Nuclear España



JOURNAL OF SPANISH NUCLEAR PROFESSIONALS

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REUNIÓN ANUAL

European Nuclear Young Generation Forum (ENYGF)

INTERVIEW: Miguel BARREIRO & Patricia CUADRADO. Chariman of the Organizing Commitee & Chairwoman of the Technical Committee

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INTERVIEW

Miguel Barreiro y Patricia Cuadrado.

Chariman of the Organizing Commitee & Chairwoman of the Technical Committee

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EDITORIAL

THE MOOD OF THE NUCLEAR INDUSTRY

ast October, around 700 professionals linked to the nuclear industry participated in the 46th Annual Meeting traditionally organized by the Spanish Nuclear Society. After the hiatus during 2020, the improvement in the pandemic conditions made it possible to restore the face-to-face format and the city of Granada became the setting for this meeting.

Year after year, the Annual Meeting becomes a reflection of the nuclear industry in our country and, once held, allows us to certify the evidence of the vitality of our sector based on the number of companies that were present to present their capabilities, the volume and quality of the presentations that were shared in the technical sessions, and, of course, the attendance of nuclear professionals through whom the generational change occurring in this sector can be noted.

Undoubtedly, for all the attendees, the value of the personal re-encounter and the closeness that the convention allows for is one of the most outstanding elements of this established event in the sector but, in this framework, it is inevitable to focus on the relevance that this event as a reflection of the reality of an industry and some professionals that, once again, we would like to highlight.

Talking about research projects such as DONES in Granada, finding out more about the new designs of small modular reactors, discussing the progress of the Spanish nuclear industry in recent months, and exchanging experiences and knowledge with experts from other countries allows us to experience the vitality of the nuclear sector. We accumulate experience, we learn day by day, and we feel prepared to continue doing so for many more years.

Finally, we must not forget that this is a sector that employs some 30 000 people in its various fields and that, since its inception, has created a solid industry with a national presence but that is also very present in international markets.

Still, there is an outdated echo of some voices who want to insist on the message that the nuclear sector and technology are something of the past, obsolete and static. Given this statement, we think that a professional meeting such as the Annual Meeting shows that the nuclear industry in Spain is more alive than ever and is a value, a resource to be taken into account as a necessary element for the decarbonization of electricity, for energy independence, and to guarantee supply, but especially, it is also an asset as a professional sector to be preserved.



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The attendees at the 46th Annual Meeting were very conscious of the need to protect each other

MIGUEL BARREIRO & PATRICIA CUADRADO PRESIDENTS OF THE ORGANIZING COMMITTEE AND THE TECHNICAL COMMITTEE FOR THE 46th ANNUAL MEETING OF THE SNE

Text: MATILDE PELEGRÍ Photo & video: Grupo SENDA

Uncertainty was one of the most used words during the first months of 2020 when Covid-19 was still very present. With this scenario, preparations for the 46th Annual Meeting began, with Granada as the venue for an in-person event once again, but with the possibility of a setback as a possibility given the health situation.

Assuming leadership in this changing environment was a challenge accepted by Miguel Barreiro at the head of the Organizing Committee and Patricia Cuadrado from the Technical Committee, with great enthusiasm but also aware that the work would be intense.

Fortunately, the pandemic provided a respite, and the 46th Annual Meeting has been a complete success both in terms of the number of participants and presentations. Those of us who had the opportunity to be there experienced the joy of reunion, hugs from a distance, and the ability of professionals in the sector to face changes. With the Presidents of the Annual Meeting, we analyzed the development of this Meeting, which is also marked in the history of the SNE

NOW IN GRANADA

The 46th Annual Meeting should have been held in Granada in October 2020. After the adaptation of this meeting to a Virtual Meeting, this venue was reinstated for the 2021 convention. At the time, what reasons led the SNE to select this city as the venue?

Miguel Barreiro. We opted for Granada to meet all the criteria that we defined for the headquarters of the Annual Meeting: a medium-sized city, good hotel capacity, well-connected and with costs that fall within the economic parameters that the SNE stipulates for annual meetings. The interest aroused by the DONES project was an attraction that we considered had to be included in the convention program. In addition, Granada has very important cultural offerings and has multiple spaces for the activities that we organize within the framework of the Annual Meeting.

How was the return to face-to-face "normality" managed, taking into account the uncertainty of the health situation?

MB. From the beginning, this was the great challenge we faced. What we did was propose alternatives from the point of view of organizing activities, to adapt as the health situation evolved. For example, we looked for spaces where the activities could be carried out outdoors or indoors, with sufficient capacity according to the capacity allowed, natural ventilation possibilities, and ensuring distancing between attendees.





PROFESSIONAL PROFILE

Miguel Barreiro is an industrial technical engineer in Industrial Electronics, with an industrial engineering and master's degrees in Electrical Technology from the Comillas Polytechnic University - ICAI.

He has been working at ENDESA since 2011 in Nuclear Standards and Regulation.

What was the response of the attendees in this regard?

MB. Behavior, in general, was very good. The recommendations that we conveyed before and during the convention were complied with and it was evident that the attendees were very aware of the need to protect each other.

In general, what has been the response of regional and local authorities and institutions such as the University?

MB. From the organization we feel very supported by the various institutions of the city of Granada. The involvement of the City Council (provision of spaces, coverage in the media, facilitating contacts,...), the University (it had an important participation in the General Session on the DONES Project, they provided space for the Nuclear Young People activities, they helped us with outreach for the convention), the Convention Bureau (all the contacts for companies whose services we needed, entry gateway to the City Hall,) was very notable during the months prior to the Annual Meeting.

TECHNICAL CONTENT

The technical program is the backbone of the annual meetings. What are the subject areas that had the most interest from the attendees?

Patricia Cuadrado. This year all the subject areas, without exception, had a lot of interest, all the rooms were full. Perhaps also because it had been a long time since we met in person, but the papers presented generated a lot of interest. As well as for the parallel technical sessions. The general sessions, single subject sessions, and workshops were also especially well-received due to the topics presented.

Where is the technical program evolving towards?

PC. Although we continue to offer general and single subject sessions and technical sessions in parallel with up to 16 subject areas, we have recently incorporated other types of more interactive sessions such as the Digitization Workshops in the latest editions.

What have been the challenges that the Technical Committee has faced during this edition?

PC. In this edition, we were facing a return to normal face-toface life with all the restrictions that this entails, and the result was very positive thanks to the response of the attendees and the support of the organization.

The general sessions allow for the analysis of current issues in the sector. What were the highlights of these sessions?

PC. This year, as Granada was officially a candidate for the construction of the IFMIF-Dones particle accelerator, we focused on the DONES (DEMO-Oriented Neutron Source) project, a facility where the materials that will constitute future nuclear fusion reactors will be tested under actual operating conditions. Many Spanish companies in the nuclear sector are participating in this great project led by CIEMAT. Another topic that we addressed was the analysis of the impact of recent events that have shown the strength of energy systems in general and electricity in particular in the face of extreme environmental phenomena.

COMPANY PARTICIPATION

The support of companies in the sector, through sponsorships and their participation in the commercial exhibition, is key. What was the response of the companies in this edition?

MB. We anticipated that after the situation caused by the pandemic, the attendance and involvement of companies could decline. But the reality is that it was quite the opposite. The involvement of the companies in the sector made it possible to recover the levels of sponsorships prior to the pandemic and the commercial exhibition was once again a success both in terms of the number of exhibitors and the content of the stands. In total, we had the support of more than 50 companies.

A MEETING FOCUSED ON SOCIETY

The interest in bringing nuclear science and technology closer to society is increasingly reflected in the Annual Meeting through the activities organized by Nuclear Young People and WiN Spain. What aspects of these initiatives stand out?

MB/PC. In order to promote STEM (Science, Technology, Engineering, and Mathematics) training among younger students, the Spanish Nuclear Society has organized the STEM Program within the framework of the Annual Meeting. It is an open and free event intended for students from Secondary Schools (IES) in their last two years (3rd and 4th of Compulsory Secondary Education). The SNE intends to provide added value to its Annual Meeting by providing information and training to Compulsory Secondary Education students in technical and scientific concepts related to science and technology in general and nuclear technology in particular. This program consists of four parallel workshops in which different organizations collaborate: ENRESA: Escape Box: El Cabril Mission, Nuclear Forum: Magic for Science Outreach, Nuclear Young People: DIY Holograms.

Nuclear Young People organized a new edition of the Basic Course on Nuclear Fusion at the University of Granada which was attended by students and others interested in nuclear science and technology.

The NEA (Nuclear Energy Agency) of the OECD and WiN Spain organized the Mentoring workshop intended for girls in order to generate interest in science and technology activities with the support of senior and junior women professionals. Within the framework of the Annual Meeting of the SNE, Women in Nuclear (WiN) Spain organized a conference open to the Granada society entitled Application of Radiation in the Conservation of Cultural Heritage.

Do you think that this type of activity should be encouraged at annual meetings?

MB/PC. Of course, the first two days (Monday and Tuesday) multiple outreach activities were carried out intended for the society of Granada while the remaining three days (Wednesday to Friday), the activities focused on the attendees who enjoyed an intense Technical Program complemented by the collective participation of attendees in social and cultural events in emblematic places of Granada.



PROFESSIONAL PROFILE

Patricia Cuadrado has a degree in Chemical Sciences from the Autonomous University of Madrid, specializing in Analytical Chemistry. She has over twenty years of experience in the energy industry. She is the commercial director in the Nuclear Area of Advanced Projects and R&D at Empresarios Agrupados.

Since 2013 she has been part of the SNE Annual Meeting Technical Committee, first as a member, and since 2018 as President. Patricia is an active member of WiN Spain, having been a member of the Board of Directors since 2017. She was President of the Technical Committee for the WiN Global World Congress held in Madrid in 2019. She has been the Secretary General of WiN Spain since December 2019.

COMMUNICATION

The activities of the Annual Meeting have a growing presence in the host society. What role has communication had in this edition in Granada?

MB. This year we had a double challenge because we had to be able to convey the message that we were organizing an attractive convention from a technical and cultural point of view and on the other hand, we had to send a safety message in the face of the evolution of the pandemic. I believe that the work of the Communication people has been remarkable, and they have been able to create interest in the convention and involve the city of Granada in our activities. In addition, I like to define the Annual Meeting as a global Communication event where the SNE sends messages and positions on current issues in the sector. That is why in the Technical Program we include the topics that we understand may be more interesting for the attendees. This year, we discussed the DONES project and Nuclear Fusion, Filomena, Small Modular Reactors, Digitization, and an Industry 4.0 Workshop was organized with the participation of many companies with their most innovative products.

What has been the response of the local media?

MB. Well, it has been a positive response. It is true that the involvement of the mayor has been key to having this impact on the Granada media. This and that it was the first face-to-face convention that had been organized in Granada for a year and a half, which generated a lot of interest from the city.

SOCIAL RELATIONS

In addition to an important level of technical content, the annual meetings are also the meeting point for professionals in the sector, and much more so this year, which has been a reunion. What is your assessment of the social program?

MB. Going back to a face-to-face event allowed us to get back to activities that are highly valued by the attendees. This year, we had a very powerful city from a cultural point of view and it offered us many possibilities for our attendees. Proof of this is that the *Chumbera* flamenco singing and dancing performance Cultural Event received the best rating of all the activities of the convention. I think the space chosen for dinner was also a success and the many possibilities it offered us to adapt to variations in weather and the pandemic situation.

And what about the activities organized for guests?

MB. In general, the Guest Program received a very good evaluation from the attendees, somewhat related to the great cultural offerings of Granada and the interesting proposals of the Events Agency (Eurocongres) that provided us support in the organization of this activity.

THE COMMITTEES

Leading the organization of an event that brought together more than 600 people in which more than 300 technical papers were presented is not an easy task. How has the work of the Organizing and Technical Committees been developed?



- Attendees
- (convention attendees + guests): 671
- Number of papers: **295**
- Participation in the sessions: **full rooms**

MB/PC. Regarding the Annual Meeting Organizing Committee, the work proceeded with the normality of a face-toface Annual Meeting although it is true that we had to deal with the uncertainty of the pandemic since the beginning of the year. The responsibility of all the members of the Annual Meeting Organizing Committee and their involvement allowed the organization to be a success, and the result to be very satisfactory.

Regarding the Annual Meeting Technical Committee, each member is assigned one or several activities according to their expertise and understands the rest well to support us. The whole team knows the sector very well and I am lucky to have a very dedicated and professional team. We are very well coordinated, and the great support of the Annual Meeting Organizing Committee and the Board of Directors greatly facilitates the organization of this event.

How has the relationship with the Board of Directors been?

MB/PC. The relationship with the Board of Directors has been very smooth and thanks to them, the organization has been a success.

LESSONS LEARNED

According to the results of the survey given to attendees, a large majority of convention attendees have assessed the 46th Annual Meeting between good and very good. Therefore, the bar set is difficult to beat. However, there are always improvements to be made. What are the lessons learned that you consider most important to pass on to the next committees?

MB/PC. With regard to the Technical Program, perhaps the most important thing for next year would be to condense some subject areas of the technical sessions in parallel since we find some very long and others with few presentations. In addition, we will maintain the Workshops that have been very well received. And, finally, modifying the procedure for uploading synopses/presentations to the website so as not to delete either of them from the system when uploading one and the other so that both remain, makes it much easier for us when classifying them by session and day. From the point of view of the Annual Meeting Organizing Committee, I believe that the awards ceremony for the dinner can be improved, being more attentive to issues of variety in the catering menus and including more alternatives, we should bring back the awards for presidents and coordinators of the technical sessions, promote the dissemination of WiN and Nuclear Youth activities that are very well received by the institutions, and then improve some internal aspects of the Annual Meeting Organizing Committee by having a better plan for the work.

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46th ANNUAL MEETING OF THE SNE

















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The formal dinner of the 46th Annual Meeting was held at the La Mamunia Complex and was preceded by a cocktail party sponsored by Coapsa and IDOM. The Official Dinner is the most important social event of the SNE Annual Meeting where attendees and their guests enjoyed the gastronomic excellence of Granada and where Society distinctions were awarded, as shown in the following pages.



46th ANNUAL MEETING OF THE SNE





SNE ANNUAL AWARDS

During the official dinner, the SNE annual awards were awarded, which were presented by President Héctor Domonguis:

"Sincerely, I tell you, what a great joy it is to see this image again and see how we have recovered the most important social event of our Society's Annual Meeting.

Winston Churchill said that an optimist sees an opportunity in every calamity, and a pessimist sees a calamity in every opportunity.

As I consider myself optimistic by nature, I want to think that all the protocols imposed by COVID-19, (and the desire to sit down to dinner) will help us speed up the awards ceremony and continue with the rest of the evening. Therefore, I take this opportunity to ask those who are going to speak today to help us in this purpose.

But before we begin, allow me to take a minute to mention a person who would have loved to be here tonight, but ultimately could not. My father... and I know he would have loved to be here, first of all, because he has been attending the Annual Meeting for years and because he somehow experiences my presidency with the same enthusiasm as if it were his own.

And ultimately, he was not able to come because we made a firm decision that to come to Granada we had to be not only vaccinated but also immunized. The antibody test was done before coming and the result was just below the limit, so despite all his regret, but respecting the criteria he set, he has stayed in Valencia. However, he has asked me to send a greeting to all of you and the message that he misses you.

From here and on behalf of the Society, I send him an affectionate greeting back and the message that he is also missed.

We now turn to the recognition and distinctions for the professionals who have stood out for their effort and selfless collaboration with the SNE during a tough, complex period full of uncertainty. First of all, I have the honor of presenting the **SNE Diplomas**. Our recognition of the continued work of exceptional partners who are part of the commissions and have played a key role in the operation of the SNE. During the time that I have been actively participating in the SNE.

I have realized the importance of the work of the commissions, which are the motor of this Society and those who keep everything moving forward on a day-to-day basis.

The two people who receive this diploma are a very clear example of effort, dedication, and performance for the functioning of the Society.

That is why it is a great satisfaction to present these diplomas to **Angela Cortés Martín and José María Zamarrón Casinello**."

Both winners personally received their award. thanking both the Board of Directors and the entire SNE for the diploma they had been awarded in recognition of their work for the development of nuclear energy and for contributing to the goals of the SNE. In her words of thanks. Ángela Cortés declared that "it is an honor to receive this recognition from the SNE," and acknowledged that the work carried out is the result of the collaboration of the members of the Magazine Editorial Committee who have worked on it over the years. Along these lines, she took the opportunity to encourage the members to participate in the various commissions and working groups that the SNE has, acknowledging that it is a rewarding task and where great friends are also made.

Next, the president of the SNE presented the **Honorable Mention**, which recognizes the continued work of a person as part of the governing bodies of the Society to **Rafael Var-gas Traid** who has been linked to the sector for more than 45 years and has developed his entire professional career at Tecnatom where he has held various positions in the Center



Ángela Cortés y José Mª Zamarrón, diplomas de la SNE.



Rafael Vargas, Mención de Honor de la SNE 2021.

for Nuclear Training Simulators and in the Training Simulators Development and Maintenance Department, in the words of Héctor Dominguis, "I attest that he is worthy of this distinction, due to his commitment, the endless hours of dedication, always with joy and a positive attitude, it has been a pleasure to collaborate with him during my last two years as Vice President."

In his speech, Rafael Vargas said:

"I want to summarize my feelings right now in one word: Thanks, and what its acrostic conveys to me: Gratitude, Remembrance, Support, Knowledge, International, Friendship and Service [Spanish acrostic for GRACIAS/ THANKS].

Gratitude to the various Boards of Directors represented by their Presidents who had the generosity and trust in nominating me, supporting me, and generously rewarding my personal work as Secretary General of this Society. On behalf of these Boards, thank you, Jose Ramón Torralbo, José Antonio Gago, Javier Guerra, and Héctor Dominguis and all of you for ratifying said agreements in the corresponding assemblies. Thank you from the bottom of my heart.

A special memory to all those members who have left us in this period. My acknowledgment and special affection for Paco Vighi, Anibal Martín, Xavier Jardí, Julio González, Antonio Alonso, and José Luis Elviro, great collaborators from this Society, and with whom I have personally felt their support and dedication at this stage. The great unconditional support received, in this Secretariat, from all the Commissions and Organizing and Technical Committees, without exception, represented here by their Presidents. Thanks to your generous support and understanding, it has allowed us, during this period, to innovate our training, communication, lectures, and events processes and to develop a new web page and a web portal for the magazine.

Thanks to the knowledge provided by our professionals in nuclear science and technology, which has contributed so much to the exemplary behavior of our nuclear fleet in this difficult time of the health pandemic. And that shows, before our authorities, that our scientists and technicians are up to the challenge to develop new technologies to make nuclear energy a strategic asset to reduce gas emissions and improve the situation for the electricity market.

Thank you for the support received to strengthen our international presence: the hosting of the European Nuclear Young Generation Forum in Tarragona a week ago, the next Top Fuel 21 Meeting in Santander, the active participation in the inclusion of nuclear energy in the EU taxonomy, and especially, the recognition of the ENS, through its President. Thanks, Emilio.

Thank you for your friendship. It is a luxury and a pleasure that the cultivation of nuclear science and technology unites the "elementary particles" with such force and esteem that they make indelible moments and memories.

Finally, I want to acknowledge the work of people who have received so much support in a silent, anonymous, and continuous way,



Matilde Pelegrí, Premio José Mª Otero Navascués 2021.

Luis Alfonso Vázquez, Carmen Montalvo, to Senda, via Lola Patiño.

To those who have voluntarily dedicated effort, time, and knowledge: José Luis Mansilla, Enrique Pastor, Pedro Ortega, and José Antonio Suárez de la Estrada. Thank you from the bottom of my heart.

I would like to recognize the work and support of Jesús Fornieles, who with a brilliant survey, and subsequent study has helped us enhance our strengths and redirect our weaknesses. Great work.

Within this list of services received, I have saved the constant support, affection, and understanding of María Luisa for last. Thank you from the bottom of my heart."

The **José María Otero Navascués Award** is a distinction that recognizes outstanding work in one of the strategic areas of this Society, communication and outreach promoting nuclear science and technology.

As every year, the award is received by a person who dedicates their life to nuclear industry outreach and the promotion of the SNE. This year, the winner was Matilde Pelegrí who began her professional career in 1982 with the launch of the NUCLEAR ESPAÑA Magazine. A few years later she joined the Publications Commission of the SNE, and to date, she still continues to be intensely involved in the Society's communication. In her speech, the winner stated: "I want to thank the entire Board of Directors of the SNE for this award, which I consider especially important because it bears the name of one of the first characters I heard about in the sector, José María Otero Navascues. The father of Spanish nuclear energy. President of the European Atomic Energy Society, JEN President, and promoter of the first Spanish nuclear reactor, the JEN-1, and the first nuclear power plant, José Cabrera. Pioneer scientist in activities such as optics and metrology.

It is a real honor to receive an award with his name on it, and for that award to be dedicated to communication. Because, in reality, my entire trajectory of many years with the Society is linked to communication. When we started with the magazine, we were already communicating, although it was not recognized as such at the time. We communicated through articles, news, interviews.

Having the opportunity to conduct all these interviews has been a privilege. I have learned from all of them, not only from the nuclear world, but from each of its protagonists, from their experience, from the evolution of the sector, and from their contribution to the Society.

We started the path of communication together with many companies that were technologically advanced but that did not have communication as a priority (because they did not need it). We supported them when they began to communicate through the



José Antonio Gago, Medalla de la SNE 2021.

magazine, not only with the articles by their professionals, but also with the first advertisements, and with the first stands at the annual meetings.

Today, fortunately, companies in the sector are aware of the importance of communication and have excellent Communication and Marketing departments.

We communicated with the first Society website and with the first experiences with social networks.

And all of that made sense, not only because it allowed us to grow as a company. Also, because there were hundreds of professionals who, especially in those difficult years of social isolation, had their main connections in this convention and to NUCLEAR ESPAÑA.

And at SENDA, we grew in parallel with the SNE, having the nuclear world as a business card, which allowed us to apply that knowledge to other professional societies, to other entities in the field of science and industry. And to a project of its own in a totally different sector.

New projects with the SNE also emerged. One of the most relevant was the transformation of this paper magazine after more than 35 years of uninterrupted publication and more than 400 issues into the revistanuclear.es portal which today is viewed by thousands of users from dozens of countries.

And last year the SENDA team faced one of the most important challenges. In just three months, we had to convert a face-to-face convention, with 45 years of history, into a virtual meeting. In short, quite a challenge.

And all this, focused on communication.

And we will continue on this path because



communication is an endless route in which new forms of understanding appear every day that become new challenges.

Thank you. To the Board of Directors for this award and to all those who have revalidated their trust in our work, and that has allowed us to advance in a strategic commitment that goes far bevond a commercial relationship.

To the members who have contributed their knowledge and experience through the magazine for so many years, and to the members of the Commission, who each month make an enormous effort, surely seldom recognized.

Thanks to all the colleagues at WiN, who have one of the axes of their activity in communication.

And, without a doubt, thanks to the entire SENDA team. Some are here, others at the Madrid headquarters. All this journey would not have been possible without his commitment, with the company but also his commitment to the SNE."

Next, it was time for the Spanish Nuclear Society Medal, a distinction that is decided upon based on admiration, respect, esteem, and gratitude for outstanding promoting the development of the Spanish Nuclear Society. This year the winner was José Antonio Gago Badenas.

In this edition, the Carlos Sánchez del Río Prize was also awarded, a distinction that is awarded only when there is a deserving candidate for their unquestionable contribution to the peaceful use of nuclear energy.

This year, the Board of Directors has unanimously decided that it be awarded to an eminence of the sector. Recognized, loved, and respected both nationally and internationally: Agustín Alonso Santos.

The winner began his professional activity at the Nuclear Energy Board (JEN, now CIEMAT) in 1958 after completing his postdoctoral specialization at the Oak Ridge National Laboratory. After his time at the JEN, he joined the teaching profession as a professor of Nuclear Technology at Schools of Industrial Engineering, first at the Polytechnic University of Barcelona (UPB) and then at Madrid (UPM). He has been an advisor to the CSN, written and participated in numerous publications, and represented Spain in dif-

ferent national and international institutions and forums (IAEA, NEA). He has been an active member of the SNE where he continues to collaborate as a member of the Terminology Commission.



Amparo Soler, Premio JJNN 2021.

Although Agustín put all his effort into receiving the award and "spending time with his dear colleagues," his health condition prevented him from doing so at the last minute. The prize was received by his son Alejandro who thanked the SNE for granting the award and apologized for his father, explaining that in Agustín's state of health, emotions "produce a reactivity excursion that forces him to lower the control bars to protect his already fatigued materials, especially after his recent cerebral LOCA

(loss of coolant accident) (already overcome and controlled)". According to Alejandro, an hour before receiving the award, emotion overwhelmed him and his blood pressure rose, forcing him to stay at the hotel.

The next day, recovered (and enraged, for "failing" the day before), he went to the Annual Meeting venue to complement the presentations given the day before and attended the closing session where he had the opportunity to convey his sincere and heartfelt gratitude for the distinction received in person to "his dear colleagues" and to convey loudly what he had been thinking since he learned

of the award: "I will tell the young people not to lose their enthusiasm for nuclear energy, that an exciting future full of new applications awaits us, and that all the know-how and technoloav developed or to come must become fundamental agents for the protection of the planet and the prevention of climate change. And to the less young ones, I will tell you that you have to make the necessary effort to ensure that this future becomes a reality."

As in previous editions, this year the prizes awarded annually by the Nuclear Young People (JJNN) and Women in Nuclear (WiN) were also awarded.

The 2021 "Juan Alberto González Garrido" Nuclear Young People Award was granted to the president of the SNE Programs Commission, Amparo Soler.

The President of Nuclear Young People, Francisco Suárez, presented the award on behalf of the Commission, valuing the support and continued relationship of Amparo Soler with Nuclear Young People. He added that "for Nuclear Young People, it is a real luxury to have so many people who selflessly help us on a day-to-day basis, and in 2021, the members of Nuclear Young People wanted to highlight the role of Amparo, who also came from actively collaborating in the European Nuclear Young Generation Forum (ENYGF'21) held in Tarragona the previous week. This award has become an official part of the set of awards and distinctions of the SNE in 2021."

Amparo Soler accepted the award stating that she was very happy with this recognition, showing her gratitude to all the young people. In addition, as a "young person with opera-tional experience" (a term coined at the 46th Annual Meeting), she highlighted the work of Nuclear Young People, particularly during these complex times, and that since she assumed the presidency of the Programs Commission, she has always had as a roadmap to have many bridges with Nuclear Young People, concluding that "if you are the future, we will do very well" because of the passion, ability, and work of the members of Nuclear Young People.

From Nuclear Young People they acknowledged all their support and trust (because the



Redes Sociales de WiN, premio WiN España.

present support will forge the future), and of course, they will continue to count on Amparo to continue growing together.

Finally, the **WiN Spain 2021 Prize** was awarded. This year, WiN turns 25 and the association is still as active as it was at the beginning, or even more so. Its main objectives, to disseminate the reality of nuclear science and technology to society and promote the transfer of knowledge and experience, promoting a network of professionals who carry out their activity in the various applications of ionizing radiation, generating interest in training scientific-technical for young people as well as making their work visible to society, are still as alive as at the beginning, but times change and evolve and the channels of communication and outreach change, becoming more immediate, closer, and more in contact with society.

The WiN Board of Directors meeting approved awarding the WiN Spain 2021 Award to the **social media communication group** of the association itself in recognition of its great selfless, daily, and continuous communication work, promoting and growing the dissemination and outreach channels for nuclear knowledge and making them available to an increasingly wider audience. For showing nuclear science and technology with a pleasant and close profile, as well as rigorous, for bringing us closer to society in these last two years where we have all been looking, more than ever, at electronic devices, for instructing with simple language and being up to date with all the news in the sector. The WiN Spain 2021 award was presented to part of the communication group present on October 7 at the 46th Annual Meeting of the SNE at its gala dinner and was presented by its president, Ms. Susana Falcón. The rest of the members will be awarded during the event for their 25th anniversary. Congratulations!







SUPPLEMENTAL ACTIVITIES

STEM PROGRAM

In order to promote STEM training (acronym for Science, Technology, Engineering, and Mathematics) among younger students, the Spanish Nuclear Society promoted hosting the STEM Program within the framework of the 46th Annual Meeting. It was an open and free event intended for students from Secondary Schools (IES) in their last two years (3rd and 4th of Compulsory Secondary Education).

The SNE intends to provide added value to its Annual Meeting by providing information and training for Compulsory Secondary Education students in technical and scientific concepts related to science and technology in general and nuclear technology in particular.



This program consisted of four parallel workshops in which different organizations collaborated:



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PHOTOGRAPHY CONTEST



framatome

BEST GENERAL PICTURE



First Prize: STARFISH - Ricardo Luna



Second Prize: BLUE - Moisés Yepes



Third Prize: THE VORTICES MADE THE ARCOS DE ALCONETAR BRIDGE DANCE TOO MUCH -María del Prado Ordiales



First Prize: ANOTHER DAY - Maita Morales



Second Prize: NUCLEAR POLICROMY - Carlos Gómez



Third Prize: INCANDESCENCE - Marc Altés



First Prize: FLY WITH ME - Francisco Javier Hernáez

BEST PHOTOGRAPH POPULAR JURY



Second Prize: ATOMI ERA - Marc Altés



Third Prize: SEA OF WOOD - Marc Altés



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OPENING SESSION

Mayor of Granada

Francisco CUENCA opened the 46th Annual Meeting of the SNE by thanking all the attendees for their presence in the city and hoping that, after two years of waiting due to the pandemic, they would enjoy the vast cultural, social, and gastronomic offerings that their capital offers to all the world. For Francisco Cuenca Granada, it is the story of an effort to stand out at a national and international level, not only in the world of culture, tourism, and heritage but also in the field of Science and Innovation.

Granada currently has 5 CSIC centers in its municipal area, with international collaborations as avant-garde as that of the Institute of Astrophysics of Andalusia with its recent research on the sun and the manufacture of various instruments that are currently on Mars or orbiting any planet in our Solar system.

The University of Granada has spent several years climbing to the top in terms of educational and research quality. It is currently the second Spanish University and the first Andalusian University according to the Shanghai ranking. Science cannot be supported without bringing it closer to the public and promoting its dissemination. For this reason, since 1995, we have had the Granada Science Park: the first Interactive Science Museum in Andalusia and the



Francisco Cuenca

second most visited Monument after the Alhambra. The daily work of institutions such as those mentioned and the commitment of this Government Team have made it possible for the Granada is Science brand to permeate the different spheres of Andalusian and Spanish society.

From the idea of setting up a Health Technology Park to the achievement of the Particle Accelerator (a great European project that has selected Granada for its headquarters), years of work and dedication have gone into making this city an international scientific reference.

For the mayor, Granada as a City of Science, Technology, and Knowledge has two great challenges. The first is "to get out of the health situation in which we find ourselves" and the second is "the challenge of activation and economic recovery for the city."

In this sense, he thanked the SNE for choosing the capital to address these challenges "from science, technology, knowledge, research, which is what has to bring us light," he stated.

After influencing the will of the Government team to take advantage of all the talent of the University to create attraction centers, he reiterated the willingness of the City Council "so that the Granada location is not only a perfect place for this convention but one that many will enjoy and return to many times."

"A convention of the level that we are hosting not only has an economic impact and job creation, but also places Granada on the national and international map for the debate on clean energy, research, science, technology, and its current and future challenges."

"I wish you success in all the technical work and discussions that you will focus on in the coming days. At the same time, I invite you to discover Granada: its innovative cultural and gastronomic offerings, the rich monumental heritage that makes us unique."

President of the SNE

Hector DOMINGUIS,

Dear authorities, dear attendees, obviously something is changing in public opinion, in institutions and in many governments around the world and we are an essential part of this change...

That is why this Annual Meeting is more important than ever and that is why it gives me great joy to be here with all of you.

In addition, many of us have not seen each other for almost two years and we really wanted to return to a certain normality in our lives,

Respecting all the necessary health measures, of course.

That is why I would like to thank all those who have worked very hard for many months to make this annual meeting a reality... the organizers, sponsors, exhibitors, speakers..., our host ENDESA...

...in short, to all those people who have supported and dedicated time to make this event possible...

...and of course, to all of you who are joining us today and will join us over the next few days at this 46th Annual Meeting of the Spanish Nuclear Society...

Thank you for making this reunion possible.

As I said, we are experiencing intense and decisive moments in the energy transition.

It is clear that new technologies are leading us towards ever-increasing electrification of the economy and that global warming is leading us towards clear and necessary decarbonization.

But this evolution (towards a more electrified and decarbonized world) must be done with an adequate legal, fiscal, and economic framework, with coherence and sanity to guarantee the sustainability of the electricity system at a time when the concept of "energy independence" is particularly relevant.

Carrying out all these plans (electrification, decarbonization, sustainability, and independence...) without counting on nuclear energy seems to me little less than a utopia or a fantasy.

The world needs nuclear energy to meet the climate change goals set by the UN and agreed upon by 185 countries in the Paris Agreement.



Hector Dominguis

But we not only need the nuclear energy of today, but also the nuclear energy of the future because the nuclear industry itself is undergoing an intense and profound process of transformation and evolution. In fact, I would rather say that we are undergoing a re-evolution.

Between long-term operation, Generation IV reactors, Small Modular Reactors, microreactors, and Fusion reactors, with all the industry that these developments entail, ...giving up the nuclear industry today means giving up all these future projects that are destined to revolutionize the world of energy.

The Dones project, which we all hope will end up materializing in Granada, is a very clear example of this future, a key project for the viability of future fusion reactors which will provide technological wealth, economic development, and will reinforce the involvement of the Spanish nuclear industry in the future global nuclear landscape.

We have said it many times, and we will not tire of repeating it... nuclear energy is key in the fight against climate change and must be an essential part of the energy transition.

At a time when the world is facing one of humanity's greatest challenges, we nuclear professionals must assume the responsibility of assuming our role in this challenge, developing new technologies that will be decisive in guaranteeing the sustainability of the planet. All of us who work in this industry have the responsibility to make this change a reality, therefore, as nuclear professionals and as a nuclear industry, we are here and we will be here to be part of the solution to revolutionize the energy sector and... to save the world.

Vice-Rector for Research and Transparency from the University of Granada

Enrique HERRERA.

I The Vice-Rector for Research and Transparency from the University of Granada (UGR) also spoke at the opening ceremony, encouraging the participants and sponsoring companies of the Annual Meeting to form part of the IFMIF Dones project as well as with other projects promoted by the UGR, while thanking the SNE for its support for Granada's candidacy to host this particle accelerator.

Enrique Herrera stressed that "we need the support, the more the better" in relation to Escúzar's candidacy. "I invite you to collaborate in the IFMIF Dones project," he insisted.

In his speech, Herrera highlighted some of the milestones of the Granada candidacy such as the identification of the project as strategic for the European Union (which earned 4 million euros in funding) and the unity shown by the administrations in these years despite political changes in both the



Enrique Herrera

central and regional governments. There are 32 million in funds from the Board and the Ministry and the focus is on developing, along with CIEMAT, research groups that "can open new lines" of work related to the accelerator and the creation of new materials.

In line with the development of new work, Herrera pointed out that work is being carried out on major projects which are included in the list of initiatives seeking financing from the European Next Generation funds. among which three were highlighted: the center for innovation in materials and energy (CINMAT) which requires financing of around 30 million: the Center for Innovation and Digitization, dedicated to artificial intelligence, cybersecurity, and 5G with a budget of 50 million, and which goes hand in hand with the private company and the experience with Indra and Google in the Health Sciences Technology Park; and the one connected to Life Watch, planned for the San Isidro Sugar Factory, dedicated to research on the environment and climate change.

ENDESA General Manager in Andalusia and Extremadura

.....



WELCOME

Let me insist on welcoming you to this beautiful land. You will undoubtedly find the beauty of the Alhambra in Granada, the murmur of the Generalife fountains, something that will undoubtedly lead to Granada becoming the European Capital of Culture in 2031.



You join a University with almost 500 years of presence and located among the 300 best universities in the world according to the Shanghai ranking.

For the future, it is undoubtedly one of the innovative spaces. One of the most attractive spaces in our community with projects that you will learn about throughout these sessions. (Examples such as the IFMIF-DO-NES particle accelerator).

THE ENERGY TRANSITION AND THE NUCLEAR SECTOR

The INECP has nuclear energy in its time horizon until at least 2035.

Nuclear energy is necessary during this period of Energy Transition since it will allow the progressive entry of renewables into the system, ensuring the electricity supply without triggering GHG emissions.

The rise in gas and CO_2 prices is a key factor explaining this price situation, as explained by the Bank of Spain.

Nuclear technology that does not depend on gas or emissions, thanks to its safety in the system and environmental sustainability, has put a halt to further increases at competitive costs.

It operates even in all weather conditions, providing inertia to the system, guaranteeing the robustness of the system's frequency in the face of oscillations and climatic disturbances.

The energy transition involves transforming the electrical mix. On September 28, we received the resolution to close the Litoral

² Environmental Sustainability as it is emission-free, emission-free energy distribution in Spain: 33% nuclear, 32% wind, 20% hydraulic-pumped, 12% solar, and 3% other renewable energies. coal plant, a benchmark plant since its origins in terms of operating parameters but which must give way to non-emitting energies.

The widespread construction and transportation sectors will fundamentally have to start their decarbonization and efficiency for the environmental improvement of our cities. On September 22, we launched our second #eCityMálaga project in the area that aims to develop a new city model based on the principles of economy and circular energy.

INTERNATIONAL REFERENCE

The ideal is to move away from the situations that we are seeing in the market, stressed by the geopolitics of oil. From the supply/production side, we need to guarantee stable revenues to cover costs following other models such as in France3 until the end of the life of our plants.

Also, the extension of the operating life of our assets, such as the United Kingdom, France (it has gone from 40 to 50 years).

In all these cases, it is the criterion of applying prudence and making this strategic asset of our country work, which can see how other countries are opting for the future nuclear generation.

FUTURE

Nuclear technology will serve to take our ships into space, waiting for a key role here on earth.

And in a distributed energy model, it will have a relevant role, both on earth and in space.

In the meantime, let us continue researching in this context of the Spanish Nuclear Society towards those horizons.

¹The reductions will be: By 2030, the shutdown of 4 reactors is expected, leaving only 3 with 3 GW of power, which will generate 7% of the energy until their definitive cessation.

³Long-term fixed-price sales contracts – France (€42/Mwh for 100TWh nuclear generation).



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INAUGURAL LECTURE

SPACE RADIATION LUZ MARTÍNEZ-SIERRA NASA Jet Propulsion Laboratory

uz Martínez Sierra is a Physics Engineer from the University of Colombia and completed masters and doctoral studies in the US in Nuclear Engineering with an emphasis on space radiation research.

North American universities have been very focused on studying radiation from space to use it in different applications.

There are three types of radiation in space:

- Galactic cosmic radiation: which comes from various sources in galaxies such as supernova explosions that leave remnants of particles, mainly alpha, and heavy ions such as iron that move throughout the galaxy in all directions.
- Solar radiation: which is a very active star in which explosions occur that cause particle ejections (mainly protons accompanied by X-rays and ultraviolet rays). These protons, known as "solar wind" travel through the Solar System and have more direct interaction with the planets and

interact with the particles coming from the galaxies described above.

• Magnetic fields. If a planet has a magnetic field, what are known as "radiation belts" are generated around it, created by the interactions as described in Maxwell's Laws of the particles that are trapped in the magnetic field lines. Not all planets have magnetic fields; The Earth, fortunately, has one that protects us from space radiation, in addition to the atmosphere.

If, for example, we talk about the design of satellites or robotic probes that we send to explore Jupiter, these must be specially protected against radiation so that they do not suffer damage and that is what I do at NASA. Designing and building these space probes requires knowing precisely what environments they are going to target. Fortunately, with telescopes and other spacecraft, the intensity of the particles can be observed.

Generally, the particles that come from the galaxy are not very intense

(4 or 5 particles per square centimeter per second) but are very energetic, unlike the solar particles (100-200 particles per square centimeter per second) but with lower energy. Therefore, we must know which planet we are going to go to and for how long to adequately protect the ships and their occupants from radiation.

For example, astronauts who traveled to the Moon (8 days) received radiation of 1.8 mSv; if we talk about the International Space Station that orbits the Earth at about 400 km, they receive about 80 mSv, and if it were a trip to Mars (for 6 months one way, the observation time, and the return trip), we would be talking about 1200 mSv.

Not everything that has to do with nuclear radiation is negative. There is, for example, neutron spectrometry and gamma ray spectrometry that is used to determine the composition of a planet.

Planets, moons, asteroids, etc., when bombarded by cosmic rays, generate secondary particles, such as gamma rays, which are characteristic of the components of the rocks of the minerals that exist on their surface. So, by determining and measuring the gamma ray emissions coming from the surface of a planet, we can determine what the composition of that planet is.

Neutron spectrometry is also used to detect the possible amount of hydrogen or hydrated minerals that can be measured from orbit and give us an indication of the possible amount of water that could exist on that planet. Regarding this issue, there is a mission called Europa Clipper that I have been working on and that will be launched in 2024 to study Jupiter's moon Europa, which we know is covered by a layer of ice and contains liquid water inside which makes us think about the possible existence of life. The idea of studying this moon is to understand its composition, temperature, how much water is available, its magnetic fields, and how radiation interacts with it. Part of my job has been to develop the shielding systems and potential hazards for the spacecraft and to work with scientists, designers, and engineers on how to optimize this mission. We know that the radiation on Jupiter is very intense and there are ways to minimize exposure, although it is not always possible. After reaching very high doses, there is a certain limit beyond which there is nothing we can do right now, especially with high-energy heavy ions, which are very difficult to block.

Next, Luz Martínez Sierra answered a series of questions that, because of their interest, are listed below:

About manned trips to Mars, is radiation in people and their protection being evaluated?

The first thing we need to know is what the radiation environment is on the surface of Mars and for this, fortunately, we have many rovers and spacecraft orbiting this planet, which is one of the most explored in the Solar System. The Curiosity rover has two detectors on board for radiation. One is a telescope designed to detect the radiation and its intensity on the surface from different particles, mainly protons but also neutrons, gamma rays, X-rays, muons, etc. Therefore, characterizing this environment is the first thing to do to design future manned missions.

The first thing that comes to mind is where those astronauts are going to live. Well, on Mars there are caves and lava tubes, and that is where it is thought that the habitats that they are going to use can be built.

Regarding the protection of materials, what materials could be used is being studied since it would be very expensive and difficult to handle if lead or concrete were used.

How is the dose received by astronauts on the International Space Station controlled?

The doses of astronauts are controlled in the same way as for any other worker in the nuclear industry and limits are established for an astronaut aged 35-45 years at 3,000 mSv and 2,500 mSv for an astronaut aged 35-45. These limits increase with age.

Astronauts are given the option of applying such a limit to a single mission or splitting it across multiple missions. For this reason, many astronauts who spend a long time on the space station lose the possibility of returning on a future mission.

In terms of protection, the ISS is made of aluminum but, fortunately, it is in a benign orbit in the middle of the magnetic fields that surround the Earth so it is very protected from energetic particles that come from the Sun and from those coming from cosmic background radiation.

Can radiation variations be predicted?

The variation comes mainly from the Sun, which is not always active, and predicting solar events is one of the keys to what is called "space weather." We can look at previous studies and models to try to understand how solar activity may behave and we currently have spacecraft orbiting the Sun that are dedicated to constantly monitoring it and can warn us within a certain time (minutes and hours) of variations in solar intensity that help us to take measurements, but predicting for a longer term is one of the fields in which more research is being done, especially for future missions that will be outside the Earth's magnetic fields.

What will be the next big news from NASA?

All the news that comes from space explorations is very exciting. They are another world, we are talking about space. We get incredible images of Jupiter's storms and Saturn's rings. We have seen rovers on the surface of Mars, now we have a drone there, and seeing it fly is unbelievable. So, I think that, as scientists and researchers and even as human beings, we can feel proud of everything we have achieved and see how this motivates us not only to continue developing but also what all these technologies that they are developed at NASA and technology centers are applied to improve our quality of life.

When it comes to scientific discovery, you're going to see a lot of opportunities now that a lot of exploration to other planets is scheduled: we're going back to Venus with three robotic missions; the lunar base for astronauts is being planned in a couple of years; the next step in the study of Mars is to bring samples from the subsoil of the planet that the Perseverance rover is already taking and a joint NASA-ESA mission is going to bring them to Earth to study them with the best existing technology to determine if there was or is life on Mars and what conditions existed on the planet because we know it had a lot of water but we don't know what happened to that water. I also can't forget to mention the exploration of the moon Europa and other icy moons on Saturn and Neptune.

Therefore, I encourage everyone to be very attentive to all these discoveries and I invite you not only to follow NASA and ESA, but to motivate the next generation to be interested in these science and technology issues to use this STEM knowledge and continue developing, researching, and discovering these topics that we are so passionate about.

Thank you very much, I hope you have a good convention and enjoy this 46th Annual Meeting very much. ■

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PLENARY SESSION 1

THE DONES PROJECT, ANOTHER GEM FOR GRANADA

he session was moderated by Ángel IBARRA who currently directs the IFMIF DONES Consortium and has led the Fusion Technologies Division of the CIEMAT National Fusion Laboratory for more than 15 years. The development of fusion is presented as one of the main scientific and technological challenges facing humanity as it is an inexhaustible source of energy and has a reduced environmental impact. IFMIF-DONES will be a strategic research infrastructure for the European Union and one of the three basic pillars for the development of fusion at a commercial level along with ITER and DEMO. IFMIF-DONES, whose location is planned in Granada (Spain), will provide a source of high-intensity neutrons with characteristics similar to those present in the first wall of a fusion reactor with the aim of researching and developing the materials with which this type of reactor will be built.

The session began with a presentation by **Tony DOMME** who currently **directs the EUROfusion Program** (CEO) and chairs the Coordination Committee of the International Tokamak Physics Activity under the umbrella of the ITER project.



The EUROfusion consortium is one of the largest in Europe with around 28 countries, 30 research institutions, and 150 universities, all of them united in a "Joint Program" with the ultimate goal of obtaining electricity through Fusion. The roadmap is divided into the short, medium, and long term and includes eight missions: "Plasma regimes of operation, Heat-exhaust systems, Neutron-resistant materials, Tritium self-sufficiency, Implementation of the intrinsic safety features, Integrated DEMO design and system development, Competitive cost of electricity, Stellarator." EUROfusion is currently designing DEMO, the first 500MWe fusion plant, a reactor that will demonstrate the commercial viability of fusion in the 2050s.



Carlos Alejaldre, current **Director General of CIEMAT** who was part of the team that built the TJ-II fusion experiment (currently the "Singular Scientific Facility") and directed the National Fusion Laboratory (CIEMAT) presented the IFMIF-DONES project; and he began his presentation by telling about the involvement of Spain in the development of fusion, recalling the Spanish candidacy to try to bring the ITER international project to



Carlos Alejaldre

Spain and the contributions to progress with the TJ-II (turbulence and energy transport studies). The work of Spain is part of the roadmap that Europe has, starting from the knowledge of the physics of the magnetic confinement of fusion, going through the construction of ITER, capable of generating 500 thermal MW, and ending with a DEMO demonstration reactor which can produce 500 MW of electricity for 1-2 hours. The ultimate goal is industrial fusion production as a source of energy. Within this framework is IFMIF-DONES, qualified as a facility of strategic interest for Europe, necessary for the development of DEMO. DONES will be able to demonstrate that the materials that will form part of the structures of the DEMO facility will be capable of resisting the neutron and particle flux that will be produced inside these reactors. Carlos emphasized the fundamental role that Granada plays in the development of fusion and thanked the participation of Spanish researchers and industry.

Ana Belén CERRO, who currently works for CDTI and is the focal point with the industry (ILO-Industrial Liaison Officer) for ITER (F4E and Iter Organization) and other fusion projects, told about the industrial-technological development for DONES. She began by reviewing the Science Industry in Spain and the industrial opportunities in fusion (ITER). We must prepare for DONES and technologically position our industry in a key energy sector for the future. The keys to success are prior industrial training, participating in early stages, and improving the



Ana Belén Cerro

techno-economic offer. In this sense, Spain is doing very well. Its industry occupies the third position in the contracting ranking with 340 contracts won for a value of 1.2 billion euros.

Pilar ARANDA, Rector from the University of Granada described



Pilar Aranda

the actions of the University of Granada for constructing and developing IFMIF-DONES. Among them, the creation of several offices for the implementation of IFMIF-DONES, technical offices and offices for the national consortium for the development of IFMIF-DONES; various virtual reality laboratories for remote manipulation tasks for DONES, for the development of control systems for LIPAc/DONES; and several research, training, and mobility programs, in addition to the creation of UGR-CIEMAT Predoctoral Scholarships. Public and private collaboration is essential for this development and Granada has emerged as a candidate to host DONES due to its geographical position and its research and entrepreneurial activity.





PLENARY SESSION 2

THE THREAT OF VULNERABILITY

Session was devoted to analyzing the impact of recent events that have shown the vulnerability of energy systems, in general, and electricity systems, in particular, to extreme environmental events.

In the United States, for example, a severe ice and snow storm in Texas earlier this year put the system in a bind. In Asia, episodes of extremely low temperatures last winter drove spectacular increases in the energy markets, for example, in Japan, the average price of electricity exceeded the level of €1,650/MWh due to the dependence on natural gas combined cycle power plants with most of the country's nuclear power plants shut down due to a political-regulatory decision.

In Spain, the storm Filomena posed a great challenge for the normal functioning of the country, negatively affecting generation from renewable sources in the case of the electricity system. In those delicate moments, all the Spanish nuclear power plants were operating uninterruptedly at 100% capacity, ensuring supply and containing prices that, without their contribution, would have been higher.

The role of nuclear energy is essential to support the robustness of electrical systems due to its reliability and in mitigating the effects of global warming due to its lack of greenhouse gas emissions.

The session was moderated by **Ignacio ARALUCE, President of Foro Nuclear**, who, after welcoming the audience, did an introduction to the session topic and introduced the three speakers.

The first to speak was Dr. Rita BA-RANWAL, Vice President of Nuclear and Chief Nuclear Officer from the Electric Power Research Institute (EPRI). The former Deputy Secretary from the Office of Nuclear Energy of the United States Department of Energy (DOE) explained to the audi-



Ignacio Araluce

ence the importance of the adequacy of resources and the resilience of nuclear power plants in the face of climate change.



To illustrate the concept of resource adequacy, he used the example of the polar vortex event that occurred in the state of Texas in February 2021. The coincidence of a historical peak in winter demand, 13% higher than the historical maximum, with unprecedented unavailability of 50% of the supply capacity forced load shedding of up to 27 GW over three days. The technology that operated most reliably during this event, by far, was nuclear.

She then went on to describe EPRI's Resourcing Initiative, a project aimed at integrating and accelerating dedicated R&D into practical solutions for industry.

The other major issue addressed by the presenter was the need for the resilience of nuclear power plants in the face of climate-related threats. These plants have robust design margins and historically high-capacity factors even when faced with meteorological challenges. With climate risks likely to worsen in the short to medium term as a result of global warming, nuclear power plants need to remain resilient to extreme weather events to contribute to grid stability and remain part of a low carbon emissions future.

Dr. Baranwal explained how key climate variables affect the operation of nuclear power plants: a rising ambient temperature, extreme storm events, sea levels rising, and temperature and availability of water for cooling. According to a survey carried out among EPRI members, practically all of them are concerned about the consequences of the worsening of these variables in the operation of their plants. Weather phenomena that were previously rare or limited to certain geographic locations are occurring with increasing frequency and in atypical places.

The effect of climatic or natural phenomena on nuclear power plants has been moving from the conventional point of view of nuclear safety, where regulation requires that plants be designed to withstand natural phenomena and extreme external events towards that of operation since climatic events are beginning to affect the operation of power plants and the impacts may increase with global warming. At the present time, weather threats affect the availability and reliability of plants more than their safety.

EPRI's activities to improve the resilience of nuclear power plants in response to climate change threats fall into three main lines: analysis of the effect of climate on energy systems, evaluation of its impact on plant availability, and development of R&D programs for mitigation.

In conclusion, EPRI believes that nuclear energy will be an important part of the sustainable energy mix of the future capable of guaranteeing the adequacy of resources as demonstrated by the events in Texas in the United States and Filomena in Spain in early 2021.

The second presentation of the session was done by **Shinya KATO**, **Director of the Paris Office of The Kansai Electric Power Co., Inc. (KEPCO)**, who spoke about the state of the electrical system and nuclear energy in Japan and the scarce margin between energy supply and demand that occurred last winter.

Nuclear energy accounts for 11% of the installed capacity in Japan, despite which in 2019 it only gen-



erated 6% of electrical energy because most of the 57 reactors in the country are still stopped as a result of the Great Earthquake March 2011 and the Fukushima accident. Specifically, 17 reactors have received approval to restart (and, in fact, 10 of them are already operational), 10 have an application in the process of being reviewed by the regulatory body, 9 have not yet applied for the permit, and the rest, 21 reactors, are in the process of decommissioning. In Japan, there are 10 large power companies that operate regionally. The operation of interconnection lines between regions, which basically occurs in emergency situations, is supervised by the OCCTO organization.

Mr. Kato then explained that as a result of the end of 2020 and the beginning of 2021 being up to 5°C colder than normal in his country, the demand for electrical energy reached record numbers for both power and energy. This coincided with planned and unforeseen restrictions on electricity supply due to maintenance of nuclear power plants, unscheduled shutdowns of coal-fired power plants, drought, etc. which forced greater use of combined cycle plants, which in turn produced a decrease in the reserves
of liquefied natural gas to such levels that it forced restricting the hours of operation of this latest technology. The effect of this on the electricity market was a historical maximum price of 251 JPY/kWh, more than 30 times the average price in 2019.

The situation forced the OCCTO supervisory body to implement special offset and exchange measures between regions to avoid blackouts, such as the temporary expansion of the capacity of the interconnection lines, instructions for the generation of additional power in the plants or for the operation of lines with less than nominal voltage with a successful result, since no blackout occurred.

Japan currently has the objective of achieving carbon neutrality in 2050, for which the government is committed to making the most of the available nuclear power plants as well as promoting the introduction of renewable energies. There is concern about ensuring sufficient base power supply capacity, especially if the effects of global warming worsen in the future.

The presenter concluded by explaining that, to achieve the aforementioned objective, all environmentally sustainable alternatives will be



Blanca Perea

needed, including nuclear energy, which is especially important for Kansai given its generation mix.

The third and final speaker was **Blanca PEREA**, **Senior Managing Director and Head of Energy Practice at the FTI Spain consulting firm**. Ms. Perea spoke about the impact of global warming on the electricity sector, with a special focus on the situation in Spain.

She began the presentation with a demonstration, supported by data, on the effects of climate change in our country, explaining that the effects have been more pronounced in large cities and on the Mediterranean coast, basic pillars of the Spanish economy. From January 2020 to the *Filomena* storm of 2021, there has been at least one extreme weather event per month, such as storms, extraordinary rainfall, cyclones, or fog, among others.

The IPCC predicts that the south and southeast of Spain will be strongly affected by variations in temperature and rainfall, increasing the risk of water scarcity, fires, and desertification. This will affect all facets of the energy system: generation, transport, and distribution, and even energy consumption.

The Spanish nuclear fleet has made a sustained contribution to electricity generation since it came into operation. It accounts for approximately 22% of the total electricity production with availability of around 90%, providing robustness to the electrical system. However, the Spanish Integrated National Energy and Climate Plan indicates that the nuclear power plants will be progressively closed between the end of the 2020s and the mid-2030s.

If we interpret the impact of climate change on the electricity sector from the perspective of security of supply and the vulnerability of the energy model, it is worrying to see that Spain has a high degree of energy dependence, having to import close to 75% of energy sources. Therefore, the vulnerability of the Spanish energy model is linked to the global market and its volatility, which has an impact on our energy prices and security of supply. Referring to the specific case of the *Filomena* storm, the presenter pointed out that it triggered the demand for electricity in Spain (close to 13% compared to December 2020), which, when combined with an increase in natural gas prices, translated into electricity prices above €120/ MWh. However, the operation of the system was not affected, thanks to the production of nuclear, hydraulic, and thermal energy. Nuclear power proved to be a stable and reliable low-carbon source.

The accelerating pace of climate change and the recent increase in global gas prices are prompting some countries to revisit the debate on nuclear power, and in particular on the long-term operation of existing nuclear power plants. Nuclear power is seen as having the potential to play a key role in decarbonizing our economies, with parts of Europe having growing concerns about plans by countries such as Germany, Spain, and Belgium to shut down 32 nuclear reactors (approximately 32 GW) by 2035.

In the context of the "Fit for 55" package drawn up by the European Commission, which aims to accelerate the move towards decarbonization, vulnerability is called to become an essential part of the discussion. Amid high volatility in natural gas, coal, oil, and CO2 prices, and consequently, electricity prices, the cost of the energy transition raises societal concerns that could ultimately delay decarbonization plans if they are not properly addressed.

The revision of the goals for 2030 proposed by the aforementioned package can generate a space to hold an informed conversation about the role of nuclear energy in Spain where the interest in extending the useful life of the plants to accelerate decarbonization a sustainable cost could be discussed.

The session ended with a question-and-answer session where the active participation of the audience, who directed several questions to each presenter, was an unmistakable sign of the interest generated by the topic and the opportunity to address it at this Annual Meeting.



MONOGRAPHIC SESSION 1

WHAT HAVE WE LEARNED FROM FUKUSHIMA?

LUIS E. HERRANZ & EDUARDO GALLEGO CIEMAT Nuclear Safety Research Unit / Polytechnic University of Madrid

On Monday, April 11, 2011, an earthquake measuring 9.0 on the seismological moment magnitude (MW) scale also triggered a *tsunami* off the northeast coast of Japan. The Fukushima nuclear plant located near the coast and operated by the TEPCO company contained six BWR-type boiling water reactors that were built between 1971 and 1979.

The earthquake caused a tsunami 14 meters high, surpassing the plant's containment dam that was only 5.7 meters tall and flooding the basements of Units 1 to 4 with seawater that filled the basements and destroyed the emergency generators. The severity level of the incident was 7, the maximum on the INES scale for reactors 1, 2, and 3.

The previously shutdown reactor 4 spent fuel pool increased in temperature due to heat generated in the newly discharged spent fuel rods, but it did not shrink enough to expose the fuel.

As a result, the cooling capacity of the operating reactors and the spent fuel pools was lost. The reactors for Units 1-3 experienced severe damage and released fission products and hydrogen. The H2 explosions resulted in severe damage to the reactor buildings for Units 1, 3, and 4.

In the days after the accident, radiation emitted into the atmosphere forced the government to declare an ever-widening evacuation zone around the plant, culminating in an evacuation zone with a radius of 20 kilometers. In this Single Subject Session, we were joined by Luis Enrique Herranz and Eduardo Gallego who have dedicated a good part of the last ten years to monitoring and investigating the Fukushima accident.

First, the head of the **CIEMAT Nuclear Safety Research Unit, Luis E. HERRANZ**, did a presentation related to the simulation of the phenomenology of a compound severe accident involving a natural disaster.



Snapshots of the accident (composition from www.tepco.co.jp).



Luis Enrique Herranz

To do this, he did an introduction linking the investigation into the accident with the optimization of the nuclear safety of our nuclear power plants and reviewed the main events that occurred in each of the Units that experienced an accident at the Fukushima site and the final condition of the Units.

Luis Enrique presented the "Forensic Analysis" that has been conducted within the framework of the OCDE-NEA BSAF research project. The BSAF project is aimed at understanding the progression of accidents at the three Fukushima Daiichi units and determining the distribution of radioactive materials dispersed from the core of the reactors. Scenarios were proposed and their consistency with the in-situ measurements made were quite plausible. The comparison of the results between different simulation tools will allow for reducing uncertainties through the improvement of methods and models.

Among the most striking results, it is worth highlighting the massive degradation of the reactor core of Unit 1, which after melting would have reached the containment of the reactor due to the failure of the pressure vessel. In contrast, the core of Unit 2 appears to have undergone significant degradation but with much less material transfer to containment than in the previous case.

Ongoing analyses provide valuable information for unit decommissioning, such as the most likely location of corium or areas where high radiation doses are expected due to high retention of fission products. The estimates that are being made and their comparison with the available data allow for a realistic assessment of the predictive capacities and the identification of crucial areas for reducing uncertainties.

Among the lessons learned, it is worth highlighting: the operation of safety systems (IC, RCIC, HPCI, spray, ...), alternative water injection (time, flow rate, quantity), degradation times and relocation in the core, relocation dynamics consistent with observations, the distribution of debris and fis-



sion products in the plant and the low source term to the environment.

Regarding the phenomenology, where there are still uncertainties still to be understood are: fuel degradation and relocation (late phase), corium nature and behavior in containment, the behavior of combustible gases, the dynamics of PFs (leakage, types, retention, remobilization, leaching), vessel failure modes, and containment failures.

Finally, Luis Enrique summarized some lessons learned in the framework of accident management concerning containment vents, the injection of water for reactor cooling and/or containment, and energy phenomena such as explosions of fuel gases emanating during accidents.

The second speaker, Professor at the Polytechnic University of Madrid Eduardo Gallego focused on everything related to the consequences of the accident on the population and the environment. The initial situation and the management of an accident after an earthquake followed by a tsunami must be taken into account. It can be said that three disasters converged at the same time: the earthquake, the tsunami, and the nuclear accidents.

Eduardo gave a very visual presentation presenting a series of photographs of the area (some of them taken by himself). He began the presentation by showing us the urgent protection measures which were mainly evacuation and confinement, as well as the impact on the population. These measures that were taken in the short and medium term caused a series of problems that were as or more important than the possible radiological damage. According to some agencies in Japan, mainly from Fukushima Prefecture, the evacuation itself may have caused more than 1,000 deaths in the following days and weeks due to stress, especially among the sick and elderly people who were urgently evacuated.

First, and in the short term, the residents were evacuated to municipal centers (sports centers, cultural associations...), as shown in the photo, and then temporary housing was built for the relocated population.

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Eduardo Gallego

Some 43,000 people from Fukushima are still displaced (because of the earthquake, tsunami, and nuclear accident).

Eduardo then presented us with the measures that were applied for the radiological characterization of both people and the environment.

In complex scenarios, with significant emissions and potentially contaminated people, decisions about treatment require initial screening (triage), decontamination (if necessary), followed by a more detailed dose assessment using biological dosimetry and body radioactivity measurement. It is necessary to pay special attention to the control of the dose in the thyroid, especially for children and pregnant women.

Dose calculation models are generally very conservative, so realistic dose projection models, along with individual activity monitoring data, should be used in the future to obtain a valid assessment on which to base decision-making.

Regarding the radiological characterization of the environment, the detailed characterization of the contamination levels of potentially large areas was a challenge due to their heterogeneity and the existence of hot spots. In the intermediate phase of the project, drones with sensors were used. Manual verification was essential to better characterize deposited activity and locate hot spots. One thing to keep in mind was the collection of data by citizens and its integration into analysis systems and operational decision-making.

Regarding the recovery phase, Eduardo visually illustrated how the area was being decontaminated. Areas outside of those considered



Temporary housing for residents.

"difficult to return" have been decontaminated. SDA zones (Special Decontamination Areas) were established as the most contaminated zones outside the 20 km. As of March 2018, 93 municipalities have been completed. The dose rate in all areas has been declining both due to natural decay and decontamination.

A very important challenge has been the management of the waste generated in decontamination. A location strategy for storage facilities was established; firstly, with facilities at the municipal level with a person in charge in each municipality to later move on to temporary storage facilities (ISF coastal area of Fukushima) and long-term storage facilities (outside Fukushima prefecture) led by the national government.

Some interesting data: In 2019, approximately 4,000,000 m3 had been transferred; the estimated total amount is 14 million m3; moves are expected to be completed in 2021; soil control and separation are carried out prior to storage.

Another aspect was the exhaustive radiological control of food production. For example, all rice produced in Fukushima Prefecture is tested for radioactivity; the same happens with other products so we have gone several years without exceeding the acceptable levels of radioactivity in food. Another example is coastal fishing and trawling which in Fukushima prefecture are subject to voluntary limitations by fishermen. The results of monitoring more than 50,000 samples have proven that almost all marine species caught in the prefecture are safe.

Finally, regarding the impact on the environment and the management of contaminated water, Eduardo visually showed us the control actions using photographic reports, which consisted of carrying out a bypass of groundwater, performing underground drainage around buildings, creating a cryogenic barrier around buildings to prevent the passage of groundwater into the damaged buildings and thus the leakage of contaminated water, establishing underground barriers against discharge into the sea, and replacing tanks with safer ones.

In March 2021 there were 1.2 million m³ of water already accumulated. Five options have been studied to eliminate stored water: 3 were ruled out due to lack of past experiences: injection on land, release with hydrogen, and burial, and two were considered viable: controlled release of steam and controlled discharge into the sea. The latter is the option with the least impact and the one chosen by the Japanese government in April 2021 with the support of the IAEA.

HOY TU ENERGÍA PUEDE INSPIRAR UN MAÑANA MEJOR.

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MONOGRAPHIC SESSION 2

"MODULAR REACTORS FOR A CLEANER ECONOMY"

CARMEN MUNOZ-DORMOY y DAVID POWELL

Deputy R&D Director at EDF / Vice President for GE Hitachi's Nuclear Power Plant Sales in the UK

Small Modular Reactors (SMRs) are defined as nuclear reactors of 300 MWe or less, designed with modular technology which optimizes construction, operation, and maintenance costs, and that are mass-produced with short periods for construction.

SMRs are expected to provide greater design simplicity compared to nuclear reactor designs of the last century; they will be more competitive and will even produce other energy sources. SMRs will play an important role in mitigating climate change in the coming years by not generating CO_2 but also because of their use in non-energy applications such as hydrogen generation, heat production, and seawater desalination, and other applications.

Today there are several SMR designs and concepts around the world, some under development while others are already designed, certified by regulatory authorities, and ready for construction with a promising deployment horizon in the medium term future.

The session began with the speech from the Single Subject Session Technical Coordinator, Domingo García Cárdenas, member of the Technical Committee for the 46th Annual Meeting of the SNE who introduced the speakers and highlighted the advantages of SMRs and their applications.

In this single subject session, we were joined by **David POWELL**, Vice **President for GE Hitachi's Nuclear Power Plant Sales in the UK**, **and Carmen MUÑOZ-DORMOY**, **Deputy R&D Director at EDF**.

David Powell focused his presentation on the competitiveness of a new reactor (BWRX-300) that, at a cost of about \$2,000/kW, could displace renewables. Licensing in the US and Canada has already started, and it could be operational by 2028. It is a scale-up of another reactor (ESBWR) already licensed by the NRC. It can do load tracking and would be used for electricity production and hydrogen generation. Its construction will be underground, using equipment

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Carmen Munoz-Dormoy



David Powell

available from many suppliers, especially in the turbo-alternator.

David Powell also mentioned the use of SMR for high temperature steam electrolysis (HTSE) using solid oxide electrolysis (SOEC) technology.

He commented that the cost of electricity rather than the operating temperature of the reactor is the determining factor in looking when the economics of the hydrogen production process. He also presented a comparison of the cost of PEM technology versus SOEC technology.

Carmen Munoz-Dormoy dedicated her presentation to the different alternatives for hydrogen production. The European Commission has set a 2030 target of 10 MtH₂/year.

She mentioned that hydrogen is a key technology for all carbon-free scenarios. World hydrogen production could increase 7-fold in 2070, reaching more than 510 Mt or 13% of final energy demand. Half of the low-carbon hydrogen production would be produced with low-carbon electricity, representing 13,750 TWh of low-carbon electricity.

"Grey" hydrogen is produced from natural gas reforming with steam and methane at a cost of around 1.5 Euros/kg, depending on the price of gas and carbon emissions.

An important issue is the competitiveness of low-carbon hydrogen (transport, production volume, electricity price, annual duration of operation of electrolyzers, energy efficiency).

Regulatory considerations are key: the mechanism for determining low carbon character and in particular choosing a threshold of 3.24 kg CO-2eq/kgH₂ corresponding to a 70% reduction in GHG emissions compared to hydrogen production from fossil gases. Nuclear power can contribute in the short term to fuel the coal-free electricity grid to maximize the load factor of electrolyzers and produce hydrogen instead of consuming it. In the medium term, a high-temperature electrolyzer could increase efficiency by pairing it with a nuclear reactor. In the long term, very high temperature fourth generation reactors will allow for new efficient types of pairing.

She also mentioned the Research and Development work being carried out by EDF on the electrolysis of hydrogen. It has a test rig for electrolyzers up to 5 MW, connected to a 115 kW photovoltaic farm.

The characterization of the systems is carried out by looking at their operation under normal conditions and with disturbances, at different points, and in different modes of operation. Degradation phenomena and the influence of the main parameters are studied as well as the impact of electrolysis systems on the network. Characterization of the intrinsic flexibility of the systems is performed as well as economic studies for the value of flexibility in different scenarios.

Optimization of the size of the systems is also studied: Power of the electrolyzer/H₂ storage.

To conclude, the Coordinator moderated the time for questions from the audience for each speaker. ■





WORKSHOP 1

INUCLEAR INDUSTRY 4.0

ARTICIPATING COMPANIES: ALYSIS, ENRESA (INGECID), GDES, GE HITACHI, IBERDROLA, TECNATOM, TOTALYMAGE, and WESTINGHOUSE.

When we devised the "Nuclear Industry 4.0" workshop from Nuclear Youth, our intention was to create a space so that anyone who was interested in the application of innovative technologies in the nuclear world could discover and interact with them in a single place at the Annual Meeting.

To do this, we contacted the companies most involved in innovation in the sector, proposing for them to showcase interactive technologies related to the hottest topics in the technological world.

In the center of the workshop, ALYSIS presented the Spot robot





different users through layers while the procedure system allows for navigating through them interactively.

TOTALYMAGE brought its Kiber 3 helmet which provides an augmented reality solution that can be easily attached to an operator's helmet, allowing him or her to see a screen where countless files can be shown without impeding the field of vision. In addition, they took a 360 video shot of the convention which they vectorized to show their tool for creating live environments.

And finally, WESTING-HOUSE presented us with several solutions: a virtual reality environment applied to

from Boston Dynamics, the most advanced quadrupedal robot in the world, of which they are official distributors in Spain. This funny robot accompanied us throughout the workshop, leaving attendees perplexed with its movements.

ENRESA, along with INGECID, presented VIRCORE, its integrated project management system for the nuclear sector which enables all project information to be centralized and for tracking planning and costs.

GDES presented a virtual reality environment applied to the design of passive fire protection with builtin virtual reality glasses for getting immersed in the experience. It also presented a real-time Monitoring System Simulator for fuel status and control rods for the Cofrentes Nuclear Power Plant.

GE let us inside the SMR BWR X-300 reactor using virtual reality goggles sitting in a swivel chair. Attendees were able to explore the different parts of this reactor in an immersive way, experiencing being inside a BWR-type SMR first-hand.

lberdrola, along with Presentys, brought another virtual reality environment in which we could walk around the Fuel Building of the Cofrentes nuclear power plant, seeing



the fuel pools first-hand. In addition, an operator connected to the simulation from the Presentys headquarters in Malaga, guiding us through the simulation as if he were also there with us.

TECNATOM displayed its TecOS VIEW solution and a system for computerized procedures on various Tablets. TecOS integrates the P&IDs with other sources of information available within the plant, displaying and sharing this information among staff training where we were able to carry out a bomb disassembly training and its Predict software which reduces maintenance by using Machine Learning techniques to detect the abnormal operation of components before reaching failure.

In summary, the workshop brought together very diverse technologies and got the participants to interact with them while having a good time and learning about the digital innovations of the sector in the process.



WORKSHOP 2

IFMIF – DONES: TOWARDS NUCLEAR FUSION

uring the Annual Meeting, the "IF-MIF - DONES: Towards Nuclear Fusion" workshop took place within the framework of a technical program focused on one of the points that concerns our closest technological future: the IFMIF - DONES project. This project would place Escúzar, the municipality that will host the facility, on the map of infrastructures necessary for the development of nuclear fusion energy to test the materials that meet the necessary requirements to build DEMO, the reactor that will demonstrate the commercial exploitation of tokamak-type fusion reactors. For the workshop, we had the unique opportunity to have Rafael VILA, head of the CIEMAT "Fusion Materials" Unit: Moisés WEBER, head of the **DONES - PRIME** program and in charge of activities on the DO-NES site: and Antonio M. LALLE-NA, Professor at the University of Granada (UGR) in the Department of Atomic, Molecular, and Nuclear Physics at the UGR.

Rafael VILA explained the scientific context of the project, describing the extreme conditions to which the materials found in the first wall of the reactor and in the diverter are exposed, namely: the high thermal loads due to the deposition of energy from alpha particles generated in the fission reaction and plasma disruptions, and neutron irradiation that induces a change in the mechanical properties of said materials. A key study parameter is the production ratio of He atoms per atomic displacement that embrittles the material. The current state of the art does not include its effect in the medium and long term on structural materials, so it is necessary to qualify these materials in conditions equivalent to the actual conditions to which these materials will be exposed in DEMO with a facility designed exclusively for it.

Moisés WEBER described the facility that consists of a deuteron accelerator, a lithium loop, and a test cell to analyze the challenges faced by the design of the facility: to irradiate intensely while maximizing the duty cycle and its availability. Generating the neutrons requires the continuous operation of the lithium loop where the (d,Li)n stripping reaction occurs, which entails the design of the regeneration cycle for liquid lithium. A challenge for the test cell will be to maximize the reliability of its components in order to minimize the number of scheduled stops. The construction of the building is also a challenge because Escúzar is located in an area of moderate seismicity (frequent medium-low magnitude earthquakes). Using seismic isolation technologies and analyzing the impact of earthquakes on the operation of the facility will be of crucial importance.

Antonio LALLENA coordinates, together with Daniel Cano Ott from CIEMAT, the FNUC group along with the US and the IFIC - CSIC to evaluate other experiments that take full advantage of the technological potential of the facility. This network holds discussions with the DONES design team to study the location of the measurement stations and the production of other reactions of interest. Proposals for experiments are isotopic separation and the generation of cold neutrons. It would also be possible to study the structure of isotopes produced by fast fission reactions or to carry out measurements of activation cross-sections. The UGR forms part of an international collaboration network with centers such as the German KIT or the QST Fusion Institute in Rokkasho in Japan to promote the training and mobility of researchers in addition to collaborating with the CIEMAT.

There is no doubt about the exceptional nature of IFMIF – DONES in the context of research in our country. It is essential to identify applications other than those inherent to the facility, discern the most viable applications, and bring them to fruition: this will involve more researchers in the project and broaden its options for the future. This task is complex and a great challenge, but it will certainly be worth it. ■

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CLOSING SESSION

President of the Nuclear Safety Council



On behalf of the Nuclear Safety Council Plenary, I would like to thank you for the invitation to this closing ceremony of the Spanish Nuclear Society Annual Meeting. It is a pleasure for me to accompany you in the wonderful city of Granada.

This meeting is already a classic within the sector. And, on this occasion, it offers us a magnificent meeting

point after the terrible pandemic that we have suffered. I would therefore like to dedicate my first words of love and affection to all the people who were affected by coronavirus.

In this globalized world, communication and the exchange of experiences, knowledge, and information is crucial. Today, transparency is not voluntary: it is an investment, necessary to generate trust in society. Because, let us not forget, it is to the society in which we live that we owe our duty.

Last year the CSN turned 40 years old. Four decades in which our priority has not ceased to be nuclear safety and the radiological protection of workers, the population, and the environment. That is our role as a regulatory body, and the nuclear industry is working with us to achieve that goal. It is our common task. Safety above all.

At the CSN, we work to fulfill our task. Since we joined the CSN in 2019, as members of the new Plenary, we have issued 6 favorable reports to renew the operating authorizations for the Almaraz and Vandellós plants in 2020, and for Ascó and Cofrentes in 2021. In total, we have thoroughly reviewed detailed the activities of six reactors.

The entire Plenary and the technical staff of both technical directorates consider it a priority to carry out these and

other evaluations. And we got it. And I couldn't be more proud of it.

We never stopped, not even during confinement and with the consequences that this pandemic is bringing us, which has lasted too long. Thanks to new technologies, we have continued our work telematically. We have even maintained inspections of facilities, on many occasions in person, taking all the necessary safety measures to avoid contagion by covid-19.

During this week, in addition to the workshops intended for young Compulsory Secondary Education students, within STEM training, and the mentoring workshop intended for girls (because it should be emphasized, science is not just a thing for men), they have raised topics as important as the Dones Project, the vulnerability of the electricity sector to climate change, the lessons learned by the nuclear sector after Fukushima, and the role of green hydrogen in the new energy context. All of them of similar importance and relevance in different fields.

This is what society demands of us: face the future, anticipating the challenges ahead. Because preparing for the future is the best guarantee of doing things well. Progress, make no mistake about it, has a lot to do with preparation and hard work. And this meeting, without a doubt, has been an excellent forum to continue preparing for these new scenarios, each time more complex, each time more demanding.

The Spanish Nuclear Society is a fundamental agent in our country for the promotion of knowledge of nuclear science and technology. And so, we recognize all of us who are gathered here today. In this sense, your work is commendable.

You already know, as the English poet Lord Byron said, that "the best prophet of the future is the past." Well, based on the Spanish Nuclear Society's past, I am convinced that a splendid future awaits it.

All that remains is for me to congratulate you on this meeting and proceed to its closure.

Thank you very much, to everyone. And congratulations on the work you have done this week in Granada.

.....

General Director of Research and Knowledge Transfer for the Regional Government of Andalusia



Teresa Serrano

Teresa Serrano spoke about the industrial applications that the infrastructure of the IFMIF-Dones scientific project will have, which the European Union aspires to build in Escúzar in the Granada metropolitan area.

The so-called particle accelerator "will offer truly unique opportunities in various fields of research and innovation, ranging from basic physics, medicine, and astrophysics to a wide variety of industrial applications."

In her opinion, the deployment of its synergies and the knowledge transfer

that it will entail will allow for "training the local and regional business fabric to apply new technological developments in other areas, probably even far from the subject on which this facility is focused, such as nuclear fusion."

For all these reasons, Serrano assured that for Andalusia it will be a key project to "promote innovation and technological development in three fundamental pillars: public institutions dedicated to research, universities, and private companies." In addition, she added that "it will position the community as a national and international benchmark for knowledge and research, while at the same time positioning it at the forefront of clean energy."

The General Director of Research pointed out that "the Granada candidacy is a solid option which has great support and has the same chance of being chosen." Likewise, she highlighted the quality of Andalusian and Spanish scientists as a competitive advantage, a factor that adds to the proximity to France, where ITER will be built, which will complement this particle accelerator.

Teresa Serrano showed that Ifmif-DOnes constitutes a "strategic opportunity" for Andalusia since it is a world-class international technological facility that can attract very significant social, scientific, technological, and industrial returns.

President of the Spanish Nuclear Society



Héctor Dominguis

We have almost reached the end of this 46th Annual Meeting and this year has been, in my opinion, one of the most special we have held.

After almost two years, we have managed to meet again and make up for lost time during these strange times of the Pandemic.

It is time to review this great step in the return to normality, and for this, allow me to give the floor to Emilio Mínguez Torres, Vice President of the Spanish Nuclear Society.

Deputy Director General of Nuclear Energy (MITERD)



José Manuel Redondo

First of all, I would like to thank the invitation that, once again, the Spanish Nuclear Society has given me to participate in the Closing Session of this 46th Annual Meeting of the Spanish Nuclear Society, which is an honor for me.

Fortunately, we are coming out of the nightmare that we have been through with the pandemic and, without detracting from the virtual meeting that was held with great success last year, we returned to the face-to-face meeting that allows for that personal relationship that is the "gravy" of these annual meetings.

When, after receiving Héctor's invitation, I started to think about what I could talk about in my speech, I found myself with the problem that there is an issue related to nuclear energy that in recent days has achieved great prominence in the media, but which, as a representative in this Closing Session from the Ministry for the Ecological Transition and the Demographic Challenge, I suppose you will understand that I am not going to talk about it.

However, in this situation, I think it makes no sense for me to talk to you. once again, about the endless transposition of Directive 2013/59 on health protection against ionizing radiation, which sometimes gives the impression that, for one reason or another, we will never finish transposing it. nor will we speak to you for the umpteenth time about the revision of the Regulation on nuclear and radioactive facilities, nor even about the approval process for the 7th General Plan for Radioactive Waste whose processing began in March of last year and whose initial version is currently pending the start of the hearing process.

Therefore, I am going to be briefer than ever in my speech, which I am sure you will thank me for, and I am going to focus on commenting on three issues that have recently come to light regarding energy supply in general and nuclear energy in particular:

The first is that, in this globalized world in which we live, in recent months we have been able to see how after a phase of world recession due to the fateful pandemic, the economic recovery that has taken place worldwide has caused strong tensions in energy markets which have materialized in considerable price increases.

This has shown the importance of diversifying supply sources, particularly in the case of countries that are highly dependent on conventional energy resources abroad, as is the case of Spain.

Secondly, another circumstance that has been verified with what we are experiencing lately is that in these situations of tension, a social debate is logically generated, and when nuclear energy comes up in this debate, its leading role in the guarantee of the Spanish energy supply is highlighted, something that, in general, most people are unaware of.

This has come to "perform the miracle" that some of the most recalcitrant in the request for the immediate closure of nuclear power plants have now reconsidered this position and have had to assume the participation of nuclear energy in the energy mix as necessary.

It is clear that the debate that is generated in these situations allows a large part of society to acquire a certain level of training on the technologies from which the electricity they use comes from and has led many people not only to speak with great familiarity about "megawatt hours" and they have also "discovered" the role that nuclear energy has been playing in the Spanish electricity supply. And I think it is important for society to know that, consecutively over the last ten years, Spanish nuclear power plants have produced more than 20% of the electricity generated in our country, something that should not only be assessed in terms of supply of emission-free energy, but also in providing stability to the electricity grid.

This aspect of the contribution to stability has been highlighted, particularly, in recent months in which the Spanish nuclear power plants have been able to hold their own, both in conditions of an unexpected pandemic as well as the sudden *Filomena* storm and even in the event with the breakage of one of the main electrical connections with France like the one that took place last July.

And the third issue that I would like to highlight is that, if this is so, that is, if nuclear energy has been playing this fundamental role in recent years, not only safely, but also "discreetly," it is because, fortunately, Spain has a nuclear sector made up of highly qualified professionals, as has been made clear, once again, in the technical sessions that have been held at this annual meeting.

I am sure that this high level of qualification will be demonstrated again in the event that, under the technical coordination of CIEMAT, the IFMIF-DONES Project is brought to Spain and, particularly, to Granada, with which the Spanish nuclear sector is going to have a new opportunity to demonstrate the reason for the great prestige it currently enjoys at the international level.

As I have said, I am going to be brief, so I am going to conclude by congratulating both the Organizing Committee and the Technical Committee of this annual meeting as well as all those who have participated in the different sessions that have been held throughout these three days that, with their effort and dedication, have contributed to the success of this 46th Annual Meeting of the Spanish Nuclear Society.

Vice President of the Spanish Nuclear Society

The forty-sixth annual meeting of the SNE began officially on Wednesday with the opening session in this magical and historic city that brings together culture, knowledge, science, and technology, using the words of its mayor. It was an emotional session, remembering the past time and because seeing each other face to face again was very



much desired by all.

The Board and the Annual Meeting Organizing Committee made a very brave decision to definitively make this meeting take place in this format.

Continuing with our founding objective to spread the knowledge and advantages of nuclear energy, a series of activities were organized as in other years along with WiN, Nuclear Young People, the NEA, and the University of Granada starting on Monday: conferences, workshops, STEM mentoring, courses intended for various groups of local society: journalists, professors, and students of the University of Granada, high school students, and the general public.

This meeting, designed and organized for 2020 for this same venue had to be held virtually in order not to lose contact between members and it has now been possible with a new organizing committee taking much of the work that was done previously. Our thanks to all the members of that committee.

The response of the sector was magnificent and unexpected a few months ago. We were looking forward to it, not only to seeing each other beyond the screen but also to exchange advances among ourselves and to communicate and interact with Granada society, showcasing the benefits and efficiency of our nuclear power plants, presenting new innovations and advanced projects that without a doubt are the present and future of the energy panorama.

During all this time, the plants and the entire nuclear sector have been in constant activity, with the due restrictions, providing the maximum service to society at all times, quickly adapting to a work model that has not at any time limited the operation of the sector. The media response has been very positive, as can be seen, as a result of Tuesday's press conference where the Mayor and our President participated. Headlines that we are not used to seeing.

TECHNICAL PROGRAM

In the opening session, both the Mavor, our President, the Director General of Endesa in Andalusia, and the Vice Chancellor of the University of Granada agreed that nuclear energy cannot be left out of an energy mix in the medium and long term due to its contribution to having a carbon-free world, for energy security and independence, and because it must contribute to the industrial and energy revolution in which we find ourselves. The innovative proposal for new types of nuclear reactors, and especially fusion with the IFMIF DONES facility, is a necessary step on the map to get from ITER to the DEMO fusion reactor, and an excellent challenge for the country.

A magnificent inaugural conference that took us to space radiation, to a dream about space explorations, and to learn about concepts such as space weather and other interesting scientific advances carried out at NASA.

The technical sessions, including the poster ones, have had a large number of speakers and attendees, and they were able to present and discuss experiences and advances. Likewise, the single subject sessions, where what was learned in Fukushima and the role of modular reactors in the hydrogen economy have had magnificent attendance with some excellent and experienced speakers.

One of the stars of the program was the first general session dedicated to the IFMIF-DONES Project, in which this province, and specifically the municipality of Escúzar, have high hopes for the social, economic, and technological impact of this large facility. It represents an excellent opportunity for research, industrial development, and innovation in the fusion program and, above all, to better understand the behavior of materials against irradiation as well as the various applications of neutrons and deuterons.

But at the same time, we cannot forget about the reactors in operation and the new reactors, addressed in the second general session that we just held on "The Threat of Vulnerability" where nuclear energy plays and must increasingly play an important role despite the difficulties at stake for a transition towards decarbonization.

DATA SUMMARY

We can say that this Annual Meeting is one of the most attended in recent years. We can see the data on the screen.

- Number of attendees: 677 registered
- Number of companies: 64
- Number of exhibitors: 33
- Number of technical and poster sessions: 34 technical sessions and 2 poster sessions, one dedicated to Fusion
- Number of presentations: 300
- Single subject sessions: topics: 2, one on Fukushima and another on modular reactors
- General sessions: topics. 2, one on the Dones project and another on the impact of climate change on the electricity sector
- Workshops: 2, one on digitization and the other on fusion (IFMIF-DONES)
- WiN: activities:
 - Mentoring workshop for girls with the participation of the NEA
 - Conference on the application of radiation in the conservation of cultural heritage
- Nuclear Young People:
 - Course for journalists with the communication commission
 - Pint of science on IFMIF-DONES
 - Basic nuclear fusion course
 - Finally:

This data indicates that the sector is alive, rejuvenated, and is in continuous activity and evolving.

Despite all the difficulties and negative messages from many sectors, we must continue to work together, conveying messages to politicians, the media, and society in general that nuclear energy:

- Is independent, reliable, continuous, safe, and does not emit polluting gases.
- Ensures supply even in extreme environmental situations, for example, during Filomena.
- With a greater installed nuclear power, it would not be so dependent on fluctuations in the price of kWh
- Is constantly innovating with new designs and extending its applicability to various areas: desalination, urban heating, heat and steam in various applications, green hydrogen generation, and all of this is compatible with renewable energies.
- Is necessary for the transition to decarbonization, for which the current reactors must continue to operate beyond their estimated life in the INECP.

- Has a very competitive sector internationally, as well as highly qualified human resources.
- That there is a new generation very involved in the fight against climate change and that defends nuclear energy, which cannot be let down. As an example, their participation in the next COP in Glasgow in Nuclear for Climate.

It is not possible to lose an entire knowledge asset when the Spanish nuclear industry has devoted many resources to gaining high prestige in the international field and when there are great expectations of a renaissance.

ACKNOWLEDGEMENTS

This meeting, together with the wonderful cultural activity of the Chumbera in Sacromonte and the excellent official dinner at the Mamunia and with excellent weather has been a wonderful finishing touch to get closer and strengthen ties circumstantially broken by the pandemic.

Congratulations to all the winners last night, for their effort and contribution to keeping the Nuclear Society alive and fulfilling its founding goals.

An emotional remembrance to all those who have left us in this unpredictable period.

A big hug for those who, for various reasons, have not been able to accompany us these days. A special, personal hug for José Dominguis and Agustín Alonso.

A well-deserved applause for the entire Annual Meeting Organizing Committee and the Technical Committee, thank you Miguel and Patricia for your work to make this meeting close and real.

Of course, to our host ENDESA

To all the Sponsors and companies that have attended the exhibition

To the Commissions that have contributed their support and activities to the Annual Meeting

To WiN and Nuclear Young People.

Thanks to all the attendees,

You are all wonderful. Without your support, this meeting would not have been possible.

As usual, the winners of the technical and poster sessions and the photography contest sponsored by FRA-MATOME will be announced. These awards will be presented at the 2022 Assembly.

The forty-seventh meeting will be hosted by IBERDROLA and the venue is... CARTAGENA. We are really looking forward to seeing you. ■

TECHNICAL SESSIONS

Session 1

ENGINEERING AND INNOVATION (I)

Session 01 "Engineering and interesting presentations that dealt with different projects and experiences related to various topics such as seismicity analysis of buildings, plant safety evaluations, and plant design improvements and modernization.

First, the session included two papers related to seismicity studies. In the first one presented by Jaime Vega from Empresarios Agrupados, the results of the analysis carried out to de-

termine the cost versus return period curves for the case of the IFMIF-DO-NES main building were shown. In the second, Juan Sabater from ANAV showed the studies conducted to evaluate the conservatism of the flooring calculations for the Vandellós NPP Control-Auxiliary building.

Next, two experiences associated with improvements at the Trillo and Vandellós II plants were discussed. In the first, Cristian Prieto described the work carried out to replace the isolation gates of the ring building, showing the main difficulties and how they were resolved. In the second, Albert Martí



Fernando Ortega PRESIDENT



Ángel de Blas Gordo COORDINATOR

shared the experiences associated with the modernization of cranes in order to guarantee adequate availability, taking into account their criticality during the refueling works of the plants.

Subsequently, several proposals were presented to improve the safety of the plants. The first showed strategies and methodologies for the adequate management of the useful life of buried pipes in the face of degradation phenomena, presented by Amador Sillero from Tecnatom. A second showed the devices developed as mobile units to support boration strategies in case of emergency by Daniel Alcaraz from GDES. And a third focused on optimizing the "Steel-plate composite wall" for the NUHOMS EOS spent fuel storage system, by Orano.

Next, two papers were presented on fire protection systems from two different perspectives. One on the information available in the Control Room in which Rafael Torrealba de Ghesa presented the installation of new signage and information to help fire response in the Almaraz NPP control room and a second in

which Juan Jose Jaimot presented the work carried out at the Ascó NPP for the renovation of the fire protection ring located outside the double fence.

Lastly, Salvador Borras from ANAV presented the work carried out to recover the cultural heritage associated with the Vandellós I NPP meteorological station, providing an interesting cultural and artistic counterpoint to the session.

In summary, the session, enlivened by various questions and comments from the audience, showed different experiences that have been developed from various fields in the last year.



NUCLEAR SAFETY, LICENSING, AND PSA (I)

In this technical session, we have had the opportunity to enjoy 10 presentations on various topics, which we could be defined globally as presentations where technical awareness, through the analysis of operating experience, applicable regulations, and risk analysis, is put at the service of nuclear safety.

In the field of operating experience analysis, we were presented with a paper analyzing



Rafael Martín PRESIDENT



Gonzalo Medinilla COORDINATOR

the applicability of the EO for the US NPPs on failures to close the safety valves in our Westinghouse design plants and another paper in which it was reflected that we are still trying to draw on lessons learned from the Fukushima accident, in this case on long-term cooling in severe accidents.

Regarding the regulatory aspect, a paper was presented on the revision of the IAEA safety guidelines on seismicity, both in the design phase and for existing plants,

after the Fukushima accident. Two other papers referred to the requirements of the IS-25 safety instruction which have led to the need to perform level I PSAs for fires in other modes of operation and a fourth paper describing the scope and main changes introduced in the analysis of radiological consequences of design basis events in the process of adaptation to IS-37.

Finally, in the area of risk analysis, we could include a presentation on the role of uncertainties in the transition from deterministic safety analysis methodology to realistic methodologies, another paper on the control of design modifications for their subsequent consideration in the different models developed for risk analysis, a thermohydraulic analysis on the evolution of the level in steam generators before the loss of said signal in a scenario of loss of external electrical current to find out the margin available for the restoration of the measurement system, and finally, a methodology on behavior instrumentation in conditions that exceed the design basis and the impact on the application of the different severe accident management guides.

The session was very well attended, and at the end of the presentations, a very interesting and professional debate was held, encouraged by the questions of the attendees and the pertinent answers of the speakers.



WASTE MANAGEMENT (I)

he session started at the scheduled time. There was an average attendance of 15 people and 9 papers related to radioactive waste management were presented.

ORANO Cycle presented a project for the recovery and conditioning of radioactive sludge stored in The Hague through the use of a remotely operated vehicle (ROV) accompanied by a suction system that allows for its transfer to be collected in suitable containers for prompt dis-

posal. Then, in a second presentation, they presented some of their innovations, including equipment for sampling and collecting objects, modular confinement systems, and mobile hot cells for characterization.

Tecnatom presented the advantages of digitizing the treatment supervision systems for the RADWASTE and MAKE-UP systems for the Santa Maria de Garoña NPP. Digitization allows the monitoring of activities remotely and in real time, facilitating decision-making, early decision on anomalies, and optimization of the resources dedicated to supervision.



José Tomás Ruiz PRESIDENT

Alejandro Mendoza COORDINATOR

Westinghouse, in collaboration with ENRESA, explained the new technical specification 031-ES-IN-0061, the focus of which is the management of bulky equipment and components with very low activity in order to optimize storage volume and which entails significant financial savings.

ORANO Federal Services presented advances in research on the use of existing fuel dry storage containers directly in the geological repository in order to avoid exchanging containers.

ORANO Recycling presented а DEM&MELT In-Can vitrification technology specifically designed for medi-



um and high level waste from decommissioning operations.

GDES presented a radiological characterization system (dose and activity rate) for drums that is operated remotely for the different types of waste drums deposited in the Temporary Waste Storage for the Almaraz Nuclear Power Plant.

Empresarios Agrupados presented the SORTED system, an autonomous system whose objective is the classification,

segregation, and transfer of radioactive waste from decommissioning.

The Sitta, Condorchem, and ENSA companies presented a project to respond to the technological challenge of Fukushima which consists of a chemical pretreatment with an evaporation and crystallization system for trapping tritium followed by its storage in solid form or in the form of salts.

At the end, the time for questions was opened up where there was a lively and enriching debate among the attendees with the session ending a few minutes before the scheduled time.



DECOMMISSIONING (I)

n the first session dedicated to Decommissioning, ten papers were presented.

Two of the papers presented operational experiences on the segmentation of large metal components ("Cutting and Removal of the Zorita Containment Dome," "Decommissioning Services at the Barsebäck and Oskarshamm NPPs") using various cutting technologies (plasma, thermal, and mechanical) and, in the case of Barsebäck and Oskarshamm, a robot to remotely dry cut the four vessels.

46th ANNUAL MEETING OF THE SNE

Using LASER technology has a number of advantages for cutting these components with complex shapes, with material hardened by irradiation. and with high activation. The presentation on the "LD-SAFE Project: Laser Cutting of Vessels and Reactor Internals" presented the evaluation project for the use of this technology that a European consortium is undertaking to demonstrate that this technology is at least as safe as the existing technologies for workers, the public, and the environment.

The challenges and solutions to perform the segmentation and compaction of special waste, such as control rods, instrumentation, channels, stopper devices, etc. in the waste pool was the subject of the "Developing Solutions to Manage the Diversity of Core Waste Segmentation Challenges" presentation followed by the "Orano TN Radioactive Material Transport Services and Casks in the United States" presentation on the transport systems and containers used in the United States for this type of waste.

In addition to the technical difficulties involved in carrying out activities in decommissioning projects, the pre-



Manuel Quecedo PRESIDENT

Leandro Sánchez COORDINATOR

sentation "VIRCORE-Collaborative Platform for the Management of NPP Decommissioning Projects with Digital Models" presented the adaptation of BIM models as a collaborative data environment for the decommissioning of Garoña including radiological characterization databases and physical and radiological inventories.

An additional application of the levers of digital transformation, virtual reality, which provides an immersive experience for the process applicable to previous simulations including events, the design of the process, tools and equipment, and the formation of the work team, was the subject of the "GE-H D&D Simulator" presentation.

The numerical simulation area was represented by two papers. Due to the high radiological load that exists after the operation of the plant, in order to define a strategy that minimizes the exposure of workers during decontamination and decommissioning work, it is necessary to calculate the radiological load (dose rates). The papers "Analvsis of Nuclear Facilities Using MonteCarlo Codes for Dose Reduction" and "On the Role of Core Simulators to Compute the Source Term for Reactor De-

commissioning Operations" presented two computational approaches for calculating the radioactive inventory.

Finally, the necessary effort to supply authorized equipment complying with the technical specification and the dedication process was presented in the paper "Operating Experience in the Procurement of a Class 1E Diesel Generator Set for Garoña." This diesel generator, dimensioned for the actual power required after the cessation of operations replaced the existing emergency generator prior to decommissioning.

The session had good attendance and participation during the time for questions from the audience to clarify any questions about the presentations.



TRAINING (I)

This session highlighted the importance of digital technologies in training programs for nuclear facility personnel and the need to include quality training for different areas of nuclear engineering in educational programs.

Ainhoa Caro from TECNATOM explained how to use the Interactive Graphic Simulator (SGI) online both for initial training and for retraining. The presentation explained how to approach the challenge of using a simulator in an online training where the instructor and students are not in

the same room. The result of the work carried out shows that the functionality of this tool, which has been so pow-



Pilar Sánchez Barreno PRESIDENT



José Luis Delgado COORDINATOR

erful to meet the standards of face-toface training for many years, can also be achieved in remote online mode. Vanessa Barambones from TECNATOM presented an ENU-SA-ENSA proposal on 3D models as a teaching aid for learning how fuel management tools work, which represents a great advantage due to their restricted access since they are used in radiological areas (such as the fuel pools of power plants), providing an additional advantage from the ALARA point of view.

Ricardo Moreno from GE Hitachi reported on a digital platform that allows the personnel of companies that operate nu-

clear facilities to be trained more efficiently and that shortens training times. In addition, this type of training reduces the time of exposure to radiation for personnel.

María Teresa Gerveno from TEC-NATOM explained a virtual reality model applied to occupational risk prevention that consists of reproducing images, recorded in 360, of load handling and lifting maneuvers in virtual reality with the aim of training personnel in the key aspects of safety and prevention that must be followed in a high-risk activity.

Patricia Romero from TECNATOM explained the experience of using a simulator for maneuver training at

AENA's airport distribution centers, a non-nuclear facility, whose lessons learned can be extrapolated to our industry. Among the advantages presented, the degree of optimization achieved in the safety and reliability aspects of the facility through the minimization of operating errors both in the control room and in local operations stands out.

Sofia Carlos from the UPV presented the RADIUM project of the European Union whose objective is the design and implementation of a master's degree in radiological protection and nuclear safety in Belarus due to the plans to build nuclear power plants in the country and, therefore, therefore, the need for industry personnel to receive high-quality training.

Finally, **Diana Cuervo** from the UPM presented the Great Pioneer Project where European educational institutions with experience in training nuclear engineers are participating to develop an educational program that includes a range of quality courses intended for undergraduates as well as graduate and doctoral students for various areas of nuclear engineering.

Session 6 RADIOLOGICAL AND ENVIRONMENTAL PROTECTION (I)

n the first of the technical sessions dedicated to Radiological and Environmental Protection, about 35 people attended and there were eleven presentations:

José Luis Cormenzana from Empresarios Agrupados (EEAA) presented "Radiological Calculations for the Cofrentes NPP Individualized Temporary Storage (ITS)" with simulations carried out with the MAVRIC code.

David de Castro García, also **PRESIDENT** from EEAA, gave us an interest-

ing presentation using 3D technology with "Integration of Radiological Information for a 3D Model of the Almaraz Nuclear Power Plant."

Víctor Manuel Expósito from CIE-MAT presented us with a paper with a slightly different topic related to Artificial Intelligence with "Application of a Neural Network for the Radiological Characterization of an Area Impacted by Mining."

Estela García from TECNATOM gave a presentation on the Internal Dosimetry Service entitled "Ten Years of the Internal Dosimetry Service by Bioelimination."



Óscar González PRESIDENT

Aina Noverques from the UPV gave a presentation on "Modelling Radon Levels in Air Generated from an Artificial and a Natural Source in an Airtight Container."

Sergio Rivera from CIEMAT presented us "Design of a Temporary Container for the Storage of Neutron Sources at the CIEMAT Neutron Patterns Laboratory."

Proton therapy is emerging as one of the most effective methods against cancer. **Gonzalo García** from the UPM presented "Evaluation of the Shielding of the Proton Therapy Centers Against the New Modalities of Treatment in Development, FLASH and PMAT, Using the MCNP6 Code and Experimental Measures."



Miguel Ángel Rodríguez COORDINATOR

Roberto García, also from the UPM, gave a presentation on the "Study of the Distribution of Alpha Particles in the Proportional Counter of a LUPIN-II Neutron Monitor Using Monte Carlo Codes."

Agustín Cerezo from the URV presented us with an interesting study that is being carried out at an international level on "Spectral Analysis Method by Windows to Monitor Artificial Isotopes Using Gamma Spectrometry in Real Time for Environmental Radiological Surveil-

lance Networks."

Beatriz Ruvira from the UPV gave a presentation on "Experimental Determination of the Diffusion Coefficient for Potential Polymeric Materials as Anti-Radon Barriers" where she presented us with the simulation results with TRACE5p5 and RELAP5-3D codes.

Finally, **Jesús Saez de Omeñaca** from ENSA presented us with a paper on the same topic as the first presentation entitled "Analysis of the Origin of the Dose Rate Generated in Individualized Temporary Storage Applied to the Minimization of the Dose Rate to the Public."



Sof the design, manufacturing, and behavior in operation and storage of

FUEL (I)

fuel cladding, as well as the challenges of the industry, new reactors, and materials. The session was well attended, highlighting the high technical content that encouraged participation in the question-and-answer sessions.

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The following topics were presented:

- CHROMED CLADDING DEMONSTRATION PRO-GRAM FOR DOEL-4 by Lustolde Martínez from ENUSA who summarized the fourband program that allows for the collection of operating experience and actual fuel behavior data that is so important for the implementation of these new technologies.
- REORIENTATION OF HY- PRESIDENT DRIDES IN FUEL CLADDING BY INTERNAL PRESSURE by Miguel Cristóbal from the UPM who explained the problem of zirconium hydrides formed during the operation and the reorientation techniques which seek a homogeneous distribution of circumferential stresses.
- DETERMINATION OF METALLIC IM-PURITIES IN ZIRCALOY USING ICP-MS by Julián Garrido from ENUSA who presented a model that allows for all elemental determinations to be carried out in a single analysis with lower quantification limits and in less time.
- INSIGHTS IN THE FISSION GAS RE-LEASE MODELING AT HIGH BUR-NUPS by Francisco Feria from CIEMAT where the differences obtained by two FRAPCON models in calculating cladding stress during the



José García Aycart PRESIDENT



José García Laruelo COORDINATOR

drying process prior to storage were shown.

- APPLICATION OF 3D ARTIFICIAL VI-SION IN THE AUTOMATIC INSPEC-TION OF THE FUEL ROD SURFACE by Jesús Castaño from ENUSA. The paper presented the 3DMPro equipment developed by ENUSA to inspect fuel rods and tubes automatically. This technique makes it possible to detect and characterize defects up to 25 microns deep by means of high-precision and highspeed 3D artificial vision algorithms.
- EFFECT OF HYDROGEN PRECIP-ITATION ON IN-CLAD HYDRIDES DISTRIBUTION IN IRRADIATED FUEL RODS by **Francisco Feria** from CIEMAT. In this paper, the effect of hydrogen precipitation on the

distribution of hydrides in the cladding is studied. To this end, a CIEMAT-derived hydrogen migration/precipitation model has been extended to take into account two existing options for precipitation modeling: the classical (empirical) and the new option (more phenomenological).

• CURRENT CHALLENGES FOR NUCLEAR FUEL by **Nuria Doncel** from ENUSA. The benefits of using a new advanced fuel design and the challenges involved in meeting the needs of the industry today and in the near future were discussed.

- SUPPORT TO DEVELOPMENT AND OPTIMIZATION OF ADVANCED RE-ACTOR BACKEND ACTIVITIES by **Even Bader** from ORANO. He presented the study that ORANO is carrying out for the development of profitable, optimized, and standardized solutions based on small, advanced reactors.
- OXIDE-TYPE NUCLEAR FUEL MAN-UFACTURING TECHNOLOGIES AND RADIOTOXICALLY SAFE AL-TERNATIVES by Sergio Fernández from CIEMAT. He showed new fuel matrices with varied compositions and morphologies through methods of conversion and incorporation of actinides in inert matrices, including dust-free processes.

Session 8 THERMOHYDRAULIC AND NEUTRONICS (I)

During the first technical session on thermohydraulics and neutronics, 10 papers were presented, which are summarized below in the order in which they were given:

 "NEUTRONIC STUDIES ON ABSORBER INTRODUCTION INTO THE ESFR-SMART CORE UNDER SEVERE AC-CIDENT CONDITIONS" presented by Francisco Álvarez Velarde who described different alternatives for absorbent materials in the ESFR-SMART design to minimize the risk of

recriticality in the event of a severe accident. The analyses show that the best option among those analyzed corresponds to B4C+W+B4C.



César Queral PRESIDENT



Amparo Soler COORDINATOR

 "COMPARISON OF SENSITIVITY/ UNCERTAINTY ANALYSIS METH-ODOLOGIES IN THE EUROPEAN SODIUM FAST REACTOR" given by Vicente Bécares Palacios who showed the uncertainty and sensitivity analyses of neutron calculations applied to an ESFR reactor model. The analyses have made it possible to determine which are the most important effective sections from the point of view of uncertainty and sensitivity.

• "MODELLING THE TVA WATTS BAR UNIT 1: START-UP ZERO-POWER PHYSICS TESTS" presented by **Luis Felipe Durán Vinuesa** in which the results of participation in

an OECD/NEA Benchmark related to the multicycle analysis of the Watts Bar-1nuclear power plant were shown.

- "PROCESSING OF JEFF NUCLEAR DATA LIBRARIES FOR THE SCALE CODE SYSTEM AND TESTING WITH CRITICALITY EXPERIMENTS" presented by **Antonio Jiménez-Carrascosa**. This paper gave an overview of the processing technique of the JEFF-3.3 nuclear data library with AMPX for its application within the SCALE code system. This library has been verified and tested using a set of 120 ICSBEP criticality benchmarks.
- "ANALYSIS AND VERIFICATION OF THE EVOLUTION OF THE CONCEN-TRATION OF THE NEUTRON POI-SON XE-135 IN A PWR-KWU TYPE NUCLEAR REACTOR DURING AN OPERATIONAL TRANSIENT" presented by Bárbara Navarro Mas in which the evolution of Xe-135 during 48 hours in a sequence of movement for two banks of bars using a coupled RELAP5 model with PARCS. The result obtained in terms of Xe-135 concentration corresponds to what was expected.
- "ANALYSIS OF THE EVOLUTION OF THE CONCENTRATION OF XE-135 IN A PWR-KWU REACTOR

WITH COUPLED CODES" was also presented by **Bárbara Navarro Mas**. In this paper, the results of the evolution of the oscillations of Xe-135 before different sequences of movements of the control rods were shown. The final objective of these analyses is to define flexible operation strategies without inducing Xe-135 oscillations.

- "PROCEDURE FOR THE ANALYSIS OF CED-A ACCIDENTS WITH COM-PLETE LOSS OF ELECTRICAL SUP-PLY WITH ADDITIONAL FAILURE OF EMERGENCY DIESEL GENERA-TORS" presented by José Ordóñez Ródenas. This paper analyzed a design basis extension (CED-A) for the long-term total loss sequence of the AC power supply along with a manual depressurization of the secondary power supply. The analysis is part of the development of a CED-A sequence analysis methodology.
- "SIMULATION USING TRACE FOR A SBLOCA ACCIDENT IN COLD BRANCH WITH TOTAL FAILURE OF THE SAFETY INJECTION SYSTEM AND OPERATION OF THE FEED-WATER PASSIVE SAFETY SYSTEM"

presented by **Enrique Saborit Rojas**. The paper includes the description of the ATLAS system model made for the TRACE code and the results obtained for a natural circulation experiment with asymmetric cooling.

- "SIMULATION OF PASSIVE SAFETY SYSTEMS. THE CAP 22 TEST FOR THE ACME EXPERIMENTAL FACIL-ITY" presented by **Manuel Pérez García**. This paper shows the model developed for the ACME facility for the TRACE code and its application to the analysis of the CAP22 test. The results show high concordance with the experimental results.
- "PARTICIPATION IN THE ISP-51. SIMULATION OF THE CAP 22 TEST FOR THE ACME EXPERIMENTAL FACILITY WITH TRACE5PATCH5" presented by **María José Rebollo Mena**. This paper shows the work carried out by NFQ related to its participation in the ISP-51 international comparison exercise, including the model developed for TRACE and the results obtained, which are adjusted in accordance with the results of the CAP22 test. ■

Session 9 QUALITY, REGULATION, ORGANIZATION, AND HUMAN FACTORS (I)

More and more compare opting for the training ore and more companies of professionals on a more personal level, providing workers with emotional and psychological management tools that train them and help them motivate work teams to carry out their duties. Also, more analysis of the sociological structures that govern companies is being carried out in order to improve, update, and prepare them for the future. Within this framework, session 9 was held on Quality, Regulation, Organization, and

Human Factors (I), coordinated by Javier Gutierrez from Enel and chaired by Claudia López from CIEMAT. In the session, 10 papers were presented, and it was attended by 25 people.

The session began with a presentation by **Joaquin Navajas** (CISOT, CIEMAT), who presented a statistical analysis based on surveys of the cul-



Claudia López del Pra PRESIDENT

tures or subcultures of the Spanish nuclear industry. The next presentation was done by **Eduard Esclasans** (TECNATOM and ANAV) who spoke about Innovation in the Plant Leadership programs. The third presentation was done by **Laura Jiménez** (CISOT, CIEMAT) who showed the value of the "field diary" in the study of the future of

Javier Gutiérrez

COORDINATOR



based on human factors engineering. The next presentation was done by **Joaquín Navajas** (CISOT, CIEMAT) evaluating the safety culture in times of COVID-19. Lessons learned from an external evaluation in an organization of the Spanish nuclear sector. The eighth presentation was done by Elisa Gil from TECNATOM presenting the virtual environment to improve the safety and reliability of organizations (HUP). The next presentation was done by **Robert Ventura** (ANAV) with the SURVEYS presentation: New Tools

for Quality Reinforcement in Spanish Nuclear Power Plants and **John Kick-hofel** (APOLLO PLUS) finished things off by presenting Use of High-Quality Industrial Grade Items in Nuclear Facilities: A European Guideline. At the end of each presentation, a time for questions was established which had considerable participation by the attendees.

Session 10

ENGINEERING AND INNOVATION (II)

Throughout this session, we had the pleasure of enjoying (6) presentations of the highest technical interest.

First, **Carlos Julian Gavilán Moreno**, Head of Engineering at the COFRENTES NUCLE-AR POWER PLANT, explained how this Nuclear Power Plant has developed system and component optimization using factor analysis and clustering techniques. The methodology used has allowed for the development of a useful and simple tool that has the ability to quick-

ly and visually determine the status of the system or component.

Ángel Moraleda from EMPRESARI-OS AGRUPADOS and head of the electrical group that supports the operation of the Almaraz and Trillo Nuclear Power Plants presented how the replacement of the generation switch at the Trillo Nuclear Power Plant is planned, highlighting that the implementation of this new switch will allow for eliminating auxiliary cooling and air compression equipment.

The third presentation was done by **Josep Jordi Imbert,** Engineer Responsible for the fire sprinkler system



María Vega PRESIDENT



COORDINATOR

and the cooling systems at ANAV, during which he spoke to us about the advances in remote monitoring of rotating equipment at the Ascó and Vandellós II plants, highlighting that the installation of wireless sensors improves the reliability of the equipment, reducing its unavailability, and reducing maintenance.

The presentation on the management of projects to replace monitored actuators in nuclear power plants came from **Ángel Baptista Romero** from EMPRESARIOS AGRUPADOS who works in the engineering support service for the operation of the Trillo and Almaraz plants, a project that reduces risks and uncertainties through the proper choice of actuators for each type of valve.

Complementing the previous presentation, **Daniel Martín Moreno de Blas**, also from EMPRESARIOS AGRUPADOS and working in the engineering support service for the operation of the Trillo and Almaraz power plants, spoke to us about the engineering activities for the replacement of motorized actuators in nuclear power plants, placing special emphasis on the

importance of integrating all the disciplines involved in the process during these activities.

In addition, Mario Di Fonzo Balmaceda, senior engineer and technical lead in the civil works department of WESTINGHOUSE SPAIN presented us with the work carried out in the four Vogtle units for the unsupported cable length and integrated head package (IHP) connector panel in containment buildings, highlighting the importance of communication and teamwork for the success of the project.

Thank you all for sharing these interesting projects with us.



NUCLEAR SAFETY, LICENSING, AND PSA (II)

 11-01. RENEWAL OF THE ASCÓ NPP OPERATING LICENSE: MILE-STONES, DIFFICULTIES, AND MAIN ACHIEVEMENTS.

Patricia González Ayestarán from the ASCÓ-VANDELLÓS NUCLEAR ASSOCIATION (ANAV)

On July 28, 2021, the CSN Plenary issued a favorable report for the authorization renewals for the Ascó 1 and 2 NPPs, which for project purposes represents the culmination of a relevant milestone for ANAV. As precursors to the process of renewing the authorization in this third stage of periodic safety reviews for NPPs, the Almaraz, Vandellòs II, and Cofrentes plants, within the framework of sector collaboration, have contributed to the successful completion of this project, contributing their previous experience, with which they paved the way for the renovation of the Ascó NPP, nevertheless, it is worth explaining the process carried out, highlighting some unique aspects. The long-term entry into operation in the following period, the confluence in time with the transition process to the NFPA-805 standard as the license base for fire protection, the need to foresee spent fuel storage strategies with a medium- and longterm time horizon under uncertainty boundary conditions, the approach of adaptation and updating to the best practices of the industry with reasonably practicable measures as

a result of the IAEA references in the elaboration of the PSR (SSG- 25), and the initiative to undertake a SALTO mission at ANAV, by this organization, meaning that the Ascó NPP authorization renewal project has been challenging and not without difficulties, not to mention, as a singular circumstance, the entry into the state of alarm derived from the COVID-19 pandemic, shortly before the formal presentation of the application, which did not affect the determination

to successfully complete it with an entire organization devoted to it. The main challenges and lessons learned will be presented, both from the point of view of project management and potential improvements in the interaction with the regulator, likely to be applied in general in the future and especially in licensing processes of certain complexity. The main conditions and actions to improve the plant derived from the renewal process will also be briefly explained.

 11-02. MODEL AND QUANTIFICA-TION OF A SEISMIC PRA FOR A GENERATION III+ NPP USING RISK-SPECTRUM SOFTWARE.

Mario Martínez, Wensheng Gao, Andrea Maioli, Rachel Christian & Adriana Sivori. WESTINGHOUSE ELECTRIC COMPANY LLC

An operational stage Level 1 Seismic PSA for a generation III+ passive NPP has been developed to update the PSA-based SMA presented in the FSAR. A site-specific PSA allows for measuring the plant's seismic risk profile and supports future risk-informed applications that require a comprehensive all-hazard risk assessment. The project has been carried out following the latest methodological guides and aiming for full compliance with the ANS/ASME Standard [1] requirements. The seismic PSA was developed for both at-power and LPSD conditions which implies seismic considerations and potentially different seismic failures for all Plant Operation States (POS). The three relevant elements included in this Seismic PSA are a site-specific seismic hazard analysis, a detailed fragility evaluation, and the integration with the plant response model anal-



Luis E. Herranz PRESIDENT



Coordinator

ysis that allows for seismic-induced failures to be coupled with random failures not related to ground motion or human error probabilities. Comprehensive walkthroughs were performed to support the development of the Seismic Equipment List (SEL) and failure modes identification. The passive nature of this specific plant design allowed for substantial simplifications in the modeling of non-safety-related systems, thus reducing the effort needed for fragility evaluation and still achieving a reasonably lowrisk estimate for the plant.

 11-03: CROSS-BORDER EMERGEN-CIES IN THE EUROPEAN UNION: PRACTICAL IMPLEMENTATION.

Javier Gutiérrez, Miguel Barreiro & Rodrigo Cuesta. ENDESA

During recent years, the preparation and response to radiological and nuclear emergencies have undergone a process of constant change and evolution. With funding from the European Commission, various studies have been published that show how the licensees of Nuclear Power Plants and the competent bodies have adopted measures and provided themselves with the necessary capacities to comply with the regulations and recommendations of the European Union (EU). However, it is considered necessary to carry out an additional detailed analysis that allows for assessing the actual degree of effectiveness of its practical implementation through a project dedicated exclusively to it. During this presentation, the analysis that will be carried out throughout the project will be described along with its objectives and work outline. The analysis will focus on the practical implementation of the measures and capacities for the preparedness and response phase in a cross-border context including the EU Member States and neighboring countries. To do this, the project will have competent authorities in the field of emergency management, regulatory bodies, representatives of power plants, and proprietary companies from 36 countries. The project activities will be coordinated by Nuc Advisor in consortium with ENEA, the Center for Energy Research, and

Vuje. The project will lead to an improvement in the implementation and coordination of the measures that must come into play during the response phase of an emergency and that have been carefully planned in the preparation phase. In addition, the exchange of operational experience and best practices among the participating organizations will be promoted with the aim of highlighting the most effective measures. To ensure a good result, scenarios with wide-ranging simulated emergencies will be developed in which the authorities and organizations must coordinate with each other. Among the objectives pursued, it is worth highlighting the analysis of the protection measures for the population and the degree of coherence in their implementation, as well as an in-depth review of the coordination mechanisms between different countries. The project seeks to further strengthen the strength of the emergency programs developed in the participating countries by testing their capabilities in the face of potential cross-border incidents.

• 11-04: APPLICATION OF THE SPAR-H HUMAN RELIABILITY METHODOL-OGY TO FLEX STRATEGIES.

Sergio Courtin, César Queral, Carlos Paris & Rafael Iglesias. POLYTECHNIC UNIVERSITY OF MADRID (UPM)

FLEX Strategies have been designed to prevent and mitigate the consequences of external events beyond design basis (BDBEE). The implementation of these involves manual actions and decision-making by plant personnel. Human reliability analysis (HRA) methodologies have limitations to quantify human error probabilities (HEP) for this type of performance. This paper presents a proposal to modify the SPAR-H methodology for its application to the analysis of FLEX strategies.

 11-05: THERMOHYDRAULIC ANAL-YSIS OF ACCIDENTAL SEQUENCES
 IN A VVER-1000/V-320 REACTOR
 WITH TRACE5P5 CODE.

Elena Redondo Valero, César Queral & Víctor Sánchez Espinoza. POLYTECHNIC UNIVERSITY OF MADRID (UPM) & KARLSRUHE INSTITUTE OF TECHNOLOGY (KIT)

The ETSI Mines and Energy group of the Polytechnic University of Madrid (UPM) along with the Karlsruhe Institute of Technology (KIT) are developing various thermo-hydraulic models for plants with VVER-1000/V-320 reactors for TRACE5p5 code in order to study the response of this design during transients and accidents. To verify this model, various sequences have been analyzed: SBLOCA (Small Break Loss of Coolant Accident), LBLOCA (Large Break Loss of Coolant Accident), and SBO (Station Blackout) with loss of inventory due to the seals of the reactor coolant pumps.

CONCLUSIONS. A thermohydraulic model of a VVER-1000/V-320 reactor has been created which has made it possible to analyze the phenomenology and behavior of the different systems in various sequences of interest.

 SBLOCA and LBLOCA: it has been verified that the level 1 PSA success criteria are sufficient to avoid damage to the core in both sequences. Therefore, the success criteria for safety systems are adequate. • SBO: It has been verified that approximately three hours are available before reaching core damage without EFW. On the other hand, the SLOCA has a very small impact on this sequence since the inventory lost due to leaks (20461 kg for t=12500s) is much lower than that discharged through SV3 after 12500s (with/without SLOCA: 150978/172084kg). In addition, it should be noted that in the case for SLOCA, less inventory is lost through SV3.

Session 12 MEDICINE AND HEALTH IN THE NUCLEAR FIELD

he first paper was presented by its author, Ms. Sandra Oliver, who belongs to the POLYTECHNIC UNIVERSITY OF VALENCIA (UPV) and who had the collaboration of several people from the UPV as well as from the La Fe Hospital in that city. The paper explained a procedure to ensure that the tissue treated by radiotherapy receives a homogeneous dose from the particle accelerator used by the La Fe Hospital in multiple oncological applications.

The second paper was presented by Ms. **Sandra Oliver** from the POLYTECHNIC UNIVERSITY OF VALENCIA (UPV) and was prepared along with several colleagues from the same university. The presented study aims to reduce the total time needed to perform medical examinations for patients diagnosed with cancer. The examinations to be optimized are performed with computed tomography (CT) and commercial equipment that is not yet adapted to perform this optimization.

The third presentation was made by several people from the POLYTECH-NIC UNIVERSITY OF VALENCIA (UPV) and was presented by Ms. **Sandra Oliver**. The rate of particles emitted by the accelerators used during surgery is very high, so a detector that does not saturate is necessary to measure



Maria Luisa Estupiñán PRESIDENT

the absorbed dose. One of the detectors used in these measurements is an ionization chamber. The work aims to characterize said chamber by obtaining the calibration factors for different configurations.

Óscar Martínez

COORDINATOR

The fourth paper was presented by Dr. MANUEL CASTELLÁ, Head of Prevention of the ASCÓ-VANDELLÓS II NUCLEAR ASSOCIATION (ANAV), and was prepared in collaboration with ANAV and Qualtis staff.

The presentation explained the successful methodology applied to control the COVID-19 pandemic at ANAV which has allowed for there to be no cases of contagion within the plants, both in normal operation and during refueling.

The fifth presentation was presented by Dr. Gonzalo Aicardi Carrillo,

Head of Health Surveillance of ALMARAZ, and was carried out jointly by the CNAT Health Surveillance team. It explained in detail the measures adopted to prevent the spread of the pandemic in facility workers, both for staff and collaborating companies, in normal operation and during refueling. With these measures, the pandemic has been controlled, preserving the health of its workers and maintaining the availability of the facilities.

The sixth paper was presented by Dr. **Óscar Alonso** and was prepared in conjunction with other people from the LA FE HOSPITAL IN VALENCIA. The objective of the work is to provide Spanish specialists with basic information on the treatment of irradiated patients as well as to have an internationally validated technical platform for a rapid response in radiological or nuclear emergencies.

The seventh paper was presented by Mr. **Gonzalo F. García Fernández** from the HIGHER TECHNICAL SCHOOL OF INDUSTRIAL ENGI-NEERING AT THE UPM, having been prepared in conjunction with several other technicians from that institution. The use of protons with energy up to 230MeV in proton therapy facilities has made it possible to observe the generation of various radioisotopes in the air of the area where the equipment is installed. Depending on the medical technique used as well as the treatment time, the need for a greater requirement for renewing the air in the facility is evaluated in the paper. The eighth paper was presented by Ms. **Mónica Chillaron Pérez** from the POLYTECHNIC UNIVER-SITY OF VALENCIA (UPV), author of the paper, along with two of her colleagues.

FUSION (I)

The paper justifies the use of GOPU to reduce the calculation necessary to generate images in computed tomography (CT). This reduces the radiation doses absorbed by patients during the use of this diagnostic technique.



he Fusion I technical session began on time and ran smoothly thanks to the punctuality and collaboration of the speakers and attendees. The session began with Juan Carlos Marugán, an engineer from EMPRESARIOS AGRUPADOS, who presented the analysis for the risk of fire caused by lithium at the DONES facilities. The objective of the analysis carried out is to limit damage and protect people and the environment. The second presentation, also on lithium at DONES, was

given by **Ángela García** from CIE-MAT who presented LITEC: an experimental circuit for the validation of lithium circuit purification techniques. The control of impurities in lithium is essential for limiting erosion and corrosion at DONES as well as the radiological dose. The next speakers, also from the CIEMAT Fusion Technology Division, were **Moisés Weber, Sebastian Johannes Hendricks, and Marcelo Roldán**. The first presented the activities for the DONES-PRIME program aimed at characterizing the



Lluis Batet PRESIDENT

Int COORDINATOR site and the construction of two relevant laboratories: LITEC, already described, and the radio frequency (RF) laboratory. Next, Sebastian Hendricks is doing his doctorate on the experimental characterization of the migration parameters for hydrogen isotopes and the formation of hydrides in fusion materials, a topic he discussed in his presentation. Marcelo Roldán disclosed the results of his experiments, in which iron samples were subjected

David Zaragoza

were subsequently characterized with transmission electron microscopy which allowed for observing the synergistic effects of the three factors in microstructural defects. The sixth presentation was given by another engineer from EMPRESARIOS AGRUPADOS, María Bello, who described the activities related to instrumentation and control that have been carried out in the basic design phase of DONES, emphasizing adaptation to the design requirements and applicable codes and stan-

dards as well as safety regulations. The last speaker of the session was **David Williams** from ORANO who explained to the audience how, through a comprehensive and iterative engineering approach in the design phase, the Orano, Jacobs, and UNED consortiums, along with the ITER Organization, have achieved a reduction the operational dose by a factor of 2 to 5. The lessons learned can be applied to DEMO in the future. After opening a round of questions to the audience, the session was concluded.

Session 14

DESIGN AND BEHAVIOR OF SSCs

to irradiation, stress deformation, and

high temperatures simultaneously and

During the technical session dedicated to the Design and Behavior of SSCs, the five planned papers were presented with the presence of about 25 attendees.

The session began with a presentation by **Ángel de Blas Gordo** (EMPRESARIOS AGRUPADOS IN-TERNACIONAL) on the possibility of using rivet nuts in the nuclear field. When properly selected and used in designs that are suitable for them, rivet nuts safely replace traditional nuts where the use of the latter is not recommended or is not possible.

Álvaro Díaz Soto (EMPRESARI-OS AGRUPADOS INTERNACIONAL) continued with a presentation on the installation of Airlocks as part of the confinement strategy at DONES. Airlocks allow for maintaining the dynamic confinement function that occurs when the static confinement barriers are opened considerably, and they prevent the dispersion of the contamination present in areas with the potential risk of contamination towards areas with lower levels. This work has been carried out within the framework of the EUROfusion consortium

The third presentation was done by **Adrián Cabrero Salvador** (IDOM) who presented a paper to determine the response spectra required at different points in a medium voltage cabinet, qualified by type testing. From the analysis carried out, spectra are obtained at different points of the cabinet, and it was concluded that the accelerometer record on the cabinet door obtained from the test is conservative for the seismic qualification of internal components of the cabinet.

David Martínez Veciana (ANAV) presented the project carried out at Ascó within the framework of the seismic reclassification of the boric acid system where the need to replace the boric acid transfer pumps was identified to meet the new requirements of requested seismicity. The reverse engineering process was applied which consists of replicating a geometry based on a mesh or cloud of points obtained

from a 3D scan with a suitable scanner to replicate the design and carry out the manufacture of the pumps.

The session ended with a presentation by David Martínez Verdú

Session 15



Javier Sala PRESIDENT

> Vandellós where, after replacing the internal assembly of charge pump C during the 23rd refueling, vibration levels were found to be above acceptable



Rubén Moreno COORDINATOR

(ANAV) who shared the experience of

values which was not possible to resolve during the refueling itself. Resolving this incident has required the use of advanced diagnostic and simulation techniques which have made it possible to reduce the vibration level of the pump to acceptable levels and lay the foundations for future actions.

The questions asked at the end of each presentation allowed for delving into detailed aspects and sustaining the subsequent discussion. It is worth highlighting the good disposi-

tion of the speakers who adjusted to the limited time available.

The session closed by thanking the speakers for their participation and the attendees for their presence.

MAINTENANCE, INSPECTION, AND TESTING (I)

ive papers were presented during the session, two of which were presented by the same speaker. All the speakers were authors of the papers. The four participants, in a coordinated manner, sequentially presented each of their papers, with the audience asking pertinent questions after each presentation. It was dynamic and participatory for the attendees and the Pedro Ortiz rest of the speakers.

In the first presentation, SGS

TECNOS shared with the attendees its analysis of the new section on reliability and mechanical integrity management that the ASME code has incorporated in its 2019 edition. It described the phases of the methodology used to assess fitness for duty, highlighting its applicability in the study of damaged materials or materials with chemical composition restrictions.

In the second presentation, Enusa presented a reverse engineering application exercise already used in real conditions at the Almaraz 2 Plant. The process of improving its control rod drive shaft release tool was revealed during the presentation. A



PRESIDENT

tour of the entire process from the design to the final validation allowed for learning about a case in detail

that culminated successfully at the

aforementioned plant.

In the third presentation, the ANAV company shared with the attendees the methodology and means it uses to carry out leak tests using helium on the more than 10,000 tubes of each box of the main condenser. A combination between the operating areas and the Chemistry and Radiochemistry service, along with the use of a tracer capable of injecting He in small areas achieves the objective of identifying leaks and proceeding to plug the tubes causing leaks.



Victor Mulero COORDINATOR

During the fourth and fifth presentations, NUCLEONOVA presented two papers on fire doors. In the first presentation. various case studies that occur when offering doors and hardware certified by the UL (Underwriters Laboratories) body, a prestigious international company of reference in this field, were presented. In the fifth and last presentation, an analysis of the Regulatory Guides in the field of fire protection and the regulations that determine the requirements of

fire barriers was conducted. A comparative study was also carried out between the main test standards, the American UL 10B/C and the European EN 16034, analyzing the possible equivalence between the two and their possible applicability in Nuclear Power Plants.

In general, the speakers presented their technical work with great clarity and order, always staying within the assigned times. The President and the Coordinator thanked the speakers for the interesting session offered and at the same time recognized the interest and active participation of the 28 attendees who attended the session.

Session 16

THERMOHYDRAULICS AND NEUTRONICS (II)

he second session on Thermohydraulics and Neutronics took place. Three interesting papers were presented in the session.

The first presentation, entitled "FRACTIONAL SCALE ANAL-YSIS APPLIED TO A SMALL BREAK IN A PRESSURIZED WA-TER REACTOR" was presented by David Blanco. doctoral student at the POLYTECHNIC UNI-VERSITY OF VALENCIA. In this Alberto Concejal paper, various aspects related to the results obtained in the different tests carried out in scale

experimental facilities and their applicability to commercial facilities were analyzed. The paper presented a methodology for the validation of applicability and application to an experimental facility and a commercial reactor for the case of an SBLOCA transient.

The second paper, entitled "EVALU-ATION OF THE TRACE CODE IN RBHT REFLOOD HEAT TRANSFER EXPER-



PRESIDENT

Álvaro Fenov COORDINATOR

IMENTS" was presented by Lucas Álvarez, researcher at the ENERGY INSTITUTE OF THE POLYTECHNIC UNIVERSITY OF VALENCIA, and showed the results obtained with TRACE thermohydraulic code in the reproduction re-flooding experiments. The reproduction of this type of experiment is vital in the validation process for thermohydraulic codes since it allows for determining accuracy in the reproduction of the study phenomena.

Finally, Yago Rivera, doctoral student at the POLY-**TECHNIC UNIVERSITY OF VA-**LENCIA, presented a complete paper on the average thickness of the liquid film in annular flow in the paper entitled "AVERAGE THICKNESS OF THE LIQUID FILM IN AIR-WA-TER ANNULAR FLOW IN VER-TICAL FREE FALL ANALYZED EXPERIMENTALLY AND BY MEANS OF CFD CODE". The

presentation showed the results obtained at the GEPELON experimental facility for the average thickness of the liquid film in annular flow and its corresponding model with a fluid dynamic computer code. The paper presented by Yago Rivera was chosen as the best of the papers presented in the technical sessions on Thermohydraulics and Neutronics.

Session 17 **QUALITY, REGULATION, ORGANIZATION, AND HR (II)**

he 5 papers were presented with clarity, rigor, and with fluid communication.

I have to point out that all the papers tried to respond to real problems and, therefore, were of an eminently practical nature (which is appreciated).

All the presentations were enjoyable, and the speakers stood out for their fluid and direct communication.

I must highlight the paper that dealt with the Definition of a spare parts prioritization in-

dex for nuclear power plants, a paper that was presented by Mr. Carlos Coll from ANAV. The speaker very clearly explained the problems faced by Nuclear Power Plants and their need to have the right certified spare parts at the right time. ANAV has developed a methodology that prioritizes needs and provides adequate numbering for each spare part. The application of



Rafael Triviño PRESIDENT

Rodrigo Panero COORDINATOR

this methodology will represent important progress for ANAV.

The paper presented by Ms. Estela García from TECNATOM related to the validation of the methods used to certify body radioactivity was also very interesting. Her presentation was very accurate and managed to capture the attention of those present in the room. It goes without saying that the subject is important enough to continue to devote efforts to it. I am not an expert on the matter, but what was presented was very clear and I think that the attending audience benefited from what was said there.

The presentation that dealt with quality management system software and organization in radioactive facilities seemed very interesting to me. In the presentation, Mr. Miguel Embid explained in an orderly

and clear manner, with very effective communication, how all the regulatory requirements have been adjusted at the CIEMAT laboratory. Ciemat has passed more than 100 national and 15 international audits; these audits have verified that the program has all the required safety measures. Mr. Miguel commented on the versatility of the program that could be adapted to other demands.

ENUSA presented a very interesting paper on organizational adaptation from human resources management. All the challenges that the company faces and how it proposes an organizational project that can meet its strategic objectives were concisely explained. The complexity of the project was noted, and it was shown that the previous study is key for the proper development of the project and the achievement of the objectives. Transparency, flexibility, and agility are sought, seeking to make maximum use of the digital tools that are available on the market.

Lastly, TECNATOM presented a paper that is oriented towards Dynamic

Knowledge Management applied to electricity generation. Mr. **Francisco José Ruiz's** presentation was successful and enjoyable; simple and practical and it managed to synthesize the objective of the presentation.

In summary, it was a practical and very interesting session in which the speakers were at their best.

Session 18

ENGINEERING AND INNOVATION (III)

Seven papers were presented during session seven, which are summarized below:

• TECHNOLOGICAL SOLU-TIONS USED BY ENSA IN THE WELDING OF PS1 AND PS4 SECTORS FOR ITER. Presented by **Domingo Lima Almeida** from ENSA.

Domingo presented the developments carried out by ENSA for the mechanization and robotization of welding processes used in the manufacturing of the PS1 and PS4 (Port

Structures) manufacturing sectors for the ITER (International Thermonuclear Experimental Reactor) project.

The ITER Project Vessel requires the fabrication and assembly of complex and costly heavy metal components. ENSA, as a manufacturer that participates in the manufacture of the PS1 and PS4 (Port Structures) sections, has developed innovative manufacturing systems within its R&D program to address these projects, improving the productivity and high quality required by these components.

The development of the robotic platform for the TIG (Tungsten Inert Gas) NG (Narrow Gap) welding process has allowed a reduction of around 70% compared to manual times and, in addition, has reduced the defects that can be found in manual welding processes to a minimum, with the objective of "0" defects.

• AUTOMATIC EXTRACTION OF THE TECHNOLOGICAL FACTORS FOR REFUELING FROM THE MANUFAC-TURING DATABASE. Presented by **Josip M. Vidal Orlovac** from ENUSA.



Pablo Noel PRESIDENT

COORDINATOR

Transformation process at ENUSA, it has been decided to automate the procedure by which the verification of technological factors is carried out. This data is known as "As-Built" Data.

The core design is carried out assuming nominal values of pellet diameter, enrichment, and density. To take into account the variability of this data during manufacturing, penalties are assumed for the hot channel factors, which are known as engineering hot channel factors. Once manufacturing is finished, the verification of the conservatism adopted by assuming the technological factors is verified.

For this, an application with a graphical interface has been developed, which is divided into two parts. The first and most extensive focuses on the automatic extraction, processing, and screening of the so-called "As-Built" Data necessary for the Core Design, Calculation of Technological Factors, and customer requests. The second part focuses on the statistical processing of



Beatriz Liébana COORDINATOR the data and the comparison with the established limits, taking into account the different requirements of each client and design.

The results have allowed for reducing the possibility of human error, homogeneity of results, and a significant reduction in the time for preparing reports.

• TAKING ADVANTAGE OF SYNERGIES FOR INTEGRATED AGING MANAGEMENT.

Presented by **Óscar Salvador** Fernández from IDOM.

Currently in the nuclear industry, the management of the physical aging of structures, systems, and components has different processes implemented independently: Equipment Reliability, Maintenance Rules, and Life Management.

In this paper, it is proposed to group the different standards, techniques, and procedures existing in the industry in an innovative aging management strategy model that reduces inefficiencies, reprocesses, and exceeded expected costs that negatively impact the objectives set for long-term operation.

Additional benefits identified would be: reducing resources in low-value tasks and reducing the repetition of maintenance activities

• QUALIFICATION / DEDICATION OF ABB ACTUATORS FOR USE IN THE TRILLO NUCLEAR POWER PLANT. Presented by **J. L. Bravo** from TEC-NATOM.

Given the need for Trillo to use motorized actuators from the qualified manufacturer ABB and to only have commercial-grade equipment, Tecnatom has carried out a qualification and dedication process that has included:

- A qualification process to demonstrate compliance with the safety function during the accident with the new actuator and the power unit that allows for its movement.
- A seismic and Environmental Qualification in accordance with IEEE 382.
- An electromagnetic Qualification
 Process in accordance with RG 1,180.

For this purpose, the functional test bench, the seismic test bench, and the accident condition test bench at the Tecnatom facilities have been used.

The project has made it possible to explore a feasible path for the installation of new models of commercial-grade actuators in severe environments, integrating the qualification and dedication processes. It has been possible to find a solution to the obsolescence of equipment already installed in power plants and the non-existence of manufacturers for basic nuclear safety components.

 NRC'S REGULATORY FRAME-WORK FOR DRY CASK STORAGE AND TRANSPORTATION OF SPENT NUCLEAR FUEL AND RELATED RESEARCH ACTIVITIES
 Presented by **Prakash Narayanan** from ORANO.

Although it is highly unlikely that a container of spent nuclear fuel will develop a crack that penetrates the container wall, it is prudent to define an inspection and aging management program as we prepare to ship loaded systems to intermediate or final storage repositories. Orano TN has performed several visual inspections and has developed an inspection ring with volumetric inspection capabilities along with a crack mitigation technique that can be applied remotely to a container surface.

ORANO TN and its partners will use a vacuum-based inspection ring for required aging management inspections at the SONGS nuclear facility in December 2021. This station is the US facility most severely affected by a coastal environment of chloride aerosols. The VT3 and VT1 inspections will look for areas of corrosion that may indicate the presence of initiation of chloride-induced stress corrosion cracking.

The main advantage of the Orano TN inspection ring is that it provides access to the entire surface of the container without the need to lift it. If required, the inspection ring will be fitted with the repair module, and the area can be cleaned and coated with a nickel-based metal coating applied using a cold spray technique.

• EQUIPMENT RELIABILITY PRO-CESS AT ANAV: STATUS AND INDI-CATORS

Presented by **José María Bueno** from ANAV.

Following the action plan for the improvement of the equipment reliability process at ANAV, new selection and scope criteria have been established in the system health reports (SHR) by applying the NEI efficiency bulletin EB 16-33 System health reporting efficiencies. Additionally, a project is being carried out to review the preventive maintenance plans (MP) for the main active components and process indicators.

The goal is to enable systems engineers to focus on action plans for the most important plant systems, resolving adverse trends and degraded conditions. For their part, the proposals for the new maintenance programs for active, critical, and non-critical components are framed within the action plan for ANAV's long-term operation.

The result is an optimization of reporting in the overall computation, with a final focus on safety and reliability. After the application of the bulletin, the Ascó NPP has gone from an initial range of 98 SHR to 78 SHR while at Vandellòs it has gone from the initial 62 SHR to 57. The results obtained in the revised plans are adequate documentation for the technical bases, optimization of the MP person-hours, and a reduction in the hours of unavailability for equipment. Finally, the process indicators have been significantly optimized which are more useful for following the evolution of the process.

• ENUSA AND NEXT GENERATION EU (NGEU) FUNDS: A UNIQUE OP-PORTUNITY.

Presented by **José Luis Girón** from ENUSA.

Two major milestones are going to generate project financing opportunities in the coming years: the first is the next Horizon Europe and the second and of greater interest to ENUSA is the Next Generation EU (NGEU) which is a temporary recovery instrument endowed with more than 800,000 million euros that will contribute to repairing the immediate economic and social damage caused by the pandemic.

This unique opportunity has led ENUSA to mobilize resources to create a new transversal and dynamic structure with a clear objective: to identify possibilities for external financing (reimbursable and non-reimbursable) for priority projects in its portfolio to improve profitability and promote collaborations.

This path that has been started becomes an added value for the company since it optimizes the profitability of the projects and the use of its resources, improves its reputation and corporate image, generates synergies with collaborators and partners inside and outside the sector, and creates new business opportunities.

Session 19 NUCLEAR SAFETY, LICENSING, AND PSA (III)

During the second afternoon of the congress, a series of different topics were proposed, all of them keeping Nuclear Safety as a common thread. Thus, for example, within the PSA theme, four papers are presented that deal with different particularities: on the one hand, the vicissitudes of how a first general revision of a level 1 PSA was proposed for the Trillo NPP, taking into account the new instructions of the new Nuclear Safety Authority (NSA), and on the other hand, how it was proposed for the Trillo NPP. On the other hand, we were reminded that the performance of these safety analyses in the field of non-power nuclear facilities, as in the case of the Juzbado plant, where the implementation of these analyses results in the improvement of a series of specific systems; From Westinghouse they enlightened us on the work carried out on the interfaces and presented us with the example of the development of the level 1 / level 2 interface of the

APS to power, in the particular case of Vandellós II NPP. To close the subiect, the UPM surprised us with the presentation of their development of their own PSA model for regulatory use that improves the knowledge of plant risks.

Grouping the probabilistic with the deterministic, first from ANAV we were



Rafael G. García PRESIDENT



Diana Cuervo COORDINATOR

shown how the mix of both analyses, added to the review of the operating experience has supported their third periodic safety review (PSR) for Ascó NPP and Vandellós II NPP. Next. and linking the PSRs, the UPV proposed a study to review the capacity of the current RAM models to incorporate the effect of obsolescence and its management strategies.

With respect to plant life extension, ANAV presented the results of the independent evaluation carried out by the IAEA on ANAV's processes and standards, compared to industry best practices and their convergence with international standards, to operate beyond the commercial operation period initially considered.

After a change of the subject, specific accident analyses were also presented in the same session: CIEMAT presented a

possible solution that would explain the retention of fusion products in the suppression pool (Fukushima Daiichi) and a methodology for evaluating and reducing the radiological consequences of design basis accidents: finally, IDOM presented a study carried out for ANAV that weighs the actions to be taken in relation to the risk of internal flooding and spraying.



WASTE MANAGEMENT (II)

his session focused on interesting aspects for Waste Management, both in current nuclear facilities, whether they are nuclear power plants or research centers, as well as in natural sites that may be of interest for future deep geological storage. Six papers were presented throughout this session related to both topics.

Within this framework of Waste Management activities at nuclear power plants, and in order to support manual decontamination work and reduce the

amount of material to be sent to El Cabril. Karen A. Guzmán from ENUSA presented us with her paper "STUDY ON THE TECHNICAL FEASIBILITY OF THE USE OF LASER SYSTEMS FOR RADIOACTIVE WASTE DECONTAMI-NATION." It is a technique that can be used both for the declassification and reclassification of medium and low level waste with an interesting reduction in costs and logistics.

Óscar Almendros from CIEMAT presented his "STUDY OF THE AD-SORPTION OF 233U IN ETTRINGITE"



Antonio Martinavarro PRESIDENT



COORDINATOR

which emphasized the importance of identifying the properties of this fundamental material in the cementitious media used in waste management tasks due to its radionuclide (RN) retention capacity. It also considered the presence of many types of organic materials whose degradation products may play an important role in the mobility of RNs.

Francisco Álvarez from CIEMAT. on behalf of his colleague Víctor Alcayne, presented the work carried out on "MEASUREMENT AND FINAL



Within the framework of the BENERO project, where the erosion of a bentonite barrier under storage conditions is being studied was the "PHYS-**ICAL-CHEMICAL PROPERTIES**

OF HYDRATED CLAYS: PROGNOSIS OF EROSION AND SEDIMENTATION IN RADIOACTIVE STORAGE" paper presented by Cynthia Rieckhof of CIEMAT. This study allows for predicting the erosion behavior of the clay barrier in the geological formation of DGS.

Manuel Mingarro, also from CIEMAT, presented his "DIFFUSIVE TRANSPORT OF 226Ra IN SELECTED CLAY MATERIALS AS A BARRIER IN RADIOACTIVE WASTE STORAGE" paper. The paper is based on information

from projects carried out by ANDRA (French waste management agency) in low-permeability clay formations where the transport mechanism is diffusion. This radionuclide is of special interest in these conditions although it is complex given the sorption capacity of radon in clays. It was shown that the clay barrier is effective in preventing radium transport to the geosphere.

Finally, Ramón Grau from the NU-CLEANTECH (Cordonchem) company presented his "TRITIUM ADSORP-TION STUDY ON FILAMENTARY MA-TRICES" paper focused on the development of tritium absorbers, one of the main contributors to coolant activity by neutron capture for lithium, deuterium, and from the ternary fissions of U-235 and Pu-239. The difficulty in removal lies in its hydrogen structure and its chemical versatility. This work has been carried out in collaboration with the Radiochemistry Laboratory from the Ascó (II) NPP and interesting results have been obtained that are expected to be continued to increase the performance of the cellulose-based filamentary matrix materials developed.

It is important to highlight the high technical content and the effort of the speakers to comply with the agenda which allowed for resolving questions from the audience that was made up of about 25 attendees.



he session was led by José Campos (ENRESA) and coordinated by Tomás Recio (TEC-NATOM).

In this session, 10 papers were presented that covered different aspects related to the decommissioning of nuclear facilities. The session was divided into two parts with a short five-minute break between them.

This session began with a presentation by P.V. Rodríguez José Campos (ENUSA) who discussed the remodeling and sealing project for a static leaching era for Uranium ore concentrate for the Quercus plant.

Next. D. Solís (ENUSA) presented the prototypes that ENUSA is developing for the use of drones for radiological characterization tasks both in open areas (outdoors) and in closed rooms (indoors), showing the different drone-detector systems adapted to each purpose.

The third speaker was E. Sánchez (ENUSA) who presented the project for the construction of an Operations Center for the decommissioning and waste management equipment that ENUSA will build in Juzbado (Salamanca), and which is scheduled to be put into operation in 2023. One of the objectives for this new facility is to become a center where it is possible to carry out tests and validate techniques that improve current technological processes, making it possible to optimize and automate work.

Then, A. Alcántara (ENRESA) did an eniovable presentation describing the methodology used in the demolition of the reactor building at the José Cabrera NPP supported by some short videos

DECOMMISSIONING (II)



PRESIDENT

Tomás A. Recio COORDINATOR

showing the work carried out.

To end the first part of this session, A. Alonso (WESTINGHOUSE) presented the strategy and the results obtained in the field of radioactive waste minimization in the Bohunice decommissioning project, with excellent results, obtaining a percentage greater than 95% of declassified material compared to the total treated metallic material.

After a five-minute break, the session continued with a presentation by E. García (ENRESA) for the SHARE project, financed by the European Commission, for the analysis of research needs in decommissioning based on the point of view of the interested parties. An overview of the project was shown along with the results of the surveys carried out. This project will help establish a strategic research agenda to define priorities and objectives and to establish a roadmap.

The seventh speaker was C. Gómez (NATURGY - José Cabrera NPP decommissioning engineering joint venture), who presented the evolution



of liquid effluent treatment systems from the start of decommissioning to its final phases at the Jose Cabrera NPP.

The next presentation was done by A. Fenov (NATURGY NUCLEAR ENGINEERING). This Eighth paper showed us an Approach to the Basement fill model in decommissioning power plants, showing some reference examples for American Nuclear Power Plants. The objective is to be able to estimate the contribution to doses for the remaining activity present

in buried structures.

The next presentation by G. Medinilla (WESTINGHOUSE) showed the INNO4GRAPH project, funded by EURATOM through the Horizon 2020 program, whose purpose is to develop tools for use in the decommissioning of graphite reactors.

The tenth and final presentation of the session, presented by M. Alberola, was entitled "ANALYSIS OF ALTERNATIVES FOR THE DECOMMISSIONING OF A GRAPHITE NUCLEAR REACTOR." The study of these alternatives was carried out using a multi-criteria analysis method, scoring different criteria for each of the possible alternatives based on their importance, which makes it possible to recommend or reject some of the available technological options.

After the oral presentations, there was a period of time to ask and answer questions and discuss some of the issues addressed in the session.

It is noteworthy the high attendance of attendees for this session, with the room practically full.



n this session, 9 papers were presented whose topics could be grouped into knowledge management, training tools, and publicizing associations and platforms for training uses. The attendance was about 20 people.

The first paper entitled "TRANSMISSION OF EX-PERIENCE IN THE GENER-ATIONAL HANDOVER FOR COFRENTES" was presented by César Alfonsín from TEC-NATOM, BWR operation instructor at the plant, who pre-

sented the work of conveying knowledge that is being carried out with different groups through a series of courses in groups for Reactor Managers, Turbine Managers, External Auxiliary Operators, and Waste Operators. Thanks to experienced people from the aforementioned groups. along with Tecnatom instructors and the Operations training coordinators, sessions have been designed to review and train the most relevant maneuvers for each of these positions in a theoretical and practical manner.

The second presentation, entitled "LEARNING ANALYTICS: MAKING KNOWLEDGE TANGIBLE AND IM-PROVING THE LEARNING PRO-CESS WITH THE USE OF DATA AND ARTIFICIAL INTELLIGENCE," presented by Francisco J. Sánchez from Tecnatom showed how Learning Analytics make it possible to enhance the 4 main attributes of knowledge management (collaborative, personalized, continuous, and digital learning) and its numerous benefits.

In the next presentation by Darío Cruz from FuseNet and entitled "ON-LINE PRESENCE, TRAINING, AND EDUCATIONAL SUPPORT IN NU-**CLEAR FUSION BY FUSENET - THE** EUROPEAN FUSION EDUCATION NETWORK," presented the coordination platform for European fusion educational activities, the creation, development, and implementation of educational initiatives on a European scale and the exchange and dissemination of information relat-



Susana Falcón PRESIDENT

COORDINATOR

ed to education in fusion. FuseNet promotes student mobility in the form of placements and internships at educational and research centers in its extensive member network in addition to coordinating events aimed at strengthening the network of European fusion researchers and promoting teaching from secondary education. It also collaborates with companies in the nuclear sector with the aim of establishing a link between employers and future employees in the fusion sector.

TRAINING (II)

In the next presentation on "CIE-MAT'S INTERNATIONAL COLLAB-ORATION IN NUCLEAR TRAINING ACTIVITIES." Susana Falcón presented the different international nuclear training activities in which the knowledge management division participates through the EUTERP and ENEN associations for the EU-RAD, ORIENT, and ARIEL European projects and in the cooperative activities carried out through IAEA and DEVCO projects.

A new TECNATOM presentation done by Jose Luis Delgado on the "NEW TRAINING METHODOLOGY FOR NUCLEAR PLANTS." ANAV has opted to give its training methodology a boost and is using the PLANT© tool developed by Tecnatom with the aim of digitizing and integrating both the process and the documentation used in training. The objective is to improve the level of interaction and participation of students in the training process and the use of the "flipped classroom" methodology that transfers the work of certain



Jesús López González

learning processes outside the classroom and uses class time to enhance other knowledge acquisition and practice processes.

Ramiro J. Fragio from IBER-DROLA GENERACIÓN then presented "EVOLUTION OF KNOWLEDGE MANAGEMENT AT THE COFRENTES NPP." A Knowledge Management Plan has been implemented within its continuous improvement processes. The objective is to spread and share the existing knowledge in the Plant in a

collaborative way through continuous learning and exchange with internal and external groups so as to increase the focus on safety and reliability as well as operational efficiency thanks to the appropriate use of intellectual and human capital.

Laura Gala of the SPANISH NU-CLEAR INDUSTRY FORUM presented "THE EVOLUTION OF THE EDUCATIONAL CORNER IN TIMES OF COVID," a tool for dissemination and training for the Forum, mainly intended for the educational world and also very useful for professionals related to nuclear technology and society in general; and as has happened in other areas. COVID-19 has led to its rapid evolution and adaptation to new circumstances to continue reaching its target audience.

The next presentation on "ANAL-YSIS OF ACCIDENTS BEYOND DESIGN BASIS AND EXTENSIVE DAMAGE IN THE ITS FOR THE JOSÉ CABRERA NPP" by Gregorio Socorro from Naturgy Engineering explained how the DOMADAT application works to analyze these accidents.

And finally, the paper presented by Francisco Suárez from ENEN (European Nuclear Education Network) on "INITIATIVES FOR THE PRES-ERVATION AND DEVELOPMENT OF EXPERIENCE IN THE NUCLEAR AREA IN EUROPE THROUGH EDU-CATION AND TRAINING" presented the initiatives currently in progress for that association.

Session 23 RADIOLOGICAL AND ENVIRONMENTAL PROTECTION (II)

In the second of the technical sessions dedicated to Radiological and Environmental Protection, about 25 people attended and eleven papers were presented:

First, **David Blázquez** from ENUSA presented the advances for the "ENUSA INTERNAL DO-SIMETRY SERVICE" and its application in the Juzbado factory.

The next presentation, also from ENUSA, was done by **Daniel García**, presenting a paper on the application of new technologies in Operational RP with "AU-TOMATION OF INTERNAL AREA DO-SIMETRY THROUGH GEOLOCATION".

Also related to internal dosimetry, **Carolina Hernández** from CIEMAT presented the paper entitled "DEVELOP-MENT OF THE GAMMA SPECTROME-TRY TECHNIQUE FOR PERFORMING INTERNAL DOSIMETRY IN VITRO".

Then Eduardo Gallego from the UPM presented Roberto García's "COM-PARISON OF LII AND AU-197 AS NEU-TRON DETECTORS IN EXTENDED



Javier Vallejo PRESIDENT Isabel Viniegra COORDINATOR

RANGE BONNER SPHERES" paper.

Xandra Campo from CIEMAT presented two papers entitled "EVALUATION OF DRIFT IN THE MEASUREMENT OF AREA NEUTRON MONITORS" and "ANALYSIS OF THE RECOMMENDED CALIBRATION METHODS FOR THE ISO 8529-2 STANDARD".

Related to ISO Standards and neutron dosimetry, which is so on-trend today, **Roberto Ménde**z from CIEMAT presented a paper on "UPDATING THE ISO 8529-1 STANDARD THAT DEFINES CALIBRATION ISOTOPIC NEU-TRON SOURCES".

Marina Sáez from the UPV presented "DEVELOPMENT OF RAPID PROCEDURES FOR THE DETERMINATION OF TRITIUM AND CARBON-14 IN WATER SAMPLES BY LIQUID SCINTILLATION" applicable for radiological emergencies.

From the same university and taking into account the impact of the ceramic industry in the Valencian community, **Aixa Sevilla** presented "Determination

of Uranium and Thorium in Aerosol Filters for the Evaluation of the Radiological Impact in the Ceramic Industry".

Again, **Marina Sáez** gave a presentation on "Rapid Determination of Plutonium in Aerosol Filters and Vegetation with Plastic Scintillators".

Finally, **Miguel Embid** from CIEMAT gave a presentation on the application of X-ray devices for Radiological Protection entitled "Creation of the First Spanish Catalog of X-ray Reference Spectra".

MAINTENANCE, INSPECTION, AND TESTING (II)

The session had an average attendance of about 24 attendees. A total of 10 papers were presented and the duration of the session was adjusted to the scheduled time, including questions formulated by the attendees at the end of each presentation.

Session 24

The first paper, presented by SGS, presented the Arc Flash phenomenon as one of the most common phenomena in electrical facilities and which, as a result of the preliminary research, development, and results obtained in the tests carried out, has led to the

creation of a new methodology for predictive analysis of electric arcs based on advanced electrical tests which will provide the whole of society with levels of operational safety and guarantees unknown to date when undertaking any work on electrical facilities in gen-



Javier Alonso Chicote PRESIDENT

eral and in nuclear facilities in particular.

Next, the Schneider Electric Spain company, as a need derived from the degree of obsolescence in some of the electrical distribution equipment in the nuclear sector, described the methodology applied to develop a Plug&Play



Sergio Gómez COORDINATOR

modernization solution for low-voltage automatic switches with the aim of being able to extend the useful life of the facility. The process to define and implement the solution at Almaraz NPP was shown as well as the actual experience of modernization on certain obsolete automatic circuit breakers which has allowed for improving the replacement installation time as well as prolonging the life of the unit, opening the door to the era of digitization.

In the third presentation, also from Schneider Electric, automation techniques for routine testing of automatic circuit breakers were presented to find out the state of their health in the electrical distribution of the plant by incorporating a test bench into tools for daily use that allows, on the one hand, for optimizing the performance of tests and their local execution, and on the other, for automating these tasks in a comfortable way, located in the workshop or on site, obtaining results immediately. Likewise, it has the capacity to carry out all the mechanical tests of insertion/extraction and opening and closing of the circuit-breaker, and all the electrical tests of the elements that make up the maneuver.

Next, ANAV explained the methodology used by the GESCAL tool that they have created for the management of automatic calibrations for protection and measurement relays for electrical maintenance and that, using the identification number of the relay, the tool is capable of identifying the adjustments to be made and can transcribe them in a results report. Through this tool and using a methodology that uses computer applications, the risk of human error in the process is minimized, in addition to significantly reducing man-hours in the maintenance of the approximately 500 relays that are calibrated at each stop for refueling.

In the fifth presentation, Tecnatom described the engineering and inspection work carried out for the Almaraz nuclear power plant and related to the long-term operation of the nozzle components for the vessel bottom and upper internals penetrations. Tecnatom was the main contractor, responsible for all the activities related to the nuclear instrumentation nozzles at the bottom of the vessel while Westinghouse carried out the engineering and inspection work related to the guide plates for the guide tubes and the lower welds of the guide tubes. The work was carried out after the nuclear industry had identified the convenience of carrying out a volumetric inspection of said components.

Next, the Tecnatom company also presented the methodology used to estimate the amount and distribution of deposits adhering to steam generator tubes in order for plants to make decisions to improve heat transfer between primary and secondary fluids, and consequently the calorific power, so that there is no loss in electrical generation. The developed tool is based on the interpretation of the data obtained during periodic inspections by induced currents carried out in the tubes as well as on the processing and comparison of data between inspections through algorithms implemented in the application.

The seventh presentation was given by ANAV and presented the fire tests carried out on silicone foam seals in which discontinuities were caused in order to study their effect on the behavior of the seal and to determine the search for a non-destructive inspection system to supplement the required visual inspections. After carrying out tests with different technologies and models of seals with discontinuities inside, it was found that whenever a seal can be adequately accessed, the most appropriate technology for this application is based on the generation of images through the emission of Low intensity X-rays and the subsequent detection of their "backscatter."

In the next presentation, Empresarios Agrupados presented the methodology implemented and developed for the structural inspection programs carried out in the CNAT nuclear power plants for the proper operation, maintenance, conservation, and renewal of the operating permit of its plants through the comprehensive management of the inspections carried out on the structures, systems, and components that make up the plant as a whole to ensure that they are capable of fulfilling the function for which they were designed and to comply with the objective of maintaining the plants in an optimal state of conservation in accordance with the highest safety standards from the industry and from the reference regulations.

In the second to last presentation, Tecnatom showed the SAIP inspection tool that it has developed as an aid for the inspection and testing services conducted at nuclear power plants and in line with the plan to digitize the services required by the life management programs for long term operation. With this tool, with a simple interface and based on a mobile app for which permanent connectivity is not required, inspection times are reduced and most of the inspection records are automatically generated, remaining perfectly structured and organized, thus facilitating their monitoring and the reduction of identification errors in inspections. thus increasing efficiency, safety, and reliability.

The tenth and last presentation was presented by SGS Tecnos and dealt with the specific AppTEX application, which, based on the UNE-EN 60079-17 standard, has been developed for the inspection and maintenance of electrical equipment in the nuclear industry 4.0. and which allows for managing the inventory of all assets located in ATEX zones. This tool includes an intuitive dashboard with relevant indicators, facilitating real-time consultation of inspection results, equipment geolocation, and information filtering for more efficient viewing. It also has a notification system for future inspections, allowing hidden patterns to be detected and for the generation of prediction models to facilitate maintenance work.

Session 25

SIMULATION WITH NUMERICAL +3D CODES (I)

In the first of the technical sessions dedicated to "Simulation with Numerical +3D Codes," a total of ten high-quality papers were presented that covered a wide spectrum of studies, all of them with the common denominator of computational simulation. The speakers scrupulously adhered to the established time, which allowed for a question time after each presentation. The session had a large and very participatory audience, giving rise to interesting comments and exchanges that made the session very enjoyable and enriching.

In the first presentation, **Samantha Larriba** from the UPM presented an analysis, using a Computational Fluid Dynamics (CFD) code, of the usefulness of implementing heat pipe type devices for heat extraction in spent fuel containers. Also in the container area, the second presentation was given by **Rafael Sánchez** from NATURGY ENGINEER-ING who presented a study based on the use of the ANSYS Mechanical tool for the thermal characterization of the ENUN 32P container with two different frames in the slab of the ITS at Almaraz.

In the third presentation, **Pedro Bonilla** from the BARCELONA SUPER-COMPUTING CENTER showed the advances in the Ayla code for high-performance numerical simulations of multiphysics problems in fusion. In particular, he presented the capabilities of magnetism, heat transfer, fluid dynamics, and neutron transport modules.

Yaisel Córdova from the UPV presented the fourth paper of the session focused on participation in the OECD/NEA international benchmark on fluid-structure interaction (FSI) based on an experiment carried out by Afrikantov OKBM. He presented

the CFD-Mechanical model developed to predict the results of the Open Test for the aforementioned benchmark.

The next presentation dealt with a severe accident and was done by **Luis E. Herranz** from CIEMAT. He synthesized the preliminary results (obtained with MELCOR 2.2 and DAKOTA codes) of the uncertainty analyses of the PHE-BUS-FPT1 experiment, analyses carried out within the framework of the European MUSA (Management and Uncertainties of Severe Accidents) project.

In the sixth presentation, Marcos Celador from EMPRESARIOS AGRUPA-





Nuria García PRESIDENT Antonio Jiménez

COORDINATOR

DOS presented the use of the versatile EcosimPro tool for updating the system calculations of a plant in operation in order to detect problems and speed up decision-making. He showed an application of the PIPELIQ library for the analysis of the sealing system for the feedwater pumps for the Cofrentes nuclear power plant.

The seventh presentation was given by **Sonia Panizo** from CIEMAT who addressed the verification and validation of the burning results from MCNP/CINDER code by comparing it with EVOLCODE code and to experimental data from

FUEL (II)

the Takahama-3 benchmark, respectively, highlighting the need to update the cinder.dat library.

Continuing in the framework of combustion calculations, in the eighth paper, **Arturo Vivancos** from the UPV described the work carried out to develop a fuel combustion code in MATLAB from data generated with the SCALE code system.

The ninth paper was presented by **James Macmillan-Scott** from IMPACT RISK ADVISORS where he presented the set of products based on artificial intelligence ca-

pable of providing predictive analysis of the impact of climate change on a given infrastructure.

The last presentation, by **Francisco Álvarez** from CIEMAT, was dedicated to the optimization of fuel cycles subject to uncertainty, presenting the methodology implemented in the TR_EVOL cycle simulator.

The high number of papers in the session and its high technical level, along with the notable interest that aroused in the audience, gives an idea of the good health of numerical simulation in Spain in the nuclear field.

The first presentation, entitled "DEVELOPMENT OF COR-RELATIONS FOR ESTIMATING FUEL BURN FROM NEUTRON AND GAMMA RADIATION MEA-SUREMENTS" was presented by **Miriam Vázquez Antolín** (ENU-SA). The presentation presented the methodology developed by ENUSA to estimate the burning of fuel elements, based on the measurement of neutrons, knowing the enrichment and cooling time of the fuel.

The second paper, entitled "EFFECT OF AXIAL DISCRETI-

ZATION IN THE CHARACTERIZATION OF SPENT FUEL" was presented by **Cristian Garrido Tamm** (IDOM). The paper analyzes the axial discretization in the characterization of spent fuel elements with special emphasis on BWR elements with the development of several ORIGAMI models.

The third paper, entitled "SPENT FUEL CHARACTERIZATION AND



Pablo T. León PRESIDENT



COORDINATOR

CLASSIFICATION PROCESS" was presented by **Paloma Viñas Peña** (ENUSA). The paper presented the process developed by ENUSA for the characterization and classification of spent fuel, with which more than 100 fuel elements with different designs and technologies have been evaluated.

The fourth paper, entitled "COATI. OPTIMIZED LOADING OF SPENT FUEL CONTAINERS IN AN ITS" was presented by **Javier Alonso Sanz** (INGECID). In the presentation, the COATI tool was presented, which allows for managing the inventory of spent fuel elements in the pools of nuclear power plants, optimizing the loading of ITS containers.

The fifth paper, entitled "FIRST LOADING OF SPENT FUEL CONTAINERS AT THE COFRENTES NUCLEAR POW-ER PLANT" was presented by Juan José Molina Hernández and José Ramón Soler Ferrer

(IBERDROLA). In the presentation, the construction and commissioning of the Cofrentes ITS were presented, describing the Equipment and Pre-operational Tests, preparing the ITS for the loading of the first 5 containers.

The sixth paper, entitled "EURO-PEAN PROJECT FOR THE ISOTOPIC CHARACTERIZATION OF IRRADIAT-ED BWR FUEL (EURAD)" was presented by **Marta Berrios Torres** (ENUSA). In the presentation, the EURAD project for the management of radioactive waste was presented, and the participation of ENUSA in the project, with the technical coordination of testing and analytical simulation of samples.

The seventh paper, entitled "DATA-BASE FOR THE MANAGEMENT OF SPENT FUEL AND SPECIAL WASTE AND GECYRE APPLICATION: NEW CATEGORIZATION OF DEFECTS IN THE CHARACTERIZATION OF EC" was presented by **Carolina Gómez** **Dueñas** (NATURGY INGENIERÍA). In the presentation, the GECYRE database of spent fuel and special waste was presented, as well as the implementation by Naturgy Engineering of a new module that allows the categorization of EC defects.

The eighth paper, entitled "EVALU-ATION OF ISOTOPIC COMPOSITION MEASUREMENTS OF FUKUSHIMA DAINI SAMPLES IRRADIATED IN A SINGLE CYCLE" was presented by **Pedro Ortego Saiz** (SEA). In the presentation, the results of the Benchmark on the isotopic composition measurements of the irradiated samples at the Fukushima Daini plant were presented.

The ninth paper, entitled "DESIGN OF CORE SHUFFLING FOR THE 23rd RE-FUELING AT THE COFRENTES NPP" was presented by **Héctor Tovar Sola** (IBERDROLA). In the presentation, the HERACLIO system, developed by the Nuclear Fuel unit, was presented for the design of the shuffling of the core for the 23rd refueling of the Cofrentes NPP, including the restrictions that apply to said shuffling.

Session 27 ENGINEERING AND INNOVATION (IV)

The session featured 4 presentations that addressed new reactor designs, digital systems to support engineering, and nuclear hydrogen.

First. David Powell (GE presented HITACHI). the "SMALL MODULAR REAC-TOR-BWRX-300," a 300 MWe reactor where its simplicity, cost reduction, and the use of proven technologies stand out. David explained the use of passive safety systems that contribute to a very significant improvement in safety and the predictions for

having an operational reactor in 2028 with 30-month construction deadlines. He explained the technological training center, the virtual reality applications developed, and the centralized service for the fleet. During the time for questions, several of the attendees were interested in aspects and details of this presentation.

Next, **David Powell** (GE HITACHI) presented "TERRAPOWER NATRIUM" a fast sodium reactor with an integrated energy storage system that allows for flexible operation and heat applications



Luis G Delgado PRESIDENT

Ana Belén Sáez COORDINATOR

in industrial processes. It is a reactor concept in which design and construction are simplified which is very attractive from an economic point of view both in terms of fixed costs and operational costs. The presentation explained the main characteristics of this reactor and the advantages it provides in the current and future scenario of the electrical system.

Third, Karina Martínez Pérez and Christina Clancey from WESTING-HOUSE presented "THE WESTING-HOUSE DIGITAL ECOSYSTEM: TECH-



Finally, **Jesús La Parra** (TEC-NATOM) presented the paper "NUCLE-AR HYDROGEN: KEY TO THE PROF-ITABLE FLEXIBILITY OF NUCLEAR OPERATIONS". Jesús explained the context of the nuclear sector that is reassessing the option of using hydrogen, explaining the methods of nuclear hydrogen production, the existing projects in the world, as well as the keys to nuclear hybridization with hydrogen. Finally, he explained Tecnatom's participation in the Euratom consortium to carry out feasibility studies and projects in this area.

NUCLEAR SAFETY, LICENSING, AND PSA (IV)

The last day of the convention, a quarter past nine in the morning, fifteen minutes to go until the start of the last technical sessions for the annual meeting... will we have to go out into the street to look for some clueless local who will lend us their

ears? Are there still interesting things to tell?

The answers are up in the air, but while we finish loading the second to last modification of the third to last paper, the background murmur of the room suggests that the answer to the first question is going to be negative. We will see what happens with the second question, but everything indicates that it will be affirmative since in the six presentations of this session alternate topics from Licensing with others from Analysis and Simulation of Accidents. It

Session 28
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is promising and will surely deliver.

Thus, TN-AMERICAS presented the benefits of their dry spent fuel storage system and how they are facing their most important design challenge of transferring all the spent fuel from the pool to their storage system within three years after its shutdown.

A CIEMAT technical paper proposed a critical review of theoretical mass transfer models considering new experimental data, PRESIDENT all within the framework of the release of volatile fission products (NAI)

in sodium pools. From the UPM within the framework of High-Performance Advanced Methods for the Safety Assessment of Generic Small Modular Reactors, they surprised





Daniel de Lorenzo

us with the presentation of their TRACE-1D model for a NuScale Power Module (NPM) to simulate boron dilution transients and the rupture of a steam line.

IBERDROLA identified the role that In-

WASTE MANAGEMENT (III)



Ángel Luis Ferrer COORDINATOR

The fourth entry of the morning by

dependent Supervision plays in Safety, whose main purpose is to question and influence the improvement of safety performance and effectiveness at all levels of the organization.

Fifth, from the COFRENTES NPP, they presented the extraordinary work of the License group to obtain what may be their last operating license renewal.

Lastly, **EMPRESARIOS** AGRUPADOS presented the state of the art in the preparation of chapter 18 of the Prelimi-

nary Safety Assessment Report (PSAR) which is specific and entirely dedicated to Human Factors Engineering (HFE).

And there are still more interesting things to tell, but we will have to wait another year.

he waste management session III was attended by more than 15 people and, in it, 7 papers were presented on the management of radioactive waste, with the presence of speakers from ENRESA, MARSEIN, ENSA, IDOM, NATURGY, CNAT, and the SLOWNEUTRON consulting firm.

SLOWNEUTRON's presentation dealt with the difficulty of managing inherited or legacy radioactive waste generated during the early development of the nuclear industry when the conditioning, storage, and treatment of

waste was not sufficiently planned or implemented. The treatment of this waste presents risks and difficulties which were explained in the presentation, indicating that, at present, a significant number of projects are already being undertaken to resolve these scenarios, and work must continue in an optimal manner and with safe solutions.

From ENRESA, the very low and low-medium activity waste management system was presented. The different phases of waste management were presented (inventory, acceptance, delivery/dispatch, and storage), as well as the different modules used in management. The way to update the system data, the interconnection of the different phases and modules, and the internal



Ferran Tarrassa PRESIDENT

Ana Alonso COORDINATOR

verifications of the system based on the requirements demanded in different acceptance documents were presented.

Two presentations, one by IDOM and the other by ENSA jointly with EN-RESA presented aspects related to life management plans for individualized temporary storage (ITS) and spent fuel containers. The regulatory aspects involved and how an aging management program is carried out were discussed. In the case of IDOM, the presentation focused on the work they have developed for the ITS for the Almaraz, Trillo, and Santa María de Garoña NPPs; while, in the second case, ENSA focused on its DPT container whose design was approved almost 20 years ago.



MARSEIN, along with ENRE-SA, presented activities developed within the framework of the decommissioning process of the José Cabrera NPP. In the first presentation, the experience in the demolition process of the reactor building was presented, with diamond wire cutting techniques for extracting large pieces of reinforced concrete which could be classified as very low level waste. In the second presentation, the methodology for the declassification of surfaces and large pieces was discussed in accordance

with ENRESA's control plan for declassifiable materials which has made it possible to declassify 564 large pieces in order to carry out conventional management.

Finally, NATURGY and CNAT presented the activities that have been carried out in recent years at the Almaraz NPP for the management of operational waste. In this context, the plant has been equipped with new technical means to carry out decontamination, cutting, characterization of waste and large pieces, and reconditioning.

At the end of each presentation, guestions or clarifications were asked that enriched the knowledge of the attendees, with the session ending 10 minutes later than planned given the interest in the issues and the debates raised.

Session 30

COMMUNICATION

The Communication session included the presentation of eight papers corresponding to the FORO DE LA INDUSTRIA NU-CLEAR ESPAÑOLA, GDES, NU-CLEAR YOUNG PEOPLE, ENU-SA INDUSTRIAS AVANZADAS, IBERDROLA GENERACIÓN NU-CLEAR, and TECNATOM entities.

Lucía Gómez (GDES) broke the ice with a presentation in which she spoke to us about the importance of raising awareness among the workforce when it comes to reducing the company's vulnerability to Cybersecuri-

ty issues. ENUSA, for its part, had two presentations: one by **Susana Sordo** in which she spoke to us about the importance of active listening on social networks to propose coherent communication strategies. The second was given by **Irina Jiménez** and she explained the internal communication policy developed by ENUSA throughout the COVID-19 pandemic.

FORO DE LA INDUSTRIA NUCLEAR ESPAÑOLA was represented by Alicia

Session 31



Manuel Fdez. Ordoñez PRESIDENT

Samantha Larriba del Apio - COORDINATOR

López who highlighted the importance of graphic designs when disseminating information on nuclear energy with special emphasis on the different design strategies depending on the target social network. On the other hand, the commissions of the Spanish Nuclear Society were represented by Nuclear Young People who explained to us how the organization of the European Young Generation Forum 2021 Convention, which took place in Tarragona last Sep-

FUSIÓN (II)

tember, was carried out. Laura Martín was in charge of preparing this presentation.

IBERDROLA GENERACIÓN NUCLEAR also had double representation on this occasion. **Beatriz Liébana** spoke to us about the resilience of workers in the nuclear sector in the difficult times that we are experiencing in the sector. For his part, **Carlos Gómez** presented us with the new website for the Cofrentes nuclear power plant, an intense project through which the Valen-

cian plant has a new channel for communication with the outside public.

Finally, **Ana Izquierdo** from TEC-NATOM explained the importance of fostering cultural change in organizations to migrate towards a new communication paradigm where the employees themselves are the brand ambassadors for companies. This work was subsequently awarded the prize for the best paper in the Communication session.

Technical session 31, within the Fusion area, took place last Friday, October 8. It was a pleasure for me to be able to chair it and to be able to hear from all the speakers about all the advances and research that is being developed around a technology such as fusion which is destined to play a fundamental role in the future of nuclear energy.

First of all, I would like to thank Sofia Corino, member of the Technical Committee, and Luis Cerrada, session coordinator, for their support and proactivity.

All their excellent work was seen during the course of the presentations.

The session was opened by Igor Peñalva with his presentation on the Characterization of Hydrogen and Deuterium Transport Parameters in EUROFER Ferritic-Martensitic Steel with Low Neutron Activation, very well structured and conducted, which at times managed to transport me back to my years at the University.



Ricardo Moreno PRESIDENT

The second speaker was Laura Maria Ruesga with her presentation on the Detailed Architecture of the ITER Nuclear Safety Control System. For different reasons I have been linked to this project in a certain way, and it was a pleasure to learn more about it.

Luis Cerrada

COORDINATOR

The third presentation should have been presented by Ana Maria Hernandez, but for personal reasons, she had



his work on the Characterization of Toroidal Alfvenic Modes in Tokamak Fusion Plasmas, very interesting research. It is a pity that the time was very short, and he had to synthesize his presentation as much as possible.

The next to present his work was Lluis Batet with his work on Activities for the UPC ANT Research Group in the FusionCAT

Project. It was very interesting to hear that Spain is also working on projects of this type.

The session continued with a double presentation by Luis Sedano, CAVITEX: A "Proof of Principle" Experiment for Helium Nucleation in Lead-Lithium Eutectic Quantifying the Impact on Transport Parameters and Properties and The Helium Solubility Constant in Lithium-Lead Eutectic Alloy, a presentation with a lot of content conducted in a very dynamic way.

And to close the session, Pedro Ortego told us about his adventures and misadventures associated with the



documentation received for the development of his project for the Reduction of Neutron Damage and Thermal Load in the First Reflector for the Load Exchange Recombination Spectroscopy Diagnostic System.

OPERATIONS

Many thanks to all the speakers. I had the opportunity to learn a lot of new things that are being developed in Spain regarding fusion technology, the technology that will be capable of supplying infinite energy to the world.

Seven papers were presented in the Operations session. The first of them dealt with the development of a management procedure in the event of a fire at the Cofrentes Nuclear Power Plant. The procedure allows the operations level to identify safety-relevant indicators and alarms that could be missed, thus allowing the operator to distinguish them among the important ones.

In the second presentation, ANAV conceptually described physical tests at low power after refueling - the HZP Test. In this

paper, a guide-assistant was presented to understand the different reactivity changes necessary to complete the tests.

The next paper presented the design of TECNATOM's control panels or "dashboards" to support decision-making which offer a quick display of information, achieving a significant optimization of processes related to operations, maintenance, staff training, and quality, among others.

This was followed by a presentation on the experience of using the Almaraz simulator, covering the history from its

Session 33



Jordi Sabartés PRESIDENT

construction to start-up and operation.

Next, the method developed at ANAV was presented for visualizing the set of operational risks in the form of a heat map, that is, those risks that can impact the safe and reliable operation of plants.

Sixth, the project developed by TEC-NATOM, TecOS VIEW, was presented, integrating the P&IDs with other sources of information available within the plant. The characteristics of the tool were described, as well as the first conclusions of the proof of concept at the Cofrentes NPP.



Marta Vázquez COORDINATOR In the second to last presentation, ANAV presented the evaluation of the impact of the flexible operation for the three reactors. The experience accumulated in recent years allows for progress to be made in operations that are adaptable to the needs of the market within the technical and operational limits of the plants themselves.

The presentation that closed the session was related to the cleaning process for the steam generators at the Vandellòs II Nuclear Power Plant by adding PAA (polyacrylic acid). This is intended

to remove the greatest amount of removable sludge from all surfaces of the GV, as well as to facilitate the cleaning of hard sludge.

Finally, it should be noted that the session was well attended and that there were questions for all the speakers. Although all the speakers tried to adjust to the time assigned to them, the intensity and interest of the topics discussed and the large number of presentations made the session exceed the total time assigned, which did not detract from its agility and dynamism.

MAINTENANCE, INSPECTION, AND TESTING (III)

The 33rd technical session was attended by about 11 people and during it, 6 papers were presented.

In the first presentation, Juan Luis Bravo from TECNATOM presented the work carried out in response to a 10 CFR 21 communication by Curtiss-Wright regarding a batch of defective silicone fluid manufactured by Momentive and supplied in a hydraulic shock absorber (HSA) to the Almaraz NPP. Some shock absorbers were also manufactured for the Ascó Nuclear Power Plant with said silicone fluid.

Suspended particles were detected in the fluid in question which could compromise the proper functioning of the shock absorbers, which could imply a possible safety risk.

As a result of this risk, the Almaraz and Ascó Nuclear Power Plants asked Tecnatom to perform a series of tests to ensure that the responses of said absorbers to an earthquake or other undesired dynamic behavior would be as expected. To do this, it must be verified that the fluid will maintain its properties without affecting the functionality of the shock absorber or its safety function. Among the tests carried out, it is worth highlighting the functional tests, those for behavior at low temperature, those for aging, as well as the analysis of particle content.

In the presentation, the details of the different tests performed as well as the

procedures and methodology followed were described.

As a closing for the presentation, the results observed for the different tests performed were mentioned as well as the conclusions drawn, which could be summarized as follows:

- All the tests had satisfactory results, complying with the acceptance criteria established by the Almaraz and Ascó Power Plants.
- Tests carried out under ex- Cerre treme conditions were also satisfactory, detecting normal decreases in relief and blocking speeds but operating within the required parameters.
- For this reason, it has been possible to conclude that the shock absorbers will perform adequately.

Next, **José Manuel Obón** from RINGO VÁLVULAS proceeded to present the Development and Analysis of an Expert System for the Characterization of Friction in Valve Packing. To this end, four prototypes were designed and manufactured that simulate packing with representative spindle diameters.

During the presentation, the prepared prototypes were described as well as the tests to which they have been subjected. The test pressures considered correspond to all ratings between 150# and 1500#. Different combinations of braided and formed graphite as well as Teflon packings from different manufacturers were also tested. For each configuration, the packing tightness necessary to avoid leaks and the thrust necessary for the stem to overcome friction with the packing was measured.

The process followed for the test consisted of first applying a minimum initial tightening to avoid leakage, then pressurizing the body to the test pressure and measuring the tightening torque. The block is then depressurized (and packing tightness is checked if necessary). Three test cycles were performed, and data was taken.

Analyzing the data obtained from the tests, it has been possible to determine the tightening necessary to keep the packing airtight at different pressures. It has also been possible to obtain the static and dynamic friction coefficients



José Manuel García Cerecedo PRESIDENT

for each type of packing as well as the friction calculation formulas applicable to each type of packing.

The third presentation, given by **Alejandro García Ramos** from EMPRESA-RIOS AGRUPADOS and entitled Methodology and Implementation of the Environmental Qualification Program for Mechanical Equipment in Nuclear Power Plants described the steps that have been carried out for the implementation of said program at the Almaraz Nuclear Power Plant, adjusting to the requirements of the corresponding CTI from the Nuclear Safety Council and complying with the NUREG-0800 criteria.

The program has been developed in 5 phases: the list of equipment, analysis of the list, breakdown of the equipment, environmental qualification reports, and finally preparation of the program documentation.

To obtain the list of equipment related to safety and its location in the various rooms, 3D scanning of the Plant was used. The next step was to analyze the rooms with "harsh" conditions (or rooms with accident conditions) and rooms with "mild" conditions (or rooms without accident conditions). The next step was distinguishing the equipment located in harsh rooms with the possibility of quick justification from that which requires detailed analysis. Within the latter, two groups were made: one formed by those that have only graphite and another by those that have other materials.

In the next phase, the equipment that requires detailed analysis was broken down, compiling plans, identifying the composition of non-metallic components, and analyzing the safety function as well as the required operating time during an accident. Once this work



Marcos Sánchez COORDINATOR

NUCLEAR FACILITY." This presentation described the implementation of a configuration and information management program at the Pallas nuclear facility in the Netherlands.

CONFIGURATION

was completed, a qualification report was prepared with all

the information obtained in the

previous phase. Finally, the final

documentation for the program

was prepared (methodology, list

of equipment, reports, and envi-

ronmental qualification sheets).

Next. Leo van Ruiiven from

CROONWOLTERENDROS B.V.

proceeded to present "CAR

WASH FOR DATA: BEST PRAC-

TICES FOR INFORMATION AND

MENT APPLIED AT THE PALLAS

MANAGE-

The information management program aims to maintain and guarantee the integrity and validity of the Design Basis knowledge and information to guarantee asset management and the safe and efficient operation of the facility.

To this end, a database technology of data and linked graphs has been chosen to create a Common Data Environment (CDE) in which to classify, standardize, and integrate all the relevant data collected throughout the life of the facility.

The data cleaning process that has been followed could be compared to a "car wash for data." This data cleansing is an essential part of arriving at a common data environment (CDE) as defined in ISO 19650.

Throughout this process, it is essential to maintain and guarantee the integrity and validity of the information on the Design Basis and license since most of the information comes from embedded systems during the various phases of the facility life cycle and, therefore, they are not integrated with each other and cannot share plant information which gives rise to redundancies in their collection, handling, transfer, maintenance, and conservation.

To ensure proper configuration management, it is necessary to structure and classify all data using various hierarchical breakdown structures where the elements of the various breakdown structures are defined by their classifications, characteristics, and relationships to other structures.

Information management is considered, on the one hand, as the process of retrieving information from various sources and, on the other hand, the delivery of the required information to end-users. The data is processed through an (auditable) cleaning process in which an integration of all the data flows is carried out through the application of a common language. If any data group cannot be handled due to ambiguity, the data file is rejected and discussed with the originator.

The information management model presented allows a better exchange, transfer, and use of design information in a sustainable way through all phases of the life cycle of the facility.

The fifth presentation entitled RAPID CREATION OF DIGITAL TWINS FOR SAVINGS IN MAINTENANCE AND USE OF EXISTING DATA given by **Jim Novack** from the Dynatec company began by defining what is meant by "Digital Twins."

According to Mr. Novack, a Digital Twin is a virtual copy or replica in digital format of something real (an object, a process, a service, or even an entire plant), connecting the real and the virtual. The presentation describes examples of what can indeed be considered a digital model, as well as cases in which digital replicas cannot be used.

In this context, the digitized replica incorporates data from sensors that are

installed on the equipment of the real facility. This data is stored, processed, and analyzed with computer tools in order to get to know and predict the behavior of the actual system.

Proper management of all this information allows for processes to be improved and even to be able to carry out predictive maintenance. In addition, additional benefits are obtained such as advanced simulation, remote support, and training.

For successful implementation of a digital twin, it is recommended to start by involving a multidisciplinary group that begins by gathering all the design information for the facility to be replicated and then prepares a 3D model using one of the currently available techniques. Once this task is completed, it is necessary to relate the data and operating parameters for the equipment with its virtual replicas as a preliminary step for the simulations.

The sixth and last presentation entitled "MULTIMODAL HUMAN-ROBOT INTERFACE FOR HETEROGENEOUS ROBOTIC SYSTEMS CONTROL IN HARSH ENVIRONMENTS" was given by **Giacomo Lunghi** from the ADAM S.A. company.

There are facilities that have intrinsic risks for the personnel who work in them, and a clear example is facilities where radioactivity is present. This makes inspection, monitoring, and maintenance particularly demanding. The commercially available robotic systems have not yet reached the technical level to simply allow their use, so their adaptation to use them in work with radiation is essential. The use of robotic systems, in addition to reducing the exposure of personnel to radiation and improving the availability of facilities, presents new opportunities in terms of maintenance.

This presentation describes the work carried out at CERN where, in addition to risks related to radiation, there are other dangers, such as oxygen deficiency (since most accelerators are in tunnels), strong magnetic fields, and electrical dangers due to high power components.

There are additional reasons for the use of robots, such as, for example, savings in access times since they can already be inside the accelerator and do not need to wait a certain time to access safely, which has an impact on better accelerator availability as mentioned before.

A novel aspect identified as part of the work at CERN has been to consider the time delay in man-machine control due to the great distances between the two.

The most important result of this work was the creation of a human-robot interface which is used by robot operators in procedures that take place in dangerous environments.

The session ended on time and all the presenters were thanked for the quality of the presentations as well as their compliance with the time allotted for them.

SIMULATION WITH NUMERICAL + 3D CODES (II)

The session began at 9:30 am and ran until 11:00 am with the presentation of 6 papers.

Session 34

Attendees and speakers were notified at the beginning of the session of its order and format as well as the applicable regulations for scoring and selecting the best presentation subject matter.

The order and content of the presentations during the session were as follows:

• (34-01). **Sofia Arfinengo del Carpio.** Higher Technical School Of Industrial Engineering, UPM. "GEOMETRI-



Carlos Gómez PRESIDENT



Francisco Álvarez COORDINATOR

CAL AND COMPUTATION-AL OPTIMIZATION OF THE ALMARAZ NPP GOTHIC 3D CONTAINMENT MODEL".

GOTHIC 3D Code, in some cases, presents numerical instability problems due to the configuration and parameterization of its cells. To prevent this problem from occurring, the Polytechnic University of Madrid (UPM) has developed a "preventive methodology" which includes the modification of the original geometry to adapt it to the Cartesian mesh. This methodology has been applied to optimize the Almaraz NPP containment model, obtaining significant improvements in computation time and convergence of results.

• (34-02). Luis Serra López. Higher Technical School Of Industrial Engineering, UPM. "MODELING STRAT-EGIES FOR THE SIMULATION OF PASSIVE AUTOCATALYTIC RF-COMBINERS WITH GOTHIC 8.3"

The objective of this paper is the creation of simple models for Passive Autocatalvtic Recombiners - PAR in GOTHIC 8.3 code using different modeling strategies. Most of the options tested are based on a bibliographic study of works that evaluate the capabilities of the code and the limitations in the representation of the phenomenology of these recombiners, concluding with a proposal for future lines of work.

• (34-03). Araceli Domínguez Bugarin. Higher Technical School Of Industrial Engineering, UPM. PARUPM: "A Simulation Code for Passive Autocatalytic Recombiners."

A proprietary code developed at the Higher Technical School of Industrial Engineers of the UPM for the simulation of PAR recombiners was described. It includes a physical-chemical model

Session (

for the study of surface chemistry, heat transfer, and mass transfer between gas mixtures and catalytic plates. For the validation, the experimental data from different facilities (BCM, Reko-3) were used, demonstrating good agreement with the models.

• (34-04). David Lázaro Urrutia. University of Cantabria. GIDAI GROUP. "STUDY OF THE INFLUENCE OF VENTILATION IN THE DEFINITION OF FIRE SCENARIOS IN NUCLEAR POWER PLANTS"

The influence of ventilation in fire scenarios for nuclear power plant enclosures is analyzed with FDS. The scenarios are modeled by varying the ventilation of the enclosure, the position of a temporary fire source, and the properties of the cables (such as fire load), noting that ventilation does not always reduce a fire.

(34-05). Alejandro Herrero Carrión. Institute of Energy Engineering Of The UPV. "Verification of Trace Code with the Development of a Module for Verification of Conservation Laws."

The presentation describes the development of a module implemented within TRACE code itself which checks the degree of compliance with the conservation of mass, momentum, and energy of the code,

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quantifying possible errors depending on the complexity of the simulation.

• (34-06), Nicolás Olmo, NFQ, REPRO-DUCTION OF NEUTRON NOISE AC-QUIRED AT A KWU PLANT

The analysis was performed using the SVD methodology for neutron noise in a KWU reactor. By introducing perturbations in the coupled simulation of TRACE and PARCS codes with the shape and evolution of the main singular values of the decomposed signal, the transmission of neutron noise was analyzed.

The session proceeded normally in the development of the presentations, with a short time for questions after each presentation. The time used by the speakers was perfectly adjusted to the established 15 minutes (12 minutes for the presentation and 3 minutes for questions) and was followed with great interest by the attendees, presenting a lively debate after the various presentations. Attendance at the presentations varied throughout the course of the presentations, with an estimated average of about 20 attendees.

The equipment and facilities were adequate, and the technical level of the session was high, with all the speakers meeting the quality requirements and expectations for the content of the papers presented.

he special technical session on the SNE Commissions began with a few words of welcome from the President, commenting that this is the first time that this session has been held and that its main objective is the internal and external dissemination of the work carried out by the more than 100 members that make up the different commissions. and to encourage all members to participate in them. After emphasizing that the commissions are "the engine and soul

of the SNE," he turned it over for the presentations by the members.

The Employment and Professional Development Commission, with the motto "knowledge is the soul of organizations," presented different papers to describe two major projects. On the



Héctor Dominguis PRESIDENT

one hand, how SOUL technology has been implemented to create a new platform within the SNE that enhances the knowledge management of its members. The presentation highlighted how the platform facilitates the fulfillment of these objectives in a simple, fluid, and



Pedro Ortega COORDINATOR

fast way, offering users total autonomy in the learning process.

On the other hand, and connected to the SOUL project, a specific presentation was dedicated to the Mentoring Program for the Spanish Nuclear Society. In it, its evolution was analyzed to date and analysis was done for the alternatives implemented in the distance program carried out during the 2020 Virtual Meeting due to the pandemic occurring. In the long term, the Mentoring Program intends to grow in order to

accompany the Mentees in their evolution, retain their talent, and ensure that the Mentees of today are the Mentors of tomorrow.

The Commission for the Nuclear Magazine Nuclear España presented the milestones for the start-up of the portal www.revistanuclear.es. From its



Rabel Leonardo - Employment & Professional Development Commission



Elisa Gil - Comisión de Empleo y Desarrollo Profesional



Matilde Pelegrí - Nuclear España Magazine Commission

evolution with respect to its predecessor on paper to its internal management, results, and its own characteristics. The first, and fundamental, is its open and informative nature as it is no longer restricted to members of the SNE. And the multi-subject nature of its new editorial line along with the success of "the threads," a new section made possible thanks to the digitization of the magazine.



Susana Falcón - WIN Commission

The **WiN Commission** dedicated its presentation to the commemoration of the 25th anniversary of WiN in Spain, also presenting its goals and its current roadmap. Among its objectives: encouraging the participation of women in the nuclear sector, creating a "WiN Spain" brand, consolidating its image as a benchmark association for attracting female talent, promoting its new website and newsletters, and finding synergies with other national and international professional associations for sharing experiences and to generate networking.

From the **Nuclear Young People Commission**, the strategic, organizing, and organizational changes that have been carried out in the last year after the new reality due to CoVid 19 were reflected. Nuclear Young People wanted to take advantage of this transformational impulse to define a new corporate visual identity: they reorganized their communication team and increased their outreach efforts in digi-



Azucena Bello - Nuclear Young People Commission



Amparo Soler- Programs Commission

tal channels which has allowed them to grow greatly in terms of the scope of their outreach efforts.

The **Programs Commission**, which will turn 40 years old in 2022, took a tour of its history since 1982. Created to provide a space for dialogue and knowledge between members, it maintains the Operating Experiences Day as its great event and adds the cultural, sports, and technical visits as the most accepted activities by members who are the true protagonists of this Commission.

The SNE Technical Commission told us about its objectives and the value of its human team. Their key work at the



Rafael Sánchez-Technical Commission



Alfonso Barbas -Communication Commission

level of "Regulations" (of interest not only nationally but also internationally), the balance of the last Annual Technical Conference, the award for the best doctoral thesis, and their multiple dissemination actions.

The Communication Commission also reported their objectives, actions, and new strategies based on the enhancement of our society and its members. From an internal (search for synergies) and external (dissemination and presence) perspective, they presented the news on the website, social networks, press relations, and newsletters.

The Organizing Committee for the Annual Meeting presented its "modus operandi" for the organization of the main event of our Society. An event



Miguel Barreiro - Organizing Committee for the 46th Annual Meeting

whose organization requires collaboration and teamwork, for a whole year, full of milestones to meet.

In line with the presentation of the Annual Meeting Organizing Committee, the **Technical Commission for the Annual Meeting** presented its work in the organization and coordination of the technical part of our Meeting. The keys to their work in the coordination of sessions, compilation of documentation, selection of speakers, and design of the technical program in collaboration with the rest of the commissions.

With all this, the attendees were offered a fairly complete and detailed vision of the collective effort of each



Patricia Cuadrado - Technical Committee for the 46th Annual Meeting

of the SNE commissions and intercommunication and the exchange of experiences among its members were encouraged. As they highlighted when talking about the SOUL project "Knowledge is the soul of organizations;" therefore, the President thanked the attendees, both speakers and the rest of the audience, for their participation and interest in this session, which was undoubtedly productive and interesting for everyone.

Session 36

FUSION POSTER SPECIAL SESSION

The **"The Alternative of the Future" Fusion Poster Special Session** took place on Friday, October 8, 2021, from 11 am to 12 p. Since this year's annual meeting location was Granada, it was decided to create a special poster session devoted entirely to fusion.

Nuclear fusion technology is a high-performance and "clean" energy source, and for this reason, it is being highly promoted with the aim of solving the growing electricity demand and combating climate change.

For the opening of this session, there was an expert in fusion, **José Aguilar**. José is the Coordinator of the Technical Office for the IFMIF-DONES at the University of Granada, so he has a long career in this field. The International Fusion Materials Irradiation Facil-

ity - Demonstration Oriented Neutron Source (IFMIF-DONES) is a single-site novel research infrastructure designed to test, validate, and qualify materials to be used in future fusion power plants as a DEMO (a prototype demonstration fusion reactor).

After the opening, José did an introduction for the session, in which he highlighted that IFMIF-DONES is a scientific and technological facility resulting from a global initiative that will serve to research and develop the materials with which future fusion reactors will be built.

The project is framed within the strategy for nuclear fusion which the European Union develops in collaboration with the main world powers with the aim of producing energy from fusion in the mid-21st century, and that fusion energy will become the energy source of the future, thus reaching one of the great global challenges such as the development of clean, safe, and sustainable energy that responds to the needs of human beings and the planet.

In a global context, achieving fusion energy will be essential to overcome the global energy crisis and replace the sources that deplete the planet's resources, a key strategy within the Sustainable Development Goals proposed by the United Nations 2030 Agenda.

But reproducing the fusion process in a controlled and profitable way is a great scientific challenge. For this, the ITER and DEMO projects are the main

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milestones to be achieved. ITER is the experimental reactor currently under construction in France whose objective is to demonstrate the technical feasibility of fusion by magnetic confinement. Its successor, DEMO, will be the first demonstration power facility to produce electricity for the grid, thus paving the way for the future commercialization of fusion power, expected after the year 2050.

As an intermediate step between both projects, IFMIF-DONES arises, whose objective is to characterize the behavior of different materials subjected to intense radiation through a source of high-intensity neutrons in order to obtain the necessary information for the design and construction of future commercial reactors.

After Jose's introduction, each of the 6 speakers had the floor. The presentations were structured in two groups, the first group focused on the ITER project represented by the first two speakers, and the second group of 4 speakers focused on DONES.

The session was opened by Rubén Moreno from EQUIPOS NUCLEARES S.A., S.M.E., with his presentation entitled "ENSA KEY PARTICIPANT IN THE ITER PROJECT." In it, the involvement of the company within the ITER project and the work that will be carried out in the field in the near future was explained. He explained that they will take advantage of the development and previous knowledge acquired over the last 7 years during the previous phases already completed (development and pre-production phases). In particular, the welding and machining equipment, etc., which to be used on-site have been tested by means of 1:1 scale



models that reproduce the ultra-demanding conditions that will be found in the real components of the reactor.

The second speaker was Luis Sedano from FUS - ALIANZ. His work was entitled "SUPPLY DEMANDS IN ITER PROGRAMS (TBM) AND QUALITY AS-SURANCE OF LITHIUM-LEAD EUTEC-TIC PB-15.7 (2) 6LI AS NUCLEAR MA-TERIAL." This alloy is the functional "design basis" material for fusion reactors. ITER will require several tons of said alloy as material in different systems (such as TBM, Test Blanket Modules). Additionally, it will require several tens of tons for the ongoing experimental programs. Industrial and development returns in the coming years are estimated at several tens of €M, depending on certain variables. This work addressed the quality demands for industrial production of said nuclear material to meet the supply demands in the coming vears.

The third presentation was done by **Iván Podadera** from CIEMAT and was entitled "SPANISH CONTRIBUTION TO THE IFMIF-DONES ACCELERA-



TOR." The presentation focused on detailing the different contributions to IFMIF-DONES as driving elements of the Spanish scientific system in the coming years. It must be taken into account that, in the design of the linear accelerator, Spanish institutions and companies have participated as key players in the design of various accelerator systems with a high technological component, and in their integration with each other, and with the rest of the



facility. The design of a radiofrequency system based on solid-state amplifiers, the medium and high energy transport lines, the beam stop block during start-up, innovative beam diagnostics to ensure the integrity of the machine and optimize it, the associated auxiliary systems (vacuum, cryogenics, refrigeration...), and control and synchronization systems for all systems are the main current contributions of Spain to the accelerator.

Next, **Claudio Torregrosa** from the University of Granada presented his poster entitled "EXPERIMENTAL FA-CILITY FOR THE VERIFICATION OF SAFETY SYSTEMS AND PROTEC-TION DUE TO LOSS OF VACUUM AT THE IFMIF-DONES ACCELERATOR."



This experiment is in the conceptual design phase. The construction and execution are expected in the next 2-3 years at University of Granada facilities. From the point of view of nuclear safety, one of the critical elements for



the IFMIF-DONES facility is the vacuum chamber for the liquid lithium target and its connection to the vacuum tube of the accelerator line through which the particle beam is transported. The main objective of the MuVacAS (Multipurpose Vacuum Accident Scenarios) prototype is to build an experimental platform recreating the vacuum chamber of the last 30 m of the accelerator's high-energy beam transport (HEBT) line and that of the lithium target. This prototype will serve for the experimental study of front propagation times in the event of chamber breakage and the validation of protection and safety systems designed to mitigate such accidents such as instrumentation, quick-closing valves, and fire retardants. In addition, the platform will have the validation of critical systems for operation as a secondary objective, such as the differential pressure of Ar in the line and the integration of prototypes for cameras and connections in the HEBT.

The next to present his work was David Sánchez from the University of Granada. As already introduced by the previous speaker, the main groups of systems for the IFMIF-DONES facility are the accelerator systems, the test systems, the Lithium systems, the control systems, and the buildings and plant systems. The prototype mechanism is part of one of the multiple systems that make up the group of lithium systems, particularly the target system. The purpose of the prototype is to test the functional feasibility of the remotely manipulated connection necessary for the union of the vacuum tubes for the target systems of the IFMIF-DONES facility. The mechanism essentially con-

sists of an assembly made up of an angled gear, two screw spindles, two flexible shafts, a blower, and an articulated elliptical fastening collar. Mechanical analyses have been carried out to verify the adequate distribution of stresses in the collar flange fastening. Its validation for remote management will be done at ENEA's DRT facility. With the research and development work of the prototype, the aim is to validate the proper operation of the remote disconnection mechanism of the vacuum line from the point of view of required tightness and operability. The main advances that will be obtained after completing the work will be the design and manufacture of a new non-commercial (elliptical) geometry for an articulated collar clamp and the development of a special maneuvering system called One Point Mechanism (OPM) that can be easily activated from a single point, simplifying the remote handling operations required in addition to integrating a remote recovery system that allows the clamp to be opened in the event of an emergency situation.

And to close the session, **Santiago Becerril** from the University of Granada presented his work entitled "STUMM-PROTO: AN EXPERIMEN-TAL PROGRAM AND PROTOTYPE FOR THE INSTRUMENTED MODULE (STUMM) FOR THE COMMISSIONING OF DONES" where the prototype design and developed test platform were described based on the current design of the instrumented start-up and monitoring module (STUMM) for the commissioning of DONES as well as the planned experimental program as-



sociated with it. The STUMM system will be a module that will be placed in the last commissioning phase of DO-NES just before starting the material irradiation campaigns. Said system is very densely populated with sensors and detectors, which, moreover, will be subjected to particularly demanding working conditions. With this prototype (STUMM-PROTO), it is intended to deepen the knowledge on the performance of sensors and detectors in a wide range of working conditions as well as the interactions and distortions that may occur between them due to the high spatial density of their distribution. This experimental program of STUMM-PROTO will include irradiation campaigns in relevant neutron sources around the world that will allow for knowing the exact response of the sensors and detectors as well as how they compare with previous theoretical neutron models.



he poster session was attended by 8 participants. Tecnatom began by presenting the work "PLATAFORMA SOUL: DIGITAL COURSES THAT INSTRUCT, EDUCATE AND TRAIN END INSPEC-TORS". The Polytechnic University of Valencia presented 4 papers: "STUDY OF THE RADON EQUILIBRIUM FACTOR IN DIFFERENT LOCATIONS AND DEPEN-DENCE ON HUMIDITY", "THE DEVEL-OPMENT OF THE JEBEA INSTALLATION FOR AIR AND/OR STEAM DISCHARGES IN A POOL WITH STAGNANT WATER USING DIFFERENT GEOMETRIES". "DESIGN OF RADON MITIGATION MEA-SURES IN A SINGLE-FAMILY HOUSE LOCATED IN A PLACE WITH HIGH CONCENTRATION LEVELS" and "NU-MERICAL SIMULATION OF DISCHARG-ES USING HORIZONTAL JET SPARG-ERS OF UNCONDENSABLE GASES IN STAGNANT WATER". The University of Granada presented "Analysis of natural radioactive elements in clays used in cosmetics and dose estimation"; and the Polytechnic of Madrid, "THE INTEGRAL MODEL FOR THE STUDY OF SPENT FUEL CONTAINERS IN ANSYS CFX". The last poster was shown by Ciemat with "APPLICATION OF LIQUID CHRO-MATOGRAPHY COUPLED TO MASS SPECTROMETRY (LC-MS) IN THE NU-CLEAR INDUSTRY".

Thank all the speakers for their great involvement and for the great presentation of their work. The objective of creating a dynamic discussion was highly achieved, making the experience very enriching not only for the speakers but also for the audience.



POSTER SESSION





WOMEN IN NUCLEAR

Within the framework of the 46th Annual Meeting of the Spanish nuclear society, WiN Spain organized and developed two activities intended for the society of the host city during the day prior to the start of the meeting itself. These activities are part of the objectives of the association.

Mentoring workshop WIN Spain - NEA (OECD)

Win (Women in Nuclear) Spain, a non-profit organization that brings together professionals who carry out their activity in different areas of application of ionizing radiation such as energy production, medicine, industrial applications, research, and restoration of works of art has outreach as its fundamental objective intended for different social groups, especially females, as well as the promotion of role of women in the professional field.

The OECD Nuclear Energy Agency (NEA) has developed the NEA International Mentoring Workshop as a platform to encourage young people to pursue careers in science and engineering, promoting gender equality. These international events have been held in several countries in recent years (for example, Japan, Russia, Kenya, and Spain) and bring together international and local mentors with young students with the purpose of advising them on their professional futures.

Under this objective of promoting science and technology among the youngest, due to the fact that fewer and fewer STEM careers are studied, WiN Spain, in collaboration with the NEA, organized the International Mentoring Workshop: "Promoting Future Leaders in Science and Technology" intended for Compulsory Secondary Education students in the city of Granada. The workshop was held at the Carmen de los Mártires, provided by the city council of Granada for the occasion, and brought together 11 mentors who shared their experience and knowledge with 72 students between 12 and 15 years old. Professionals from different companies and organizations in the sector participated as mentors: CIEMAT, ENSA, ENUSA, CSN, Foro Nuclear, GE, GDES, and Naturgy.

The opening of the event was attended by Ms. Elvira ROMERA (CSN Director), Ms. Natalie BONILLA (Deputy Head of Human Aspects of Nuclear Safety AEN/OECD), Ms. Susana FALCON (President of WiN Spain), and Mr. Héctor DOMINGUIS (President of the SNE) among others.

Various very motivating videos were projected electronically for the students by Ms. Sama BILBAO (WNA General Director), Mr. William D. MAGWOOD (General Director of AEN), and Ms. Rita BARANWALL (Vice President of Nuclear and EPRI Nuclear Director).

It is inspiring that both the NEA and the professionals of WiN Spain work



and organize events like this so that youth can meet women who have contributed to the field of science since its inception. People who can be role models and who provide the best example that being successful is not a matter of gender but of dedication, motivation, and effort. During the activity, a space was provided so that each of the participants had the opportunity to speak, think, and reflect on their future; to meet people who have already followed the path that they might also like to follow and who were able to give them information and clues to help them find the field of activity towards which they would like to direct their professional future. Undoubtedly a very rewarding activity that will be organized again in future meetings.

LECTURE Application of Radiation in the Conservation of Cultural Heritage



The second WiN activity, framed in the society outreach aspect, was the "Application of Radiation in the Conservation of Cultural Heritage" lecture given by Ms. Miriam BUE-SO MANZANAS. Granada, with its magnificent cultural heritage, was the perfect place to give this lecture and learn how ionizing radiation helps us in the conservation of cultural heritage. The lecture took place at the Palacio de La Madraza, a space provided for the occasion by the University of Granada, and was presented by the Vice-Rector for University Outreach and Heritage Mr. Víctor Jesús MEDINA, host of the event, who commented that the dissemination of science to society is very important for the university, and he acknowledged the topic presented; the Councilor for Culture and Heritage of the City Council of Granada, Ms. Maria LEYVA, who stressed the importance of conservation for a city like Granada; Ms. Susana FAL-CÓN, President of WiN Spain; and Mr. Héctor DOMINGUIS, President of the SNE, organizers of the activity. The invited speaker, expert in Conservation of Spanish cultural heritage, Ms. Miriam Bueso Manzanas has a

degree in Prehistory and Archeology and a diploma in Conservation and Restoration of cultural assets, specializing in Archaeology. She is part of the Research and Training Area for the Spanish Cultural Heritage Institute (IPCE). She is the head of the Project Services and Supervisor of the IPCE radioactive facility.

Miriam explained how her department works with image examination techniques derived from exposure to electromagnetic radiation of the cultural assets under study (radiography, infrared photography and reflectography, ultraviolet photography, endoscopy, etc.). Its application today is widespread as unique graphic documentation is generated, which provides information on the state of a cultural asset at a specific moment in its material life and allows for first-hand knowledge of aspects that are not visible in direct observation of the object without the need to manipulate it or take any samples.

The speaker, with a magnificent presentation with a multitude of visual examples of all kinds, many of them from Granada, showed us how the comparative study of these images, therefore, provides essential information to ad-



Miriam Bueso Manzanas

dress conservation and/or restoration interventions and provides valuable information for research studies of these cultural assets.

However, the special characteristics of some techniques such as radiography and scintigraphy and their method of use force the facility to acquire the category of a radioactive facility and, for obvious safety reasons, require the figures of supervisor and operator to validate and develop the work that is carried out in it, guaranteeing the derived safety requirements.

Through the presentation, which introduced us to the world of art, we were able to see how the IPCE has a long history in this field, and it brought us closer to the working procedure with these techniques and the technological innovation around them with practical examples of their application in a varied typology of cultural assets and formats.

It is another way of showing how the use of radiation has other beneficial applications for society other than medical and energy applications. After the lecture ended, an interesting question and answer session took place.



NUCLEAR YOUNG PEOPLE (JJNN)

The face-to-face organization of the 46th Annual Meeting in Granada allowed Nuclear Young People to resume some of its traditional activities intended for professionals and students as well as the general public. Having closed the European Nuclear Young Generation Forum (ENYGF'21) in Tarragona the previous week, several members of Nuclear Young People headed south and went to Granada to add their contributions to the range of activities that the Annual Meeting hosts.

After coming from organizing several editions of our Basic Courses virtually, we were finally able to return to the classroom and Nuclear Young People traveled to the University of Granada on October 7 to teach the Basic Course on Nuclear Fusion. This course, coordinated by **Aina Noverques**, was structured around the following eight topics:

• Topic 1: Introduction to Nuclear Physics by Eva Jabaloyas Cases (NUCLEONOVA)

- Topic 2: Fundamentals of Nuclear Fusion Energy by Luis Felipe Durán Vinuesa (UPM)
- Topic 3: Fusion by Magnetic Confinement by Pau Aragón Gabriel (CIEMAT)
- Topic 4: Fusion by Inertial Confinement by Alejandro Carrasco Sánchez (ENUSA)
- Topic 5: Challenges of Nuclear Fusion by Elisa Gil Crespo (TEC-NATOM)
- Topic 6: Update on Fusion by Magnetic Confinement by Araceli Domínguez Bugarín (UPM)
- Topic 7: Current Status of Inertial Confinement Fusion by Samantha Larriba (UPM)
- Topic 8: Nuclear Fusion and Sustainable Development by Alfonso Barbas Espa (ENUSA)

The course was attended by about 35 people who were able to participate in the time for questions that took place at the end of the presentations, with topics such as the type of waste that these technologies could generate or their connection with safety being especially interesting for the students. For the opening of this course, we had **Emilio Mínguez, Vice President of the SNE**, in addition to **José Aguilar Medina (IFMIF-DONES Project Office Coordinator)** who briefly presented the IFMIF-DONES project.

In 2021, in line with the objective of promoting the positioning of Nuclear Young People in favor of science, its development, and its promotion, we continue our support for the Pint of Science organization (having been national sponsors, along with the SNE, for its 2021 virtual edition in Spain). In this sense, Nuclear Young People organized, along with PoS-Granada, an informative event with an informal tone (but maintaining the brilliance of scientific rigor) on October 4 at the Palacio de la Madraza which consisted of two talks open to the society of Granada:

- "What is the Future of Energy Made of?" presented by Elisa Gil Crespo (Tecnatom)
- "Lighting Stars" presented by Sara Cazzoli (PoS Granada) This event was attended by about



Emilio Mínguez

20 people who attentively followed the speakers' presentations. From the subsequent round of questions, it is worth highlighting Sara's amazing professional experience and how she brought the world of cosmology closer to the attendees. As in previous Annual Meetings, the Nuclear Young People and Communication Commission organized a course for journalists on October 4 with the aim of disseminating the basic concepts of nuclear energy in an activity intended for all journalists in the area who might have an interest in the sector as well as journalism students. The course was held at the Cartuja Campus of the Granada Faculty for Communication and consisted of presentations given by Elisa Gil Crespo (Tecnatom) and Luis Felipe Durán Vinuesa (UPM).

Likewise, and in collaboration with other entities such as Foro Nuclear and Enresa, Nuclear Young People, led by **Pablo García** (ARN), coordinated the STEM (Science, Technology, Engineering, and Mathematics) Workshops that were held in various Granada schools. The workshops that were held were **"Escape Box: El Cabril Mission"** by Enresa and **"Magic to Disseminate Science"** by Foro Nuclear.

In this edition of the annual meeting, Nuclear Young People also participated in the Mentoring Program organized by the Employment and Professional Development Commission of the SNE through the coordination of our colleague **Elisa Gil Crespo** (Tecnatom). In addition, the President of Nuclear Young People **Francisco Suárez** (Tecnatom) was the moderator of the session "**Onboarding the Nuclear Sec-** **tor**" where the mentees participated as well as professionals from 5 companies in the sector.

Within the agenda of activities held at the Convention Center. Nuclear Young People also supported the coordination of the Workshop on Nuclear Industry 4.0, where, with the help of Alejandro Carrasco (Enusa) and Luis Felipe Durán (UPM), the attendees were able to see the latest digitization techniques in the industry first-hand. More than 100 convention attendees participated and were able to see demonstrations of digital tools from companies in the sector as well as interact in virtual reality, augmented reality, and other technology environments.

Nuclear Young People would like to thank all the people and institutions that have supported us in carrying out these activities, starting with the Spanish Nuclear Society and the Technical and Organizing Committees of the Annual Meeting for their trust. Of course, to all the people who have been speakers and organizers of these activities, to PoS-Granada and the University of Granada for welcoming us to their city and collaborating in the shared objective of scientific dissemination which is so important during these times. And last but not least, to each and every one of the attendees for their interest and participation in these activities.





COMMUNICATION

The Annual Meeting of the Spanish Nuclear Society got back to its usual format, face-to-face, for the 2021 edition held in Granada. Thus, it once again became the most important meeting point for professionals in the nuclear sector in Spain with more than 700 registered who were able to network again, update their knowledge, and analyze the common challenges and objectives they face in the coming years.

This return to the face-to-face format has marked the strategy developed by the Communication Commission to approach the 46th Annual Meeting, focusing on two fundamental issues: the dissemination of the meeting at an internal level to achieve successful participation and to externally convey the main messages that the Society proposed this year. In this way, the Committee began to develop a communication plan that followed the lines of the one carried out at the 45th Annual Meeting held in Vigo in 2019. The good prior organization, having a large team of communication professionals who carry out their work in the nuclear sector, and the experience acquired in the previous Annual

Meeting have made it possible to carry out the planned tasks and achieve the objectives set.

This plan, prepared in coordination with the Organizing and Technical Committees was also accompanied by the preparation of key messages that we wanted to send to the media, such as the consideration of nuclear energy as an essential part of the decarbonization of the Spanish energy system, the importance of the IF-MIF-DONES project for Granada and the development of fission eneray, the possibility of continuing the operation of the Spanish nuclear park for (at least) 20 more years, and the added value for a city like Granada for hosting a convention with more than 700 professionals from the nuclear sector.

The trust placed in the Communication Commission by the Board of Directors and its collaboration in the different actions that were carried out has been a fundamental part of achieving the media impact objectives that had been set. In this sense, getting the local authorities involved in an appropriate way and reserving spaces for them in the meetings organized by the Society with the media has allowed our messages about holding the Annual Meeting, its activities, and nuclear energy to reach the media with more force. A broad media impact has been achieved with positive content aligned with the key messages set as objectives.

The actions focused on the media, with the sending of press releases, calls for statements by our spokespersons, and management of articles and interviews have been reinforced with the work plan carried out on social networks. The prior planning in this section has made it possible to maintain intense activity on our social media channels during those days.

The communication strategy for the 46th Annual Meeting of the Spanish Nuclear Society has been based on a mix of actions that have made it possible to impact the different target audiences with the appropriate messages, both internally and externally, and have helped the SNE to achieve the main objectives that had been set with hosting its most important annual event.

Fabricación y Reparación:

- Diseño y modificación de equipos.
- Fabricación de equipos a medida y circuitos impresos.
- Reparación de tarjetas electrónicas
- Ingeniería inversa.

Servicios de Ingeniería:

Realización de proyectos llave en mano o incorporación en cualquier de las fases del proyecto: diseño, gestión de suministros y materiales, supervisión de obras, instalación y montaje, puesta en marcha, formación, mantenimiento una vez en funcionamiento.

Automatización y Control:

- Automatización industrial.
- Integración de redes de comunicación industrial.
- Integración de sistemas de seguridad programables en PLC/AS.
- Modernización de sistemas de control.
- Diseño y fabricación de cuadros de control y potencia.





Valladolid – Tarragona – A Coruña

Diseño y Mantenimiento Grúas y Sistemas de elevación y pesaje:

- Realización proyectos integrales en grúas y equipos de elevación, abarcando todos los aspectos en el desarrollo de ingeniería: diseño eléctrico, diseño mecánico, software de control a medida, fabricación cuadros eléctricos y equipos de control, instalación y montaje, puesta en marcha.
- Mantenimiento de equipamiento y sistemas de elevación: comprobación equipos eléctricos, calibración equipos pesaje y células de carga, revisiones de frenos y equipos de transmisión.

Mantenimiento:

- Mantenimiento de equipos de electrónica de potencia: reguladores de tensión, rectificadores, cargadores de baterías y UPS, revisión de cabinas eléctricas y CCM's, revisión de baterías. Ingeniería y consultoría. Suministros.
- Mantenimiento predictivo en transformadores, máquinas rotativas, interruptores, transformadores de medida, etc.
- Calibración y revisión de protecciones eléctricas.
- Puesta en marcha de subestaciones eléctricas.



Formación:

 Formaciones de reguladores de tensión, rectificadores / cargadores, protecciones eléctricas, sistemas de manejo de combustible, máquinas rotativas.





Nanav

COMMERCIAL EXHIBITION



The leadership ability displayed by Iberdrola Generación Nuclear in the use of nuclear technology was revealed once more during its participation at the 46th Annual Meeting of the SNE (Spanish Nuclear



Society), held in Granada. During this event, Iberdrola Generación Nuclear was represented by the Nuclear Generation Director, Francisco López, and the Cofrentes Site VP, Tomás Lozano, together with other members from their teams who, in turn, participated actively as speakers or coordinators during the sessions of this not-to-be-missed event for the national and international nuclear industry.

Under the exhibition stand slogan "Somos Esenciales" (We're Essential), Iberdrola Generación Nuclear highlighted the value of its nuclear power plants, which make use of safe technologies contributing to a reliable, emission-free power supply, completely environmentally friendly and committed to its surroundings. More specifically, at the exhibition stand event attendees learn more about Cofrentes' latest construction: The Interim Storage Facility -ISF-, a facility allowing the station to start the next operating cycle with no space restraints in the spent fuel pools.

Our alignment to the SDGs, specially numbers 7, *Affordable and Clean Energy*, and 13, *Climate Action*, speak volumes about our essential role in the fight against climate change.

The exhibition stand served as a meeting point for professionals and to showcase the use of virtual reality technologies, which are gradually being incorporated into the stations to favor the implementation of new, more effective work practices.

46th ANNUAL MEETING OF THE SNE



Once again, EMPRESARIOS AGRUPADOS INTERNACIONAL took active part this year at the Annual Meeting of the Spanish Nuclear Society. The leading nuclear engineering firm presented its main works in providing complete engineering services for new nuclear power plant projects, support for plants in operation, decommissioning and radioactive waste management, and research reactor projects. Notable domestically are the firm's engineering and consultancy activities for the nuclear power plants in Spain. Internationally, noteworthy achievements include EMPRESARIOS



AGRUPADOS INTERNACIONAL's participation in the pre-construction and project development phases of new nuclear power plants, operational support projects, plant decommissioning and radioactive waste management in several different countries across Europe. Also worth highlighting is EMPRESARIOS AGRUPADOS's participation in the IFMIF-DONES projects

for research and development of materials to use in constructing fusion reactors in the future, and the ITER project for the fusion reactor currently under construction in Cadarache (France). As in other years, personnel from EMPRESARIOS AGRUPADOS played a relevant role at the Annual Meeting, where EAI's CEO and various members of its board of directors engaged in technical and monographic sessions with the broad participation of presidents and session coordinators as well as helping organize the Meeting and its committees.



endesa

NDESA, as the leading utility in the Iberian Electrical System and the main nuclear operator in Spain, was present in the 46th Annual Meeting of the Spanish Nuclear Society. Furthermore, ENDE-SA was the host company of the congress and was the responsible of the proposals of Granada as host city and Miguel Barreiro Bugallo as president of the Steering Committee of the 46th edition. The company's delegation was led by its General Director, Gonzalo Carbó, and was represented on the Organizing and Technical Committees. In this case, the General Director of Andalusia and Extremadura of ENDESA, Rafael Sánchez Durán, acted as representative of the host company in charge of opening the commercial exhibition and welcoming the exhibiting companies. On the other hand, ENDESA decided to include in its stand the important role that nuclear energy will play, providing a guarantee of supply and stability to the grid, in the extreme weather events that are expected in the coming years, as well as highlighting the importance that electric mobility will have in future societies and their ways of moving around.

46th ANNUAL MEETING OF THE SNE



ENUSA was present at the 46th Annual Meeting of the SNE held in Granada, the first one in person after the pandemic caused by COVID-19.

ENUSA took part in the commercial exhibition with an innovative and modern stand with a large screen as a differentiating element. Different videos on the company's technical and social activities were shown on the screen. The stand reflected the company's commitment with the Sustainable Development Goals (SDGs), specifically six were represented: SDG 3, Health and well-being; SDG 5, Gender equality; SDG 7,



Affordable and clean energy; SDG 8, Decent work and economic growth; SDG 9, Industry, innovation and infrastructure; and SDG 13, Climate action.

ENUSA's presence at this meeting was particularly noteworthy, since it was attended by a large representation of the company's management, led by its Chairman José Vte. Berlanga and Corporate Director Rosario Arévalo. In addition, several people were part of the organization: Lourdes Guzmán on the Board of Directors; Carmen Vallejo on the Organizing Committee and Javier García on the Technical Committee. Alfonso Barbas, Alejandro Carrasco and Clara Montalvo also participated actively in the organization.

ENUSA was also present in the coordination of the technical sessions and in the presentations, a total of twenty-one people attended as speakers, presenting the different projects which are being carried out in the company. Finally, three papers were awarded: Marta Berrios, with "European project for the isotopic characterization of irradiated BWR fuel (EURAD)" was the Best Paper on fuel; Karen Arlet Guzmán, with "Technical feasibility study of the use of laser systems for decontamination of radioactive waste" was the Best Paper on Waste Management and Daniel García, with "Automation of internal dosimetry of the area through geolocation" was the Best Paper on Radiological Protection. Besides, Maita Morales won the first place in the photographic contest organized by Framatome in the energy category.

On this occasion, ENUSA was able to demonstrate its commitment to building a more sustainable world within the framework of the 2030 Agenda. lacksquare



GDES participates once again in the Annual Meeting of the Spanish Nuclear Society. The latest innovations at GDES, the new passive fire protection services, and virtual reality solutions all featured on our stand this year. A stand where not only the different services of the Group and milestones in Quality and Safety were on display, but which also showcased our geographical and industrial diversification. Consolidating the group position as one of the companies with the most promising outlook in: nuclear maintenance, surface treatment, decommissioning services, radiological protection, logistics services and industrial digital transformation.

Within the programme of lectures and techni-

cal sessions GDES has had a particularly active participation with the exhibitions: "Decommissioning services at the nuclear power plants of Barsebäck and Oskarshamn (Sweden)", "Mobile boration units for emergency response", "Automated system for the radiological characterisation of radioactive waste drums" or "Internal communication, essential to raising awareness of cybersecurity". GDES not only participated in the technical sessions but also in the workshop on Industry 4.0 organised by Jóvenes Nucleares, introducing "Simulator of the real-time system for monitoring the status of fuel and control rods at Cofrentes NPP" and giving a demonstration on "Virtual reality applied to the design of passive fire protection and testing prior to installation in the plant".

Naturgy



NATURGY GENERACIÓN together with NATURGY INGENIERÍA NU-CLEAR have participated in the SNE Annual Meeting for another year. As in previous years, NATURGY has shown its commitment to the safe and efficient generation of nuclear electrical energy. In this meeting NATURGY has attended with a large group of professionals, who have contributed a large number of presentations in various technical sessions, once allowing them to maintain contacts with other professionals in the sector.

NATURGY has presented its stand under the slogan "We work with energy to serve society, preserving the environment" in which the company's commitment to sustainability has been reflected. The design of the stand has facilitated attendance and has contributed to making it a relevant professional meeting point.



One more year, RINGO VÁLVULAS has actively participated in the Annual Meeting of the Spanish Nuclear Society, held in the city of Granada.

At RINGO VÁLVULAS we really were looking forward to returning to the face to face meeting to be able to have contact with our clients and be able to share experiences and exchange ideas that allow us to have a better understanding of the situation and needs of such important market in our country: nuclear power generation. In this edition, José Manuel Obón - our R&D Director - gave an interesting lecture: "Development and analysis of an expert system for characterizing friction in valve packing"

After overcoming all the difficulties of last year, Ringo has continued to provide service to Spanish nuclear plants during 2021, with relevant supplies:

- Several contracts for Cofrentes NPP, including valves nuclear class 2 and 3 for the Water injection system for the mitigation of fires, accidents, core cooling and spent fuel pools.



- Supply of several contracts to Almaraz-Trillo including nuclear class 2 gate valves with pneumatic actuator for the Isolation of the Fire Protection System (FP) of Almaraz NPP

- Completion and supply of several contracts have also been for Ascó-Vandellós, highlighting the 6"150 # butterfly valves in nuclear class 3 for the Non-Radioactive Refrigeration System of Ascó NPP.

On the other hand, RINGO VÁLVULAS has completed other important supplies in other markets where it is already established. For example, a contract for gate valves up to DN500 with electric actuators, with remote controls by means of stem extensions that pass a wall, for Forsmark NPP in Sweden or the successful completion of the prototype tests of the DN300 nuclear class 2 angle control valves for discharge to the atmosphere of the Kursk NPP in Russia.

Moreover, RINGO VÁLVULAS continues significantly growing in the North American market, where several orders have already been supplied in the US and Canada and new projects have been booked for delivery in 2022: Watts Bar Nuclear in the US and Pickering, Darlington and Bruce Power in Canada. Many of these projects include valves with ASME III Stamp N.

Definitvely, RINGO VÁLVULAS aims to continue being a supplier of nuclear valves with the highest levels of demand, from the point of view of Engineering, Quality and Nuclear Safety Culture. Today, more than ever, in view of the high cost of energy in our country, RINGO VÁLVULAS is clearly committed to nuclear energy: energy with competitive production costs, stable, safe and emission free.



ECNATOM's main activities focus on the management of people, assets and processes at nuclear power plants, both at national and international level. In particular, the inspection of components, the training of plant personnel, operations support engineering, the digitalisation of processes, simulation, the development and supply of equipment for inspection by means of non-destructive testing and the management of radioactive wastes are some of the company's most relevant lines of activity.



TECNATOM is currently an international business group with subsidiaries in France, Brazil, China, Slovenia, the United Kingdom, the United Arab Emirates, Mexico and the United States, which carries out its activities in several sectors, including the energy, petrochemical, transport and aerospace sectors. The company provides services and products with a high technological content, generally designed and developed with in-house technology, tailored to the customer's needs and requirements and always state-of-the-art in terms of mechanical design, electronics, data processing and software. Supporting our customers in their digital transformation is another of our strategic lines of activity. The development of digital solutions to support operations, the implementation of asset monitoring strategies, digital solutions for personnel training and digital simulation solutions are some of the examples of where we support our clients in their transition towards Industry 4.0.

TECNATOM carries out projects in more than 40 countries throughout the world and its methodology and equipment have been validated and certified by the clients and regulatory bodies worldwide.

Westinghouse



This year, WESTINGHOUSE had a team of more than 25 professionals at the 46th annual meeting of the Spanish Nuclear Society, where it has once again participated as a sponsor of the most important nuclear energy event in Spain. Our experts led presentations in the areas of probabilistic safety analysis, technological innovation as engineering support, graphite reactor decommissioning, longterm operations, waste management and reduction in decommissioning projects, among others.

WESTINGHOUSE has more than 50 years of ex-

perience in our country. In 1968, Westinghouse supplied the first Spanish nuclear power plant José Cabrera and, at present, five of the seven nuclear power plants in Spain are equipped with Westinghouse reactor technology: Almaraz I, II, Ascó I, II and Vandellós II. The company opened its Madrid office in 1972. In 1999, WESTINGHOUSE acquired the nuclear division of Initec, and in October of this year, Westinghouse announced the acquisition of 50% of Tecnatom in line with its strategy to expand its technical capabilities in nuclear refueling, engineering and digital services worldwide. The transaction is subject to approval by the relevant authorities.

In addition to the Madrid office, WESTINGHOUSE has two more offices in the Tarragona area: an engineering office in Vila-seca and a field services office in Hospitalet. The Vila-seca office provides engineering support services to the three nuclear power plants of the

Ascó-Vandellós Nuclear Association (ANAV). In addition to the AP1000 construction support projects, the Tarragona/Madrid Engineering Group participates in several international projects, mainly for clients in Sweden, Switzerland, France, Belgium and Ukraine.

The services and products offered by the company in Spain include engineering services, nuclear fuel supply (through a license agreement with ENUSA); fuel inspection and repair services; field services and modifications; instrumentation and control for the plant's reactor protection and control systems; decommissioning and decontamination services, as well as construction services for Spanish plants.

Today, WESTINGHOUSE employs around 300 highly qualified professionals in Spain, providing its Spanish utility customers (Endesa, Iberdrola, Naturgy) with the most reliable and dependable nuclear power plants, nuclear fuel, plant automation and plant operation products and services.

BEST PAPERS

QUALITY, REGULATION, ORGANIZATION & HUMAN FACTORS AREA

17-01 SOFTWARE PARA SISTEMAS DE GESTIÓN DE LA CALIDAD Y ORGANIZACIÓN DE INSTALACIONES RADIACIVAS (SIGOR)

Miguel Embid Segura. CIEMAT - Centro de Investigaciones energéticas medio ambientales y tecnológicas.

FUEL AREA

26-06 **PROYECTO EUROPEO PARA LA CARACTERIZACIÓN ISOTÓPICA DE COMBUSTIBLE IRRADIADO BWR (EURAD)**

Marta Berrios Torres. Enusa Industrias Avanzadas, S.A., S.M.E.

DECOMMISSIONING AREA

21-10 INNO4GRAPH: DESARROLLO DE HERRAMIENTAS PARA DESMANTELAMIENTO DE REACTORES DE GRAFITO. RECOPILACIÓN DE DATOS DE REACTORES DE GRAFITO EUROPEOS

Gonzalo Medinilla Téllez. Westinghouse Electric Spain.

DESIGN AND BEHAVIOR OF SSC AREA

14-01 USO DE TUERCAS REMACHABLES EN ESTRUCTURAS CIVILES DEL ÁMBITO NUCLEAR COMO ALTERNATIVA A UNIONES ATORNILLADAS TRADICIONALES

Ángel de Blas Gordo. Empresarios Agrupados Internacional.

WASTE MANAGEMENT AREA

20-01 ESTUDIO DE VIABILIDAD TÉCNICA DEL USO DE SISTEMAS LÁSER PARA DESCONTAMINACIÓN DE RESIDUOS RADIACTIVOS Karen Arlet Guzmán García, *Enusa*,

ENGINEERING AND INNOVATION AREA

18-01 SOLUCIONES TECNOLÓGICAS APLICADAS POR ENSA EN LA SOLDADURA DE LOS SECTORES PS1 Y PS4 DE ITER Domingo Lima Almeida. *ENSA*.

MAINTENANCE, INSPECTION & TESTS AREA

24-09 **SAIP COMO HERRAMIENTA DE INSPECCIÓN** Ernesto Villalba Jabonero. *Tecnatom / Inspección y Pruebas.*

MEDICINE AND HEALTH IN NUCLEAR AREA

2-07 ESTUDIO DE LA ACTIVACIÓN DEL AIRE Y AGUA EN CENTROS DE PROTONTERAPIA

Gonzalo García Fernández. *Universidad Politécnica de Madrid.*

OPERATION AREA

32-03 EXPLOTACIÓN DE DATOS Y USO DE DASHBOARDS PARA OPTIMIZAR LA TOMA DE DECISIONES EN LAS PLANTAS

Javier Barroso. Tecnatom.

RADIOLOGICAL PROTECTION AREA

23-02 **AUTOMATIZACIÓN DE DOSIMETRÍA INTERNA DE ÁREA MEDIANTE LA GEOLOCALIZACIÓN** Daniel Garcia Garcia. *Enusa Industrias Avanzadas, S.A., S.M.E.*

NUCLEAR SAFETY, LICENSING, AND PSA AREA

28-05 ANALYSIS OF BORON DILUTION SEQUENCE IN NUSCALE POWER MODULE WITH TRACE CODE Jorge Sánchez Torrijos. *UPM*.

RADIATION AND ENVIRONMENTAL PROTECTION AREA

25-10 NUCLEAR FUEL CYCLE OPTIMIZATION UNDER UNCERTAINTY

Francisco Alvarez Velarde. Ciemat.

COMMUNICATION AREA

30-08 CAMBIO CULTURAL: CLAVE PARA EL MARKETING DIGITAL

Ana Izquierdo Garijo. Tecnatom.

TRAINING AREA

05-02 EVOLUCIÓN DE LOS SIMULADORES 3D. UNA PROPUESTA DE ENUSA-ENSA AIE PARA ENTRANMIENTO VIRTUAL CON UN ENFOQUE OJT. Vanessa Barambones. *Tecnatom.*

FUSION AREA

31-02 CARACTERIZACIÓN DE LOS PARÁMETROS DE TRANSPORTE DE HIDRÓGENO Y DEUTERIO EN EL ACERO FERRÍTICO-MARTENSÍTICO DE BAJA ACTIVACIÓN NEUTRÓNICA EUROFER Igor Peñalva Bengoa.

Universidad del País Vasco (UPV/EHU.)

THERMOHIDRAULIC & NEUTRONIC AREA

16-03 ESPESOR MEDIO DE LA PELÍCULA DE LÍQUIDO EN FLUJO ANULAR AIRE-AGUA EN CAÍDA LIBRE VERTICAL ANALIZADO DE FORMA EXPERIMENTAL Y MEDIANTE CÓDIGO CFD

Yago Rivera Durán. UPV-IIE.

POSTER AREA

36-05 CONTRIBUCIÓN ESPAÑOLA AL ACELERADOR DE IFMIF-DONES

Ivan Podadera Aliseda. CIEMAT - Centro de Investigaciones energéticas medio ambientales y tecnológicas.





La energía nuclear es una alternativa limpia, segura y competitiva



ROSATOM

ENYGE



ing this event, whose cell division process was already beginning. It was necessary to establish a presidency to host the ENYGF: the representative part, a restless, intelligent mind

with projection capacity, was merged with the presidency of Nuclear Young People with Francisco Suárez at the helm. Proactivity, know-how, being an executive in decision-making, and a degree of experience defined the following components of that leadership: Daniel Gallego and Alfonso Barbas following the advice of Gert Pille, who headed the technical program of the previous edition of ENYGF. They, together with the ENYGF proto-team, began to elaborate the choice of the place.

In our minds were Madrid, Cáceres, Valencia, Tarragona, and other cities. The city had to offer a good compromise solution between logistics, the roots of the nuclear industry, and ease of access from abroad. Finally, it was decided to hold the ENYGF21 in Tarragona in anticipation of all the activities to be carried out outside the convention and due to the proximity to large companies in the sector and the Catalan nuclear power plants. And well, why not say so, also because of its enviable spring weather since the convention would take place in April 2021. A convention of this magnitude needed a division of tasks, and to establish an organizational structure divided into areas. Therefore, we replicated what we had learned from the Nuclear Society, creating committees.

First, logistical issues had to be resolved. A person with experience in resource management in contact with Tarragona was needed, and who could function like a fish in water in contracting services. Irene Ramírez, a new member of the Board of Directors, was the person we needed to put our future prospects into practice. The technical committee, essential, needed two figures who had enough relationship and connections with the world of research and industry to organize a strong, ambitious technical program that would make our edition of ENYGF stand out. Since we couldn't find those people, we had to make do with Antonio Jiménez and Carlos Vázquez (Charlie), who began to wonder what kind of convention they wanted to build.

Next, and as a lesson learned from all these years, understanding the importance of communication, it was necessary to know how to convey not only the future content of our convention but also to establish a general strategy to bring to all audiences what was about to be pass in ENYFG21. This figure involves many aspects, from knowing about social networks, programming, and content generation and development to managing relationships with the media and speakers. It is not an easy task, and since two heads are better than one, a team with different talents had to be created. With this task, the ideal person for the position of leader, Luis Felipe Durán (spokesperson for Nuclear Young People with two years of experience in communication) began looking for the best profiles that were in the SNE sphere to undertake this new path.

Last, and not least, but much more delicate is the figure for our financial administration. Here you should put a person with enough trust from the top, but without too much familiarity with the rest of the team to be able to tighten the screws when necessary. We have Ana González Felgueroso, a person with experience in the world of finance and with sufficient knowledge to guarantee that we would not mess up in any of our legal decisions.



Photograph of the family of the Nuclear Young People Board of Directors at the gala dinner.

46th ANNUAL MEETING OF THE SNE

46th ANNUAL MEETING OF THE SNE



opment of a vaccine, and the agreement between the politicians who directed our lives in those days almost millimetrically.

During the summer months, the first bucket of cold water arrived: our contingency plans. Would it be canceled? Would it be postponed? In April would everything be alright? Many doubts: points for and against in a completely unknown situation. With the support of the SNE and the ENS, it was easier to make a supported decision, and since giving up this opportunity was never really an option, the prudence that characterizes this sector and that already flows through our veins led us to postpone the event to September 2021 with the consequent paradigm shift: we had more time, a strategy to abort and restart, uncertainties for logistics for the technical part, and a reverse gear in communication, a return to prudent silence and learning to convey confidence to our teams, potential participants, those we already had, and those yet to come. The important thing in those days was to convey an image of security and trust, even if we had never organized a convention, even if we had only attended face-to-face conventions, and even if for months all the activity took place in virtual format.

We had to quickly become familiar with the concept of a virtual convention and a hybrid convention, recognizing that a virtual convention was easier to organize (and cheaper) than a hybrid format, but the hybrid decision, technically riskier, was nonetheless the one that offered us greater chances of success for the following reasons: we increased our potential audience, as well as our staff of authors and speakers. In the event that the pandemic had subsided, the hybrid format could be maintained, although with 90% attendance, or if the opposite occurred,



Workshop on communication given by Amparo Soler and Laura Ortega from WiN Spain.



Workshop on the Spanish decommissioning model given by Teresa Palacio and Álvaro Rojo from Enresa.

we could give more importance to the virtual part. However, in favor of trust and providing guarantees to all our stakeholders, even if it were more difficult, we never gave up trying to reach the perfect compromise solution between one extreme and the other, allowing everyone to participate at all times, and also to do so in the format of their choice. Tick – tock, tick – tock, ... - the second hand of the wall clocks in our homes.

Without a doubt, if we had to choose a metaphor to describe this process of joint decision making, planning, and execution, we could assimilate it with the convergence of an iterative calculation in which the numerical seed was quite far from the final solution: goings and comings, oscillations, and many, many iterations. But the SNE was there to provide us with our room to maneuver, to make these youngsters feel protected, and our leadership, always attentive, listened to us and made us part of this whole story.

The backstage of a convention

Finally, mid-September 2021 arrived, we were uneasy about Monday the 27th. The weekend before starting, we took our suitcases and got on a train, plane, or car to get to our beloved "Seminari." This would be the place where all the madness of the convention was involved, and it gave us so many joys and the occasional scare. It must be said that the biggest scare was the one given to us by the "hostels" where we stayed to save on the budget. Sleeping there the first night had already prepared us for what was to come that week.

To put this in context, we started on Monday, and it was now Saturday. Imagine, some of us hadn't even been in the situation for half an hour and problems had already arisen. For starters, a sponsor poster was missing, and for some reason, another one had arrived in its place. And not from anywhere, from the Brotherhood of Silence in Almería (if you read this, we don't have your poster). Yes, this is true. It has been engraved on us forever. And more things. It also didn't help that downtown Tarragona didn't have anything open on a Saturday mid-afternoon. You know, hunger and stress, that doesn't go well. Fortunately, today's young people can handle anything.

Of course, on Monday morning everything was already resolved. Minus one small detail, the most important problem of our generation. We had no signal. It was a hybrid convention and there was no internet connection! Full panic. With the concrete walls and being located next to the Tarragona wall did not help. Luckily, those who had to be connected to broadcast the event got connection cables, and the rest, because those of us who had unlimited data rates thanked our companies, and when we did not find coverage, we went out the door to upload that announcement to Whova (our convention app) or send a press release.

The first day was an unforgettable experience. You know that sense of fear when a small child runs off and crosses a sidewalk without their parents? Maybe it's a bit of an exaggeration, but it was something like that. We started the online connection 10 minutes late, which meant not broadcasting the speech of the President of the SNE. For us, this was a disappointment after the support he had shown us. After that, we managed to come back. In the afternoon, we had internal crisis meetings for each committee because we were like headless chickens, but now with a more relaxed attitude. Some more than others. Some didn't sleep that night, and not because they were drinking beers but because of the pressure that everything would go well. We learned the importance of PROTOCOL.

From that first day, we learned three things: the first was that you have to expect things to happen that you did not expect and learn to be decisive; the second was that you have to plan as much as possible in advance to be prepared in the moment; and the third, a phrase from our convention leader Francisco Suárez, "You cannot run through the halls. Act normally, you have to maintain your composure." Thanks, Pac.

As the days passed, everything went smoothly and we received very good comments from attendees, both in person and online. The team performed well in all situations. They enjoyed presenting their own work and there was even a time to escape to the beach. It was definitely a learning curve, all at once all of a sudden and then we settled down. Such were the lessons learned from the first day that we then had a team meeting at 9 in the morning every day. Yes, every day, even the day after the gala dinner. We took away unforgettable personal and professional experiences. From visiting the Ascó simulator (those who could), visiting the ruins of Tarragona (those who could), getting the CSN Advisor, Javier Dies, or the director of WNA, Sama Bilbao, to attend our convention, to putting our English into practice. From this humble paragraph, we could never write a few words of gratitude that reflect our feelings for having been able to count on them.

In conclusion, they were very long days, but at the end of the day when we all sat together on a terrace to talk about the day and establish the protocol for the next day, we only had words of pride. It seems unbelievable, but there were 150 people present, 200 people connected online, and 100 papers were presented. Wow.

There is only one last thing we can say about the experience. Everything only works when it's on track. Sometimes it's better to be safe than sorry. And as we have said before, a project is only the shadow of the true team of human beings that supports it.

For me, for Whova, and for all my colleagues

We nuclear young people have gone through a completely new situation, and we have had to make decisions that we had never considered making. But we haven't done anything that any of you, our readers, haven't had to deal with over the last two years. These lines serve to tell our experience and to try to convey our emotions to you.Once everything is done and we see all the people who have accompanied us in this experience, we think of all the personal and professional facets that we have discovered about them. We



Photograph of the representatives from European nuclear young generation with members of the Nuclear Young People team.



Final photograph of the convention: participants, speakers, VIP guests, and the organizing team.

see them in their day-to-day carrying out their role at the University or at the company, and we realize that this experience has helped us to discover much more about all of them, things that we would never have been able to see if they had not accompanied us. They, perhaps without realizing it, have made us discover ourselves.From Nuclear Young People, we are deeply grateful to all the organizations and institutions that have supported us, we always will be, because without them we would not have been able to carry out this enterprise. But without hesitation, we will never find the words to express our gratitude to all the people who have helped us. Our colleagues, friends, have lent us the most important resource they have: their time. This time of yours, wrapped in your way of working, in your kindness, and in your good attitudes in the face of adversity. Knowing how to work as a team, solve problems together, exercise our critical vision, and propose solutions. And always with a smile on their face. The same smile after only 3 hours of sleep that left in the morning for the Seminari and that returned every night walking silently from the beaches of Tarragona and that has made us trust them and not feel desperate while we thought that our plans did not work out, or that at any given moment the world would fall on us. And it is their faces, our faces, that we see in the photos remembering their eyes fondly, because we see them happy, enjoying themselves: participants, collaborators, organizers... and we can feel no other sensation than pride in having been able to share this experience with them, and joy in knowing that everything we have done, with our successes and our mistakes, is ours, yours, theirs, all of you who have made it possible. May the successes serve us to proudly remember those days, and our mistakes to reinforce the lessons learned.We could never describe all that we experienced during the organization of this convention in a single article. From the beginning, the emotion, the expectations, during the organization the fears, the uncertainties, the illusions, and during the days of the convention, the stress, the chaos, the satisfaction, the support of all the people who reached out to us... but if we have only been able to convey one percent of what happened, we leave satisfied. The taxi is already waiting for us to take us to the Camp de Tarragona station, suitcase in hand, we return home. Goodbye.

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- Plant decommissioning

ACTIONS

- Preventive, predictive and corrective maintenance
- Design modifications
- Auxiliary activities in the NSSS
- Boiler and turbine adjustments

REFERENCES

- Almaraz 1 & 2 NPP
- Cofrentes NPP
- Trillo NPP
- Vandellós 1 & 2 NPP
- Ascó 1 & 2 NPP
- Sta. M^a de Garoña NPP
- José Cabrera NPP
- Valdecaballeros NPP
- Andújar Uranium Plant
- Escombreras TPP
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Almaraz Nuclear Power Plant (Spain).



ITER (France).



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