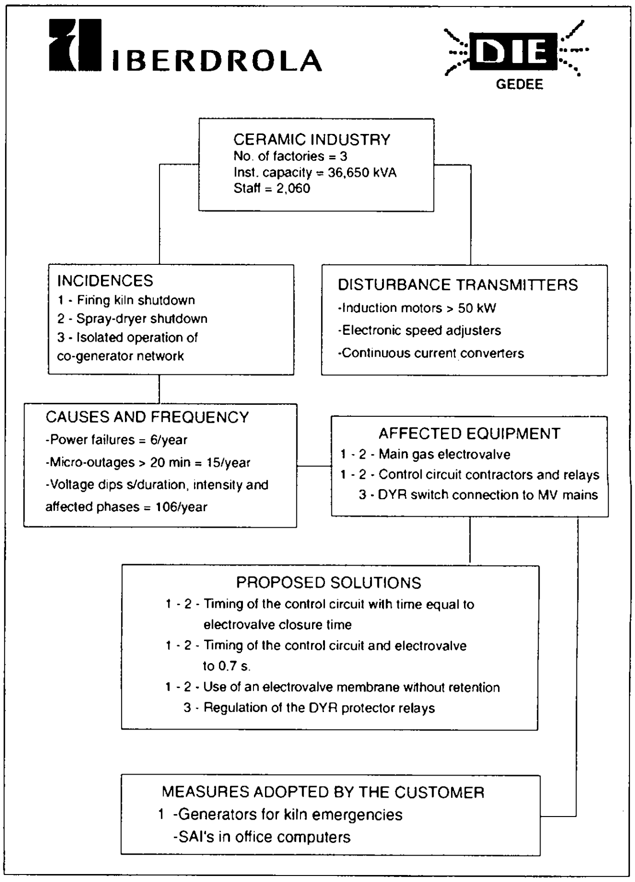


FIGURE 3

Some factories within this sector are involved in raw materials preparation by means of spray-drying facilities, normally using heat from co-generation. Incidences here have specific features in each case, and affect both the unit which, when cut out from the mains, must reconcile its power to internal demand, and also the spray dryer, whose output must be limited to heat supplied by the new working situation.

FIGURE 4



3.Repercussions on the ceramic industry

Within the various processes affected by electrical disturbances, ceramic manufacturing is particularly sensitive to these due to the continuous nature of its processes.

The excessive sensitivity of the processes and the heterogeneous response to voltage dips detected in the various kilns have encouraged the search for solutions which will provide common operating criteria consistent with safety guarantees.

To begin with, an analysis was carried out of regulations affecting this type of facility: Regulations for gas-fired equipment, approved by Royal Decree 494/1988 of 20 May and Complementary Technical Instructions from Order 29375 of 15 December 1988, ITC MIE-AG20, referring to the UNE 60-740-85 Standard concerning burners as the recommended standard and, in some terms (safety times), as the compulsory regulation to be applied.

These regulations make reference to a variety of gas appliances, and many sections are not, therefore, specific. Analysis of regulations leads to the following considerations:

- **It is thought that the term automatic does not define the electrovalve's closure time, which implies ambiguity in the interpretation of this regulation.**
- **A considerable degree of inaccuracy has been observed in reference to electrical power failures, since neither their DURATION nor their MAGNITUDE are specified.**

Current regulations impose the same restrictions on power failures. Insufficient definition of power failure which may affect kiln operation currently places higher demands on its operation, falling back on a more conservative option: blockage of the kiln independently of power failure.

From these conclusions, an interpretation has been put forward of certain sections of the regulations applicable to kilns, dryers and spray dryers used in the ceramic industry.

Specifically, a paper has been submitted to the Department of Industry as a first step in the process of requesting an updated INTERPRETATION OF REGULATIONS currently in force on gas-fired kiln facility operation.

The paper is to be taken as the Technical Justification of the proposed Interpretation Sheet, and shows the effects of power failures on parameters which assess the safety of the ceramic manufacturing process, specifying the magnitude of processes affected, sensitive pieces of equipment and their response to the various disturbances. The following sets out the most important points covered in this document:

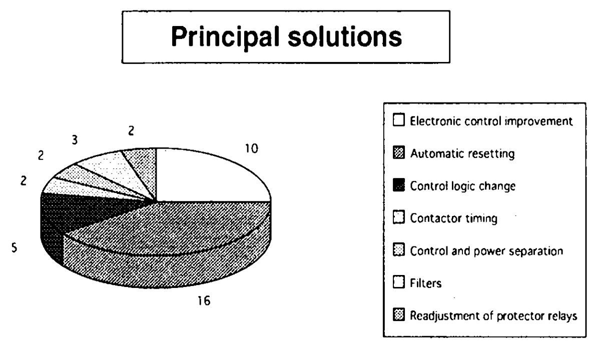


FIGURE 5

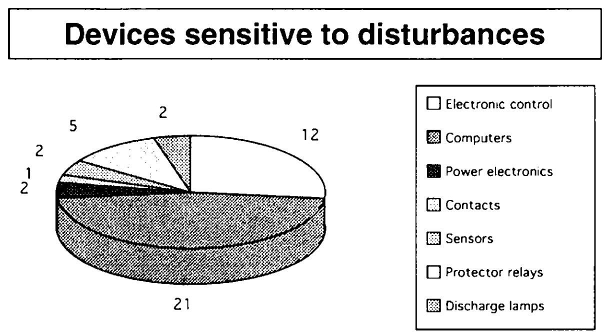


FIGURE 6

3.1. Effects on the manufacturing process.

Disturbances in electricity supply affect the various operations which make up the ceramic manufacturing process; firing, spray-drying, pressing, outgoing product, ..., and these effects have considerable economic repercussions.

A) Firing

This is the most sensitive operation. The kiln shuts down, with a range of possible effects: closure of the electrovalves regulating gas flow to the burners, shutdown of the roller-driving system, stoppage of the flue-gas extractors and combustion air supplying fans, and loss of process control.

It has been observed that, as a general rule, the voltage dips affecting the kilns last less than one second. A kiln stoppage calls for relighting, which in turn creates complications within the process. From an economic standpoint it implies the following:

Quality loss in the finished product

Firing is the most critical part of the process, since it is during this stage that the product acquires the targeted finished product properties and qualities.

Firing of the various materials requires certain temperature and atmosphere conditions within the kiln. A kiln shutdown causes a swift drop in temperature within the kiln, due on the one hand to the low thermal inertia typical of modern single-layer roller kilns, and on the other to loss of ventilation, which also alters heat distribution inside the kiln. This can lower the temperature by up to 100º, depending on the duration of the interruption. All this visibly alters the programmed firing schedule. It gives rise to an uncontrolled firing process which damages material being fired, and can lead to rejection of the product or, at best, considerably impair its quality.

This loss of quality is caused by:

- unwanted changes in the structure of clays and glazes, viz. internal fissures and cracks which are not always visible and make the product brittle.
- loss of planarity or variation in product sizes, with wedging and dimensional variations.
- appearance of «black coring», due to incomplete oxidation.
- variations in compactness.
- variations in product vitrification.
- changes in colour or appreciable differences in shades.
- variation in mechanical properties ...

Drop in productivity

An accidental stoppage of the process involves a drop in productivity for two reasons:

- material and finished product

Material losses arise mainly inside the kiln, with finished product loss due to the impaired quality mentioned above.

- downtime

However short the interruption of the power supply, restarting the process in compliance with the sequence required by regulations for relighting requires a period of time which would hardly be less than 5 minutes. The time also depends on the features of the kilns and the specific resources of the industries. An additional period of time must also be borne in mind for a return to normal working situations.

Compliance with any restarting sequence involves a considerable period of non-productive time, the duration of which will depend on the number of kilns affected and the experience and skill of machine operators, but which is not normally less than 15 or 20 minutes.

There are other economic repercussions to be considered:

Deterioration of equipment

Damage may be caused to rollers and spray nozzles, and damage assessment is not always immediate, giving rise to a finished product with disturbances which will be detected at end quality control, with the consequent effects on productivity. Although provision has been made for generator start-up at sufficient notice to ensure drive after power failure, there is still some risk involved.

Manpower

Possible stoppages create difficulties for kiln operation, which requires sufficient staff to enable relighting to be carried out in the shortest possible space of time.

B) Spray drying

The spray dryer's basic feature is a burner creating a hot air current for atomising the slip. As in the case of the kiln, the gas burner is also governed by the above-mentioned regulations, and gas flow is controlled by an electric safety valve sensitive to voltage dips. This blocks the spray dryer with the following economic repercussions:

Loss in productivity

• <u>Product loss</u>

The lack of a hot air current creates precipitation in the slip, and sludge which sticks to the spray-dryer walls, obstructing the pressure nozzles carrying the suspension to be atomised. The result is that all the material inside the spray dryer is lost.

• <u>Downtime</u>

The unit must be cleansed for restarting. This involves a period of non-productive time and therefore economic losses.

Manpower

During the incidence, manpower must be used to clean the spray dryer and return to a normal work schedule.

Deterioration of pressure nozzles

C) Co-generation

During voltage dips and micro-outages in the electricity supply, the switch connecting the plant to the medium voltage network [10] is opened. This «isolates» the factory and causes the following:

- When the co-generator is reconciled with works consumption, there is a transitory period which affects low voltage supply, which in turn reduces the co-generator's useful life.

- If the power generated is very similar to or less than that consumed on the shop floor, it may be necessary to disconnect some processes during the «isolation» period.

- Drop in extracted gas flow when generated power is reduced, which calls for stoppage of some spray dryers.

- Co-generation does not prevent the voltage dip prior to disconnection of the switch being experienced on the shop floor, and thus some of the above-mentioned repercussions may occur.

D) End product lines

End product lines are coordinated by automated programming and may lose information during power failures. All this involves line stoppages to reclassify the packaged product and return the machines to operation.

3.2. Response of kiln equipment to disturbances in the electricity supply.

Maintenance of gas pressure depends on the sensitivity of the gas flow electrovalve to power failure, while combustion air and flue-gas extraction pressures will depend on the extent to which the fans are affected. Thus the theoretical study concentrates on the behaviour of these elements in the event of temporary disturbances.

The large share of floor and wall tile manufacture in the ceramic industry's energy consumption allows the single-layer roller kiln to be defined as a standard kiln. Having assessed the features of the various, most widely used kilns in this branch, and considering gas regulation and ventilation systems, we may conclude that the kilns all operate in similar fashion. Differences arise in the type of electrovalves used and the size of the kiln, which will determine the dimensions of the fan and extraction motors.

A) The automatic gas flow electrovalve and contactors

The following electrovalves have been studied:

Counterweight: GC2

Membrane: VG80; VG 50; VG40 RO1

As for contactors and disjunctors in control circuits, the following have been studied:

Sprecher + Schuh CA 4-9-10
Siemens 3TB4017-OBM4

At the Engineering Department of the Polytechnic University of Valencia both these types of element have been subjected to various voltage dips, in a bid to obtain failure curves: on analysing the curves obtained from the various tested elements, the following conclusions may be drawn:

- The kiln's control elements (contactors, relays etc) are more sensitive than the gas regulating electrovalves. Kiln stoppage is governed by these control elements.

- The membrane electrovalves are more sensitive than the counterweight variety, although they have recovery capacity.

- The membrane electrovalves begin the closure process before 100 ms., although their recovery capacity does not make closure effective until 200-300 ms.

- There are standardised counterweight valves which do not close if there is not 300 ms. voltage.

B) The fan

In specific reference to the ceramic industry, it might be said that 90% of the load consists of induction motors. These use up large amounts of energy and have a high level of inertia. They are less sensitive to power drops. Incidences are observed most frequently in motors which power large fans, glaze pumps, clay crushers, compressors etc.

As has been observed, the behaviour of the gas regulating electrovalve is determined by the kiln's safety devices. Some safety devices are based on measurements of fan output pressures.

Safety measures pertaining to the formation of the mix and extraction of flue gases are based on pressure measurements at the fans, and so the fan is deemed to be a critical piece of equipment for kiln safety.

The working point of a fan coupled to a facility is defined by the pressure-flow rate pair of values (p-Q) for a fan at a certain speed. The change in fan revolutions will thus modify the initial pressure and flow rate values.

A dynamic study of the motor-fan unit can determine the time taken for the unit to move from one running speed, n1, to a new working point, n2.

From this equation, it may be appreciated that the most critical form of working for a fan is at higher speeds. This situation becomes even more critical in the case of large-size kilns that require larger flow rates.

4.Conclusions.

The paper shows the general conclusions which have been made during this investigation, although it must be pointed out that since the electrical system is a unit consisting of elements from the electric company and from the various customers, disturbances created by either party affect the entire system, and the co-operation of both parties is necessary to prevent them as far as possible or to mitigate their effects. It should also be noted that a specific solution to the effects of disturbances in a given manufacturing process requires, in general, a detailed study of that particular process if specific and satisfactory solutions are to be found.

Regarding the ceramic industry, particularly in the case of single- layer roller kilns, an «Interpretation Sheet» of current regulations has been put forward, which calls for: **Greater accuracy in terms defining operations to be carried out in ceramic single-layer roller kilns on power failure in the electricity supply:**

- **Definition of what constitutes «power failure», differentiating between modes of behaviour according to their duration and magnitude.**

- **Behaviour of the control circuit after transitory disturbances lasting less than 1 second.**

- **Behaviour of the electrovalve after transitory disturbances lasting less than 1 second.**

The interpretation requested is to be found in the enclosed Interpretation Sheet in Annex 1, which attempts to differentiate between demands on ceramic kiln operations in the event of disturbances in the electricity supply for less than 1 s.

Recently, the Industry and Energy Board of the Autonomous Valencian Government's Department of Trade and Industry passed a resolution approving operating criteria for gas-flow control devices in single- layer roller kilns used in ceramic manufacturing in the event of an electrical power failure, and this is to be found in ANNEX 2.

5.ANNEX 1

INTERPRETATION SHEET PROPOSAL

RE: GAS-FLOW CONTROL DEVICE OPERATIONS IN SINGLE-LAYER ROLLER KILNS USED IN CERAMIC MANUFACTURING IN THE EVENT OF AN ELECTRICAL POWER FAILURE.

INTRODUCTION:

In its capacity as an appliance using gas as fuel, the single-layer roller kiln is subject to the Regulation approved by Royal Decree 494/1988 of 20 May, and Complementary Technical Instructions from Order 29375 of 15 December 1988, MIE AG 20, referring to Regulation UNE 60- 740-85 Part 2 concerning burners as the recommended standard and, in some terms (safety times), as the compulsory regulation to be applied.

In section 1.9.2. of the Complementary Technical Instructions MIE-AG 20 Annex, reference is made to the operating features of appliances with combustion equipment and burners with fans. It states that stoppage of the combustion equipment may be carried out manually or automatically, either due to a power failure or as the result of operations carried out by regulating or safety devices.

Section 1.8. of the ITC MIE AG 20 annex defines minimum safety devices which must be implemented and safety times applicable in cases of Safety Stoppage, but it does not cover those applicable in cases of Power Failure Stoppage.

Regulation UNE 60-740-85 Part 2, and more specifically section 4.1.2.2.5., defines the operations carried out by the control devices, so that gas arriving at the burner shall be automatically shut off in the event of power failure, and when the control circuit is down.

This definition contains two inaccuracies:

- Firstly, in reference to power failures in the electricity supply, neither their DURATION nor their MAGNITUDE are specified.

- Secondly, the term «automatic» imposes no safety time for the operation carried out by the gas regulating electrovalve.

This Interpretation Sheet aims to place limits on such inaccuracies, which currently cause a certain diversity in the operations carried out by the various kilns and, on occasion, excessively strict application of regulations.

INTERPRETATION:

In the case of power failures in the electricity supply of up to 1 minute, the inertia of the combustion air supplying and gas extraction motors is sufficient to maintain combustion in the single-layer roller kilns under safety conditions. Moreover, assuming that the relevant contactors and the gas regulating electrovalve are still operational, the following action may be taken to prevent kiln shutdown:

- **Timing of the control circuit to a time equal to the gas electrovalve's closure time, never more than 1 second in any case.**

- **Timing of the control circuit to 1 second, when recovery membrane electrovalves are in use.**

In these cases, during the timing process it will be necessary to keep the kiln's protection devices operational.

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Adjunto se remite para su conocimiento Resolución de la Dirección General de Industria y Energía por la que se aprueban los criterios de actuación de los dispositivos de control de paso de gas en horno monoestrato de producción cerámica, ante fallo de tensión en el suministro eléctrico.

Valencia, 21 de noviembre de 1995

EL JEFE DEL SERVICIO DE ORGANIZACIÓN
Y ADMINISTRACIÓN INDUSTRIAL

Fdo.: Pedro González García

IBERDROLA REGISTRO INTERNO
03103 30 NOV. 1995

ACCIÓN:

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Resolución de la Dirección General de Industria y Energía por la que se aprueban los criterios de actuación de los dispositivos de control de paso de gas en horno monoestrato de producción cerámica, ante fallo de tensión en el suministro eléctrico.

VISTA la propuesta presentada en el Servicio Territorial de Industria y Energía de Castellón por la empresa Iberdrola, S.A. en la que acompaña la justificación técnica sobre el funcionamiento de las instalaciones de hornos de gas, con el objeto de reducir los perjuicios económicos, técnicos y sociales que producen las perturbaciones de la energía eléctrica, y que en síntesis se reduce a que:

El horno monoestrato como aparato que utiliza gas como combustible se rige por el Reglamento aprobado por el Real Decreto 494/1988 del 20 de mayo, y su Instrucción Técnica Complementaria MIE-AG 20 de la Orden de 15 de diciembre de 1988, en la que se alude a la Norma UNE 60-740-85 (Parte 2) sobre quemadores con ventilador, como norma de aplicación recomendada y en algunos términos (tiempo de seguridad) exigida.

En el apartado 1.9.2. del Anexo de la Instrucción Técnica Complementaria MIE-AG 20, se hace referencia a las características de funcionamiento de los aparatos con equipos de combustión con quemadores con ventilador, indicándose que, el paro del equipo de combustión puede llevarse a cabo de forma manual o bien de forma automática, ya sea por fallo de la energía o mando por actuación de los elementos de regulación o seguridad.

En el apartado 1.8 del anexo de la ITC MIE-AG 20 se definen los dispositivos mínimos de seguridad que deben ser implantados y los tiempos de seguridad aplicables en los casos de paro por seguridad, pero no se recogen los aplicables en caso de paro por fallo de tensión.

En la Norma UNE 60-740-85 (Parte 2), y en concreto en el apartado 4.1.2.2.5. se define la actuación de los dispositivos de control de forma que la aportación de gas al quemador debe cerrarse de forma automática en caso de fallo de tensión en la red, así como de la interrupción del circuito de mando.

En esta definición se detecta, por un lado, al referirse a fallos de tensión del suministro de energía eléctrica, no especifica duración, ni magnitud de los mismos, y por otro, el término "automático" no impone tiempo de seguridad concreto para la actuación de la electroválvula de paso de gas.

Los presentes criterios pretenden delimitar dichas imprecisiones, que actualmente llevan a cierta heterogeneidad en la actuación de los diferentes hornos y en ocasiones, a una excesiva rigidez en la aplicación de esta normativa.

VISTO el informe favorable emitido por el órgano instructor del expediente, de fecha 5.06.95.

Esta Dirección General de Industria y Energia resuelve aprobar los siguientes criterios de actuación de los dispositivos de control de paso de gas en los hornos monoestrato de producción cerámica:

Para fallos de tensión en el suministro eléctrico, de duración hasta 1 segundo, la inercia de los motores de aporte de aire y extracción de humos es suficiente para mantener la combustión en los hornos monoestratos, en condiciones de seguridad, suponiendo además, que se mantienen en operación los contactores correspondientes y la electroválvula de gas, se pueden permitir las siguientes acciones alternativas, a fin de evitar la parada del horno:

- Temporización del circuito de control a un tiempo igual al cierre de la electroválvula de gas, en ningún caso superior a 1 segundo.

- Temporización del circuito de control hasta 1 segundo, cuando se utilicen electroválvulas de membrana con recuperación.

En estos casos, durante la temporización, será necesario mantener activas las protecciones de seguridad del horno.

Valencia, 21 NOV. 95

EL DIRECTOR GENERAL DE
INDUSTRIA Y ENERGIA

José Luis Ramirez Sorribes

6. ANNEX 2

Resolution of the Board of the Department of Industry and Energy, approving operational criteria for gas control devices used in single- layer roller kilns for ceramic manufacture, in the event of a power failure in the electricity supply.

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