



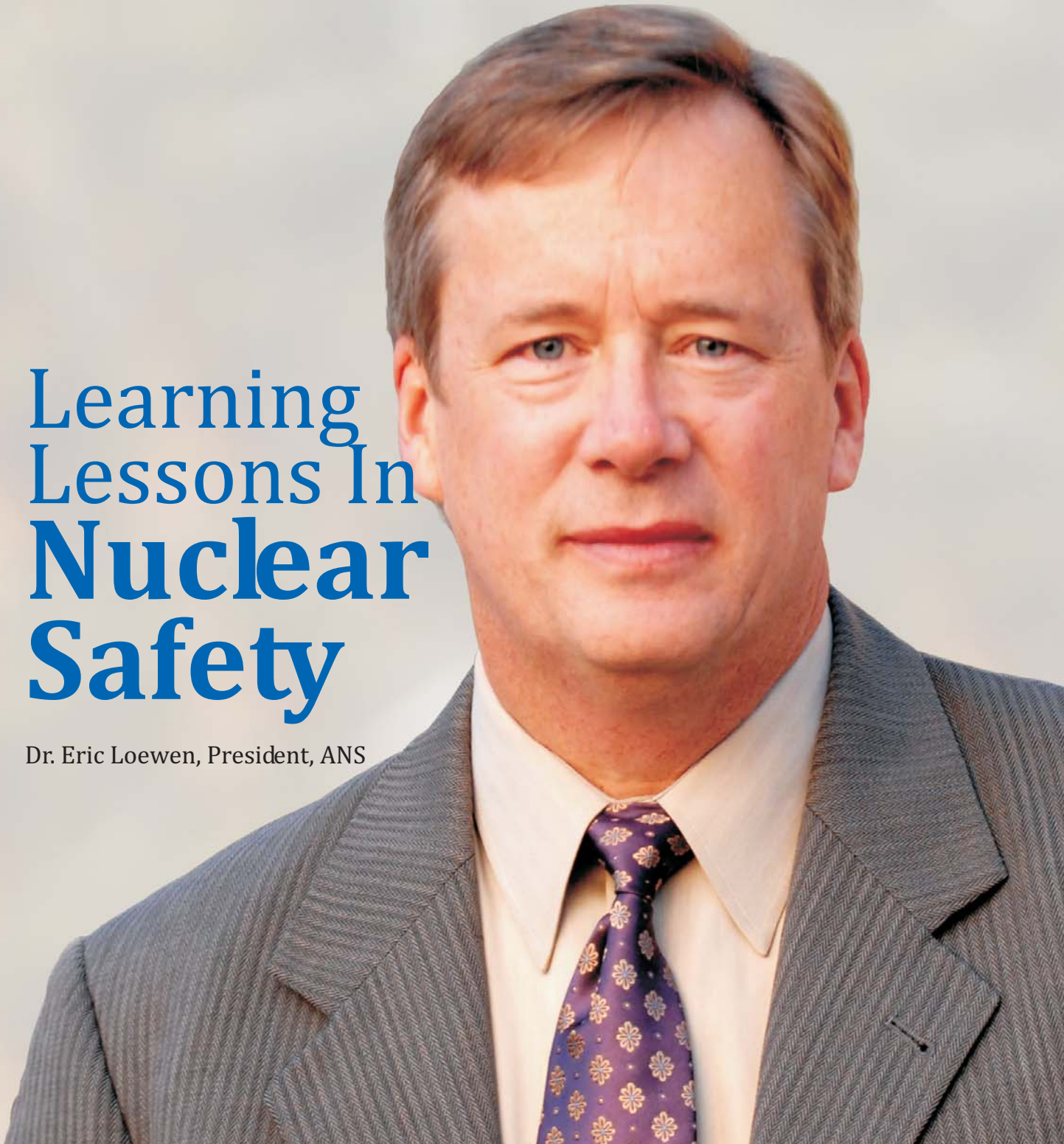
# ASIAN NUCLEAR ENERGY

Powering Global Nuclear Commerce

Vol. 2 Issue 3 Sept - Oct 2011

## Learning Lessons In Nuclear Safety

Dr. Eric Loewen, President, ANS





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**Dear Reader,**

Greetings. The recent disaster at Japan's Fukushima nuclear reactor has sent shock waves across the world, compelling nations to review their option for nuclear energy as a safe bet. In this context, the Indian Nuclear Energy Summit 2011, being held from 29 September to 1 October 2011 in Mumbai, is very timely. Organized by UBM India, in association with the Department of Atomic Energy (DAE), the Summit will surely provide a platform for government policy makers, nuclear technologists, planners and builders to interact with each other and come up with concrete suggestions to make nuclear energy a safe proposition for the world at large. American Nuclear Society (ANS) President Eric Loewen, who is leading a 20-member US nuclear industry delegation to the Summit, thinks the event will provide a great opportunity for technology convergence. We carry an exclusive interview with Dr. Loewen, which is the cover story of the magazine. We carry brief profiles of Dr. Loewen and some of the key members of the mission. The issue also carries two more interviews, one with DAE Public Awareness Division head S. K. Malhotra, who talks about India's intensified nuclear safety measures and its ongoing expansion programme. In the other interview, Ankit Rastogi, Sales Manager, SCHOTT Glass India Pvt. Ltd, tells us about his company's future plans in India, whose government has drawn up a massive expansion programme for the country's nuclear power industry, with emphasis on safety. In the focus section we have an address delivered by the Chairman of India's Atomic Energy Commission, Dr. Srikumar Banerjee at the 55th General Conference of the International Atomic Energy Agency (IAEA), held on 21 September 2011 in Vienna, highlighting the safety measures the Indian Government has initiated in the aftermath of the Japanese nuclear disaster. He also highlighted India's progress achieved in the last one year, covering the ongoing Research & Development work in the nuclear power generation field. The issue also carries a brief account of other speeches given at the IAEA meet. Then, we have a report on the safety evaluation of the existing Indian nuclear power plants, done in adherence to the Codes of the Atomic Energy Regulatory Board (AERB). Besides all these, the issue carries news developments and other regular features.

Wish you happy reading



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# India Well-Prepared on N-Safety Front Progress on N-Power Expansion in Full Swing

- AEC Chairman Dr. Srikumar Banerjee

The Chairman of India's Atomic Energy Commission, Dr. Srikumar Banerjee, in his address to the 55th General Conference of the International Atomic Energy Agency, held on 21 September 2011 in Vienna, highlighted the safety measures the Indian Government has initiated in the aftermath of the nuclear disaster at Fukushima in Japan to ensure safety at all the nuclear plants across the country. He also highlighted India's progress achieved in the last one year, also covering the ongoing Research & Development work in the nuclear power generation field. Following is the full text of Dr. Bajerjee's speech.

It gives me great pleasure to congratulate you, Mr President, on your election as the President of the 55th General Conference. Under your able leadership and with support from the Agency's Secretariat, we are certain that the current General Conference will be able to accomplish all the tasks before it.

I welcome the entry of Lao People's Democratic Republic, the Kingdom of Tonga and the Commonwealth of Dominica to the Membership of the IAEA. I take this opportunity to congratulate them on the occasion of their joining the IAEA family.



India joins other countries in expressing its deep condolences to the Japanese people for the sufferings in their country due to the terrible twin natural disasters that have struck that country. India also takes this opportunity to convey its appreciation of the efforts of the Japanese Government and people in dealing with the consequences of this tragedy.

The IAEA Ministerial Conference on Nuclear Safety during June this year, which followed soon after the Paris Ministerial Seminar on Nuclear Safety, has reiterated the consensus that nuclear safety is a national responsibility. The unanimous adoption of the Declaration at the end of that Meeting shows the importance Member States have accorded to nuclear safety and the role of IAEA in addressing

this important topic.

At the cost of a small digression, I may mention that against the backdrop of India's long standing association with the IAEA, the Comptroller and Auditor General (CAG) of India has presented its candidature for IAEA's External Auditor for the period 2012-13. An independent constitutional authority, the CAG has wide experience of auditing international organizations. May I request the esteemed delegations present here for favorable consideration of the candidature of CAG of India.

Nuclear energy remains an important element in India's energy mix for sustaining rapid economic growth. India remains firmly committed to its indigenous nuclear programme and is planning a major expansion of nuclear installed capacity to 20,000 MWe by 2020 and to reach about 60,000 MWe during the early 2030s. This accelerated capacity addition includes installation of large-size water cooled reactors planned under international civil nuclear cooperation. This is being pursued with full regard to safety and environment, and livelihood of the people living around the plants.

Immediately after the accident at Fukushima, the Prime Minister of India had underlined that safety of nuclear power plants is a matter of highest priority for the Government while implementing the national nuclear programme. Several actions have been taken in this regard. A bill to confer statutory status to the national safety regulatory authority has been introduced in the Parliament. The results of the safety reviews that were mandated by the Government of India have been made public. Several recommendations have already been implemented and a road map is prepared for implementing the other recommendations. A decision has been made to invite IAEA missions, namely, Operational Safety Review Team (OSART) and Integrated Regulatory Review Service (IRRS), for peer review of safety of nuclear power plants, and of the regulatory system, respectively.

The emergency response and preparedness measures have been further strengthened in our nuclear facilities. India's National Disaster Management Authority has drawn up a holistic and integrated programme of "Management of Nuclear and Radiological Emergencies".

While we learn lessons from the accident and take

all necessary measures to enhance emergency response to a nuclear accident, we should also be prepared to scientifically examine the substantial data now available from the accidents at Chernobyl and Fukushima, and factor these while establishing new guidelines for intervention limits for emergency response.

As a contracting party to the Conventions establishing international framework on Nuclear Safety, Assistance, and Early Notification, India is committed to fulfill all its obligations and looks forward to participating in reviewing these for effective implementation.

In pursuing India's 3-stage nuclear power programme formulated under the visionary leadership of Dr. Homi Jehangir Bhabha, we strongly believe in adopting a closed fuel cycle in order to extract the maximum energy from the limited uranium resources and to provide long-term energy security by utilization of the vast resources of thorium. Let me now give you some of the highlights of the achievements during the last year.

- The installed nuclear power capacity in the country has now reached 4780 Mwe.
- The total number of operating reactors is 20 including three new 220 MWe PHWRs, recently connected to the electricity grid. This has elevated India to the sixth rank among nations in terms of the number of nuclear power reactors in operation. I would like to mention here that the Indian PHWRs have a very competitive capital cost and offers a very low unit energy tariff. By now the Indian nuclear power sector has registered over 345 reactor years of safe operation.
- The nuclear power generation during the year recorded an increase of about 40 percent over the previous year, due to increased fuel availability, both indigenous and imported. In particular, the average capacity factor is more than 80 percent, while that of seven reactors has exceeded 90 percent.
- En-masse Coolant Channel Replacement and En-masse Feeder Replacement were completed in unit-2 of Narora Atomic Power Station and unit-1 of Kakrapar Atomic Power Station.
- The construction work at two 1000 MWe LWRs at Kudankulam being set up in technical cooperation



with the Russian Federation is nearly complete. The commissioning activities in unit-1 have reached an advanced stage and the hot run in this unit has been recently completed. The progress of unit-2 of Kudankulam nuclear power project is closely following that of the first unit.

- The 500 MWe Prototype Fast Breeder Reactor (PFBR) is also at an advanced stage of construction. The reactor vault is nearing completion with all major reactor equipment in place. Welding of the Roof slab (Top shield of Reactor) with reactor main vessel has commenced. Installation of steam generator and secondary sodium pump has started.

- Four indigenously designed 700 MWe Pressurised Heavy Water Reactors, two each at existing sites of Kakrapar in Gujarat and Rawabhatta in Rajasthan, were launched during the last year, thus raising the number of reactors under construction to seven.

- The Fast Breeder Test Reactor (FBTR) at IGCAR completed 25 years of successful operation in last October. The process for life extension of FBTR up to the year 2030 is progressing well. The test fuel subassembly for the prototype fast breeder reactor (PFBR) was irradiated in FBTR; after seeing a peak burn up of 112 GWd/t, as against the target burn up of 100 GWd/t, it is now undergoing post irradiation examination. A test loop called SADHANA has successfully demonstrated the natural convection in sodium to air heat exchange for validating the decay heat removal process in PFBR. In the domain of fast reactor safety, a test facility for molten fuel coolant interaction to understand the severe accidents has been commissioned.

- Detailed engineering design of advanced heavy water reactor, AHWR, has now been initiated so as to enable launching the construction of the plant during the next plan period 2012 - 2017.

- India is a founder member of INPRO. We are glad to see its progress during the last decade.

- India has rich experience in the entire gamut of activities related to nuclear power plants and associated fuel cycle, which places it in a position to export reactors, equipment and components, as well as services to the global nuclear energy market.

- We possess all technologies and infrastructure relevant to small and medium sized PHWRs of 220 MWe, 540 MWe and 700 MWe capacities, which would be a safe, proven and cost-effective option

for countries with small grids planning to start their nuclear power programme. In this context, India is looking forward to exporting its proven Small and Medium Sized Reactors (SMR).

- India is self-sufficient with regard to heavy water, zirconium alloy components and other related materials and supplies for PHWRs. Nuclear Fuel Complex (NFC) at Hyderabad manufactures fuel assemblies for different types of reactors, such as PHWRs, boiling water reactors and fast breeder reactors.

- The recently opened uranium mine in Tumalapalle has a potential to be a major uranium resource, the current assessment being over 60000 tons of reserve. The alkali leaching process indigenously developed has been adopted for processing uranium ore from this mine.

- A new reprocessing plant inaugurated at Tarapur has been working satisfactorily to its design capacity.

- A High Flux Research Reactor (HFRR) to be set up at the new BARC campus at Visakhapatnam is designed primarily to meet the large requirements of high specific activity radio-isotopes and to provide enhanced facilities for material testing under controlled conditions.

- India assigns equal emphasis to non-power applications of nuclear energy.

- Applications in the areas of health care, agriculture, hygienisation of municipal waste and water-desalination are making greater impact in India.

- Nuclear desalination plant at Kalpakkam with a capacity of 6.3 ML per day employing the hybrid technology of multi-stage flash evaporation and reverse osmosis technique is currently the largest nuclear desalination unit in the world.

- Isotope hydrology is being used more broadly to improve the understanding of climate change on water resources. In one such effort, India is among the 17 research groups who participated in an Agency coordinated research project on designing a global network of isotope monitoring in large rivers. It is a matter of great satisfaction that the theme of the Scientific Forum of this General Conference is related to application of nuclear techniques in water.

- Indian health authorities attach great significance



to fighting the cancer menace and several cancer care institutes have been expanding their facilities and treatment capabilities. A national cancer grid network initiative has also been launched. For example, the facilities at the Tata Memorial Centre (TMC) under the aegis of the Department of Atomic Energy, which provides services to nearly 500000 patients per year, have been expanded with a new block equipped with several sophisticated facilities. An International Peer Review conducted in October 2010 has rated the services of TMC at par with the global standards.

- The IAEA's Programme on Action for Cancer Therapy (PACT) enables the channeling of the resources and expertise to the needy and developing countries.

- India has been an active supporter of PACT initiative. The Bhabhatron Teletherapy machine, donated to Sri Lanka under the PACT last year, is expected to be commissioned shortly. Arrangements are underway for providing the next machine to Namibia.

- In our continuing support to nuclear medicine practices in India, a new facility for production of Technetium-99m generators has been set up at the laboratories of the Board of Radiation and Isotope Technology in Navi Mumbai. In order to further enhance our self-reliance, we will set-up a new facility for production of fissionproduced Molybdenum-99 in Trombay. In view of India's large interest in electron accelerator based applications, we are developing competencies and building facilities to address several aspects of accelerator technologies.

## Research & Development

India's nuclear programme attaches high importance to R&D work and some recent achievements are as follows:

- The Advanced Heavy Water Reactor, AHWR, has been designed to address siting and safety-related issues relevant for future large-scale deployment of nuclear power in a densely populated country like ours. Its design was revisited to understand and confirm its robustness against events such as earthquake, flooding and extended Station Black Out.

- India has taken an important step in assessing the behavior of containment under 'beyond-design-basis' accident conditions. A one to four scaled

down reactor primary containment test-model of the 540 MWe PHWR, with 9 extensive instrumentation is being subjected to a series of tests leading up to its ultimate failure. The results are being analyzed as an International Round Robin exercise involving fifteen participants from various countries. This is one of the largest containment test facility in the world.

- More than 100 solar powered Environmental Radiation Monitors have been deployed at various locations in India covering Nuclear Power Plant sites, uranium mining sites, major metropolitan cities etc. under the Indian Environmental Radiation Monitoring Network (IERMON).

A Global Centre for Nuclear Energy Partnership, GCNEP, is being set up near New Delhi to pursue studies in the field of Advanced Nuclear Energy Systems, Nuclear Security, Radiological Safety, and Applications of Radioisotopes and Radiation technologies. MOUs are already signed with USA, Russia and will soon be signed with the IAEA. France has also expressed a desire in signing an MOU.

To mark the launch of GCNEP, a regional training course on Nuclear Security - "Physical Protection of Nuclear Facilities against Sabotage, Assessing Vulnerabilities and Identifying Vital Areas" is scheduled at New Delhi during 14-18 November this year.

The role of nuclear power as a safe, clean and viable source to meet the energy needs, as well as to adequately address the concerns of global warming and climate change, cannot be undermined. This is all the more so for developing countries and emerging economies, which aim to provide a better quality of life for their people. As regards safety, we must recall that the world has logged over 14,000 reactor-years of nuclear electricity generation in about 30 nations, with far fewer casualties compared to any other energy generating technologies over a sustained period. This in itself testifies to the strength of nuclear technology, which must be further pursued to provide an important part of sustainable energy solution for the future.

## Indian N-Plants Have In-built Safety Measures

# Expansion Plan for 20,000 MWe by 2020 Unaffected



S. K. Malhotra, Head, Public Awareness Division, Department of Atomic Energy, has his task cut out more pronouncedly, in the aftermath of the nuclear disaster at Fukushima, Japan. The incident has thrust the issue of nuclear safety into focus, which is one of the key areas Malhotra has been handling since he took over as head of the Public Awareness Division in 1999.

Malhotra, who has a ringside view of India's nuclear energy programme, tells Asian Nuclear Energy magazine about India's intensified nuclear safety measures and its ongoing expansion programme. Excerpts of the interview.

The forthcoming Indian Nuclear Energy 2011 Summit is being held in the aftermath of the recent nuclear disaster at Fukushima, Japan. Do you think nuclear safety concerns will pose a threat to the future growth of the nuclear energy industry in India, especially when the country has drawn up a massive plan for its expansion?

No doubt, the Fukushima incident which in itself was the rarest of rare has resulted in fresh concerns about safety in nuclear power. It will however, not have, any long term impact on the growth of nuclear power the world over including India. We must remember that the world has logged over 14,000 reactor-years of nuclear electricity generation in about 30 nations, with far fewer casualties compared to any other energy generating technologies over a sustained period. This in itself testifies to the strength of nuclear technology, which must be further pursued to provide an important part of sustainable energy solution for the future.

Please give us a broad picture of safety infrastructure in place at various nuclear power generation plants across the country and what extra measures will the DAE take in further fortifying safety for proposed new plants?

Eighteen of the 20 operating nuclear power reactors in India are pressurized heavy water reactors (PHWRs) having inherent safety strengths. They have design provisions to cool the reactor core even under extended SBO. Provisions for providing additional water to the primary heat transport system under the condition of extended SBO will be made in all the operating and future PHWRs. Provisions will also be made to ensure operability of the fire water system even during flooding. Even the two boiling water reactors at Tarapur (TAPS 1&2) are equipped with emergency condensers capable of providing post shutdown cooling for eight hours even under the condition of total Station Black Out. Steps have already been taken to supply cooling water to the emergency condensers to enhance their cooling capability for extended periods. Similarly preparatory work has been initiated for inerting the containment with nitrogen to avoid hydrogen explosions that happened at Fukushima. Many more such initiatives are being taken at all the operating nuclear power plants to further strengthen safety provisions. It may also be noted that as a standard practice, all nuclear power plants undergo periodic safety reviews by AERB. The high level AERB Committee on Safety review of Indian Nuclear Power Plants Against External Events of Natural Origin have recently released their report and work has already been initiated to implement their recommendations at all the power stations. As regards the proposed new plants both indigenous PHWRs and the LWRs to be imported, their design and safety features are once again being reviewed to ensure that they have the capability to withstand even beyond design basis external event and have provisions for cooling of the core and the spent fuel in a prolonged SBO condition.

What measure DAE has undertaken to educate the people about nuclear safety awareness to reduce their fears about a Japanese type calamity occurring in India

at the existing as well as the proposed new plant sites?

DAE has always had a strong public awareness programme in place which has been further intensified recently after the Fukushima accident to allay any fears or misconceptions about atomic energy. We are reaching out to them through public seminars, media (both print & electronic), workshops for teachers and students and exhibitions. Steps are being taken to further intensify these efforts for even stronger outreach to the general public.

Could you provide a review of the progress of DAEs plans to scale up the present installed nuclear power capacity of 4780 MWe to 20,000 MWe by the year 2020?

Presently, we have in all seven reactors (2x1000 MWe VVERs, 4x700 MWe PHWRs and 1x500 MWe PFBR) under construction which will add 5300 MWe to the current installed capacity of 4780 MWe. We plan to launch at least six more PHWRs of 700 MWe each, six LWRs (each of capacity 1000 MWe or more), two FBRs (500 MWe each) and AHWR (300 MWe). All these reactors when complete (by 2020) will take the installed nuclear capacity in the country beyond 20,000 MWe.

You have a ringside view of the country's long-term strategy for nuclear energy 2050 and the role that indigenous technology would play in it in achieving the targets, especially through thorium-based FBR technology. What is the progress made in this regard?

India right from the inception of its nuclear power programme has been pursuing its unique three stage nuclear power programme based on the closed fuel cycle and with an objective of utilization of its rich thorium resources to provide energy security to the country for at least a couple of centuries. Up to the early thirties, our installed nuclear capacity will be majorly based on the first stage (PHWRs and LWRs). Beyond that the growth will be mainly in terms of the indigenous fast breeder technology. DAE is developing the metallic fuel based fast breeder reactors and the growth

beyond 2030 is envisaged to be mainly in terms of these metallic fuel based reactors which will have the advantage of short doubling time thus facilitating faster growth. It is envisaged that based on the plutonium obtained from the spent fuel of our indigenous PHWRs, an installed capacity of 200 GWe in terms of fast breeder reactors will be in place by the middle of this century. Plutonium obtained by reprocessing of the spent fuel from imported LWRs will further enhance this growth. Studies carried out by us have shown that thorium based reactors should be introduced commercially only after attaining the installed fast breeder capacity of 200 GWe. Thus, thorium-based reactors will play commercial role only in the second half of this century. A road map for developing future reactors to be fuelled by thorium based fuels is very much in place and we at DAE have undertaken technology development for the high temperature reactors (HTRs) and accelerator driven sub-critical systems (ADSS).

**What concrete outcome do you expect from the forthcoming Indian Nuclear**

## **Energy 2011 Summit which could help India's nuclear power industry?**

Besides being in an unprecedented expansion mode, the nuclear power sector is in a transition in terms of multiple technologies on the verge of entering the Indian scenario, the nuclear liability issues, the regulatory issues and most important the safety issues and concerns in the post Fukushima scenario. The forthcoming Indian Nuclear Energy 2011 Summit would provide a common platform to address all the above. In fact, the Summit has been structured to focus on these issues in its various sessions. I am particularly happy that we have participation from a large number of companies engaged in nuclear power reactor business both from India and the rest of the world are participating in the three days' event and will be showcasing their achievements and capabilities and may be their business plans. It will also provide an opportunity to the participants for bilateral (or multilateral) discussions or business deals.

## **US, Russia Pledge to Help Global N-Power Expansion**

Energy leaders from Russia and America have made a "commitment to supporting the safe and secure expansion of civil nuclear energy" on the sidelines of the International Atomic Energy Agency's General Conference.

Officials from the US Department of Energy and Russia's Rosatom signed what the US side called a "joint statement on strategic direction of US-Russia nuclear cooperation."

US energy secretary Stephen Chu said it was a milestone for the two nuclear energy pioneers. They were long separated by their opposition during the Cold War, but now share a leading role in nuclear security and disarmament.

Chu said in his address to the Conference that nuclear energy's role grows more valuable as we confront a changing climate, increasing energy

demand and a struggling economy. "At the same time, Fukushima reminds us that nuclear safety and security require continued vigilance."

He noted the agreements made by Russia and the USA to reduce their weapons stockpiles and the importance of the widest possible sign-up to the framework of international conventions supporting the safe use of nuclear energy.

Russian nuclear energy chief Sergei Kiriyenko focused comments on his country's efforts to help new nations enjoy the benefits of nuclear energy. Their entrance to the field raises "questions of nuclear safety, infrastructure, creation of licensing and safety oversight and development of a clear legal framework in accordance with the requirements and recommendations of the IAEA," he said.





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Indian Nuclear Energy Summit 2011

## Best Opportunity for Technology Convergence

Dr. Eric Loewen, President, ANS

Dr. Eric Loewen, President of American Nuclear Society (ANS), is also the Chief Consulting Engineer of GE-Hitachi Nuclear Energy (GEH). He is leading a high-powered nuclear experts' mission to the Indian Nuclear Energy Summit 2011. During the three-day Summit Dr. Loewen is expected to mingle and interact with his global peers and Indian counterparts on the issues of nuclear safety and the prospects for nuclear industry growth worldwide, especially India. His thrust, of course will be on Indo-US Civil nuclear energy cooperation and collaboration, in which US companies are expected to participate in a big way. In an interview with Asian Nuclear Energy, Dr. Loewen talks about his Mission to India. Excerpts.



The forthcoming Indian Nuclear Energy 2011 Summit is being held in the aftermath of the recent nuclear disaster at Fukushima, Japan. Do you think nuclear safety concerns will pose a threat to the future growth of the nuclear energy industry worldwide in general and the Indo-US civil nuclear cooperation in particular?

No in fact, I think the recent events have created an opportunity for our community to demonstrate to the world the safety that's built in to every facility we construct. We have to remember that no one died as a result of the damaged cores at Fukushima, while we mourn the loss of the tens of thousands who died from the earthquake and tsunami.

What challenges and hurdles does the global nuclear energy industry need to surmount in this regard?



We're good at learning lessons, and not so good at expressing what we've learned to our fellow citizens. This is an area where we need to improve and that's why ANS has a special committee on Fukushima.

The summit program indicates that you will be making a presentation on fast breeder reactors. Do you foresee future growth for thorium-based reactors with fast breeder reactors that Indian nuclear scientists have developed over the years?

As demand for electricity increases, we as a community must provide our best thinking and technology to respond. I certainly hope and believe that the next generation of facilities will use the best science and technology we can create; fast reactors using a U-238 or Th-232 fertile matrix are a part of that mosaic.

The Summit is also a global event of nuclear commerce. Do you expect significant collaborations, especially between American and Indian nuclear energy companies? If so, which are the potential areas of collaboration? Will nuclear safety be one of them?

I genuinely believe that every gathering of professionals devoted to nuclear science and technology is an opportunity where epiphanic events can occur and not just in safety, but in all areas of our endeavours. I would not have traveled to the Summit if I did not believe in future collaboration.

Will Indo-U.S. cooperation facilitate the strengthening and streamlining of nuclear regulatory infrastructure, which is one of the major challenges that the Indian nuclear industry is facing today?

Strengthening yes; streamlining remains to be seen. We have to remember that there is a considerable aspect of political interest in what we do, both in the US and in India, and we have to remain sensitive to those concerns. But at the base, cooperation is a not just a goal, but actually a way of

proceeding which is well established in our community.

The Framework for Indo-US nuclear education cooperation is to be discussed during the ANS Mission to India. What prospects does this move hold for the training and development of nuclear technologists as well as research institutes from both countries?

The nuclear community does more to ignore boundaries than almost any other I can name. By sharing our science and our people, we most definitely will be able to grow and train the next generation of nuclear professionals who will continue to solve problems and provide solutions to the problems facing all of us as global citizens.

Facilitating global technical exchange through Indo-U.S. cooperation is an area of importance for both countries. What steps are on to expedite such an exchange?

Well, certainly events like this Summit are key to those exchanges. I also note that the American Nuclear Society holds major events several times a year where all, from around the world, are welcome and participate.

What measures should India and the U.S. take to further ease US nuclear export controls that India faces?

I'm an engineer, not a politician, but I'm also a citizen of the world. In that last capacity, I would say that the men and women charged with the responsibility of developing policies of export controls should carefully consider the unbiased scientific and technical information that the nuclear community is uniquely positioned to provide. Further India has taken a very responsible path forward as a country.

Ensuring nuclear safety through quality assurance in the manufacture of nuclear components is an issue that will receive great attention at the summit. Do you foresee collaborations between US and Indian companies in the nuclear component and accessories sector?





Promoting safety, as I suggested above, knows no geographical boundaries; I think the only impediments to collaboration in this specific regard would be created by the forces of the free market and competition.

**Will the ANS India Section' Summit help take the Indo-US Civil Nuclear Energy Cooperation to the next level? Please elaborate.**

Only a year after its chartering by the American Nuclear Society, the ANS India Section has played a key role in creating this Summit. Its members have demonstrated their passion for leading in all aspects of the nuclear community and I applaud them. Just think what we can do in 2, 5, and 10 years; we are in it for the long haul.

**What prospects do you expect from the Summit as a whole?**

I suggested above that every gathering of nuclear scientists and engineers is an opportunity to move forward. This Summit is no different except in that it is more so. Rarely is there such a chance for so many pivotal figures to meet and learn from each other.

**What is your message to business and educational communities from both countries as well as global investors about the future growth of the nuclear energy industry?**

Be positive and be encouraged we hold in our hands the ability to grant our grandchildren a future free of worry of energy production, and thus we can help them create a world in which their chief concern is to focus on learning to live together better. Energy input is key to any economy, nuclear needs to be a part of that energy mosaic.

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## Profiles of US Nuclear Mission Delegates

### **Dr. Eric Loewen**

**President, American Nuclear Society (ANS).**

**Chief Consulting Engineer, GE-Hitachi Nuclear Energy (GEH).**

Dr. Loewen supports GEH's Advanced Reactor and Advanced Recycling Center, which couples electro metallurgical processing and the PRISM sodium cooled reactor. His current work involves leading GEH's efforts to deploy the integral fast reactor (PRISM - a small modular reactor [SMR]) that will recycle spent nuclear fuel from their current fleet of light water reactors and also eliminate weapon grade material. Dr. Loewen received both his masters and Ph.D in Nuclear Engineering and Engineering Physics, respectively, from the University of Wisconsin-Madison after completing

several years of service in the United States Navy. He also received his two BA degrees in Chemistry and Math from Western State College. Dr. Loewen also served as a Consulting Engineer for the Idaho National Laboratory and served as an advisor to a U.S. Senator as the 2006 ANS Congressional Fellow.

### **Prof. Sukesh Aghara**

**Associate Professor, Prairie View A&M University (PVAMU), Chemical Engineering (Nuclear).**

**Director, NSF Center for Energy and Environmental Sustainability,**

Dr. Aghara is in the Department of Chemical Engineering (Nuclear) at PVAMU, a member of the Texas A & M University System. He is the





PI/Director of the \$1 million per year, 5 year, NSF CREST Center for Energy and Environmental Sustainability. In addition he is the leader for radiation transport group with NASA Center for Radiation Engineering and Science for Space Exploration (CRESSE). He served as a NASA Administrator's Fellow for 1 year at NASA Langley Research Center (LaRC). Previously he has been a visiting scientist with Nuclear Science and Technology Division at Oak Ridge National Laboratory. His expertise includes radiation shielding analysis and experimental design, applications of nuclear analytical techniques, nuclear energy and nuclear security. Dr. Aghara earned a Masters in Environmental Engineering from Vanderbilt University. He received his Masters and Ph.D. in Nuclear Engineering from the University of Texas at Austin (UT). He serves on the board of the Nuclear Power Institute (NPI), a multi-agency (university/industry/utilities) consortium focused on the development of the nuclear workforce of the future.

## **Mr. Jack Allen**

### **Westinghouse, President, Asia**

Jack Allen is responsible for customer relationships, business development, and project and product delivery in Asia. In addition, as President and CEO of Westinghouse Electric Japan KK, Mr. Allen is responsible for growing Westinghouse's presence and expanding its businesses in Japan. He assumed this position in July 2009. And on 1 July 2010, Mr. Allen was appointed Chairman, Nuclear Fuel Industries, Ltd. (NFI), the sole Japanese producer of both PWR and BWR nuclear fuel and related services. Westinghouse acquired 52 percent ownership of NFI in May 2009. Mr. Allen has more than 40 years of Westinghouse experience in the nuclear field. He has a Bachelor and Master of Science in Metallurgical and Materials Engineering and a Master of Business Administration from the University of Pittsburgh.

## **Prof. Yousry Y. Azmy**

### **Chairman, Nuclear Engineering Department Heads Organization (NEDHO).**

### **Professor of Nuclear Engineering & Department Head, North Carolina State**

## **University.**

Prof. Azmy is lead PI of development activities for the renowned neutral particle transport code TORT. His expertise includes implementation of neutron transport and diffusion methods on multiprocessing computers, and the development of parallel performance models. He previously taught at Penn State University and served as a research scientist at the Oak Ridge National Laboratory. Prof. Azmy received both his masters and Ph.D. in Nuclear Engineering from the University of Illinois, and earned his bachelors of science in Nuclear Engineering from the University of Alexandria, Egypt.

## **Prof. Sama Bilbao y León**

### **Member, Board of Directors & International Committee of American Nuclear Society.**

### **Director, Virginia Commonwealth University (VCU), Nuclear Engineering Programs.**

Sama became an Associate Professor in the Department of Mechanical and Nuclear Engineering at VCU in January 2011. She was one of the key individuals involved in the creation of the Dominion-sponsored Master in Nuclear Engineering offered by VCU from the fall of 2007. Until December 2010, Sama was the Technical Head of the International Atomic Energy Agency (IAEA) Water Cooled Reactors Technology Development Unit. From February 2001 until March 2008, Sama was a Nuclear Safety Analysis Engineer at Dominion Generation. Sama earned the ANS Public Communications Award in 2002, and in 2007 she received the NA-YGN Founder Award, the highest award given to an NA-YGN member. Sama holds a bachelor's degree in Mechanical Engineering and a master's degree in Energy Technologies from the Polytechnic University of Madrid; a master's degree and a PhD in Nuclear Engineering and Engineering Physics from the University of Wisconsin Madison; and an MBA from Averett University.

## **Thomas Bergman**

### **Director, U.S. Nuclear Regulatory Commission, Division of Engineering, Office of New Reactors.**

Mr. Bergman has more than 20 years of experience



with the U.S. Nuclear Regulatory Commission. He is the NRC's senior management lead for bilateral relations with India. Previously, he was Deputy Director for Licensing Operations in the Division of New Reactor Licensing, a position he held since the Office of New Reactors was formed in 2006. His other NRC experience includes the Office of the Executive Director for Operations, Office of Nuclear Regulatory Research, Region III, and Office of Nuclear Reactor Regulation. Prior to joining the NRC in 1990, Mr. Bergman worked for ARINC Research Corporation, and for the Naval Nuclear Propulsion Directorate in the U.S. Navy. He has a Bachelor of Science Degree in Aerospace Engineering from the University of Michigan and a Master of Business Administration from the University of Maryland.

## David Blee

### **Executive Director, U.S. Nuclear Infrastructure Council (NIC).**

The U.S. NIC is a national coalition of more than 40 member companies for policy, business and public education issues affecting nuclear materials transporters, suppliers and customers. Mr. Blee's public service includes appointments as Principal Deputy Assistant Secretary of Energy and Director of Public Affairs for the U.S. Department of Energy and as Chief of Staff to former U.S. Senator Connie Mack, during his service in the U.S. House of Representatives. His private sector experience includes assignments as Executive Vice President for Marketing and Business Development and Group Executive Vice President for Worldwide Consulting for NAC International, an Atlanta-headquartered energy services company. Prior to joining NAC, he served as a principal in several leading strategic communications firms, including Robinson, Lake, Lerer & Montgomery and Franklin, Blee & Burling.

## Jyoti Chatterjee

### **President, Holtec Asia a subsidiary of Holtec International. As the President of Holtec Asia.**

Jyoti is directly responsible for Holtec's business development and operations in Asia and India. Born in Kolkata, India, Jyoti completed his undergraduate education in Civil/Structural Engineering from the Indian Institute of

Technology, Khargapur, India. As a fellow of the National Science Foundation, USA, Jyoti has carried out extensive research in Seismic Engineering and Risk Analysis of Power and Industrial plants. His research and publications in the area of application of Information Technology in the A/E/C (Architectural/Engineering/Construction) market have been extensively incorporated in national building/industrial codes of practices worldwide.

## Robert Cleveland

### **Asia Pacific Manager, Rosemount Nuclear Instruments.**

Robert Cleveland has 10+ years of experience in the field of nuclear power marketing Rosemount Nuclear safety-related pressure transmitters worldwide. He has managed Rosemount's nuclear business in Asia Pacific since 2003. Rosemount Nuclear Instruments, Inc. is a division of Emerson Process Management which is dedicated to the design, manufacture and distribution of safety related pressure measurement instrumentation for the worldwide nuclear power industry. Robert has a Bachelor of Arts Degree from Lenoir-Rhyne University. He has recently participated in business management courses at St. Thomas University.

## Matthew J. Dryden

### **Vice President, Business Development Strategic Initiatives, AREVA USA.**

Matt Dryden is responsible for strategically positioning and providing linkage to AREVA's entire North American Operations portfolio offering by actively engaging and aligning interests within both new and existing customer bases, governmental policy and financial communities. Previously, Matt served as Vice President of Marketing and Commercial Operations for GE-Hitachi Nuclear Energy and spent the first 16 years of his career at American Electric Power. Matt holds an Associate's Degree in Nuclear Power from Terra Technical University, a Bachelors Degree in Business Administration from Siena Heights University and a Masters Degree in Business Administration from Indiana University.

## Dr. Paul Harding

### **Executive Director, Commercial, URENCO**



## **Enrichment Co Ltd,**

Paul was previously Managing Director of URENCO's Capenhurst site, near Chester in the UK. He is based at URENCO Group Head Office in Marlow, Buckinghamshire, UK. Dr Harding plays a key role in continuing URENCO's long-term relationships with its global customers and associates and will be responsible for developing relationships with new customers and partners to grow URENCO's business as demand for nuclear energy increases across the world.

## **Benjamin Holtzman**

### **Nuclear Fuel Rod Design Engineer, Westinghouse.**

Benjamin Holtzman previously worked at Knolls Atomic Power Laboratory, GE-Hitachi, and Sargent & Lundy. Ben earned his M.S. in Nuclear, Plasma, and Radiological Engineering and a B.S. in Nuclear Engineering at the University of Illinois. Ben is most prominently serving the American Nuclear Society (ANS) as Presidential Executive Assistant to ANS President Dr. Eric Loewen. He is an executive board member of the ANS Young Members Group, serves on the Professional Development Coordination Committee, and is the Finance Chair for the 2011 Young Professionals Congress. Additionally, Ben is the Pittsburgh local section secretary.

## **Dr. Tim Mason**

### **General Manager, Marketing and Sales, URENCO Enrichment Co Ltd.**

Dr Mason is responsible for the marketing activity of URENCO, and its subsidiary LES, in key European and Asian markets, as well as countries with developing nuclear programs. Dr Mason has over 20 years of experience in nuclear fuel cycle industries and joined the URENCO Group in 2006. Prior to joining URENCO, Dr Mason held a senior position in the Fuel Cycle Services division of RWE NUKEM GmbH (1994–2005) and was responsible ultimately for the UK trading desk from 1999. Dr Mason started his career in the Nuclear Industry with BNFL in 1989 where he worked primarily in the Hex Business Unit. Dr Mason received his PhD in Radiobiology from the University of Manchester.

## **Mark W. Marano**

## **Areva USA, Senior Vice President, New Plant Build Operations - USA**

Mark Marano was appointed to his current position on January 1, 2010. His previous position was Senior Vice President New Plants Business Development for AREVA NP INC. upon his initial hire in March 2009. Marano has also served as Senior Vice President Marketing at GE Hitachi Nuclear Energy. In this position he was responsible for all inorganic and organic growth initiatives for the global nuclear business, including mergers & acquisitions, strategic partnerships, alliances, joint ventures and dispositions. Other positions held include Vice President Uranium Business Unit at (GE) Global Nuclear Fuels, Vice President, Financial Planning at AEP Service Corporation and Vice President of Business Services for both the fossil and nuclear generation fleet at AEP Generation. Prior to joining AEP, Marano worked at Florida Power Corporation, (Crystal River Nuclear Plant), Carolina Power and Light's (Brunswick Nuclear Plant), PSEG's (Hope Creek and Salem Nuclear Stations) and as a Pricing Analyst and Industrial Engineer for several New York state companies, including a large defense contractor (Grumman Aerospace). Marano earned a Bachelor of Science degree in business administration from State University of New York, College of Oswego, and is completing his MBA from the New York Institute of Technology, Old Westbury, New York.

## **Dr. Corey K. McDaniel**

### **President, India Local Section, American Nuclear Society, Chairman, International Committee.**

### **Country Manager for India, NuScale Power.**

### **Chairman/Managing Director, McDaniel Technical Associates Inc.**

Corey McDaniel represents NuScale Power in Mumbai. Dr. McDaniel has over 20 years of experience as a manager and advisor on nuclear technology, business and policy issues. Before moving to India he spent five years as the senior advisor to three United States Senators advising on energy and environmental policies on seven Senate Committees. Corey previously served as a managing director of an energy development



company, as the senior technical associate at an energy and environment consulting practice, and as a nuclear safety scientist at the Los Alamos National Laboratory. Corey earned his Ph.D. in Environmental Science and Public Policy from George Mason University, and his M.S. and B.S. degrees in Nuclear Engineering from the University of New Mexico and Purdue University respectively. Corey first joined the American Nuclear Society (ANS) as a student in 1989.

## **Shikha Prasad**

**American Nuclear Society, Local Section Committee, Executive Committee**

**Doctoral Candidate, Department of Nuclear Engineering, University of Michigan.**

Shikha Prasad is a University of Michigan Barbour Scholar. She is the President of the Teach for India Chapter at the University of Michigan. She has served the American Nuclear Society for over five years in various capacities and is presently a member of the executive committee of the ANS Local Section Committee. In the past she has worked for General Atomics, Hitachi-GE Japan, Bhabha Atomic Research Center, Oak Ridge National Laboratories and ERIN Engineering and Research Inc.

## **Dr. Atam S. Rao**

**American Nuclear Society, International Committee**

**ALTRAN, Principal Consultant Global Nuclear**

Dr. Rao is a recognized leader, innovator and effective proponent of complex issues, having traveled to over 40 countries, having many international contacts, and speaking several languages. Most recently he spent five years at the International Atomic Energy Agency, Vienna, Austria as the Head Nuclear Power Technology Development. Previously he had a 31-year distinguished career at GE in the Nuclear Power Industry. Atam has organized several very large international projects and activities, and has worked extensively with industry, government regulators and different organizations. Dr. Rao earned his PhD and MS degrees in Mechanical Engineering from the University of California,

Berkeley, and his bachelor's degree in mechanical engineering from the Indian Institute of Technology, Kanpur, India. Atam is an ASME Fellow and has received the ASME George Westinghouse Gold Medal and the Distinguished Alumni Award, IIT, Kanpur West Coast Chapter.

## **Dr. Vijay K. Sazawal**

**Director of Government Programs, USEC.**

Dr. Sazawal has over 35 years of professional experience in the nuclear industry covering the entire fuel cycle. USEC, Inc., is a leading supplier of enriched uranium fuel for commercial nuclear power plants worldwide. Dr. Sazawal is a member of the U.S. Department of Commerce's Civil Nuclear Trade Advisory Committee (CINTAC). Prior to joining USEC Inc., Dr. Sazawal worked at COGEMA Inc. (now Areva NC) for seven years where his last position was the Vice President of Engineering and Technology. Dr. Sazawal completed his doctoral degree in structural mechanics in 1975 and immediately joined Westinghouse Electric Corporation in the Advanced Reactors Division, his tenure in Westinghouse lasted 20 years. Dr. Sazawal holds a Bachelor's degree in Mechanical Engineering from the Banaras Hindu University (India), M.Tech. in Materials Engineering from the MA College of Technology, Bhopal (India), and Ph.D. in Structural Mechanics from the Michigan Technological University. Dr. Sazawal played an active role as a subject matter expert (SME) in the US-India civil nuclear agreement.

## **Shailesh R. Sheth**

**Vice President of India Strategy, GE Hitachi Nuclear Energy (GEH).**

Shailesh leads a matrix 30-person GEH team in the execution of commercial negotiations and early project planning activities with NPCIL and has overall responsibility for the planning and implementation of GEH's business strategy in India. From March 2008 and until he assumed his current role in October 2010, Shailesh was the Vice President of Global Marketing for GEH's New Plants business with responsibility for the formulation and execution of GEH's New Plants business and marketing strategy globally in collaboration with the New Plants product line. Shailesh has a B. Tech.





in Chemical Engineering (Ch. E.) from The Indian Institute of Technology (IIT), Mumbai, India, Master's (Ch. E.) from the State University of New York in Buffalo and a Ph.D. (Ch. E.) from the University of Illinois at Urbana-Champaign. He is a GE-certified Six Sigma Black Belt. Shailesh was born and raised in Mumbai, India and lives in Wilmington, North Carolina with his wife, Trupti, their 4-year old son, Sohum and his mother, Beena Sheth.

## **Gary T. Urquhart**

**Vice President and MD for the India, SE Asia and Taiwan region, Westinghouse Electric.**

Mr. Urquhart is responsible for all business activities within the region including business development and project delivery. He is located in the Westinghouse Asia Regional headquarters in Tokyo. He started his career in the nuclear power industry nearly 40 years ago with Babcock & Wilcox and moved to Westinghouse in 2002. He has diverse engineering experience in nuclear primary component design and manufacturing, quality assurance, remote inspection and service equipment design and field services. Besides his technical experience he has had business development, sales and project management leadership responsibility for nuclear services and fuel including an assignment at BNFL's Sellafield

MOX plant. He relocated to Tokyo in 2007 and assumed his current position in 2010. Mr. Urquhart has a BS in Mechanical Engineering from the State University of New York at Buffalo and an MBA from Lynchburg (Virginia) College. He is a licensed registered engineer in Virginia, USA.

## **Ed Wolbert**

**President, Transco Products.**

**Chairman, U.S. Department of Commerce's Civil Nuclear Trade Advisory Committee (CINTAC)**

Transco Products Inc., is a leading U.S. medium-sized manufacturer and contractor dedicated to nuclear power. Mr. Wolbert has been in the nuclear power industry for over 30 years, has been with Transco for the last 26 years, and has served as its president for the last 14 years. Mr. Wolbert oversees the daily strategic direction and tactical operations of the company, including direct guidance of its foreign activities. Mr. Wolbert is a member of the American Nuclear Society, and is also a member of ASTM (serving on the C16 committee). Mr. Wolbert was also recently appointed to serve on the NIST/MEP National Board of Advisors for a three-year term.

## **Kirloskar Gets NPCIL Order for Backup Generators**

Kirloskar Oil Engines Ltd has been awarded a contract by Nuclear Power Corporation of India Ltd (NPCIL) worth \$80 million for the supply of 16 emergency diesel generating sets. Each set would have a generating capacity of 4.2 MWe.

In a statement to the Bombay Stock Exchange, Kirloskar said that delivery of the generators would be completed over the next 42 months. It was not disclosed at which nuclear power plant

sites the backup generators are intended to be installed. In normal operation, a nuclear power plant is self-sufficient in the power it needs to keep itself running safely.

Diesel generators provide a backup to ensure that safety-critical systems such as coolant pumps and electronic controls are guaranteed a power supply should the reactor be forced to shut down for any reason.

# ANS Chief Loewen Leads Mission to N-Safety Summit

A high-powered nuclear energy delegation from the United States, led by American Nuclear Society (ANS) President Dr. Eric P. Loewen, is visiting India this week to participate in the Indo-U.S. Nuclear Energy Safety Summit being held here on 30 September, 2011.

Explaining the objective ahead of his first ever visit to India, Loewen said, "Twenty of my ANS colleagues, who come from academia, the government, and industry, will join me in seeing first-hand how India develops nuclear energy to provide safe, clean and affordable electricity to a growing population and economy."

Loewen added, "Of course, as a nuclear engineer, I am particularly eager to visit some of India's leading

nuclear sites." Loewen's delegation will visit the Indira Gandhi Atomic Research Centre (IGCAR) and Bhabha Atomic Research Centre (BARC) government sites, and will meet with government and industry officials in both Chennai and Mumbai. ANS last led a mission to India in 2007.

Loewen will present an ANS Presidential Citation to Dr. Anil Kakodkar, former Chairman of Atomic Energy Commission and Secretary of the Department of Atomic Energy, for his critical leadership role in successfully negotiating the Indo-U.S. civil nuclear agreement. He will also present opening remarks at the Indo-U.S. Summit and will discuss the safety advantages of Fast Breeder Reactors, a technology Loewen manages at

General Electric, and that is part of India's three-stage plan for civil nuclear energy.

Presenting along with Dr. Loewen will be Dr. R.K. Sinha, Director of the BARC, on the safety advantages of the Advanced Heavy Water Reactor being developed by India to take advantage of vast Thorium reserves. U.S. representatives of four lightwater reactor (LWR) suppliers will also make presentations: Westinghouse on the AP-1000 pressurized light-water reactor (PWR); GE-Hitachi on the ESBWR boiling



Secretary Locke lights lamp, to commemorate chartering of ANS India. From left to right: Admr. Grossenbacher, Gary Urquhardt (Westinghouse VP for India), GE Nuclear CEO Caroline Reda, Secretary Lock, Corey McDaniel NuScale Country Manager (ANS-India President), Ramesh Deshpande Westinghouse (ANS-India Treasurer), Dr S.K. Jain, CMD – NPCIL, GD Mittal - Indian Nuclear Society Treasurer.



water reactor (BWR); NuScale Power on the light-water pressurized Small Modular Reactor (SMR); and Areva USA on the EPR pressurized light-water reactor. The presenters will describe the safety advantages of their reactors for India.

US Government speakers from the State Department, Embassy New Delhi, Department of Commerce, and the Nuclear Regulatory Commission will address the Summit on the mutual benefits of the Indo-U.S. civil nuclear agreement, signed nearly three year ago on 8 October, 2008. Other U.S. presenters will discuss the safety advantages of technology from the following companies: USEC, Transco, Holtec, and Rosemont Nuclear.

A U.S. Nuclear Infrastructure Pavilion at the India Nuclear Exposition (INE), certified by the U.S. Department of Commerce will feature the organizations mentioned above plus the American Society of Mechanical Engineers, the Nuclear Engineering Department Heads Organization, Urenco USA, Curtiss Wright, Bechtel, mPower, Milbank, and the Indo-American Chamber of Commerce. The INE, India's largest nuclear exposition, will run from 29 September thru 1 October at the Bombay Exposition Centre in Goregaon, Mumbai.

On Saturday, 1 October, IIT-Bombay and the ANS India Section will host a Framework on Nuclear Education Cooperation featuring students and professors from more than a dozen Indian and U.S. universities. All events are open to the public.

"The goal of the mission, summit, pavilion, and education outreach activities are to promote cooperation between nuclear professionals of our two countries," said Dr. Corey McDaniel, President of the ANS India Section. "The theme of these activities is a discussion on the public safety advantages for India and the U.S. as a result of Indo-U.S. civil nuclear cooperation," McDaniel added.

Chartered on 11 February 2011, ANS India Section is the ninth international section of the Society. The India Section was formed as the implementing organization of a memorandum of agreement with the Indian Nuclear Society signed on the second anniversary of the Indo-U.S. civil nuclear agreement, 8 October 2010.

Founded in 1954, ANS is a professional organization of engineers and scientists devoted to the peaceful applications of nuclear science and technology. Its 11,500 members come from diverse technical backgrounds covering the full range of engineering disciplines as well as the physical and

biological sciences. They are advancing the application of these technologies to improve the lives of the world community through national and international enterprise within government, academia, research laboratories and private industry.

For more information about the American Nuclear Society, visit [www.ans.org](http://www.ans.org).

For more information about the Indo-U.S. Nuclear Energy Safety Summit, U.S. Pavilion, Mission, and Education Symposium please visit <http://local.ans.org/india/>



*Memorandum of Cooperation signing ceremony between the Indian Nuclear Society and American Nuclear Society. At table (left to right): Corey McDaniel (ANS International Committee), David Hill (ANS Fellow), V. Venugopal (INS past Vice-President); R.K. Singh (INS Secretary). Among the Standing : Sushil Kumar Shinde, Minister of Power, Government of India; Paul Folmsbee, Consul General, US Consulate General, Mumbai, Pradeep Udhas, President IACC-WIC, Anand Desai, Immediate Past President, IACC-WIC, Shailesh Sheth, VP Marketing, GE Hitachi, Nanik Rupani, Committee Member, IACC.*



# India N-Energy Summit 2011 to Provide Roadmap for Future

Economies around the world continue to grow, and the need for electricity, near-carbon-free, reliable, and low-cost energy is growing tremendously.

In order to reap the benefits of nuclear energy, to effectively bridge the demand supply gap for India and to also necessitate the need to bring the industry at one platform, UBM India is pleased to bring the 3rd edition of 'India Nuclear Energy 2011' - International Exhibition and Conference. India Nuclear Energy 2011 will be, held from 29 September to 1 October, 2011 at the Bombay Exhibition Centre, Goregaon (East), Mumbai.

India Nuclear Energy 2011 is co-partnered by Department of Atomic Energy (DAE), the nodal Government body in the Indian nuclear energy sector and supported by Indian Nuclear Society (INS).

The topic of discussion at the press conference revolved around India's use of nuclear energy to meet growing electricity demand and to endorse programs to expand the peaceful use of nuclear energy while minimizing the risks of proliferation.

The Conference provides a platform for luminaries from the power sector and the government to share their views on India's Nuclear Power future.

S.K. Malhotra, Department of Atomic Energy (Government of India), M. V. Kotwal, Senior Executive Vice-President and Director, L&T, Eric P. Loewen, President, American Nuclear Society, and Sanjeev Khaira, MD, UBM India, addressed the media.

Sanjeev Khaira, MD-UBM India said: "India's effort has been to achieve continuous improvement and innovation in nuclear safety. The basic principle being, for all projects the Government gives priority to people's safety as generation of power. This is important at a time when we are in the process of expanding nuclear capacity at an incredible pace."

In tandem with the Asian peers, India is recording a

high growth rate and the demand for energy is always on the upper curve. India is facing an acute shortage of fuel, like the coal and gas.

Considering the capital involved in solar, wind and other power generation options, the viable option for the developing nations is nuclear energy which provides a feasible source of energy.

The Conference supports the establishment and implementation of national and international safety standards in the design, construction, operation, and decommissioning of nuclear facilities.

The Conference enumerated various pro's & con's that could be brought about by Nuclear energy, for India, Nuclear power is foreseeable as there is no other viable option. Due to the lack of indigenous uranium, India has uniquely been developing and utilizing a nuclear fuel cycle to exploit its reserves of thorium. And now with foreign technology and funding, it is expected that India's nuclear Power programme will receive a considerable boost. Through the upcoming three day event from 29 September, 2011, the Indian power & energy sector will be linked to global players providing efficient and innovative solutions to make India a world leader in nuclear technology in the future.

Dr. Srikumar Banerjee \_ Chairman, Atomic Energy Commission will deliver the Key Note Address at "India Nuclear Energy Summit 2011" on 29 September 2011.

Pierre Lellouche, French Minister of State for Foreign Trade has confirmed to be Guest of Honor for the Summit.

"The event will see participation from leading companies like DAE, L&T, GMR, Areva, GE, Westinghouse, Alstom, HCC, JSL, REC, Power Grid Corporation of India, Nuvia India, NuScale Power, Schiess, American Nuclear Society, UBI France, Rosatom, Infotech, Lisega, United to name a few.





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## Post Fukushima Accident

# Safety Evaluation of Indian N-Power Plants

The design, construction, commissioning of a Nuclear Power Plant (NPP) is done with the prevalent Atomic Energy Regulatory Board (AERB) Codes and Guides and takes into account feedback available from the operating experience of national and international plants.

Later during operational life of the Plant, its safety performance is regularly evaluated by the internal review process at NPCIL and AERB. Periodic Safety Reviews (PSR) and related improvements in safety of the plant are carried out as per regulatory practices at the time of periodic reviews. The national and international Operational Experience provides another means of online safety review and keeps the features up to date. For example, the

reviews of and lessons learnt from Narora Atomic Power Station (NAPS) fire incident, Madras Atomic Power Station (MAPS) Tsunami event, Three Mile Island (TMI) accident and Chernobyl accident have been used to improve safety wherever required.

As part of this practice the lessons learnt from the event at Fukushima are being reviewed.

- Accident at Fukushima Nuclear Power Plants (NPP) in Japan occurred on 11th March, 2011, due to Earth Quake followed by Tsunami.
- On 15th March, 2011, CMD NPCIL constituted four task forces to review consequences of occurrences of similar situations in INDIAN NPPs under operation, which broadly fall into



four categories. They are:

Boiling Water Reactors (BWR) (TAPS 1&2)

Pressurized Heavy Water Reactors (PHWRs) at RAPS 1&2

PHWRs at MAPS 1&2

Standard PHWRs from NAPS onwards

- These task force were asked to make a quick assessment of safety of Indian NPPs assuming non availability of motive power and design water supply routes and recommend improvements, so that situation as it developed at Fukushima can be avoided even under adverse conditions.
- All the task forces submitted their reports by end of March 2011, based on preliminary information available on Fukushima event at that time.
- The details of this event are still unfolding. The observations of International community are also being tracked so as to provide additional input to the action plans for Indian NPPs.
- The reports of the Task Forces were summarised in a document titled "Safety Evaluation of Indian NPPs Post Fukushima Incident" to provide an integrated picture for broad appreciation of the associated topics like description of Fukushima event, process of safety review and assessment in NPCIL along with specific recommendations applicable to respective plants.

Subsequently, two more task forces were formed by CMD NPCIL, to assess safety of Indian NPPs under construction, assuming non-availability of motive power and design water supply routes.

- One task force for VVER, Pressurized Water Reactors (PWR) under construction at KKNPP.
- One task force for 700 MWe, PHWRs under construction at KAPP 3&4 and RAPP 7&8.

## Executive Summary

An unprecedented earthquake of magnitude 9 (Richter scale) followed by a Tsunami of height much larger than the value considered in design of Fukushima Dai-ichi Plant had hit north eastern part of Japan on March 11, 2011.

There are 13 nuclear power plants, all of Boiling Water Reactor type located in the affected zone. Six

of the units are located at Fukushima Dai-ichi (3 under operation and 3 under shutdown), 4 at Fukushima Dai-ichi and 3 at Onagawa all operating.

The severe earthquake resulted in the disruption of the grid resulting into non availability of offsite power. All the operating plants were automatically shut down on sensing the earthquake. The decay heat removal system started functioning normally as per design requirements. The Tsunami which hit the affected area about half an hour later, resulted into submergence of the emergency power supply systems at Fukushima Dai-ichi leading to total loss of on-site power supply, termed as station blackout condition. The decay heat removal could not be resumed, which ultimately resulted in the fuel assemblies getting uncovered. This led to overheating of the fuel. Metal water reaction between zirconium and water resulted in generation of hydrogen.

In the process, the reactor containment vault pressure increased and reached upto almost two times the design pressure. It was decided to vent the reactor containment vault to prevent damage to it. During the depressurization, hydrogen and steam leaked into the secondary containment resulting in hydrogen explosion. Spread of radioactivity necessitated evacuation of public in the nearby areas extending up to 20-30 Kms to prevent exposure of the public. The event was initially rated as Level 5 on the International Nuclear Event Scale. The rating was subsequently revised to Level 7. However, the total radioactivity released during this incident was about 10% of that released during the Chernobyl accident in 1986. There was also degradation in the cooling provisions of spent fuel pool in Unit-4 resulting in spent fuel getting uncovered. The situation is still evolving.

NPCIL was in constant and continuous contact with World Association of Nuclear Operators (WANO), International Atomic Energy Agency (IAEA), Japan Atomic Industrial Forum (JAIF) and also NPCIL representative posted at WANO, Tokyo Centre. The scenario has been developed based on information obtained from these sources. WANO quickly provided a Significant Operating Experience Report highlighting generic aspects to be checked out at all Nuclear Power Plants. Considering the severity of the situation at Fukushima resulting out of severe multiple natural events leading to loss of operational and safety



system in Dai-ichi plant, it was decided to comprehensively review and re-evaluate the readiness at our nuclear power plants for dealing with extreme events. For this purpose, four task forces were constituted covering different types of reactors, namely, Boiling Water Reactors at Tarapur Atomic Power Station, Pressurized Heavy Water Reactors with dousing and single containment at Rajasthan Atomic Power Station, Pressurized Heavy Water Reactors with suppression pool and partial double containment at Madras Atomic Power Station and subsequently built standardized Pressurized Heavy Water Reactors from Narora Atomic Power Station onwards having double containment, suppression pool, and calandria filled with heavy water, housed in a water filled calandria vault. The stations were asked to conduct walk down and inspect all important provisions required to withstand flood and fire events.

The reports of the four task forces have been discussed in detail by Operations, Design and Safety directorates together with the top management at NPCIL HQ. The reports of the task forces have been collated and presented in this report along with the existing safety features and practice of safety management in force in our nuclear power plants. It may be noted that present review and re-evaluation is an interim measure and is based on the present understanding of the Fukushima event.

This exercise is required to be updated at a later stage when the detailed chronological events of Fukushima become available. The important design features of the Indian NPPs including the boiling water reactors have provisions to handle complete loss of power, differing from Fukushima Dai-ichi plant.

In the context of scenario at Fukushima, it may be recalled that pertinent incidents at Indian nuclear power plants, like prolonged loss of power supplies at Narora plant in 1993, flood incident at Kakrapar plant in 1994 and Tsunami at Madras plant in 2004 were managed successfully with existing provisions.

An in depth safety analysis and review of these events was carried out and lessons learnt were adequately utilized for taking corrective measures in all the operating as well as under construction plants.

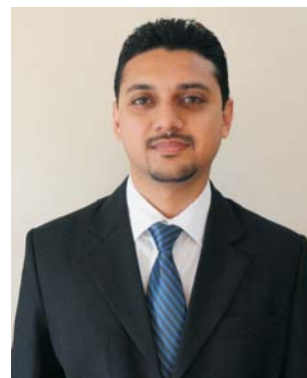
Similarly, to assess safety of our reactors in light of International events in nuclear industry like Three Mile Island and Chernobyl, detailed independent safety review of events were conducted and key lessons learnt were implemented in all plants.

Present review and re-evaluations conducted indicate that adequate provisions exist at Indian nuclear power plants to handle station blackout situation and maintaining continuous cooling of reactor core for decay heat removal. However, to further augment the safety levels and improve defense in-depth, salient recommendations which have been made for short and long term implementation are given below:

- Automatic reactor shutdown initiation sensing seismic activity Inerting of the TAPS-1&2 containment Increasing the duration of the passive power sources/battery operated devices for monitoring important parameters for a longer duration Provisions for hook up arrangements through external sources, for adding cooling water inventory to Primary Heat Transport (PHT) system, steam generators, calandria, calandria vault, end shields and Emergency Core Cooling System (ECCS) as applicable and also the provisions for mobile diesel driven pumping units
- Augmentation of water inventory and the arrangement for transfer of water from the nearby sources if required Revision of Emergency Operating Procedures (EOPs) to include additional provisions recommended Organize structured training programs to train plant personnel on modified EOPs
- Additional Shore protections measures at Tarapur Atomic Power Station and Madras Atomic Power Station which are located on the sea coasts, as deemed Necessary
- Additional hook up points for making up water to spent fuel storage pools wherever necessary for ensuring sufficient inventory
- A detailed implementation programme is being worked out to address all the identified requirements.



# SCHOTT to Further Intensify EPA Promotion as Best N-Safety Tech



Ankit Rastogi, Sales Manager, SCHOTT Glass India Pvt. Ltd, handles one of the world's most advanced nuclear safety products for which there is a huge market in this country. Electrical Penetration Assemblies (EPA), manufactured by the German High-Tech group SCHOTT AG, is an essential safety component used in nuclear reactors. In fact, in the aftermath of recent disaster at Japan's Fukushima nuclear reactor, SCHOTT's Nuclear Safety Division is intensifying efforts to raise awareness about nuclear safety and to promote the use of the EPA technology worldwide. In an interview with Asian Nuclear Energy, Rastogi talks about SCHOTT's future plans in India, which has drawn up a massive expansion programme for its nuclear power industry. Excerpts.

Do you think the recent nuclear disaster at Fukushima in Japan has sharply brought into focus the safety concerns in the nuclear energy industry the world over?

The disaster in Japan was devastating and it underscored the importance of nuclear safety for everybody all over the world. SCHOTT feels strongly for those affected by the incident, and sincerely wishes the country and its people a smooth recovery.

SCHOTT has an exclusive Nuclear Safety Division. Has it been geared to meet challenges thrown by this latest development to further fortify safety measures at both the existing plants across the globe and those planned in the future?

SCHOTT's Nuclear Safety team is very experienced in the design and manufacture of hermetically sealed electrical penetration assemblies (EPA). More than 12,000 of such EPAs have been installed in approximately 100 nuclear power plants worldwide, performing maintenance-free even after 50 years of service.

This glass-to-metal sealing (GTMS) technology used is inorganic and non-aging, and has also been proven in many high-risk applications such as liquefied natural gas (LNG) vessels, nuclear submarines and automotive safety systems.

With a minimum of 60 years' of qualified lifetime, our team is certain that glass-to-metal sealed EPA offers the safest technology for nuclear power plants, and would continue to intensify our efforts in raising awareness and promoting the use of this technology in nuclear power plants worldwide this generation and beyond.

What will be SCHOTT's role in India's nuclear

industry's massive expansion plan? As a global high-tech engineering group, what can SCHOTT contribute to India's nuclear safety infrastructure development?

SCHOTT has been supplying EPAs to the nuclear industry since the 1960s. Having accumulated strong experience in this area, as well as in other equally high-risk applications, our team looks forward to leveraging upon this experience and working closely with experts in India to enhance the safety levels of nuclear power generation.

**What is the outlook for SCHOTT's reputed products such as Electrical Penetration Assemblies (EPA) from both short-term and long-term perspective in India?**

In recent months, SCHOTT is receiving more customer enquiries from various countries about the company's hermetically sealed EPA. This could be related to an online TEPCO report which discussed about a hydrogen leakage through the epoxy-sealed EPA as a possible cause of a hydrogen explosion at the Fukushima reactors. While it's still



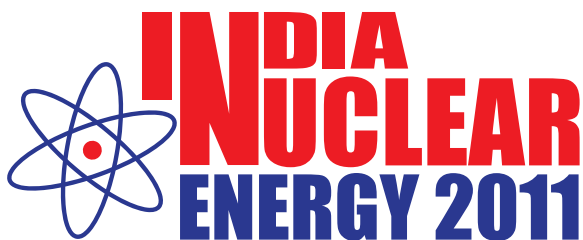
too early to comment about SCHOTT's potential in India, the team is in constant contact and communication with the involved parties and would gladly release to the media, any positive news the company might have in the future.

**Apart from nuclear products, SCHOTT AG is known all over the world as a manufacturer of glasses for Ceran cooktop panels, buildings and reflector telescopes, as well as photovoltaic modules. What is the global as well as local (India) outlook for these products?**

While there has been some recovery, the global economic environment is still in a tough situation. The photovoltaic industry, for example, is significantly influenced by the respective country's political support for renewable energy. Overall, SCHOTT projects that the global solar market will show annual growth of 20 to 30 percent in the years to come. The solar programs and incentives implemented in India will certainly help to boost installation potential, and SCHOTT looks forward to servicing this demand. At the same time, the company is keenly aware of the growing international competition, price erosion and pressure to consolidate.

**What do you expect from the forthcoming Indian Nuclear Energy 2011?**

The Indian Nuclear Energy has been very successful in bringing together the top minds of the nuclear industry to a common and interactive platform. SCHOTT is keen further its network and share its international nuclear experiences and technology with the industry players at the show.



*Energy Security for the Future...*



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### INDIA NUCLEAR ENERGY 2009 & 2010 HIGHLIGHTS

- Eminent Speakers at India Nuclear Energy Summit
  - ❖ Dr Srikumar Banerjee—Chairman, Atomic Energy Commission
  - ❖ Mr Sushil Kumar Shinde, Hon'ble Minister of Power
  - ❖ Dr R K Sinha, Director—Bhabha Atomic Research Center (BARC),
  - ❖ Dr Anil Kakodkar—Former Chairman, Atomic Energy Commission
- Major Corporates like DAE, Alstom, BHEL, Hindustan Construction Co., Schneider Electric, ECIL, Areva, GE Hitachi, Westinghouse, American Nuclear Society, Power Grid Corporation of India, Kirloskar, Lockheed Martin, Wartsila, Nuvia, Khaitan & Co. Rolls Royce, GMR, Gammon, ONGC, NHPC, REC, Exxon Mobil, GUVNL, Ratnamani, JSW, Ingersoll Rand, Schott, Sandvik Asia, Premium Energy Transmission to name a few
- Country pavilions from USA, France, Russia & Finland

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