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— William Arthur Ward

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Interview with Carmelo Palacios, General Manager at SNGC
Interview of the Month

Interview with Carmelo Palacios, General Manager at SNGC

E-mail: carmelo@sngc.es

Dynatom: Good morning/ afternoon, Mr. Palacios. Could you introduce yourself, and tell us about your background, in particular the reason you joined the Polytechnic University of Madrid.

Carmelo Palacios: I am a mechanical engineer since the beginning of the 1970s when I got my degree. I have been working all my life in international trade and commerce, specifically after 1976 in the nuclear sector.

I enrolled in the Polytechnic University of Madrid in the mid-1960s to study mechanical engineering because during school I was very good in sciences (Physics, Math and so on) and not so good in the other subjects. I liked engineering.

Additionally during the 1970s and at the same time that I was working I also studied economics at the Madrid Central University. I got my degree in economics at the end of the 1970s.

Dynatom: After your graduation as mechanical engineer, did you join immediately the nuclear market/ ENSA?

Carmelo Palacios: I was working for 5/6 years at an international trade company before I joined ENSA in 1976 where I held different positions. The most important were Purchasing Manager and lately Business Development Vice-president.

After the downfall of the Soviet Union I worked and coordinated several Spanish companies to help to improve the safety of the Ex-Soviet Nuclear Power Plants through several programs (Tacis, Phare, and also EBRD) and also through swap and barter operations.

In the 1980s I visited India many times and we supplied SGs to NPCIL before the Nuclear Supply Group (NSG) banned the supply of these components to India in 1985 and 1986.

During my time as Business Development Vice President, in addition to commercial, my responsibilities also covered the projects and ENWESA, which is the ENSA services company.

Dynatom: Where ENWESA does has its activities?

Carmelo Palacios: Mostly in Spain, also in France.

Dynatom: Can you tell us more about your achievements in ENSA?

Carmelo Palacios: I was responsible for ENSA capacities development in spent fuel transport and storage, for example the cask and rack business and worked in countries like Finland, Korea, the USA, the Chinese mainland and Taiwan and of course Spain.

In 2005, with China/Taiwan we finished a very successful turnkey project for the re-racking of the Kuosheng NPP spent fuel pool, including design, manufacture, supply and, most importantly, the erection of the racks under difficult radiological and others conditions using both Spanish and Chinese/Taiwan personnel working together to the total satisfaction of our customer, Taipower.

At the beginning of the 2000s, I contributed to the signature of the nuclear agreement between China and Spain.

I was the salesperson responsible for the contracts for casks for Daya Bay fuel transport to Lanzhou (contract signed with EEEC
and CGNPC), Racks for Lingao 3 and 4 and heat exchangers for Taiwan.

I have also been a member of the Spanish Nuclear Society Board and of other Spanish companies. I am currently serving as SNGC General Manager.

**Dynatom: Before the creation of the SNGC, did you have experience in the Chinese market?**

**Carmelo Palacios:** My first visit to China was in 1987 to participate in a Nuclear Exhibition in Beijing and then we took a long trip to visit nuclear installations in Xian, Chengdu and Shanghai. The trip was sponsored by the Chinese Nuclear Society and included about 30 westerners.

In ENSA, the first contract was for Qinshan 2 steam generators back in 1995. I was a member of the team.

Afterwards I was responsible for the contract, in 2002, between ENSA and EEEC for the two transport and storage casks to transport fuel from Daya Bay to Lanzhou, in 2007 for the supply of the spent fuel racks for Lingao 3&4, localizing the fabrication at Xian Nuclear Equipment, and in 2010 for the Taishan heat exchangers.

**Dynatom: the SNGC was created in 2006 as a result of common marketing needs from three Spanish companies, Tecnatom, ENSA and ENUSA. Can you tell us how this consortium originated?**

**Carmelo Palacios:** The three companies were collaborating from time to time in different aspects of the business. We decided to make these collaborations stable as the three original partners have significant potential synergies, which could be capitalized on in the international markets and in China in particular. The SNGC members could benefit from the increase in size resulting from the joint venture as well as from the long-term relationship between them, mainly in the Spanish market. The main objective was clear: offer the Chinese nuclear market an alternative competitive option through the combined capacities of each member company.

**Dynatom: two years later, Ringo Valves joined the consortium, and since the last 5 years this consortium has four founding partners. Do you have an expansion plan for new partners and members?**

**Carmelo Palacios:** Yes, after Ringo Valvulas joined the SNGC, we have always been open to new value-added collaborations and we are currently studying the possible participation of other partners. We want the new partners to be similar to us, in the way they sell and behave with the market.

**Dynatom: can you tell us more about the structure and operation of the SNGC, such as the election of the president?**

**Carmelo Palacios:** The SNGC structure is very simple. There are four levels to manage the consortium: Presidents, Board of Directors, Executive Committee and the General Manager.

The President rotates yearly from each company. I am the General Manager and I have the full support of the four companies. We have full time employees in China working for us.

**Dynatom: this consortium represents today 2,000 professionals from the nuclear industry. How the Chinese market impacted the Spanish industry?**

**Carmelo Palacios:** The Chinese market has had a significant impact on the Spanish Nuclear Industry as it has enhanced our international position and improved our competitiveness. Our technology has enabled the four companies to be on the cutting edge of the nuclear Industry.

Our presence in China has allowed us to develop new business lines (for example: fuel equipment), reinforcing the cooperation among the partners in Spain. It has also offered us the opportunity to gain visibility in front of the Spanish Administration and present
ourselves as relevant actors capable of undertaking complex projects in the international markets. Our activity in China has also served in some cases to increase the workforce with highly qualified employees for demanding projects (Tecnatom control rooms). Finally, we have received important media coverage which is not easy to obtain in other markets.

At the 10th China International Exhibition on Nuclear Power Industry

Dynatom: the SNGC is oriented to technology transfer to local organization and international cooperation; can you give us some case studies in China?

Carmelo Palacios: We have several examples of technology transfer and cooperation:

ENSA has supplied Steam Generators to China for many years. As an example we can mention the collaboration with SENPEC (former Shanghai Boiler Works). In 2000 ENSA supplied 3 SGs for Qinshan phase 2, units 1 and 2 collaborating with SENPEC which manufactured 1 SG. After that in 2008 ENSA manufactured for the same power plant units 3 and 4, one SG and SENPEC made 3 SGs. In 2012 ENSA repeated the same collaboration with SENPEC for Hainan (Changjiang). Recently, ENSA has continued the collaboration with SENPEC in the very challenging project of manufacturing 2 AP1000 SGs for Sanmen2 also with SENPEC.

Advanced technology has been used to manufacture the AP1000 SGs. ENSA is supporting SENPEC in the completion of the AP-1000 SG at SENPEC’s shop.

In other areas, ENSA has manufactured the Ling Ao 3&4 racks in CNNC Xi’an Nuclear Equipment according to a cooperation agreement between both companies.

TECNATOM has established in Beijing a representative office and they are in the process of creating a local Chinese subsidiary company (WOFE). From this new company they would be working in the areas of control room and simulator design.

On December 11th, the signing ceremony for the contract between TECNATOM and CTEC for the Yangjiang 5 & 6 DCS back-up panel was held in CTEC.

TECNATOM has established a Joint venture named CITEC for inspections. I may talk later about this.

We have held many seminars and workshops for different Chinese companies in which we have transferred and proposed to transfer many of our technologies and international experiences of the four companies.

The importance of a long-term relationship between companies is that it leads to more confidence and helps to enable new collaboration in future projects.

Dynatom: Basically you match the strategy of the Chinese government: you base your business on technology transfer...

Carmelo Palacios: Yes we “try” to follow the market!

Dynatom: SNGC aims to provide an integrated offer to Chinese customers, can you tell us for example how Enusa and Tecnatom cooperated with China Jianzhong Nuclear Fuel in Yibin?

Carmelo Palacios: ENSA has supplied jointly with its partner TECNATOM, fuel rod ultrasonic inspection equipment to modernize the fuel manufacturing capabilities of CJNF’s Yibin Plant. This has been the first contract for ENSA in China and it can be considered as a good example of synergies between the SNGC partners and a great achievement in the relationship between CJNF and ENSA. This relationship began in 2008 with the signature of a MoU and since then this relationship has consolidated over time.

Under the contract, ENSA markets the technology implemented in its Juzbado factory and coordinates the different phases of the project, with TECNATOM as the lead manufacturer. Both companies work together in the final implementation of the technology in Yibin.
Dynatom: Do you have the similar cooperation with Baotou?

Carmelo Palacios: Not yet, but we are working on that!

Dynatom: the four companies participate Candu, VVER, EPR, AP1000, HTR and others type of reactors. Are they actively involved in Qinshan III, Tianwan, Taishan, Sanmen, Haiyang and Shidaowan?

Carmelo Palacios: The participation in Candu, VVER, EPR, AP1000 and HTR refers to the international markets. In China we are participating in Taishan (EPR), Sanmen and Haiyang (AP1000), but not in Tianwan (VVER) and Shidaowan (HTR). Ensa was awarded a contract in South Africa for the HTR technology, for the design of the vessel and stress analysis; but the project of the HTR stopped in South Africa.

Dynatom: you expansion is also the result of many cooperation agreements signed with CNPRI, Xi’an Nuclear Equipment, NPIC, China Technology Engineering Company and Suzhou Nuclear Power Institute. Can you tell us if the SNGC was at the origin of this market development or this is due to individual actions?

Carmelo Palacios: A great part of this development is due to individual (company) actions. SNGC has participated on a case by case basis to a greater or lesser extent.

Dynatom: Can you elaborate more on the Joint Venture between Tecnatom and CITEC?

Carmelo Palacios: CITEC is a good example of success. It was created in 2007 and now is working at full speed.

CITEC is an inspection company created to meet the needs of pre-service (PSI) and in-service inspection (ISI) of the nuclear units of China Nuclear General (CNG). CITEC mainly covers the Chinese market and collaborates with Tecnatom in certain activities on the international market. Currently, Tecnatom owns a 25% stake in CITEC.

CITEC is a specialized company focusing on the supply of professional in-service inspection and non-destructive testing, technology research and development and technical services. Through in-service inspection technology transfer and cooperation with TECNATOM, CITEC possesses the capability for automated inspection equipment design, development, manufacture, operation and maintenance as well as technology updating, and it masters in-service inspection techniques and methods for various types of nuclear power plant reactors. According to different in-service inspection code requirements, CITEC can supply in-service inspection services for different types of nuclear power units, including the reactor pressure vessel body inspection, dissimilar metal weld inspection, steam generator tube inspection, automatic piping inspection, nuclear control rod assemblies, etc., and other major inspection items.

Dynatom: Have you offered training service as well?

Carmelo Palacios: I remember in 2008, we had Chinese engineers who came to Spain to be trained, and before that Tecnatom in 1988 trained the operators for Qinshan 1. As you know Tecnatom is owned by the Spanish Utilities: Iberdrola, Endesa and Gas Natural-Fenosa. At the beginning Tecnatom had two simulators in their office in Madrid, and in 1987-1988, the Chinese engineers came and were trained.

Dynatom: your main scope is a general marketing effort and coordination, such as participation in exhibitions, common delegation and publication. How is the finance generated to set up this organization?

Carmelo Palacios: The budget is financed by fees paid by each of the four companies according to the services provided by the SNGC. We do not have any external support. For the exhibition we have a support from ICEX, the Spanish export trade promotion, but we rely mostly on our members.
Dynatom: So do you plan to open your organization to new members to become financially independent?

Carmelo Palacios: Around 95-98% of the cost is already supported by our members. There can be supports for international exhibitions according to the international treaties signed by Spain, but this is a very small part of our budget.

Dynatom: Since 1987 you participate on regular basis to trade shows in China and recently the Spanish Institute for Foreign Trade (ICEX) supported your presence in various events. Can you tell us more about your relation with ICEX?

Carmelo Palacios: ICEX is the governmental Spanish Export Promotion Agency to help Spanish companies develop foreign trade operations. It is similar to agencies in other countries like USTDA in the USA, UK Trade & Investment (UKTI) in the UK and UBIFRANCE in France. Its activities are similar.

ICEX supports and coordinates all the Spanish nuclear companies, and not only SNGC, which require a presence at international nuclear trade conferences and exhibitions and in many other sectors of the economy. It is also a source of information.

Dynatom: ICEX has offices in Guangdong, Beijing, Shanghai and Hong Kong, do you use these offices as a platform for SNGC?

Carmelo Palacios: The Spanish embassy in China has commercial offices in these four Chinese cities. ICEX is also at these offices. We use the services of these offices and of course the Embassy, but not in Hong Kong. We use the offices in particular during the exhibitions.

Dynatom: we heard that you signed a MOU General Agreement with CNEA. The French PFCE did the same last year as well. What are the benefits for such consortium to sign with the CNEA?

Carmelo Palacios: Yes we signed an MOU with CNEA in 2011. The benefits are the exchange of information and ideas and better knowledge of the market.

We have signed different collaboration MOUs with Chinese companies such as

- Xi’an Nuclear Equipment Co. Ltd. (XNE), capital goods manufacturer.
- China Nuclear Power Research Institute (CNPRI)
- China Jianzhong Nuclear Fuel Corp. (CJNF), which operates the Yibin nuclear fuel factory
- CNNC broad scope MoU SNGC General Agreement with CNEA at Shenzhen mentioned above
- NPIC MoU for irradiated fuel inspection equipment
- Suzhou Nuclear Power Institute
- China Technology Engineering Company
- Nuclear Power Institute of China

Dynatom: What about their cooperation with NPIC on electrical penetration for European NPP? Do you consider the SNGC as the ideal partner for the global expansion of the Chinese nuclear industry?

Carmelo Palacios: Tecnatom is working with the Nuclear Power Institute of China (NPIC).

One focus is electrical penetrations for nuclear facility containments manufactured by NPIC.

Tecnatom and NPIC have analyzed the steps to be taken to ensure their compatibility with Western standards. Different commercial opportunities have been identified at both Spanish and overseas plants. There is currently a commercial agreement with NPIC that gives Tecnatom exclusive rights to commercialize the penetrations.

Regarding your second question SNGC helps support the commercial relations between the four partners and other companies. Although this collaboration is focused on Chinese territory, it is not strictly limited to it.

Dynatom: Ringo Valvulas was established in 2000 and manufactured more than 100,000 valves for 20 NPP, using French, American and Russian standards in particular for Qinshan I and II. Do you see more pressure for localization of such valve in the Chinese market?

Carmelo Palacios: Yes, there is a lot of pressure for localization but we expect to overcome this situation. There are two important factors:

- Ringo Valvulas will obtain the ASME stamp very soon.
- Ringo Valvulas has recently finished the erection and installation of a new bay at the Zaragoza (Spain) shop. This bay has the most modern equipment that the valve industry needs for design and
fabrication of nuclear grade valves.

These facts position Ringo Valvulas as one of the leaders for the supply of nuclear valves. At this time Ringo Valvulas is supplying valves to more than 20 NPPs in 11 countries.

Dynatom: Ensa is one of the most successful stories for a foreign manufactures: The company manufactured casks for Daya Bay, Steam Generators (Changjiang, Qinshan II) Racks (Ling Ao II) and recently Steam Generator for the AP1000 in Sanmen and Heat Exchangers for the EPR in Taishan: Do you see this success as a direct result of a group marketing through SNGC?

Carmelo Palacios: Ensa is one of the most qualified world suppliers and its portfolio is very attractive because of its diversification and high technology. Ensa started to collaborate with Chinese companies before the SNGC group was created. Nowadays, Ensa is looking for more collaboration in China, with new products and new areas. SNGC is working with Ensa to help identify new opportunities and partners. We are also looking to offer to the Chinese market a potential combined portfolio of the four Group companies.

An example of the continued efforts being made is the very recent contract for Ensa of one cask for the Chinese market that was done with the support of SNGC. SNGC is more on the marketing side and support, the sales and technical aspects are of course executed by the companies.

Dynatom: your website is maybe the only platform in English and Chinese that is updated on regular basis. How did you decide to create such a media?

Carmelo Palacios: First of all thank you very much for this acknowledgment.

From the very beginning we thought that it was very important to show to the Chinese market our capabilities and operations all over the world. We are highly specialized companies with high technology and we have to make a special effort to show everybody our capabilities. One of the main reasons for establishing the SNGC was to make us more visible.

Dynatom: We checked the websites of other organizations involved in the Chinese market, in particular the French ones “PFCE” and “GIIN”. Their websites shows the profile of their members. You decided to have a top notch platform of communication; can you tell us the reason?

Carmelo Palacios: We had several reasons: China is a very big market, and complex. We decided to promote and inform the market through a good website, regularly updated. If you are a SME, you may not have someone who can updated the website, but in SNGC we have a team dedicated to this activity. We thought from the beginning that we have good capability but we have to educate our prospects and clients. Our newsletter in Chinese is an example of our communication.

In addition to our website http://www.sngc.es/ in Chinese and English, we created a mirror website in China http://www.sngc.com.cn/only in Chinese; we launched this website in October to let our Chinese friends have a fast access to our information.

Dynatom: the website is not only on nuclear, do you expect to use the SNGC for other markets?

Carmelo Palacios: Maybe you refer to some newsletters in which we mention valves for gas and oil supplied by RINGO VALVULAS.

We have added these references in cases in which the product, the valves, supplied by RINGO VALVULAS are of high quality and difficult to design and manufacture and with requirements as demanding as nuclear, in order to show our web visitors that we are also in the top ranks of other industries.

The SNGC as such was created specifically for the nuclear sector.

Dynatom: how do you see the future of SNGC in China? And its impact for the overseas Chinese markets such as Argentina?

Carmelo Palacios: The companies of the SNGC group have a tremendous world acceptance and experience. They are extremely attractive partners to work with. We are optimistic in this area. We have been working all these years with Areva, Westinghouse, GE, so we are also looking forward a close relation with our Chinese friends in overseas markets.

For SNGC in China, we of course ambition to grow in China, to be more intensive and support the business of our members and we also start in India.
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"The function of leadership is to produce more leaders, not more followers"

— Ralph Nader

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2014 the 14th China International Metallurgy Industry Exhibition
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Contact: Wang Tao
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The 12th China International Foundry Expo (Metal China)
Date: May 19, 2014 -22 days
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June
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1. Introduction

The environmental and geopolitical problems that are associated with nuclear power stem in part from the accumulation of the transuranics Am, Cm, Np and Pu in used nuclear fuel. By limiting the production of these four elements many of the concerns that surround the future development of nuclear energy would be significantly reduced. This fact has been known within the nuclear engineering community for decades, and several methods for transmuting these transuranics into more benign forms have been proposed. At present, the only option for recycling any of the transuranics is to use commercial reprocessing mix plutonium and uranium oxides to produce a mixed oxide fuel that can be used in a conventional reactor. However, due to neutron capture in the uranium, these fuels also produce transuranics while in the reactor, and are only somewhat effective at limiting their production.

An alternative to mixed oxide recycle is to entrain the transuranics in a uranium free matrix. The thorium fuel cycle is an example of this. Here energy comes from the fission of 233U which is bred in by neutron capture in the thorium. However, 233U poses a significant proliferation risk and in practice 238U would be added to the fuel to dilute it. However, the presence of uranium in fuel again results in the production of the transuranics that one is trying to get rid of. Another option that has been explored is to blend the transuranics into a zirconium dioxide matrix, Fig. 1.

Figure 1. The inert matrix fuel cycle. Spent fuel from a conventional light-water reactor would be reprocessed and the transuranics Am, Cm, Np and Pu stripped, and blended with a uranium free matrix. The resulting fuel would be placed back into the light-water reactor. Because it contains no uranium, the inert matrix fuel form allows for the consumption of transuranic waste without any additional production. The inert matrix fuel would also reduce the overall amount of uranium in the core. The percentage of the core that is uranium dioxide (UOX) or inert matrix fuel (IMF) is a design parameter.

Fuels such as these were originally proposed for burning down stockpiles of weapons plutonium, but can also be for efficient transmutation in light-water reactors. The lack of uranium in the fuel allows for the consumption of transuranics without any additional production, hence the term ‘inert’. Because of its mechanical properties and radiation hardness, zirconium dioxide based fuels has received considerable attention in the past decade and have gone through initial testing at high flux test facilities with good results.

The energy produced by nuclear fuel is expressed in terms of ‘burnup’ which has units of MWd/kgHM, where HM is the initial heavy metal present in the fuel when it is loaded into the reactor. Since the transuranics represent the only heavy metal in an inert matrix fuel, all of this energy would come from their consumption. Previous work has shown that a burnup of 750MWd/kgHM, which corresponds to ~80% transuranic consumption, may present a practical limit for zirconium dioxide based fuel. However, achieving this level of burnup in a real reactor would require a relatively high transuranic content in the fresh fuel if the reactor were to remain critical between loadings and recycle its own transuranics. Unfortunately, high transuranic content can result in a high power density. This
present a particular problem for a zirconium dioxide based fuel because of the material’s low coefficient of thermal conductivity.

Past work with uranium dioxide fuels has shown that burnable absorbers can be used to reduce power and temperature. Common methods for doing this include the addition of gadolinium and erbium oxides to the fuel or the use of a thin zirconium boride coating and these poisons are often referred to as ‘integral burnable absorbers’ because they are integral to the fuel. In the current contribution we show that burnable absorbers can be used with zirconium dioxide based fuel to help keep the reactor, and the fuel, within licensable limits.

2. Methods

2.1. Overview

We consider a modified AP1000 pressurized water reactor with both inert matrix and uranium dioxide fuels in assemblies in 8x8 square lattices. The uranium assemblies help to maintain criticality between refuelings while the inert matrix fuels are used to burn the transuranics present in the spent uranium fuel. Full core simulations were done using MCNPX 2.7.0, a Monte Carlo radiation transport code, to determine the pin and assembly power profiles. The change in isotopic composition was determined using the CINDER90 burncard and verified with an in-house collision probability code. The results of the Monte Carlo simulations were coupled to a steady state thermal transport model to compute peak fuel and cladding temperatures using thermal resistances for the materials and the coolant. These temperatures were then fed back into MCNPX to capture thermal effects on reactor performance. The simulated reactor core had a power of 2000MWth and ran on a standard 18 month refueling schedule that would be encountered with current generation light-water reactors.

2.2. Monte Carlo simulations and fuel composition

The uranium dioxide fuel was enriched to 5% 235U, burned to 42 MWd/kgHM, and run through the core in three campaigns so that 1/3 would be removed and replaced at refueling every 18 months. Once removed, the fuel was allowed to cool for a simulated 5 years. The resulting transuranic vector was used as an input for the formulation of the simulated inert matrix fuel, which had 15wt%transuranics at its beginning of life in the core. The inert matrix fuel was run in seven campaigns, so that 1/7 was removed every 18 months. The total residence time for the inert matrix assemblies was 10.5 years and 4.5 years for the uranium dioxide assemblies. Table 1 gives the reactor parameters used in the Monte Carlo simulations with Fig. 2 showing a 1/8 cross sectional view of the core and the layout of the uranium and inert matrix assemblies.

### Table 1. Fuel Assembly Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel pin radius</td>
<td>0.356 cm</td>
</tr>
<tr>
<td>Pin pitch</td>
<td>1.3 mm</td>
</tr>
<tr>
<td>Pin height</td>
<td>426.7 cm</td>
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<tr>
<td>Cladding thickness</td>
<td>0.05 cm</td>
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<tr>
<td>Cladding</td>
<td>Zircalloy</td>
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<tr>
<td>Gap thickness</td>
<td>0.02 cm</td>
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<tr>
<td>Lattice size</td>
<td>8 pin x 8 pin</td>
</tr>
<tr>
<td>Number of fuel pins per assembly</td>
<td>60</td>
</tr>
<tr>
<td>Number of guide tubes per assembly</td>
<td>4</td>
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<tr>
<td>Active Core diameter</td>
<td>925 cm</td>
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<tr>
<td>Uranium fuel density</td>
<td>11 g/cm³</td>
</tr>
<tr>
<td>Inert matrix fuel density</td>
<td>5.75 g/cm³ (doped)</td>
</tr>
<tr>
<td>Pressure vessel inner diameter</td>
<td>401.6 cm</td>
</tr>
<tr>
<td>Pressure vessel thickness</td>
<td>20 cm</td>
</tr>
</tbody>
</table>

**Figure 2. Fuel assembly configuration.** (left) Schematic of an 8x8 fuel assembly with 60 fuel pins and 4 guide tubes. (right) The assembly layout of the reactor was designed with 8-fold symmetry. Here the Ux and Ix represent the xth campaigns of uranium fuel and inert matrix fuel assemblies. A center assembly is left empty (moderator region). Each fuel assembly is 8x8 with 4 control rod guide tubes and 60 fuel pins.

.0 Uranium dioxide fuel pins were doped axially with boron oxide and the inert matrix pins with erbium oxide. In each case the pins were divided into 5 axial regions, Fig. 3. The concentration of boron and erbium was varied in these regions to reduce power peaking. The concentration of boron in regions 1 and 5 was 0 w/o, in regions 2 and 4 it was 2.55x10^-4 w/o, and in region 3 it was 3.27 x10^-4 w/o boron respectively. The concentration of erbium in the same regions was 0 w/o, 1.70e-2 w/o, and 2.18
x10-2 w/o respectively. Table 3 shows the resulting composition of the uranium and inert matrix fuels at beginning of life. Natural boron and erbium were used.

**Figure 3. Axial distribution of burnable absorber in fuel.** The uranium dioxide fuel was doped with boron and the inert matrix fuel with erbium oxide, both of which absorb neutrons and reduce the power output of the pin. Over time, both the boron and the erbium burn out.

In all simulations the composition of the uranium and inert matrix fuels were equilibrated to reflect the isotopes that would be encountered in a real reactor containing fuel at various degrees of burnup. This was done by iterating on the fuel composition until the end of life fuel composition in campaign j was identical to the beginning of life composition in campaign j+1fuel for each fuel form and age of fuel, Eq. (1):

\[
\text{MaterialVector}_{\text{eq}}(t) = \text{MaterialVector}_{\text{eq}}(t + \Delta t)
\]

The fraction of the core that is comprised of inert matrix fuel was chosen under the constraint that the core reactivity remain > 1 between refueling, and that the reactor can recycle the transuranics from its own spent uranium fuel. The simulated cores have 712, 8x8 assemblies, where 516 are uranium dioxide fuel. This is equivalent to a 178 assembly core of 16x16 assemblies. Additional details on the reactor geometry and equilibrated composition of the fuel can be found in the supplemental information.

**2.3 Thermal transport.**

The peak fuel and outer cladding temperatures were determined using a steady state thermal transport model:

\[
q' = \frac{\Delta T}{R}
\]

where \( q' \) is the linear power density of the fuel W/m, \( \Delta T \) is the temperature difference between two points, and \( R \) is the respective resistance. The linear power density was determined using the MCNPX simulations. The temperature of the moderator along a coolant channel was determined using Newton’s law of cooling and the temperature dependent heat capacity of water. It was assumed that the power density of the fuel varied only axially, not radially. Table 2 gives the thermal transport parameters that were assumed for the uranium and zirconium dioxide as well as the cladding, gap and coolant.

**Table 2. Thermal transport parameters.**

*These values are consistent with existing pressurized water reactors and were chosen to keep the simulated reactor within operational limits. SI is supplemental information.

Figure 4 shows the average linear power density immediately at startup after refueling, both with and without the addition of burnable absorber along with the axial temperature profile for the hottest uranium and inert matrix fuel pins.

**2.4 Reactivity coefficients.**

The reactivity coefficients were computed using static calculations in MCNPX 2.7.0 at various times during the simulated 18 month burnup cycle. The fuel, moderator, and void coefficients of reactivity were computed at the full core and assembly level using reactor simulations of the full core. We used makxsto create a higher resolution MCNPX library with temperature dependent cross sections built in 10 K intervals from 300 K to 610 K and in 50 K intervals from 650 K to 2500 K.

The coefficient of thermal reactivity for the fuel was computed by perturbing the temperature of the fuel in the reactor by ±50 K. The coefficients were computed using:

\[
\alpha_{\text{fuel}} = \frac{1}{k^2} \frac{\Delta k}{\Delta T_{\text{fuel}}}
\]
Fuel reactivity coefficients for all of the fuel assemblies (uranium dioxide and inert matrix) were found to be negative both at startup and at the end of cycle before shutting down for refueling. Plots of the reactivity coefficients can be found in the supplemental information.

**Figure 4.** Effect of burnable absorber. The axial power profile and temperatures are shown at startup for the beginning of life uranium and hottest inert matrix fuel assemblies. Axial grading reduces the power peaking by more than 5% and lowers the inert matrix fuel maximum temperature by 200 K.

The core average moderator coefficient of reactivity was computed by modeling the full core for a range of core average moderator temperatures. The moderator density was updated to match saturated liquid water tables at a pressure of 155 bar. The coefficients were computed using:

\[ \alpha_{\text{mod}} = \frac{1}{k^2} \frac{\Delta k}{\Delta T_{\text{mod}}} \]  \hspace{1cm} (4)

Figure 5 shows the core averaged moderator coefficients as a function of the temperature of the moderator at the beginning and end of the campaign. The core average void coefficients were computed using:

\[ \alpha_{\text{void}} = \frac{1}{k^2} \frac{\Delta k}{\Delta x_{\text{void}}} \]  \hspace{1cm} (5)

Here x is the core average void fraction, and is computed by decreasing the fluid density uniformly within the core. Figure 6 shows the core average void coefficients of reactivity for a set of void percentages at the beginning and end of the campaign. At zero void, the beginning of cycle and end of cycle void reactivity coefficients were found to be -1.67 x 10^{-3} (1/K) and -1.58 x 10^{-3} (1/K) respectively.

Assembly level reactivity coefficients have been computed and are included in the supplemental material. The errors bars on Figs. 5 and 6 were generated from ten simulations, each done with different initial seeds. The error bars then indicate the range about the mean value.

**3. Results and discussion**

Figures 7 and 8 show the power and thermal profiles for the hottest uranium and inert matrix fuel elements with and without doping. The temperature profiles in Figs. 4 and 8 differ because the data in Fig. 8 correspond to shortly after startup when the xenon and samarium fission products (which absorb neutrons) have come to
secular equilibrium. The data in Fig. 4 are from directly after startup and the xenon and samarium have not built up.

**Figure 7. Axial power profile.** The linear power of the hottest 4 assemblies are shown at the beginning and end of cycle.

![Axial power profile](image)

Figure 7 shows the linear power of the hottest 4 assemblies at the beginning and end of cycle. The data in Fig. 4 are from directly after startup and the xenon and samarium have not built up.

**Figure 8. Axial temperature profile.** The axial temperatures of the four assemblies in Figure 7 at the beginning and end of cycle.

![Axial temperature profile](image)

The hottest fuel assemblies are those in the second campaigns since the doping has largely burned out by this point. As can be seen, the use of an integral burnable absorber significantly flattens the power and thermal profiles in both the uranium and inert matrix fuels. Peak linear power density in the inert matrix fuel was reduced by 23% with a 15% decrease in peak temperature. While zirconium dioxide has a melting point of ~ 2715 °C, in pile testing has shown that fission gas release from zirconium dioxide fuels increases significantly with elevated temperatures, but at the temperatures shown it would be more comparable to uranium dioxide fuels.

The addition of the integral burnable poisons has the beneficial effect of significantly flattening the radial power distribution as well. Figure 9 shows a cross sectional view of the average linear power density in the core at the assembly level at the beginning of cycle, end of cycle, and the average over an 18 month period between refueling. As can be seen in Fig. 9 (bottom right), there is a significant change in the linear power density between the hottest and coolest assemblies which is attributable to the high degree of transuranic burnout in the inert matrix fuels. Figure 10 shows the time dependent linear power density in each campaign and more detail is included in the supplemental material. As can be seen, most of the power is derived from the uranium assemblies and the first three campaigns of inert matrix fuel. The last four inert matrix fuel campaigns act as net neutron absorbers.

**Figure 9. Radial core power profile.** The power distribution within the core assemblies is shown for the end of campaign (top left), beginning of campaign (top right), minimum values (bottom left), and maximum values (bottom right).

![Radial core power profile](image)

**Figure 10. Assembly level power.** The power from each assembly within the core changes over the course of the campaign.

![Assembly level power](image)
A remarkable feature of the results presented here is the high degree of burnup that is achieved in the inert matrix fuel by the time it is removed from the core. The inert matrix fuel experienced a burnup of ~780 MWd/kgHM, which corresponds to an 84% burnout of the transuranics. Notably, the only heavy metal in an inert matrix fuel comes from the transuranics and this degree of burnup would be equivalent to burning a uranium dioxide fuel to ~60 MWd/kgHM. Despite this, the core maintains a $K_{eff} > 1.008$ in between refuelings, Fig. 11, and the 8x8 fuel assemblies play an important role here. The small assemblies allow for a more even distribution of the low reactivity fuel assemblies (late stage inert matrix fuel) and a reduction in the power variations across an assembly. Additionally, the inert matrix assemblies have a fixed composition at the beginning of their life in the core. Ideally the transuranic content of the beginning of life inert matrix fuel assemblies will exactly match the transuranic content of the end of life uranium assemblies. This is impossible since the reactor has an integer number of assemblies. However, for a fixed core size, reducing the size of the assemblies will increase the total number of assemblies and allow for a closer match.

**Figure 11. Reactor Criticality.** The reactor criticality must be above 1 at the end of the campaign. This figure shows the drop in $K_{eff}$ over the campaign. For these simulations $K_{eff} = 1.008 \pm 0.001$ at end of cycle.

The cost for the high transuranic depletion is a reduction in core operating power. The simulations discussed here were done with a nominal reactor power of 2000MWth, which is two thirds of that for a conventional AP1000. Operation at a higher power would cause an earlier depletion of the uranium driver assemblies and the simulated reactor would not be able to operate on an 18 month cycle. The power could be increased to a more conventional value if the uranium fuel were enriched beyond 5% or if the refueling schedule were increased to a higher frequency than once every 18 months. Both possibilities will be the subject of future work.

### 4. Conclusions

In the present study we show that integral burnable absorbers can be used in a mixed core running both inert matrix and uranium dioxide fuels to keep the fuel temperatures, and reactivity coefficients, within allowable limits. Erbium oxide was used with the inert matrix fuel and integral boron oxide with the uranium fuel. The integral burnable absorbers were shown to reduce axial power peaking by more than 23% and to reduce the peak to average power within the core from 1.80 to 1.44. By the end of its life in the core the inert matrix fuel acts as a neutron absorber with 84% of its initial transuranic inventory depleted. Importantly, the simulated core remains critical between refueling while running at a simulated power of 2000MWth.

The axial thermal and power profiles in the fuel can be reduced to acceptable levels with the use of an integral burnable absorber and this has the additional benefit of flattening the core power profiles. Importantly, the simulations show that the reactivity coefficients in the various fuel types are all negative and that the core average moderator and void coefficient are negative as well, which are requirements for a commercial power reactor in the US. The results demonstrate that inert matrix fuels could be used in conventional pressurized water reactors to achieve significant reductions in the overall production transuranics.
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China First Mention to Accelerate Nuclear Power Development

The Fukushima nuclear incident in 2011 resulted in the rapid development of China's nuclear power industry being suddenly shut down. China suspended approval of new nuclear power stations for 20 months, while the capacity of China's medium-long term nuclear power development plan was reduced from the previous 86 million kW down to 58 million kW.

However, increasingly serious air pollution will probably re-accelerate China's nuclear power development.

On December 10, the National Development and Reform Commission (NDRC) organized a picturephone conference on strengthening energy conservation and emission reduction to promote the prevention and control of air pollution, among which the second point of "paying special attention to energy conservation work in 2014" is to promote a clean energy structure. NDRC announced it is to "accelerate the development of hydropower, nuclear power, wind power, solar, biomass, and promote the development of distributed energy."

This is China's first mention of the "accelerating development" of nuclear power after a lapse of more than nearly two years. Unlike fossil fuel generation technologies (coal, natural gas etc.), nuclear power produces virtually no pollution or greenhouse gases during the power generation process so it is a clean and efficient way of generating electricity. However, safety and security have become the biggest concerns for China's nuclear power development since Japan's Fukushima incident on March 11, 2011. The State Council's executive meeting held on March 16 required relevant departments to adjust and improve the long-term nuclear power development plan and suspend approval of nuclear power projects awaiting nuclear safety planning approval, including for the preliminary work of the project.

On October 24, 2012, the State Council Executive Meeting discussed and adopted "Nuclear Safety Planning" and the "Long-Term Nuclear Power Development Plan." The meeting noted that, the State Council has discussed these plans twice on the basis of comprehensive safety inspection during operation, based on a comprehensive safety inspection of units under construction and operation since March 2012. The attitude towards security and development of nuclear power is "very serious and careful." That means unfreezing the new batch of nuclear power.

Now, NDRC is pushing forward "to accelerate the development" of nuclear power, and the core of the current problem is whether the level of long-term development of nuclear power previously identified will be increased?

Many nuclear power insiders said that the nuclear power sector is currently having a voice in this regard, but NDRC don't have the final say in how planning figures would be raised, for there is no specific increase in the numbers, "but this is a signal."

Zhang Huazhu, President of China Nuclear Energy Association (CNEA) previously said in his speech at the annual meeting of CNEA held in Shanghai "China lowered its nuclear power development plan after the Fukushima nuclear incident, but the initiative is in hands of the nuclear power industry itself, and if nuclear power construction and operation are in a safe and stable situation, then breaking the original plan is also possible at the end of the 13th Five-Year Plan."

However, China's newly added nuclear power installed capacity as a proportion of the total remains modest in 2013. According to statistics released by the National Energy Administration, from January to October, 62.95 million kilowatts of installed power capacity was newly generated, 22.28 million kilowatts hydropower, accounting for 35.4% of newly installed capacity; 27 million kilowatts was thermal power, accounting for 42.9%; 2.21 million kilowatts was nuclear power, accounting for 3.5%; 7.85 million kilowatts was wind power accounting for 12.5%; and 3.61 million kilowatts was solar power, accounting for 5.7%.

Latest news shows that at present, there are 10 nuclear power plant units approved by the Ministry of Environmental Protection, with a total installed capacity of 12.8 million kilowatts. Besides 17 units under operation (total capacity 14.6 million kilowatts) and 29 units under construction, with a total installed capacity of 31.6 million kilowatts, this falls short of demand in China. By 2020, at least 25 units with millions of kilowatts will be required.

In addition, according to the industry’s conservative estimate, there may be up to six newly-built approved units from 2011 to 2015, namely Sanmen units 3&4, Haiyang units 3&4, Lufeng Units 1 &2. All six units will use AP1000 technology. Source:http://www.hdxx2010.ibicn.com

Pump Valve Share Opportunities as Nuclear Policy is Revived

In a recent report, IAEA predicted that global power generation...
would maintain sustainable growth up to 2030 with an optimistic figure of 268 GWe, with East Asia holding the highest growth rate.

Domestically, the nuclear industry will enter a period of warming after the two-year adjustment resulted from the “Black Swan Event” in 2011. The Ministry of Environmental Protection recently released a public notice on its website regarding planning for reports approval on Yangjiang NPP units 1&2 (operating phase) on October 12th.

Although the core technology and equipment for nuclear power in China mostly relies on imports, though domestic products such as pipe material and some of the pump valves have been widely used. Therefore, recovery of the nuclear industry would further promote development in the field of technology research and equipment manufacture, and provide opportunities for enterprises producing pump valve equipment.

Zhejiang JIULI Hi-tech Metals, Co., Ltd., which mainly provides nuclear power tube, obtained early qualification of nuclear equipment, and Jiangsu Shentong Valve Co., Ltd. is a main supplier of nuclear valves. NNSA has authorized several private enterprises with qualifications for design and manufacture of nuclear power equipment, including Sichuan HuaDu Nuclear Equipment Manufacture Co., Ltd., China-Kinwa High Technology Co., Ltd, and Wuxi Huaertai Machinery Manufacture Co., Ltd.

Now pump valve enterprises must enhance the ability of independent innovation, eliminate outdated technology, and focus on talent cultivation to improve comprehensive competitiveness worldwide.

Source: http://news.bjx.com.cn

**Key Condition Experiment of ACP1000 Passive RRA is Successfully Completed**

CNNC witnessed experiments on the ACP1000 PRS at the Nuclear Power Institute of China in Sichuan province on November 11th. The experimental result shows that the design of ACP1000 PRS that CNNC-developed is successful. This marks the Nuclear Power Institute as having made a significant breakthrough on passive experiment technology.

Experts from National Energy Administration, NNSA, Nuclear and Radiation Safety Center and other relevant units agree that the experimental facility does a reasonably good job of modeling ACP1000 PRS system design features, and the experimental result demonstrates a successful design by means of some processes such as listening to previous working reports and real-time witness of the test condition.

The purpose of this research is to verify operational performance characteristics of PRS under the condition of an ACP1000 reactor station blackout accompanied by a feed water pneumatic pump failure. It confirms the design capability of the prototype accident cooling water tank and prototype emergency RHRS cooler, providing a test database for design improvement.

Source: http://www.cnnc.com.cn

**CGN Solid Waste Device Succeeds in Filling Gaps in China**

Recently, the cement curing core device, independently developed by CGNPC, has passed the acceptance review in Wuhan.

Cement curing is used for solid waste management in the process of NPP operation, mainly dealing with waste resin, concentrated solution and waste filter cartridges, mixing the solid waste with the cement and reprocessing it after the cement
has solidified. This kind of device is involved in complicated technology and has been monopolized by foreign suppliers for a long time. This has given rise to a high cost of procurement, execution under pressure and uncontrolled quality.

CGNPC set up the project to develop this kind of device in order to break the monopoly at the end of 2011, and the core device is finally successfully developed through the untiring efforts of 3 years; it not only helps to smash the monopoly, but also contributes to reducing NPP operation cost.

Source: http://news.bjx.com.cn

**NPP “Nerve Center” Realizes the Label of "Made in China"**

Recent news released from CGNPC is that the nuclear power technology in China has obtained a significant breakthrough – DCS, the nerve center of NPPs, had completed the prototype system design and entered the stage of engineering application. So, China has become another country, after the US, France and Japan, which owns the proprietary intellectual property rights of nuclear DCS.

The DCS system is one of the key pieces of NPP equipment, and plays an important role in NPP security and operation. For the moment, all nuclear DCS that exist in China have been provided by foreign countries because of its complicated technology.

The National DCS research center has been located in CTEC with the support of MOST since 2007, accelerating the development steps of nuclear DCS research work. He Yu, CEO of CGNPC, said: “Nuclear DCS localization is not only a strategy requirement, but also an inevitable requirement for nuclear power development.”

Source: http://www.china-nea.cn

**New Breakthrough on China Nuclear Zirconium Alloy Tube Fabrication**

CAST Company received its production license for new tube from AREVA on November 6th. This has filled in the blank of CNNC’s nuclear chain and ensures that the material supply of fuel assembly is highly economical and secure, and the localization of production of China’s nuclear fuel assembly zirconium alloy has also started.

Domestic supply of the new tube completely relies on imports for the moment, and CAST Company has been dedicating itself to technology transfer of this kind of new tube since its inception, having completed production line modification, key equipment procurement, personnel training and quality assurance reconstruction. A principal of AREVA said that, through comparative analysis, AREVA’s zirconium section is confident in the tube quality manufactured by CAST.

It is said that JNF, the future user and designer of CAST, has participated in witness at the scene. JNF considers CAST a qualified and certified supplier.

Source: http://www.china-nea.cn

**AP1000 is Expected to be the Major Force in China’s Nuclear Industry**

Xu Yuming, the Vice Secretary General of CNEA, said in the NPP Security Requirement and Solution International Seminar that “The domestic nuclear projects such as Sanmen phase 2, Haiyang phase 2, Guangdong Lufeng, Liaoning Xudapu and Hunan Taohuajiang will all adopt AP1000 technology, apart from two projects under construction. AP1000 is expected to be the nuclear driving force in China.”

Xu also said that the establishment of new projects would mainly depend on the progress of Sanmen and Haiyang NPP, and at the same time rely on localization and economic efficiency. The third generation technology with independent intellectual property rights should have its certain development space before long.

In Xu’s opinion, at present the most significant problem for the nuclear industry is how to tackle challenges. He said there are still lots of key issues remaining in respect of nuclear power’s technical route, natural uranium supply, key equipment localization and system innovation.

After many years of development, the national relevant enterprises have reached or approached the top world class with regards to design, manufacture, construction and management ability. At present, main equipment manufacturers in China are comparable with worldwide companies on their processing and transportation capability, and there would be at least 10 sets of equipment manufactured every year.

Source: http://news.bjx.com.cn

**Contract for AP1000/CAP1400 Residual Heat Removal Pump is Signed**

SNPTC has signed a contract for the AP1000/CAP1400 Residual Heat Removal Pump Localization Research and Intellectual Property Sharing with the relevant unit. SNPTC will
The Deputy Director of Zhejiang Bureau of Energy said that the installed capacity of nuclear power in Zhejiang province would reach 28.9 million kW by 2030, according to the 12th five-year plan of electricity development.

Chen Haitao said that Zhejiang was a strategic province and birthplace of domestic nuclear power development, in particular for the first prototype of pressurized water reactor NPP in Haiyan, Zhejiang.

Chen also said that the main factor restricting the sustainable development is the environment problem which has arisen by the energy structure, which is primarily based on fossil energy. “Nuclear power is an efficient energy with cleanliness and security, and it plays an irreplaceable role in the construction of a friendly environmental society when compared to other energies.”

Source: http://www.china-nea.cn

Zhejiang Nuclear Power’s Installed Capacity Will Reach 28.9 Million kW in 2030

The first session of the Nuclear Power & Sea Salt Forum hosted by the People’s Network has opened in Zhejiang province.

Source: http://www.snpec.com.cn

jointly invest in this project with Deep Blue Pump Co., Ltd.

The completion of this research will fill the gaps in China, avoiding restriction from foreign companies, and will provide a safe energy field.

Source: http://www.snpec.com.cn

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China Makes a New Breakthrough on ACP100 Small PWR

A meeting on ACP100 Small PWR Passive Emergency Core Cooling Integrated Simulation was held on November 7th by the Nuclear Power Institute of China. Lv Huaxiang, vice president of CNNC, attended the meeting. After a field test, experts agreed to approval the project.

The panel composed of the National Nuclear Safety Administration (NNSA), the Nuclear and Radiation Safety Center and CNNC probed the state before the test, and agreed that the design method is reasonable for the research, and the equipment is qualified for the test.

resource:http://mil.huanqiu.com

CAP1400 is Expected to be Constructed in 2014

"Large-scale equipment manufacturing enterprises in China have fully grasped the AP1000 technology of manufacturing main equipment of Nuclear Island and more than 80 main domestic equipment manufacturers have obtained nuclear equipment manufacturing permits and established the quality assurance system as required so far" said Wang Binghua, Chairman of State Nuclear Power Technology Corporation (SNPTC). Meanwhile, the R&D of CAP1400 has achieved important progress; its design is based on the Westinghouse AP1000, Generation III technology.

"It is estimated that the localization rate of CAP1400 major demonstration projects will achieve over 80%, said Zheng Guangming, Director of Shanghai Nuclear Engineering Research & Design Institute (SNERDI), in which SNERDI undertook the major work of the design. He also added that China should have its own advanced nuclear power intellectual property rights or otherwise they are constrained by others, no matter the experiment, construction and operation.

"CAP1400 is scheduled to start construction in 2014. This will not be a brand of SNPTC, but of China. This brand will definitely meet the needs of the international market," Wang Binghua said.

Source:http://news.bjx.com.cn

BYD Passes Complete Test of Nuclear Storage Equipment

BYD has successfully passed the whole set of tests on nuclear storage equipment and has become the first company to make the storage technology for Iron Cells applied to nuclear emergency power supplies, creating a precedent of iron cells being used as reserved power in the nuclear industry.

The safety issue of nuclear power in China has risen to unprecedented heights since the Fukushima incident. This test was finalized entirely on the basis of the nuclear standard at the most authoritative testing institution – Electric Apparatus Research Institute and Shanghai Tongji University. The test lasted for 60 days under strict conditions. The process includes an EMC test, damp heat test, anti-seismic test and short-circuit withstand test, in addition to some routine tests.

According to HAFJ0053 Nuclear Equipment Anti-Seismic Evaluation Guidelines established by NNSA and GB13625-92 NPP Safety System Aseismic Appraisal, the energy storage prototype has tested on OBE three times and SSE once with aseismic fortification intensity of 8 degrees, and the whole set of storage equipment is running stably.

The completion of this test symbolizes an historic and significant breakthrough of the storage equipment applied in the nuclear industry.

Source: http://www.china-nea.cn

The First Half-Speed Nuclear Power 1200MW Turbonator Succeeds in Being Launched on Market

A half-speed nuclear power 1200MW turbonator succeeded in being put on the market at Harbin Electric Corporation (QHD) Heavy Equipment on November 12th, this is the first product developed based on China AP1000 the 3rd generation technology. The completion marks that China is completely capable of independently manufacturing the 3rd generation nuclear island super generator equipment.
The first half-speed nuclear power 1200MWtubonator is under testing at nuclear heavy equipment station

This equipment has passed 53 index tests and will be applied to Sanmen NPP soon.

Sanmen NPP turbonator units adopt AP1000 technology which is the most advanced 3rd generation nuclear power technology in the world. Harbin Electric Corporation obtained the technology transfer qualification of the 3rd generation PWR AP1000 nuclear power regular island turbonator with an auxiliary system from Japan Mitsubishi Electric at the beginning of 2008, then began with the subtle drawing transform, and finally completely finished the design transform in 2010 opening the curtain of the 3rd generation nuclear equipment localization process.

Harbin Electric Corporation invested 200 million RMB in the construction of the nuclear power heavy equipment test station in Qinhuangdao. It has taken 150 technicians 3 years to develop the 3rd generation nuclear generator and has finally made breakthroughs in hundreds of key technologies.

Compared to the previous 1st and 2nd generation of generators directly using nuclear reactor internal recycle water heat, the 3rd generation produces thermal energy without nuclear radiation to generate electricity, greatly improving security.

Source: http://www.china-nea.cn/

Shanghai JV Enterprises Expand into Area of Nuclear Control Valves

Shanghai Automation Instrumentation Co., Ltd has invested with UK IMI Group to establish SAICCCI Valve Co., Ltd. The new company is created mainly to focus on the design and manufacture of key nuclear control valves for target markets. It is reported that the amount of investment is 40 million RMB. The control valve localization helps to break the monopoly and reduce nuclear construction cost.

The nuclear control valve is flow process and control equipment, and plays an important role in nuclear security and operation. For the moment, only a few multinational corporations in the world, such as IMI Group, are equipped with the manufacturing technology. Shanghai Automation Instrumentation Co., Ltd is a qualified supplier of all the commercial NPPs in China.

Source: http://www.caea.gov.cn

CGN Launches the First Nuclear Power Industrial Training Union

The first nuclear power industrial training union was launched in Dayawan NPP on November 21st, aiming to improve the quality of nuclear power builders, as well as guarantee the safety and quality of nuclear construction.

Nuclear safety is an ever-lasting theme, and engineering quality is the foundation of safety. Years of experience and practice have shown that humans are the core of nuclear construction, and man-made faults should be avoided for security insurance.

CGNPC has been developing rapidly in recent years. It takes charge of 15 million-kilowatt units, with the installation now reaching 17.71 million kilowatts.

Source: http://news.bjx.com.cn/

Project on “of SECRI” Won First Prize in China Machinery Industry Science and Technology

Shanghai Electric Cable Research Institute’s project on “Technology research and application of LOCA test system” was awarded first prize of China machinery industry science and technology. After striving to make technological breakthrough for five years, the third-generation LOCA test system technology solved the security verification problem for the world’s most advanced and safe commercial NPP under operation at present. This system has become the only testing system in the world which fulfills the requirements of “design-base accident” of the third-generation non-active series of AP1000 nuclear power plants and has reached the international advanced level. It also reversed the passive situation in which in-containment cable of NPP has depended on the foreign imports for the long term. This has significantly pushed forward the domestic localization process of the nuclear power cable and is of great importance for China to promote its core competitiveness in the field of nuclear power technology.

Source: http://www.dxdl.cago365.com
CTEC DCS Industrial Project has Passed Acceptance

The national scientific project of DCS Industrialization undertaken by China Tech-Energy Co., Ltd (CTEC) has successfully passed the acceptance of authority, which indicates the completion of DSC infrastructure.

The project of DCS Industrialization is a sub-project to national industry revitalization and technical transformation. During acceptance, experts gather to hear reports and audit materials, reaching an agreement that this project should be accepted.

Source: http://www.ctecdcs.com

The First Set of Nuclear Pump Shaft Seal Succeeds in Manufacturing

AREVA DONGFANG Reactor Coolant Pumps Co., Ltd. held a ceremony to celebrate the first manufacturing of nuclear pump shaft seal on November 21st, which marks the localization of the million-kilowatt nuclear pump reactor being realized in China.

Source: http://www.cnnc.com.cn

World’s First AP1000 Production Line Finishes Equipment Installation and Debugging

The world’s first production line for the third-generation nuclear fuel elements manufactured by China North Nuclear Fuel Company (CNNFC) in Baotou, Inner Mongolia has completed equipment installation and debugging. The line will reduce the risk of a reactor nuclear accident by 100 times compared with the second-generation NPP in formal operation.

Tian Youjun, assistant of GM of CNNFC, said that it will be the first line of the third-generation nuclear fuel elements in the world to become operational, and an accident similar to the Fukushima NPP leakage accident will never happen even under the double shock of earthquake and tsunami.

Mr. Tian added that a total of RMB 1.2 billion has been invested in this line since it started to be constructed on March 28th, 2012. It will provide the first furnace domestic refueling components for Zhejiang Sanmen and Shandong Haiyang NPPs once in production in 2015.

Source: http://news.bjx.com.cn

CNNPC To Join EPRI Research Programs

The Electric Power Research Institute (EPRI) has announced that the China National Nuclear Power Company, Ltd. (CNNP) has joined two of EPRI's nuclear-related research programs. The China National Nuclear Corporation (CNNC), China’s largest nuclear power conglomerate, is the primary shareholder in CNNP. The participation will provide CNNP with access to EPRI research results and technical guidance that can inform the safe, cost-effective operation of CNNP’s nuclear fleet. The two EPRI research programs that CNNP is joining are:

1. Nuclear Maintenance Application Center (NAMC): This program develops technologies, systems, and guides to drive improvements in nuclear plant maintenance activities.

2. Nondestructive Evaluation (NDE): This program develops technologies and procedures to quickly, accurately, and cost-effectively inspect and characterize nuclear component condition and inform strategic decisions on whether and when to replace, repair, or continue operation. CNNP operates 9 commercial nuclear units with a combined capacity of nearly 6,506 MW, and has more than 12 units under construction. The agreement also covers CNNP’s key affiliates in the operation of nuclear power plants.

Source: http://www.nuclear-exchange.com/

CNNC 404 Company Limited Completes Work on Fluorine Electrolysis Power Transformation

China National Nuclear Corporation (CNNC) 404 Company Limited has finished the transformation work of fluorine electrolysis power on uranium conversion production lines. About 24 sets of high-frequency switching power supply have been put into production and operation, with an energy saving of around 20% after the transformation. Verified by the production run, the newly installed high-frequency switching power supply unit has met the requirements of both the control parameters and control mode, and also the output power quality has achieved the desired purpose of fluorine electrolysis.

With the aim of completing the transformation of a rising uranium production task, reducing production costs and improving the automation and stability of the equipment, the company conducted the technological transformation on 24 sets of silicon controlled rectifier devices within four months. The renovation work was divided into two stages during the implementation of the production, in which the technical staff made a reasonable re-use of the old electrical enclosure, high and low voltage cables, etc., minimizing the cost of the power transformation project.

Source: http://www.caea.gov.cn
**International Cooperation**

**Sun Qin and Qian Zhimin Meet with Secretary of the US Energy Department**

The chairman and the General Manager of CNNC, Sun Qin and Qian Zhimin met with Moniz, the Secretary of the US Energy Department at the company's headquarters. They held friendly exchanges on the issues of nuclear technology and engineering projects.

Sun Qin welcomed Moniz and expressed that CNNC is not only a participant in technology cooperation of Sino-US nuclear power, but also the main holder of technical exchange cooperation, and even the major partner of the Sino-US AP1000 nuclear power project. The first AP1000 unit is constructed on the site of Sanmen NPP.

SMR plays a unique role in the aspects of reduction and environmental enhancement, Sun hopes that China could carry out technical cooperation on a small reactor with the US; CNNC is willing to cooperate with Terra Power on TWR under the principle of benefit sharing, risk sharing and cooperation and mutual benefits; and suggests the US Energy Department considers lifting the 810 clause restriction between parties.

Qian Zhimin expressed thanks to Moniz for paying attention to Sanmen AP1000 nuclear project and introduced the processes of Sanmen nuclear project, AP1000 technical transformation and AP1000 nuclear fuel manufacture.

Moniz said that the US Energy Department attached great importance to the exchange and cooperation with China. He would promote agreement renewal on Sino-US nuclear usage and is in favor of nuclear technical exchange. He is willing to promote the process of Sanmen AP1000 nuclear project and technical transformation. Besides, Moniz also introduced the relevant situations of US nuclear development policy, small reactor, TWR and 910 clause certificates.


**TVEL FC Supplied a Batch of Nuclear Fuel to China for the 7th Refueling of the 1st Unit of the Tianwan NPP**

November 6, 2013. TVEL Fuel Company has delivered TVS-2M nuclear fuel for the 7th refueling of the 1st unit of the Tianwan NPP. The cartridges are intended for standard refueling of the 1st unit. The fuel was produced by Novosibirsk Chemical Concentrates Plant (JSC NNCP within the JSC TVEL's management circuit). Currently the Tianwan NPP operates two types of fuel assemblies – TVS-2M and UTVS. The deliveries of modified fuel for the 1st unit of the Tianwan NPP until 2020 have been contracted since 2013. The Chinese party plans to resume the negotiations on further deliveries in several years.

In 2010, TVEL FC signed a set of contractual documents with Jiangsu Nuclear Power Corporation (JNPC) and China Nuclear Energy Industry Corporation (CNEIC) for packaged supply of TVS-2M modified nuclear fuel for the 1st unit of the Tianwan NPP in the amount of six refueling. The contracts provide for transfer of TVS-2M fuel fabrication technology with a view to fabricate it at the Yibin Fuel Factory, China, and beginning with the 7th refueling of the Tianwan NPP. The total value of the contracts signed in November 2012 amounted to about USD 500 mln. These signed contracts presented an opportunity for the Russian company to continue strategic cooperation, started in 1997, through offering more up-to-date and cost effective
TVS-2M fuel to the Chinese party.

In September 2012, an addendum to the contract for fuel supply for the 7th refueling of the 1st unit was signed, and the delivery date was agreed on.

Starting from 2014, TVS-2M fuel for the 2nd unit of the Tianwan NPP will be fabricated at the Yibin Fuel Factory under the Russian technology and using Russian accessories. Transition to the modified fuel allowed TVEL FC and JNPC to reach an agreement on converting the 1st and 2nd units of the Tianwan NPP to the long-term 18-month fuel cycle operation.

Source: http://www.tvel.ru

**Chinese Engineers Receive Training in Nuclear Project Management**

The engineering division of China’s National Nuclear Corp has appointed AREVA to train its teams in the management of major nuclear projects.

The first training session concluded on 8 November, AREVA said. The course was designed and executed by AREVA University, which trains the group’s engineers, executives and managers.

"AREVA is committed to supporting Chinese utilities in the development of their skills," said Tarik Choho, AREVA’s chief commercial executive officer.

"This contract reflects CNNC’s recognition of our dual expertise in the fields of training and project management. It strengthens our relationship with this important customer."

Source: http://www.neimagazine.com

**Westinghouse Supports AP1000 Development in China**

With the environmental issue heating up worldwide, China has been seeking new energy technology to meet the demands of economic development. The newest generation AP1000 which is under construction is atypical example, and the Westinghouse AP1000 technology is chosen as the objective, which is regarded a strategic step. For the moment, Westinghouse technology extends toneary half of the commercial NPPs in the world.

AP1000 technology adopts the latest passive safety system and has passed the design certification by the Nuclear Regulatory Commission in America. The system would invokeits shutdown unit and make use of natural law to keep the NPP running safely in the case of anemergency. What's more, this system can work without exchange power and human intervention for upto 3 days. Simplicity is another feature of the AP1000.

Westinghouseobtained the construction contracts in 2007 that allow building four units with millions of kilowatt at Sanmen and Yangjiang NPPs. Both of these two NPPs, the first to be equipped with AP1000 technology, have entered the final phase of construction, and will take test runs.

Benjamin, the vice president of Westinghouse, said that the company would spare no effort to cooperate with China and devote itself to completing delivery.

Source: http://news.bjx.com.cn

**CNNC Participates Jointly with CGNPC in the UK’s Nuclear Power Construction**

It was acknowledged from the First Senior China-France Financial Conversation that CNNC has joint stock with CGNPC to participate in the nuclear construction at Hinkley Point in the UK which EDF is in charge of.

Zhang Yuqing, Deputy Director of NNSA, said “France and China have made very good cooperation on nuclear power over last 30 years, and we will keep on developing the cooperation plans.”

A Joint Statement was established at this meeting announcing that both parties would spare no effort to strengthen collaboration on fuel processing technology based on the highest standards of security and environment protection.

Source: http://www.china-nea.cn/

**CNNC Signs the MOU with SKB**

Magnus Holmqvist, President of SKB, and his staff visited Beijing Research Institute of Uranium Geology on November 18th and 19th. Lin Sen, director of CNNC International Cooperation Dept., formally signed the MOU with regard to the radioactive waste arrangements.

During the visit, the institute experts exchanged and discussed with Magnus on further cooperation, and suggested to develop personnel exchanges, investigation and research.

As an important industrial department in Sweden, KBS has experience in radioactive waste arrangements.

Source: http://news.bjx.com.cn/
China Assists a Nuclear Construction Project in Pakistan

A large nuclear power project was launched in Karachi, Pakistan on November 26th. This project is supported by China and is costing 9.59 billion USD. It should be completed within 6 years.

Nawaz Sharif, Pakistan's Prime Minister said it was a proud moment in history for Pakistan, and thanked China for aiding at such a critical period as power shortages were the most difficult problem for Pakistan.

Source: http://www.china-nea.cn

China and France to Jointly Develop the Third-Party Nuclear Power Markets

China and France on Friday vowed to expand their three decades of nuclear energy cooperation to target markets in other countries.

"We agreed to jointly exploit third-party nuclear energy markets. China hopes the two countries can find broader space in the markets," said Chinese Premier Li Keqiang while meeting reporters after his hour-long talks with visiting French Prime Minister Jean-Marc Ayrault. Li described their discussion as "candid and friendly."

He called on the two countries to develop a more equal partnership in nuclear energy cooperation, and at the same time, to jointly research and develop new reactor types and strengthen the sharing of experience. He said he hoped France would transfer more technology to China.

Governements and businesses of the two countries also held a seminar to mark China-France nuclear energy cooperation on Friday.

In addition to nuclear energy, the two leaders told reporters that the two countries will further cooperate in areas including aviation, trade, investment, finance, food, agricultural products, health, automobile manufacturing and sustainable development.

Li called on the two countries to actively advance negotiations on a second phase project of an Airbus final assembly plant in Tianjin Municipality, strengthen joint research and production of large commercial planes and civil helicopters, and continue to push forward satellite cooperation projects.

Li said the two sides will co-pilot sustainable development schemes, and combine their respective advantages of capital, technology, markets and experience. An eco-friendly city program for sustainable development in Wuhan, capital of central China's Hubei Province, will serve as an example of this and receive corporate efforts from the two countries.

Ayrault echoed Li, saying France hopes the two countries can promote the program with concrete actions, and he will visit Wuhan and learn about this program during his China tour.

He added the two countries have scored substantive results in food and agricultural joint work.

"Chinese consumers will soon taste French pork and other products. I am also looking forward to seeing bilateral cooperation in health and pharmaceuticals," Ayrault said.

The leaders also reached a consensus on expanding bilateral cultural exchanges. The two countries will hold concerts, exhibitions and film festivals in 2014 to mark the 50th anniversary of bilateral ties.

"China and France are both important representatives of the diversity of civilization. These activities will help mutual understanding between the two peoples, and communication between the two civilizations," according to Li.

The Chinese premier also voiced appreciation for France's decision to shorten the visa processing time for Chinese citizens to two days, saying this will facilitate personnel engagement, tourism, trade and investment between the two countries.

He hoped France would make it easier for employees of Chinese companies to get work and residence permits. He also urged France to provide a safer and more convenient environment for Chinese tourists.
Ayrault welcomed more Chinese tourists to visit France, and promised to simplify the visa processing procedure.

After their talks, the two prime ministers jointly unveiled a logo for activities marking next year's 50th anniversary.

"France was one of the earliest Western countries to establish diplomatic relations with the People's Republic of China. China-France relations are strategic, epochal and global," Li said.

He noted the two countries should continue to respect each other, treat each other on an equal footing, seek common development, consolidate traditional friendship, expand cooperation and strengthen coordination in international and regional affairs.

"China will make joint efforts with France to promote multipolarization and democratization of international relations, and safeguard the international order established after World War II and a hard-won peaceful situation," Li said.

Ayrault echoed Li, saying France will make closer high-level engagement with China, strengthen strategic communication, and coordinate closely on global and regional issues.

On China-Europe relations, Li said China attaches high importance to relations with Europe while France is a "core major country" in the European Union.

He called on France to actively promote the negotiation of a China-Europe investment agreement and to urge the EU to uphold free trade and be cautious in taking trade remedy measures, so as to play a positive role for the sound development of China-Europe relations.

"China hopes the EU will not start an investigation into China's wireless telecom products," Li noted.

Ayrault said France will join hands with China to oppose trade protectionism, and promote Europe-China cooperation.

Ayrault arrived in Beijing on Thursday morning, starting a five-day official visit to China at the invitation of Li.

This is Ayrault's first China visit, which he said is an important opportunity to get to know Chinese leaders and learn about China. After a stay in the capital, he will fly to Wuhan in Hubei and Taishan in south China's Guangdong Province, where another China-France nuclear power plant is under construction.

Source:http://www.nuclearpowerdaily.com/
Sanmen Unit 1 Reactor Plant Shield Wall has been Poured

The last can of concrete was poured into the 18th layer of the shield wall relying on Sanmen unit 1 AP1000 on October 31th, 2013. That is to say, the whole shield wall is completely poured, this creates the conditions for subsequent steel dome lifting and placement of CB20 module.

The shield wall is designed as a tube structure with in-situ reinforced concrete, and a 52.4m high cylindrical exterior. It was divided into 18 layers for pouring, with 1-14 layers being poured in sections, while 15-18 layers were poured integrally.

The shield wall had higher technology requirements as it is difficult to construct. SNPEC helped construct with good quality, without any accidents and with elaborate plan and careful preparation.

Source: http://www.china-nea.cn

China's Northeast First NPP Unit 1 is Connected to Grid

Hongyanhe NPP, the first NPP in northeastern China, was finally connected to the grid on November 17th, that is to say, this unit has formally entered the debugging phase and capable of generating electricity.

With the strongest innovation in China, the localization equipment of Hongyanhe NPP phase 2 is over 80%, including its sea water desalination system. The 4 units of phase 1 will have fulfilled its goal to generate electricity by 2015. The annual energy output will be 30 billion kWh, up from 28.7 billion kWh in 2012, covering 16% of the total electricity consumption of Liaoning province.

Source: http://www.china-nea.cn

Yangjiang NPP Units 1&2 is Approved for EIA Report

The ministry announced its approval of Yangjiang NPP units 1&2 Environmental Impact Report at the phase of operation on October 21th.

The National Nuclear Safety Administration (NNSA) also approved the test program report for Yangjiang Nuclear Power.

Yangjiang NPP is a key construction project with 73.2 billion RMB of investment. It adopts the CPR1000 PWR technology with a self-owned brand. It will continue building 6 units of 1 million kW, which is currently the largest project. The localization rate of key equipment is over 85% and the average localization rate of the 6 units is 83%.

Source: http://www.china-nea.cn

First Fuel Loading of Yangjiang NPP Unit 1 Gets Approval

Yangjiang NPP unit 1 makes a new breakthrough on grid connection and commercial operation. Unit 1 has obtained its First Fuel Loading License authorized by the National Nuclear Safety Administration. According to the established plan, unit 1 is predicted to be connected to the grid at the end of 2013.

Yangjiang nuclear power project adopts the CPR1000 PWR technology, and plans to build 6 nuclear 1 million kW units with an investment of 73.2 billion RMB.

At present, 6 units at Yangjiang NPP are approved, unit 1 is planned to be connected to the grid and generate electricity at the end of 2013; unit 2 will conduct a cold test in October; unit 3 has entered the phase of installation and debugging; unit 4 is under construction; unit 5 began construction at the end of September; and unit 6 will start to run at the beginning of 2014.

Source: http://news.bjx.com.cn

CGN Ningde NPP Unit 2 Starts Fuel Loading

CGN Ningde Nuclear Power Unit 2 completed the first group of
fuel loading on November 11th, which indicates the official start of this project, and also marks a critical step towards nuclear commercial operation.

Source: http://www.cgnpc.com.cn

**Seawater Treatment Project Lands in Yutian, Tangshan**

The seawater treatment project, by Dongfang Electric and Tangshan Dongya Heavy Industry Equipment Group Co. Ltd., has been launched in Yuntian, Tangshan, with a total investment of 250 million RMB.

The project, located in the Yutai industrial area, covers 100 mu of land. The production valve, after the completion of the project, will cost 350 million RMB and comprise 200 sets of equipment including cooling device, heat-exchange equipment and coal chemical anticorrosive equipment.

Resource: http://www.caea.gov.cn

**Fuqing Unit 1 Debugs the Device and Predicts to Generate Power in July 2014**

Fuqing Nuclear Power unit 1 is believed to be ready to realize power generation next July 31st.

Unit 1 was started on November 21st, 2008, and would last for 68.5 months. Now 60 months has passed and the construction has reached the peak of debugging. It is predicted to realize the first grid connection next June 5th and performance testing next July 31st, followed by power generation.

Unit 2 started on September 18th, 2008. Its construction has reached the phase of system turnover. It is predicted to realize performance testing on January 15th, 2015 and will then begin generation.

Unit 3 and unit 4 started on December 31st, 2010 and November 17th, 2012. For the moment, these two units have entered the phase of installation and construction separately.

The engineering understructure for unit 5 and unit 6 are under construction.

Source: http://www.china-nea.cn

**Aerospace Materials Support 4th Generation NPP Construction**

The key project of Aerospace Materials and Technology Research Institute— the graphite absorption production line used for high temperature gas cooled reactor (HTGR) NPP shutdown system has been completed and put into service with an annual output of 80 million graphite nodules containing boron carbide in Dezhou, Shandong. This project aims to meet all the requirements of the first 4th generation nuclear power HTGR system in the world.

The Aerospace Materials and Technology Research Institute spent two years on project testing, and finally achieved the technical result.

Source: http://news.bjx.com.cn

**Fuqing unit 1 Starts Hot Functional Test**

Fuqing unit 1 has gained recognition from NNSA on its hot functional test, which will be conducted in two stages. The primary coolant circuit begins to heat up to 120 degrees Celsius. It marks an official start with stage 1 and realizes the goal in advance.

Source: http://www.cnnc.com.cn

**Sanmen Unit 1 Nuclear Shielding Workshop Hoisting into Place**

The nuclear shielding workshop of Sanmen unit 1 was hoisted and finally completed capping on November 23rd. The whole process was smooth and steady, and the quality was within tolerance.
The whole structure of this steel roof is a truncated pyramid 11 meters high and weighing 920 tons. The edge distance above is 12.5 meters and below is 41. The superstructure of the roof is made of concrete and could firmly support an AP1000 passive device.

All parties related to this project have worked in collaboration to prepare an elaborate plan in advance as there are many difficulties in hoisting.

Source: http://www.cnnc.com.cn

Tightness test kicks off for Changjiang No.1 Plant Spent Fuel Pool

Changjiang No.1 fuel plant completed the water injection of the spent fuel pool to +19.5 m level, marking that the tightness test of the spent fuel pool water has been officially launched.

The spent fuel of the No.1 plant is a 12.608 × 8.008 m rectangular stainless steel pool with standard designed elevation from +20.150 to +7.490 meters and water storage capacity of about 1,265 cubic meters. The construction quality of the stainless steel will be checked in this test, and then it will be transferred to the installation unit for the subsequent installation of the fuel storage framework and relevant equipment.

Source: http://www.cnecc.com
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我们有没有可能在那些正面临困难的核电企业中发现一些其共同特征呢？如果可以，那么怎样才能够提早遏制这种趋势并扭转局面呢？

福岛事故在核操作上的失败显然最能够说明当前的问题。然而，在很多情况下，如果当某一电力公司或公共设施遭遇不测或其安全文化被监管机构视为是无法接受的，将会导致电站停闭，巨大的声誉损失和严重的财政后果。

Ontario Hydro, PG Millstone, TVA, Dounrey, Peach Bottom, Barsebäck 和 Davis Besse 等公司同样可以作为参考，但实际可以说明问题的远非这些公司。

福岛事故在核操作上的失败显然最能够说明当前的问题。然而，在很多情况下，如果当某一电力公司或公共设施遭遇不测或其安全文化被监管机构视为是无法接受的，将会导致电站停闭，巨大的声誉损失和严重的财政后果。

这些事件都显示了某些共同特征，而且现在这些特征已经能够充分说明问题，并可以被看作是核电运营商在面对事故和灾难时的“指纹测试”。

这些常见的特征有：

- 自鸣得意
  行业里广泛地流传着这样一种说法，就是很多公司都自认为是行业里的佼佼者。通常，这往往是因为夸大了对生产性能的关注，而更多是在可用性方面。这样的话，将导致对其他关键性能指标关注度的缺乏，而保守决策的制定则将面临被侵蚀的风险。

- 公用事业单位和各监管部门将重点放在技术层面
  而对公司管理和人材培养缺乏重视。核电领导者需具备统筹兼顾的能力。举例来说，如果维修人员能力欠佳，便会出现频繁的技术故障。如果仅从技术层面寻找失败的原因，真正的问题根源将会被忽视，或造成永久性的技术故障。

- 较差的领导与管理技能
  通常归因于个人较差的领导能力。核电站的大多数管理者都有相关的技术和工程背景。技术兴趣往往是驱使他们进入核电行业的最初推动力，而很少有人将管理作为其主要动因。因此，对于管理者来说，能够意识到这一现状并且对所有管理层人员进行相关管理培训是极其重要的。

- 组织僵化
  通常归因于个人较差的领导能力。核电站的大多数管理者都有相关的技术和工程背景。技术兴趣往往是驱使他们进入核电行业的最初推动力，而很少有人将管理作为其主要动因。因此，对于管理者来说，能够意识到这一现状并且对所有管理层人员进行相关管理培训是极其重要的。

- 缺乏有效的企业监督
  这里不仅指的是企业管理中沟通的缺乏，也包括沟通的质量低下。如果公司法人团体被员工视为失败领导，企业监督所不熟知的企业文化的发展就会面临很大的风险，既而将减少监督的效果。

- 工作积压
  这些警告信号不仅指工作积压的多少，也指工作向后拖延的可接受度。当工作积压逐渐扎根并成为一种文化，那么人们的确有理由开始担心了。

- 质量保障部门的低水准与不良的质保结果跟踪
  这一点显然与前一点相关联。

- 持续的管理方向变化和成本削减
  这与资金短缺紧密相关，同时与经验丰富的人员流失和“企业记忆”的损失相关。在这方面，裁员和外包都属于风险因素。

- 反复出现问题
  这是一个很有用的警告信号，说明员工的工作能力过低或工作主动性不足。如果问题没有及时得到合理分析，那么问题的根源就会被忽视，从而也未能采取相应的补救措施。结果就会导致同样的问题反复出现。

- 整体不满 vs 监管权威
  通常表现为双向影响：监管者对操作者表示不满，反之亦然。监管者指出不足，而其得到的回应却是操作者认为监管者的通告有失公允。

- 共同原因
  因此，对于核电运营商来说，确实能够从以往的经验总结中获知一些可靠的危险预示。其中，高层领导力显然是一个非常重要的因素。很明显运营商将出现下滑的最主要因素就是领导能力差。而核电站运行年份和技术现状并不十分重要。与新运行核电站的安全性能相比，对旧核电站的大规模维护就未必是一个更大的挑战。

- 明显运营商一路下滑的最主要因素就是领导能力差。

- 另一个问题就是难以对监管者的行为设定固定的准则。例如，监管者的行为糟糕到什么程度才能称之为糟糕？很简单，这个问题很难回答。

- 尽管以往的成就并不能保证未来的辉煌。相反，很多曾经所谓的“杰出管理者”如今都面临着严峻的挑战。然而，找到这种“杰出”的优越感判断主要是基于生产结果等标准，特别体现在可用性方面。只有采用更广泛的行为评估并综合考虑关键行为指示，才能够在自我定位方面掌握更加全面和科学的风险。

- 以往的成就似乎会令人滋生过分的自信和自满。也许尤里乌斯凯撒是历史上最杰出的核电安全专家？在他胜利游行的马车上坐着一个奴隶，凯撒不断地在他耳边低语：“记住，你是凡人…”

- 领导力与文化
  成功的核电运营商领导力很大程度是指建立和强化一种健全的文化。那么，我们所指的文化是什么？一种简单未必科学的但却有效的定义就是：
“文化就是我们做事情的方式”

人与人之间的关系中确实存在着固定的行为规则，即便通常是无意识的。这就是文化，我们做事的方式，往往是不假思索地进行着。这种无意识的天性使文化根深蒂固。通常来说，要改变一种文化是极其困难的，它需要有影响力的人坚持不懈的推进使其成功发生改变。

核能运转协会（INPO）对于核安全文化的定义为：“文化是指某个组织的价值观和行为——由领导者规范而由其成员内化一对于核安全来说，这是压倒一切的首要任务。”

这就清晰地说明了领导这一角色的重要性。Edgar Schein 将其概括成 “领导者唯一需压做的并具有真正重要意义的事情就是创建并管理一种文化…”

他认为可以从三个方面来考虑文化，如下图所示：

![图示](image)

大多数文化都暗含在表面之下：规范、价值观和对现实的基本假设。成功的领导需要使诸如规范和价值观这样的无形文化部分与其有形文化部分保持一致。例如，管理者传递的相关信息与采取行为的一致性方面。当管理者的言行未能与应有的价值观保持一致时，人们通常能够很容易对其做出相应的辨别。例如，如果一个核电站的管理者总是在工作时间强调安全的重要性，而却在周末醉酒驾车，那么他的员工很快就会得出这样的结论，那就是他所强调的安全只是一种口头的空话而已。由此可见，有形的行动与潜在的价值观并没有达成一致。

领导力面临的挑战

很多家长都注意到他们的孩子不太注意父母的讲话，但却模仿他们的行为。同理，领导者对于一种文化的影响不在于他们怎么说，而在于他们怎么做。记住，文化是“我们做事情的方式”，因此，久而久之，领导者的行动就成为了“我们做事情的方式”。

那么人们关注的是什么？
- 管理者 / 领导者的衡量标准
- 管理者 / 领导者会亲自审查哪些方面
- 管理者 / 领导者如何应对危机
- 谁来制定决策, 决策怎样制定
- 分配资源的标准
- 管理者 / 领导者的培训方法
- 谁会得到奖励和认可, 为什么能够得到
- 谁可以得到晋升
- 管理者 / 领导者使用什么语言
- 管理者 / 领导者如何对待监管者

即使领导者身上那些微妙的行为也能够对一个组织的表现产生巨大的影响。例如，在某些核电站，它们奖励那些解决危机的员工，却无视管理者在其职责范围内本该具备的统筹全局和规避危机的基本职能，而你可以预期到人们对预防工作的兴趣会随着时间的推移而减弱。久而久之，这样的组织会经常遭遇危机。

另一个例子：在某个工厂，厂长经理作为培训委员会的主席，而在另一个工厂，却将培训事宜委托给一个助理。你认为哪一个组织的员工会希望加入这个培训部门？

领导力对安全管理作用

根据上述原因，可以知道领导者自身的行为对于企业文化来说是至关重要的。由于核电安全的重要意义具有无可争议压倒一切的优先性，所以领导力是安全管理的首要任务。传达给下属员工的高效领导力具有以下特征：

- 高级管理明确致力于安全管理
- 各个管理层次都做出明确的安全承诺
- 有条不紊的开发领导技能
- 在相关安全活动中参与管理的有形领导力
- 确保有充足的并具有竞争力的员工
- 寻求在安全管理中的员工积极参与
- 在变更管理过程中考虑安全影响
- 在整个组织中持续努力的争取开放和保持良好的沟通
- 解决必要冲突的能力
- 管理者与员工建立在信任基础上的人际关系

安全管理能力可以概括为“核安全的十大任务”：

1. 引导安全文化
   高级领导力全权负责提高组织的安全文化，安全并不仅仅是安全部门考虑的问题，高层管理者应给予高度的关注度。

2. 制定高标准
   高层管理者致力于在方法、行为和结果方面制定并改善标准。

3. 经营未来
   领导者鼓励并奖励好的规划并保证计划能够遵守质量程序。

4. 确保人才培养
   确保各个级别的人员具备足够的知识、技能和能力来履行各自相应的职能。

5. 提供信息与工具
   确保提供一组一致的信息和工具（包括流程、IT系统、文档和物理工具），使人们能够正确定地执行任务。
6. 成为学习型组织

确保组织内部有强烈的学习愿望，时刻保持一种开放、诚实和不懈渴求进步的状态，这是成功的基础。使组织能够致力于不断改进，评估绩效，留意身边的问题，包括小的问题，并不断从自身与他人的经验中学习。

7. 必备的行为激励

领导者必须知道稳定现状的运行需要员工做出哪些行为表现，并且能够激励他们遵守这些行为准则。

8. 保证核电站的运营状况

确保核电站符合法律法规与现代更新能够时刻满足设计标准。

9. 保证操作配置

确保工厂设备配置和操作时刻在相关设计规范和限制之内进行。

10. 实现商业成果

商业领袖必须掌握财政和其它方面的资源，并实现预设成果。

安全性和盈利性

安全是压倒性的首要任务，但并不意味着商业结果不重要。二者不应被视为相立的价值概念，而优秀的领导人会将二者视为是相互支持的，一个安全的核电站具有很高的可用性，而高可用性在推动实现业务结果方面是尤为重要的一个因素。

核商业头脑就是指在变化的核环境中以其洞察力、知识和能力来管理技术、经济、人力资源与组织因素与安全性之间的关系。

领导力通常被定义为核商业头脑，是指在变化的核环境中以其洞察力、知识和能力来管理技术、经济、人力资源与组织因素与安全性之间的关系。反过来，二者之间也呈现出一种关系：相比低利润的核电厂，一个创造价值的核电厂会更好的定位于改善其安全性能。因此，将安全管理与商业管理成功结合是一个组织长期健康发展的前提条件。

综合而言，想要成为一名成功的核电领袖，需二者兼具。需要通过领导力要求的复杂结构来增强，从而使看起来相悖的两方面保持平衡。你不能犯错，但仍需从错误中学习；你需要遵守规则，但仍需有质疑的态度；你首先要考虑安全性，但仍要实现商业绩效。成功地平衡这些不同的方面是核领导力至关重要的一点。

结论

总而言之，拥有核领导能力具有非常重要的意义。我个人认为，无论是从历史还是现在的角度来看，核工业中的领导者们，都将大部分努力投入到技术方面，而对主要的领导力挑战方面投入甚少，能够使两方面同时运作——安全保障、经营业绩、员工能力、公众接受程度、环保性能，而以上这些只是其中一部分挑战。我期待着这样一天的到来，在那一天，核商业智慧将会被人们普遍视为核工业中最为重要的资产。
欢迎您来到《代邦核讯》这个平台与12,000多位核电领域人士分享并发布您的专长与宝贵经验。

“普通老师只讲述事实，好老师解释事实，优秀的老师展示事实，伟大的老师激发人们去思考。”
——威廉·亚瑟·伍德

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专 访

专 访

国,中国台湾,当然还有西班牙等其它国家。2005年,在与中国台湾合
作时, 我们成功地完成了一项国圣核电站乏燃料水池格架改装的承包项目,
包括设计, 制造, 供应, 并且最重要的就是在西班牙人员与中国台湾人员
的共同努力下完成了在高辐射和其他困难条件下的格架改造安装工作,这
使我们的客户,台电公司感到十分满意。在21世纪初期,我开始负责中
国和西班牙核电项目的合同签署工作。作为一名销售人员,我主要负责乏
燃料运输容器的项目合同, 这些乏燃料运输容器从大亚湾运往至兰州 (EEEC
与 CGNPC 签署的合同), 为岭澳核电站 3,4 号机组提供燃料格架以及为台
湾提供热交换器等业务。我也曾为西班牙核能协会董事会的成员之一。目
前, 我在西班牙核企联盟担任总经理一职。

Dynatom: 在 SNGC 建立之前, 贵公司有关
于中国市场的任何经验吗?

Carmelo Palacios: 我第一次来中国是在1987年参加北
京核电展,随后进行了一个长途旅行,参观了西安, 成都和上海的核设施。
这次旅行是由中国核学会赞助,其中包括 30 名西方人。在 ENSA, 我签
署的第一个合同是关于秦山二期的蒸汽发生器, 当时是1995年, 我还只
是这个项目的成员之一。随后,我开始负责相关合同, 2002年, ENSA和
EEEC 为从大亚湾向兰州进行乏燃料运输提供了两个运输容器; 2007年,
为岭澳 3,4 号机组供应乏燃料格架并为西安核设备公司提供本地化制造;
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2010 年, 签署台山核电热交换器项目。

Dynatom: 当您以一名机械工程师身份毕业后，
是否立即就加入到了核电市场这一领域或者说是
ENA?

Carmelo Palacios: 在 1976 年加入 ENSA 公司前, 我已经
在一家国际贸易公司工作了六五年并经历了不同的职位。当苏联解体后,
我开始协助一些西班牙公司一起去改进前苏联核电站的安全性能, 通过不
同的项目（塔西斯计划, 法尔计划和 EBRD）以及培训操作流程等方式来
完成。20 世纪 80 年代, 在 1985 年与 1986 年核供应集团 (NSG) 禁止向
印度提供原件产品以前, 我曾多次访问印度并向印度核电公司 (NPCIL) 提
供蒸汽发生器。在我担任 ENSA 事业发展部副主席期间, 除了商业拓展,
我还负责项目以及 ENSA 的子公司 ENRESA 的业务, ENWESA 主要业务是核
电站服务。

Dynatom:ENWESA 主要在哪里开展业务?

Carmelo Palacios: 大部分在西班牙和法国。

Dynatom: 您能让我们了解一下您在 ENSA
所取得的业绩吗?

Carmelo Palacios: 在 ENSA, 我主要负责乏燃料运输和
存储的能力发展, 例如, 燃料容器和格架业务, 涉及到如芬兰、韩国、美
国、中国台湾, 当然还有西班牙等其它国家。2005年, 在与中国台湾合
作时, 我们成功地完成了一项国圣核电站乏燃料水池格架改装的承包项目,
包括设计, 制造, 供应, 并且最重要的就是在西班牙人员与中国台湾人员
的共同努力下完成了在高辐射和其他困难条件下的格架改造安装工作,这
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燃料运输容器的项目合同, 这些乏燃料运输容器从大亚湾运往至兰州 (EEEC
与 CGNPC 签署的合同), 为岭澳核电站 3,4 号机组提供燃料格架以及为台
湾提供热交换器等业务。我也曾为西班牙核能协会董事会的成员之一。目
前, 我在西班牙核企联盟担任总经理一职。
Dynatom: 两年后，RingoValves 也加入到联盟体系当中，那么在过去的 5 年里，联盟中已有四位核心成员，未来贵公司是否有扩充新的合作伙伴或成员的计划？

Carmelo Palacios: 是的。在RingoValves 加入到SNGC后，我们对能够带来附加值的企业保持开放态度。目前，我们正在研究其他合作伙伴加入的可能性。我们希望新的合作伙伴同我们保持一致，无论是在销售方式还是在市场行为方面。

Dynatom: 关于 SNGC 的结构和运营方面，您能为我们提供更多的一些信息吗？例如，主席的选择？

Carmelo Palacios: SNGC 的组织构成很简单，主要从四个层面进行管理：主席，董事会，执行委员会和总经理。主席每年由各个公司轮流担任。目前，我担任公司的总经理一职，我需要全力支持所有四个公司的业务。在中国，我们有全职工作的员工。

Dynatom: 如今，联盟代表了核工业 2,000 名专业人士，那么，中国市场是怎样影响西班牙核工业的？

Carmelo Palacios: 中国市场对西班牙核电行业产生了重要的影响，因其提升了我们的国际地位，同时增强了我们的竞争力。我们技术使四个公司处于核电行业的前沿。立足中国市场，能够为我们开发新的业务种类，巩固与西班牙国内合作伙伴之间的合作关系；也为我们提供了可以深入了解西班牙政府的机会，并且使我们获得在国际市场中处理复杂项目的能力。在中国我们所参与的一些活动也为我们提供了一些项目的需求增加相应的高素质劳动力，例如Tecnatom的控制室。最后，我们也得到了重要的媒体报道，而这些是在其它市场所不容易获得的。

Dynatom: SNGC 最初是为当地组织与国际合作提供技术转让服务，您能为我们提供一些可供分析的案例吗？

Carmelo Palacios: 在技术转让与合作方面，我们有很多案例可供参考。

Carmelo Palacios: 是的，我们“试图”跟随市场的需求！

Dynatom: SNGC 的目标是向中国客户提供综合报价，您能为我们介绍如Enusa和Tecnatom是如何在宜宾燃料厂与中国建中核燃料有限公司（CJNF）进行合作的吗？

Carmelo Palacios: Enusa 联合 Tecnatom 向宜宾的中国建中核燃料有限公司提供燃料棒超声检测设备使其具备现代化燃料制造能力。这是 Enusa 在中国的第一个合同，也可以被看做 SNGC 成员伙伴之间协同效应的一个很好案例，同时也是 CJNF 与 Enusa 合作所取得的重要成果。二者之间关系的建立始于 2008 年合作备忘录的签署，自此之后，两者间的关系日益巩固。

根据合同文本，Enusa 针对 Juzbado 工厂的技术并协调完成项目的不同阶段，而 Tecnatom 则作为领先的制造商，两个公司最终共同实现
了宜宾燃料厂的技术转让。

Dynatom: 贵公司是否与包头核燃料厂有过类似的合作？

Carmelo Palacios: 还没有，但我们正朝那个方向努力。

Dynatom: SNGC 旗下四家公司都有参与 Candu, VVER, EPR, AP100, HTR 等其它类型反应堆项目，那么四家公司是否都积极参与进秦山三期、田湾、台山、三门，海阳和石岛湾核电项目中去呢？

Carmelo Palacios: 参与 Candu, VVER, EPR, AP100 和 HTR 核电类型属于国际市场的范围。在中国，我们正涉及台山（EPR），三门和海阳核电站（AP1000），目前还没有参与进田湾（VVER）和石岛湾（HTR）项目。ENSA 获得了南非 HTR 技术的项目合同，对其进行压力容器的设计和压力分析，然而南非却搁置了 HTR 这个项目。

Dynatom: 公司发展扩大也来源于很多合作协议的签署，比如中国核电技术研究院（CNPRI），西安核设备有限公司，中国核动力研究设计院（NPIC），中国技术工程公司和苏州热工院。您能告诉我们 SNGC 联盟是市场发展的来源还是归功于单独的某个公司的行为？

Carmelo Palacios: 发展的绝大部分来源于某个公司单独的行为，而 SNGC 联盟则或多或少的参与进一些项目。

Dynatom: 关于 Tecnatom 与 CITEC 合资公司，您能为我们详细的介绍其中的内容吗？

Carmelo Palacios: 中广核检测技术有限公司（CITEC）是一个非常成功的案例，成立于 2007 年，目前，正处于全速发展当中。CITEC 是一个检测公司，目的是满足中国广东核电集团机组的役前（PSI）和在役检测（ISI）工作。CITEC 主要负责中国国内的检测，同时也在国际市场同 Tecnatom 参与某些项目的合作。目前，Tecnatom 拥有合资公司 25% 的股份。

中广核检测技术有限公司是从事在役检查、无损检测技术研究开发和技术服务的专业公司。通过 Tecnatom 在役检查核心技术的全面转让，中广核检测技术有限公司已具备各类在役检查自动化设备的自主设计、研发、使用、维护、和更新的能力，并掌握各种堆型核电站在役检查技术和方法。中广核检测技术有限公司可以依据不同核电机组不同规范和要求实施相应的在役检查，包括反应堆压力容器检查、接管安全端异种金属焊接检查以及蒸汽发生器储壳检查等重大项目在内的所有在役检查项目。

Dynatom: 您们也提供培训服务吗？

Carmelo Palacios: 2008 年，中国的工程师来到西班牙接受培训，在此之前的 1988 年，Tecnatom 为秦山一期对操作员进行相关培训。正如你所知，Tecnatom 由西班牙公共事业所拥有：Iberdrola, Endesa 和 Gas Natural-Fenosa。起初，Tecnatom 在马德里的办公室有两台仿真模拟机，随后在 1987 至 1988 年，中国的工程师来到这里并接受培训。

Dynatom: 您们的主要范围是一般性的营销策略与合作，如参加展会，代表团和出版物，那么建立起这样一个联盟的资金来源于哪里？

Carmelo Palacios: 公司预算来源于四个公司所交纳的费用，费用是依据联盟所提供的服务。而展会的资金则来源于 ICEX, 西班牙出口贸易促进等的支持，然而，我们主要还是依靠我们四个成员公司。

Dynatom: 那么是否有计划添加新的成员，进而实现资金独立？

Carmelo Palacios: 大约 95-98% 的成本都是由联盟成员来支撑的。根据西班牙签署的国际条约，会为召开国际展会提供所需资金支持，但那也只是我们预算的一小部分。

Dynatom: 自从 1987 年您定期参加中国的贸易展览到如今由西班牙对外贸易研究所（ICEX）支持您出席各个展会，您能告诉我们您和 ICEX 之间是怎样的关系？

Carmelo Palacios: ICEX 是西班牙政府的出口促进机构，旨在帮助西班牙企业发展对外贸易业务。这同其它国家的一些机构相类似，
如美国的 USTDA，英国的英国贸易投资署（UKTI）和法国的 UBIFRANCE。

ICEX 支持并协助所有的西班牙核电企业，而不仅仅是 SNGC，它要求企业出席国际核电贸易会议与展会，还包括其它经济领域的会议等。这也是获得信息的一种来源。

Dynatom: ICEX 在中国的广东，北京，上海和香港都有办事处，贵公司是否将其作为 SNGC 的一个平台？

Carmelo Palacios: 驻中国的西班牙大使馆在这四个城市都有商务办公处，ICEX 也是这些办公室其中之一。我们会利用这些办事处所提供的服务，当然，还有西班牙使馆，而香港的办事处则没有采纳。特别是在展会期间，我们同这些办事处保持密切来往。

Dynatom: 贵公司与中国核电工程公司签署了一份谅解备忘录通用协议，去年 PFCE 也签署了一份这样的协议。那么，和工程公司签署这样一份协议对于联盟来说有什么样的优势？

Carmelo Palacios: 是的，我们在 2011 年与中国核电工程公司签署了一份谅解备忘录。优势就是我们能够及时交换信息与观点以及更好的了解市场。

Dynatom: 贵公司与中国核动力研究设计院合作为欧洲核电站提供电气贯穿件的情况又是怎么样的？您是否认为 SNGC 是中国核电市场在全球扩展的理想合作伙伴？

Carmelo Palacios: Tecnatom 目前正与中国核动力研究设计院（NPIC）合作，其中一个业务焦点就是为由 NPIC 制造的核安全壳提供电气贯穿件。Tecnatom 和 NPIC 已经分析了将要采取的步骤来确保其与西方技术标准的兼容性。西班牙与海外核电站都有着不同的商业机会。目前与 NPIC 签署的商业协议则给予 Tecnatom 在贯穿件商业化方面的专有权利。

关于第二个问题，SNGC 负责支持四家合作伙伴与其它公司之间的商业往来，尽管四家公司致力于中国市场，但并不严格限制与此。

Dynatom: RingoValvulas 于 2000 年成立并且为 20 个核电站提供了将近 100,000 个阀门产品，采用了法国，美国和俄罗斯的技术标准，尤其是秦山核电站一期和二期工程。您是否认为在中国市场对阀门进行国产化将更具压力？

Carmelo Palacios: 是的，想要实现国产化有很大的压力，但我们希望能够克服这个局面。有两个主要因素：

- RingoValvulas 很快就会取得 ASME 认证
- RingoValvulas 近期完成了在 Zaragoza （位于西班牙）工厂一个新的机架生产线的安装工作，这个工厂拥有阀门行业所需核级阀门设计和制造
专 访

的现代化设备。

这些因素使 RingoValvulas 成为核阀门供应链的领导者之一。现在，RingoValvulas 正向 11 个国家的 20 多个核电站提供阀门产品。

Dynamot: ENSA 是外国制造商中一个最为成功的案例：公司为大亚湾核电站制造乏燃料运输容器，为昌江和秦山二期提供蒸汽发生器，岭南核电站提供冷却，最近又为三门核电站提供 AP1000 技术标准的蒸汽发生器并为台山 EPR 机组提供热交换器。您是否认为 Ensa 的成功直接来源于 SNGC 的集团市场营销行为？

Carmelo Palacios: Ensa 是世界上最合格的供应商之一，而且它的投资组合具有吸引力，因其多样化和高新技术。在 SNGC 成立之前，Ensa 就开始同中国的公司在新的产品与领域方面建立合作关系。SNGC 与 Ensa 一道来发现新的商机与合作伙伴。我们也希望为中国市场提供四个集团公司潜在的投资组合。

Dynamot: 贵公司的网站是唯一一个定期更新的中英文平台，贵公司是怎样决定建立起这样一个媒体平台的？

Carmelo Palacios: 首先，非常感谢您的评价。一开始我们认为向全球展现我们在中国市场所具备的能力与操作运营是十分重要的。因为我们是拥有高科技的专业公司，所以我们需要特别努力向每个人来展现我们的能力。创建 SNGC 联盟其中一个最为重要的原因就是要使我们被人们所熟知。

Dynamot: 您如何看待 SNGC 在中国未来的发？以及其对如阿根廷等的海外中国市场的影响力？

Carmelo Palacios: SNGC 的联盟公司都有着丰富的接受力与经验力，也是极具吸引力的合作伙伴。在这一领域里，我们很有信心，多年来，SNGC 一直与 Areva，西屋电气，通用电气等公司进行合作，因此我们也希望同中国伙伴在海外市场里保持密切的往来。

关于 SNGC 在中国市场的未来发展，当然，我们有发展壮大的雄心，会更加注重密集型发展，更加注重业务成员的发展，目前，我们在印度的业务已经展开。
Kabelwerk EUPEN AG is an independent and fully integrated manufacturer of Electric Cables & Wires, employing 930 people in its factories in Belgium.

The product range includes MV & LV Power Cables, Instrumentation & Control Cables, Telecommunication Cables (Copper, Coaxial, Fibre Optics) and last but not least Halogen-free Fire Safety Cables.

Within the last product family, EUPEN also stands for 30 years experience in manufacturing 1E-LOCA qualified cables and cables for use outside containment of Nuclear Power Plants.

Kabelwerk EUPEN AG是一家完全整合型的独立电缆和电线生产商，仅比利时的工厂就拥有员工达930人。

它的产品涵盖中低压电缆，仪控电缆，通信电缆（铜芯电缆，同轴电缆和光纤）以及无卤消防电缆。

在最后的产品系列中，对于1E级LOCA认证电缆和核电站安全壳外使用的电缆，EUPEN已经有30多年的制造经验。
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三月

2014 第七届亚洲（北京）国际电子信息产业展览会
时间：2014 年 3 月 4 日—6 日
地址：北京国家会议中心
联系人：刘洋
联系电话：010-52837066
网址：http://www.chinacinte.com

2014 第十九届中西部仪器仪表工控自动化及测试计量国际展览会
时间：2014 年 3 月 6 日—8 日
地址：重庆国际博览中心
联系人：尹静
联系电话：023-67778812
网址：http://www.ca8888.com

2014 第十四届中国金属冶金展
时间：2014-3-27---2014-3-29
地址：重庆国际博览中心
联系人：陈游江
联系电话：86 023 67745022
网址：www.cmpi.cn

四月

2014 第六届中国国际低碳建筑给排水展览会
时间：2014 年 3 月 28 日—30 日
地址：北京展览馆
联系人：陈涛
联系电话：010--57075003
网址：http://www.cnwaternews.com

中国（上海）铸造展览会
时间：2014 年 4 月 8 日—10 日
地址：上海新国际展览中心
联系人：巴 蓉
联系电话：86 21 5283 8700 -831
网址：http://www.foundryshanghai.com/

2014 上海国际锻造展览会
时间：2014 年 4 月 8 日—10 日
中国（上海）钢结构材料及应用展览会
地址: 上海新国际展览中心
联系人: 邵海伟
联系电话: 021-52838700-805
网址: http://www.steel-str.com/

2014 第十一届中国（天津）国际精细化工展览会
时间: 2014年4月10日—12日
地址: 天津国际展览中心
联系人: 韩红莎
联系电话: 022-28235538
网址: http://www.tsf-expo.com

2014 第十一届中国（天津）国际涂装、电镀及表面处理展览会
时间: 2014年4月10日—12日
地址: 天津国际展览中心
联系人: 高然
联系电话: 86-22-28233538
网址: http://www.tsf-expo.com

2014 中国（天津）国际电子工业展览会
时间: 2014年4月10日—12日
地址: 天津国际展览中心
联系人: 杨小姐
联系电话: 86-22-28233538
网址: http://www.tsf-expo.com

2014 第十五届中国国际泵、阀门博览会
时间: 2014年4月14日—16日
地址: 北京全国农业展览馆
联系人: 田真龙
联系电话: 010-85865739
网址: http://www.qfbengfa.com

2014 第十五届中国国际管道管件展览会
时间: 2014年4月14日—16日
地址: 北京全国农业展览馆
联系人: 赵静
联系电话: 0086-10-85866179/3179
网址: http://www.qfbengfa.com/

五月
2014 第十四届中国国际冶金工业展览会
时间: 2014年5月19日—22日
地址: 中国国际展览中心新馆
联系人: 王涛
联系电话: 010-84079258
网址: http://www.metallurgy-china.com

第六月
2014 FlowEx China 上海国际泵管阀展览会
时间: 2014年6月25日—27日
地址: 上海世博展览馆
联系人: David
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Organizer
可燃吸收体惰性基质燃料性能与超铀元素燃耗对低功率密度轻水反应堆的影响
1. 介绍

所有与核电相关的环境和地缘政治问题某种程度上都源于核废料中积累的超铀元素镅（Am）、锔（Cm）、镎（Np）与钚（Pu）。通过限制这四种元素的产生，很多围绕核能未来发展的担忧将会显著地减少。数十年来，这个事实一直为核工程领域内的人们所熟知，并且也提出了将这些超铀元素转化为其他形式的计划。目前，回收超铀元素的唯一选择就是使用商业后处理组合钚和铀的氧化物来生产可以在传统的反应器中使用的混合氧化物燃料。然而，由于铀元素的中子俘获反应问题，这些混合氧化物燃料也会在反应器中产生超铀元素，只在一定程度上限制了超铀元素的产生。

另一种可以替代混合氧化物燃料循环的方法就是在铀的自由基质中加入超铀元素，例如钍燃料循环。在这种情况下，能量来自于233U裂变，233U是钍元素俘获中子后进行两次β衰变生成的易裂变核素。但233U同时带来显著的扩散风险，并且在实际情况下，将会在燃料中加入238U来对其进行稀释。然而，燃料中铀的存在再次导致人们试图摆脱的超铀元素的产生。还有一种已经探讨过的方法是将超铀元素混合到二氧化锆基燃料中，如图1所示。

图1：惰性基质燃料循环对传统轻水堆的乏燃料进行再加工，剥离出如镅（Am）、锔（Cm）、镎（Np）与钚（Pu）等的超铀元素并将其混入铀自由基质中，随后将所得到的燃料放回轻水堆。因其不含铀素，因此这种惰性基质燃料形式就使得消耗超铀废物而不产生任何额外的物质。该惰性基质燃料也将减少堆芯中二氧化铀（UOX）或惰性基质燃料（IMF）的比例，是相应的设计参数。

产生的这些燃料最初是用来焚烧武器级钚储备，但也可以用于轻水堆的高效燃烧。燃料中铀的缺乏能够吸收超铀元素而无需产生任何添加物，术语“惰性”一词由此而来。由于其热性能和中子吸收率等特性，在过去的十年中，二氧化锆基燃料受到人们高度重视，并且在高通量样本的初步测试中取得了良好的效果。

由核燃料产生的能量被人们表示为‘燃耗’，单位为MWd/kgUHM。这里的 UHM 指的是当燃料被装载到反应堆中时，存在于燃料中的初始重金属部分。由于超铀元素代表了惰性基质燃料中唯一的重要金属，因此这种能量将全部来自动于自身的燃耗。以往的工作经验表明，750MWd/kgUHM 的燃耗（相当于约 80%的超铀消耗）可能会对二氧化锆基燃料产生实际限制。然而，在实际应用中实现这个水平的燃耗，在反应堆的燃料装载量保持在临界值内，并同时对其自身的超铀元素实现再利用的条件下，燃料中的超铀元素含量相对要高。不幸的是，高含量超铀元素又将导致高功率密度。这里就出现了因二氧化锆基燃料的低热导率而引出的值得思考的问题。

以往与二氧化锆燃料相关的工作经验表明，可燃吸收体可用来降低功率密度。常用方法包括向燃料中掺入钆和醚的氧化物或使用较薄的硼化锆涂层。这些毒物燃料通常被称为“整体可燃吸收体”，因为它们对于燃料来说是不可或缺的组成部分。就当前的研究来看，可燃吸收体可与二氧化锆基质燃料一同使用，以便将反应堆和燃料限制规定的范围内。

2. 方法

2.1. 概述

考虑到在改进型 AP1000 压水堆中，其 8x8 平方格燃料组件里同时存在的惰性基质和二氧化铀燃料，其中铀燃料组件有助于维持燃料置换的临界状态，而惰性基质燃料则用于燃烧废铀燃料中存在的超铀元素。全堆芯模拟使用了蒙特卡罗辐射传输代码MCNPX 2.7.0，以确定元件和组件电源配置。同位素成分的变化则使用 CINDER90 烧录卡来评定，并由一个内部碰撞概率的代码进行验证。蒙特卡罗模拟的结果被汇合到一个稳态热传递模型，并通过热传递来计算元件和冷却剂的尖峰燃料值和包层温度，这些温度数据，随即反馈到 MCNPX 以获取热效应对反应堆性能的影响。该模拟反应堆堆芯功率为 2000MWth，并且按照模拟的 18 个月换料周期运行，该周期也将适用于当下的轻水堆。

2.2 Monte Carlo 模型和燃料组成

二氧化锆燃料被浓缩为 5%的 235U，烧录至 420MWd/kgUHM，并在堆芯经过三次循环置换，以便在每 8 个月的换料周期中对其 1/3 的燃料进行移除与更新。一旦移除，在 5 年的模拟期间，燃料将被冷却。所用的超铀元素将被使用输入端，用作模拟惰性基质燃料的配制，其中堆芯中有 15%o 的超铀元素处于萌芽阶段。惰性基质燃料需要经过七次循环置换，使 1/7 的燃料
料每18个月被移除一次。惰性基质组件的总停留时间为10.5年，二氧化铀组件为4.5年。表1给出了用于Monte Carlo模拟中的反应堆参数。图2展示了堆芯1/8的剖视图与铀和惰性基质组件的布局。

表1. 燃料组件参数

<table>
<thead>
<tr>
<th>参数</th>
<th>数值</th>
</tr>
</thead>
<tbody>
<tr>
<td>核燃料元件半径</td>
<td>0.398cm</td>
</tr>
<tr>
<td>直径</td>
<td>1.3 cm</td>
</tr>
<tr>
<td>惰性基质热导</td>
<td>426.7 cm</td>
</tr>
<tr>
<td>覆盖厚度</td>
<td>0.05 cm</td>
</tr>
<tr>
<td>包装</td>
<td>2 Zircaloy 混合金</td>
</tr>
<tr>
<td>间隙厚度</td>
<td>0.02 cm</td>
</tr>
<tr>
<td>格子大小</td>
<td>8 pin × 8 pin</td>
</tr>
<tr>
<td>每个堆芯燃料棒的数量</td>
<td>60</td>
</tr>
<tr>
<td>每个燃料棒的燃料数量</td>
<td>4</td>
</tr>
<tr>
<td>堆芯燃料棒类型</td>
<td>625 cm²</td>
</tr>
<tr>
<td>惰性基质燃料密度</td>
<td>5.75 g/cm³ (doped)</td>
</tr>
<tr>
<td>压力容器内径</td>
<td>401.6 cm</td>
</tr>
<tr>
<td>压力容器厚度</td>
<td>20 cm</td>
</tr>
</tbody>
</table>

图2. 燃料组件结构。左:一个8×8的燃料组件内有60个燃料元件和4根导向管。右:堆芯的组件布局的设计采用了8倍对称。这里的Ux和Ix代表了铀燃料和惰性基质燃料组件的第x次循环置换。一个中心组件留空(慢化剂区域),每个8×8的燃料组件都有4根控制棒导管和60个燃料元件。

在所有模拟中，铀和惰性基质燃料的合成需要平衡反应在真实反应堆燃料中同位素遇到不同程度消耗的反映结果。将过量燃料成分迭代直至j阶段的燃料组合物的结构，并与在j+1开始时每种燃料形式和寿命达到一致为止。公式(1)所示:

\[ MaterialVector_{i+1}(t) = MaterialVector_i(t) + \Delta MaterialVector_i(t) \]

由于惰性基质燃料构成的堆芯比例受堆芯反应度所限，每次换料间堆芯反应度必须>1，并且反应堆可以无其自身的废铀燃料回收超铀元素。模拟堆芯中含有712个8×8的组件，其中516个为二氧化铀燃料，这相当于178组16×16的燃料组件的组件堆芯。关于反应堆几何结构和燃料平衡组成的其他细节可以在补充资料中找到。

2.3 热传输

峰值燃料和外包层温度采用稳态热传输模型来确定:

\[ q = \frac{\Delta T}{R} \]

表2. 热传输参数

<table>
<thead>
<tr>
<th>属性</th>
<th>位置</th>
<th>数值</th>
<th>参考</th>
</tr>
</thead>
<tbody>
<tr>
<td>导热系数</td>
<td>1</td>
<td>2.9 W/m-K</td>
<td>[28] SI</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>16,000 W/m²-K</td>
<td>[29] SI</td>
</tr>
<tr>
<td>冷却剂流量</td>
<td>3</td>
<td>0.384 kg/m³</td>
<td>*</td>
</tr>
<tr>
<td>温度</td>
<td>4</td>
<td>550 K</td>
<td>*</td>
</tr>
</tbody>
</table>

*这些数值与现有压水堆一致并使模拟反应堆保持在操作限制内。SI为补充信息。

图4展示了换料后立即启动时的平均线性功率密度，同时具有和不具有可燃吸体添加物以及用于最热的铀和惰性基质燃料元件的轴向温度剖面图。
2.4 反应性系数

反应性系数的运算是在18个月燃耗循环的模拟中根据不同时间内使用MCNPX2.7.0的静态计算得出。燃料、慢化剂和反应性空穴系数则使用全堆芯反应堆模拟器在完整的核心和组件水平进行计算。我们使用makxs来创建一个更高分辨率的MCNPX库,其横截面随温度而变,300 K到610 K的间隔为10K,650 K至2500 K的间隔为50K。

燃料热反应性系数的运算,是通过在±50 K上下微调反应堆燃料的温度计算得出,计算使用以下公式:

\[ \alpha^{\text{fuel}} = \frac{1}{k^2} \Delta k \Delta T_{\text{fuel}} \]

所有的燃料组件（二氧化铀和稀性基质）的反应性系数,无论是处于启动阶段,还是处于燃料停止置換之前的循环末期,均为负值。其它关于反应性系数的信息可参考补充资料。

图4. 可燃吸收体的影响,轴向功率分布和温度在铀元素周期的开始阶段和最热的稀性基质燃料组件即将启动的阶段得以显示,轴向分组的功率峰值减少超过5%并且稀性基质燃料最高温度降低了200 K。

慢化剂平均系数通过建模一系列堆芯慢化剂平均温度的完整过程进行计算。慢化剂的密度进行了相应更新以匹配155巴压力下的饱和液态水表。该系数使用以下公式计算:

\[ \alpha^{\text{med}} = \frac{1}{k^2} \Delta k \Delta T_{\text{med}} \]

图5显示了在燃料更换开始和结束时的作为慢化剂温度函数的堆芯平均慢化剂系数。在零空隙下,循环开始和结束的反应性系数分别为-1.67 x 10^-3 (1/K)和-1.58 x 10^-3 (1/K)。

慢化剂的空穴反应系数显示为一定范围内的堆芯平均空隙。空隙率为10%时,开始和结束的反应系数分别为-0.00185±1.3 x 10^-5 (1/K)和-0.00179±1.1 x 10^-5 (1/K)。

组合层次反应性系数经过计算并已列入补充材料。图5和图6上的这些误差产生于十次模拟结果,每次结果都源于不同的初始种源。误差则表示了大约范围内的平均值。

3. 结果与讨论

图7和图8显示了最热铀元素与稀性基质燃料元件分别在掺杂与未掺杂的不同条件下的功率和热分布图。图4和图8的温度分布图不同,是因为图8中的数据对应为启动不久之后的数据,那时氙和钐裂变产物（吸收中子）已处于长期平衡的状态,而图4中的数据则直接来自于启动后的数据,那时氙和钐还没有形成。

图7. 轴向功率分布。图像显示为4组最热燃料组件的线性功率分别处于循环的开始和结束阶段。
图8. 轴向的温度分布。图8显示了图7中四个组件在循环的开始和结束阶段的轴向温度。

最热燃料组件是指那些在所述第二个燃料置换阶段的组件，由于这一点的掺杂在很大程度上都已被耗尽。可以看出，利用一个完整的可燃吸收体能显著平缓铀和惰性基质燃料的功率和热分布。惰性基质燃料的峰值线性功率密度降低了23%，伴随峰值温度下降15%。然而二氧化锆的熔点为~2715摄氏度，桩基检测表明二氧化锆燃料所释放的裂变气体的温度明显有所提升，但在所显示的温度下，将会显示比二氧化铀燃料略胜一筹。

整体可燃物的添加同样对平缓放射性功率分布具有明显效果。图9显示为堆芯组合水平的平均线性功率密度的横截面，分别为循环开始、结束，与18个月换料间隔平均值。从图9（右下）可以看到，最热与最冷组件之间的线性功率密度发生了显著的变化，这主要是由于惰性基质燃料中超铀元素的高温消耗。图10则显示了每个循环阶段随时间而变化的线性功率密度，更多信息请参见补充材料。可以看出，大部分功率产生于铀组件和惰性基质燃料前三个燃料置换阶段。最后四个惰性基质燃料置换仅用为纯中子吸收剂。

图9. 径向堆芯功率分布图。堆芯组件功率分布如下所示：分别为燃料置换结束（左上）、置换开始（右上）、最小值（左下）和最大值（右下）。

图10. 组件级功率。在燃料置换过程中，每个组件堆芯内的功率不断地发生变化。

图11. 反应堆临界。反应堆临界必须高于1在燃料置换结束时。该图显示了Keff值随着燃料置换有所降低，处于周期末期这些模拟中的Keff=1.008±0.001。

超铀的高消耗成本在堆芯运行功率中有所降低。这里所讨论的模拟是在额定的2000MWe反应堆下完成的。是传统AP1000反应堆功率的三分之一。较高的功率运行将导致铀驱动组件较早的损坏，而且模拟反应堆的运行周期将不能够维持18个月。如果铀燃料浓缩度超过5%，或者燃料置换频率增加，不在每18个月进行一次，那么功率则可以增加至一个更常规的数值。这两种可能性都是将未来工作的话题。

4. 结论

在本研究中，研究表明整体可燃吸收体可以用于惰性基质和二氧化铀的混合燃料堆芯的运行中，以能够在允许的范围内保持燃料的温度和反应性系数。氧化铒与惰性基质燃料一起使用，整体氧化硼与铀燃料一起使用，整体可燃吸收体的使用使轴向功率峰值减少了23%以上，并使堆芯内平均功率峰值从1.80减少到1.44。作为中子吸收剂的堆芯惰性基质燃料，在循环结束时，其原始的超铀库存耗尽了84%。更为重要的是，当在2000MWe的模拟功率下运行时，模拟堆芯在换料过程中起到了关键的作用。

通过使用整体的可燃吸收体，燃料中的轴向热功率分布可以减小到可接受的水平，并且会对堆芯功率的分布产生额外的效果。重要的是，模拟结果表明，不同燃料类型的反应性系数均为负值，并且堆芯的一些微量化和空穴系数也均为负值。这是美国商业动力反应堆所要求的。结果表明，惰性基质燃料可以被用于常规的压水反应堆，以显著降低整体的超铀元素的产生。
效力的作用是培养更多的杰出领袖人物，而非更多的追随者。

——拉尔夫·纳德

核电运营管理课程（NOL）：

- 面向核运营机构的领导者及潜在高级管理人员
- 以实用核电业务模拟培训为基础
- 以业务领导力为重点
- 由国际公认的核电工业领袖人物为您解析

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两年来中国首提“加快发展”核电

2011年爆发的日本福岛核电事故为高速发展的中国核电产业踩下了刹车，使得中国的新建核电审批暂停了20个月的时间，同时中国的核电中长期发展规划的数字也从此前的8600万千瓦降到了5800万千瓦。

不过，日益严重的雾霾或许使得中国的核电发展重新加速。

10日下午，国家发改委组织召开全国发展改革系统加强节能减排促进大气污染防治工作电视电话会议，其中“抓好2014年节能减排工作”的第一条是推动能源结构清洁化。国家发改委称，要“加快发展水电、核电、风电、太阳能、生物质能，推动分布式能源发展”。

这是中国时隔近两年多，首提“加快发展”核电。核电不同于化石能源发电技术（煤电、天然气发电等），其发电过程中几乎不产生任何污染，也不会产生温室气体，是高效清洁的发电方式。不过由于2011年3月11日日本福岛核电事故的发生，安全问题成为中国核电发展的最大顾虑。当年3月16日召开的国务院常务会议要求，调整完善核电发展中长期规划，核安全规划批准前，暂停审批核电项目包括开展前期工作的项目。

2012年10月24日召开的国务院常务会议讨论通过《核电安全规划》和《核电中长期发展规划》。会议指出，2012年3月以来，在对运行、在建核电机组进行综合安全检查的基础上，国务院两次讨论这两个规划，对待核电安全和发展是“十分严肃和慎重的”。这意味着新批核电解冻。

现在，国家发改委提出“加快发展”核电，目前问题的核心是，这是否意味着此前确定的核电中长期发展规划数字会进行上调？有多名核电业内人士接受早报记者采访时表示，核电界目前是有这方面呼声的，但是规划数字具体怎么上调，也不是国家发改委说了算的，而且至少目前还没有具体上调的数字，“不过这也是一个信号。”

此前，中国核能行业协会理事长张华祝在上海举行的中国核能行业协会年会上发言时提及，“福岛核电事故后，中国调低了核电发展的规划，不过核电发展的主动权是掌握在核电行业自己手中的。如果核电建设、运行态势安全稳定，那么‘十三五’末，突破原有规划也是有可能的。”

但是，今年以来，中国的核电新增装机比重在总盘中仍然不大。根据国家能源局发布的统计，1-10月，全国新增发电装机6295万千瓦，水电新增2228万千瓦，占新增装机35.4%；火电新增装机2700万千瓦，占新增装机42.9%；核电新增装机221万千瓦，占新增装机3.5%；风电新增装机785万千瓦，占新增装机12.5%；太阳能发电新增装机361万千瓦，占新增装机5.7%。

核电业界的最新消息显示，目前，环保部已受理的核电厂址审批机组有10台，总计1280万千瓦，除去已经投入运行机组17台（总装机容量1460万千瓦），在建机组29台，总装机容量1160万千瓦，这意味着2020年前中国至少还有25台百万千瓦级核电机组缺口。

另外，业界保守估计，“十二五”末之前获批新建的核电机组可能还有6台，分别是三门3、4号机组，海阳3、4号机组，陆丰1、2号机组。上述6台机组都将采用AP1000技术。

来源：http://www.hdzx2010.ibicn.com

核电政策回暖 泵阀等辅助设备迎机遇

国际原子能机构（IAEA）在最新发布的一份报告中预测，全球核能发电量将在2030年以前持续增长，增长率最高的是包括中国和韩国在内的东亚地区，预计将由2012年底的835GWe增长至2030年的147GWe，而乐观预测的数字则为268GWe。

从国内的政策来看，核电行业也将迎来回暖，受2011年“黑天鹅”事件的影响，我国核电行业经历两年的调整，而近日环保部在其官方网站发布公示，拟于近日批复阳江核电一、二号机组影响报告书（运行阶段），公示期至10月12日。

而核电行业的回暖，尽管我国核电方面的核心技术、核心装备在很大程度上依赖进口，但在管道材料、部分泵阀等辅助设备方面的国产化程度已得到广泛采用，因此，将会在技术研发、设备制造等领域进一步推动中国核能事业发展，给泵阀等辅助设备生产企业带来发展良机。

国内较早获得核电设备资质的有久立特材（主要提供核电管），而江苏神通是核阀门的重要供应商。自今年5月起，国家核安全局先后批准多家民营企业获得核能辅助设备设计制造资质，而富海新材旗下的四川中亚、中核华兴、无锡华能机械制造有限公司、江苏海狮泵业制造有限公司、山东北辰机电设备股份有限公司等企业先后获批。

目前泵阀企业要进入核电领域，必须提高自主创新能力，淘汰落后的产品技术，在自主研发、人才培养等方面向高端化方向发展，积极参与参与重大专项研究，提高产品的国际竞争力。

来源：http://news.bjx.com.cn

国产压水堆核电站数控系统项目 纳入智能装备制造拟支持名单

30日，财政部经建司发布了2013年拟支持智能制造装备项目名单，中广核下属的北京广利核系统工程有限公司和阳江核电工程公司的百万千瓦级压水堆核电站安全技术数字化控制系统研发与应用项目（简称“DSC系统”）纳入了拟支持名单。

自从去年10月我国核电恢复重启以来，国产核电装备研发进展一直受到各方关注。据核电专家介绍，我国部分核电关键设备以满足最新的核电安全标准。

为实现国家提出的百万千瓦级核电站“自主设计、自主制造、自主建设、自主运营”的目标，中广核集团已把DSC系统列为我国改进型压水堆核电技术（CPR1000）的标准配置。

自2009年开始，中广核集团就在百万千瓦级核电站DSC系统研发不断取得突破。打破了百万千瓦压水堆核电站仪控系统的中央计算机系统由国外公司“包办”的局面，对于推进我国内核电站自主化、国产化进程，保证核电站运行安全，降低目前在建核电站建设成本具有深远而积极的影响。

去年4月，广利核公司与中核核电运行管理有限公司在北京签署秦山核电站二期1、2号机组常规岛分散控制系统（简称KPS）改造项目订货合同。此前，上述技术和设备已陆续应用在广利核公司承
我国核燃料组件锆合金管材制造实现新突破

11月6日，中核阿海珐（上海）锆合金管材有限公司（以下简称“CAST公司”），获法国阿海珐集团（以下简称“AREVA集团”）签署的新型包壳管生产许可证。此举将填补中核集团核产业链的空白，确保燃料组件原材料供应的经济性及安全性，中国核燃料组件锆合金管材本土化生产也将由此开启。

目前在国内新型包壳管供应完全依赖进口，CAST公司成立以来一直致力于完成新型锆合金管制造技术转让工作，先后完成了生产线设备改造、关键设备采购、人员培训、转让技术的消化吸收、质保体系重建等大量工作：在完成设备及工艺鉴定之后，CAST公司根据转让方AREVA集团的技术要求，编制了新型包壳管制造技术转让产品鉴定大纲，启动了3个鉴定批新型包壳管生产性能检测结果表明：鉴定批产品性能指标通过转让方AREVA集团的技术条件要求，产品质量与AREVA集团在欧洲的锆管厂生产产品相当，同时CAST公司完成的产品鉴定报告也得到了AREVA集团燃料锆分部的批准。

AREVA集团相关负责人表示，“AREVA集团燃料锆分部对CAST公司鉴定批新型锆合金管质量是充分认可的，通过对比分析，CAST公司新型锆合金管与AREVA集团法国本土工厂潘泊夫或杜伊斯堡生产的管子性能水平相当，基于这些事实，AREVA集团燃料锆分部向CAST颁发了新型锆合金管制造许可证书。”

据称，CAST公司主管部门认定过程得到了其直接用户中核建中核燃料元件有限公司和部分电站的指导和全程见证，中核建中核燃料元件有限公司和AREVA集团燃料锆分部也参加了此次鉴定会，与会人员对CAST公司与AREVA集团合作成功完成新型锆合金管制造技术转让表示祝贺，对CAST公司鉴定批产品的性能和质量水平表示认可。

CAST公司与AREVA集团签订的合作协议规定，CAST公司生产的产品性能和质量水平与AREVA集团在欧洲的锆管厂生产产品相当，基于这些事实，AREVA集团燃料锆分部向CAST颁发了新型锆合金管制造许可证书。

CAST公司新型锆合金管的未来用户方和设计方中核建中核燃料元件有限公司、中国核能电力股份有限公司、中广核核技术研究院等单位代表也参加了此次鉴定会，与会人员对CAST公司与AREVA集团合作成功完成新型锆合金管制造技术转让表示祝贺，对CAST公司鉴定批产品的性能和质量水平表示认可。

CAST公司当下正在对生产线进行扩大产能的升级改造，预计明年将正式批量生产。

来源：http://www.china-nea.cn

AP1000有望成我国核电主力堆型

“除在建的两个项目（三门、海阳）外，三门二期、海阳二期、广东陆丰、辽宁徐大堡、以及湖南桃花江在建核电项目均拟选用AP1000技术，AP1000技术有望成为中国未来核电发展的主力堆型。”中国核能行业协会副会长徐玉明在近日召开的“核电厂更高的安全规范要求及解决方案”国际研讨会上表示。

不过，他同时表示，AP1000新项目的建设取决于三门、海阳两个依托项目进展情况，也取决于其国产化程度及经济性。而未来一定时期内，具有自主知识产权的三代技术也会有一定的发展空间。

今年上半年，福建宁德1号机组、辽宁红沿河1号机组顺利投入商业运行，我国在运核电在役机组达到17台，总装机容量达到3300万千瓦。

下半年，阳江5号机组、田湾4号机组陆续开工，我国在建机组数达到30台，总装机容量达到3300万千瓦。

根据《核电发展中长期规划》要求，2020年我国运行核电装机容量将
达到5800万千瓦，在建3000万千瓦。2013—2020年期间，平均每年新建核电机组500万——600万千瓦。

2020年以后的核电发展规模到底是多少？目前还没有形成正式的规划文件。

据了解，2011年2月出版的中国工程院《中国能源中长期（2030、2050）发展战略研究》报告中，提出过“2030年核电装机2亿千瓦”、“2050年核电装机4亿千瓦”的目标。2011年3月福岛核事故后，中国工程院正在组织对核能中长期发展战略的再研究，预期核电发展目标可能会适当调整。

在徐玉明看来，目前最关键的是如何解决核电面临的挑战。在核电技术路径、天然铀供应及铀资源保障、关键设备制造及国产化、以及核电产业的体制机制创新等方面，还有许多重点课题需要解决。

根据徐玉明的分析，核电装机1亿千瓦左右，每年需要天然铀量18000多吨，供应是有保障的，如果核电规模超过2亿千瓦，铀资源保障就有较大的不确定性，必须考虑非常规铀资源利用。

“非常规铀资源开发、钍资源利用、堆嬗变目前处于技术可行性研究阶段，从技术可行性到工程实施、再到商业运行，还有相当长的路要走，必须及时安排，统筹考虑，努力降低和消除风险。”徐玉明说。

经过多年发展，我国相关企业的设计、关键设备制造、建造安装、现场管理能力已经达到或者接近世界一流水平。国内主要装备制造企业的加工设备及运输能力都达到世界一流水平，每年可以提供10套以上核电关键设备。

但问题是，企业高端能力不足，低端能力富余，制造厂一方面“能力放空”，另一方面又存在“设备交付延期”、“工程拖期”等现象。而且在一些关键技术的掌握上，与国外先进水平仍有差距。

与此同时，政府内部的多头管理与职责不清，产业机构的不合理与同质化竞争，影响了我国核电产业国际竞争力。

“加强技术创新和体制机制创新，用改革创新的红利促进我国核电与核燃料产业的健康、可持续发展，任重道远。”徐玉明表示。

### 2030年浙江核电装机容量将达2890万千瓦

由人民网主办、中国核工业集团新闻宣传中心协办的首届核电·海盐论坛今日在浙江海盐开幕。与会嘉宾就地方与核电和谐发展以及中国核电和谐发展问题进行讨论。浙江省能源局副局长陈海涛在论坛中指出，根据浙江省“十二五”电力发展规划，到2030年，浙江省核电装机容量将达到2890万千瓦。

陈海涛讲到，浙江经济发展较快，2012年全省生产总值34606亿元，位居全国第四，人均生产总值63266元，首次突破一万美元。全年能源消费总量达到1.8亿吨标准煤。“浙江是大陆核电发源地和核电大省，我国自行设计、自行建造、自行运行管理的第三座原型压水堆核电站就诞生于浙江海盐。”

陈海涛表示，目前以化石能源为主的能源结构带来的环境问题是制约可持续发展的重要因素，抑制化石能源消费已经成为人们的共识。“核电是清洁、安全、高效的能源，核电不排放硫氧化物、氮氧化物和温室气体，在实现减排、减少污染，建设环境友好型、资源节约型社会方面具有其他能源不可替代的作用。

“浙江也是我国大陆核电发源地和核电大省，我国自行设计、自行建造、自行运行管理的第三座原型压水堆核电站就诞生于浙江海盐。”陈海涛表示。
比亚迪通过核级储能设备全套鉴定试验

10 月 24 日,比亚迪成功通过核级储能设备全套鉴定试验,成为全球首家将“铁电池”储能技术应用于核电应急电源领域的企业,开创了铁电池储能作为核电领域后备电源的先河。

日本福岛核事故后,中国的核电安全被提升到前所未有的高度。此次鉴定试验要求完全依据核电标准进行,更是在中国最具有权威性的测试机构电器科学研究院和上海同济大学完成的。整个测试历时 60 天,除常规测试外,还包括电磁兼容 (EMC) 试验、交变湿热试验、抗地震试验、短路耐受试验等等。测试条件和流程极为严格,对抗地震性能要求更是近乎苛刻。

依据国家核安全局制定的 HAFJ0053《核设备抗震鉴定试验指南》和 GB13625-92《核电厂安全系统电气设备抗震鉴定》,储能样机在同济大学土木工程防灾重点实验室模拟抗震设防烈度 8 度进行了 3 次 OBE 和 1 次 SSE 测试,整套储能设备 (包括换流器、变压器、汇流柜、电池柜等) 均稳定运行。

全套核级储能设备鉴定试验的顺利通过,标志着自主研发的储能设备在核电应用领域取得了历史性的突破,对该公司在核电领域的发展具有重大而现实的意义。

来源: http://www.china-nea.cn

我国首台核电半速 1200MW 级汽轮发电机在冀成功下线

11 月 12 日,核电半速 1200 兆瓦级汽轮发电机在哈电集团 (秦皇岛) 重型装备有限公司成功下线,这是我国在 AP1000 第三代技术上研发制造的首台产品,该产品的研制成功,标志我国已全面拥有独立自主制造第三代核电岛超大型发电主机设备的能力。

目前,该设备已通过公司 53 项指标试验,不久将发放三门核电站装机使用。

来源 : http://news.bjx.com.cn

CAP1400 预计在 2014 年开工建设

AP1000 是我国从美国西屋公司引进的先进三代核电技术, 采用发生事故后, 72 小时内无须人为干预的“非能动”的安全系统, 安全性、经济性将比目前运行的核电站大大提高。国家核电技术公司董事长王炳华介绍, 目前,国内相关大型设备制造企业已全面掌握了 AP1000 核岛主要设备的制造技术,全国已有 80 多家主要设备制造厂家取得了国家核安全局颁发的核设备制造许可证,并根据要求建立了质保体系,在实施中得到有效运转。

同时,在引进消化吸收 AP1000 三代核电技术的基础上, 结合我国核电设计、建设、运行经验, 开发具有自主知识产权的“中国大核电”——CAP1400 核电站研发设计取得重要进展, 这是我国 16 个重大科技专项之一。

目前,CAP1400 已先后完成概念设计和初步设计。CAP1400 初步设计已通过国家能源局组织的专家评审, 并完成了专家评审程序, 从安全及经济指标上看, 具有世界先进水平。

“通过对 AP1000 主设备消化吸收, 我们掌握了一大批关键制造技术, 预计 CAP1400 重大专项示范工程核岛国产化率将达到 80% 以上。” 国家核电上海核电工程设计院承担了重大专项的设计工作, 院长郑明光认为, 我国的核电建设开始靠自主研发, 之后从法国、俄罗斯引进了技术, 但没有先进核电的核电知识产权, 无论是在设计、建设和在运行上都受制于别人, “所以关键设备咬牙也要提升, 实现国产化。”

“CAP1400 预计在 2014 年开工建设, 这不是国家核电的品牌, 将是中国品牌。” 王炳华相信, 这个中国品牌将会面向并满足国际市场的需求。

来源: http://news.bjx.com.cn
三门核电站汽轮发电机组采用的ap1000技术，是目前世界上最先进的第三代核电制造技术。2008年初，哈电集团取得了日本三菱公司第三代压水堆ap1000核电常规岛汽轮发电机及辅助系统的技术转化资格，开始进行精细的图纸转化。到2010年设计转化工作全部完成，第三代核电设备国产化大幕由此拉开。

2010年，哈电集团在秦皇岛投资2亿元建设核电重型装备试验站，经过150余名技术专家的努力，历时3年时间，研发出了第三代核动力发电机系列产品，并取得了上百项关键技术的转化和突破。

与前两代发电机直接使用核反应堆内循环水热量相比，第三代产品通过一次水和二次水的热量交换，生成无核辐射的热能推动汽轮机发电，电过程的安全性大为提高。

来源：http://www.china-nea.cn

上海合资企业进军核电调节阀领域

日前，上海自动化仪表股份有限公司与英国IMI集团共同投资组建上海自仪希希埃阀门有限公司，新成立的公司将主要从事关键核电调节阀加工、设计和生产，为目标市场提供关键核电调节阀，填补上海电气乃至国家在核电调节阀这个关键领域的空白。据悉，合资公司投资额为4000万元人民币，投产后，可实现关键核电调节阀的国产化制造，降低核电项目建设成本，打破国外技术垄断。

据了解，核电调节阀是核电站运行的流程设备和控制设备，对核电站正常、安全和稳定运行具有极其重要的作用，目前，全球只有IMI集团等少数跨国公司具有生产能力。上海自动化仪表股份有限公司为国内所有商用核电站提供了近百套核电系统装置和数万台核电仪表，同时也是我国所有商用核电站（包括出口项目）的合格供应商。

来源：http://www.caea.gov.cn

中广核发起成立中国首家核电产业链培训联盟

中国首家核电产业链培训联盟21日在中广核大亚湾核电基地成立，该联盟旨在提升核电建设者素质，以保障核电建设的安全与质量。

核安全是核电永恒的主题，核电工程质量又是核安全的基础与根本，中广核多年的核电工程建设实践表明，人是核电工程建设质量的核心，防止人为因素失误是确保安全质量的重要因素。

中广核工程有限公司表示，此次号召核电产业链上下游企业成立培训联盟，将有力促进各相关单位实现培训协作、管理协同、资源集成；通过统一培训理念、加强培训专业化建设、整合培训资源及专家队伍，从业者的整体素质将得到有效提升。

根据联盟组建协议，中广核工程有限公司、上海电气电站集团、山东电力建设第三工程公司等23家单位加入联盟，并成为第一届理事会成员单位。

中广核工程有限公司近年来发展迅速，目前共承担了15台百万千瓦级核电机组的建设任务，装机总容量达到1771万千瓦。

来源：http://www.cnnc.com.cn

电缆所“LOCA试验系统技术研究与应用”项目荣获中国机械工业科学技术奖一等奖

电缆所科研项目“第三代核电站(AP1000系列)LOCA试验系统技术研究与应用”近期被评为中国机械工业科学技术奖一等奖。第三代核电站( AP1000系列)LOCA试验系统技术历时5年的技术攻关，解决了目前世界上最先进的、最安全的商业运行核电站AP1000系列核电站的安全验证问题，其LOCA试验系统成为国际上唯一一个满足第三代非能动AP1000系列核电站“设计基准事故”要求的测试系统，达到了国际先进水平，并解决了长期以来核电站安全壳内冷源必须依靠国外进口的被动局面，有力助推了国内核电设备国产化的进程，对于提升中国在核电技术领域的核心竞争力具有重大意义。

来源：http://www.dxdl.cago365.com

广利核核安全级DCS产业化项目顺利通过国家验收

日前，广利核承担的国家级科研项目——“核电站安全级数字化仪控系统产业化”项目成功通过北京市经济和信息化委员会的现场验收，标志着公司核级DCS产业化基础设施建设完成，为我国自主知识产权的核级DCS产业化应用奠定了设备和设施基础。

核电站安全级数字化仪控系统产业化是工信部国家产业振兴和技术改造专项的子项目，在验收过程中，专家听取了项目汇报，审核了项目资料，并实地考察了项目的完成情况，一致认为项目达到预期目标，同意项目通过验收。

北京市经济和信息化委员会装备处处长艾滨、副处长汪宏、公司副总经理施波等参加了项目验收会。

来源：http://www.ctecdcs.com

中国首套核电主泵轴密封成功制造

11月21日，东方电气阿海珐核泵有限责任公司举行中国首套核电主泵轴密封成功制造庆典仪式。核电主泵轴密封的成功制造，攻克了百万千瓦级核反应堆冷却剂泵国产化的最后一个堡垒，结束了国内不能生产百万千瓦级核反应堆冷却剂泵轴密封的历史，标志着百万千瓦级核反应堆冷却剂泵轴密封制造实现了完全国产化，是东方电气核电设备国产化取得的又一重大成果，大大推进了我国核电设备国产化的进程。

来源：http://www.cnnc.com.cn

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来源：http://www.cnnc.com.cn

世界首条AP1000核电燃料元件生产线完成设备安装调试

11月22日从位于内蒙古包头的中核北方核燃料元件有限公司获悉，由该公司生产的全球首条第三代核燃料元件生产线——AP1000核燃料元件生产线近日完成设备安装调试，正式投产后可使反应堆发生核事故的风险比
第二代核电站低 100 倍。中核北方核燃料元件有限公司总经理助理田有军表示，这条生产线建成后，将是全球第一条新建的第三代核电燃料元件生产线，即使遇到地震和海啸双重冲击，也不会产生类似日本福岛核电站的泄漏事故。据了解，核电站与常规火电站最大的不同是，带动电站运行的能源不是煤而是核燃料元件。因此，核燃料元件又被称作核电站的核心，它的质量如何，关系到核电站能否安全运行。AP1000 技术采用“非能动安全系统”，靠重力等自然力来驱动和维持安全系统运作，即使失去动力，安全系统也可以自动启动，不受影响，同时，这种技术能将核反应堆的堆芯熔融物保持在安全壳内，使大规模放射性物质释放到环境的可能性进一步降低，反应堆发生事故的风险比第二代核电站低 100 倍。田有军说，第三代核电作为中国的主要发展堆型，今后的发展速度会很快。据介绍，该 AP1000 核电燃料元件生产线总投资 12 亿元人民币，于去年 3 月 28 日开工。2015 年项目投产后，将为浙江三门和山东海阳核电站提供首炉国产换料组件。来源：http://news.bjx.com.cn

中国核电公司参与美国电力研究协会研究项目

美国电力研究协会（EPRI）宣布中国核电公司（CNNP）已确定将参与其下两个与核电相关的研究项目。中国核工业集团公司（CNNC）作为中国最大的核电企业集团，是中国核电公司最大的股东。此次项目参与将使 CNNP 有机会切实了解并结合 EPRI 的研究结果与技术指导规范，对 CNNP 的核工业舰队在安全与成本效益运行方面有所参照。而此次 CNNP 所参与的两个项目分别为：

1. 核维护应用中心：此项目旨在通过技术及系统的提高以完善核电站的维护活动。

2. 无损评价（NDE）：此项目侧重于通过技术程序研发，从而进行更为快捷高效并合理的核元件检查与识别，同时在对核电站进行评估或再运行的过程中提出相应的战略决策。CNNP 现有 9 台商业机组正在运行中，总发电量均超过 6506 兆瓦，与此同时还有 12 台机组在建。此次合作还包括 CNNP 旗下负责核电站运行方面的附属公司。

来源：http://www.nuclear-exchange.com

中核四〇四完成铀转化生产线电解制氟电源改造工作

目前，中国核工业集团公司四〇四有限公司完成铀转化生产线电解制氟电源改造工作。改造后的 24 台高频开关电源，目前已陆续投入生产运行，节约电能 20% 左右。经生产运行验证，新安装的高频开关电源装置，各项控制参数、控制方式、输出电能质量满足电解制氟工艺的要求，达到预期的改造目的。

为完成逐年增加的铀转化生产任务，降低生产成本、提高设备自动化及稳定性，该集团公司用 4 个月的时间，对在用的 24 套可控硅整流装置进行了技术改造，改造工作在生产运行期间实施，分两个阶段进行。在电源技改中，技术人员精心设计，合理安排，在满足正常生产电力保全及电气设备安全用电的情况下，对旧电气盘柜、高低压电缆等进行了合理再利用，最大限度地降低电源改造项目的费用。

来源：http://www.caea.gov.cn

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孙勤钱智民会见美国能源部部长莫尼兹一行

10月29日，中核集团董事长孙勤、总经理钱智民在集团公司总部会见了美国能源部部长欧内斯特·莫尼兹一行。双方就核能技术交流、核电工程项目合作等方面进行了坦诚友好的交流。

孙勤对莫尼兹一行的到访表示欢迎。他表示，中核集团不仅是中美和平利用核能技术合作、中美民用核能合作行动计划这两个技术合作平台的积极参与方，还是技术交流合作的主要承担方，更是中美AP1000核电工程的重要合作伙伴，世界首台AP1000机组正是在中核集团三门核电厂址建设。

模块式小型反应堆（SMR）在节能减排、改善环境等方面将发挥独特作用，孙勤希望在小堆方面同美方开展技术合作；中核集团愿意在“利益共享、风险共担、合作共赢”原则下，与美国泰拉能源公司讨论行波堆合作；建议美国能源部考虑取消810条款对双方开展核能合作的限制。

钱智民感谢莫尼兹对三门AP1000核电工程的关注，并介绍了三门核电工程、AP1000技术转让以及AP1000核燃料生产制造等方面的进展情况。莫尼兹表示，美国能源部高度重视同中方开展核能交流与合作。他将着力推动中美和平利用核能协议的续签工作，支持中美双方开展核能技术交流合作。他非常关注中国AP1000核电工程建设进展情况，愿意推动三门AP1000核电工程建设及技术转让相关工作。莫尼兹还介绍了美国核能发展政策、小堆、行波堆以及810条款许可等相关情况。

来源：http://www.cnnc.com.cn/

俄罗斯核燃料产供集团向中国田湾核电站1号机组供应第七组先导燃料组件

2013年11月6日，俄罗斯核燃料生产供应集团向中国田湾核电站1号机组供应第七组TVS-2M先导燃料组件，该燃料被用作为1号机组的标准燃料组件，由新西伯利亚化学浓缩厂生产。目前，田湾核电站①号机组的燃料供应合同签订始于2013年，供货截止期为2020年。中国方面表示考虑续签计划。

2010年同时与江苏核电有限公司和中国原子能工业公司签订了一套合同文件，规定将对中国田湾核电站1号机组打包供应六组TVS-2M燃料组件。合同同时包含了TVS-2M燃料制备技术转让要求，为方便其在宜宾燃料工厂今夕第7组燃料组件的制备工作。合同于2012年11月签订，总价值为5亿美元。这些合同的签订标志着俄罗斯与中方在供应TVS-2M燃料方面的战略合作机会的延续，据悉，该战略合作始于1997年。

1号机组第七次燃料组件的合同附件于2012年9月签订，并就交付日期意见达成一致。

从2014年起，田湾核电站2号机组的TVS-2M燃料制备工作将在宜宾燃料工厂开始进行，制备工作将全部采用俄国的技术和设备。

来源：http://www.tvel.ru

中国工程师接受核电项目管理培训

中国核工业集团公司工程部门向阿海珐集团提出约定，要求对其核电团队进行项目管理培训。

阿海珐方面表示，第一期培训课程已于11月8日结束，全部课程设计均来自阿海珐大学，并由大学方面亲自授课。据悉，该大学专业向集团提供工程师、主管和经理人方面的培训。

阿海珐的副首席商务官Tarik Choho表示：“阿海珐致力于帮助中国公共事业开拓他们自身的技能。”

“这联系合作说明中国核工业集团公司对我们公司在管理培训领域内专业度的双重认可，并加强了我们的合作关系。”

来源：http://www.neimagazine.com

西屋电气助力中国AP1000发展

长期稳定的经济发展从来离不开充足稳定的能源供给。随着环境保护问题在全球范围内不断升温，中国已开始大力寻求清洁、可靠的新能源技术，以满足经济快速发展的需求。近些年，一系列重大项目的启动预示着这一趋势正在加速发展，正在建设的最新一代AP1000核电站就是其中的典型代表。

为了在满足能源需求的同时兼顾改善空气质量，提高国民生活品质，中国选择了西屋电气AP1000技术，这被视为极具战略意义的一步。

安全、清洁能源的新标准

安全作为西屋电气的核心价值观和公司企业文化，贯穿于其50多年成熟丰富的商业核电站运营实践之中，西屋电气始终致力于为客户提供符合最高安全标准的产品和服务。如今，全球近半数正在运行的商业核电站均采用的是西屋电气的核电技术。

AP1000技术采用最新的非能动安全系统，并且通过了美国核管会设计认证。该安全系统的设计灵感来源于基本自然定律，摆脱了上一代技术对于场外电力、应急柴油机和泵的依赖，借助重力、自然循环、冷凝/蒸发等原理加强核电站的安全性。发生紧急情况时，AP1000的非能动安全系统会启动停堆装置，利用自然定律保障核电站的安全和稳定。此外，该系统在3天内不需要交流电源或人力干预。3天后，通过几项简单的操作即可将场内的水导出，实现反应堆的永久安全停堆。这些安全环保的特性使得核能在全球能源领域的地位不断攀升，成为应对气候变化、减少环境污染的理想选择。
AP1000技术的另一大特点是设计“简约”。由于没有更多的泵，核电站在建设过程中不需要铺设过多的管道、电缆和阀门，从而大大减少了混凝土的使用，缩短了占地面积。同时，AP1000核电站采用模块化的设计原理，有效降低了电站建设的复杂性和建造成本。与上一代技术相比，在60 年使用寿命内，新一代表技术不仅在运行还是维护方面都有明显改进，充分体现了“少即是多”的设计理念。

2007年，西屋电气获得了浙江三门和山东海阳核电站自主化依托项目的建设合同，在三门和海阳两地建造4台百万千瓦级机组。目前，这两座全球首批采用AP1000技术的核电站已进入项目建设的最后阶段，即将进行调试和试运行。

西屋电气新电站业务高级副总裁贝杰明表示：“西屋电气会不遗余力地与中国的客户、合作伙伴和供应商合作，顺利完成这两座核电站的交付工作，为中国的家庭和社会提供安全、清洁的电力。很快，三门和海阳核电站将向全世界展示它先进的技术设计理念及其带来的经济效益！”

倡导持续改进
对AP1000核电站技术安全的关注也体现在电站的建设方面。今年年初，三门和海阳1号机组钢制安全壳顶封头（CVTH）分别吊装就位，安全壳内主要设备也随之顺利安装，主控室设备的安装和调试正在进行，预计不久便可投入运行。自开工以来，三门和海阳核电站建设项目的建设进程稳健推进。

中国AP1000项目副总裁鲍睿表示：“西屋电气的首要任务就是以最高的安全和质量标准交付核电站项目。没有什么比这更重要的了。持续关注中国在建项目的安全和质量能够使我们的核电站安全、可靠地运行。”

鲍睿还表示：“与此同时，我们也在持续改进产品的交付。为此，在工作中我们坚持总结经验和实践。全球在建的8台AP1000机组中，中国有4台，美国有4台。我们不断地把从中国项目中获得的经验应用到美国项目上，同时将美国的项目经验应用到中国的后续项目中，以帮助我们进一步改善未来电站的交付工作，使我们的核电项目迈入持续改进的良性循环。”

AP1000核电站在建设过程中也遇到了一些挑战，为实现电站项目的安全设计标准，项目参与各方群策群力，共同积极地解决了供应链和现场建设中存在的问题，在此过程中也提升了国内供应商的整体实力。

立足长远的解决方案
西屋电气的愿景是通过提供领先的核技术，满足全球对能源需求的增长，成为客户的明智之选。公司旗下共设有四大业务板块——核自动化、核燃料、核服务和核电站。

西屋电气中国副总裁兼总经理高礼霆表示：“除了核电站业务，我们还计划在中国建立核能产业链，以更好地服务我们的中国客户以及未来的海外市场。我们将积极地与本地的客户和供应商开展深入合作，一同推进中国核电事业的进一步发展。”

高礼霆补充道：“目前在美国，绝大多数运行的核电站都属内陆核电站，美国的4台AP1000机组都在内陆。我们希望能在不久的将来，在中国看到一些内陆核电站项目的建设。”

来源：http://news.bjx.com.cn/

中国核电再出海：中核中广核联手法企参建英核电项目

从2014年3月31日至2015年3月31日举办的首次中法高级别政府间经济财金对话会上独家获悉，中核集团和中广核近期组成联合团队参与法国电力公司在英国欣克利角核电项目。

据国家能源局副局长张玉清介绍，中国广核集团有限公司和中国核工业集团公司是以参股分包方式参与法国电力公司在英国的这一核电项目。

“中法两国核能合作已经有30年合作历史，将会进一步鼓励中法两国企业在核能上下游领域探讨有竞争力的合作方案。”他表示。

周二举行的两国对话活动还通过了《首次中法高级别经济财金对话联合声明》，声明称，在最高安全和环保标准以及共同利益基础上，中法双方将加强核能政策和技术领域合作。

根据中国核能行业协会的公开资料，中国出口的核电站仅有巴基斯坦恰希玛核电站，为30万千瓦压水堆型，2000年9月投入商业运行。此次中广核和中核集团竞夺英国核电项目是国内核电出海的又一次成功尝试。

来源：http://www.china-nea.cn

中核集团与瑞典核燃料和废物管理公司签订合作备忘录

11月18日至19日，瑞典核燃料和废物管理公司（SKB）所属国际公司总裁Magnus Holmqvist一行，访问了核工业北京地质研究院。中核集团国际合作开发部主任林森代表集团公司，与其正式签订放射性废物管理领域合作谅解备忘录。这标志着中国与瑞典在放射性废物管理领域的合作进入了一个新阶段。

访问期间，核地研院专家与Magnus一行就今后两年的合作进行了深入交流和探讨。双方建议以人员交流、考察、研讨会和共同研究等多种形式在多领域开展合作。

作为瑞典承担放射性废物管理工作的主要单位，SKB在该领域具有先进的研究和开发经验。近年来，核地研院与瑞典SKB进行沟通交流，并在放射性废物管理领域展开合作，与SKB合作谅解备忘录达成一致。

来源：http://news.bjx.com.cn

中国援建巴基斯坦核电项目动工巴总理致谢

巴基斯坦大型核电项目26日在巴南部港口城市卡拉奇举行启动仪式，巴总理谢里夫亲自参加破土动工仪式。该核电项目造价95.9亿美元，由中国援建，预计6年内完工，建成后有望缓解巴基斯坦长期以来的能源危机。
谢里夫表示，“2200 兆瓦的核电项目开始动工，是巴基斯坦历史上值得自豪的时刻”，他对中国政府在关键时刻提供的帮助表示感谢，电力短缺是当前困扰巴基斯坦的最大难题之一。

另据巴基斯坦媒体报道，巴基斯坦陆军中将拉希勒・谢里夫27日被任命为新一任陆军参谋长，拉沙德・马哈茂德被任命为参谋长联席会议主席。

来源: http://www.china-nea.cn/

中法将共同开发第三方核电市场

中法两国总理12月6日举行会谈后，一致同意扩大核能领域的合作，开拓新市场。

据报道，中国是全世界最大的核电市场之一。艾罗在访华的第二天强调了中国在核能领域的领先技术。

艾罗说，他将参观广东省台山市的一个大型项目。在那里，中法正联合建设两个反应堆。

他说：“我们在核能方面的合作在台山达到了新高度。”

法国《世界报》早些时候援引一位专家的话说，与“重要的政治大国”中国合作将使法国获益。

艾罗说，这项工作正在“稳步”推进。他还说，他希望该工程能为建设另外两个反应堆的协议铺平道路。两国最早是在30年前开始在核能领域展开合作的。

据报道，法国2012年的对华贸易赤字达270亿欧元（1欧元约合8.36元人民币）。双方还同意扩大在航空、金融和汽车制造等领域的合作。

来源: http://www.heneng.net.cn/

L-3 MAPPS获比利时Tihange电站全规模模拟机项目

蒙特利尔，2013年12月10日—L-3 MAPPS公司今日宣布已经与 Electrabel S.A.公司达成合作协议，将为比利时Tihange核电站1号机组提供全规模模拟机。据悉，该项目将立刻启动，并预计在2016年第一季度投入服务，特克贝尔工程公司，作为Electrable S.A.公司的工程部门，将主要负责该项目的执行。

“L-3 MAPPS很高兴能够与 Electrable 达成合作，这对于我们双方来说都是一个很好的机会。”L-3 MAPPS电力系统及仿真市场销售副总裁MichealChatlani说道，“接下来的两年中，我们将致力于为Electrable量身打造一种先进的全规模操作培训模拟机，并一如既往确保为客户提供满意的服务。”

Tihange核电站

“我们经过广泛调查对比，最终选择了L-3 MAPPS，源于其在全规模核电站模拟机方面一直做得很出色。”Tihange电站1号机组长期运行项目负责人MichelDeboeck说道，“因此，我们相信基于其专业的Orchid®平台，L-3 MAPPS会交出一个令人非常满意的产品。”

Tihange全规模模拟机配备全复制性控制室面板，工厂模型和指导员台将采用L-3最先进的基于PC/Windows的图形化模拟工具，所有的电站系统被模拟至Orchid模拟环境中，包括反应堆、核装置蒸汽供给系统、核电厂配套设施、电子交流和直流配电系统以及仪控系统、输电网络，包括主发电机和变压器，将同FAS一起进行模式化，FAS是特克贝尔工程公司的一款产品。

Electrable公司总部位于比利时布鲁塞尔，隶属法国燃气苏伊士集团－－一家世界领先的能源环保型公司。Electrable活跃于电力生产及电力、天然气能源销售领域。2012年末，公司发电量为9879兆瓦，略低于比利时总发电量的一半（47.9%）。Electrable运行下的7座核反应堆，4座在Doel核电站，3座在Tihange核电厂，总发电量为6000兆瓦，Tihange电站1号机组地处默兹河沿岸，位于布鲁塞尔东南方95千米处，是一座三回路压水堆，发电量为962兆瓦。该电站1975年开始运行，到2012年7月4日，核控制联邦机构决定将其运行寿命延至2025年。

来源: http://www.mapps.l-3com.com/
三门1号机组反应堆厂房屏蔽墙浇筑完成

2013年10月31日，AP1000依托项目三门核电1号机组反应堆厂房屏蔽墙第18层最后一罐混凝土浇筑完成，即1号机组反应堆厂房屏蔽墙全部浇筑完成，为后续钢穹顶吊装以及CB20模块的就位创造了条件。

依托项目三门核电1号机组反应堆厂房屏蔽墙设计结构为现浇钢筋混凝土筒体结构，外观呈圆柱形，总高度为52.4米。屏蔽墙共分成18层进行浇筑，其中1—14层为分段浇筑，15层至18层为整体浇筑。

屏蔽墙的施工难度大，技术要求高，国核工程有限公司协同施工方精心策划、周密准备，墙体施工保持了零事故，墙体质量整体良好。

来源：http://www.china-nea.cn

中国东北首个核电厂1号机组并网发电

中国东北地区首个核电厂——辽宁红沿河核电站1号机组17日15时09分并网发电，这标志着该机组正式进入并网调试阶段，具备发电能力。

红沿河核电站位于辽宁省大连瓦房店地区，是中国“十一五”期间首个批准开工的核电项目，也是东北地区最大的能源建设项目。

据中国官媒报道，辽宁红沿河核电站是中国自主创新最多、国产化率最高的核电站，其二期工程设备，包括关键设备的国产化比例，均超过80%，例如它的海水淡化系统，开辟了中国内地核电站利用海水淡化技术提供淡水资源的先河。

辽宁红沿河核电站有关部门表明，一期工程4台机组到2015年全部建成发电的目标将会如期实现。这4台机组年发电量为300亿千瓦时，高于大连市2012年全社会用电量287亿千瓦时的水平，约占辽宁省2012年全社会用电量的16%。

据介绍，与同等规模的火电项目相比，辽宁红沿河核电站一期工程4台机组全部投入运行后，每年减少标煤消耗约1000万吨，减排二氧化碳2400万吨、二氧化硫23万吨、氮氧化物15万吨，相当于造林6.6万公顷。这将优化辽宁地区电力供应结构，实现节能减排，改善空气和水质量。

阳江核电站1号机组首次装料获批

阳江核电站1号机组首次装料获批，国家核安全局周二发布通知，1号机组获得国家核安全局颁发《首次装料批准书》。按照既定规划，1号机组预计今年底并网发电。

一位核电行业分析师介绍，阳江核电站建设基本按照原定进程推进，如果一次装料后各控制点调试稳定，预计今年底将并网发电。

据了解，阳江核电项目采用我国自主品牌的压水堆核电技术—CPR1000及其改进型技术，规划建设6台百万千瓦级核电机组，总投资约732亿元。
中广核宁德核电基地2号机组开始首次核燃料装载

11月11日7时28分，中广核宁德核电基地2号机组完成第一组燃料组件的装载，标志着宁德核电基地2号机组首次装料正式开始，也标志着宁德核电建设又向前迈出了关键一步，为早日实现2号机商运目标奠定了坚实的基础。

来源：http://www.cgnpc.com.cn

核电海水处理设备项目落户唐山玉田

日前，总投资达2.5亿元，由中国东方电气集团和唐山市东亚橡胶制品有限公司合作建设的核电海水处理设备项目落户河北省唐山市玉田县。

经了解，该项目选址在玉田县玉泰工业区，占地100亩，项目建成后，预计年可生产核电常规岛海水覆盖、冷却设备及热设备、核岛防核设备等200台套，实现产值3.5亿元，上缴税金2150万元。

来源：http://www.caea.gov.cn

福清核电站1号机组调试设备 预计2014年7月发电

记者19日从福清核电公司获悉，2008年11月21日正式开工的福清核电工程，1号机组可望于明年7月31日实现发电。

福清核电站位于三山镇西南前薛村岐尾山前沿，截至10月底，工程已累计投入建设资金300多亿元。

1号机组于2008年11月21日正式开工，总工期68.5个月，目前已开工60个月，工程建设进入设备调试高峰。预计2014年6月5日实现首次并网，2014年7月31日进行性能试验、开始发电。

2号机组于2009年9月18日开工，工程建设进入系统移交高峰期，预计2015年1月15日进行性能试验、开始发电。

3号、4号机组分别于2010年12月31日、2012年11月17日开工建设，目前分别进入安装高峰期和土建高峰期。

5号、6号机组目前均处于地下工程开挖阶段。

根据规划，核电站6台机组可连续建设。从明年起，核电站将实现每年有一台机组发电。

来源：http://www.cnnc.com.cn

航天材料助力第四代核电站建设

日前，航天材料及工艺研究所所航天碳材料产业化基地重点项目——高温气冷堆核电站停堆系统用石墨吸收球生产线在山东省德州市建成投产，年产8000万颗含碳化硼石墨球，以满足世界上第一座第四代核能系统安全特征的20万千瓦级高温气冷堆核电站的需求，并在关键材料领域有力助推和保障第四代核电站建设和商业推广。

航天材料及工艺所隶属中国航天科技集团第一研究院，是我国航天系统材料工艺中心研究所。

来源：http://news.bjx.com.cn

福清核电1号机组热态功能试验正式开始

11月27日11时18分，福清核电1号机组热态功能试验分两阶段实施的方案顺利获得国家核安全局认可，1回路开始升温至120摄氏度平台工况。这标志着福清1号机组热态功能试验第一阶段正式开始，提前19天实现集团公司对热态功能试验开始节点的摸高目标。

来源：http://www.cnnc.com.cn

三门核电1号机组核岛屏蔽厂房钢屋顶吊装就位

11月23日7时36分，三门核电1号机组核岛屏蔽厂房钢屋顶经过调平、起钩、变幅、回转、行走、落钩等步骤，历时1小时38分钟，顺利吊装就位，实现封顶。整个吊装过程安全平稳，质量受控。

屏蔽厂房钢屋顶整体为棱锥台结构，上口边距12.5米，下口边距约41米，高度近11米。钢屋顶共计附属结构本体总重量约780吨，吊装总重量达到920多吨。钢屋顶吊装就位后，其上部为钢筋混凝土结构，并起到支撑AP1000的关键非能动设备——非能动安全壳冷却水箱的作用。

本次吊装具有重量重、体积大、高度高、重心偏等难点。为了保证吊装工作安全顺利进行，项目各方通力协作，提前进行了精心的筹划和准备，编制了完善方案、程序和计划，并经过了项目管理各方及国家核安全局华东核与辐射监督站的严格评审。吊装过程中，各有关方严格执行方案，保证了吊装活动的顺利实施。

来源：http://www.cnnc.com.cn

昌江核电1号燃料厂房乏燃料水池水密封性试验启动

11月30日下午，昌江核电工程1号燃料厂房乏燃料水池水密封性试验正式启动。乏燃料水池水位标高，标志着乏燃料水池水密封性试验正式启动。

1号燃料厂房乏燃料水池为12.608×8.008米的矩形不锈钢水池，设计标高为+7.490米至+20.150米，储水量约为1265立方米。水密性试验将对水池的不锈钢施工质量进行检验，试验完成后将移交安装单位进行后续燃料贮存构架及相关设备安装。

来源：http://www.cnec.com.cn
第十届
中国核能国际大会
2014
5月29-30日
北京

10年历史，从2005至2014。自2005年始，中国核能国际大会已历经了10年的发展路程，累积汇聚了2200+位来自中国、法国、美国、韩国、日本、俄罗斯、德国等四十多个国家的行业决策者，俨然成为了享誉全球的顶尖核电盛会！

- 250+名高层核电参会嘉宾 & 25+名全球著名发言人
- 25+个国家参与
- 3场圆桌会议
- 50+位决策层领导
- 20+个小时的社交活动
- 40场一对一会谈
- 1场盛大的颁奖典礼

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News Summary

11月4日，在议会官员委员会举办的听证会中，能源与气候变化署核能开发副部长Mark Higson向欧盟委员会提议工业和议员Margaret Hodge表示，“事实上，我们期待在新建的压水堆中使用Mox（混合氧化物燃料）。” Higson将法国电力公司（EDF）在欣克利角计划建设的EPR作为可能的顾客。

燃料源自于未来的英国MOX燃料厂，但一位来自EDF的英国子公司的发言表示RBCL记者说：“我们并没有在任何核电站中使用Mox燃料，也没有任何计划在未来在现有的核电站或新建的核电站中使用。当Hodge询问到政府将庞大的钚库存视为资产还是负债时，Higson回答说：“目前我们处理钚的首选方案是建立一个Mox工厂，并将其使用在新建的核电站中，但是根据目前的规定，燃料的价值将会低于建设运行核电站的成本。由此，我们提出的方案是需要国会和总统的批准，而埃及一直在努力推进一项新的核设施的计划，最终将在建议厂址完成21,000 MW-TH的压水堆。从表面上看，计划是需要国会和总统的批准，而埃及的核政策是需要国会议员和总统的批准和持续的替换方案。

韩国

周四的听证会将参与者在会上公开表示韩国应该减少对核能的依赖，但政府应该提出新的核反应堆的审查。一个研究小组在上月表示，为在核能领域和工业上购买的决定，到2035年，核能贡献率应削减至22%至29%，而不是规划的2030年41%的核能贡献率。首尔国立大学的教授Yun Sunjin在听证会上表示：“比例似乎有增无减，但政府已基本停止了核电站的招标。该声明紧随埃及临时总统Adly Mansour之后。在上个月的发言中称该国正在推进招标计划。在始于2011年政治动荡前，埃及一直在努力推进一项新的核设施的计划，英国正在为在地中海Dabaa计划中的核设施进行招标。该声明紧随埃及政府对其核能发展的推动。

据夏洛特企业杂志，三菱重工（MH）的一家美国子公司，三菱核能系统公司，在方向上做了新的转变，其第一个显著地行动就是裁掉了48名在北卡罗来纳州夏洛特的EPR工程中心工作的员工。本月裁员遵循三菱重工于11月宣布的决定，以减缓有关其1,700兆瓦US-APWR设计获得美国设计认证的工作，转向专注于服务市场并协助日本反应堆进行重建，即将被解雇的员工约占在夏洛特工厂工作的100名工人的一半。夏洛特工厂是在2012年春天开设的。

据国家电网公司称，中国明年可能会为地中海地区的核能项目提供支持。本月据路透社报道，国家电力部门的发言人称中国可能为在地中海的核电站提供支持。当RSCC被阿联酋核能公司（ENEC）选定为四个核反应堆提供1E级核电时，将需要中国电力部门的支持。Higson表示：“中国电力部门在支持正在建设的核电站的计划中发挥了重要作用。”
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<tr>
<td>boric acid removal</td>
<td>亚硼酸</td>
</tr>
<tr>
<td>boric acid surge tank</td>
<td>硼酸流动体</td>
</tr>
<tr>
<td>boric acid tank</td>
<td>硼酸钠</td>
</tr>
<tr>
<td>boric acid oxide</td>
<td>硼酸氧化物</td>
</tr>
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L-3的超级仿真培训系统采用Orchid 仿真技术，为电厂操作人员提供真实的操作环境，帮助他们获得处理任何紧急事故的经验。不管是多复杂，多危险的事故工况，都可以在仿真器上实时逼真地推演，对事故工况提供有效的监视并能对事故工况进行适当的调整。

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