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Speaking about Nuclear Power

For far too long the nuclear community seems to have stuck to the old French motto "bien faire et laisser dire", which can be translated as "do your job well and ignore what others may say about it". We have paid the price for this policy (or should I say culture?). Our silence has been interpreted either as secrecy - supposedly inherited from the military beginnings of nuclear technologies, or as disdain towards the man-in-the-street.
It is high time for us to get out and about and talk to people. The "us" I refer to does not mean a few specialized P.R. or communications experts, but rather the whole community of people working in the field, and we have a lot to say!
Every one of us should elaborate his or her own speech, selecting a few deeply adhered to arguments, according to experience, character and sensitivity. As most of us lack the presentation skills of professional actors or traveling salesmen (not to mention politicians), we cannot be convincing unless we are convinced ourselves.
Let me present the arguments that I frequently use, based on my belief in their validity:

- Nuclear power is just one of several ways to generate electricity. There is no point in considering it *in abstracto*: it must be put into perspective and analysed comparatively.
- All energy sources have advantages and drawbacks, but none is worse than the lack of energy. Without minimal access to energy there can be no development.
- We must not forget that today, 2 billion people have no access to electricity. Moreover, during this century the population will grow from 6 to 9 billion human beings.
- The challenge of limiting CO2 emissions to prevent catastrophic climate changes, is formidable, at a time when 80% of our energy comes from the combustion of fossil fuels, and when energy consumption continues to increase to allow for development. Nuclear power must form *part of* the solution, along with conservation, renewables and carbon sequestration.
- Oil and gas are valuable and non-renewable chemicals; we should not burn them too quickly.
- In Europe, if we want to keep our dependence on foreign oil and gas to tolerable levels, and if we are serious about our international commitments to preserve the environment, we must not only "keep the nuclear option open" (to quote the politically correct formula), but also significantly *increase* the nuclear share of total energy consumption.
- To this aim, we must not only increase our nuclear electricity generation but furthermore strive to develop other uses of nuclear power, such as district heating desalination, process heat, and in the future, hydrogen production from clean sources.

Most of you will think I am just stating the obvious. Rest assured, however, that these key messages go down much better when you spread the word outside!

B. Barré
President ENS

During these last few weeks the press headlines have brought good news on energy issues and on the role that nuclear energy must necessarily play. In this respect, during the "Foro de las Naciones" in Barcelona, James Lovelock, an authority on ecology and promoter of the "Gaia" theory, according to which the earth is a living being, and Mikhail Gorbachov, ex-President of the former Soviet Union, who will go down in history for the decisive role he played in the closing stages of the 20th century, have both clearly opted for the use of nuclear power in order to meet the important challenge of future energy supply.

In Spain also, during a meeting that brought together the top brass of the past and present sphere of energy policy, along with leaders of business and finance, all of whom brought along different ideologies and approaches, the speakers declared themselves to be in favour of the use of nuclear energy.

We should celebrate the fact that these high-ranking leaders have adopted a position favourable to nuclear energy and that this should have been done publicly.

This is the best "salute" that the Spanish Nuclear Society can give to its European colleagues.

Francisco Martínez Córcoles
President SNE

Institutional and Political Changes in the EU

by:
FORATOM

Introduction

With the enlargement to ten new countries, the appointment of a new 25-strong European Commission and the European Parliament elections bringing in a fresh crop of new MEPs: the European Union (EU) is experiencing one of the biggest developments in its history. On top of that, EU leaders recently agreed a Constitution for Europe that consolidates the various EU treaties into one single text and introduces some innovations. Although it remains difficult to fully assess the importance of these institutional and political developments for the public image and future development of nuclear in Europe, from the nuclear industry point of view, these changes will certainly create many new opportunities and challenges. If we look at the new and accession member states, seven have nuclear power plants, and all depend heavily on them in terms of economic development. Before enlargement on 1 May 2004, nuclear was in use in eight of the 15 EU Member States. From the

Institutional Changes overview

EU Institution	**1 May 2004 to 31 October 2004: Transitional Period**	**1 November 2004: Remaining provisions of Treaty of Nice come into force**
Council of the European Union	The 15 'old' Member States maintain their current number of votes. The 10 'new' Member States each obtain a number of votes in line with the current system. This brings the total number of votes to 124. Qualified majority is 88 votes.	The total number of votes is 321. Qualified majority is 232 votes from a majority of Member States. Additional criterion: any Member State may request verification that the Member States constituting a qualified majority represent at least 62% of the EU population.
European Commission	The Commission will be composed of 30 members: the 20 'old' Commissioners and 10 Commissioners from the new countries.	A new Commission takes office on 1 November. This Commission will be composed of 25 Commissioners (one from each Member State).
	Post June 2004 EP Elections	**Post prospective accession of Romania and Bulgaria to the EU (2007)**
European Parliament	The total number of seats is set at 732.	The total number of seats will exceptionally be raised to 785 for the remainder of the 2004-2009 Parliamentary term.

current 25 countries, 13 of them are users of nuclear. In 2007, 15 of the 27 Member States will be 'nuclear'. It is clear that now, and at the following stages of enlargement, there will be a slight majority of countries using nuclear energy. In this context it is vital to maintain an overview of the most important developments within and between the EU institutions – the subject of the following sections. As it still remains to be seen when or if the new Constitution will be adopted due to the long and possible arduous ratification process in all 25 Member States, it is premature to address this in any great detail here. The emphasis will rather be on the implementation of measures adopted in the Nice Treaty and the effects of enlargement.

Council of the European Union

The Council of Ministers is changing its shape; from May 1st 2004, 10 new Member States have become members in the Council and have voting rights. Additionally, the new qualified majority voting system (QMV) agreed in Nice will take effect from November and will make agreements significantly more difficult. Qualified majority is the number of votes needed in the Council for a decision to be adopted when the Treaties so require. Until 1 November 2004 (the date of the entry into force of the provisions in the Nice Treaty on Council decision-making), the threshold for the qualified majority is set at 62 votes out of 87 (71%), and Member States' votes are weighted on the basis of their population and adjusted in favour of less-populated countries.

Following the 2000 Intergovernmental Conference (IGC) leading up to the Nice Treaty, the number of votes allocated to each Member State has been re-weighted, in particular for those with larger populations, so that the legitimacy of the Council's decisions is maximised in terms of demographic representation. The Nice Treaty also amended the qualified majority decision-making system. A qualified majority is deemed to have been reached when two conditions are fulfilled: the decision receives a set number of votes (which will change as new countries join) and is agreed by a majority of Member States. Moreover, a Member State may request that it be verified that the qualified majority represents at least 62% of the total population of the Union. If this is not the case, the decision is not adopted.

The EU Constitution agreed at the IGC on 17-18 June introduces a new procedure for qualified majority voting (QMV) in the Council. Under the EU Constitution a qualified majority for decision-making is defined as at least 55% of the members of the council - comprising at least 15 of them - and representing at least 65 per cent of the population of the EU. This is both a simplification and a revision of the system adopted in the Nice Treaty. Compared with that agreement, the population threshold has increased from 62 per cent to 65 per cent. In an attempt to make QMV more comprehensible, the EU Constitution has also entirely abandoned the traditional 'weighted votes' system for individual member states, which had been retained in the Nice Treaty.

If the EU Constitution is adopted, these modifications to the voting procedure would come into force only on 1 November 2009. The changes have aroused considerable controversy, especially in Poland and Spain, two countries, which - compared to Germany for example - benefited disproportionately from the system agreed at Nice.

European Commission

Before the recent enlargement, the European Commission consisted of 20 Commissioners (2 each for France, Germany, Italy, Spain and the United Kingdom and one each for all other Member governments). However, as soon as the new Member-States enjoyed full membership, the Commission received a group of 10 new Commissioners in addition to the previous 20, until the end of the term, i.e. November 2004. As they only have a brief transitional term in office, the new Commissioners do not hold a specific portfolio but are working alongside an existing Commissioner. This "twinning" arrangement is intended to smooth the way for their integration into the work of the Commission and to prepare them as members of the next Commission.

The Treaty of Nice provides that, from November 2004, the scheduled date of the next Commission taking up office, the five largest Member States will forego their right to nominate a second Commissioner. So from November 2004 onwards, each Member State, including newly admitted Member States, will nominate one member of the Commission until the EU reaches 27 Member States.

In the meantime some ideas have been circulated as to how to enable the next Commission to function with 25 members from 1 November 2004. Despite the problem that there are not enough real jobs for the time being, it is most likely that each new commissioner will be allocated a portfolio, which means that five new jobs have to be created by dividing existing portfolios.

The EU constitution includes an article to reduce the number of Commissioners to two thirds of the number of Member States in 2014.

European Parliament

On 10-13 June, the population of 25 Member States elected an entirely new

European Parliament. For the period June 2004 - June 2009, the number of seats in the European Parliament has been modified. This has resulted in a reduction in the number of seats per country (except for Germany) and in a change to the total number of seats. The current limit is 732; however, if Romania and Bulgaria join the EU before 2009 as expected, the total number of seats will exceptionally be raised to 785 for the remainder of the 2004-2009 Parliamentary term.

If the EU Constitution comes into force, the role of the European Parliament as co-legislator will again be strengthened and the so-called "co-decision procedure" will be broadened to new areas of legislation. The extension of the co-decision procedure means that the Council will not be able to legislate on its own in many areas, but will be dependent on co-operation with the European Parliament.

The impact of enlargement on the political composition of the Parliament has been significant. On the basis of the party affiliation of the MEPs sent by national parliaments, the May 2004 enlargement has reinforced the relative weight of the two largest parties: the European People's Party and the Party of European Socialists. The Liberals, previously the third largest group by a thin margin, have widened this margin thanks to the newcomers - while all other groups (United Left, Greens, etc.) - have seen their relative weight diminish, given that they are virtually non-existent in the new Member States.

It is easy to understand that with the new members, the nuclear industry stands a good chance to see increased support for nuclear in the newly elected, enlarged European Parliament. From 20 June 2004 the new Member States have 162 seats in parliament, more than 50% of which are held by 'nuclear' countries. Moreover, in 2007, Romania and Bulgaria are likely to become official members as well. This means that the total number of seats held by the new Member States will increase to 215, and 'nuclear' countries will hold 135 of these.

In other words, from 2007 over 60% of the new Member States' seats in the new parliament will be held by 'nuclear' nations. Given the positive state of public opinion regarding the nuclear sector, and its importance in these countries, it is realistic to assume that more than half of these new MEPs will be both pro-nuclear and interested in energy issues. If this assumption proves to be accurate there will be profound changes in the composition of all the political groups of the parliament.

Welcome to the New Ballgame

The first issue of *European Nuclear Features* last May saw the light thanks to the efforts of the French Nuclear Society (SFEN) together with the other national societies who contributed wholeheartedly. The publication of the second issue, prepared by the Spanish Nuclear Society (SNE) and the third one by the German Nuclear Society (KTG), will show that through the collaboration of the European Nuclear Societies and their individual members, a joint project can be developed.

From FORATOM, we welcome this initiative, which comes at a very special moment in the evolution of the European nuclear scene. In 2004, two aspects of the situation facing nuclear in Europe are evolving in a very positive way.

First of all, the enlargement of the European Union makes even more evident the need for nuclear power in the continent. Five new entrants rely 31-80% on nuclear for their electricity supply and have the technological and industrial capacity to complement the existing EU-15 nuclear park. The economic growth impulse that these countries are receiving will require additional capacity, and nuclear power will be there to meet the challenge.

The second aspect is that, after many years of oblivion, nuclear power is making its comeback. The Green Paper on Security of Energy Supply already indicated the need for this type of energy to be considered in the European energy mix, but today there is a growing consensus that nuclear is a part of the solution to the energy issues with which the European Union is confronted. The European Economic and Social Committee (EESC) report on nuclear energy presents the facts that support the evidence of an industry, which is fundamental to drive our economic growth and maintain or improve our well-being. The proposal of the nuclear package, even if it has not been supported by all member states, shows the political appreciation of the need for nuclear power. This opinion has been brought forward by the Commission Vice-President, Loyola de Palacio, but it has also been supported by the majority of the members of the Commission.

This new atmosphere has had its main manifestation in the new Finnish reactor that is going to be supplied by the European Industry. The Finns have thoroughly analysed the different alternatives and have come to the conclusion that nuclear is the one that fits best their interests, from an economic and environmental point of view. Other countries are already considering the construction of new reactors, and I am convinced that more will follow the same route, once the limits of the other alternatives become evident to the public.

All these issues will have to be addressed in the following months, and this publication of the European Nuclear Societies will be an important instrument in presenting our views and participating in the definition of the Europe's energy future.

Both as FORATOM President and as a member of the European Nuclear Society Board, I welcome such a timely initiative, and I congratulate the three Member Societies that took it.

Long live European Nuclear Features!

Eduardo González
President FORATOM

CIEMAT Department of Nuclear Fission: A General Overview

by:
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DFN. CIEMAT
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The **Department of Nuclear Fission (DFN)** provides technical support to the Spanish Nuclear Authority (CSN) and Nuclear Sector and promotes new developments. The main activities performed in the recent years, research capabilities and projects carried out are presented. DFN has 141 employees, 73 Scientists and 68 Auxiliary personnel. The areas of research are grouped into four programmes.

The **Programme of Materials** is a reference laboratory to support the materials research needs of nuclear and non-nuclear power plants, new concepts, in particular ADS and fusion (figure 1).

- **Research lines:** Life extension, diagnosis, metallurgical tests and materials for transmutation systems.
- **Facilities and laboratories:** Microscopy, X-Rays Diffraction (Optical, SEM, TEM, Auger, ESCA), Irradiated materials testing, IASCC, Mass Spectrometer, Chromatography, Gamma Irradiation (Náyade), Loop of Pb-Bi for corrosion.
- **Main projects and partners:** IAEA (CPR V), REVE (EDF), CIRII (EPRI), OECD-Halden, CRIEPI (Japan), EU-FWP: CASTOC, GRETE, AMES, ATHENA, ITEM, COBRA, PERFECT, PRIS and INTERWELD, LIRES, TECLA and SPIRE; PCI and ENDURO (CSN).

Particular attention is paid to the effect of irradiation on structural materials and their degradation by corrosion, in which field relevant results have been achieved.

With the general goal of improving NPP safety, the **Nuclear Safety Programme** main activities aim at investigating SGTR accident, regarding aerosol retention, aerosols and iodine simulations in the containment, fuel reactivity insertion accidents and human error in commissioning and computerised alarm systems (figure 2).

- **Research lines:** Severe Accident, innovative design, fuel high burn-up, man-machine interaction, risk perception and communications.
- **Facilities:** PECA, Pool Scrubbing; RECA, Recombiner; GIRS, Sprays.
- **Analytical tools:** MELCOR, ASTEC, CONTAIN, IODE, FLUENT; FRAPCON FRAPTRAN, SCANAIR
- **Main projects and partners:** EU FWP and CSN: SGTR, PHEBUS-FP, PHEBEN-2, SARNET, LEARNSAFE; ARTIST (PSI, CSN), AASC(CSN); EDAH-HAMMLAB (Halden); IOS-2 (CSN); ALARMAS (Halden / NPP); CABRI (IRSN, CSN, etc), OECD-Halden.

The results obtained can be summarized as: implantation of computer codes; development of models and database on heat transfer by steam condensation, aerosol retention and iodine chemistry behaviour in the containment, SGTR mitigation actions and human factors.

The **Radioactive Waste Programme** provides support: a) for radioactive waste management in the areas of reprocessing, characterisation, treatment, conditioning, analysis of waste behaviour, and dismantling and decontamination techniques, and b) on spent fuel behaviour under geological repository conditions (figure 3).

- **Research lines:** Hydro and Pyrometallurgical Reprocessing, LILW, Characterisation of spent fuel
- **Facilities:** Characterisation of LILW (IR-15), Conditioning of LILW (IR-17) and Partitioning of long-lived nuclides (IR-30)
- **Main projects and partners:** EU FWP and ENRESA: PARTNEW, SFS, PYROREP, CALAXPART, INTERLAB, HOTLAB, DECAPO, EUROPART, ACTINET, NF-PRO.

Encouraging results were achieved in partitioning by liquid-liquid extraction and employing various organic compounds; on spent fuel stability under repository conditions and lixiviation phenomena of radionuclides for granite and saline and saline bentonite scenarios.

Figure 1: ***Pb-Bi loop for materials corrosion studies.***

Figure 2: ***PECA facility and SGTR make-up.***

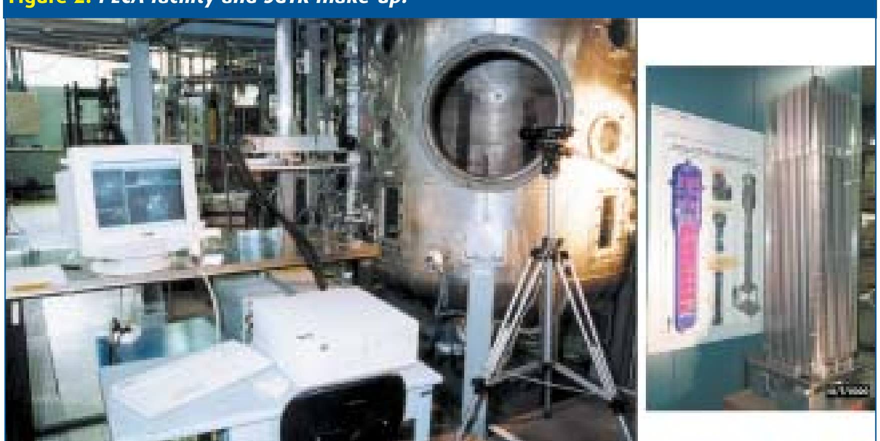

Figure 3: *Globe box of the irradiation facility (IR-30) for spent fuel stability and pyrometallurgical separation of radionuclides studies.*

The goal of the **Nuclear Innovation Programme** is to study ADS and their application in nuclear waste transmutation; it has two main research lines: a) the development of concepts, designs, operation models and computer simulation tools characteristic of this type of systems, and b) participation in the design, construction and data analysis of advanced experiments in this field of research.

- **Research lines:** Advance fuel cycles, transmutation, ADS
- **Associated facilities:** MUSE (CEA) and MASURCA (CEA), n-TOF (CERN)
- **Analytical tools:** EVOLCODE, MCNP, GEANT, Isotopic Evolution and Fuel Cycles Evaluation.
- **Main projects and partners:** EU FWP and ENRESA: nTOF, MUSE, PDS-XADS, ADOPT, Red-Impact; SAD and YALINA (Kurchatof).

Studies have been done on the neutronic response of a subcritical fast system to an external neutron source, neutron cross sections of for relevant nuclides, and on the impact of partitioning and transmutation techniques for final repository, and in recycling processes. Also, a considerable effort is being made to validate computer codes and their application.

Final Remarks

The main features of the CIEMAT Department of Nuclear Fission have been briefly highlighted in this paper. International cooperation plays an essential role in nuclear research in the medium and long term to optimise resources and ensure the necessary infrastructure for future development. In this sense, the JHR materials test reactor, Myrrha, Generation IV and Inpro, among others, are welcome initiatives.

Inertial Fusion Energy at DENIM (Spain)

by:
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(Spain)

The first steps in inertial confinement fusion were taken in 1966 in the Spanish Atomic Energy Commission (JEN) when we developed a radiation-transport code, named ISLERO, to analyze a ellipsoidal microcapsule with uranium walls. In its interior there was a DT micropellet with a Pu layer and in the opposite extreme of the microcapsule there was a hole allowing the passing of a laser beam. To a certain extent, this microcapsule, holhraum-typed, was based on the H-bomb. Due both to the simplifications of the code Islero equations and the inaccuracy of the parameters, the results were not reliable. For that reason I gave up temporarily this research.

Eight years later, I organized a group with half-a-dozen of scientists to study the processes produced in the fusion of direct-driven targets based on the micropellet of DT with a layer of Pu, as I had previously done in the code ISLERO. We developed NORCLA code, the first non-classified coupled code, including time-dependent hydrodynamics and realistic neutron-gamma transport with adequate energy source from fusion and fission materials. Two modules composed NORCLA: NORMA (for hydrodynamics) and CLARA (for fusion-fission sources and neutron-gamma transport).

NORMA in its first version (adapted using CHART-D code from Sandia as a base) considered one-dimensional time dependent evolution of fluids/plasmas under flexible boundary pressure conditions, supposedly formed by laser-matter interaction with the pellet. By means of a lagrangian scheme, momentum and energy equations were solved including radiation diffusion and suprathermal electrons terms in a simple mode. Interchange of energy terms among the different species were also included. Equation of State (EOS) and atomic coefficients were considered through analytical solutions (ANEOS package) using the average atom ionisation model. Shock waves were treated using the concept of artificial viscosity (von Neumann & Richtmyer) by adjustment up to quadratic terms. The results from NORMA (density, temperature, velocity, position) for each computational zone were treated as the necessary input for the CLARA module of burnup and transport processes.

The CLARA module includes a detailed one-dimensional and time dependent treatment of the neutron-gamma transport equations. A key aspect in this module was the Legendre decomposition of nuclear data (cross section) in angular dependence (PN) and the neutron fluxes studies in discrete ordinates modelling (S_N).

A modification of this NORCLA code was also considered by coupling the NORMA module with a MonteCarlo time dependent system (TIMOC-ESP/LIBERTAS) including also burnup equations for fusion and fission.

In 1980 the JEN focused all its efforts on nuclear fusion research in the magnetic confinement field. For this reason our group decided to leave the JEN and to create the Institute of Nuclear Fusion (DENIM) at the Polytechnical University of Madrid to continue with inertial fusion energy.

The nuclear countries classified from the very beginning the research on ICF, mainly about holhraum. Although necessary at first, this classification produced one negative effect. The prohibition for the American scientists to publish sensitive theoretical and experimental results, whereas scientists from Italy, Germany, Spain and specially Japan could publish their work without any restriction. Sometimes the works published by these scientists were already done by their American colleagues. This fact produced nuisances that affected negatively to the quiet environment and collaboration which are so important in any process of scientific research.

In this confusing and complicated environment, in June 1988 the 19th ECLIM was held in Madrid. Relevant scientists and directors of different laboratories devoted to the ICF participated in this Conference. Professors Chiyoe Yamanaka, Erik Storm, Vladislav Rozanov, Heinrich Hora and myself took advantage of this opportunity to write the **Madrid Manifesto** which was signed by over 130 scientists. In this Manifesto it was said:

Recent research results in Inertial Confinement Fusion (ICF) have put to rest fundamental questions about the basic feasibility of achieving high gain ICF, and make it clear that there should be an aggressive program to design, build and operate ICF facilities to demonstrate high gain fusion in the laboratory... The time has arrived to begin to seriously seek a new age in the development of ICF. The laudable goal of the international ICF community is to use the fullest possible collaboration among nations in order to provide the technological benefits from fusion that will serve all humanity.

In the spirit of the 19th European Conference on Laser Interaction with Matter (ECLIM) held in Madrid, we urge the international community to take action now.

In 1992 the Herald Tribune and the New York Times made public that *The Federal Government... is beginning to declassify some of the most sensitive aspects of its design and to let American scientists publish them in scientific literature. The reason for this reversal is not internal policy considerations, the end of the cold war or the collapse of the Soviet Union as a military threat. Rather it is foreign competition. Scientists in Japan, Germany, Spain and Italy... have openly published the "secrets" for years. Continued secrecy for similar research in the United States was seen as stifling the exchange of ideas, inhibiting progress and limiting international cooperation. At times American scientists have been ordered not to attend meetings with foreign scientists, because they would have run the risk of discussing classified information. As a result, the Department of Energy, the keeper of the secrets, carried out one round of declassification in 1990, and says it is readying another.* After this event, the US DOE decide to declassify almost all IFE research.

Since then, we have extended the research to the following areas: radiation fluidynamics (two dimensional transport code ARWEN); atomic physics (JIMENA and ANALOP codes, NLTE screened hydrodynamic model and detailed configuration code M3R); safety and environment (ACAB code); materials and reactor chambers and advanced fuels for IFE.

Interpretation of experiments done at LULI (Ecole Polytechnique) during 2003 supported by the European Union and by the CEA (France). This includes discussions and preparation of papers for Physics Review and JQRTS in collaboration with LULI, Universitie Paris-VI. (France), Universidad de Las Palmas de Gran Canaria, UNED (Spain) and University of Nevada. Reno (United States).

New experiments has been proposed in the new LULI-2000 installation for the study of new spectroscopic techniques of hot and dense plasmas.

With the collaboration of Professors J.M. Aragonés, C. Ahnert, P. Velarde, F. Ogando, E. Mínguez, J.M. Martínez-Val, M. Piera, P.T. León, J.M. Perlado, M. Velarde, J. Sanz, O. Cabellos and N. Carpintero.

Lean Manufacturing and Six SIGMA, Key Tools for the Competitiveness of ENUSA

by:
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Introduction

The nuclear fuel market is characterized for being a liberalized sector, with a dynamic concentration of customers and manufacturers and with an excess of manufacturing capacity. The strong competitiveness forces to a small player like ENUSA to find ways to survive in this market. ENUSA's Strategic Plan focuses in three areas: growth, quality and productivity as well as technological development. The first two areas are directly related forcing ENUSA to simultaneously seek the quality improvement together with the reduction of costs and production lead times in order to gain productivity and capacity for growth. These goals, which seem to be antagonists, may be achieved by choosing and applying different improvement tools in the production management.

Six Sigma and Lean Manufacturing in Fuel Manufacturing

The systematic application of Six Sigma and Lean Manufacturing gives us a potent improvement tool to achieve the goals sought:

- High quality levels. achievement and maintenance.
- Manufacturing lead times reduction and cost down.

Quality Improvement Projects

All customers express a common need (CTQ): reliability in the operation. ENUSA factory performs improvement projects strongly related with reliability, which basically means the supply of defects free manufacturing products. ENUSA focuses on the following:

- First time quality levels.
- Inspection beta error (type II).

We can mention the following examples:

1.- Soft start equipments in the welding process (tungsten contamination elimination)

Figure 1: ***Pellets visual inspection.***

3.- Artificial vision pellets inspection (see figure 1).

4.- Welding digital radiography.(in process).

5.- Debris free assembly areas (in process).

As an example the fuel rods are manufactured with 5 Sigma level.

Operational Improvements Projects

The main goal is to reduce manufacturing time and operational costs.

ENUSA factory has three UO_2 lines and one Gd_2O_3 line. The value stream analysis show that technical and human resources can be managed in different way optimizing the operational costs. To get a significant increase in production speed and therefore raise factory's capacity we carried out a project in several stages:

1. - Ceramic lines capacity optimization.
2. - Fuel rods lead time reduction
3. - Fuel assembly lead time improvement.
4. - Human Resources polyvalence.

When starting the program of operative efficiency the factory, data showed an improvable parameter of line usage. The program was based in optimizing the capacity and usage of each line in such a way that every line were operated in a level of 90% capacity before starting up the next.

The first global constrain factor was the minimum total capacity station (bottle neck). The overall fuel manufacturing process can only be speeded up till getting the capacity of this station. We set out the following work sketch:

- Bottle neck capacity optimization.
- Increase of global capacity increasing overall process speed.

Bottle neck capacity optimization (global limitation)

Out of the analysis of real capacity data we determined that the bottle neck laid out in the pellet press station.

The first step was to define the method and the necessary tools to achieve the goal. We adopted of TPM concepts:

Real Capacity = Technical capacity x OEE

Overall Line Efficiency (OEE) = %Quality * %Line Availability * % Usage

There are 4 parameters that can be worked with in an independent way, whose result is multiplicative, although can be resumed in two: Technical capacity and OEE (Overall Equipment Efficiency).

OEE gave us information about the "gap" of improvement: OEE (press) = 54%.

We did an analysis to improve this OEE as much as possible without significant investments; we also observed a margin in the technical capacity. We performed the following improvement actions:

Technical capacity:

- Increase of 10% of press speed in PWR.
- Increase of pellet length in PWR.

Availability time:

- Elimination of the most frequent cause of failure by RCM.

Usage time:

- Down Time reduction.
- Elimination of enrichment marks.
- Production programming.

Quality improvement (bottle neck downstream)

- Reduction of grinding speed.

The capacity evolution is showed in the figure 2.

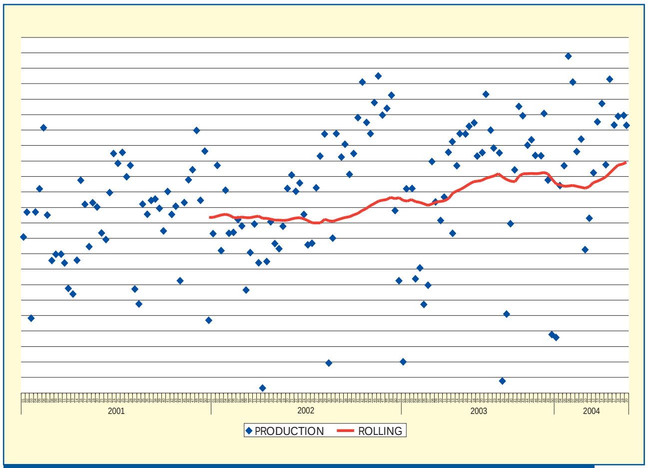

Figure 2: ***Pellets operation capacity evolution.***

Global capacity increase speeding up the process

The second project was focussed in reducing the transport and waiting time as process overall accelerator. For this purpose we modified the **lay-out** of the fuel rods area in such a way that the movements were the minimum essential. Besides, we did the following necessary improvements:

- Rods handling automatization
- L3 welding station automatization.
- New UT equipment
- New EC equipment for fuel rods inspection.

As a consequence of the projects developed during the last two years we have achieved a great increase in capacity giving an answer to the production demand from our customers. It is worth to point out that we have increased production in **30%** and, at the same time, we **closed one line**. The line operating parameter (capacity usage of each line) has improve a 100% with the saving of costs that implies, as an example direct labour cost has been reduced 30% in the last two years.

The capacity of the factory has increased from 300 to 400TnU with limited investments. ENUSA uses currently 300TnU leaving an immediate extra capacity (100 TnU) as a back-up for supply assurance to our customers.

Conclusions

ENUSA INDUSTRIAS AVANZADAS experience in the application of Six Sigma and Lean Manufacturing is highly positive. The use of a permanent improvement structure, to dispose of experts in tools and methods, the use of the scientific method, the simultaneous attack to symptoms a root causes, the control of variability, and, above all, the cultural change that all this implies makes that the company progresses with a great dynamic towards the achievement of the company goals.

High Temperature Reactors. European Research Programme

by:
D. Hittner
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M.T. Domínguez
Empresarios Agrupados (Spain)

Background

Leading European organisations in the field of nuclear engineering decided in April 2000 to set up the HTR-TH network in order to join efforts to develop European Modular High Temperature Reactor (HTR) technology. This decision was based on the results of an earlier survey that found this technology to have the highest potential for early industrial deployment and the most promising prospects for a wider scope of applications like the production of hydrogen, thanks to their high coolant temperatures.

As a result of this effort, a large European research programme, led by Framatome, has been developed. Launched in the frame of the 4th EURATOM Framework Programme and consolidated as a large programme during the 5th Framework Programme, it will now be continued in the frame of the 6th Framework Programme through an Integrated Project, now in the negotiation phase.

This European HTR programme did not start from scratch, as the bases of HTR physics and technology have been developed and demonstrated in different research programmes and industrial projects for more than 40 years. Earlier experimental reactors like the Dragon, AVR, Peach Bottom, Fort Saint Vrain (FSV) and THTR-300 provided a sound basis and knowledge of these concepts. Besides building on this past experience, the EU programme is also drawing on the results of other HTR programmes now being carried out in Japan and China, which took the initiative ten years ago of building two demonstrators (HTTR and HTR-10, respectively). In addition, the HTR is the first step in the Very High Temperature Reactor (VHTR) prototype selected in Generation IV, and South Africa is promoting the first medium-sized modular reactor, the PBMR.

Founded on the pillars set out above and considering the new objectives defined for innovative reactors, research activities were identified in the areas of fuel, core design, materials, components and safety in order to define the European HTR research programmes instrumented through six different projects in the 5th Framework Programme of the European Commission: HTR-F, HTR-H, HTR-M, HTR-E and HTR-L and now integrated into one Integrated Project in the 6th Framework Programme, V/HTR-IP.

This paper summarises the results achieved to date and the objectives for the near future.

HTR-F Fuel Technology

One of the main innovations of the HTR compared with traditional LWRs is its fuel concept, based on coated fuel particles embedded in a graphite matrix which retains the fission products and thus provides a uniquely robust first barrier to contamination. These fuel particles are configured into pebbles or blocks, depending on the type of modular reactors.

In the areas of fuel, two important aspects were considered in order to meet new critieria of proliferation resistance and sustainability : low enrichment and different fissile materials,.

The following areas were considered of interest for the EU research programmes:

- Fuel behaviour in very high burnup and very high temperature conditions
- Improvement of the coating materials
- Fuel modelling
- Development of the fabrication process

The reference coated particles used in the past, called TRISO, have four layers: a buffer layer and an SIC layer between two high density PyC layers. Extensive TRISO particle qualification had been performed in Europe in the past through the experimental programmes HFR, OSIRIS, SILOE, DIDO and DRAGON, but insufficient data are available on their behaviour at very high burnup. To fill this gap, the following tests were included under the EU's 5th Framework Programme:

- HFR-EU1, consisting of the irradiation in the HFR in Petten of five TRISO pebbles of 60 mm in diameter, from former German fabrication and from present Chinese fabrication with 16.7% U-235, at a temperature of 1100°C (corresponding to an outlet helium temperature of 850°C), up to a burnup of 200 000 MWd/tHM.
- HFR-EU1bis, consisting of the irradiation in HFR of German pebbles of the same fabrication than in HFR-EU1, at a temperature of 1250°C (corresponding to an **outlet helium temperature of 1000°C, which makes of this irradiation the first VHTR fuel irradiation**), up to a burnup of 160 000 MWd/tHM.
- HFR-EU2, consisting of the irradiation in the HFR in Petten of 10 compacts manufactured in the USA by GA with 10.6% U-235.
- Heat-up of the irradiated fuel elements (compacts and pebbles) up to 1600°C or more in the KÜFA facility at ITU (Karlsruhe) to measure the release of the fission products (Cs, Sz, I and others relevant to the source term definition) in accident conditions.

With respect to fuel manufacturing, Karlsruhe (FZK) in Germany and CEA in France have recovered and updated know-how from past processes, GSP (Gel Support Precipitation) and HMTA (Hex-Methylene Tetra Amine). The first coated particles were manufactured by CEA in 2003 with UO2 and Karlsruhe has just turned out its first kernels with Pu early in 2004 (figure 1). Activities included in the 6th Framework Programme will continue to consolidate the manufacturing process of the new fuel.

Finally, alongside the experiments and manufacturing of fuel, the ATLAS code has been developed to model the behaviour of the fuel. This activity will also continue in the next framework programme.

Figure 1: ***first U Pu mexed oxide kernels manufactured in ITU.***

Figure 2: ***LYRA test rig for vessel metal irradiation in HFR.***

HTR-N: Reactor Physics, Waste and Fuel Cycle

Highly enriched uranium (HEU) was used in the past HTR projects mentioned above (DRAGON, AVR, FSV, THTR-300 and Peach Bottom). Due to the requirement of higher resistance to proliferation defined for innovative reactors, low enriched uranium (LEU) has been chosen for use in future HTR projects.

The objective of the European programme in reactor physics is to develop the means and tools to design new cores.

Models of the test reactors HTTR (Japan) and HTR-10 (China) have been developed for the Monte-Carlo codes TRIPOLI and KENO and for transport-diffusion code systems like APOLLO-CRONOS for calculation of the first criticality of these two reactors. A similar work has also been performed for the tests made in the critical facility PROTEUS at PSI (Switzerland).The analysis of the discrepancies between calculations and experimental results allowed improving the modelling of the specific features of HTR physics (double heterogeneity of the fuel, neutron streaming…). It can be concluded on the basis of the results obtained that the tools used for these benchmarks can also be used in LEU core calculations.

The possibility of burning in HTRs the plutonium formed in LWRs has been assessed. The feasibility of 100% Pu cores, without U was confirmed. In such cores the Pu is burnt with a high efficiency (about 70% of the Pu initial mass is destroyed and 90% if fissile isotopes only are considered).

A process for the decontamination of graphite after irradiation is under development at a laboratory scale. The first leach tests on HTR fuel materials – which have still to be confirmed – are showing that the unique robustness of the fuel provides a confinement of fission products not only during reactor operations but also in geological disposal conditions, for very long periods of time (more than 10 000 years).

HTR-M Materials

One of the main issues of the HTR is the qualification of materials to withstand its high coolant temperatures, ranging from 700°C to 1000°C. The research programme focused on the selection and validation of the material for the vessel, for a direct cycle the turbine and for the graphite in structures of the core.

During the 5th Framework Programme, Mod 9 Cr 1Mo was chosen for the vessel because it allows operation at a higher vessel temperature than the steels commonly used for LWRs. Thick weldments of this material have been produced and small samples of welded thick plates have been irradiated in the HFR (figure 2). Post irradiation tests will soon be performed.

For the turbine, the programme has focused on the qualification of alloys for the blades and disc. Two grades of materials have been chosen for the blade (IH 792 DS and DM 247 LCDS). UDIMET 720 has been selected for the disc. Even with the best performances of all metals reviewed, it cannot be used without cooling above a temperature of 750°C.

The main issue with respect to the structural graphite is the selection of an appropriate graphite grade within the grades presently available on the market, as the ones previously used are no more available. Five different grades that answer the best the specifications defined for HTR applications were selected with the help of the largest graphite producers in the world (SGL, UCAR-GRAFTEC, TOYO TANSO). Then various samples of each grade were fabricated for testing in the INNOGRAPH irradiation in HFR, Petten, and for oxidation in the THERA and INDEX facilities in FZJ. The irradiation, at a temperature of 750°C, started early this year, will reach, in the time frame of the 5th Framework Programme, a range of fluence just below the "turn-round point", which is not sufficient for design purpose, but allows making a first selection of the best candidate grades for HTR internal structures (figure 3). The irradiation will be restarted during the 6th Framework Programme for going beyond the turn-round point. Another irradiation will also be undertaken at 950-1000°C.

HTR-E Components

The programme in the components areas focuses on the design of the turbine for a direct cycle, of of the hot gas

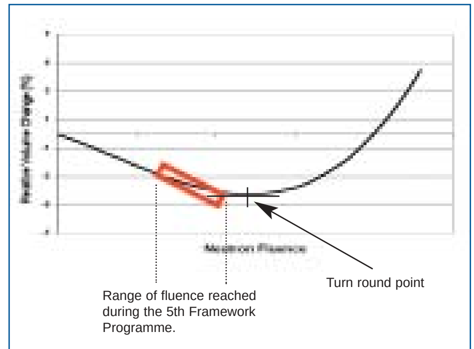

Figure 3: ***typical evolution of a property of graphite under irradiation and range of fluence reached during the 5th Framework Programme.***

duct in the recuperator, of the magnetic bearings required for the support of rotating machines in the primary circuit and of a leak tight rotating seal that would allow putting the alternator outside the primary circuit. The tribological issues of friction and wearing in impure helium atmosphere are also tested and the specifications for helium impurities are defined.

In the case of the turbine design, the main results are the need for disc and perhaps blade cooling and a strong recommendation to have the turbine shaft horizontal. A thermal isolation for the hot gas duct has been validated for normal and transient operation. In the case of the recuperator, a test loop has been constructed in CEA (the CLAIRE loop) to test mock-ups manufactured by HEATRIC and NORDON.. S2M has proposed a design for the magnetic bearings. The dynamic behaviour of a turbo-machine shaft controlled by such active bearings will be tested in a dedicated facility of the of Zittau University.

HTR-L Safety

A major reason for choosing the modular HTR as the most promising system for the future is its inherent safety, which is the result of its using coated particles that do not release fission products up to very high temperatures (at least 1600°C), a strong negative temperature coefficient which tends to cause it to passively shut down, very slow temperature transients and passive core cooling through inherent natural phenomena (conduction and radiative heat transfer).

Even though this inherent safety is generally recognised, no common safety approach has been developed for this type of system and key questions remain unanswered, in particular related to confinement requirements.

The EU programme focuses, in this area, on the definition of the safety approach and the criteria to be applied in the safety analysis.
An interaction with the American NRC could be organised and the exchange of ideas with its representative has been of special interest. A workshop with several Safety Authorities will take place in Brussels in September 2004 to discuss the results of the work performed to date.

Table 1
Summary of Results

• Reactor physics *- First step of improvement and qualification of reactor physics methods for HTRs* *- Feasibility of 100% reactor Pu core and confirmation of its high rate of Pu destruction*
• Fuel technologies *- Restoration of the base HTR fuel manufacturing technologies* *- Development of advanced modelling of HTR fuel*
• Materials *- First elements of feasibility of an HTR reactor vessel in Mod. 9Cr 1Mo steel.* *- Selection of alloys for a direct cycle turbine, but need for cooling the discs shown* *- Selection of the most promising industrially available graphite grades for reactor internals*
• Components *- Requirements on the turbine design (diameter of discs, horizontal shaft)* *- Conceptual design of components (magnetic bearings, leak-tight rotating seals…)*
• Safety approach: *the bases have been defined*
• Waste management *- Process for decontamination of irradiated graphite tested at lab. scale* *- Good behaviour of HTR fuel in disposal conditions: first confirmation*

Conclusions

This paper discusses the results of the HTR research programme developed under EURATOM during the 4th and 5th EC Framework Programmes in response to the initiative taken by a leading network (HTR-TN) of industrial and research partners in Europe.
The wide scope of the programme in all areas of fuel, nuclear design, materials, components and safety and the relevance of the countries represented along with the competence of the companies involved have been decisive to its success. The results obtained so far have been very important to consolidating HTR technology as one of the most promising for the innovative reactors of the future.
The 5th Framework Programme is now drawing to a close with the interesting results set out above. Now, V/HTR-Integrated Project (V/HTR-IP), recently selected for funding by the EC in the 6th Framework Programme, looms before us. It will be a major component of the EURATOM participation in the "GENERATION IV International Forum" initiated by the USDoE, which aims at developing, on the basis of a large international co-operation, six different innovative nuclear systems, in particular the Very High Temperature Reactor (VHTR).
The continuation of the research activities during the 6th Framework Programme along with other international programmes will consolidate the HTR as a viable option for the near-term renaissance of nuclear energy.

In-Service Inspection Technology and Materials Emerging Issues

by:
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TECNATOM
(Spain)

Figure 1: ***Full Replica Simulator of Trillo NPP.***

Tecnatom is an engineering company that was set up in 1957 and that carries out activities in more than thirty countries.

The company's main activities centre on the rendering of the following services:

- Training of the operating personnel of industrial facilities,
- Component inspection and structural integrity,
- Operating aid engineering for electricity generating plants and complex industrial facilities.

For all these activities, Tecnatom has its own technology development allowing equipment and spares to be designed, manufactured and commercialised together with the execution of the services.

The company currently has 500 professionals, approximately 50% of which are post-graduates.

In relation to component inspection, the company has a high level of specialized experience in the inspection of Nuclear Power Plant, not only in Spain but also in almost all countries with this type of the technology. In last years, this experience has been extended to the Aircraft industry with great success.

In the decade of the ´80, several international projects demonstrated that the ultrasonic inspection procedures for defect detection and sizing showed important limitations to achieve their goals. The qualification of the inspection procedures, i.e. the demonstration of their capabilities to detect, localize and size defects, became a significant technological challenge to all inspection companies around the world, but also to the Nuclear Utilities that have to develop the methodologies to guarantee

Figure 2: ***Qualification of Reactor Vessel Inspection System for Sweden.***

the qualification results. In the decade of the ´90, qualification methodologies were developed in Europe and USA.

These methodologies require now that the technical capabilities of the inspection system, i.e. equipment, procedure and personnel, must be demonstrated in practical demonstrations on flawed test specimens reproducing the area to be inspected and technical justifications that analyse the technical basis and evidences of the non-destructive methods and techniques proposed. As a consequence, the inspection companies have now to face new inspection technological development to make sure they succeed in the qualification.

Tecnatom with its extensive experience in in-service inspection and as data acquisition system and mechanical equipment designer and manufacturer has succeeded in all the inspection qualifications performed in USA and Europe. In the first case, Tecnatom qualified the inspection system of reactor pressure vessel wall welds at the Performance Demonstration Initiative (PDI) of the American Utilities, administrated by EPRI. In fact, it was the first company to pass this examination in the first attempt. In Europe, succeeded inspection qualifications for nuclear power plants took place in Spain, Sweden, Finland, Switzerland, Czech Republic, Bulgaria, etc. Also inspection qualifications were achieved in Russia and Ukraine. New qualification activities are now going on in United Kingdom and France.

In last years, new emerging issues related to corrosion degradation mechanisms in Ni alloys materials localized in several areas of the nuclear systems are under discussion. A combination of years of operation, temperature, stress levels, sensitisation of materials, etc, might lead to the generation of corrosion cracking in the weld area and base material. Few examples of these areas are: base metal and welds of Control Rod Driving Mechanisms (CRDM) nozzles, bottom-mounted instruments (BMI) tubes base material and penetration welds, reactor pressure vessel safe-end welds, spray nozzle weld, etc. Several of these areas are not included in the standard inspection programmes and now the position of the Nuclear Safety Regulators is that inspection, and therefore qualification, shall be performed in all of them identified as areas that could potentially develop corrosion cracking.

A new technological challenge is then foreseen in the near future for all parties involved in the inspection and qualification. For the inspection companies, the challenge is to develop new inspection technologies to be applied in areas that, in some cases, have never been inspected before. The geometrical configuration of these areas and accesses are, in general, very complex and need mechanical inspection equipment that produces trajectory movements originated by computer programs. Also defect detection and sizing techniques require new developments due to the morphology and branching of the corrosion cracks. On the other hand, Utilities and Qualification Bodies must develop technologies to generate corrosion cracks in test specimens controlling their locations and sizes in order to verify the capabilities of the inspection systems during qualification. Additionally, as many of these areas were not scheduled for in-service inspection, the surface conditions due to the final mechanical work on the weld area are not as suitable as they should be to have an appropriate inspection performance and as a consequence, both the inspection procedures and the qualification demonstration must take into account those factors.

The challenge is so important that the Utilities and the Nuclear Safety Regulators previously to any decision on new inspection requirements should do a rigorous analysis of the whole situation, with the support of experts in materials and inspection performance and qualification. In any case, on the basis of the extended experience gained by Tecnatom in in-service inspection and qualification, and considering our own technological capabilities on inspection, the company is ready to face the new challenges with a great level of confidence.

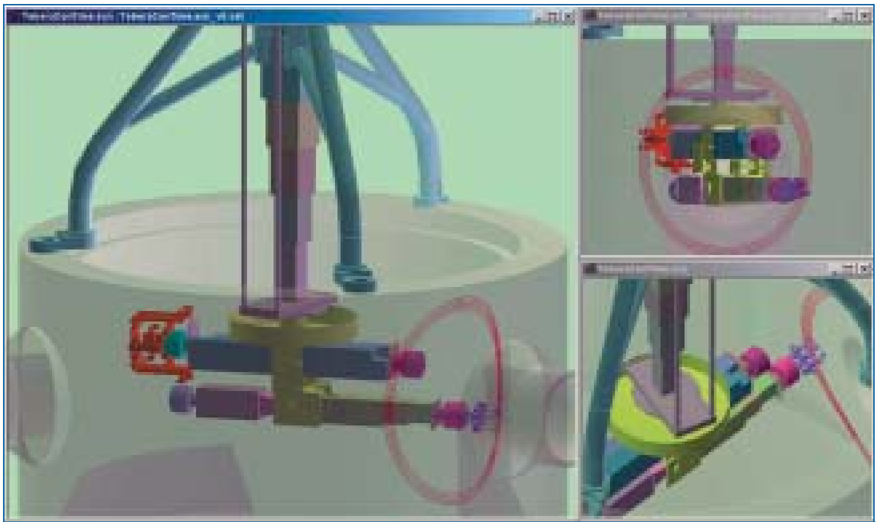


Figure 3: ***3-D Simulation of Reactor Vessel Nozle Inspection for qualification.***

On Site Assistance to Khmelnitsky NPP 1&2 (Ukraine)

by:
Aníbal Martín and ***Joaquín Suárez***,
IBERDROLA Ingeniería y Consultoría
(Spain)
and ***Ennio Traini***,
SOGIN
(Italy)

Nuclear Safety in Eastern Europe and the Community of Independent States has been the subject of significant attention and international assistance and co-operation efforts over the last years. Over the coming years the importance of nuclear safety is expected to be maintained. In parallel the relative importance of co-operation is steadily increasing, both at the level of nuclear operating utilities and amongst nuclear regulatory authorities.

The European Union countries and the European Commission initiated, specific programmes to assist nuclear safety improvement of the Central and Eastern European countries and the Newly Independent States. PHARE and TACIS programmes are keystones of this effort.

The main objective of these Assistance Programs is that operations of the nuclear operating plants do not pose undue risks for the European Community and to assure by assisting utilities and regulators of these eastern countries to improve their levels of nuclear safety and making them equivalent to those in the west.

IBERDROLA through its engineering and consultancy company (IBERINCO) and as part of its strategy for business development in Eastern Europe is now directly involved in TACIS projects. IBERDROLA as leader in a Consortium with the Italian company SOGIN has been lately awarded TACIS programs for Khmelnitsky NPP Units 1 and 2 (Kh1 and Kh2) in Ukraine. This Consortium provides synergic effects for capabilities enlargement and allow the beneficiaries to receive a broader view of western European practices.

- For Kh1 NPP the IBERDROLA-SOGIN will assist the plant owner Energoatom in two different kinds of activities: 'hard' OSA activities, where improvements to the plant design related with safety will be developed and implemented, and 'soft' OSA activities, that would help the plant in the improvement of their management and processes: emergency procedures, alarm sheets, outage optimization, etc. The project will be developed in two phases: the first one (Bridging Phase) will last one year, and the second (Large-Scale) about three years. During the Bridging Phase some design changes already started will be finished, and the definition of the 'soft' activities will be established and agreed upon. In the Large-Scale, the 'soft' OSA and some other design improvements will be implemented.
- For Kh2 NPP the Consortium will assist Energoatom to organize and perform an assessment of the proper implementation of some safety related measures (modernization, completion, rehabilitation). The final objective is to help Energoatom to get loans from the EC/Euratom and the EBRD for the modernization of the plant. The project will be accomplished in 9 months and a number of European and local experts are selected to achieve all the necessary activities and specialities involved.

On top of proven technical capacities and demonstrated project management capabilities as would any typically regular project require, TACIS projects management present a series of specificities that must be taken into consideration from the onset to assure assistance effectiveness.

The Customer is the European Commission, who is the promoter of the Assistance Program, and has established uniform rules and guides to properly administer the aid. The Beneficiary and the End User are the subject Plant to undergo improvement and its utility owner. A Contract is established regulating relationship, roles and responsibilities between participants.

Specific requirements include formal kick-off meetings at the plants site, a detailed inception report and periodical comprehensive reporting on the progress of the activities. Progress is measured in terms of satisfactory goals accomplishment.

For the Kh1 NPP assessment most notable reference is to be made to the so called "2+2 approach" this includes the review and approval not only by the safety authorities of the beneficiary country but by the Joint Research Center experts selected by the European Commission to insure compliance with western standards and practices.

Several steps had been taken since the onset of TACIS from the determination of the status of each individual plant to the present situation of implementation of improvement actions. Assistance is the goal, but as progress is achieved the role of cooperation and interchange enhancement will increase as a benefit for safety and business development. IBERDROLA expects to play its role in this important program and to maintain its active presence in these challenging scenarios.

Dismantling and Decommissioning of Vandellós I

by:
Jorge Lang-Lenton
Director of Comunications ENRESA (Spain)

When a nuclear power plant is definitively shut down, suitable measures are taken so that it does not represent a danger to people and the environment in the short, medium and long term. Faced with this situation, the universally accepted approach under normal conditions is to proceed with dismantling and decommissioning of the installations.

Dismantling is a controlled industrial process that ensures conformance with the standards demanded of final products depending on their destination.

Decommissioning is the administrative act whereby, once the facility has been dismantled, the spaces subject up to that point to nuclear regulations and conditions are considered as freely available for use.

There is very little experience in the world in the dismantling of powerful commercial reactors, as there are very few facilities that have begun this phase and none of them have fully completed it. In all cases, the recommendations of the International Atomic Energy Agency are being followed. According to these recommendations, the dismantling of nuclear power plants must be carried out at three levels of closure; level 1, conditioning activities are completed; level 2, the structures are dismantled and preparations are made for the latency period; period 3, the reactor enclosure is dismantled. In Spain, the dismantling of the Vandellós-I nuclear power plant has been completed through closure Level 2.

The Vandellós-I power plant, a graphite-gas facility with a power of 500 MW, began commercial operation in May 1972 but, after an accident in the turbine room, operation was terminated in October 1989 after the plant had generated 55,647 million kWh.

HIFRENSA, a plant operating utility, completed Level 1 between 1991 and 1997. During this phase, the fuel was unloaded from the reactor and removed from the site, the operating waste was treated, and the waste stored in the graphite silos was removed and pretreated.

ENRESA was responsible for carrying out closure Level 2, which began in February 1998 and concluded in the month of June 2003. This level included dismantling of all structures, systems and components except for the reactor enclosure, with clearance of most of the site and the rest maintained as a regulated zone, and the reactor enclosure was confined and covered by a newly built outdoor protective structure.

This level included two execution phases:

First phase executed between February 1998 and February 1999. Its objectives were as follows:

- Condition the site to do dismounting work in radiological zones.
- Dismantle and remove from the site the conventional equipment and structures not logistically required to support project activities. These activities are included as part of the Conventional Component Dismantling Plan (PDCC).

Second phase begun in March 1999 and completed in June 2003. Its objectives were as follows:

- Execute the Active Part Dismantling Plan (PDPA).
- Apply the Clearance Plan to ensure that clean materials are not contaminated and, therefore, can be conventionally managed.
- Continue with the PDCC.
- Ship the low- and intermediate-level radioactive waste (RBMA) to the El Cabril storage center.
- Ship the conventional materials to centers authorized for recycling.
- Ship the conventional waste to specialized waste dumps.

The materials involved in this closure Level 2 of dismantling were: 16,500 t of conventional scrap; 277,000 t of conventional concrete debris; small amounts of toxic and hazardous products; and 2,000 t of low- and intermediate-level radioactive waste.

Having completed Level 2, the parts of the site still not released remain under the responsibility and supervision of ENRESA. This situation will last for 25 years, a period during which the radiological activity of the internal enclosure structures will decay until it represents approximately 5% of the original value. At that time, they will be able to be dismantled with minimum radiological risk to the personnel executing the work.

Level 3 will start around 2028 when the latency period is over. In that stage, the reactor enclosure and its internal structures will be removed, thus clearing the entire site.

Vandellós 1: in operation.

Vandellós 1: after closure Level 2.

News from...

Bulgaria

• Bulgarian Nuclear Society in defence of Nuclear Energy

Bulgarian Nuclear Society is an association which incorporates scientists, physicists, engineers, chemists, physicians, and other specialists who work in the nuclear field and in the application of nuclear methods. During the last years, BgNS has developed and propagated among the society and politicians documents showing that the nuclear energy has no real alternative as in warranting the national sustainable energy supplies so in preserving the climate changes. Definitely, BgNS has the purpose of making approachable the knowledge about the application of nuclear science and technology for increasing the quality of life.

EU

• 9th Nuclear Marathon (BULGARIA-2004)

Last month of May (13th and 14th) was taken the 9th Nuclear Marathon in Bulgaria. Over 500 runners, all of them nuclear industry workers, have arranged to meet to run from Pleven to Sofia, relaying each other over the total distance of 330 km. The spanish participation was 15 workers of the nuclear power plants. Each team had participated in four legs at a rate of around one leg every five-seven hours, excluding the departure from Pleven, the final in Sofia and other in the evening of the first day in Kozloduy Nuclear Power Plant.

Since 1996 to 2002, always in May, nuclear workers are running a 350 km length approximately. The Nuclear

Marathons were run in the following countries:

1996 & 1997: Paris- Bruxelles.

1998: Budapest- Mochovce NPP & Bohunice NPP (Slovak R.)- Dukovany NPP (Czech R.)-Vienna.

1999: Constantza- Cernavoda NPP- Bucarest (Rumania).

2000: Stuttgart- Neckarwestheim NPP- Grafenrheinfeld NPP- Isar NPP- Munich (Germany).

2001: Smolensk NPP- Diesnogorsk – Obninsk – Moscou (Russia).

2002: Malmö – Barsebäck NPP – Ringhals NPP – Götheborg (Sweden).

IAEA

• Vienna, 26 June 2004

Twenty-two of the last 31 nuclear power plants (NPPs) connected to the world's energy grid have been built in Asia, driven by the pressures of economic growth, natural resource scarcity and increasing populations. Of the new NPPs presently under construction, 18 of the 27 are located in Asia, while construction has virtually halted in Western European and North American countries with long-standing nuclear power programmes, says the International Atomic Energy Agency (IAEA).

Slovakia

• Nuclear Energy in Slovakia

The past month of May was celebrated the Conference: Can Slovakia secure energy supply and sustainable development without Nuclear? In this interesting conference, it has been analysed the nuclear energy as a part of a balanced energy mix and it has been considered that the role of government is establishing overall policy for the economy, energy and environment with an adequate base in legislation and institutional competence.

• 50 Years of Civilian Nuclear Power

Fifty years ago, at 5:30 pm, June 26, 1954, in the town of Obninsk, near Moscow in the former USSR, a nuclear power plant was for the first time connected to an electricity grid to provide power to residences and businesses. Nuclear energy had crossed the divide from military uses to civilian applications.

Nuclear fission was discovered in 1939. The world's first nuclear chain reaction took place in Chicago in 1942 as part of the wartime Manhattan Project. The first nuclear weapons test was in 1945 at Alamagordo, New Mexico. And electricity was first generated from a nuclear reactor in December 1951, from EBR-I (Experimental Breeder Reactor-I) at the National Reactor Testing Station in Idaho, USA. EBR-I produced about 100 kilowatts of electricity (kW(e)), enough to power the equipment in the small reactor building. The Obninsk reactor in 1954 produced 5000 kW(e) or 5 megawatts (MW(e)), enough to power 2,000 modern homes. A typical nuclear power plant today is about 1000 MW(e), enough for 400,000 modern homes.

Nuclear power grew rapidly in the 1970s and early 1980s. From 1970 to 1975 growth averaged 30% per year, the same as wind power recently (1998–2001). By 1987 nuclear power was generating slightly more than 16% of all electricity in the world.

Nuclear expansion slowed in the 1980s because of environmentalist opposition, high interest rates, energy conservation prompted by the 1973 and 1979 oil shocks, and the accidents at Three Mile Island (1979, USA) and Chernobyl (1986, Ukraine, USSR). The Three Mile Island accident was the first major accident at a civilian nuclear power station. It had no radiological effect on public health but increased opposition to nuclear power, and the large financial loss further discouraged new nuclear investment. The Chernobyl accident was much more severe. The accident broadened opposition to nuclear power and brought the USSR's nuclear expansion to a halt. Worldwide growth in nuclear power slowed to the rate of worldwide growth in overall electricity use. Thus, in the 17 years since 1987, nuclear power's share of global electricity generation has held steady around 16%.

IAEA

Atw, Nuclear España, Revue Générale Nucléaire

Spain

• The CSN releases the first publication on Nuclear Law

The Consejo de Seguridad Nuclear (CSN) has begun publishing the journal “Studies in Nuclear Law”, a unique biannual publication in Spain that will deal with issues concerning current and future legislation on this type of energy and all the activities related to the fuel cycle. The “challenge” is to address the constant evolution of regulations related to nuclear and radioactive facilities.

• Tecnatom Participation in the Almaraz NPP Power Up-rate

Tecnatom has taken part, in conjunction with Almaraz NPP and Westinghouse, in the Almaraz power up-rate project. The Plant’s electric power has been increased by 28 MW.

The project has basically involved the installation of a new measurement system of feed-water flow to the steam generators.

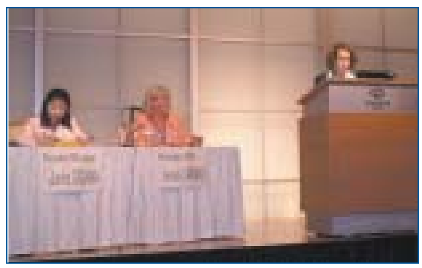
The system is basically composed of a high-precision ultrasound flow meter and another high-precision temperature meter in each of the feed-water loops. With the flow measurement obtained, which is more precise than before, the reactor thermal power can be calculated with a very low level of uncertainty. This helps to boost the production associated with a power up-rate of 28 MW electric.

Tecnatom’s job was to develop a redundant system for each of the two plant units that is used to exchange data between the plant computer (SAMO) and the new metering instruments and that then calculates the plant’s thermal power. The development is based on a SCADA system used by the plant engineering department to display the measured signals, track the thermal power calculation, control the alarms generated by the computation system and display graphics of historical data.

In order to facilitate system maintenance and extension, a customized controller has been developed that conforms with communications standard OPC (OLE for Process Control). As a result, the interface used by the end user is supported by the use of open tools. For example, the main thermal power calculation parameters can be displayed on-line on Excel spreadsheets developed by Tecnatom. This display can be done from any properly configured computer in the plant’s internal network if the user is authorized to access these data. These are currently installed in the computers of the Operation Shift Director’s assistants.

WIN

• WIN GLOBAL Annual Meeting in Japan



The WIN Global-2004 international meeting was held in Tokyo on May 17 to 20. More than 200 people from 17 countries took part in the event, which was organized by the Japanese WIN group and sponsored by the country’s leading electrical utilities. The main purpose of this annual meeting was to exchange experiences on the way to inform the communication media, politicians and opinion-making sectors in a familiar, comprehensible way about nuclear power and its applications, and to explain the reality of nuclear power’s contribution to electric energy production and other applications in the medical and industrial fields in the participating countries.

The representative of WIN España, Piluca Núñez (Spanish Nuclear Industry Forum) presented a paper on public opinion of nuclear power, the need to guarantee the electric supply in the face of the growing demand for electricity, and the role that nuclear power plays in Spain.

The conclusions of the meeting can be summarized in the promising situation of nuclear power in Chain and other developing countries, the decisive stake of some countries in developing nuclear power applications, and the leading role of hydrogen in Japan.

There are more than 20,000 WIN members in the world, from 57 different countries. New countries such as Australia, Pakistan, Vietnam and South Africa have joined the organization in 2004. In this meeting, Junko Ogawa (Japan) was elected as new WIN Global President, as the successor to Annick Carnino. WIN España’s President is Carolina Ahnert (Polytechnic University of Madrid) and its representative on the WIN Global International Committee is M. Luisa Perez-Griffo (Westinghouse).

• ENS Calendar of Conferences & Events

OCTOBER

Spanish Nuclear Society, SNE, 30th Annual Meeting,
Date: 29 Sept-1 Oct. 2004
Place: Alicante, Spain
Organiser: The Spanish Nuclear Society (SNE)
Contact: SNE
E-mail: postmaster@sne.es
More: www.sne.es

Nuclear Reactor Thermal Hydraulics, Operations and Safety (NUTHOS-6), 6th international topical meeting
Date: 4-8 Oct. 2004
Place: Nara, Japan
E-mail: info@nuthos6.org

11th Russian Particle Accelerator Conference, RuPAC2004
Date: 4-9 Oct. 2004
Place: Dubna, Russian Federation
Organiser: JINR, Russian Academy of Science, and Ministries for Atomic Energy, and for Industry, Science and Technology of the Russian Federation
More: http://www.accelconf.web.cern.ch/accelconf/

Hearing of New European Commissioners (EU25) by the new European Parliament
Date: 4-14 Oct. 2004
Place: European Parliament, Brussels, Belgium

Water Chemistry of Nuclear Reactor Systems, international conference
Date: 11-14 Oct. 2004
Place: San Francisco, California, USA
Organiser: Electric Power Research Institute, EPRI with the IAEA
Contact: EPRI1355 Willow Way, Suite 278, Concord, CA 94520-5728, USA
E-mail: cwood@epri.com

Simulation Methods in Nuclear Engineering, 6th international conference
Date: 13-15 Oct. 2004
Place: Montreal, Quebec,
Organiser: Canada Canadian Nuclear Society (CNS)
Contact: Denise Rouben
E-mail: cns-snc@on.aibn.com
More: http://www.cns-snc.ca/simulation2004

Inelastic Ion Surface Collisions, 15th international workshop
Date: 17-22 Oct. 2004
Place: Mie, Japan
E-mail: iisc15@nucl.nagoya-u.ac.jp
More: http://www.iisc15.nucl.nagoya-u.ac.jp/index.htm

Topical Issues in Nuclear Safety, international conference
Date: 18-22 Oct. 2004
Place: Beijing, China
Organiser: IAEA
More: www-pub.iaea.org/MTCD/Meetings/Meetings2004.asp

VVER-2004, international topical meeting, 'VVER-2004, Experience and Perspectives'
ENS sponsored
Date: 19-22 Oct. 2004
Place: Prague, Czech Republic
Organiser: The Czech Nuclear Society
E-mail: teris@teris.cz

International Conference on Isotopes in Environmental Studies - Aquatic Forum 2004
Date: 25-29 Oct. 2004
Place: Monte-Carlo, Monaco
Organiser: International Atomic Energy Agency, IAEA
Contact: Ms. Mariel Solarik-Leahy. Division of Conference and Document Services. Conference Service Section IAEA-CN-118
E-mail: M.Solarik-Leahy@iaea.org
More: http://www.iaea.org/

Division of Nuclear Physics of the American Physical Society, 2004 autumn meeting
Date: 27-30 Oct. 2004
Place: Chicago, Illinois, USA
Organiser: American Physical Society, APS
Contact: APS Meetings Department, One Physics Ellipse, College Park, MD 20740-3844, USA
E-mail: meetings@aps.org

November

'Nuclear Power for the 21st Century', international conference
Date: Oct.-Nov. 2004
Place: Paris, France
Organiser: International Atomic Energy Agency (IAEA)
More: www.pub.iaea.org/MTCD/Meetings/Meetings.asp

Fusion Energy 20th IAEA conference, FEC 2004
Date: 1-6 November 2004
Place: Vilamoura, Portugal
Organiser: International Atomic Energy Agency, IAEA
Contact: Ms. Hildegard Schmid, Division of Conference and Document Services, Conference Service Section
E-mail: H.Schmid@iaea.org
More: www.iaea.org

The Rertr-2004 International Meeting On Reduced Enrichment For Research And Test Reactors
Date: 7-12 November 2004
Place: Vienna, Austria
Organiser: IAEA
Contact: "RERTR-2004" International Atomic Energy Agency
E-mail: RERTR2004@iaea.org

Operating Nuclear Facility Safety, international meeting
Date: 14-18 Nov. 2004
Place: Washington DC, USA
Organiser: American Nuclear Society, ANS
Contact: ANS Meetings Dept.
E-mail: meetings@ans.org
More: www.ans.org/meetings/

• Young Generation Network: Latest News

International Youth Nuclear Congress. Toronto.

• International Youth Nuclear Congress

The third edition of the *International Youth Nuclear Congress* (IYNC 04) was held from 9th to 13th of May, 2004 in Toronto, Canada, following former editions organized in Bratislava (Slovakia, 2000) and Taejon (Korea, 2002). This congress is an interesting experience exchange between young professionals, with papers about lots of subjects related to both Young Generation Groups activities and technical issues. This third edition was, again, a success, with about 300 young nuclear professionals from all over the World.

During this congress, an international meeting of country representatives was held to form the *International Youth Nuclear Congress*, an international association to give the suitable structure for the periodic organization of the congress. Furthermore, in this meeting Sweden was elected as the place to celebrate the next International Youth Nuclear Congress in 2006.

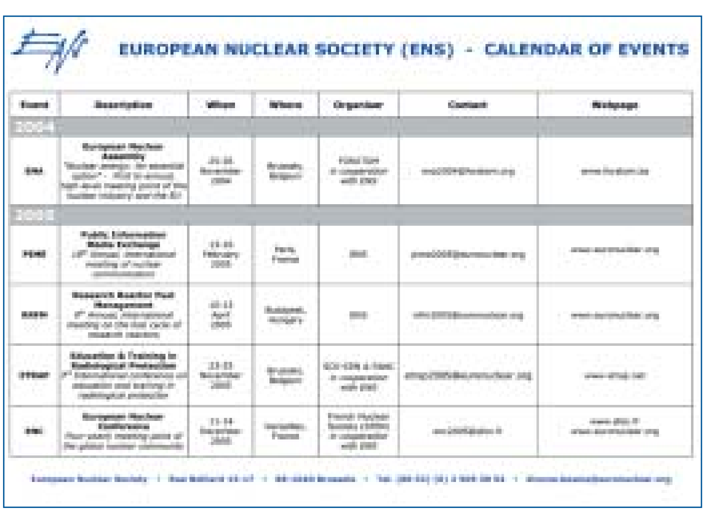
• Celebration of the first Spanish Young Generation Debate

The *Spanish Young Generation Network*, a Committee from the Spanish Nuclear Society, gathers young professionals from Spanish nuclear field. It also belongs to the *European Nuclear Society Young Generation Network*, taking part in this ENS Committee's meetings and activities.

Last months have been very busy for Spanish Young Generation Network members, as lots of activities were organized. But one of them can be pointed out: The celebration of the first Spanish Young Generation Debate.

The idea of organizing such activity came from some members of the Committee. In these debates, one expert in some area from the nuclear field joins the members of the Committee to exchange experiences and opinions. This activity tries to reach two main targets: to facilitate the transfer of knowledge between generations and to form a collective way of thinking for the Spanish Young Generation Network.

The first debate took place the 21st of June, and the subject to discuss was Nuclear Safety. Agustín Alonso, a well-known Spanish professional in this area, shared with Spanish Young Generation members his opinions, views and experience. An interesting and lively discussion followed Mr Alonso's speech.



EUROPEAN NUCLEAR SOCIETY (ENS) - CALENDAR OF EVENTS

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