

# SPANISH INDUSTRY IN THE CONTEXT OF MANUFACTURING ACCELERATOR COMPONENTS

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## ABSTRACT

Spanish industry is rather young, in terms of its participation in activities related to accelerator component manufacturing, due to its late incorporation into CERN. However, it has been gradually acquiring a proven experience in different accelerator technologies, namely superconductivity, ultra high vacuum, power supply, radiofrequency, cryogenics, engineering (mechanic & electronic) and software. Its expertise has been shown by getting industrial contracts in CERN and ESRF in hard competition with the main European companies in the field of accelerator technologies. Furthermore, Spanish industry has the willingness and capability to undertake new developments which allow us to be quite optimistic of its success in the future projects like LHC, the Spanish Beamline in ESRF, and specially, the Spanish Synchrotron. To this end, we in CDTI promote actions to enable industry to get new know-how, which added to that which it now has, must lead to good participation in the future projects, in coordination with Spanish National Plan for High Energy Physics (mainly for experiment detectors) and alongside CERN (for technology transfer purposes). If the LHC is going to be the acid test for our industry to demonstrate its maturity, the Spanish Synchrotron should show it to be of age.

## 1 INTRODUCTION.

Spanish industry is rather young in terms of its participation in activities related to accelerator component manufacturing, although there were remote previous experiences, during the initial incorporation of Spain into the CERN Organization in 1962. However, at that time our industry did not have the necessary continuity, because of problems linked Spain's exit from CERN in 1968.

With the reincorporation of Spain to CERN in 1983 and the beginning of the Spanish National Plan for High Energy Physics, a new era started for Spanish industry. Although this growth has been slow, it has produced tangible results in different fields of technology namely superconductivity, ultra high vacuum, power supply, radiofrequency, cryogenics, engineering (mechanical & electronic), software, etc.

In this new era, CDTI has bet decidedly for strengthening the industrial capabilities of Spanish companies in order to increase the industrial returns from CERN and ESRF. To this end, we promote technological activities for our industries, both internally in Spain, in coordination with the Spanish National Plan for High Energy Physics (for experiment detectors) and externally alongwith CERN managing the transfer of technology from CERN to industry through collaboration contracts.

To illustrate the present situation of industrial returns from CERN, I can tell you that the participation of Spanish industry in this Laboratory has achieved an industrial return of 60% during 1995. This return has been achieved through contracts which include the majority of the above mentioned technologies. In our opinion, this percentage begins to be significant in comparison with the poor results of the past.

However, the decisive momentum for our industry will be attained with its participation in the new CERN project, LHC. Our aim in this project is to achieve an industrial return of at least 80%, during the construction period of the LHC. To reach this result, we are putting into practice an industrial plan, in coordination with the Spanish National Plan for High Energy Physics. This plan includes a technological program, to promote the participations of a group of companies in different technological activities so that these firms can get the appropriate know-how to allow them to be in a good position to compete in the forthcoming projects.

This is not to say that we have forgotten other projects which will run concurrently with the major CERN one. We will not overlook other possibilities close to home, namely the Spanish beamline in ESRF, participation in OSIRIS (at Rutherford Appleton Laboratory), possibilities in the Fusion Program (ITER), the possible participation in LHC detectors, CMS and ATLAS, and of course, in the Spanish star program in the accelerator field, the Spanish Synchrotron.

## 2 PROVEN TECHNOLOGICAL CAPABILITIES OF SPANISH INDUSTRY

Ladies and gentlemen we are speaking about realities, we are speaking of those industries which have already demonstrated their capabilities by getting contracts in CERN and ESRF after hard competition with the main

European companies in the accelerator field. That is why we say proven capabilities. This group of companies would be the front line of a bigger one, able to undertake new developments, not only in the specialities in which they have obtained their expertise, but in other complementary areas to which they can extend their present know-how.

Firstly we will comment on the companies with solid expertise in certain areas leaving for later companies and areas with potential for the future.

## 2.1 Superconductivity

In 1989 the joint venture ACICA was set up, with the aim of acquiring know-how in the design, production and testing of superconductor magnets, specifically quadrupoles and corrector magnets (sextupoles, octupoles and decapoles), destined for CERN. As consequence of this acquired expertise, ACICA have provided prototypes of quadrupole and corrector magnets to CERN, fulfilling all the specified requirements. All of this shows that superconducting magnet technology is available in our country today.

I would not like to jump to another technology without mentioning the important role played by the Electronics Engineering Division of CEDEX (Ministry of Civil Works) in the design and testing of all these magnets.

## 2.2 Electric And Electronic Engineering : Power Supply

Spanish capability in this field is very well known, following the success of some Spanish companies in getting industrial contracts for LEP in CERN. There are three companies in this situation: ABENGOA, JEMA and GH ELIN.

\* ABENGOA.- Inside the ACICA group, this company has won different contracts for the production of power converters ( 20.000 A and 2.000 A) for LHC.

\* JEMA.- Won a contract for the powering of LEP magnets (2000A ). In addition to that they produced a power supply for the TOKAMAK based in Madrid.

\* GH ELIN.- Has received 4 contracts for the production of different power supply system. They have developed the "Fully Reversible Bipolar Power Converter" ( 30 KW, 1.550 A) for the LHC.

## 2.3 Ultra High Vacuum

Two Spanish companies have developed products in this field which have been bought by CERN and ESRF through different contracts. These companies are: INGOVI and TELSTAR. The first focuses mainly on

vacuum vessels and mechanical components, whereas the second is devoted to vacuum pump components. It has to be emphasized that INGOVI has also manufactured a polymeric press for magnet production. This press is presently working at CERN. On the other hand, the cancelled project SSC committed one of these presses for its magnets.

\* INGOVI.- Since 1993 INGOVI has won several contracts with CERN and ESRF for the manufacture of Collimators, Vacuum Chambers, Couplers and Flanges for the UHV system.

\* TELSTAR This is the Spanish main supplier of vacuum pumping equipment for industry and research programs.

## 2.4 Radiofrequency

To date the Spanish company CEMTYS has delivered different radiofrequency amplifiers to CERN, up to now, to be used in the resonant cavities of LEP. As for passive radiofrequency components, companies like INESPAL and TALLERES PIEDRAFITA, have provided CERN with waveguides for the LEP project.

## 2.5 Cryogenics

ACICA produced a cryostat for testing the tuning quadrupole in the past and more recently the company SANTA BÁRBARA has signed a collaboration contract with CERN to develop the 14 meters cryostat for the main LHC dipoles.

## 2.6 Mechanical Engineering

There is solid experience in Spain in this field of technology, which extends from the development of bench test magnets ( dipoles) for CERN, to undulator mobile carriages for ESRF linebeams, through to different mechanical components ( such as valves, inertial tubes, emergency stops, vacuum barriers of composites, etc..). The companies active in this field are:

\* CHACONSA.- Delivered two benches for dipole tests for CERN in 1991 and 1993

\* NORTEMECÁNICA.- Has won several contracts from CERN and ESRF to produce various mechanical components such as support assemblies for mirrors, undulators and vacuum chambers.

\* TAM.- Recently won a contract for the undulator support carriages for ESRF.

\* ACD.- Developed an emergency stop system for CERN in 1991

\* FIBERTECNIC.- Has produced 3 vacuum barrier prototypes out of composite material.

\* MECÁNICA DE LA PEÑA.- Has manufactured different equipment for the LEP experiment OPAL and the DELPHI detector.

\* BURDIÑOLA.- Has delivered assorted equipment for the ESRF laboratories.

## 2.7 Other Activities

There are a number of activities which are not directly linked to the specific components of the accelerator, but which are essential for its correct functioning. These are auxiliary activities related to beam cleaning and operation, civil engineering, services and installations. We have decided to include them in this presentation, thus giving a complete picture of the capabilities of our industry.

There are two companies with proven expertise in maintenance and operation of large facilities. They are: EMPRESARIOS AGRUPADOS, CAE/DRAGADOS. Regarding civil engineering, we have to highlight the participation of ENTRECANALES in the LEP tunnel construction, and its subsidiary IBERINSA which participated in the selection process for the works to waterproof the tunnel. Along with these firms there are others like SENER and INTECSA. The latter has been awarded a contract for LHC civil engineering consultancy for LEP tunnel modification to house the LHC machine.

Regarding services and installations, several Spanish companies have been recently competing for CERN contracts: GTD, ABENGOA, EMPRESARIOS AGRUPADOS, SULZER ESPAÑA, COMSIP/CEGELEC, SPARK IBÉRICA and FELGUERA MONTAJES E INSTALACIONES. I am pleased to say that during 1995, for first time, Spain has been awarded some service contracts. Our expectation for this year is to exceed 20%. I would also like to emphasize here the success of the Spanish firm GTD in the recent adjudication of two important contracts from CERN for the "LEP access control system" and "Supply and installation of fire detection systems"

## 3 POTENTIAL CAPABILITIES OF SPANISH INDUSTRY

But our companies aspire to do more. In addition to the above mentioned proven capacities, they are prepared to break new ground. To this aim, there is a program currently underway, to prepare industry and guarantee the availability of this new know-how for the near future. This program is managed by CDTI and companies, Universities, Technological Centers and CERN are involved. We must keep in mind that all of the future projects mentioned are attractive markets for our firms and justify such entrepreneur and institutional effort.

The technological options open for Spanish industry are :

## 3.1 Cryogenics

The Spanish firm SANTA BÁRBARA agreed on a collaboration contract with CERN, last year, to develop a cryostat prototype for the LHC dipoles. Needless to say the importance of this component which will lodge such an essential element as is the main dipole of LHC. In addition, the experience gained on this work will put them in a very good position to compete for some other dipole components. Advised by CDTI, SANTA BÁRBARA, have reached an agreement with the cryogenic dept of Zaragoza University for scientific development support.

EMPRESARIOS AGRUPADOS is an engineering firm with wide experience in nuclear power plants. Their valuable experience in the management of complex engineering projects makes them well positioned to bid for contracts related to the engineering of LHC. This company has a joint venture with the French firm SEP (Société Européenne de Propulsion), who are very well known as experts in the cryogenic field. Thanks to this EMPRESARIOS AGRUPADOS should have a good chance of getting cryogenics contracts.

## 3.2 Mechanical Engineering

The production of the mechanical components of superconducting magnets, specifically the so called "cold mass", is a reasonable goal of our industry.

For instance, the "shrinking cylinders" component, which encloses all the cold mass, is within the capabilities of the Spanish firm TAM which presently is making an important effort in equipment and facilities in order to be prepared for this activity. On the other hand, companies as NORTEMECÁNICA, INTERNATIONAL TECHNOLOGY or PRECIMECÁN have become regular suppliers of CERN and ESRF.

Regarding the production of "yoke" and "collar" for dipole cold mass, the Spanish firm ELAY has the facilities, experience and technology to bid in optimum conditions.

To produce the component called "bus bar" there are several companies and Institutes which have a good chance, namely TECAL, CARBUROS METÁLICOS, INASMET and the Superconducting Group of Material Science Institute of Barcelona.

We at CDTI, are now studying the feasibility of developing the elements called "spacers" and "end caps", in Spain, taking advantage of synergies from different products in other fields which are applicable to accelerator technology.

The Spanish firm INTERNATIONAL TECHNOLOGY is willing to participate in CERN and ESRF bids for different cryogenic and ultra high vacuum system elements. To this end, and advised by CDTI, they have signed an agreement with the Universidad Autónoma of Madrid to collaborate in the development of these elements.

Outside the cold mass, there are some other units such as the "UHV composite barrier" and "cold support" which are presently developed by the Spanish companies CASA (Space Division) and FIBERTECNIC, thanks to some collaboration contracts with CERN. Both elements are made of composite.

### *3.3 Electronic Engineering And Control*

With respect to electronic and control field, companies as ELIOP and GTD are in the position to offer good solutions for different systems at CERN and ESRF. The new electrical distribution concept for CERN will be a challenge for them.

CRISA is a company coming from the aerospace field. They have developed a high speed bus video, into the Spanish National Space Program, which is under assessment by CERN today. This product could be applied to the acquisition data system for CERN experiments.

### *3.4 Participation In Experiment Detectors*

This is, perhaps, one of the subjects pending for Spanish industry. I do not mean that our industry has never participated in it, before. In fact, the Spanish firm EQUIPOS NUCLEARES played an important role in the LEP experiment L3 in the past. It should have new opportunities in CMS and ATLAS.

Besides, there are some areas in the detectors for which we have never had the chance to compete, namely those linked with high speed electronics and S/W for massive acquisition data.

In our opinion this is a field in which we should participate in the future. To this end, we have coordinated actions with the Spanish National plan for High Energy Physics, CIEMAT and the Universities involved in the LHC experiments, ATLAS and CMS in order to promote the potential of Spanish industry in experiment detectors. We firmly believe that the joining of efforts of the experimental teams and industries should produce an important increase in the participation of the Spanish industry in the LHC detectors.

In short, Spanish companies, specially those dealing with mechanical engineering activities have a good chance to participate in detectors manufacture. These

firms along with the others mentioned in the electrical and electronics fields should have a significant contribution in the LHC detectors manufacture.

## **4 POSSIBILITIES OF SPANISH INDUSTRY IN THE SPANISH SYNCHROTRON PROJECT**

These are, ladies and gentlemen, the dramatis personae. Regarding what has been said, it is quite evident what our capabilities and our aspirations are. We believe that we can be moderately optimistic regarding new future projects, specifically the Spanish Synchrotron. In this we have the hope of providing important components in several areas. We are not forgetting that there are essential elements of it in which we have low or non-existent know-how, namely those related to some machine components or specific equipment for synchrotron, as monochromators and optical components.

However, I am convinced that even in these activities our industry could participate. If we were able to plan our actions appropriately, our industry could produce elements or parts of elements either alone or in cooperation with other European firms.

To summarize, our industry is able to participate in the following areas of the Spanish Synchrotron:

- \* Design Engineering.
- \* Manufacturing a significant part of the mechanical and electrical components.
- \* Cooperating in optics, electronics and s/w of the beamline.
- \* Civil Engineering.
- \* Services.
- \* Maintenance of installations.

## **5 CONCLUSION**

I began by saying that our industry was rather young in terms of its experience in accelerator technologies. Our group of firms in this field is not large in number. Hardly 20 companies regularly bid for CERN and ESRF contracts (although I must say that there are an additional number of around 100 companies which potentially could be incorporated into the first group). However, this small detachment have gained expertise in a variety of activities in which they are competitive. In addition to that, they are willing to enter into some other additional areas, if they could get the appropriate preparation through technological development programs of the Spanish National R&D Plan. In a nutshell, if the LHC is going to be the acid test for our industry to demonstrate its maturity, to become of age, what better opportunity could there be than the Spanish Synchrotron ?

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