ENUSA, INTERNATIONALIZED ENTERPRISE IN NUCLEAR FUEL MANUFACTURE AND ASSOCIATED ENGINEERING SERVICES

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Since the beginning of its activities, in 1972, ENUSA has been providing an important contribution to Spanish nuclear energy development, performing activities in the first part of the nuclear fuel cycle.
Few years after starting the production at the Juzbado manufacturing plant, ENUSA realised that, in order to be competitive, needed to expand its activities beyond the Spanish border and took the decision of being present in the Nuclear fuel market in Europe internationalizing its activities.
ENUSA reached Strategic Alliances with two of the most important technology owners, General Electric and Westinghouse. These alliances have allowed the Company to be one of the players in the very competitive European fuel market, and have also been important to position ENUSA in an industry in process of consolidation.
In parallel to these activities, ENUSA has been present in different international R&D projects, being member of the NFIR of EPRI and Halden projects, and promoting other international R&D programs with companies from USA, Japan, etc. This R&D efforts, together with those Alliances, will allow ENUSA to have an advanced product in this new deregulated market, creating value to the service of our customers.

ENUSA was created in 1972 as a result of the Spanish government's interest in the integrated development of nuclear power in Spain. This firm was entrusted with full nuclear fuel cycle management, at first only for Spanish power plants. As is known, the final nuclear program fell far short of what was initially planned. As a result, fuel manufacture needs declined drastically, and ENUSA's fuel factory in Salamanca had to adapt to the lower manufacturing volume.

The factory began producing in 1985, and around 1989 it became obvious that the company's future would not make any sense, owing to a lack of long-term competitiveness, if it depended exclusively on Spanish fuel needs. Therefore, the strategic decision was made to try to enter other European countries by targeting the European market.

Compared to other European and U.S. competitors, ENUSA is a very small company and focuses exclusively on fuel, whereas competitors, in addition to fuel manufacturing, also have technology and reactor manufacturing capabilities and some even have fuel reprocessing capabilities.

The decision to internationalize and enter the European market was accompanied by the decision to form Strategic Alliances with two American suppliers, General Electric and Westinghouse, which in turn were ENUSA's technological partners for manufacturing BWR and PWR fuel and contractors of all the Spanish nuclear power plants except for Trillo NPP.

Thus the European Fuel Group was created together with British Nuclear Fuel (BNFL) and Westinghouse, and GENUSA was created with General Electric Company. The purpose of both organizations is to market ENUSA-manufactured fuel in Europe. Both partnerships gave ENUSA the size and technology required to compete on an equal footing. ENUSA provided its facilities, its Spanish market position and its commercial capability in Europe, and it facilitated General Electric's and Westinghouse's access to the European market.

The internationalization process has been successful, as 50% of the production of ENUSA's factory is exported. Specifically, ENUSA supplies or has supplied nuclear fuel to the following electric utilities and nuclear power plants:

- TVO, for the Olkiluoto plant in Finland.
- RWE, for the Gundremmingen plant in Germany.
- HEW, for the Krümmel plant in Germany.
- Vattenfall, for the Ringhals and Forsmark plants in Sweden.
- BKW, for the Mühleberg plant in Switzerland.
- EGL, for the Leibstadt plant in Switzerland.
- Electrabel, for the Doel plant in Belgium.
- EdF, for the Belleville and Cattenom plants in France.
- British Energy, gadolinium rods for the Sizewell B plant in Great Britain.

Fuel manufacturing in Spain features a wide range of highly flexible products and designs. To achieve this, ENUSA had to adapt its engineering and production lines to meet the requirements of its different customers.

Table I shows the different types of fuel manufactured by ENUSA.

Thanks to the diversification of its supplies, ENUSA has been qualified for fuel design and manufacture by different European regulatory bodies, as well as by other independent auditing organizations. This qualification is periodically reviewed.

ENUSA currently offers very competitive designs, both for pressurized water and boiling water reactors. Figure I shows some examples.

PRODUCT	PLANTS
MAEF 17x17	Almaraz I, II Vandellós II
MAEF 17X17 – IFM	Ascó I, II
MAEF 17X17 – XL	Doel-4
AEF 17X17 – XL	EDF Belleville 1 Cattenon 1
LO-LOPAR 14X14	Zorita
16X16-20 CNT	Trillo
MAEF 15X15	Ringhals-2
GE12	Cofrentes TVO Grundenmingen
GE14	Nuclenor Forsmark

Table I

In addition to fuel manufacturing, ENUSA has developed a significant engineering services market in Spain and in the rest of Europe and the U.S., and in the two technological areas. ENUSA thus has a human team offering experience and proximity to the customer.

ENUSA has invested heavily in Research & Development in order to satisfy the demands of the European market as a whole and to leverage its own capabilities to serve this market. In this respect, the following activities are noteworthy:

- Development of 16 x 16 fuel for Trillo NPP
- Experimental irradiation programs with new materials
- High-burn irradiation programs
- Development of behavioral models
- Participation in international fuel programs.

By taking part in international research programs, ENUSA has demonstrated its commitment to invest in Research at the very highest level and its ability to lead new product development programs in order to improve fuel performance and nuclear power plant safety. In the early 90s, ENUSA joined the International Fuel Research Program of Halden, Norway. It later joined the EPRI's NFIR Program. This participation in specific programs provides the basis for development of future nuclear fuel.

ENUSA has been involved in multiple Joint Development Programs. These include the technological Research & Development agreements that ENUSA has with Mitsubishi Electric Company and Westinghouse on one hand, and with Japan Nuclear Fuel and GE on the other, aimed at improving the knowledge of manufacturing materials and processes. These help ENUSA to more competitively position itself on the international market.

The partnership strategy has not only had positive results to date, but it also is considered as key to successfully confronting the changes that are occurring as a result of fuel manufacturer consolidation, which is being driven by the intense competition caused by deregulation of the electric industry and business globalization.

It is to be expected that mid-term consolidation will also be significant on the demand side, i.e. owner utilities of nuclear power plants.

Given ENUSA's characteristics and specifically the internationalization process it has undertaken, we consider that, in the new competitive environment, it will continue to be a reference manufacturer in Europe at the service of its customers.

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Figure I: *ENUSA's Technology Offering. Products*