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www.iync.org
Dear IYNC community,

IYNC2014 is getting close! The IYNC2014 Executive Committee has worked hard this year to prepare the best congress ever. Technical program, venue, logistics, social events, sponsors, promotion, technical tours ... It’s amazing the job our volunteers are doing for IYNC2014 on top of their work for their companies or universities. In December, I had the opportunity to meet the Spanish Local Committee in Madrid. It’s a good team and they are doing a great work organizing all the logistics. The Spanish volunteers took me for a ride to Burgos to visit IYNC2014’s congress center at Abba Hotel. The city is perfect for a conference like IYNC. It’s convivial and there are many places that offer opportunities of networking during the social events. But the core of the congress is the technical program. In 2014 again, the IYNC technical program will be impressive: 15 workshops, 11 tracks for technical papers and more than twenty top managers speaking in plenary sessions. As you will read in the interviews in the present bulletin, Generation IV reactors are being developed in India and France. Generation IV is one of the subjects of IYNC2014 Technical Track 3. If you work on this subject, don’t hesitate to share a summary. The technical program couldn’t be possible without the help of more than 50 young volunteers hired worldwide. Being an IYNC volunteer requires a personal investment but is largely rewarded by the large knowledge of the nuclear your are gaining and the professionals and friend connections you are making.

At the same time, the officers have been busy extending the network. We have attended major international nuclear conferences to extend the IYNC network and promote IYNC2014: the WANO BGM in Moscow, the WNA Symposium in London and the IAEA General Conference in Vienna. We also organized an IYNC board of directors meeting in Stockholm last May. This effort has enabled the network to extend to 3 member countries since May: Ecuador, the United Arab Emirates and the latest one: China. But I would particularly like to highlight the cooperation between IYNC and India who recently started its Young Generation Network. You will read in the interview of Mr. Rajadhyaksha that India already has a lot of young nuclear professionals but is hardly working on developing many more new talents to meet the increasing needs of the Indian nuclear industry.

In conclusion, if you want to benefit from the IYNC technical program and broaden your international network in the best conference environment, there is only one place I could recommend: Burgos!

Sincerely Yours,
Nicolas Anciaux,
IYNC President
Makarand Rajadhyaksha – CEO of PM Dimension

Makarand Rajadhyaksha started his career as sales manager at Hoganas India Ltd. He moved then to Tata Steel, still in the metal industry. Between 1999 and 2002, he completed an MBA in India where he gained a lot of skills. He gained experience in Gartner India, specialised in global IT research & consulting. In 2007, he decided to create its own company, PM Dimensions, to respond to the increasing demand of nuclear engineering services and qualified human resources in India. He will give us his view on the Indian nuclear market and explain how PM Dimensions is involved in.

Could you describe your academic background and professional path?


In terms of professional experience, I have worked for three companies in the past:

- Hoganas India Ltd (the Indian subsidiary of a global leader in Swedish metal powder manufacture) as Sales manager;
- Tata Steel;
- Gartner India (US headquartered global IT research & consulting company).
- In 2007, I turned entrepreneur and incorporated PM Dimensions along with my former senior colleague from Gartner, Rob Gout.

In a few words, could you describe your current position within PMDimensions?

As I said, I promoted PM Dimensions in 2007 with one of my previous colleague, Rob Gout. As CEO of the company, I am dealing with the planning execution and the main directions I want to give to the company for the coming years. From a strategy point of view, I am thinking on how to increase the revenues, develop new businesses and diversify our services & products.

Could you give us a structured view of the different PM Dimensions’s nuclear activities while mentioning the approximate importance of each entity in terms of employees and revenues?

PM Dimensions’ nuclear business is organized in two divisions:

a. Training Division
b. Engineering Services Division

In our business model, both divisions are equally important as to undertake engineering services (basically technical support services – such as construction supervision, operations and maintenance support, engineering analysis and consulting) on a large scale in global markets, we see the need to create a very large talent pool of young nuclear engineers. When I went to the IAEA in Vienna in 2009, I realised that a lot of countries need help within the nuclear sector.
The flagship program of the training division is a 1-year program in nuclear engineering. We are like a “corporate university” in a way. The fact however is that this is a paid program that is sold to engineers with 0-3 years of professional experience, although we support almost all with education loans. A key feature is that all those who undertake the program are necessarily employed by *PM Dimensions* in the engineering services division.

The program has extensive classroom sessions, laboratory sessions, project work, internships with organizations such as EPC companies, equipment manufacturers, technical service providers,... and last but not least trainings at the redundant Zwentendorf Nuclear Power Plant in Vienna in Austria.

We have trained/are training over 200 engineers since the program was introduced in late 2010. About 175 have already joined us on completion of the program. Our goal by 2015 is to have a training base that will produce 500 nuclear engineers per year for global deployment.

In terms of engineering services, this comprises:

- Technical support services
- Engineering analysis
- Consulting

Some examples of the work that we are currently doing are:

- Operations & Maintenance Support, Commissioning Support & development of procedures at a NPP under construction;
- Establishment & Management of the Engineering Documentation Centre at BHAVINI (readiness for regulatory/WANO review)
- Engineering Drawing – Piping Design in Balance of Plant
- Projects pertaining to Computational Fluid Dynamics
- Development of 15 Year Strategic Plan for Kenya’s nuclear power program
- 5-year advisory engagement to Government of Sudan for their nuclear power program (across Human Resource Development, Bid Information Specifications, QA, Site Characterization, etc).

At this stage, the training division contributes for 30% of the revenues, while the engineering services division contributes the balance 70%.

There are 15 fulltime employees in the training division and about 225 in the engineering services division. However we can also count on an additional 175 former employees of the Department of Atomic Energy organizations such as NPCIL, BARC, AERB, IGCAR, etc empanelled as consultants who are utilized on a need basis.

*PM Dimensions* offers nuclear trainings:

- a) Could you please detail these latest?
- b) Who are these trainings dedicated to? Who are the clients?
- c) Does *PM Dimensions* offer trainings/nuclear services abroad?
As explained above, the 1-year program has extensive classroom sessions, laboratory sessions, project work, internships and training at the Zwentendorf Nuclear Power Plant in Austria. The talent pool that we create is deployed on projects in India, Africa & Europe. The customers are the NPP operators, EPC companies, equipment manufacturers, technical service providers, etc...

After university, students in India are used to look for an additional program to get a better job. Our 1-year nuclear programme actually responds to their ambitions. In India, this is not difficult to attract graduates in the nuclear sector. People are not scared of the nuclear technology.

In addition, we have about 100 short-term training programs (3 days duration) that we deliver to corporate, i.e., primarily to experienced professionals.

We are also looking at e-learning and a nuclear knowledge repository; however that is at the preliminary stage.

We deliver training abroad, mainly in Vienna through the International Atomic Energy Agency. We have trained teams from 38 countries at the Zwentendorf NPP over the last 3 years.

In a few words, can you present a view of the nuclear sector in India (number of reactors in operation/construction, number of operators, fuel cycle operations, human resources ...)?

The nuclear sector in India is fully controlled by the government, more precisely the Department of Atomic Energy. This department has various organizations that report to it:

Operator: Nuclear Power Corporation of India Ltd. (NPCIL)

- Research Organization: Bhabha Atomic Research Centre, Indira Gandhi Centre for Atomic Research
- Regulatory Body: Atomic Energy Regulatory Board
- Number of reactors: 20 in operation (of which 18 are Pressurised Heavy Water Reactors (PHWR)) generating 4,780 MW; and 7 under construction, expected to generate an additional 5,300 MW, among which:
  - 4 are PHWR;
  - 2 are Pressurized Water Reactors (PWR)
  - one is a GEN-IV Fast Breeder Reactor (FBR)

India is also working on its own design, a very advanced technology using heavy water as moderator and fuelled with thorium. The construction of a 300 MW prototype of this Advanced Heavy Water Reactor (AHWR) is planned to start in 2016.

- Human Resources: Homi Bhabha National Institute.

As far as the fuel preparation is concerned, India is involved in uranium mining, conversion and fuel fabrication via State organizations as well:

- Uranium Corporation of India Ltd. (UCIL) responsible for mining activities;
- The Nuclear Fuel Complex (NFC) working on conversion and fuel fabrication.
Does India have enough human resources qualified in the nuclear sector to face its strong nuclear development or, on the contrary, will India be forced to rely on international resources?

No. Given the current growth & projections, it is estimated that the country will require an excess of 100,000 nuclear engineers over the next 5-7 years. This includes of course requirements for all stages of projects.

The Homi Bhabha National Institute produces 400 engineers every year. However that is only for DAE organizations. All universities put together provide with less than 50 nuclear engineers per year.

That’s where a corporate university like *PM Dimensions* steps in. Be aware that for 400 seats at the Homi Bhabha National Institute, there are more than 85,000 applications every year.

At the moment, there still exists a massive gap between the demand and supply of nuclear engineers. Private ventures, as opposed to educational institutes, are going to play a major role with regard to this issue.

How did the company do to get known within the nuclear industry as a training provider, without being by itself industrially committed?

First of all, it took time to assemble capabilities, infrastructure and solutions. When I went to the IAEA for the first time, I realised the large scope of business opportunities but I definitely understood that the first step would consist in acquiring credibility on the nuclear market. With regard to that purpose, we have reached out extensively to the market and showcased:

- Capabilities of our experts;
- Our unique infrastructure at the Zwentendorf Nuclear Power Plant\(^1\) that we lease in Austria;
- Our business model – where we provide experts & young engineers – aligned to a specific project need and compelling business need;
- Track record from customer such as BHAVINI, NPCIL, IAEA, international governments.

Now, we are still working hard to increase our business in Sudan, Kenya,... and we can rely on the expertise of our employees who already have a strong experience in the nuclear industry.

What is the expected development of the company based on the strong nuclear development in India?

The company is at an inflexion point, the reason being that the capabilities have been evidenced by the track record. There are major contracts that are under negotiation in India & internationally.

We are establishing a training & engineering services complex in Gujarat where the first building is dedicated to the nuclear industry. This will be inaugurated in 2015.

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\(^1\) Zwentendorf NPP was the first nuclear plant to be built in Austria, but was never put into business. The operation of the plant was prevented by a referendum in November 1978.
What are the main challenges for PMDimensions for the years to come?

- Rapid deployment of innovative solutions.
- Develop or increase our capabilities in new areas as for example the decommissioning
- To mitigate business risks until all the customer projects stabilize

Does PM Dimensions have strong competitors on the Indian nuclear market?

There is no competition for the training business but there are of course very well established engineering companies who compete for the services business.

PM Dimensions is taking the lead in setting up the IYNC-India Chapter. What direction have you planned to give to this International Organization? How do you want to make PM Dimensions involved in IYNC?

IYNC is a brilliant concept and very relevant in the Indian context. Because PM Dimensions

- has 200+ young professionals in-house,
- constantly reaches out to similar age group levels in various nuclear establishments,
- is very entrepreneurial in its approach,

we can potentially support IYNC ramp up rapidly.

We would be happy to provide dedicated resources, administrative support and some insights from our training/events business.

Please note that there is already a team within PM Dimensions especially dedicated to the young generation activities (event, conference, collaboration with other organizations,...).

As a summary, PM Dimensions would be happy to welcome the 2016 IYNC conference in India. I really expect a lot from IYNC!

Do you have any message that you wish to address to the young generation and students who intend to work in the nuclear sector in India?

Indian talent will play a major role in global nuclear commerce in the coming years, very similar to what the IT industry has done over the last two decades. The dynamics of project delivery within India and internationally are changing rapidly. As the nuclear business increases rapidly in India, young professionals are directly in relation with very experienced people from all over the World. It is thus possible for these individuals to achieve in three years, adequately in terms of professional and betterment, what one would normally achieve in 10 years. However, with regard to that process, one needs to have correct skill sets, experience and be at the right place at the right time. PM Dimensions does not want to miss out on this opportunity!

By Pierre-Henri D’haene, BNS-YG, IYNC.
INTERVIEW WITH MR FRANÇOIS GAUCHÉ, CEA

Mr GAUCHÉ is the Manager of the “Generation IV Reactors” Program at the Nuclear Energy Division of CEA, the “French Alternatives Energies and Atomic Energy Commission”. SFEN Young Generation has interviewed him on the ASTRID project (Advanced Sodium Technological Reactor for Industrial Demonstration).

1. MR GAUCHÉ, COULD YOU PLEASE INTRODUCE THE ASTRID PROJECT TO US?

The ASTRID project consists in the R&D, design and development of a 4th Generation Sodium Fast Reactor Prototype, the level of safety of which will be at least equivalent to the third generation of LWR and will integrate into its design the lessons learnt from the Fukushima accident.

The project involves several companies of the nuclear industry:

- CEA, the contracting owner, is in charge of core design,
- AREVA is in charge of Nuclear Steam Supply System, Instrumentation and Control systems and Nuclear Auxiliaries,
- EDF provides support and experience to the contracting owner and performs safety studies.
- Alstom Power Systems brings its worldwide expertise to the design of the energy conversion part of the plant
- Other companies are involved in various parts of the design (TOSHIBA, COMEX Nucléaire, ASTRIUM, Rolls-Royce, JACOBS France)

2. WHAT IS EXACTLY A SODIUM FAST REACTOR?

The most widespread reactor technology uses water as a coolant, whereas Sodium Fast Reactors are cooled by liquid sodium. Water slows down neutrons, and liquid sodium does not. That is why nuclear reactions in SFRs are governed by neutrons of high speed, and it explains the name of the Fast Neutron Reactors. On the contrary, nuclear reactions in water-cooled reactors are governed by low speed neutrons (“thermal” neutrons).

In nuclear reactors, fissile nuclei can be split by neutron absorption into “fission products”, releasing at the same time energy (used for electricity generation) and neutrons. These neutrons can either produce new fissions (chain reaction), or be captured by nuclei, or leak out of the reactor.

There is a remarkable fact that, although the most part of the natural uranium – made of uranium-238 – is not fissile, it can be transformed into fissile plutonium-239 by capture of a neutron: this is called conversion.

In a thermal neutron reactor, the ratio between conversions and fissions is always less than 1, thus the quantity of fissile material decreases in the reactor over the cycle. In a fast neutron reactor, it is possible to obtain a balance between conversions and fissions (iso-breeding mode) or even more conversions than fissions (breeding mode).

Using that possibility, the spent fuel unloaded from a Fast Neutron Reactor can contain as much fissile material as when it started. Of course, uranium-238 is consumed in the process.

There are limitations due to the fission products (that hinder the chain reaction) and to the dose supported by materials like the fuel cladding. These limitations rule the duration of the cycle, at the end of which it is required to unload the fuel, recycle the uranium and plutonium while removing the waste products, and reload new fresh fuel.

ASTRID will operate in iso-breeding mode, so as to stabilize the quantity of plutonium in its fuel cycle.

Fast Neutron Reactors can also burn so-called minor actinides, i.e. isotopes that were produced in a reactor by neutron capture on plutonium (neptunium, americium and curium). ASTRID will provide demonstration capabilities for such a process that is also called transmutation.
3. HAVE THERE ALREADY BEEN SUCH REACTORS THROUGHOUT THE WORLD?

Many SFRs have already been built and operated. The most powerful SFR ever built was the French “Superphenix” reactor. It was able to deliver up to a power of 1200 MW on the electrical grid and has been operated during 12 years. The accumulation of all SFRs years of operation has a total of approximately 400 years of experience in this technology. Today, several SFRs are under operation (Japan, Russia, India and China).

4. WHAT ARE THE CHALLENGES ASSOCIATED WITH THIS REACTOR TECHNOLOGY?

Liquid sodium is harder to handle than water. Indeed, hot liquid sodium inflames in contact with air, and it reacts chemically in contact with water. Not really attractive at first sight, right?

The choice of such a coolant for a Fast Neutron Reactor is based on several criteria. The first one is not to slow down neutrons. That is why water is excluded. But other key parameters (such as thermal properties, viscosity, compatibility with steel, etc.) are of utmost importance as well. There are other possible coolants that can let the fast-neutron reactions take place. However, following an analysis on advantages and drawbacks, taking into account safety and operability considerations, it is difficult to find a good replacement for sodium.

For example, liquid lead could be considered as coolant instead of sodium. But one of its major disadvantages is the narrow range of operation: indeed, above 480°C lead gets highly corrosive for the steel that the reactor vessel, circuits and fuel cladding are made of. On the other side, the reactor must not be cooled less than 400°C to ensure that lead does not freeze in the circuit.

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2 After the Fukushima accident, the future of Japan fast neutron reactors remains uncertain
So the mandatory temperature range of the reactor at all times would be between 400 and 480°C, which is not that comfortable, e.g. for maintenance in “cold” state. In order to widen that 80°C range, Bismuth element can be combined with lead to lower its freezing temperature. Unfortunately, under radiation, bismuth is transmuted into Polonium-210, which is a highly radiotoxic isotope.

As another example, instead of liquid sodium, a gas might be used, like helium. But gases have a low thermal inertia, which means that these types of reactors are sensitive to depressurization. Safety commands in that case to take high margins and use materials that can withstand up to 1600°C: this technology is not available today and will need significant R&D before a proof of its feasibility.

These two examples show that there is no such thing as the “perfect” coolant. The weaknesses of sodium are well known and engineered barriers can be designed to control them, so that as a result of a multi-criteria analysis, sodium is worldwide considered as the reference choice for fast neutron reactors.

Circuits of a Sodium Fast Reactor

5. HOW DOES THE ASTRID PROJECT COPE WITH THE REQUIREMENTS FOR SAFETY?

There are three main issues to deal with: air-sodium fires, sodium-water reactions and a more technical issue known as “positive void-coefficient”.

So as to ban sodium fires in case of a contact with air, on top of design provisions and quality control of the piping, the rooms where sodium circuits are located can be filled with nitrogen instead of air. Moreover, the vessel is made of three layers: the main steel vessel is contained in a safety steel vessel, which is in turn contained in a concrete vessel-shaped pit with steel-liner. The “pool-type” reactor design benefits from a fully integrated primary circuit, i.e. all the
equipment is contained in the vessel, instead of drawing pipes out of the three-layer vessel. That makes the reactor mechanically stronger and provides the guarantee that the sodium cannot physically escape the primary circuit.

In classical designs where steam generators provide steam to a conventional turbine connected to an electrical generator, sodium-water reactions can occur and need to be addressed. To make sure the consequences of such sodium-water reaction do not affect the primary circuit, one possibility is to limit the size of the steam generators (modular steam generators). They are installed on a so-called “intermediate circuit” which is a second sodium circuit to provide for an additional barrier between the primary circuit and the environment, so that the water-sodium interface, located in the steam generator between the intermediate circuit and the water circuit, is far away from the nuclear material. Another more radical solution currently studied is to replace the water by another fluid, pure nitrogen for instance.

There is a last drawback at using sodium: contrary to most water-cooled reactors, SFRs’ void-coefficient is positive in classical designs, which means that in case of coolant boiling, the core reactivity increases and leads to a power excursion. To avoid that, the shape of the core for ASTRID has been designed to get a very low or negative void-coefficient and thus to avoid the power excursion in case of loss of cooling accident: this is a major safety improvement compared to former design of Sodium Fast Reactors.

6. **ONCE THE ISSUES ARE TACKLED, WHAT ARE THE ADVANTAGES OF SODIUM?**

“Pool-type” Sodium Fast Reactors have a thermal inertia combined with the boiling margin around 20 times greater than for water-cooled reactors. That is of great help in accident studies: in the case of a loss of reactor cooling, the low kinetics of the accident increases the “grace period” to take the necessary actions to bring back the plant in a safe state and avoid severe accidents of reactor core meltdowns.

Another good point is that the operating temperature of SFRs is around 550°C, which allows heat exchanges of great yield with air. Thus, the heat sink, usually a sea or a river, can be diversified: in case of loss of the main heat sink, dedicated safety systems transfer the heat directly to air via dedicated heat exchangers. Such systems can be designed as passive systems operating under natural circulation (heated sodium going up, and cooled sodium getting back down) is quite efficient in SFRs. This passive feature is of course very interesting in the frame of Post-Fukushima studies, as focus of studies of total loss of electrical supply gets more important.

Unlike PWRs, that are pressurized at 155 bar, SFR vessels are at almost the atmospheric pressure: this eliminates by design pressure-related loss of coolant events.

Lastly, one of the best assets of sodium is that we have 400 years of cumulated operating experience with it, so that we know its strengths, that can be used for instance to design efficient safety systems, and its weaknesses for which we can design dedicated engineered barriers. Let us not forget that safety is improved by learning lessons from the experience.

7. **ACTUALLY, WHAT IS THE POINT IN WORKING ON A NEW TECHNOLOGY OF REACTORS?**

This comes from the need to better use and recycle nuclear matters that are uranium, plutonium and minor actinides.

Natural uranium is composed of two isotopes: Uranium-238 is present at 99.3%, Uranium-235 for 0.7% of natural uranium.

Water-cooled reactors – like the 58 reactors currently in operation in France – mostly “burn” Uranium-235 out of fuels made of enriched uranium. Even if another type of fuel can be partially used (MOX fuel, i.e. plutonium-uranium oxide), this means that a maximum of 1% of the energetic content of natural uranium is used, leaving the larger part in form of depleted uranium or reprocessed uranium.
In the enrichment process, the percentage of uranium-235 is increased in the fuel, leaving aside depleted uranium. For example, in a typical open cycle for a 63GWe fleet, the enrichment of 9600 tons of natural uranium leaves 8400 tons of depleted uranium aside containing almost only uranium-238.

On earth, there are 189 billions of tons of oil, 187 Tm$^3$ of Natural Gas, 860 billions of tons of coal$^3$ and 4 millions of tons of Natural Uranium$^4$. If we consider the uranium is used only in thermal neutrons reactors, converting these stocks into energy makes the following chart:

![Chart](image1)

**Total energetic contents of various sources of energy according to confirmed stocks**

Purple: Coal / Pink: Oil / Orange: Natural Gas

Green: Uranium in Thermal Neutrons Reactors

This uranium-238 cannot be used in water-cooled reactors but could be used in fast neutron reactors, multiplying the energy content of uranium by a factor of more than 100. Thus the chart becomes the following:

![Chart](image2)

**Total energetic contents of various sources of energy according to confirmed stocks**

Purple: Coal / Pink: Oil / Orange: Natural Gas

Green: Uranium in Fast Neutron Reactors

Global reserves of this uranium-235 (the 1%-part) could be exhausted in less than a century if the rate of use follows the current trend. On the contrary, global reserves of coal are high enough to let coal power plants be operated for centuries, which could lead to an environmental disaster.

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$^3$ Source: BP statistical Review of World Energy, June 2011

$^4$ Source: Red Book, 2009 edition (RRA)
However, the nuclear reactions that take place in Sodium Fast Reactors use the uranium-238, the exhaustion of which is forecasted after several millennia of electricity consuming! On top of that, due to uranium enrichment activities, several countries already own great amounts of depleted uranium, France included. This depleted uranium can be used to fuel Sodium Fast Reactors, enabling to secure the uranium supply.

In a view to keep alternatives to CO2 emissions, SFRs stand as a millennium-sustainable, economically viable and carbon-free source of energy.

France has a leading position in the nuclear energy industry, for its experience and its high safety standards. Thus it has the duty to keep an eye on the long-term strategy to adopt. If France does not get involved in the future of the nuclear industry, other countries will take the lead and their safety standards might become global standards, for better or for worse.

General interest commands to do whatever is possible to stop emitting greenhouse gases. That is why the future of nuclear energy must be developed now, by countries that have experience and have credibility as regards improving more and more nuclear safety.

8. WHAT ARE THE MILESTONES OF THE ASTRID PROJECT?

We have completed at the end of 2012 the first phase of the conceptual design. The main safety orientations of the reactor have been presented to the French Nuclear Safety Authority in a document sent in June 2012. Within 3 years, a major document, called the Safety Options File, will be written. It will gather all the strategy and rules that will be applied to go on in the reactor design. Thanks to this document, the basic design of the reactor will be carried out, leading to the writing of a Preliminary Safety Analysis Report, in 2019. First criticality could be achieved in 2025, so that the operation of ASTRID provides sufficient feedback of experience for commercial deployment from 2040.

9. WHAT IS YOUR MOTIVATION FOR A PROGRAM WITH SUCH A LATE END?

This program is not meant to optimise short-term profit. It is meant to prepare the future of energy sources. I strongly believe that centralized, intensive energy sources are needed, and that nuclear energy can continue to give our country a competitive advantage. In a few decades, thanks to the ASTRID project, there will still be some economic, sustainable and carbon-free energy sources to prevent the release of greenhouse gases. This is the reason of my involvement in the ASTRID project.

An interview performed by Fadhel Malouch and Charles Michel-Lévy for the SFEN Young Generation
Alumni Section

I am Young but Not Callow

'Winter 2013 arrives, time to finalise my summary for IYNC2014!' That is not a good statement to start my story in this bulletin. I am asked to write a feedback on IYNC as alumnus, to an international organisation, not to my local newspaper. My friends from IYNC(2010) in South-Africa will laugh when reading that winter is starting...

What is true is the timing to send your paper to the motivated technical programme committee, and to start planning your attendance to IYNC2014 in Burgos (Spain). Needless to say that IYNC is the young generation conference to attend, recognised by more than 600 colleagues from all continents that went before to the previous edition in Charlotte (USA), a record!

Iodine, Yttrium, Neodynium and Cesium

'But why should I attend the conference?' Well, IYNC broadens your scope on the nuclear scene in an informal atmosphere.

- The 4 above-mentioned chemical elements appear in IYNC's technical presentations in different domains related to nuclear, from the Japanese accelerator-driven system proposal to the Ghanese research reactor.
- You have the possibility to present a paper about your job, and publish it in a special edition of a peer-reviewed international journal.
- Unique visits to nuclear installations in the region around the conference venue are organised. By the way: we don't have zebra's at our research centre, at Ithemba labs (IYNC2010 visit) they have...
- The conference is your opportunity to meet and listen to nuclear keynote speakers, as they are motivated to speak to young professionals. Last conference, dr. Atsuyuki Suzuki, director of the Japanese Atomic Energy Agency, came to speak in Charlotte about the Fukushima accident.
- Since IYNC2012, the program committee organises small interactive workshops in technical areas and soft skills. Ever played a nuclear fuel cycle game?

Imagine You Never Communicate

'I am convinced, but how can I convince my management to spend my precious time for IYNC?' (only valid in case you are not your own boss)

Show them the benefits of the network and the conference. As president of the Belgian young generation network, we went in 2008 to the directors of nuclear installations in Belgium to show the long-term benefits of IYNC for their company. As a consequence, a delegation of 8 young professionals from our little country attended the very well organised edition of IYNC2008 in Switzerland. For IYNC2014 for example, why not propose that you will attend a communication workshop? Support but no money? Check the IYNC grant program on the web.
Besides the conference, it is even more important to take the responsibility to join the IYNC network, which is more than only the congress. It is a fantastic opportunity to set up a technical program with a team of about 100 enthusiastic volunteers from all over the world. As IYNC has no mother organisation, the conference is made by and for young professionals, a challenge! Last years, IYNC’s Executive Committee is spending a tremendous effort to expand the network with new member states: the intercultural aspect of our network can only grow.

Finally, did you know you can make international friends for life? There is also a social program at the conference, finetuned towards young professionals ;-) 

Viva IYNC,

Wim Uyttenhove,

SCK-CEN, National Nuclear Research Centre, Belgium

Past Program Chair IYNC2012
IYNC Network news

Hello bulletin readers! Aside from our regular activities and preparations for IYNC2014 in Burgos, the IYNC Network has been very busy the past year. I am pleased to catch you up to date on the network activities that have been going on. In chronological order:

IYNC Vice President Melissa Crawford, was invited by the International Atomic Energy Agency (IAEA) to be part of a Young Generation Panel at the IAEA International Conference on Fast Reactors and Related Fuel Cycles: Safe Technologies and Sustainable Scenarios. The aim of the Panel was to discuss sustainable energy solutions for our future, and it took place on March 7, 2013.

The day before the Panel took place at the conference; there was a 3 hour workshop with 35 young professionals in attendance who worked in teams to prepare the presentations for the panellists. Melissa was able to present IYNC and the next congress to the attendees.

IYNC President Nicolas Anciaux, was invited to present IYNC and the important role of the Young Generation in Nuclear networks in knowledge transfer to the general assembly of the 2013 WANO Biennial General Meeting, which took place May 20-22 in Moscow, Russia. This was the first WANO meeting where inclusion of young professionals was encouraged by the attendees, and the presentation was well received.

June 15, 2013 marked the date of the first ever IYNC Mid-Term Board of Directors meeting. This meeting took place in Stockholm, Sweden at the KTH Royal Institute of Technology. Country reports were made and the milestones for the IYNC2016 bidding process were presented. A major event during this meeting was a vote to amend the IYNC Bylaws to specify the definition of a country as being part of the list of countries identified by the United Nations. Following the meeting Sweden National Representative Petyt Cartemo helped to organize a very special IYNC BoD dinner which took place in the decommissioned research reactor on campus.

World Nuclear University invited IYNC to present the Young Generation in Nuclear to the 2013 fellows at the Christ Church in Oxford, UK. In response, IYNC Vice President and IYNC2014 Technical Tracks Chair, Denis Janin, attended WNU July 23-24, 2013. This was a unique opportunity to present the IYNC Network activities and the upcoming IYNC2014 to over 60 young leaders from around the world in the nuclear industry. The presentation was successful and IYNC hopes to continue a supportive relationship with WNU in the future.

The World Nuclear Association was supportive of IYNC to provide the opportunity to have an exhibition booth at the 2013 World Nuclear Symposium which took place September 11-13 in London. Nicolas, Melissa and Denis were all in attendance to promote IYNC and the upcoming congress to the WNA participants.
After the close of the WNA Symposium it was straight to the Vienna International Center for the IAEA 57th General Conference. Earlier in the year the IAEA officially recognized the IYNC as a Non-Governmental Organization. As a result IYNC is now invited to participate as an observer to IAEA activities. IYNC had a booth set up inside the VIC beside WIN. IYNC President made a presentation introducing IYNC to the participants of the IGO-NGO Briefing.

IYNC Welcomes 3 new member states: China, Ecuador and United Arab Emirates

In August 2013 the Chinese Nuclear Society appointed National Representative Daiyong Song to IYNC. Mr. Song has since been very helpful to IYNC in organizing the first ever IYNC Delegation to China. The meetings took place November 17-24 and 7 members took part in the delegation. More details about the IYNC Delegation to China and introduction of Chinese Nuclear Industry to the IYNC network will be published in a special forthcoming report in January 2014.

IYNC now has 633 members on Linkedin. Additionally, it has a Facebook following of approximately 369 people for recent posts associated with IYNC. These followers are from various countries, thus reflecting the diversity of IYNC. For all our social media updates, follow us on our Facebook page and Linkedin group titled International Youth Nuclear Congress. Our twitter handle is @IYNC.

IYNC new roll-up

www.iync.org
IYNC 2014: Update

Extended Deadline for call for summaries

The initial deadline for the first call for summaries was October 15, 2013. The deadline has now been extended to January 17, 2014. We have received a high volume of quality summaries and hope that the trend continues until January. Selected candidates will present their summaries at the IYNC 2014 conference between July 6-12, 2014 in Burgos, Spain.

IYNC2014 promotional video

The IYNC2014 promotional video was launched last month and received an excellent response. To view the video, please visit http://www.iync.org/iync2014-burgos-promotional-video/

Registration for IYNC 2014

In an Ex-Com meeting last month, the registration details for IYNC 2014 were agreed upon. These details will be posted soon on the website and shared over social media.

Talk on IYNC 2014 at Recent Conferences

IYNC members promoted IYNC 2014 at the WNU 2013 on July 23 and elicited a lot of interest and appreciation for IYNC activities. Similarly, the IYNC 2014 event was discussed at a local North American Young Generation in Nuclear (NAYGN) event in Baltimore in August 2013.
Updates on IYNC 2014 at Technical Program

15 workshops will be organized with one manager and one co-manager per session. A communication/media training session will also be organized. Several technical tracks are also scheduled as part of technical program.

The following distinguished industry leaders are confirmed to speak at IYNC 2014
Danny Roderick, CEO Westinghouse (USA)
Mike Weightman, Former ONR Chief (UK)
Dr. Ibrahim Babelli, K.A. Care (Saudi Arabia)
Ken Ellis, WANO (International)
Dr. Ralf Gudner, E.ON (Germany)
Country reports

- China
- France
- Hungary
- Japan
- Kenya
- South Africa
- United States of America
China

Overview and Significant Developments of Nuclear Energy in China

Current Status and Future Plan

Due to the rapid economic development and increasing concerns about air quality, climate change and fossil fuel shortages, nuclear power has been looked into as an alternative to coal power in China. For many years, China has sought out a road of peaceful use of nuclear energy and remarkable achievement has been made. The basic strategy for nuclear energy development in China is “Thermal-neutron Reactor, Fast Breeding Reactor and Controlled Nuclear Fusion Reactor”. Besides the pressurized water reactor, the high-temperature gas-cooled reactor-pebble bed module (HTR-PM) is also constructed in China. By mid-century fast breeding reactors are seen as available technology for commercial nuclear power generation.

As of 2013, in mainland China, there are 17 nuclear power units in operation, with installed capacity of 14.69 GW, and 28 units under construction with installed capacity of 30.57 GW, which accounts for 41% of the total number construction globally. China’s National Development and Reform Commission has recently indicated the intention to raise the percentage of electricity produced by nuclear power from current 2% to around 6% by 2020, and this will require the current installed capacity to be increased to 88 GW, including 58 GW in operation and 30 GW under construction.

Nuclear Safety

“Safety First” is the basic principle of nuclear energy development in China, and different measures have been implemented to ensure safe and reliable operation of nuclear facilities:

- Strengthen nuclear safety and emergency response infrastructure building.
- Improve legal and regulatory system and regulatory mechanisms.
- Enhance human resource development of nuclear safety and nuclear emergency management.
- Increase support to personnel training and technical research and development.

Up to now, all operating nuclear power plants in China have kept a sound safety record. The new Nuclear Safety Plan states that beyond 2016 all new projects will be building in line with the world highest safety requirements, and must meet the Generation III safety standards.

Complete Fuel Cycle Industry

China adopts a closed fuel cycle strategy and has built a complete nuclear fuel cycle industry, including uranium mining, conversion, fuel fabrication and reprocessing. All the nuclear fuel assemblies for the nuclear power plants in mainland China are fabricated in two plants Yibin and Baotou of China. In terms of reprocessing, China has built a reprocessing pilot plant. Efforts have been made to improve the production capacity, technical standards and innovation capability on all elements of the nuclear fuel cycle, so as to secure long-term and stable supply of nuclear fuel.
Self-reliance Innovation

China is positioned to become a main reactor exporter and aiming at the maximize self-reliance on nuclear reactor technology design and manufacturing through innovation and international cooperation. Large advanced pressurized water reactors such as the CAP1400, ACP1000, ACPR1000 and small modular reactor such as ACP100 will be the mainstream self-reliance technology in the near future.

Young Generation Network in China

China has just officially joined the International Youth Nuclear Congress (IYNC) in August, 2013. A few young professionals from Chinese Nuclear Society (CNS), institutes, companies, universities has been selected as members of CNS Youth Working Committee to establish the Young Generation Network in China (CNS-YGN). More information can be found on IYNC China Weibo (http://weibo.com/IYNCChina/home).

International Cooperation

China has cooperated with more than 40 countries and relevant international organizations, and fruitful cooperation has been carried out in the fields of nuclear energy, nuclear technology application, nuclear safety and emergency response, nuclear non-proliferation and nuclear security, etc.

Guided by the international framework, relative trade laws, the principle of quality, service, efficiency, prestige and mutual benefit, China is ready and willing to establish more harmonious cooperation with new and old friends all over the world, to share the practices and experience of nuclear energy development, and to strive for a more brilliant future of nuclear energy.
France

The SFEN JG (French Nuclear Society Young Generation) has been working actively to establish a strong and dynamic network. The SFEN JG has been aiming to share knowledge amongst the young professionals in the nuclear field through presentations in universities, interviews, visits and conferences. Another perspective is to share at the European and international level with our colleagues, remaining open for new possibilities and development lines for our network and willing to make the broad French nuclear industry available for some insight to our international counterparts.

Amongst our latest interviews, one can find the ones of Dominique Minière (EDF Senior Vice President, Deputy Chief Operating Officer and SFEN President) and of Thibault Labalette (Programme Director of ANDRA) – both in French. Our will to share internationally however also motivated leading some of our interviews in English for example the one of François Gauché (CEA) on the Sodium Fast Reactor ASTRID (see below).

Making French nuclear facilities accessible to our counterparts is also a major international objective. Our Belgian and Dutch colleagues had therefore the possibility to visit the La Hague and Flamanville site on October 2013, getting the chance to share a convivial dinner with young professionals and SFEN active members in the frame of this visit.

Our highest efforts for the last months have moreover been dedicated to the organisation of our annual event Atoms for the Future on Nuclear Energy and Power Grid, opening the debate to the different energy sources and the grid issues (flexibility need, volatility of Renewables, black-out situations, load-follow and impact on reactor design and emergency operation, etc.). What a better introduction for this conference dedicated to the 250 international participants than a motivating speech from Dominique Minière, sharing the good news on Hinkley Point project in the UK? This introductory speech set the mind frame of this conference, aiming to highlight the challenges yet to take and objectives to reach for young professionals. After two days of conferences with high-ranking speakers (Christophe Béhar, CEA Director of Nuclear Energy Division; Philippe Knoche, AREVA Chief Operating Officer and Member of the Executive Board; Michael Fuchs, E.ON Head of Technology; Ron Cameron, Head of OECD/NA Nuclear Development Division; Hadid Subki, IAEA Technical Lead for SMR Technology Development; etc.), 55 participants had also the opportunity to visit the sites of EDF Research Centre Les Renardières, the RTE Dispatching Centre and the NPP Dampierre. The great success of this conference is another motivating achievement and a step towards the organisation of the ENYGF2015 conference at European level.

In order to keep and share our strong motivation toward our colleagues around the world, the SFEN-JG is pleased to announce that Atoms for the Future 2014 topic will be “Design, construction and licensing of Nuclear Power Plants”. We will come back to you soon regarding this event, hoping many of you will attend our open and international conference!
Hungary
Summer of the HNS-YGN

The busiest time of the Hungarian Young Generation Network is the summer, the summer festival season. This time we participate in several music festivals addressed to young people. We set up a tent, the “Nuclear Tent” where festival visitors can talk with our members about nuclear energy and technology. The visitors can take tests for small prizes. This year we focused also on the geographical distribution of our presence, we optimized our resources during the summer to show ourselves in as many parts of the country as possible. We participated on five major festivals:

- EFOTT (Zánka, Central Hungary),
- VOLT (Sopron, West Hungary)
- Campus (Debrecen, East Hungary),
- Sziget (Budapest, Central Hungary),
- Hegyalja (Tokalj, East-Hungary).

While talking with visitors our experience was that Fukushima is becoming a less hot topic. Discussion topics have moved back to their old proportions.
Japan

1 Policy and Governance

After the temporary shutdown of unit 4 of Ohi NPP on 15 September 2013, Japan has been experiencing “zero nuclear” status again. It is second time for Japan to experience “zero nuclear” status after the Fukushima accident, but short-term prospect of nuclear power is totally different from previous one. In “Japan Revitalization Strategy”, approved by the Cabinet on 14 June 2013, current government announced clearly that it will proceed with the restarting of the nuclear power plants which the Nuclear Regulatory Authority (NRA) determines to be in compliance with the new regulatory standards. In line with the announcement, 14 reactors of 5 utilities have already been applied for the safety review and the NRA started the reviews. It is expected that some of them will be restarted within a certain period of time.

With regard to long term prospect, current government also announced in the “Japan Revitalization Strategy” that it will develop a new basic energy plan including medium- and long-term energy strategies by the end of 2013. A council established under the Ministry of Economy, Trade and Industry started discussing the new basic energy plan, and it is expected that the role of nuclear energy in Japan’s energy mix will be defined in the plan.

In parallel with reconstruction of energy policy, restructuring of the governance has been continuing in both the government and nuclear industry. On the part of the government, the role and functions of the Atomic Energy Commission are under review and might be reorganized. Japan Atomic Energy Agency (JAEA), the national research center for nuclear science and technology, will also be reorganized to concentrate on some key areas, such as safety research, safe operation of Monju (prototype FBR), and restoration of environment of Fukushima. On the part of industry, International Research Institute for Nuclear Decommissioning (IRID) was established under the encouragement of Japanese government to promote R&D, human resource development and international cooperation on decommissioning. It is expected that IRID as well as Japan Nuclear Safety Institution (JANSI), established in November 2012, will play vital roles within the nuclear industry to improve self-governance and accelerate the efforts in the crucial areas, such as decommissioning and safety.

1.2 Current status in Fukushima

(1) Onsite

Although there is a steady progress toward stabilization of the Fukushima-Daiichi site, such as initiation of removal of spent fuels from the pool of Unit 4 whose risks had been highly concerned, one of the highest priority issues, which Tokyo Electric Power Company (TEPCO) and the government of Japan are facing, is the management of contaminated water around the Fukushima-Daiichi site.

TEPCO has been struggling with this issue ever since the Fukushima-Daiichi accident occurred, and TEPCO argues that the influence of contaminated water remains inside the plant port area and there is no negative impact to outer sea based on their monitoring data. However, the amount of contaminated water keeps increasing despite that TEPCO makes a lot of effort to control the ground water infiltrated from the west
side of the site. TEPCO rigs up hundreds of aboveground tanks for the storage of contaminated water as a temporary arrangement, although there have been some leakage incidents from these tanks.

The government of Japan announced “Basic Policy for the Contaminated Water Issue at the TEPCO’s Fukushima Daiichi Nuclear Power Station” on 3 September 2013, including three principles for the countermeasures against contaminated water issue; “removing the source of the contamination” (e.g. removal and decontamination of highly contaminated water in a trench of the site), “isolating ground water from the contamination source” (e.g. construction of ground water bypass, etc.), and “preventing leakage of the contaminated water” (e.g. construction of impermeable wall around the nuclear reactor buildings area, etc.). The government of Japan is intensifying its involvement in this issue, including establishment of “Inter-Ministerial Council for Contaminated Water and Decommissioning Issues” under the Nuclear Emergency Response Headquarters and its suggestion to IRID to collect the technical expertise and wisdom from home and abroad.

(2) Offsite

Over 140,000 people have been evacuating for more than two and a half years; over 90,000 are within the Fukushima prefecture, and about 50,000 are in different parts of Japan. Although nobody died from acute radiation exposure, the surveys by Fukushima prefecture and local municipalities revealed over 1500 cases of “disaster-related deaths” (deaths due to physical and nervous breakdown by long-term evacuation, insufficient medical care, suicide, etc.). To minimize further health problems, Fukushima prefecture and related organizations have strengthened the implementation system of “Fukushima Health Management Survey” in cooperation with academia and international organizations, which includes thyroid ultrasound examination, comprehensive health check, mental health and lifestyle survey and pregnancy and birth survey of the local residents,

National and local governments have made significant efforts to reconstruct and revitalize Fukushima, and their central focus is on the remediation work in the surrounding area, toward the ultimate goal “to return home”. The government of Japan rearranged classification of the contaminated area for several times to accommodate remediation works, and currently, contaminated area consists of “Areas to which evacuation orders are ready to be lifted” (annual intergral dose; 20mSv or less), “Areas in which residents are not permitted to live” (annual intergral dose; 20mSv or more), “Areas where it is expected that residents will face difficulties in returning for a long time” (annual intergral dose; 50mSv or more). Although a great deal of effort have been taken by the government, related organizations and the people, remediation works are not proceeding smoothly in some areas and one of the biggest problems is the difficulty of local consensus building toward siting temporary disposal facilities of contaminated soils.

As for the compensation issues, TEPCO have been settling reparation payments in compliance with the guidelines published by the Dispute Reconcilation Committee for Nuclear Damage Compensation under the Ministry of Education, Culture, Sports, Science and Technology. However, some criticizes the rigidity of accreditation process and there still be increasing in litigation.
2. YGN Japan Activity

2.1 Nuclear Energy Forum of Young generation 2013 (NEFY2013)

YGN-Japan organized the 2nd Nuclear Energy Forum of Young generation NEFY2013. The forum was held at Tokyo Institute of Technology, Tokyo from 7-8 June 2013. A total of 110 participants who gathered from utilities, manufacturers, general contractors, trading companies, research institutions, universities, and governmental bodies attended the forum. NEFY2013 focused on “action plans” that should be performed by the young generation over the next 10 years. The main program of the forum was group discussions on the following topics:

- Treatment of spent fuel (interim storage, recycling, final disposal)
- Revitalization of Fukushima (remediation, decommissioning)
- Nuclear safety (new safety standard, re-operation of NPPs)
- R&D (next-generation reactors, nuclear sciences and applications)
- International cooperation
- Human resources development

In addition to group discussions by the participants, we also organized special sessions with two invited speakers, Dr. Akihiro Tagawa, former president of YGN-Japan, and Dr. Haruki Madarame, ex-chairman of the Nuclear Safety Commission (NSC). Dr. Tagawa provided “first hand” information about current status of Fukushima, based on his experience as administrator of decontamination demonstration program. Dr. Madarame shared his experience as the chairman of NSC at the time of Fukushima accident and expressed his expectations to young nuclear professionals, especially in the area of nuclear safety.

2.2 Monju & Fugen Facility Tour

We organized “Monju & Fugen facility tour” on April 29 and 30. Monju (Demonstration Fast Breeder Reactor) and Fugen (Advanced Thermal Reactor under decommissioning) have been playing important roles in Japan’s nuclear development program for many years. In our tour, we looked on upper core pit and turbine building of Monju, and bottom of reactor vessel and control room of Fugen. After the facility tour, we discussed and reconfirmed the importance of both plants, in terms of R&D for nuclear fuel cycle and for decommission of LWR in the future.
Kenya

The progress in nuclear energy in Kenya is now taking shape as the government has recognized its contributions to the realization of vision 2030. The 10th parliament passed the energy bill that allows inclusion of nuclear power in the energy mix among hydro, geothermal, wind and solar power that remain the current source of electricity in the country. With rising energy demands from the growing industries, nuclear electricity is arguably the best alternative to offer reliable solution. Apart from nuclear energy, the peaceful use of nuclear science and technology has been in existence for a very long time in Kenya. However, many Kenyans are still ignorant of what nuclear science and technology entails. In most cases, nuclear science and technology has been associated with atomic bombs or weapons of mass destruction. Therefore, there is need to demystify nuclear science and technology and educate the general public on the importance of nuclear science and technology.

Milestones by the Ministry of Energy and Kenya Nuclear Electricity Board

Human resource development is ongoing both in Kenya and abroad with South Korea and the US institutions giving their full support to Kenya’s quest for nuclear developments. Regulatory framework is also being set up and reviewed with the close guidance and support of the International Atomic Energy Agency. During Member States meeting at the 57th IAEA General Conference in Vienna, Kenya was among the 11 new countries to be elected to serve on the 35-member IAEA Board of Governors for a one-year period from 2013-2014.

On a positive note also, Kenya’s Energy Cabinet Secretary Davis Chirchir asked development partners to back Kenya’s plan to establish a nuclear power programme. Speaking in Austria during the 57th International Atomic Energy Agency general conference, Chirchir said Kenya’s quest to develop nuclear power is out of the need to diversify its energy mix. "This is guided by the need to mitigate the rising cost of fossil fuels for electricity generation and to meet our growing domestic and industrial energy demands," Chirchir said. The CS said a draft Atomic Energy Bill has been submitted to the IAEA for legal review and technical input. Once enacted to law, he said, it will lead to the establishment of an Atomic Energy Commission to regulate nuclear-related projects and businesses in the country. The Bill will also give guidelines on radioactive waste management and decommissioning of nuclear facilities. Currently the Nuclear Electricity Board undertakes the development and implementation of a nuclear power programme.

Adopted from ‘The Star*’ Kenyan local news.

Kenyan Young Generation in Nuclear Conceived

Kenyan Young Generation in Nuclear (KYGN) was therefore formed not only for its members to join the rest of the world and create networks globally, but also to foster the peaceful use of nuclear science and technology in Kenya in collaboration with other stakeholders.

So far several meetings have been held and a constitution has successfully been drafted, and we hope to register it as by the end of October 2013.

KYGN Motto is Demystifying Nuclear and our objectives include:

(a) Develop new approaches to communicate benefits of nuclear science and technology
(b) To inform and educate the general population about nuclear science and technology
(c) Promote peaceful and safe uses of nuclear science and technology for the welfare of mankind
(d) Transfer knowledge from the current generation of leading scientists to the next generation
(e) Provide a platform and create an enabling environment to facilitate the building of professional Organizations that will open up future opportunities

Interim Leadership

- President – Pamella Kageliza Kilavi
- Vice President – Raphael Chesori
- Executive secretary – Stephen Tollah
- Treasurer – Simon Adede
- Public Information Officer – Wilson Kairu
- Professional Development Officer – Christine Matindi

Anticipated Networks and collaborations

In order to achieve the aforementioned objectives, KYGN will work in collaboration and partnership with key institutions and organizations in Kenya and overseas. This includes Nuclear Electricity Board, Radiation Protection Board, National Commission of Science & Technology, Kenya Bureau of Standards, Kenya Industrial Research Development Institute, Kenya Agricultural Research Institute, Kenya Medical Research Institute, University of Nairobi; Institute of Nuclear Science & Technology among others.

We also hope to closely work with International Youth Nuclear Congress, Other Young Generation Networks in Nuclear, International Atomic Energy Agency, Nuclear Energy Agency, International Livestock Research Institute, World Agroforestry Centre (ICRAF), and other Intergovernmental agencies involved with nuclear energy developments and also leading overseas institutions of higher learning in Nuclear Science and Technology.

Proposed Activities

(a) KYGN Launch and Summit

We hope to have a launch of KYNG by mid 2014. This will also be an opportunity to sensitize the public on the peaceful use of nuclear science and technology and we hope to have as many of the institutions and/or stakeholders using this technology to present and showcase the use of nuclear in their field.

(b) SAYNPS (South African Young Nuclear Professional Society) Summit

We are looking forward to learning the best practices from our South African counterparts. We therefore hope to send the officials to the SAYNPS summit which will be held on the 4th to 6th December, 2013. This will offer an opportunity to learn from them as our partnering network in the formative stage of KYGN.

Complied by the KYGN Interim Leadership
South Africa

The South African Government is proceeding with its nuclear new build plan to produce 9.6 GW of electricity using nuclear power by the year 2030. This commitment was further emphasized during the Nuclear Africa 2013 Conference by the Deputy President, Honorable Kgalema Motlanthe and Department of Energy Minister, Honorable Ms. Dipuo Peters. The South African Young Nuclear Professionals are preparing to play a vital role in ensuring that these plans are realized. On 2013-03-08 a new SAYNPS National Executive Committee was elected. This committee is committed to ensuring that the society’s activities are in line with the proposed new build. The Nuclear Industry Association of South Africa (NIASA) has taken the lead in preparing for the nuclear new build, and therefore SAYNPS has aligned itself with NIASA to be the champions in addressing issues important to the youth as the country prepares to increase the nuclear power generation industry. In a survey conducted by NIASA in 2012, it was found that 40% of participants knew nothing about nuclear energy and technology and therefore cannot have an opinion about use of nuclear technology. Therefore, SAYNPS was encouraged to play a major role in campaigns geared towards raising awareness of nuclear power and technology. SAYNPS has already taken the lead in raising public awareness through a visit to Morokweng Village North West Province.

Another outreach programme is planned for 2013-04-20 at Orange Farm Township situated south of Johannesburg, Gauteng Province. The aim this programme is to raise awareness among high school learners about nuclear technology and possible careers within the nuclear industry. Not neglecting youth that is already employed within the industry, SAYNPS plans to engage with employers to ensure that young professionals obtain knowledge and skills necessary to take leadership positions within the industry in future.

The SAYNPS website has been revived, please visit [http://saynps.com/](http://saynps.com/).
United States of America

The NAYGN Annual Conference was held in Washington, DC in May 2013. More than 700 young nuclear professionals from the US, Mexico and Canada were in attendance. The conference included a visit to Capitol Hill where the American attendees were able to meet with their Congressmen and/or their aides to discuss the importance of nuclear energy and technology.

Also in May 2013, the US sent three YGN delegates to the WANO Biennial General Meeting in Moscow, Russia. Delegates were able to meet with YGN members from other countries to discuss how to attract and retain new talent in the nuclear industry.

The North American Young Generation in Nuclear has now expanded to 110 chapters and welcomes the following chapters in the US: Argonne National Laboratories, NextEra/FLP Juno Beach, Structural Integrity, Duane Arnold, and Rolls-Royce. NAYGN is nearing 10,000 members and is in the planning stages for the 2014 Annual Conference in Phoenix, Arizona.

Both the American Nuclear Society and NAYGN are sponsoring many nuclear outreach activities during National Nuclear Science Week (October 21-25th). Activities include school visits, public meetings, and plant tours to promote nuclear science and technology.

The American Nuclear Society Young Members Group will host the Young Professional Congress in conjunction with the 2013 ANS Winter Meeting in Washington, DC. The meeting will be held on November 2, 2013. More than 100 young nuclear professionals are expected to attend. The event will include a lobbying day on Capitol Hill where attendees will have the opportunity to speak to their Congressmen about nuclear science and technology.
Future Events

Past

**NESTet 2013**, conference dedicated to education and training in the nuclear field was held on 17-21 November in Madrid, Spain. The conference gathered around 130 persons from five continents. Among the delegates were representatives from nuclear industry, research institutes, universities and NGOs, who presented their education and training activities in form of oral or poster presentation during three days. In the framework of the conference the ENS – YGN organised a workshop on the use of new technologies for education and training. New educational tools like virtual simulators or clickers to help the professors to transfer the knowledge to students on an attractive way were presented. [www.nestet2013.org](http://www.nestet2013.org)

Next

The annual meeting of communicators in the nuclear sector, **PIME 2014** is taking place in Ljubljana, Slovenia. Next to the subject on social media, communication challenges, Fukushima and communication or communication of radiation, the participants will have an opportunity to visit communications showcases. The PIME 2014 Showcase will focus on initiatives aimed at raising the level of public understanding of nuclear science, engineering & technology. In particular the PIME 2014 Showcase will give centre stage to ideas that explain nuclear technology to young people in schools and at universities. A whole range of creative initiatives which were developed by NPP’s, ENS Young Generation Network, Nuclear National Societies and companies will be presented in the frame of PIME 2014 communications showcases. [www.pime2014.org](http://www.pime2014.org)

For the next conference, **RRFM 2014**, we will come back once again to the capital of Slovenia. The RRFM is focused on research reactors issues. The RRFM 2014 delegates will meet on 30 March – 3 April next year to discuss the subjects like fuel cycle, operation and maintenance, utilisation of research reactors or innovative methods in reactor physics and thermo-hydraulics. [www.rrfm2014.org](http://www.rrfm2014.org)

**The European Nuclear Conference (ENC)** is THE international get-together of nuclear science and industry in Europe. This European Nuclear Society (ENS) event has a multidisciplinary approach, looking at nuclear science and technology in energy production, non-power industrial and life science applications. ENC 2014 will be a unique networking event for scientists, nuclear industry representatives and policy makers, who can consider and discuss ideas and innovations that will drive the technological developments of the future.
In the framework of the ENC 2014 conference we organise two interesting side activities for young nuclear professionals: Young Generation Support Programme and the Career Convention.

Young Generation Support Programme is dedicated to young scientists and professionals (< 36 years and preferably members of the ENS-Young Generation Network), who would like to present their scientific projects. ENS will waive the registration fee for the young person if her/his paper will be accepted for oral or poster presentation at ENC 2014 (the paper will be peer-reviewed by the ENC 2014 Programme Committee and published in the ENC 2014 conference proceedings). The deadline for uploading the abstract is over but we are still accepting the incoming one.

The Career Convention is for the persons, who are seeking for a challenging job in the nuclear field. The last ENS Career Convention attracted highly skilled candidates from over 30 countries applying at various different stages of their career – ranging from outright beginners to professionals with more than 10 years of experience. They applied for job opportunities that corresponded to 44 different profiles in areas as diverse as safety and process engineering, procurement management and marketing. Very soon we will open a call for CVs so get ready! Please follow the website: www.enc2014.org

European, American and Asian countries Nuclear Societies have jointly organized the Reactor Fuel Performance Meetings annually on a tri-annual rotational basis. AESJ, KNS and CNS have organized the WRFPM in Kyoto (2005), Seoul (2008) and Chengdu (2011). Following the successful TopFuel 2012 in Manchester and LWR Fuel Performance Meeting 2013 in Charlotte, WRFPM 2014 will take place 14–17 September 2014, Sendai, Japan. Currently the WRFPM2014 Program Committee is calling for both oral and poster presentations in different special program and tracks. Papers describing theoretical, analytical, methodological, empirical, and application research on fuel performance under various conditions in water cooled reactors are welcomed. In the WRFPM 2014, the Program Committee features the special program considering the accident in the Fukushima-Daiichi NPP


ENS member, The Israel Nuclear Society is organising its 28th conference on 11-13 February 2014 in Israel. The subjects of the conference are aspects of nuclear energy and nuclear technology, applications of radioisotopes and radiation, radiation measurements, issues in radiation protection and radiation in medicine. Additionally during the conference awards will be given for outstanding student work.

The ENS sponsored events coming in 2014: http://www.euronuclear.org/1-networking/2014-events.htm

The American Nuclear Society' cosponsored coming events: http://www.ans.org/meetings/c_3
INTRODUCTION

The design for the 1250 MW<sub>e</sub> KERENA™ Boiling Water Reactor (BWR), formerly known as SWR1000, has been jointly developed by AREVA and E.ON since 2008, building on early development efforts already started in the 1990s. The goal of this cooperation was to complete the Basic Design of the plant, reaching such level of maturity that a Construction License Application can be filed and reliable cost estimation is possible.

In order to achieve this development stage, and given the significant interactions between Nuclear Island (NI) and Turbine Island (TI) in a BWR, it was clear that a partner taking responsibility for the conventional part of the plant was needed. ALSTOM took over that role, providing a complete Basic Design for the Turbine and Switchgear Buildings, including all systems, structures and components (SSCs), as well as non-site-specific designs for the pumping station and other Balance of Plant (BOP) SSCs. One of the most tangible final results has been a fully integrated 3D model of the complete plant (Figure 1).

E.ON has brought in the operating experience from its fleet, which includes BWRs such as Isar-1 in Germany and the three Swedish units in Oskarshamn. This was implemented by reviewing the design documents produced by AREVA and ALSTOM, as well as through numerous workshops involving experts in fields such as Operations, Maintenance, I&C and Health Physics from both the existing plants and the supporting engineering departments at E.ON’s headquarters.

BASIC FACTS ON KERENA™

ORIGIN AND OBJECTIVES

The starting point for the development of the KERENA™ was Gundremmingen-C, a BWR from the denominated “Model Line 72” built by Siemens-KWU, which belongs to the “second generation” of German Nuclear Power Plants. Excellent operating experience made it the most...
logical candidate to build on, with the goal of improving the safety and operational characteristics of the next-generation BWRs.

The main objectives were a further decrease in the Core Damage Frequency (CDF) and Large Early Release Frequency (LERF), increased economic competitiveness, and reduced licensing and construction risks. In order to achieve the first two goals, the addition of passive safety systems appeared as the way forward, since they provide at the same time diversity (greatly reducing the chances of common-cause failure) and simplification (thus limiting the role of active systems, and allowing minimization of the associated investment costs). The third goal was tackled by establishing an extensive test program for the new passive solutions, including full-size components, and application of the lessons learned from the ongoing construction in Olkiluoto-3 and Flamanville-3.

- **ACTIVE SAFETY FEATURES**

  The KERENA™ design integrates both active and passive safety systems (Figure 2). It is fitted with two, 100%-capacity-each Residual Heat Removal (RHR) systems which, similarly to traditional BWRs, provide shutdown cooling but also low pressure injection to the reactor and suppression pool cooling. The Spent Fuel Pool is also actively cooled by means of heat exchangers located inside the pool. This arrangement further reduces the possibility of inadvertent drainage of the pool.

  The active systems are safety-classified, and consequently they are backed up by Emergency Diesel Generators (EDGs), located inside separate buildings at opposite sides of the Reactor Building. This physical separation essentially guarantees the survival of at least one complete division for power supply and ultimate heat sink in case of Airplane Crash (APC). Furthermore, the Reactor and Control Buildings are covered with outer arch-shaped APC shells, which are decoupled from the inner structures and offer protection even in case of crash of a large passenger jet.

- **PASSIVE SAFETY FEATURES**

  As additional defense-in-depth, and also serving as an investment protection improvement, an option is available to incorporate a reduced set of auxiliary active systems consisting basically of an additional diesel generator and cooling chain. The need for this option, as well as its safety classification, will depend on country-specific licensing requirements, as well as the preferences of the Operator in relation to maintenance practices and target availability.

  

Figure 2. Main safety systems of the KERENA™.

In any case, even if all active systems fail, the passive systems are still available to come into action and bring the reactor to hot shutdown conditions, preventing core damage.

A prominent role among these systems is occupied by the Passive Pressure Pulse Transmitters (PPPTs). This hydro-pneumatic system initiates certain protective actions (SCRAM, Main Steam and Feedwater Isolation, and Automatic Depressurization) diversely to the conventional Instrumentation and Control (I&C) system.
Thus, a further layer of defense against common-cause failures is implemented.

Additionally to the Control Rods, which can be operated by electrical motors or hydraulically to quickly shut down the reactor, a boron injection system is available. Since it is nitrogen-driven, it is fast-acting and only requires signals to the actuating valves.

In order to remove decay heat, the Emergency Condensers are able to transfer it to the Core Flooding Pools (CFPs), without relying on any signal or valve actuation. In case of Loss of Coolant Accident, the water stored in these pools flows by gravity to cover the core, requiring only a check valve to open. The heat added to the containment is removed by the Containment Cooling Condensers, which are gravity-fed with water from the Reactor Cavity and Dryer/Separator (D/S) Pool.

As an ultimate line of defense, in case of imminent core melt the water from the CFPs can flow through the Drywell Flooding Line following remote actuation, initiating an In-Vessel Retention strategy.

The Ultimate Heat Sink for the passive systems is the atmosphere, given that the water in the D/S Pool boils and the resulting steam is released outside under monitored conditions. The amount of water initially available suffices for 72 hours of autonomy, which can be easily extended by replenishing water to the D/S Pool.

- **E.ON’s contribution to the kerena™ basic design project**

The KERENA™ Basic Design Project has in many aspects gone quite beyond the level of detail that is normally expected at such stage. In consequence, more than 800 design documents were produced for the NI, and around 400 for the TI. Different E.ON departments have reviewed these documents, incorporating decades of operating experience with their detailed comments.

E.ON’s experience and needs were also applied for the development of the Plot Plan (Figure 3). Changes in the location of several buildings enabled a clean layout that prevents tunnels and galleries from running under buildings.

The Single Line Diagram has experienced considerable modifications requested by E.ON, such as the autarkic arrangement of the EDGs. The influence in the I&C and water chemistry concepts is remarkable as well.

E.ON has also participated in the evaluation of the KERENA™ design against the post-Fukushima requirements that the Finnish regulatory authority (STUK) published on the 20th of March, 2011. The main conclusion was that the KERENA™ Safety Concept is highly robust and would have fared well in a Fukushima-style event. Further detailed investigations, including assessment of the seismic and flooding margins, will be undertaken in next phases.

![Figure 3. Plot Plan for a KERENA™ plant.](image)

**References**

INTRODUCTION
This research project is based on the intersection of nuclear fuel cycle system dynamics on waste management options with a concentration on the economic parameters present in used nuclear fuel storage location which will assist in pre- and post-reactor fuel cycle economic calculations.

A variety of nuclear fuel cycle system analysis models are currently available for such a task [1]. These include CAFCA (Code for Advanced Fuel Cycles Assessment) of MIT, DANESS (Dynamic Analysis of Nuclear Energy System Strategies) of Argonne National Laboratory, VISION (Verifiable Fuel Cycle Simulation) of the Advanced Fuel Cycle Initiative, COSI (Commelini-Sicart) of the CEA, NFCSS (Nuclear Fuel Cycle Simulation System) of the International Atomic Energy Agency, as well as a variety of lower level system analysis tools which have been created by private companies and institutions. A critical issue in the development of these models is that their complexity leads to difficulty of use and even greater difficulty in end result analysis.

Previous work has been accomplished in the development of a simple and understandable model INFUPOD [2] and has led to interest in further investigation of the location dependency of used nuclear fuel in the parameters of economics, environmental impact, and proliferation risk. To study the economics of location dependency, three options of local, regional, and national storage were studied. The preliminary product of this research is the creation of a system dynamics tool known as the Waste Management Module (WMM) which provides an easy to use interface for education on fuel cycle waste management economic impacts.

DESCRIPTION OF THE ACTUAL WORK
Many of the tools which have been described along with WMM use a methodology known as system dynamics to solve problems with dynamic complexity. The term dynamic complexity has been used to describe problems such as nuclear waste management along with a variety of others such as healthcare, food markets, and political decisions. Dynamically complex problems are often characterized by long delays between causes and effects, and by multiple goals and interests that may in some ways conflict with one another [3]. In such situations, it is difficult to know how, where, and when to intervene, because most interventions will have unintended consequences and will tend to be resisted or undermined by opposing interests or as a result of limited resources or capacities.

WMM was programmed using the system dynamics software known as Vensim which is produced by Ventana Systems [4]. Vensim facilitates development, analysis and compartmentalization of dynamic processes with feedback models. It is a visual modeling tool that allows you to conceptualize, document, simulate, analyze, and optimize models of dynamic systems.
Through a review of available literature [5,6,7] and interactions with each of the programs available, comparisons of post-reactor fuel storage and handling options were evaluated based on the economic parameters and a consensus of preferred system values were established.

The storage cost for each of the three options is similar in calculation with six inputs contributing to the costs (with additional factors likely but not included in this preliminary version of the model). The regional and national options use Monitored Retrievable Storage (MRS) facilities while the local option uses Independent Spent Fuel Storage Installation (ISFSI) facilities. The cost of the MRS or ISFSI is divided into construction and operation costs.

Additional costs are combined into the transfer/transport cost and the cost of the cask used to store the spent nuclear fuel. After dividing the spent nuclear fuel into the number of needed MRSs and casks, costs are multiplied to that minimum value. Operation costs are assumed to be zero until construction is complete. Figure 1 provides a snapshot of the National Storage Total Cost parameters.

**RESULTS**

Preliminary validation has shown WMM provides results within ranges provided in literature with some limitations to its validity concerning national long-term storage due to limited resources available in creating the cost assumptions needed for that calculation. However, WMM currently provides a strong foundation to future waste management economic tools in a system dynamics context.

Although difficult due to the extreme variability in economic parameters and ranges in preferred values, initial testing of the program seems to stay in alignment with average values. To validate against a report in which values were not considered in the base case value calculation, “Key Attributes, Challenges, and Costs for the Yucca Mountain Repository and Two Potential Alternatives” was used [8]. This report asks for the estimated cost of 70,000 MT spent fuel storage for 100 years in $2009 dollars. There calculations provide the following values:

- At Reactor Storage = $10-$26 billion
- Centralized Storage = $12-$20 billion
- Permanent Repository = $27-$39 billion

Applying the same constraints to WMM (70,000 initial fuel) and then performing cases in which only dry local, dry local to regional, and dry local to national are allowed provides the following values.

- At Reactor = $11.27 billion (Within the range)
- Regional = $19.61billion (Within the range)
- National = $47.86 billion (Not within the range)

Although the TSLCC report, a trusted national repositories cost report, has a range of $45.7 to $57.2 billion and WMM fits within this range it is troubling
that WMM does not fit into the Key Attributes report. There are very few national repository cost estimates and so those that were included dominate the assumption calculation in WMM. Further research into national repository cost estimation will bring WMM into ranges of more reports. It was also noted that if the costs are divided by the volume (70,000 MT) the cost are 161.00, 280.10, and 683.70 $/kgHM for local, regional, and national storage options respectively which is within alignment of the MIT [9] and NEA [10] reports.

As stated in the section of this report concerning system dynamics, the variation of parameters within ranges to study the effect of the final value variation is of strong importance. This sensitivity analysis allows policy makers to concentrate research efforts on variables which have strong impact on the system. In the sensitivity analysis of WMM, it was found that the cost of the cask is the dominant factor in dry local storage scenarios while the cost of construction of the national storage facility is the dominant factor in the national storage scenarios. All cost parameters in the regional scenarios seem to have similar effects on the final value variation so no policy recommendation can be made in this case.

The accuracy of the economic parameters is not of utter importance since the user has the ability to change any of the parameters directly. The relative values for each of the options are more significant, and are helpful in assessments of the preferred options. The present study did not consider the discount factors if the funds for each option were to be borrowed. Further economic considerations should include the discount rate sensitivity analysis. Also decommissioning costs of the storage facilities were not included which should be considered in the following versions of WMM. These improvements will make WMM a stronger tool for economic policy analysis.

References

- “Key Attributes, Challenges, and Costs for the Yucca Mountain Repository and Two Potential Alternatives” GAO-10-48 (2009)