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Exploit
N-Energy's
Vast
Potential
for Human
Progress

- Manmohan Singh



India Trendsetter in
Global N-Boom

- Thomas Fink, Schott AG



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Exploit N-Energy's Vast Potential for Human Progress

- Prime Minister Manmohan Singh



Prime Minister Manmohan Singh has called for exploitation of the vast potential of nuclear energy to advance human progress while assuring at the same time global peace and

While inaugurating a three-day International Conference on 'Peaceful Uses of Atomic Energy-2009 held in New Delhi on 29 September, 2009, the Prime Minister said, "The task would require the collective will, wisdom and determination of the international community but it is a task that can no longer be put off".

The conference, part of the Dr. Homi Bhabha Centenary Commemorative Celebrations, was also addressed by Dr. Mohamed ElBaradei, Director General, International Atomic Energy Agency (IAEA), Dr. Anil Kakodkar, Secretary, Department of Atomic Energy (DAE) and Chairman, Atomic Energy Commission (AEC), Prof. P. Rama Rao, President Indian Nuclear Society (INS) and Dr. S. Banerjee, Director, Bhabha Atomic Research Centre (BARC).

Prime Minister said that "It is not beyond the imagination of the human mind to devise solutions and strategies that exploit the vast potential of atomic energy to advance human progress, while assuring global peace and security."

"If we do not use the power of the atom wisely for the universal good, the consequences would be devastating for the peace and progress that all nations seek for their people. Mentioning Dr. Homi Bhabha as one of India's greatest nation builders and scientific pioneers, the Prime Minister said that Dr. Bhabha laid the foundation of our nuclear programme while enunciating the three-stage nuclear power programme based on closed nuclear fuel cycle.



Finance Minister Pranab Mukherjee, Prime Minister Manmohan Singh and IAEA Director General Mohamed ElBaradei at the inaugural session of the International Conference on 'Peaceful Uses of Atomic Energy-2009', in New Delhi on September 29, 2009.

Prime Minister Singh further said that the first stage of India's three-stage Nuclear Power Programme, based on the Pressurised Heavy Water Reactors (PHWRs) and associated fuel cycle facilities, has now reached a level of maturity. The second stage envisages setting up of Fast Breeder Reactors (FBRs) backed by reprocessing plants and plutonium-based fuel fabrication plants. With the construction of the Prototype Fast Breeder Reactor at Kalpakkam we have entered the second stage of the programme. A facility for reprocessing thorium fuel has been set up. An Advanced Heavy Water Reactor (AHWR) has been designed and its construction will be launched in the near future. This will expedite the transition to thorium-based systems that will mark the third stage of the programme. Prime Minister Singh also mentioned that the return of India to the International nuclear global mainstream is of high significance not only for India but for global energy security as well. If India could manage its three-stage strategy well it might yield a potential of 4,70,000 MW of power by the year 2050, which would sharply reduce our dependence on fossil fuels and would be a major contribution to global efforts to combat climate change.

He also addressed the vital issue of destructive uses of nuclear energy. He said that just as we seek to enhance peaceful uses of nuclear energy, we have a pressing and immediate moral obligation to draw down and eventually do away with its destructive use.

The Prime Minister regretted that global non-proliferation regime has not succeeded in preventing nuclear proliferation. He stressed the need for making global non-proliferation universal, comprehensive and non-discriminatory and linked to the goal of complete nuclear disarmament.

Prime Minister Singh said that "India is proud of its non-proliferation record and is committed to global efforts for preventing the proliferation of all weapons of mass destruction. We are committed to a voluntary, unilateral moratorium on nuclear testing".

Finance Minister Pranab Mukherjee released Bhabha Centenary Commemorative Coins on the occasion. Describing Dr. Bhabha as the architect of Indian Nuclear Programme, he said that the national and international recognition being achieved by Indian nuclear scientists was due to the conceptualization and vision of Dr. Homi Bhabha about the nuclear energy.

Dr. ElBaradei, also recalled the contribution of Dr. Homi Bhabha, as President of first International Conference on peaceful uses of atomic energy held in Geneva in 1955. He said that despite global recession, the nuclear energy has recorded a sustained growth, adding that Asia remained the focus of growth in the field of nuclear power.

Elaborating the peaceful uses of nuclear energy, Dr. ElBaradei said that the nuclear radiation is being utilized for treatment of diseases like cancer and it

has tremendous potential for developing techniques for enhancing the yield of various crops in agricultural field. He appreciated India's major role in the field of nuclear disarmament. The nuclear energy has a potential of generating power on a large scale which may be able to face the challenge of energy deficit in the world.

India's Three-Phased Programme

Excerpts from Prime Minister Singh's Speech

This Conference commemorates the birth centenary of one of India's greatest nation builders and scientific pioneers, Dr. Homi Bhabha. Dr. Bhabha laid the foundation of our nuclear programme by enunciating the three stage nuclear power programme based on a closed nuclear fuel cycle. We are proud of our national achievements in mastering all aspects of the fuel cycle. The current international interest in closing the fuel cycle is a vindication of Dr. Bhabha's pioneering vision and genius.

Dr. Bhabha was a brilliant scientist and a true visionary. At the first International Conference on Nuclear Energy in Geneva in 1955, Dr. Bhabha in his presidential address had said:

'For the full industrialization of the under-developed countries, for the continuation of our civilization and its further development, atomic energy is not merely an aid, it is an absolute necessity. The acquisition by man of the knowledge of how to release and use atomic energy must be recognized as the third epoch of human history.'

This bold vision of what the peaceful uses of atomic energy meant for humanity at large proved to be prophetic. This Conference is taking place on the crest of a global nuclear renaissance, in which I believe India will be a significant factor.



Dr. Homi Bhabha

As a result of the far-sighted plans of our scientists, India emerged as a leader in the developing world in harnessing the peaceful uses of nuclear energy. The first stage of our three stage nuclear programme,

involving the setting up of Pressurised Heavy Water Reactors (PHWRs) and associated fuel cycle facilities, has now reached a level of maturity. The technology for the manufacture of various components and equipment for PHWRs in India is now well established and has evolved through active collaboration with Indian industry. The second stage envisages setting up of Fast Breeder Reactors (FBRs) backed by reprocessing plants and plutonium-based fuel fabrication plants. With the construction of the Prototype Fast Breeder Reactor at Kalpakkam we have now entered the second stage of the programme. A facility for reprocessing thorium fuel has also been set up. An Advanced Heavy Water Reactor has been designed and its construction will be launched in the near future. This will expedite the transition to thorium-based systems that will I believe mark the third stage of our programme. We are proud of the achievements of India's nuclear scientists and of our industry.

Dr. Bhabha had famously remarked that "no power is as expensive as no power" to justify his strong advocacy of nuclear power as an instrument of economic development. This is truer than ever before as the developing countries seek new energy sources to sustain high rates of economic growth. There is now a growing consensus that nuclear power is an important energy source that is also clean. In fact the majority of nuclear power plants under construction worldwide are now located in Asia.

A number of agreements and reciprocal commitments were concluded as part of the Civil Nuclear Initiative to allow the resumption of full civil nuclear cooperation between India and the international community and we look forward to their full and effective implementation in the coming months and years. The return of India to the international nuclear global mainstream is of high significance not only for India but for global energy security as well.

In our country, we see nuclear energy as a vital component of our global energy mix. The vast energy potential of the three stage programme allows us really to think big. Our nuclear industry is poised for a major expansion and there will be huge opportunities for the global nuclear industry to participate in the expansion of India's nuclear energy programme.

If we can manage our programme well, our three stage strategy could yield potentially 470,000 MW of power by the year 2050. This will sharply reduce our dependence on fossil fuels and will be a major contribution to global efforts to combat climate

change.

The peaceful uses of nuclear energy are not just about power. There are promising applications in the areas of agriculture, food production and preservation, medicine and water desalination. In India, we have successfully developed 37 mutant varieties of seeds for commercial cultivation using nuclear techniques. Use of radiation technology for food preservation is growing. We have built a nuclear desalination plant at Kalpakkam and are working on the use of isotope hydrology techniques for rejuvenation of springs, which is an important source of drinking water. I see a growing role for nuclear energy in these areas in the coming decades.

With this limitless potential, I believe that the international community should reflect more on how international cooperation can multiply the benefits of nuclear energy for all humankind.

The International Project on Innovative Nuclear Reactors and Fuel Cycles is an example of such international cooperation. India is a participant in the International Thermonuclear Experimental Reactor, or ITER Project. We are ready to contribute to global research and development into new proliferation-resistant fuel cycles. There are proposals for an international fuel bank and we would support efforts in this direction as a supplier nation.

Another critical area of cooperation is that of nuclear safety. The nuclear industry's safety record over the last few years has been encouraging. It has helped to restore public faith in nuclear power. But the technology and management of nuclear safety must be continuously improved.

This brings me to a vital issue that is fundamental to the safety and security of all humanity the destructive uses of nuclear energy. Just as we seek to enhance peaceful uses of nuclear energy, we have a pressing and immediate moral obligation to draw down and eventually do away with its destructive use of nuclear energy.

I wish to reaffirm that this collective effort will have no greater proponent than India. India's first Prime Minister Jawaharlal Nehru had advocated the prohibition and abandonment of all weapons of mass destruction way back in the 1950s. It was a call that went largely unheeded at that time. We should not repeat the mistakes of the past.

In 1988, Prime Minister Rajiv Gandhi put forward at the General Assembly of United Nations a comprehensive Action Plan for the complete elimination of nuclear weapons. We remain

committed to that objective.

In 2006, India put forward a set of proposals at the United Nations General Assembly that outlined specific steps that could lead to the elimination of nuclear weapons. It included the proposal for the negotiation of a Nuclear Weapons Convention that would prohibit the development, production, stockpiling and use of nuclear weapons and providing for their elimination within a specified time frame.

The specter of nuclear terrorism is a formidable challenge facing the entire global community. At the United Nations General Assembly India has been sponsoring a resolution calling for measures to address this threat.

We support strengthening international efforts in improving nuclear security and in this context, welcome President Obama's timely initiative to convene a Global Summit on Nuclear Security in 2010.

If we use the power of the atom wisely for the universal good, the possibilities are unbounded. But if we do not, the consequences would also be devastating for the peace and progress that all nations seek for their people. The choices are stark and the challenges are indeed daunting. But it is not beyond the imagination of the human mind to devise solutions and strategies that exploit the vast potential of atomic energy to advance human progress, while assuring global peace and security. This task will require the collective will, wisdom and determination of the world community but it is a task that can no longer be put off.

Asia Remains Focus of N-Energy Growth

Excerpts from ElBaradei's Speech

It is always a great pleasure to visit India. I am especially honoured to speak at this International Conference on Peaceful Uses of Atomic Energy, part of the commemoration ceremonies to mark the centenary of the birth of Dr. Homi Bhabha.

Dr. Bhabha was an outstanding scientist and a great visionary, who built from scratch a comprehensive nuclear energy programme, based on self-reliance. Within little more than a generation, he made India a significant player in the world of peaceful nuclear energy.

His far-sightedness in launching systematic training for nuclear scientists and engineers is still showing results today. Indeed, in this very room we see some



of the most distinguished alumni of the training school established by Dr. Bhabha in 1956 at the institution that now bears his name - the Bhabha Atomic Research Centre (BARC). They include my friend Dr. Anil Kakodkar, Chairman of the Indian Atomic Energy Commission.

Dr. Bhabha also had the foresight to build capacity in other areas of nuclear science, including in medicine and agriculture. He was an influential figure in the birth of the International Atomic Energy Agency, which I have had the honour to lead for the past 12 years. He was Chair of the first International Conference on Peaceful Uses of Atomic Energy, held in Geneva in 1955, that laid the foundation for the launch of the IAEA two years later. Legend has it that Dr. Bhabha cast his vote in favour of Vienna as the seat of the Agency's headquarters because of his great love for opera. As a music lover myself, I have special reason to be grateful to him. India has been a Member of the Board of Governors since the IAEA was established and many BARC alumni have served with distinction on the staff of the Agency.

Globally, the fortunes of nuclear energy have fluctuated since Dr. Bhabha's untimely death in 1966. The low point was undoubtedly the Chernobyl disaster in 1986, which effectively halted the expansion in nuclear power in its tracks. However, the pendulum has swung back in the past 10 years or so and we look set for a significant expansion in global use of nuclear energy in the next 20 to 30 years. There are a number of reasons for this. The urgent and ever-growing need for energy, particularly in the developing part of the world, fluctuations in fossil fuel prices and climate change are major factors.

The world has accumulated more than 13,000 reactor-years of experience. Considerable improvements in safety since Chernobyl have been matched by improvements in efficiency. Nuclear plants are more economical to run, productivity has increased and there is less down-time for maintenance. The long-term stability of the cost of electricity generated by nuclear power is an important attraction. Public attitudes towards nuclear energy have become more positive in the past decade. But the nuclear industry needs to remain open and transparent in order to generate and maintain public trust.

Despite the global economic crisis, the IAEA's latest projections continue to show a significant increase in nuclear generating capacity in the medium term. The low projection is now for 511 GW(e) of generating capacity in 2030, compared to 370 GW(e) today. The high projection is for 807 GW(e), more than a

doubling from present levels.

Most of the 30 countries already using nuclear energy plan to expand their output. Scores of countries - mostly in the developing world - have informed the IAEA that they might be interested in launching nuclear power programmes. Of these, 12 countries are actively considering nuclear power. Growth targets have been raised significantly here in India, as well as in China and in the Russian Federation. Asia remains the focus of growth in nuclear power, not least because of this region's robust economic growth.

Every country has the right to add nuclear power to its energy mix, as well as a duty to do it responsibly. That means adhering to the highest safety and security standards and ensuring that nuclear material is not diverted from peaceful to military purposes. Demand for the IAEA's services in all three areas - safety, security and safeguards - has grown exponentially in the past two decades and will continue to increase as more and more countries build nuclear power reactors.

But in addition to the use of nuclear energy for power generation, nuclear techniques have been making a difference in detecting and treating cancer, producing more robust and higher-yielding food crops and maintaining supplies of fresh water. I am especially proud of the Agency's Programme of Action for Cancer Therapy, which is helping to make radiation medicine available for cancer diagnosis, treatment and palliative care in developing countries, many of which have no radiotherapy services at all.

Another area in which the IAEA has made a significant difference is induced crop mutations using nuclear techniques, for example to produce salt-tolerant rice and drought-resistant wheat. These have increased food production and boosted farmers' incomes in many countries. Likewise, isotope data provide a unique tool to determine the availability and vulnerability of groundwater systems and ensure that reliable supplies can be developed in the long term.

On a more sombre note, the number of states that possess nuclear weapons has risen to nine since Dr. Bhabha's death. This is nine too many as far as I am concerned. After a couple of what I consider to be wasted decades, I am gratified that nuclear disarmament has now moved back to the top of the international agenda. Russia and the United States are negotiating significant cuts in their nuclear arsenals. There is increasing global recognition that nuclear weapons are a threat to us all and growing



momentum for their complete abolition.

India called for the elimination of all nuclear weapons as far back as 1948. It is important that India's voice should continue to be heard as a leading advocate for nuclear disarmament. I believe there is reason to hope that we could achieve a world free of nuclear weapons in my children's lifetime, if not in mine. But if we want to turn our hopes into reality, we have to start laying the groundwork for a global security system that does not depend on nuclear weapons; a system built on human solidarity and equity; a system based on cooperation and not confrontation; on inclusion and not exclusion.


Let me say a few words on India's current role in using nuclear energy for peaceful purposes and the lessons it can teach other countries. India undertakes a lot of research into advanced fuel cycles based on thorium fuel, as it has abundant natural thorium resources and a comparative shortage of uranium. India continues to set the agenda for research and development in the field of sodium-cooled fast breeder reactors.

Experts from India participate in IAEA activities on innovative small and medium sized reactors. India is also a very active member of the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) and is on the cutting edge of development in many waste management technologies, especially for high level waste from reprocessing. Cooperation with the IAEA is expected to increase in the area of decommissioning in the coming years as many older installations in India will require either refurbishment or decommissioning.

In the area of nuclear applications, India is making radiation and nuclear medicine increasingly available in rural areas. And Indian specialists are actively deploying nuclear techniques in agriculture, as evidenced by the large number of varieties of crops produced through radiation-induced mutation which are now on the market, including chick peas and oil seeds.

India's remarkable economic dynamism in the past two decades has made it a role model for many developing countries. It is ideally placed to share its technological expertise and economic know-how with less advanced countries. In the nuclear field, it is vital that countries planning to build nuclear power reactors understand the need to ensure the highest safety standards and avoid problems faced by some countries which already have nuclear power. These problems include ageing reactors, operators which are poorly managed or under-funded and weak

regulators. A strong focus on safety and security should be seen as enablers for the further development of nuclear energy rather than as hindrances.

Let me conclude by saying that nuclear power, while not a panacea for all the world's energy problems, can play a major role in overcoming the huge energy deficit we face. Energy is the engine of development and nuclear techniques contribute to accelerating development. 

IAEA Pays Rich Tribute to ElBaradei

The Governing Board of the International Atomic Energy Agency (IAEA) has paid a rich tribute to its outgoing Director General Mohamed ElBaradei, ahead of his relinquishing office at the end of November 2009, after being at the helm of affairs of the global nuclear watchdog for 12 years.

Speaking to the board members at a function held for this purpose on 10 September 2009, ElBaradei said he was "humbled, grateful and honoured" by comments from the 35 board members. He recalled the challenges and successes of his 12 years at the head of the IAEA which has gone through a "metamorphosis" to "become a major player in the international community."

He said: "We know the difference between what's right and what's wrong and we are all committed - meaning all of you - and we are absolutely determined to make sure that we do our utmost for the benefit of humanity." In trying to create the right environment for global development while preventing proliferation of nuclear weapons, the member states of the agency are "Working together knowing that, as a human family it is not a zero sum game - we are either going to win together or fail together."

A motion was approved that will see ElBaradei granted the lifelong title of Director General Emeritus.

On the opening day of the IAEA General Conference on 14 September 2009, a vote of member states confirmed Yukiya Amano as ElBaradei's replacement. Amano lauded ElBaradei's "tireless efforts and selfless dedication towards world peace and prosperity."



President Pratibha Patil conferring the Indra Gandhi Prize for Peace, Disarmament and Development-2008 on Dr. Mohamed ElBaradei for his impassioned opposition to the use of nuclear energy for military purpose, in New Delhi on 30 September 2009.



Mohamed ElBaradei accepts the gratitude of the IAEA board of governors at his last general conference

India, Namibia Ink Crucial Pact on Uranium Supply

India and Namibia have signed landmark agreements on cooperation in wide-ranging sectors, including mining and nuclear energy. The agreement on cooperation in civilian nuclear energy is of great significance to India as Namibia has one of the best qualities of uranium, the shortage of which has badly affected India's nuclear power generation. These agreements were signed during Namibia's President Hifikepunye Pohamba's state visit to India recently at the invitation of Indian President Pratibha Patil. Besides President Patil, the visiting leader also met Prime Minister Manmohan Singh. "Among the agreements that we signed today is the cooperation between us on uranium. I believe that we have the best uranium (in the world)," said President Pohamba. The umbrella agreement in civilian nuclear energy includes sale of uranium to India.



The Chairman, AEC & Secretary, DAE, Dr. Anil Kakodkar and the Minister for Mines and Energy of Namibia, Mr. Erkki Nghimtina signing an agreement on cooperation in peaceful uses of Nuclear Energy, in the presence of the Prime Minister, Dr. Manmohan Singh and the President of Republic

President Pohamba was accompanied by Madam Penehupifo Pohamba and the Ministers of Trade & Industry, Foreign Affairs, Agriculture, Water & Forestry, Mines & Energy, Defence and Director General of National Planning.

A statement issued by the Indian External Affairs Ministry said the discussions between India and Namibia were held in an atmosphere reflective of the traditional friendship, warmth and close understanding that characterized bilateral relations. The two sides expressed satisfaction at the state of bilateral relations, and the mutually beneficial cooperation and partnership that was developing between the two countries. They discussed a wide range of subjects of bilateral interest covering economic cooperation, trade and investment, SMEs, mining, energy, defence, agriculture, education, information and communication technology, health,

railways, culture and arts.

The following MOUs/agreements were signed during the visit: (i) MOU on Cooperation in the Field of Geology and Mineral Resources, (ii) MOU on Cooperation in the Field of Defence; (iii) MOU on Pan-African e-Network; (iv) Agreement on Cooperation in Peaceful Uses of Nuclear Energy; and (v) MOU on Waiver of Visas for Diplomatic and Official Passports.

The two sides noted that the bilateral trade volume and investment, though small, have been steadily increasing and resolved to take measures to enhance such flows. They noted the many opportunities for investment available in Namibia in the uranium, diamonds, agriculture, energy, transportation, railways, mining, ICT and SMEs sectors and resolved to encourage Indian investments in these areas.



EI Baradei's Farewell Address to UN IAEA Needs More Funds to Function Effectively

International Atomic Energy Agency (IAEA) Director-General Mohamed EI Baradei has called for funds for strengthening the global nuclear watchdog to enable it function more effectively.

Delivering his last address to the UN General Assembly on 2 November 2009, before bowing out of office at the end of 12 years as head IAEA, he said, the organization is now a "major player at the centre of issues critical to international peace and security."

Alongside an IAEA beefed-up with funding and authority, reform is required across the UN and in particular at the Security Council. This should lead to a "new global system of collective security" not based on the "insurance policy" of nuclear weapons and driven by mistrust.

EI Baradei called on all states to make a success of the Nuclear non-Proliferation Treaty review conference next year in the light of moves by presidents Barack Obama and Dmitry Medvedev and the Security Council resolution in September to create the conditions for a world without nuclear weapons.

The IAEA's mandate to spread the benefits of nuclear energy, while strictly limiting it to peaceful uses, results in technical cooperation to develop new strains of crops and study fresh water sources, he said. This portion of its role exists on only \$96 million per year. A program for cancer therapy is working to expand facilities in places such as



some in Africa where entire countries have no radiotherapy services at all, EI Baradei added.

Another role to prevent illicit trafficking of nuclear materials is also under-funded, he said. "it is disconcerting that nuclear security continues to be funded almost entirely from voluntary contributions, which come with many conditions attached and are both insufficient and unreliable."

These issues were discussed in August, when the IAEA's budget for the next two years was set. But instead of a dramatic increase - as advocated by Obama - a meagre 2.7 percent increase was agreed. Countries were split on whether the IAEA should be boosted immediately, or whether it should refocus and streamline its work first. The agency will have €318 million (\$471 million) for 2010 with €354.3 million (\$525 million) pencilled in for 2011 while a special committee is set up to determine a final 2011 figure and also consider the period 2012-2013.

Its "dual mandate of security and development is unique," EI Baradei said, expressing disappointment that "we are still fighting the same battles to secure funding as we were back in the 1990s; that the development side of our mandate remains chronically under-funded; and that we still lack adequate legal authority to do our job effectively in verification, safety and security."

In terms of non-proliferation, the IAEA's role has switched from straightforward checking of material inventories at declared sites to verifying the total absence of any undeclared activities. This is impossible, ElBaradei said, without the proper legal status - which it lacks in over 90 states - and independent access to top-quality satellite imagery.

"Our credibility depends on our independence," he said, noting later that the IAEA "must draw conclusions justified by the facts only." This comes in the context of a world where "nuclear power seems set for a significant expansion... with scores of countries expressing interest."

ElBaradei concluded with thanks for the General Assembly and congratulations for his successor Yukiya Amano.

It is clear that ElBaradei hopes Amano will be able to effect funding changes after he takes over at the end of this month. The General Assembly passed a resolution thanking ElBaradei for his "distinguished service" as IAEA Director General and the "indispensable role of the agency."

Think Big, Think Long-Term

Earlier, addressing the agency's general conference, ElBaradei said that, "Without further legal, political and financial resources the IAEA would no longer be fit for purpose."

In his opening speech at the conference, ElBaradei said that the IAEA had "reached a turning point." He said that years of zero growth in funding has meant that the IAEA is currently dependent on voluntary support for "90 percent of our nuclear security program", 30 percent in the field of nuclear safety and 15 percent for verification.

ElBaradei voiced his concern that it "is nearly four years since the UN Secretary General ... described the IAEA as an 'extraordinary bargain'," and since then "almost nothing has changed as far as our resources and authority are concerned."


This "troubling dependence" has been assessed by the independent Commission of Eminent Persons, which has recommended that the Technical Cooperation Fund be increased substantially.

ElBaradei stated that the commission's report, published in May, "did not disappoint": the report assessed the role of the IAEA to 2020 and beyond, and gave a series of recommendations designed to facilitate the Agency's success in the future. "Better equipment, more staff and funding" will be essential to the efficacy of the IAEA.

The report said the financial dependence which burdens the agency is not the only obstacle to be overcome: "more legal authority", the power to negotiate "binding agreements" to counter the threat of nuclear terrorism, and greater "political commitment" will all be necessary to prevent the 'erosion of the effectiveness' of the Agency. ElBaradei also wants to put nuclear disarmament back on the agenda, warning that it had been on the back-burner for far too long.

ElBaradei said that making the IAEA more effective would be crucial to international security. One requirement is a one-off €80 million (\$114 million) investment in updating the IAEA laboratories, which are used in safeguards tests of the highest international importance.

Besides powering-up the IAEA in terms of staff, equipment and budget, the commission also recommended a focus on internationalising the fuel cycle for the benefit of 'newcomer' countries entering into nuclear power generation for the first time. These international arrangements should cover both the front- and back-ends of the fuel cycle: producing reactor fuel as well as managing that fuel in the long term once it has been used and is highly radioactive.

"It is time to think big and to think long term," ElBaradei concluded. 

India Trendsetter in Global N-Boom

SCHOTT's 'Fit & Forget' EPAs Offer Best Bet for N-Reactors



Electrical Penetration Assemblies (EPA) allow for the electrical wiring to pass through the wall of the safety containment structure in nuclear reactors. In an interview with Asian Nuclear Energy, Thomas Fink, Head of the Nuclear Safety Division of the German High-Tech group SCHOTT AG, says glass-to-metal seals are best suited for this. Excerpts.

Mr. Fink, 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, in more recent times. Probably only very few people know that you also supply products for nuclear power plants.

That is correct. We build Electrical Penetration Assemblies or EPAs for short, through which the control and power cables are guided inside the safety containment structure of the reactor. Conductive feedthroughs are an important part of our business. We not only make them for nuclear power plants, but also for liquefied gas tankers, where they seal off the tanks and guide the electrical wiring to the submersible pump inside the tank. We manufacture millions of units of feedthroughs for encapsulating electronic components for sensors and airbag igniters in automobiles or for optoelectronic components for the telecommunications industry, for example.

What does this have to do with glass?

The unique thing about all of our feedthroughs is that the seal between the conductor and the metal housing is made of glass. Regardless of whether this is intended to be an EPA for nuclear power plants or a housing for a small sensor inside the motor, the principle is always the same: a glass ring is inserted between the conductor and the housing and then melted down. By selecting the appropriate coefficient of thermal expansion, the metal housing presses against the glass ring, which in turn presses against the conductor. This bond remains perfectly sealed even with major leaps in temperature.

What advantages do glass-to-metal feedthroughs offer?

Well, to start with, they are hermetically sealed, which means that gases are unable to permeate the seal. Of course, this applies for the hot steam that results from an accident inside a reactor, as well. Our penetrations have a life span of sixty years and more. The earliest glass-to-metal feedthroughs from SCHOTT in nuclear power plants have been in use for over 40 years and they are still in use, performing very well. This is why we are sure that they actually last longer than 60 years. We owe their long service life in nuclear power plants to the fact that glass, an inorganic material, is radiation resistant. It doesn't age, neither in response to nuclear radiation, nor shifts in temperature. No other material offers this.

More than 50 nuclear power plants internationally are equipped with EPAs from SCHOTT. Can you tell us more about this?

That's correct. All of the German nuclear power plants since the 1960s have been equipped with our EPAs and since the German Nuclear Safety Standards are amongst of the highest worldwide this makes us very proud. The last few years have clearly shown that our EPAs are, in fact, superior. The operators of 23 nuclear power plants located outside Germany have replaced their old epoxy EPAs with glass-to-metal sealed EPAs from SCHOTT because they apparently had problems with the seals. This doesn't surprise me, because epoxy is an organic material that ages noticeably when it is subjected to nuclear radiation or high pressures and temperatures. In the meantime,

our EPAs have been installed in 50 nuclear power plants internationally.

If glass-to-metal feedthroughs offer so many advantages, why aren't other manufacturers offering them too?

Because they don't have the specialized know-how. One can't just use any type of glass for glass-to-metal seals. You have to know exactly how the glass will react when it is heated up and cools down, for instance, and how well it will work together with certain metal alloys. Here, there are virtually infinite combination possibilities. We have been manufacturing glass-to-metal feedthroughs since 1941 and our scientists and engineers at our research and test centers are constantly striving to further develop and improve the technology designs. Here, however, it is not only important that one has a command of the materials, but also the way in which the cable connection is constructed. For example, we have developed feedthroughs that can be equipped with up to seven modules, whereby one module can accommodate up to 118 conductor feedthroughs. The wires inside and outside of the safety containment structure can be connected quite easily by plugging them in. This is a lot easier and more flexible than the wiring boxes that epoxy EPAs use. We are also in a position to supply feedthroughs for hermetically sealed fiber-optic transmission lines for use in transmitting optical data.

How do you feel that the market for EPAs will develop?

Nuclear energy is experiencing a boom once again all over the world, whereby India certainly plays the role of a trendsetter. Some 40 new reactors are currently under construction on a global basis. Even nations that are seeking to get out of nuclear energy are now either planning or building new reactors. As a result, the market for EPAs will grow and I am confident that SCHOTT will be able to increase its market share rather quickly.

What makes you so certain?

The development of new reactors is working in our favor. The systems of the new generation, such as

Gen 3, 3 plus and 4, as well as future generations, will be placing much higher demands on materials. For instance, in current reactors, temperatures reach around 160 degrees Celsius and pressure is around 5 bar when hot steam escapes as a result of an accident. For the next generation reactors, the temperature can increase to 220 degrees in the event of an accident. The pressure requirements are also increasing considerably: to 9.5 bar and even 80 bar in helium-cooled high-temperature reactors. There is no way that epoxy EPAs can handle values like these, while glass-to-metal EPAs from SCHOTT meet these demands quite easily. They can resist pressures of up to 1000 bar and temperature spans ranging from minus 200 to plus 240 degrees Celsius.

We simulate conditions like these in the laboratory by subjecting all of the EPAs to hot steam before we allow them to be shipped. We test for whether they are hermetically sealed with the help of a mass spectrometer that is capable of detecting even the smallest conceivable volumes of a test gas. The electrical properties of the feedthroughs are yet another important aspect of this test.

Because they offer so many advantages, glass-to-metal EPAs are probably a lot more expensive, aren't they?

Not at all. Our products are very competitive, especially when we look at this over their entire lifetime, then EPAs from SCHOTT are actually the best offer because the principle "fit and forget" truly applies to them. And maintenance costs are zero; therefore the total costs are lower.



India's N-Power Generation Drive Sparks Safety Fears

With the Indian Government launching a massive drive for stepping up the country's nuclear power generation capacity, the issue of nuclear safety has assumed great significance. Some analysts say there could be cause for alarm, given the non-transparent nature of India's state-controlled nuclear energy sector - there is no way to estimate whether safety issues will be carefully followed.

India has embarked on a spending spree since a civilian nuclear deal with the United States last October removed sanctions that had long denied it access to the international atomic energy market. It has signed agreements with an array of nations to share and access nuclear fuel and technologies since the deal was completed. The most significant have been with Russia, the US and France.

The government recently allocated sites for Russian, French and American firms to build five new light-water reactors. French firm Areva is earmarked to build a reactor in Jaitapur in Maharashtra state; Russian firms will build two plants, in Kudankulam, Tamil Nadu, and in Haripur, West Bengal; and US firms are set to build a plant in Kovvada, Andhra Pradesh, and in Chayamithi Virdi, Gujarat.

"This important announcement [of the allocation of sites] comes in welcome recognition of the trust and confidence as well as the growing partnership between our two countries," said United States ambassador to India, Timothy Roemer. He said the power plants would bring greater access to clean and affordable energy and electricity for all Indians as well as create business opportunities for India and the US.

Data on the sector are closely guarded by the nuclear establishment, which functions under the purview of the Department of Atomic Energy (DAE).

The Indian chapter of the International Physicians for Prevention of Nuclear War, in a 2008 survey, found that "sterility was found to be more common in people residing near uranium mining operations." Birth defects and congenital deformities followed a similar pattern.

In the early 1990s, the Tarapur plant near Mumbai leaked radioactivity from faulty cooling systems. Incidents of genetic disorders have been recorded in

populations at Rawatbhata in Rajasthan state and in the sea near Kalpakkam in Tamil Nadu, where nuclear power plants are located. In 2004, the Kakrapar-1 reactor in Gujarat was shut down.


In the 1990s, the former chairman of the Atomic Energy Regulatory Board, A Gopalakrishnan, expressed fears about the safety status of some nuclear installations under the DAE.

The government has approved a total of 15 new nuclear plants to be built at eight different sites, with firms including GE Hitachi, Toshiba Westinghouse, Areva and Rosatom vying for contracts worth an estimated US\$100 billion. India has notified the International Atomic Energy Agency of its plans and 14 of its reactors will come under the nuclear watchdog's ambit by 2014.

India has signed nuclear and technology deals with Namibia, Mongolia, Tajikistan, South Korea and Kazakhstan since October, and is close to signing an agreement with Canada. Argentina this month became the latest nation to sign a civil nuclear agreement after the 45-nation Nuclear Suppliers' Group lifted a 34-year-old ban on nuclear commerce with India, in September, 2008.

The chairman of the state-controlled Atomic Energy Commission, Anil Kakodkar, has announced plans to construct four 700-megawatt (MW) pressurized heavy water reactors that could run on indigenous natural uranium as well as imported low-enriched uranium. India's present capacity of electricity production from nuclear power plants is 4,120 MW, but it has targeted 20,000 MW by 2020 and nearly 65,000 MW by 2032, according to the Planning Commission's 2006 integrated energy policy report.

Prime Minister Manmohan Singh recently said that India could increase its atomic electricity generation capacity to 470,000 MW by 2050, if new power plants and technologies were in place. This would translate into nuclear power contributing 40 percent of estimated total power, from 2.7 percent currently.

"This would not only sharply reduce the country's dependence on fossil fuels but also contribute to global efforts to combat climate change," Manmohan said. 

India Plans Exports of AHW Reactors Fuelled by LEU

India has announced intentions to export power reactors to other nations and is developing an advanced design for that purpose.

Chairman of India's Atomic Energy Commission Anil Kakodkar has announced recently in Vienna a special version of the forthcoming Advanced Heavy Water Reactor (AHWR) adapted to use low-enriched uranium (LEU) fuel.

The original design is fuelled by a mix of uranium-233 and plutonium bred from thorium using fast neutron power reactors earlier in a thorium fuel cycle. The LEU variant is suitable for export because it does away with the plutonium, replacing it with uranium enriched to 19.75 percent uranium-235.

Producing 300 MWe, the unit is less than one third the capacity of a typical large reactor. It is designed to operate for up to 100 years and has a "next generation" level of safety that grants operators three days' grace in the event of a serious incident and requires no emergency planning beyond the site boundary under any circumstances.

The design is intended for overseas sales, and the AEC says that "the reactor is manageable with modest industrial infrastructure within the reach of developing countries."

The new fuel mix, AEC said, produces less plutonium than mainstream light-water reactors and what it does produce contains three times the proportion of plutonium-238, lending it proliferation resistance. Furthermore, it leaves only half the amount of long-lived radioactive waste per unit of energy compared to mainstream light-water reactors.

As well as introducing India as a potential new major player in reactor sales - especially to new markets - the announcement reaffirms India's commitment to proceeding with the thorium fuel cycle using the original AHWR as the final stage.

India was effectively isolated from international nuclear trade from 1992 until early this year when a US-led initiative resulted in special arrangements for India under the Nuclear Suppliers Group, based on an India-specific safeguards agreement with the International Atomic Energy Agency. Overseas firms can now do business with India, which is keen to import uranium and large power

reactors. In turn, India may now offer its goods and services to the wider world.

The long-term goal of India's nuclear program has been to develop an advanced heavy-water thorium cycle. The first stage of this employs the pressurized heavy-water reactors and light water reactors, to produce plutonium.

Stage two uses fast neutron reactors to burn the plutonium and breed uranium-233 from locally mined thorium. The blanket around the core will have uranium as well as thorium, so that further plutonium is produced as well.

In stage three, AHWRs burn the uranium-233 from stage two with plutonium and thorium, getting about two thirds of their power from the thorium.

The first AHWR is meant to start construction in 2012, although no site has yet been announced. A prototype 500 MWe fast neutron reactor being built at Kalpakkam should be complete in 2011.



Canadian Firm in Talks with Indian Cos Ahead of N-Deal

India and Canada are in talks to sign a nuclear cooperation pact soon. Canadian Prime Minister Stephen Harper is visiting India on 15 and 16 November, 2009 and the deal in all likelihood will be signed then. Meanwhile, Atomic Energy of Canada Ltd, or AECL, is in talks with three private sector Indian power generation companies, including Anil Ambani's Reliance Power Ltd, for setting up nuclear power generation plants based on its Candu (Canada Deuterium Uranium) reactor.

The Candu pressurized heavy water reactor technology, developed by Canada and currently meeting around 16 percent of that country's electricity demand, is marketed worldwide by AECL. India has developed expertise in the whole lifecycle of a nuclear programme, including life extension of pressurized heavy water reactors.

"We are in talks with three Indian private sector firms who have plans to set up nuclear power projects," said Hugh MacDiarmid, President and CEO of state-run AECL, on his recent visit to India. "There is mutual synergy between our markets."

Industry sources confirmed preliminary talks between AECL and Reliance Power. Under the current policy guidelines in India, atomic energy is exclusively reserved for execution only by Nuclear Power Corporation of India Ltd (NPCIL), a public sector company under the Department of Atomic Energy (DAE).

This will change as part of the planned opening up of the sector following the civilian nuclear energy agreement with the US, freeing up overseas companies to enter the country.

"The private sector is doing the preparatory work. As contractors they have come in quickly, but as developers they will take some time. For that the present laws, rules and regulations need to be changed," said Anish De, Chief Executive at Mercados Asia, an energy consultancy firm. "Reliance Power has been at it for the last few years. However, the timing will depend upon the change in regulations."

The participation of the private sector and other PSUs



is expected to increase with the expected changes in the legal and policy framework, the effects of which will only be visible by 2019.

The participation of private firms is expected to give a boost to the sector once the government liberalizes rules governing atomic energy. Private sector power firms such as Tata Power Co. Ltd, GMR Energy Ltd, Jindal Steel and Power Ltd, JSW group, NTPC Ltd, Vedanta Resources Plc and Reliance Power have earlier evinced interest in setting up nuclear power plants once this takes place.

AECL is seeking opportunities in the Indian market, given the significant demand for electricity in the country and its inability to sell a single reactor in the last 10 years. Out of India's installed power generation capacity of nearly 150,000 MW, nuclear energy accounts for only 4,120 MW, even as it tries to close the gap between galloping demand and deficient supply.

According to the India Energy Outlook report by audit and consulting firm KPMG, the department of atomic energy hopes to build 250,000 MW equivalent of nuclear power capacity by 2050 to meet the country's

N-Energy to Power N-Tech Professional Job Market

Students of engineering have a wider choice these days with the nuclear energy getting a boost as an industry with greater involvement of the private sector in it. The added choice is nuclear technology as subject of specialization for aspiring engineering students in Indian universities.

With the government planning a five-fold increase in the existing nuclear power capacity by 2020 and a strong interest by global majors to shift manufacturing operations to India, it is estimated that the country would require about 2,000 trained nuclear engineers every year to staff the increased capacity.

Currently, the number of specialist nuclear post-graduates and PhDs from IITs and other universities is only about 50 every year. The supply is limited as only a few IITs—Kanpur and Mumbai, the Indian Institute of Science, Bangalore and few other universities offer specialized courses. In addition, Nuclear Power Corporation of India Ltd. (NPCIL), the sole nuclear power generator in the country, has a capacity to train 250 people annually, while the Department of Atomic Energy (DAE) schools around 500-700 people every year.

“The existing situation (for trained nuclear technologists) is stretched,” says L&T board member MV Kotwal. “If BARC (Bhabha Atomic Research Centre) opens its training facilities for non-BARC students also, it could help the industry,” he added. L&T is spearheading the private sector’s thrust into nuclear power generation. The government plans to add 20,000 mw of nuclear power generation capacity by 2020, after India and the US jointly agreed last year to cooperate on civil nuclear energy programme. India also signed a similar agreement with France and Russia.

Additional trained manpower requirement for supporting proposed nuclear power generation projects is in the range of 10,000 to 19,000 people (based on the norm of 1 to 1.4 person per mw), says a recent PricewaterhouseCoopers India report.

“The industry usually hires and trains such professionals in-

house,” says Kameswara Rao, Executive Director, PricewaterhouseCoopers India. The attrition in this sector is the lowest at about 3-5 percent, while it is as high as 10-12 percent in other streams of engineering.

Adding to the demand for trained nuclear technologists is the spate of joint ventures that were recently signed by L&T, BHEL, NPCIL and others.



Finance - Single Largest Snag in US N-Industry Growth: NEI

The Nuclear Energy Institute (NEI) of the United States, an industry body, has drawn up a package of policy initiatives to facilitate the expansion of the country's nuclear energy industry. The group says that federal policy in a number of areas, particularly financing, is required for such an expansion.

The NEI says that independent analyses conclude that a major expansion in the USA's use of nuclear energy is needed over the next 30-50 years in order to meet future electricity demand while reducing greenhouse gas emissions. The Waxman-Markey climate bill passed by the House of Representatives last June and the Senate climate legislation unveiled in recent weeks both call for an 83% cut in greenhouse gas emissions by 2050.

The US Environmental Protection Agency determined in its evaluation of the Waxman-Markey bill that under the core policy scenario to reduce emissions, nuclear power generation would increase 150 percent - the equivalent of 187 new reactors - by 2050. Meanwhile, the Electric Power Research Institute concluded this year that the potential exists for the electric sector to achieve a 41 percent reduction in carbon dioxide emissions from 2005 by 2030 using a full portfolio of technologies that include 46 new reactors. Similarly, the Department of Energy's Energy Information Administration, in its analysis of Waxman-Markey, determined that the basic scenario projects that the USA would need nearly 70 new reactors (totalling 96,000 MW of new generating capacity) by 2030.

The NEI said, "A program to expand reliance on nuclear energy to meet US climate change goals, even if it only approaches this scale, will require a sustained partnership between federal and state governments and the private sector,

including additional support from the federal government."

Financing, the NEI says, is "the single largest challenge to accelerated deployment of new nuclear power plants. The financing challenge is structural." It added that the cost of new nuclear power reactors - some \$6 to \$8 billion each - is very high, especially for the utilities proposing to build them, which are "relatively small companies." The NEI said that these companies "do not have the size, financing capability or financial strength to finance power projects of this scale on their own, in the numbers required."

The current loan guarantee program of \$18.5 billion is "clearly inadequate", the NEI said, adding that a program of at least \$100 billion is required for clean energy technologies, including nuclear. It called new plant financing arrangements, principally through the creation of a Clean Energy Deployment Administration that would function as a permanent financing platform. It also called for tax incentives for nuclear energy manufacturing and production facilities, as well as a streamlined licensing process for new reactors. The NEI also called for legislation to support the development of voluntary used fuel interim storage facilities.

Marvin Fertel, NEI's president and CEO, said: "If you want to address climate change and produce electricity, nuclear energy has got to be a significant part of the equation." He added, "Inclusion of a meaningful nuclear energy title by itself doesn't get you to an agreement in Congress on climate change legislation. But at the same time, you can't get there without it."

Responding to the NEI's proposals, Energy Secretary Steven Chu was quoted as saying that the Obama administration is "looking at all the things that are within our control to actually restart the nuclear industry." He said, "I would say that in order to really restart in a serious way you might want more than just three or four (new nuclear plants) in order to get it going."

