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### EDITORIAL

#### Dear Readers,

Greetings. Welcome to another edition of the Asian Nuclear Energy. President Barack Obama made a historic visit to India. On the face of it, it may look like nothing majorly significant was achieved between the two countries on the nuclear front. But a closer look at the finer points reveals much. For instance, the visit did not pay much attention to non-proliferation issues related to India. This is



highly unusual, if we make comparisons with previous US Presidential visits especially in recent decades. Our cover story on Obama's visit points this out, among many other things. India's assurances to the United States to address Washington's discomfiture over New Delhi's nuclear liability law is also well covered. We also carry a commentary on India signing the international treaty the Convention on Supplementary Compensation for Nuclear Damage (CSC) preceding Obama's visit, and how that may run at variance with the domestic Nuclear Liability bill in future. That's as far as the cover story goes. India begins work on its first pair of indigenous reactors, Kakrapar 3 agnd 4; Russia has offered uranium-starved India participation in its uranium projects and Saha Institute of Nuclear Physics is setting up a high-energy third generation synchrotron source, putting India on an elite club. What is also interesting is that several countries, including France and Russia, are looking towards collaborating with India on nuclear power not for domestic use, but for global markets. We carry reports on all these developments. But while India has an ambitious agenda of building nuclear plants upto 2050, given the enormous political, technical and operational obstacles that lie ahead, how much of it will be realized is a matter of uncertainty, and concern. This is analyzed in detail by a former chief economist of the Asian Development Bank. This apart, we have commentaries on the vexing Indo-Japan nuclear deal which still eludes the two countries, the need for an Indo-Pak nuclear commission and for India to give up its No First Use doctrine. We also take a look at the new generation of nuclear reactors, known as Generation IV. Happy reading!

Satya Swaroop Managing Editor satya@newmediacomm.biz



### Obama Receives Assurance from India on Liability Bill



While it stopped short of a straightforward commitment, the joint statement between India and the US at the end of President Obama's visit promises to address Washington's discomfiture over New Delhi's nuclear liability law that makes foreign suppliers of nuclear equipment liable for financial damages in case defective parts are supplied.

The joint statement envisages a strong India-US nuclear energy cooperation to be built through participation of US nuclear energy firms in India, on the basis of mutually acceptable technical and commercial terms and "conditions that enable a viable tariff regime for the electricity generated". It goes on to say that India is committed to "ensuring a level playing field for US companies seeking to enter the nuclear energy sector".

A resultant rise in tariffs of electricity has been one of the major arguments used by the US to oppose the

provisions related to supplier liability in the Indian law, recently passed by Parliament. US companies, mostly privately owned, would have to take insurance for vast amounts in case liability is shifted on them and this would ultimately raise the cost of electricity produced. The inclusion of the phrase "viable tariff regime" in the joint statement, therefore, gives the indication that the last word on supplier liability is still to be heard.

Especially so as India also promised to provide a "levelplaying field" to US companies. American firms have been arguing that suppliers for existing nuclear facilities are free from any financial liability and the move to pass on such liability to future suppliers distorts the balance.

The issue of making suppliers liable for financial damages had been the subject of a major political discussion before Parliament passed the Civil Damages for Nuclear Liability Act. After extensive discussions, it



was decided that while the operator of the nuclear facility would be solely liable for financial damages in the event of an accident, it would have a right to recourse against a foreign supplier in case the accident had "resulted as a consequence of an act of supplier or his employee, which includes the supply of equipment or material with patent or latent defects of sub-standard services".

The US had taken up this issue with the Indian government, arguing that also making suppliers liable for financial damages in case of accidents might not even be consistent with international nuclear conventions like the Convention for Supplementary Compensation (CSC) that India has only recently signed on. But in view of almost complete political unanimity at home on this score, New Delhi has so far resisted any cajoling from the US on dropping of this provision from the law.

#### Following is the Joint Statement by President Barack Obama and Prime Minister Manmohan Singh:

"The two leaders affirmed that their countries' common ideals, complementary strengths and a shared commitment to a world without nuclear weapons give them a responsibility to forge a strong partnership to lead global efforts for non-proliferation and universal and non-discriminatory global nuclear disarmament in the 21st century. They affirmed the need for a meaningful dialogue among all states possessing nuclear weapons to build trust and confidence and for reducing the salience of nuclear weapons in international affairs and security doctrines. They support strengthening the six decade-old international norm of non-use of nuclear weapons.

They expressed a commitment to strengthen international cooperative activities that will reduce the risk of terrorists acquiring nuclear weapons or material without reducing the rights of nations that play by the rules to harness the power of nuclear energy to advance their energy security. The leaders reaffirmed their shared dedication to work together to realize the commitments outlined at the April 2010 Nuclear Security Summit to achieve the goal of securing vulnerable nuclear materials in the next four years.

Both sides expressed deep concern regarding illicit nuclear trafficking and smuggling and resolved to strengthen international cooperative efforts to address these threats through the IAEA, Interpol and in the context of the Nuclear Security Summit Communiqué and Action Plan. The two sides welcomed the Memorandum of Understanding for cooperation in the Global Centre for Nuclear Energy Partnership being established by India. Both sides expressed deep concern







about the threat of biological terrorism and pledged to promote international efforts to ensure the safety and security of biological agents and toxins. They stressed the need to achieve full implementation of the Biological and Toxin Weapons Convention and expressed the hope for a successful BWC Review Conference in 2011. The United States welcomed India's destruction of its chemical weapons stockpile in accordance with the provisions of the Chemical Weapons Convention. Both countries affirmed their shared commitment to promoting the full and effective implementation of the CWC.

The two leaders expressed regret at the delay in starting negotiations in the Conference on Disarmament for a multilateral, non-discriminatory and internationally and effectively verifiable treaty banning the future production of fissile material for nuclear weapons or other nuclear explosive devices.

India reaffirmed its unilateral and voluntary moratorium on nuclear explosive testing. The United States reaffirmed its testing moratorium and its commitment to ratify the Comprehensive Test Ban Treaty and bring it into force at an early date.

The leaders reaffirmed their commitment to diplomacy to resolve the Iranian nuclear issue, and discussed the need for Iran to take constructive and immediate steps to meet its obligations to the IAEA and the UN Security Council.

Recognizing that India and the United States should play a leadership role in promoting global nonproliferation objectives and their desire to expand high technology cooperation and trade, Prime Minister Singh and President Obama committed to work together to strengthen the global export control framework and further transform bilateral export control regulations and policies to realize the full potential of the strategic partnership between the two countries.

Accordingly, the two leaders decided to take mutual steps to expand U.S. - India cooperation in civil space, defense, and other high-technology sectors. Commensurate with India's nonproliferation record and commitment to abide by multilateral export control standards, these steps include the United States removing Indian entities from the U.S. Department of Commerce's "Entity List" and realignment of India in U.S. export control regulations.

In addition, the United States intends to support India's full membership in the four multilateral export control regimes (Nuclear Suppliers Group, Missile Technology Control Regime, Australia Group, and Wassenaar Arrangement) in a phased manner, and to consult with regime members to encourage the evolution of regime membership criteria, consistent with maintaining the core principles of these regimes, as the Government of India takes steps towards the full adoption of the regimes' export control requirements to reflect its prospective membership, with both processes moving forward together. In the view of the United States, India should qualify for membership in the Australia Group and the Wassenaar Arrangement according to existing requirements once it imposes export controls over all items on these regimes' control lists.

Both leaders reaffirmed the assurances provided in the letters exchanged in September 2004 and the End-Use Visit Arrangement, and determined that the two governments had reached an understanding to implement these initiatives consistent with their respective national export control laws and policies. The Prime Minister and President committed to a strengthened and expanded dialogue on export control issues, through fora such as the U.S. - India High Technology Cooperation Group, on aspects of capacity building, sharing of best practices, and outreach with industry.





The possibility of cooperation between the two nations in space, to advance scientific knowledge and human welfare, are without boundaries and limits. They commended their space scientists for launching new initiatives in climate and weather forecasting for agriculture, navigation, resource mapping, research and development, and capacity building. They agreed to continuing discussions on and seek ways to collaborate on future lunar missions, international space station, human space flight and data sharing, and to reconvene the Civil Space Joint Working Group in early 2011. They highlighted the just concluded Implementing Arrangement for enhanced monsoon forecasting that will begin to transmit detailed forecasts to farmers beginning with the 2011 monsoon rainy season as an important example of bilateral scientific cooperation advancing economic development, agriculture and food security.

The two leaders welcomed the completion of steps by the two governments for implementation of the India -U.S. civil nuclear agreement. They reiterated their commitment to build strong India - U.S. civil nuclear energy cooperation through the participation of the U.S. nuclear energy firms in India on the basis of mutually acceptable technical and commercial terms and conditions that enable a viable tariff regime for electricity generated. They noted that both countries had enacted domestic legislations and were also signatories to the Convention on Supplementary Compensation. They further noted that India intends to ratify the Convention on Supplementary Compensation within the coming year and is committed to ensuring a level playing field for U.S. companies seeking to enter the Indian nuclear energy sector, consistent with India's national and international legal obligations.

India will continue to work with the companies. In this context, they welcomed the commencement of negotiations and dialogue between the Indian operator and U.S. nuclear energy companies, and expressed hope for early commencement of commercial cooperation in the civil nuclear energy sector in India, which will stimulate economic growth and sustainable development and generate employment in both countries...

Prime Minister Singh and President Obama concluded that their meeting is a historic milestone as they seek to elevate the India-U.S. strategic partnership to a new level for the benefit of their nations and the entire mankind. President Obama thanked President Patil, Prime Minister Singh, and the people of India for their extraordinary warmth and hospitality during his visit. The two leaders looked forward to the next session of the U.S.-India Strategic Dialogue in 2011."



## Obama's Visit and the Nuclear Conundrum

#### - Rajiv Nayan

### Institute for Defence Studies and Analyses

especially in recent decades. The current Indian diplomacy needs to be complimented for managing to draw attention away from the contentious non-proliferation or nuclear issues before and almost throughout the visit.

One may also attribute it to a sense of purposelessness of the US non-proliferation community. Surprisingly, the US nonproliferation community and various think tanks working on the subject did not issue any demand list on non-proliferation to make the visit contentious and the relationship tense. True, we heard some occasional noises on the nuclear liability bill and export controls reforms by India.

The Joint Statement issued at the end of the visit had a reasonable section devoted to nuclear and non-proliferation matters. These issues indicate the kind of relationship India is developing with the US. The relationship between the two countries is also called strategic, though the plethora of joint statements on strategic partnerships is increasingly complicating the phrase. The joint statement on nuclear and nonproliferation issues would point to the struggle the negotiators of both countries may have waged to make it a balanced document.

In the joint statement, there are some pleasant issues, but these are hardly inspiring for the relationship. The joint statement has talked about "common ideals, complementary strengths and a shared commitment to a world without nuclear weapons." Indian diplomacy may be congratulated for making the US talk about nuclear disarmament. It seems it was for the first time that the US administration shared nuclear disarmament ideals in an India-US bilateral document.

Interestingly, the talk of complementary strengths could also be a new experiment for the bilateral agenda. India may delight its Non-Aligned Movement and nuclear disarmament constituency and take the leadership on the issue of nuclear disarmament. This constituency was apparently unhappy with India because of the July 18,



The 2010 American presidential visit to India was arguably an economy-dominant event. Admittedly, Pakistan and the endorsement of the Indian candidature for permanent membership of United Nations (UN) Security Council dominated media discussions. Both issues constituted a big thriller before and during President's address to the Indian Parliament. The Strategic Trade management or export controls issue may fall in the grey area. It has both geo-strategic and geo-political connotations.

Other than strategic trade management and the nuclear liability bill, the writings and discussions during the visit did not pay much attention to other nuclear or nonproliferation issues. This was highly unusual, if we make comparisons with previous US Presidential visits



2005 joint statement and subsequent developments. This international force felt that India, the friend and the leader of nuclear disarmament, distanced itself from its long cherished ideal and commitment. The US may have addressed that section of the Western world which is restless about nuclear disarmament.

India or at least a strong section of the Indian strategic community always has had a nuclear disarmament dream. It dreamt when India won its freedom, kept dreaming during the Cold War and even after it, and more importantly, did not stop dreaming in nuclear India. Needless to say, this dream was shattered. It seems the joint statement intends to do something to synthesize a common dream. Chasing American nuclear disarmament dreams may be soothing, but like any dream would end without producing any result.

President Obama's promised the moon during his elections. A campaign pamphlet of the Democratic Party informed that "Obama and Biden will set a goal of a world without nuclear weapons, and pursue it. But they will take several steps down the long road toward eliminating nuclear weapons." Obama's famous Prague speech made a fleeting landing. Obama told the Prague audience, "I'm not naïve. This goal will not be reached quickly perhaps not in my lifetime." Afterwards, the American nuclear disarmament dream came to an end. Several disarmament enthusiasts all over the world, including Indians, were utterly disappointed. Global disarmament initiatives were left for brave hearts and lofty idealists.

Like the Prague speech, the India-US joint statement awakens us to the reality. In the same line in which a world without nuclear weapons has been mentioned, it talks of global efforts for non-proliferation before universal and non-discriminatory global nuclear disarmament in the 21st century. It seems the US priority took over. The struggle continued in the next line. Here it seems Indian diplomacy toiled to incorporate mention of "...the need for a meaningful dialogue among all states possessing nuclear weapons to build trust and confidence...."

At the press conference, the Prime Minister referred to India and the US as two nuclear weapon countries. This aroused expectations that advancement towards recognition of India's nuclear weapon status would be made, and the joint statement would use a new formulation recording India's nuclear weapon status. The 2005 joint statement had alluded to "other leading countries with advanced nuclear technology." Unfortunately, the joint statement, possibly because of American reluctance, did not refer to India and the US as two nuclear weapons countries. However, for getting the phrase (all states possessing nuclear weapons) used in the joint statement, we must give credit to Indian diplomacy. India may have to consolidate upon this and move forward towards gaining recognition as a nuclear weapons state. Needless to add, the best option would be joining the NPT as a nuclear weapon country.

The other half of the same line talks about "reducing the salience of nuclear weapons in international affairs and security doctrines." This is quite significant. India has a 'no first use policy' in its nuclear doctrine. In the run up to the 2010 Review Conference of the Nuclear Non-Proliferation Treaty, many countries as well as intergovernmental and non-governmental groupings campaigned for no-first use. An idea of a no-first use treaty was also floated. However, nothing came of it.

The Indian government and its diplomacy must build on this US commitment, and mobilize American think tanks working on nuclear issues. It could be the first practical step towards reducing the salience of nuclear weapons in the nuclear doctrines of all nuclear weapon countries - declared and undeclared. Other components may be taken up later.

India seems to prefer countering nuclear terrorism with the US framework. The joint statement mentioned the Nuclear Security Summit and the documents produced at the summit. The US has a somewhat different approach towards Pakistan on terrorism in general and







nuclear terrorism in particular. Through the summit, it has tried to project Pakistan as a responsible actor. Moreover, the US deals with Pakistan unilaterally and hardly shares information with other countries.

The US' ambivalent approach towards Pakistan is reflected in the joint statement on illicit nuclear trafficking. This is a major security issue not only for India but also for the US. Pakistan and AQ Khan do not figure in the joint statement. America's own allies complain about Washington not sharing information about the proliferation network. India should insist on highlighting Pakistan's involvement. Non-governmental organizations may underscore the role of Pakistani diplomacy in managing the fallout of its nuclear proliferation network. Help from the International Atomic Energy Agency, Interpol and the nuclear security summit framework has been mentioned. The Indian government should make maximum use of these institutions.

The US government and a section of its policy making community saw the Indian civil nuclear liability bill quite negatively. They demanded changes in the provision which made suppliers responsible for supplying defective items that may cause an accident. If an Indian operator finds that the accident has been caused due to defective equipment supplied by a supplier, it has the right to ask for compensation from the supplier under the passed bill.

The joint statement seems to have tried to address American uneasiness. It has secured a level playing field for American companies. US sceptics would do well to remember that there are many Indian suppliers for the Indian nuclear industry. The bill nowhere discriminates between an Indian private supplier and a foreign supplier. It seems the government of India has taken an extra step on the Convention on Supplementary Compensation which has been recorded in the joint statement.

There are other significant nuclear issues in the joint statement. First is the information about the Memorandum of Understanding for cooperation in the Indian Global Centre for Nuclear Energy Partnership. During his recent visit to Tokyo, the Indian Prime Minister agreed to work with Japan for development of this Global Centre. The future challenge for Indian diplomacy would be to make the Centre an important hub of nuclear energy and nuclear security activities. It could do well by becoming more transparent.

The joint statement has also talked about Iran. The formulation on Iran is guite positive. Obama began his Presidency and indeed conducted his election campaign by promising to use the diplomatic framework to manage the Iranian nuclear issue. In the last few months, he and his administration seem to have moved away from the diplomatic approach to confrontational and worse, military approach. In the joint statement, the emphasis on diplomacy to deal with the Iranian puzzle has been made. At the same time, the statement has urged Iran "to take constructive and immediate steps to meet its obligations to the IAEA and the UN [United Nations] Security Council." Quite interestingly, any reference to its treaty obligations is missing. It seems the allusion to IAEA and UN Security Council indirectly addresses the issue.

Quite terribly, some superfluous issues haunted the joint statement. For example, the unnecessary mention of the Indian commitment to unilateral and voluntary moratorium and the American commitment to the Comprehensive Test Ban Treaty could have been avoided. It is well known that the changed US Congress and the American security establishment would not allow the ratification of the treaty.

In sum, the visit witnessed several positive developments on the nuclear front. The joint statement on nuclear issues reflects the joint endeavour of the two countries to find a new common ground. Yet, the final outcome reflects the struggle of the traditional contending approaches of the two countries. The synthesis of the two approaches tries to paper over old differences, but is becoming manifest at most of the places in the joint statement. In the future, these wrinkles need to go.



### India Signs International Liability Treaty

India has signed the Convention on Supplementary Compensation for Nuclear Damage (CSC), thereby delivering on the last of its commitments stemming from the landmark 2005 nuclear agreement with the United States.

The international covenant which provides a framework for channelling liability and providing speedy compensation in the event of a nuclear accident was signed on October 27 at the International Atomic Energy Agency offices in Vienna by Dinkar Khullar, India's Ambassador to Austria. The IAEA is the "depository" of the CSC, which has so far been signed by 14 countries and ratified by four, including the U.S.

Adopted on 12 September 1997, the Convention on Compensation for Nuclear Damage was opened for signature at the IAEA's 41st General Conference at Vienna that same month. The CSC is consistent with principles set forth in previous international agreements governing nuclear liability, including the Vienna Convention on Civil Liability for Nuclear Damage and the Paris Convention on Third Party Liability in the Field of Nuclear Energy. It provides a bridge between these two regimes, is open to States that are party to neither of these two regimes, and establishes an international fund to increase the amount available to compensate victims. The CSC also allows for compensating civil damage occurring within a State's exclusive economic zone, including loss of tourism or fisheries related income. It also sets parameters on a nuclear operator's financial liability, time limits governing possible legal action, requires that nuclear operators maintain insurance or other financial security measures and provides for a single competent court to hear claims.



### - Siddharth Varadarajan The Hindu

At the moment four States have signed and ratified the Convention - Argentina, Morocco, Romania and the United States. India's signing brings a total of 14 States as current signatories to the Convention. The Convention is set to enter into force on the ninetieth day after date of ratification by at least five States who have a minimum of 400,000 units of installed nuclear capacity. Even if India ratifies it and Indian officials say this is unlikely to happen soon the CSC will not enter into force unless at least one or two countries with a large civilian nuclear programme also do so.

With India signing the CSC and the Obama administration issuing the requisite 'Part 810' licensing certifications, the stage is now set for the Nuclear Power Corporation of India Ltd. to begin full-fledged commercial negotiations with General Electric and Westinghouse for supply of two 1,000-MWe reactors. Three rounds of discussions have already been held, Indian officials say, but these have largely been exploratory in nature.

India promised the U.S. in 2008 that it would sign the CSC, a treaty that requires signatories to pass a domestic liability law in conformity with a model text. Washington's aim was to ensure that its companies were legally exempted from any liability burden in the event of an accident occurring in an American-supplied nuclear reactor.

Though India has passed its liability law, the U.S. objected to Sections 17(b) and 46 of the Act which open the door for legal action against nuclear suppliers if an accident is caused by faulty or defective equipment. Washington says



these provisions violate the CSC, a charge New Delhi rejects.

With GE and Westinghouse lobbyists up in arms, the U.S. side initially suggested that the Manmohan Singh government find a way to delete or negate the two offending sections. When the impossibility of this was pointed out, they suggested that NPCIL be asked contractually to accept the entire liability burden of its suppliers in the event of an accident. This suggestion has also been vetoed.

Leaving aside the explosive political implications of a public sector company granting a free pass to an American supplier, legal advisers have pointed out that neither NPCIL nor the government can sign away the provisions for tortious and criminal liability that have been embedded in the new law.

Now that the CSC has been signed, Indian officials hope the U.S. will ease up on its pressure. "We have delivered on all our commitments. Now there is nothing which stands in the way of American companies having commercial negotiations for the sale of their reactors," a senior official said.



The CSC provides no forum for signatories to challenge each other's national laws. Article XVI allows for arbitration as well as adjudication by the International Court of Justice, in the event of a dispute. But the U.S. entered a reservation while ratifying the Convention in 2008 declaring "that it does not consider itself bound by [these] dispute settlement procedures." When it eventually ratifies the treaty, India is likely to make a similar declaration.

That would leave the Supreme Court of India as the only forum competent to rule on the compatibility of the Civil Liability for Nuclear Damages Act, 2010 with India's international obligations stemming from its accession to the CSC.

### Russian Uranium Invitation to India

Russia has invited India to participate in uranium production projects in Russia and other countries. Citing Rosatom spokesman Sergey Novikov and general director Sergei Kiriyenko, reports suggest that Russia has already made a proposal to India and is now awaiting a response. The massive Elkon uranium development project is mentioned as a possible area for cooperation - Japanese and Korean companies are already reported to have signed memoranda of understanding on involvement in the project - although Russia would retain control, with foreign partners able to take up to 49% of projects within Russia according to Novikov.





### France, Russia Look Towards India for Nuclear Collaboration

France and Russia are among several countries that are looking towards collaborating with India on nuclear power for global markets, principal scientific adviser to the government, R Chidambaram said recently.

As a result of the Indo-US nuclear agreement, nuclear supplier guidelines have undergone few changes, following which many countries, including France and Russia, are talking about partnering with India, he said. "They (France and Russia) are not just looking at India as a temporary market but they are all looking for joining (partnership) with India and looking for global markets not only in nuclear power but other sectors...And that's what we should aim for... to reach for global markets as for as possible with our own efforts and later with international collaboration," he said.

After the Indo-US nuclear deal, projections on nuclear power have been raised and it (nuclear) is expected over 60,000mw by 2032 while till 2020 nuclear power was projected at 20,000mw. "Export oriented IT service has created lot of wealth in the country, but if you want to think of India as a developed country you have to become a global leader in manufacturing," he emphasised.

Quoting a report issued by the Deloitte Global Manufacturing Industry group and the US Council on Competitiveness, Chidambaram said they have put India on the second rank after China in the Global Manufacturing Competitiveness Index for 2010. "One of the reasons they attribute is the talent driven innovation in India being a factor for its emergence," Chidambaram said, adding, "The greatest resource in India is its human resource."

He said India is aiming for an electricity capacity of over a million



megawatts by 2050 of which a large percentage should be nuclear. "For India to become a developed economy, the per capita electricity consumption has to increase manifold and nuclear (energy) has to play an important role in this increase," he added.

Even Abu Dhabi is developing a nuclear plant as it does not want to depend on fossil fuel alone for (power production) and 30 other countries are also starting nuclear power projects, Chidambaram said. "Closing the nuclear fuel cycle is essential if nuclear (energy) is to be a sustainable mitigating technology in the context of the climate change threat and this is in coherence with India's threestage nuclear programme," he said.

Chidambaram said work on the Kalpakkam 300mw advanced heavy water reactor would begin shortly and was likely to be completed in five years "Thorium is in the longer term (as fuel) for India and Kalpakkam is a technology demonstration project. This project will give us better understanding of physics of thorium-based reactors which holds the future for India's power generation capacity," he said. Work on the country's first and biggest Integrated Coal Gasification Combined Cycle (ICGCC) 180MW power plant will commence shortly at Vijayawada in Andhra Pradesh, he added.



### Faultlines and Fortunes

#### - V.V. Desai

#### Former Chief Economist, Asian Development Bank

India today operates 19 nuclear power plants, or NPPs, with a total capacity of 4,500 MW and is adding 5,000 MW with seven plants that are under construction and slated for commissioning by 2015. An NPP can take eight to nine years to come up, so India's nuclear power capacity is unlikely to cross 10,000 MW by 2020.

Still, the country has massive expansion plans over the next four decades: 20,000 MW by 2020, 63,000 MW by 2032, and 470,000 MW by 2050. To meet the 2032 target, for instance, India will have to add around 4,500 MW each year. The enormity of the 2050 target can be appreciated by the fact that the total global capacity across 30 nations is around 400,000 MW at present.

So far, the state-owned Nuclear Power Corporation of India Ltd or NPCIL has been the only owner and operator of NPPs. It is unlikely to be able to cope with the demands that a multi-fold capacity expansion will place on its organisation, managerial and technical capacities, and financial resources. Fortunately, the government has signalled that it intends to invite the private sector (without direct foreign equity) to accelerate investments in nuclear energy.

By law and practice, policies and deliberations concerning NPPs remain opaque, driven as they are by a small group of interrelated government entities, namely, the Department of Atomic Energy (DAE), the Atomic Energy Commission (AEC), the Atomic Energy Regulatory Board (AERB) and the NPCIL. Little information is publicly available on the working of the sector.

Implementation of a large and fast-paced expansion programme would require systems and processes to be streamlined, roles of different entities to be clearly defined, and their performance made transparent and available to public scrutiny.

There have also been concerns about the independence of the sector regulator, AERB, which reports to the DAE. The DAE also has administrative control over NPCIL. Regulatory independence and credibility will be critical especially as the regulator will be called upon to work closely with a larger number of PSU and private investors, as also domestic and foreign participants. For this, capacities of sector entities and personnel would need to be substantially upgraded.

The other problem is public perception of nuclear energy, or, more specifically, the hazards around it. Project sponsors often spend the initial years fighting legal challenges, and resorting to police interventions in project area instead of moving ahead on construction. Dissemination of transparent and meaningful project





information, sensitivity to the legitimate concerns of the affected population, market-guided compensation for acquired land, and serious attention to rehabilitating the affected could be the solution.

Also, today's practice of Environmental Impact Assessment studies being prepared by consultants paid for by the licensee/operator needs to be reconsidered to enhance public confidence.

Another major issue in public acceptance is the uncertainty related to storage and disposal of nuclear waste. As yet, no country has found a reliable long-term solution to the problem, with plant sites often used for such storage. While India may not be able to solve the problem, what will help is provision of information on how the interim measures are expected to safeguard public health and environment until a superior solution is found.

Historically, cost estimates of NPPs have proven highly unreliable, often ending with significant cost increases and delays. Besides, several different definitions are used for different purposes (overnight costs, owner's costs, all-in costs, etc.) giving a wide range of costs. Estimated investment costs per MW today vary from \$4 million to \$9 million. The AEC has benchmarked costs at \$1.6 million per MW, but its scope and basis is unclear.

Uncertainty of costs is even greater for the "new generation" plants, offered by Areva, Westinghouse and GE-Hitachi. The first plant in an advanced stage of completion, by Areva in Finland, has had a 75 per cent cost increase (at \$5,500/KW), and a delay of 60 per cent. Areva has also announced a 50 per cent cost increase on plants it is building in France and China. It is safe to assume that capital requirement for building additional capacity of 50,000 MW in India would be \$250 billion to \$300 billion, to be incurred mostly in the 2015-2030 period.

Despite the challenges and uncertainties, the intended multifold expansion of nuclear energy in the country holds business opportunities of several billions of dollars for Indian and foreign industry. Even if only about half of the targeted new capacity of 53,000 MW - that is 25,000 MW - is added by 2032, it would involve an investment of around \$150 billion. Much of the technology and core plant would be supplied by foreign suppliers, especially for the NPPs to be built in the early years, and the government has already entered into preliminary supply agreements with major technology and plant suppliers from Russia, France, and the US.

There will be massive and growing opportunities for the Indian industry and investors as well. An unintended



benefit of 35 years of embargo on Indian nuclear energy sector has been the limited yet important development of indigenous capacity in selected areas of design, construction, and manufacturing needed for NPPs.

NPCIL has developed capability to design and build NPPs in the 220 MW to 700 MW capacity. It plans to build up to 10 such plants in the country, and also hopes to export some. Private sector construction major HCC, short for Hindustan Construction Company, has built several NPPs in the country. L&T has supplied steam generators and produced heavy components for 17 of India's pressurised heavy water reactors and can fabricate nuclear-grade pressure vessels and core support structures - making it one among a dozen major nuclear-qualified heavy engineering enterprises worldwide.

Development of such indigenous capacity, although significant, is somewhat limited in amount and scope. Substantial expansion of indigenous capabilities is critical for sustaining the planned rapid development of capacity. Several firms, then, are gearing up. HCC has formed a joint venture with a UK-based engineering and project management firm to undertake consulting services and nuclear power plant construction.

L&T has entered into agreements with several foreign NPP providers to produce components in India as well as in third country markets. It is also setting up a major plant for manufacture of heavy engineering components for nuclear reactors in collaboration with NPCIL and BHEL for the domestic and export market. BHEL has plans to supply components for the new-generation, 1,600 MW reactors as well as set up a JV with NPCIL and Alstom for turbines. Similarly, Bharat Forge is setting up a JV with Areva for casting and forging components.

The extent to which the Indian industry will succeed in turning the potential into reality will depend, in part, on its dynamism and innovative spirit; and also on the government's ability to put in place major institutional changes that are needed.



### Nuclear's Next Generation

- By Giovanni Verlini, IAEA



Concerns over energy resource availability, climate change and energy security suggest an important role for nuclear power in supplying energy in the twenty-first century. However, if nuclear is to make a contribution in meeting the world's future energy needs, it has to be developed and expanded in a sustainable manner.

A new generation of nuclear reactors and related fuel cycles involving different technologies, collectively known as Generation IV, is being developed globally to meet the criteria of sustainability, enhanced safety, economics, and proliferation resistance.

Generation IV nuclear energy systems are nextgeneration technologies being developed to have comparative advantages including reduced capital cost, enhanced nuclear safety, minimal generation of nuclear waste, and further reduction of the risk of weapons materials proliferation:

- Gas-Cooled Fast Reactor (GFR);
- Very-High-Temperature Reactor (VHTR);
- Supercritical-Water-Cooled Reactor (SCWR);
- Sodium-Cooled Fast Reactor (SFR);

- Lead-Cooled Fast Reactor (LFR); and
- Molten Salt Reactor (MSR).

The IAEA is playing a pivotal part in this effort, bringing together nuclear technology holders and users to consider jointly international and national actions that would result in innovations in nuclear reactors, fuel cycles and institutional approaches. The Agency's efforts in this sense are led by the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO), a mechanism for members to collaborate on these issues and to help member states to assess the sustainability.

"International cooperation and collaboration are instrumental to both of our missions and objectives, and INPRO strives to work in synergy with other international initiatives such as the Generation IV International Forum (GIF)," said Yury Sokolov, IAEA Deputy Director General and Head of the Department of Nuclear Energy. "Recognition of the complementarities of the two projects opens opportunities for new forms of cooperation," he said.

We need cooperation on technical innovation to reduce



costs, enhance both safety and proliferation resistance capabilities," explains Yutaka Sagayama, Deputy Director General of the Japan Atomic Energy Agency (JAEA) and Chairman of GIF. "We need to cooperate to make the best efforts to develop these systems as early as possible."

While GIF is focused on reactor technologies, INPRO is looking at broader issues, focusing more on institutional and infrastructure requirements that can support the implementation of technological innovation and developing a methodology for Nuclear Energy System Assessment (NESA).

"To begin with, we will hold a series of workshops on issues relating to safety approaches and priorities for advanced sodium-cooled fast reactors," explains Jong Kyun Park, Director of the IAEA's Division of Nuclear Power. Work on other types of reactors and areas will follow.

"Both GIF and INPRO are working on methodologies to assess these new nuclear energy systems in the areas of proliferation resistance and physical protection, risk and safety assessment, and economics, and there is great value to harmonizing these efforts between the two multi-lateral projects," said Randy Beatty, INPRO Group Leader.

As to the timeframe of a possible debut of at least some of these technologies in the market, the target date for deployment is currently proposed around 2020 to 2030. "We are working on the viability and feasibility of these systems right now," says Harold McFarlane, Technical Director of GIF. "They are promising systems but they are not at the stage of deployment yet."





### The Elusive Japan-India Civil Nuclear Deal

In a rapidly developing and energy-hungry nation such as India, the promise of nuclear power is still to be realized. The 19 nuclear power plants in operation generate a power output of less than 5,000MW which is grossly inadequate. India, however, has developed an ambitious plan to scale up its nuclear power generating capability to 63,000MW by 2032. Thanks to the Indo-US nuclear deal, this mega-plan is slowly taking shape. Two American firms, GE-Hitachi and Westinghouse, a subsidiary of Toshiba, are set to build two new nuclear reactors in India. Since Japanese firms are involved, business is on hold unless and until the Japanese government too enters into a civilian nuclear deal with India. These conglomerates are thus eagerly waiting for the Japanese government to give the go-ahead.

During his visit to Japan in October, Indian Prime

### - Miyuki Fujii Japan Forum on International Relations

Minister Manmohan Singh expressed a strong desire to accelerate negotiations on a civilian nuclear agreement between the two countries, which would enable the transfer of Japanese nuclear technology and materials to India. Given the strong anti-nuclear sentiments among the Japanese people, Prime Minister Singh reiterated India's commitment to a unilateral moratorium on nuclear testing and emphasized his country's constructive role in nuclear non-proliferation. Yet, Japan's fundamental stance that it will nullify the agreement should India conduct another nuclear test remains unchanged.

The fact that India is a nuclear-armed state has been a big obstacle for Japan in concluding negotiations. India is neither a signatory of the Nuclear Non-Proliferation Treaty (NPT) nor the Comprehensive Nuclear Test Ban



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Treaty (CTBT). As Japan is the only nation in human history which has suffered from an atomic catastrophe, the Japanese media and public opinion remain hostile towards nuclear cooperation with non-NPT signatory states.

It is, however, worth looking into the US rationale for getting into a civil nuclear deal with India because this applies to Japan's motive for starting the negotiations with India as well. First, the US took the realistic standpoint that India possessed nuclear weapons and will continue to do so. Second, the US admitted that India had all the capabilities to be a great

power with a stable democratic setup. Third, with its economic decline, the US has been losing its bargaining power to China and therefore, began to view India as a potential counter-balance. More importantly, it was more of a practical decision for the Americans to engage India and seek cooperation to prevent the proliferation of nuclear technologies even without the NPT framework, than to wait until India someday abandoned nuclear weapons and joined the NPT.

Some criticize American favouritism with respect to India, stating that it jeopardized the NPT regime. It may have, but the NPT is, in the first place, an unequal treaty and the regime has always been full of flaws. China has in the past allegedly offered nuclear assistance to Pakistan and continues to do so even today. Iran too, is about to go nuclear. While the NPT remains an important tool for the prevention of nuclear proliferation, it is wrong to see the NPT as the only or an infallible means to stop nuclear proliferation. By bringing India back into the mainstream of international nuclear politics, it is possible to help strengthen the cause of the NPT regime which consists of many other legal and political instruments in addition to the NPT.

Non-proliferation efforts do not rely solely on the NPT framework, and Japan's civil nuclear deal with India will not harm Japan's non-proliferation efforts. However, the absolutist view of the NPT as the sole instrument of nuclear non-proliferation is still prevalent in Japan.

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Hence, the Naoto Kan administration needs to provide a cogent explanation to the populace of the need for the nuclear agreement with India.

What should Japan do in future negotiations with India? It should continue to press India to stay committed to its unilateral moratorium on nuclear explosive testing and encourage India to move forward on nuclear disarmament together with Pakistan. In addition, Japan can seek to work together with other nuclear supplier states to India, such as the US and France, to cease nuclear cooperation in the event that India carries out another nuclear test. Above all, Japan should stick to its original stance and include the condition in the agreement that it will nullify the agreement if India conducts another nuclear test.

It is undeniable however, that Japan is living with a contradiction when it advocates a nuclear-free world while simultaneously enjoying a security guarantee under the American nuclear umbrella in the region. This dual nature of Japan's standing in international affairs appears to be hypocritical to other countries, particularly when Japan lacks a realistic standpoint in the ongoing efforts on nuclear non-proliferation. It is time for Japan to have an objective view on the international environment surrounding India's nukes and respond flexibly to global political realities.

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### Mooting an Indo-Pak Nuclear Commission

### - D. Suba Chandran Institute of Peace and Conflict Studies

Between India and Pakistan, there is little understanding of each other's nuclear capabilities and doctrines. There is likely to be an increased international pressure on both countries, as a part of the renewed efforts towards global nuclear disarmament. Both regional instability and the likely international pressure calls for an intensive dialogue and innovative approaches.

At the regional level, Pakistan does not consider India's nuclear doctrine (especially the No-First-Use and Minimum Credible Deterrence) as credible. Rather, Islamabad in Pakistan believes that during crisis period, India will not adhere to its NFU. Besides, the NFU will result in India preparing for a second strike capability, thereby increasing its nuclear arsenals considerably. According to Pakistan, this makes India's credible deterrence anything but minimal, besides the fact, leading to an arms race. More importantly, Pakistan today believes, that after the Indo-US nuclear deal, India will be able to amass sufficient fissile materials, enabling it to lead the nuclear arms race in South Asia, at a considerable pace, leaving Pakistan behind.

On the other hand, India believes, that its doctrine including the NFU and minimum credible deterrence, is a source of stability. A section within India even believes that the NFU actually provides the space for Pakistan, to engage in overt and covert activities, as India will not be the first use nuclear weapons. Regarding the nuclear deal with the US, a section believes, that this agreement has come up with certain military costs (besides the economic costs), in terms of opening its nuclear facilities to international inspection. India has made substantial commitments to the international organizations including the IAEA and NSG. Pakistan, however, has got a similar understanding with Beijing, without any such commitments.

At the international level, after the relative success of the NPT Review Conference 2010, one is likely to see an increased international pressure on India and Pakistan; especially relating to certain international nuclear treaties primarily the CTBT and FMCT. The fact that it will not be easy for Obama to get the CTBT ratified will provide space for India and Pakistan to debate the CTBT or prolong the decision. Unfortunately, the FMCT does not provide that space to both countries. Despite the bold statements, it is unlikely that the two countries would be able to withstand the international pressure. Pakistan is dilly dallying with calling for a FMT (Fissile Material Treaty) instead of an FMCT. This suits India, for New Delhi can argue that it will be willing to sign the FMCT, if Islamabad is ready to do the same. Pakistan is afraid that if it signs the FMCT now, it will not be able to match up with India's already produced fissile materials.

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While the Lahore Memorandum provides space for a nuclear dialogue, and there already exists an earlier agreement on sharing each other's nuclear installations, there is not much trust between the two countries. The reason is the lack of any meaningful and intensive nuclear dialogue, sustained over a period either at Track-I or Track-II levels. As a part of confidence building, numerous nuclear risk reduction measures have been proposed already. Establishment of Nuclear Risk Reduction Centers (NRRCs) on the models of US-Russia has been widely discussed in the strategic circles. Undoubtedly, the NRRCs are a welcome suggestion, but are limited and negative in approach. It hopes to establish two nuclear centers, which will be technical in nature, providing details/alerts regarding nuclear dangers, accidental use and related issues.

What is needed now, at the Indo-Pak level is a positive, larger institution that provides space for continuous and intensive interaction on nuclear issues, which remain uninterrupted with other political/militant developments in Indo-Pak level. None of the major nuclear treaties at the international level are a result of casual one-off meeting, held over a period of two days. International nuclear agreements are the result of an intensive interaction, over a period of years. If India and Pakistan are to have any productive debate leading to a stable understanding, then the nuclear dialogue needs something larger than a mere NRRC, at the technical level.

### Should India Give up its NFU Doctrine?

Doctrines are not static and are always linked to an objective. If the primary Indian objective is to have a stable nuclear South Asia, then New Delhi should consider giving up its No-First-Use doctrine (NFU), for the following three reasons.

First, the India's NFU contradicts its other nuclear emphasis Minimum Credible Deterrence (MCD), and has the potential to convert its deterrence into maximum and not minimum. NFU means, that India will not be first to use its nuclear weapons; this prepares India to absorb the first strike. Why would India prepare to take the first strike and how can this secure India from receiving a first strike? India's NFU implies that to be safe and secure, and prevent any first use against it, India should have a large second strike capability. This second strike capability, should frighten the adversary to an extent, that none will consider using nuclear weapons against India in the first place.

Since, there are only two likely adversaries Pakistan and China in India's neighbourhood, who could consider using nuclear weapons against India, what will be the size of nuclear arsenal, that will take the first strike, and deliver the second one? To have a deterrence, that is considered 'credible' by India, in case if New Delhi is willing to take the first strike, will that number be minimum or maximum? From the adversaries' perspectives, if China and Pakistan are to be frightened against using the nuclear weapons against India, what will be the size that will scare the hell out of them?

The first question is inward looking, in terms of what will make us safe and protected against the first strike. The second question is how our adversaries will feel, in terms of getting absolutely frightened, that they will dare not strike us first. The numbers may not be the same in both the cases. For example, India may consider X-1 number of weapons to have a credible deterrence with second strike against a Y-1 number of weapons with its adversaries. On the other hand, China and Pakistan may consider India to have X-2 number of weapons, if it has to be credible to avoid their first strike, with Y-2 number of weapons. The danger in this calculation is what if X-1 and X-2, and Y-1 and Y-2 are not the same numbers?

NFU is unlikely to make the situation stable in Southern Asia. It will only lead to a nuclear arms race.

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This is where an Indo-Pak Nuclear Commission on the models of Indus Water Commission may be an idea worth pursuing. Indus Water Commission, created in 1960 after a prolonged negotiation, which resulted in the famous Indus Waters Treaty (IWT), provides two Indus Water Commissioners in India and Pakistan. The Indus Water Commission has met periodically ever since 1960, irrespective of wars and proxy wars, and regime changes. If the IWT is hailed as a major example, of a treaty that have survived four wars and numerous proxy wars, it is because that the Indus Water Commission never broke down, and its Commissioners never failed to meet each other. Two positive ideas from the Indus Water Commission are worth borrowing: an exclusive commission and periodic meeting, irrespective of the prevailing political climate.

The Indo-Pak Nuclear Commission, unlike the proposed NRRC should not be only technical. It could be an ideal forum for the discussion of nuclear doctrines and understanding each other's anxieties and fears. While

A Second reason for New Delhi to give up its NFU is because it makes India's credible deterrence no more minimum. NFU, as discussed above, means that India is willing to take the first strike. This essentially means that India not only should have sufficient second strike capability to first, prevent the first strike, and second, to have sufficient number of nuclear weapons, that will survive the first strike. This will not only result in increasing the number of India's nuclear arsenals, but will also take New Delhi into the dangerous path of building a triad. Second strike capability necessitates the

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the NRRCs will contain two centers in India and Pakistan, the Nuclear Commission could facilitate regular meetings, alternatively in India and Pakistan. In fact, the NRRC could be the technical arm of the Nuclear Commission. Such an Indo-Pak Nuclear Commission has the potential to become a great stabilizer of nuclear relations between the two countries.

triad, especially nuclear weapons in mobile platforms.

Second strike capability, undoubtedly an option, which India has the right to pursue. But unfortunately, such an option will not only be expensive, but also affects it deterrence numbers. In case of India wanting to have a credible deterrence with second strike, it will no more be minimum. India can have either NFU or a MCD. Both are not complimentary.

The final reason why India should give up its NFU is the Pakistan factor. No one in Pakistan believes India's NFU. In fact, no other countries (except for China, that too with a footnote) that possess nuclear weapons have an NFU. Pakistan also believes, that in case of a crisis, it can never trust India's NFU. In short, for Pakistan, India's NFU is frivolous and not trustworthy. Besides, from an Indian perspective, New Delhi's NFU is self defeating vis-à-vis Pakistan. Since India follows the NFU, it only provides Pakistan with a space to make calibrated military efforts (as in the case of Kargil) and support proxy war and militant attacks across India (as in the case of the Parliament attack, 2001 and Mumbai, 2008). Though India has proposed a limited war doctrine to undercut this strategic deficiency, Pakistan has not taken this seriously. As a result, Pakistan not only disbelieves India's NFU, but also uses the same against New Delhi to make military and militant exercises under the nuclear umbrellas.

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### Third Gen Synchrotron to Propel India to Elite Club

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Saha Institute of Nuclear Physics (SINP) will soon put India on the premier club of five top nations by setting up a high-energy third generation synchrotron source, which will facilitate cutting edge state-of-the-art crossdisciplinary scientific research. The project will cost Rs 6,000 crores.

"Synchrotron is the process of moving a particle through an electromagnetic field in such speed that it provides us photons or lights. The photons produced through this system have a wide range spetrum: from radio waves to infrared light, visible light, ultraviolet light, X-rays and gamma rays. The synchrotron light is used for measurements in basic research and technological development all over the world," explained M. K. Sanyal, director of SINP.

The facility will boost indigenous research in various areas like drug development, automobile, nano

technology, environment pollution, arsenic mitigation and preservation of artefacts and heritage architecture. "The presence of a third generation state-of-art highenergy synchrotron facility in India will provide beams of light with outstanding brilliance and stability for investigation of materials

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ranging from medical applications to nano technology. For India, which is perceived as the future economic leader, developing this key technology is extremely important," said Helmut Dosch, director general, Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany, which will be helping India in setting up the facility.

While several countries all over the world have synchrotron sources, only Japan, USA, Germany and the European Union (Switzerland) have the high-energy third generation synchrotron source. "India will be the fifth nation to have this facility. On November 11 we had a meeting with the directors of third generation synchrotron source of the four countries. They have agreed to help us setup the facility which would be executed over the 12th and 13th plan period," said

Sanyal.

Bhabha Atomic Research Centre, Tata Institute of Fundamental Research, Indira Gandhi Centre for Atomic Research, Variable Energy Cyclotron Centre and Raja Ramanna Centre for Advanced technology will help SINP in setting up the facility.

![](_page_23_Picture_0.jpeg)

### Work Begins on India's First Indigenous Reactors

India's first pair of indigenously designed 700 MWe pressurised heavy water reactors (PHWRs) are now officially under construction with the first pouring of concrete recently, at Kakrapar 3 and 4.

Ground breaking for the two units, in Gujarat state, began in January 2010 and excavation works and other preparatory site works were completed by August, in record time according to Nuclear Power Corporation of India Limited (NPCIL). Approval from India's Atomic Energy Regulatory Board (AERB) was needed before concrete pouring could go ahead. The units are slated to start up in 2015 and 2016. Indian plans call for 20,000 MWe of nuclear capacity to be on line by 2020 and 63,000 MWe by 2032, with nuclear supplying 25% of the country's electricity by 2050. It already has 19 operating reactors totalling 4183 MWe, and Kakrapar 3 and 4 mean the country now has 6 reactors under construction, the others being a 220 MWe PHWR at Kaiga 4, two 1000 MWe Russiandesign VVER pressurised water reactors at Kudankulam, plus the 500 MWe Kalpakkam prototype fast breeder reactor (PFBR). All are scheduled to start up by mid-2011, although reports earlier this year suggested that the Kalpakkam PFBR could be delayed by up to a year.

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NPCIL's 700 MWe PHWR design is a scaled-up version of its 540 MWe design, two of which have been in operation at Tarapur 3 and 4 since 2005. Two more 700 MWe PHWRs are to be built at Rawatbhata in Rajasthan, referred to as RAPP 7 and 8. Ground breaking took place at Rawatbhata in August 2010, and NPCIL now says that first concrete is expected by March 2011.

Meanwhile, reports in the Indian press suggest that another proposed nuclear construction site at Jaitapur in Maharashtra could be nearer to gaining necessary governmental clearance. The Ministry of Environment and Forests (MoEF) has indicated to the Maharashtra state government that it is willing to permit the project to go ahead. Ministry clearance is seen as an essential step in the permitting process for the site, earmarked for up to six Arevasupplied EPR pressurised water reactors.

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### Schott Solar Receives VDE Certification

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Schott Solar's in-house lab for testing new products, processes and materials according to IEC 61215, IEC 61646 and IEC 61730 has been certified by VDE Association for Electrical, Electronic and Information Technologies. VDE regulatory agency is among Europe's largest technical & scientific associations.

Schott Solar, with its high-quality products, enables the potential of the sun as a nearly inexhaustible source of energy to be utilized. Schott Solar produces important components for photovoltaic applications and solar energy plants.

Test reports prepared by the Alzenau test centre are now directly forwarded to VDE, which verifies them and then issues approval for the use of the VDE mark. This accelerates the entire production process at Schott Solar significantly.

The solar manufacturer Schott Solar complies with all required IEC standards in its in-house test lab. This was also verified in an exacting certification process conducted by VDE. Companies have to demonstrate their test capabilities and expertise to qualify for VDE's Test Data Acceptance Program (TDAP). Schott Solar has now successfully completed this process.

"Achieving VDE certification is confirmation and recognition of the expertise held by Schott Solar. Insights gained at the test centre are now immediately included in product development. This is the basis for us to continually improve our products and enhance our quality," concluded Uwe Fliedner, Director Global Module Development Department at Schott Solar. Dr. Schier, head of the test centre, added: "Thanks to cooperating closely with VDE, we are now also in a position to accelerate our product development processes significantly, as test results are sent to VDE for approval immediately."

Stringent criteria apply for acceptance into VDE's TDAP Program. Workflows, documentation and test facilities were enhanced with the help of VDE during the ninemonth certification phase. Arnd Roth, project manager at VDE Offenbach, confirmed: "The Schott Solar test centre meets the criteria because it is equipped with the required test and measurement devices and prepares the documentation for all tests to our full satisfaction. On top of that, all members of staff employed at the lab have the required on a regular basis by VDE in audits it conducts.

Schott Solar has production facilities in Germany, the Czech Republic, the USA and Spain. Schott Solar is a wholly owned subsidiary of the international SCHOTT technology group. Schott develops special materials, components and systems for the household appliance, pharmaceutical, solar energy, electronics, optical and automotive industries. With around 17,400 employees, the Schott Group generated a worldwide turnover of about 2.3 billion euros in fiscal year 2008/2009.

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