Dogs of War

The most complicated part of India-Pakistan missile development is that it locks them into a dangerous race, says Syed Talat Hussain

THE Sub-continent's summer season should be renamed nuclear season. While last May the region was clouded by mini mushrooms of ten nuclear explosions by India and Pakistan, this time around a month early though there has been a virtual missile rain. India first tested Agni-II, an improved and more accurate version of medium range nuclear capable Agni-I which was responded to by Pakistan which launched its Ghauri-II and Shaheen-I, both nuclear capable, medium and shortrange missiles. India also tested another missile Trishol which showed its accuracy when it hit a pre-set target in the air.

Obviously a missile mindset has set in both countries. Pakistan says that it has concluded "only for the time being" its missile experiments, while India has always kept its missile option open. This means that in the future there can be more missile tests. The most complicated part of the present India-Pakistan missile development is that it locks them into a missile race. This issue happens to be the topmost concern of the world, particularly for the Americans, in the subcontinent. Even more important it is for the people of the sub-continent whose majority lives truly backward lives. The issue's immediacy and urgency revolves around the fact that it is a harbinger of war in the fu-

India wants to build a formidable war machine as part of its larger effort to get recognised as a major power and Pakistan, its smaller neighbour does not want to be placed in a position where it is totally overwhelmed by India's power. While India sees its missiles as an important detail of the comprehensive policy script of a great power status, Pakistan sees them as critical weapons of survival, of defence and offence. For Pakistan missiles are the short-cut to meeting the growing might of the

Indian war power. Seen in this context it appears predictable that on the missiles front both India and Pakistan will be caught in a sort of a race, with India deterinining the pace and rhythm

The second factor which will see disturbing trends of growth and race on the missile front is that both India and Pakistan are not bound by any international treaty not to build weapons. The most important international document on missiles happens to the Missile Technology Control Regime, which does not quite apply to India and Pakistan. India does not get affected by it because MTCR only deals with missile technology which relates to export of missile technology. India has always maintained that its missile programme is indigenous and therefore outside the purview of the MTCR.

Pakistan has been in the past affected by the MTCR because of its alleged links with China and North Korea, two countries which the West says have been supplying it missile

HERE is a general feeling

company (HFC), the better.

While most HFCs offer tenures

of up to 20 years, it was sug-

gested that they should be in-

creased, even, up to 40 years as

is done in the developed coun-

tries. Obviously, the impression

is that long tenure loans are

beneficial to borrowers. Com-

mon sense also dictates that the

longer the terms, the monthly

repayment instalments ought to

be easier and lighter. However,

if one takes into account the

prevailing interest rates and

the system of repayment

adopted by HFCs, this may not

necessarily be so. Repayments

of loans are normally made to

HFCs through equated monthly

instalments (EMIs) where the

same amount is paid each

month throughout the term of

the loan. An EMI comprises of

part repayment of principal

and the balance as interest on

the outstanding loan. In the

process, the principal is repaid

in small amounts in the initial

Now let us see how the rate of

years and in large sums there-

interest charged on the loan af-

fects the EMI calculated for dif-

ferent tenures of repayment. In

India, the interest rate on hous-

ing loans have been hovering

around 15 per cent in the last

two decades. In this context, an

analysis of the above figures

clearly indicates that while

there is a marked difference be-

tween EMIs of shorter and

longer tenures at 5 per cent, it is

not quite so when the rates are

feature is the variation in EMIs

for the same interest rate for

15 per cent. Another interesting

that the longer the term of

repayment of a loan taken

from a housing finance

Housing

Holes

Paul Diamond explains why short-

tern housing loans are good for all

technology. But now Pakistan has got enough missile technology and know-how and tested missile designs and it does not have to worry about getting hurt by MTCR. It can also can now rely on this technology which is indigenous and

further develop it. Realising the importance of this fact, Pakistani authorities clearly told Strobe Talbott, US Deputy Secretary of State, during his latest visit to the subcontinent that they would not halt their missile programme and will reserve the right "to change, modify, enhance, and diversify" their missile- capa-

bility. A pointer towards the future direction of missile development in India and Pakistan has come in the shape of credible reports that both are working to improve the quality and quantity of their missile stockpiles. Some details of this work are already available and these point to the third future trend, which is sophistication of missile technology in the hands of India and Pakistan.

The latest proof of this fact has come in the shape of Agni II which has two characteristics: one it has an enchanced range of 2500 kms and secondly it is solid fuel which means it is more powerful and quicker to be put in a state of readiness. Pakistan's Saheen 1 which has a range of 750 kms and is also solid fuel. It is a ready-forlaunch sort of a missile. Ghauri-II though is liquid fuel has a greater range, 2300 kms, and can carry, 1000 payload.

Connected with these issues is the fourth trend which is that given the likely escalation in the missile race, and given the US anxiety over the issue, there will be greater pressure on India and Pakistan from Washington on the score which might mean more complications in their bilateral relations. The US has already imposed trade sanctions against both countries for their missile misdemeanour.

A further cause to worry is that reports in Pakistani newspapers suggest that India is planning to test more nuclear devices. These reports are based on apprehensions that India is going to use its signing of the CTBT as means to deal with the furore which would be a natural reaction to its decision to explode further devices. There are no factual basis to these reports, but then in these matters perception is more important than facts. If the perception deepens in Pakistan that India is planning to further improve its nuclear capability, the government of Nawaz Sharif may find itself in a difficult position on how to respond to it.

In testing its missiles in response to India's it has already created a tit-for-tat policy parameter for itself. How will it break this reaction mould India were to test a Hydrogen Bomb? A perplexing question not only for Pakistanis, but also for the people of South Asia who deserve a future more secure than one promised by missiles and nuclear bombs.

different terms. For instance,

the difference in EMIs for 30

years and 40 years at 15 per cent

is a mere Rs. 15 per month. It

means it would make little

sense to elongate the repayment

period by an extra 10 years and

pay an EMI of Rs. 1,255 each

month for the extra ten years

merely to save a meagre Rs. 15

per month over the loan tenure

so on. The borrower should,

funds faster by re-lending to

for HFCs to raise long-term re-

The maximum tenure for

sources. ...

OUR governments in the three years since 1996, and a fifth likely to take office in a few days! It is not clear how long it would last, but political speculators do not give it more than six months, some even less, although they could be

wrong just as they have been so

often in the past. Nevertheless this is hardly a record India is used to, or Indians are comfortable with. Perhaps this is largely because they are at a loss to explain the phenomenon of short-lived governments. More, they cannot determine how much of a disaster such arrangements have been on account of their short-lived character.

Or, have they been disastrous at all? Have shortterm governments not dealt with critical issues before the nation with reasonable aplomb?

The government with the shortest life was a coalition led in 1996 by Atal Behari Vajpayee. It lasted all of thirteen days! But it took a gigantic step though it was condemned for it within the country. Hours before being voted out on the floor of parliament, the first Vajpayee

From Rao to Vajpayee

Anand K Sahay looks at how short-lived governments have left their mark on India

government cleared the highly controversial Enron proposal, thus permitting the leading American power multinational to enter the Indian market at a time when India did not permit its own private sector to enter commercial power generation.

Letting Enron in was an entirely hypocritical act as Vajpayee's party, the BJP, and its principal ally, the Shiv Sena, had condemned the previous Congress government for so much as entertaining a proposal from Enron. But the power major's entry cleared the air to a great extent with respect to foreign private investment in India, a subject of sharp, even emotional, political debate to this day.

Vajpayee who belongs to the political right was succeeded by H D Deva Gowda, a not too well known centrist politician, who would have got nowhere without the backing of the Communists. Naturally, his government was pulled from side to side with ideological argumentation. But it was hailed by business and industry

major impact. "Still, no one

knows what is happening in

New Delhi. As no one has a ma-

jority, it is a very confusing sit-

was not sure about the next gov-

ernment in New Delhi, his par-

ty's parliamentarian Jayalath

Jayawardena was confident the

people would rally around the

Congress. "Whether it is a

Congress government or a

Congress-backed government,

it would bring stability," he told

Although Wickremasinghe

uation there," he added.

for the many steps it took which were seen as a continuation of the. liberalisation process started by P V Narasimha Rao five

years earlier. When the Congress pulled down the Gowda government, angry newspaper editorials lashed India's premier party. Though they were very sceptical when Gowda had taken office, and openly made fun of him, they cried their hearts out when he departed.

Gowda was succeeded by I K Gujral, a party colleague. This meant the nature of the coalition - which was backed from the outside by the Communists and the Congress - was not disturbed. The change was confined to a change of leader. Gujral, widely seen as a leftist politician with no mass base but willing to do deals for survival, also did remarkably well in the papers, and even came to be gently ribbed as a

"paper tiger". But his contribution was not entirely without substance. Within the politically riven

Indian subcontinent, he was able to create an overall sense of amity with neighbours, though nothing concrete emerged in India's ties with Pakistan, the country's most crucial neighbour. With Bangladesh, however, Gujral signed the Ganges waters accord which closed a contention of fifty years, and laid the ground for a wider spirit of accommodation in the SAARC (South Asian Association for

Regional Cooperation) region as Gujral fell when the Congress withdrew its support. Elections followed and the electorate once again rendered a splintered verdict. Indeed, the composition of the Lok Sabha, Lower House of Parliament, had never before been so closely divided, the numbers on both sides of the politico-ideological divide being roughly fifty-fifty. Vajpayee was able to form a government with the greatest difficulty and only after Sonia Gandhi, by then president of the Congress, turned down the opportunity. She did not then

want to depend on disparate parties for survival, a stance which may have to be soon given up, given political compulsions.

Vajpayee's second term in office which ended last Saturday after a defeat on the floor of Parliament, principally at the hands of his own alliance partners, was racked by little and big political earthquakes right through its 13 months. These were all internal, and mostly caused by rivals within his own party.

Nevertheless Vajpayee's second tenure saw India openly declaring itself a proven nuclear weapons and missile

In both fields Indian scientists had been at work for four decades. However, after the nuclear explosions, the Prime Minister virtually seemed to buckle under US pressure, and many worried that India may not eventually succeed in having its own nuclear deterrent though it had the

Under American pressure

the Vajpayee dispensation also took a step forward in establishing peace with Pakistan and took his famous bus ride to Lahore. Whatever the inspiration behind the move. most Indians and Pakistanis would welcome a move towards friendship, though in the end it

may prove to be elusive. It is noteworthy that in the three years since P V Narasimha Rao, the last Indian to be Prime Minister for a full five years, had gone out of office, the country has been through economic ups and downs - it is a down right now but it was not thrown off balance by the meltdown in Southeast Asia even when the phenomenon was threatening the economic structure of the

whole globe. India's economy needs key changes if it must break new ground and compete on even terms with the rest of the world, but it is equally clear that the structural foundations laid in the last 40 years have not been in vain, though they are now in desperate need of maintenance and repair. Otherwise, unstable political coalitions may have

taken a huge toll. India Abroad News Service

Business As-usual for Lanka

Colombo is not perturbed by the change in New Delhi, writes Sugeeswara Senadhira

RI Lankan leaders are of the view that the latest political developments in India would not affect bilateral Ranil Wickremasinghe. relations. But some opposition leaders chief of the main opposition believe a Congress government United National Party (UNP), or a Congress-backed regime agreed that there would be no

would be helpful to Colombo's fight against Tamil rebels in the island nation's north and The Sri Lanka government is confident that a change in New Delhi would have no impact on bilateral relations. "As

far as Sri Lanka is concerned. the impact is none at all because the desire of Sri Lanka is to have good relations with whatever party is in power," said acting foreign minister Lakshman Kiriella.

HREE developments this

L be concerned over their

past week give us cause to

India Abroad News Service. Dismissing the contention that Italy-born Sonia Gandhi, the Congress party chief, was an alien, Jayawardena, who participated in a Rajiv Gandhi commemoration seminar in New Delhi, said: "I have met Mrs. Sonia Gandhi and I was highly impressed with her commitment to Indian people and her simplicity. I found her to be more Indian than thousands of other South Asian elite women who are more Westernised than Westerners them-

Jayawardena claimed Sri Lanka could expect the

Congress and the All India Anna Dravida Munnetra Kazhagam (AIADMK) to be helpful in Colombo's fight against terrorism. "Both the parties are well aware of the dangers of Tamil extremism and Sri Lanka could get Indian help to counter terrorism," he claimed.

Sonia's husband Rajiv Gandhi was assassinated by a rebel Sri Lankan Tamil suicide bomber in 1991.

Some economists expressed concern about adverse impact of the uncertainty in New Delhi on the Indian economy and its influence on neighbouring countries. Manel de Silva, an

economist with a leading private bank, said the change in New Delhi could further delay the implementation of the Indo-Sri Lankan free trade agreement signed in December. 1998. "A political directive is necessary to break the current deadlock on duty waivers and until a new commerce minister takes a decision, the treaty would stall," she said.

Former Sri Lankan High Commissioner to India Stanley Kalpage said the economic con-sequences would be more damaging than the political fallout

for India. "The fate of (Finance Minister) Yashwant Sinha's widely welcomed budget hangs in balance," he said. "Political uncertainty will scare away foreign investors as they are likely to worry more about the future of economic reforms than about the fate of the government," he added.

However, he said India could absorb any reversals because of its vast economic base. Kalpage said it was extremely difficult to predict what would happen tomorrow. "In the present state of flux and uncertainty and before the voters give another verdict, strange things can happen on the political scene in Îndia," he said.

India Abroad News Service

A Problematic Foot in the Future

Given the proximity of India and Pakistan, and the brief minutes in which a nuclear exchange will bring their world to and end, Eqbal Ahmed can't imagine how even the most unreconstructed hawk can make a rational case for following India

impact on our future. The first was the action-reaction series of missile tests carried out by India and Pakistan. The second was the Ehtesab Court's conviction of Ms Benazir Bhutto and Mr Asif Zardari on corruption charges. Both events have been greeted by the government as achievements which on the one hand vindicated the government's claims against the opposition leader, and on the other hand me', I replied. manifested its resolve in matters of national security.

A third incident involved the killing, by her own family and inside the Lahore offices of the Human Rights Commission of Pakistan, of an innocent young woman. On reflection, the three events may be viewed as bad omens for Pakistan's fu-Since the tests of last May,

India and Pakistan are formally nuclear military powers. For a decade earlier, they were putative nuclear states. Both were facing then, as they do now, basic questions relating to the possession of nuclear weapons. Yet, there has not been an informed discussion in either country about the risks and responsibilities which arise from the possession of a weapon which, as Henry Kissinger has been fond of repeating, is still in "search of a doctrine". Like the nuclear technology they have duplicated, officials and their supporters in both countries mimic a borrowed language which, to begin with, was arcane and full of obfuscation.

With these tests, so India's defence minister pronounced, "We have achieved minimum deterrence." Period! Mr. Fernandes says so, therefore Q.E.D. The quest of "minimum deterrence" also compelled Pakistan to respond by testing not one but two missile systems. Oth-

erwise, said Pakistani officials, including the prime minister and the army chief, we are not engaged in an arms race. A caller from a prestigious 'think tank' in the US asked: "What is the Indian or Pakistani sense of minimum deterrence?" 'Search Despite months of trying, I

have not understood what the officials mean by 'minimum deterrence'. I suspect that it is a relative of 'strategic depth' in search of which one country (Afghanistan) has been completely destroyed, the other (Pakistan) is under menace, and the Taliban are pushing toward Badakhshan and Peshawar. If they mean what I know minimum deterrence to mean, then neither India nor Pakistan would have publicly brandished their nuclear capabilities which they, like Israel, were known to possess and, unlike South Africa, had not opted to renounce. So let us face it: India is psychologically,

therefore strategically, locked in with China, and Pakistan with India. Neither has a concept of or commitment to the "minimum". Minimalism in strategic matters takes thought and discipline. Sun Tzu had it, as did Mao Zedong and, in his unique way, Gandhi too. But I have not detected any trace of it in the last three generations of South Asian politicians, soldiers, and experts.

We are not in an arms race, they said in Islamabad. Facts suggest otherwise. A year ago, Pakistan tested a missile named Ghauri. Its makers swear to its accuracy. It flies 1,500 kilometers with a 'payload' sufficient to destroy any Indian city. That means that

Delhi and Bombay, Kanpur and Ahmedabad were already within its range - targets that would be considered ample under any calculus of nuclear warfare. Do we need to have the capacity also to hit Patna and Cuttack, Gauhati and Goa in order to have a credible deterrence? If yes, then can we afford to stop at Ghauri II? Given the proximity of India and Pakistan, and the brief minutes in which a nuclear exchange will bring our world to an end, I at least do not imagine how even the most unreconstructed hawk can make a rational case for following India into the dumb pit of testing more missiles. In the circumstance, it is impossible not to conclude that Pakistan's latest missile tests are a consequence of competitive reflex and not of rational strate-

With due apologies to the ex-

perts who claim a monopoly on patriotism, it seems to me that with six heady nuclear tests and half a dozen missile systems behind us, we are very much in the middle of an addictive arms race. Like all addictions, external stimulus - which we can count on India to keep supplying - sustains the internal dynamics of remaining hooked to ever-advancing strategic arms. External and internal compulsions combine to feed the competitive craving to keep up with the Joneses. On April 15 it was hard for me to exit from the arrival lounge of Islamabad airport. It was mobbed by a frenzied crowd that was shouting Jiye Jiye to welcome the scientist (other than Dr. Abdul Qadeer Khan) who was returning from the Shaheen test site. Airport officials were not quite

gic calculation.

prepared for this avalanche, yet somehow someone had gathered a large crowd to give him a noisy welcome. "There is great rivalry", an acquaintance said ence to women's rights." Could the next day, "between Kahuta and AEC - the liquid versus the solid groups - and they compete for credit in the making of the missiles and bombs."

The prime minister and the Chief of the Army Staff have publicly affirmed Pakistan's resolve to not get into an arms race with India. There is no reason to disbelieve their disclaimer. Yet, it is also known that more often than not structures overwhelm intentions instincts defy intelligence, and reflex takes precedence over reflection. They must have known that the recent missile tests will add not a fraction to the strategic balance between India and Pakistan, and could well hurt Pakistan's economic interests. Yet the reflex was to show Delhi where we stood, and deliver two missiles for a missile. At the expense of a certain diversion one may cite another instance of instinct overcoming

intent. I doubt that it is Mr. Nawaz Sharif's intent is to encourage homicide and 'honour killing' Yet, the world has been shocked by the silence and callous indifference of our highest officials toward the killing in Lahore of Saima Imran and subsequent incitements by some religious and business leaders to kill Asma Jahangir, the human rights lawyer. A communique from the London headquarters of Amnesty International reads in part: "By remaining silent in face of such blatant incitement to murder and by taking no effective action against those re-

sponsible for the so-called honour killing of a young woman, the government of Pakistan has displayed a disturbing indifferit be that their reflexes and instincts sympathize with the It may be too early to specu-

late on the impact of Ms. Bhutto's conviction. She and Mr. Zardari are expected to file an appeal in the Supreme Court, and it may take months for the court to decide on the appeal. It is premature to assess the court proceedings and outcome of the case. What one can say without hesitation is that the appearance of justice had been greatly marred by the government's propaganda campaign against Bhutto and Zardari. They were tried and convicted by the official media before the case reached the court. I am not familiar with Pakistani laws and judicial practices but can say with reasonable certainty that had this occurred in the United States, any reputable American judge would have dismissed the case against Ms. Bhutto on grounds merely of unfair pretrial publicity. Thus, what could have been an important, precedent-setting case was turned into a deeply flawed instance of pre-trial political witch-hunting which denuded the trial itself of its meaning. Vested political interests may have been served but sadly the affair has helped neither the judicial nor the political pro-

Should it happen, Ms. Bhutto's disqualification from politics and more seriously her incarceration will harm Pakistan and its nascent parliamentary system. A primary po-

litical gain of this country during the last decade was the emergence of a two-party system which is an essential attribute of stable parliamentary democracy. The downside was that both the major parties are personality oriented, function undemocratically, and sorely lack institutionalized structures and mobility of leaders and cadres. Take away the leader and, in the absence of a dynastic heir, the party will crumble. This may well happen to the Pakistan People's Party if Benazir Bhutto is removed from the scene. The chairperson-forlife has no heir of age, no potential successor, and not even a rival capable of picking up the

The beneficiary of her misfortune will be Mr. Nawaz Sharif who already wields more power than a prime minister should. The Muslim League under him may step into the anomalous position of the Indian National Congress under Jawaharlal Nehru Irom 1948-1964, heading a virtual oneparty state under a parliamentary system. Unlike Nehru. Nawaz Sharif is not a dedicated liberal, or secular democrat. He is not likely to promote opposition to himself as Nehru used to do. Nor is he likely to seek progress through enlightened legislation and policies. His instincts are absolutist and outlook conservative. He may seek to harden the authoritarian and theocratic tissues of state and society. Without a viable opposition he will have more of a free hand than might be good for the country.

Z.A. Bhutto is a more apt comparison. He manoeuvred himself into a position of unchallenged power after taming the armed forces and throwing his opponents in prison. We know how tragically harmful this was for the country, and for

Courtesy: The Dawn of India

Question Marks on Nuclear Safety A heavy water leak in the second unit of the Madras Atomic Power Station

(MAPS) on March 26 causes widespread concern. T.S. Subramanian in

Kalpakkam, India writes

money to repay part of the loan capital can be drawn from personal savings, life insurance policies, PF Loans, arrears of salary or bonuses received, and however, ensure that the HFCs he borrows from encourage such periodic part-repayments without imposing any penal provisions and also permit the reduction in the EMI, or the tenure, or in both, as desired by the borrower. Shorter tenures also help HFC recycle loan more borrowers. In today's market it is almost impossible

which fixed deposit schemes can be floated by HFCs is seven loans of, say, 15 years or less place both the borrowers and HFCs in a win-win situation.

years. Even bank loans and re-finance from the National Housing Bank would be of tenures of 7 years and 15 years. respectively. Hence, shorter tenure housing loans will enable HFCs to bring about a better asset-liability match and secure higher credit ratings from rating agencies. So, in the present market, shorter tenure

By arrangement with the Businesstine with India

TOW much heavy water did leak into the reac-Lator vault of the second unit of the Madras Atomic Power Station (MAPS) at Kalpakkam, about 60 km from Chennai, on March 26? Consequently, how much radioactive tritium was released into the reactor building? What was the level of radioactivity to which the people who stopped the leak and mopped up the heavy water that had spread on the floor were exposed? Opinion is divided on these questions, which are at the heart of a new debate on the safety of Indian nuclear reactors. However, there is no uncertainty about why the leak occurred: a sealing plug of a coolant channel of the second unit was not positioned properly after the completion of maintenance work which was undertaken during the reactor's biennial shutdown. Top MAPS officials main-

tained that the leak was an insignificant and anticipated incident which occurred during a planned operation and that the level of tritium released was within permissible limits. Knowledgeable sources, however, asked why then a plant emergency was declared. These sources said that the declaration of a plant emergency was just a step short of ordering the evacuation of plant personnel. They challenged officials of the

Nuclear Power Corporation (NPC) to release the figures regarding the heavy water leak and tritium release. (All nuclear power stations in the country come under the um-

brella of the NPC.) Officials at MAPS countered these arguments and said that a plant emergency was a part of routine procedure to insulate the plant and bring safety mechanisms into play, besides regulating the entry of persons into the plant in order to prevent the spread of any contamination. A plant emergency, they said, did not mean that the reactor was going to "explode like a nuclear bomb", as was made out in a section of the

MAPS has two units of Pressurised Heavy Water Reactors (PHWRs), each with a capacity of 170 MW. They use ordinary uranium as fuel and heavy water as both coolant and moderator. According to K. Hariharan, Station Director, MAPS, both units had performed very well in 1998-99, with an average capacity factor of 75 per cent. The second unit was shut down from February 14 to carry out maintenance

work. It was scheduled to be restarted this summer when the demand for electricity peaks, Maintenance work, includ-

ing the overhauling of the turbine generator, was almost complete and the MAPS authorities planned to synchronise the unit with the Tamil Nadu grid by May 1. The inspection of coolant channels to assess their health is the main component of the maintenance work. Remote-inspection through ultrasonic methods reveals the channels' metal in-In a reactor, the coolant

tubes (also called pressure tubes) are situated inside the calandria tubes (calandria is the reactor vessel). Both coolant tubes and calandria tubes carry heavy water, and between them are garter springs. Coolant tubes with end-fittings on either side are called coolant channels. Seal plugs (or sealants) form part of the endfittings. The 306 coolant channels in the calandria tubes are arranged within a circular space and together they resemble a lattice. The flow of heavy water in the coolant tubes results in vibrations, as a result of which the garter springs tend to move. This in turn causes the coolant tubes to sag and come in contact with the calandria tubes.

Since there is a temperature difference — it is 295° C inside the coolant tubes and about 70° C in the calandria tubes — the temperature of the coolant tubes comes down at the point of contact. This results in the formation of zirconium hydride, which leads to the coolant tubes, made of zircaloy, becoming hard and brittle. This in turn causes micro-cracks in the coolant tubes. (Such cracks have been noticed in the reactors at the Rajasthan Atomic Power Station, or RAPS, at Rawatbhatta and at MAPS.) If the micro-cracks cut across the thickness of the tubes, they can lead to loss of coolant from the primary system and result in inadequate cooling of fuel in the core. Such a "loss of coolant accident" (LOCA) may lead to a

fire in the reactor. The Bhabha Atomic Research Centre (BARC) in Mumbai has developed a technique to carry out a vibration probe near the face of the end-fitting

of the coolant tube to help determine the extent to which the coolant channels will sag and the possibility of their coming in contact with the calandria tubes. These channels are defuelled and subjected to a BARC Channel Inspection System (BARCCIS) to determine the position of the garter springs. All the 306 coolant channels in the second unit of RAPS were replaced and the unit attained recriticality on May 27, 1998. The new coolant channels are made of zirconium niobium instead

of zircaloy. BARCCIS was under way at the second unit of MAPS as part of maintenance work. The coolant channels are ultrasonically tested to assess their condition. These checks are conducted through remote-handled semi-automatic tools. The data collected help assess the life of the tubes and the unit's potential for continued operation. During such inspections, when new seal plugs are positioned and operated, a certain amount of information is available to

When a seal plug operation was undertaken in one of the

the control systems.

coolant channels at the second unit of MAPS, the control systems received information that the plug was not seated properly. It was discovered on March 26 that heavy water had leaked out into the reactor building because the seal plug was not positioned properly.

Hariharan said: "We undertook the operation of re-seating the plug in the form of replacement which involves planned escape of heavy water from the channel inside the fuel machine vault." According to him, such situations are not unusual and there are adequate built-in provisions in the unit to tackle them. These included provisions to collect heavy water and heavy water vapour through recovery systems and make an adequate inventory of heavy water available. He said: "The March 26 incident thus did not involve an unusual situation especially since the unit was under shutdown and the whole activity was planned." During such operations, it is customary for nuclear stations to ensure that the environment is not affected. Hariharan said that there was "no such release into the environment" around MAPS.

By arrangement with the Frontline magazine of India