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Fri, 23 April 2021

Match Chinese MRLs with Pinaka: Lt Gen. P. Ravi Shankar | India Today Insight

Lt Gen. P. Ravi Shankar, former director-general, artillery, on the need for India to fill the gaps in its rocket artillery and train at high altitudes

By Sandeep Unnithan

On April 19, China's military newspaper, *People's Daily*, carried a report confirming the deployment of what it said was 'a regiment of an advanced long-range rocket launcher' to the Himalayas. The report came two months after India and China disengaged troops after a 10-month long standoff near the Pangong Lake in the Kailash Range. To understand the significance of this deployment, India Today Executive Editor Sandeep Unnithan spoke with Lt Gen. P. Ravi Shankar, former director-general, artillery, who spoke of the need for India to fill the gaps in its rocket artillery and train at high altitudes.



An advanced version of the DRDO-developed Pinaka rocket was successfully flight tested from Integrated Test Range, Chandipur off the coast of Odisha, Nov. 4, 2020 (PTI)



Lt Gen. P. Ravi Shankar in conversation with Sandeep Unnithan

What do you make of the report in the PLA daily about the deployment of a new rocket system in Xinjiang?

PRS: The report says they have deployed a new weapons system as a deterrent against India, and that an artillery brigade has carried out firing drills. It also says that it has precision strike capability, a multiple launch system with more than 100 km range and entered service in 2019. One of the experts quoted in a *South China Morning Post* report says that only long-range MRLs

(multiple rocket launchers) are powerful enough to act as a deterrent to India. The Indian troops are also increasing military deployment along the borders. About a month or two back, there were reports that China has extended its map grids well into India, which means that they can acquire and strike at targets on our side.

Based on recent reports, these MRLS are either the 280 km AR- 3, the PHL-03 MRL with 12 launch tubes for 300-mm rockets (range 130-160 km) or the standard A-100 rocket launcher which is very similar to the Smerch which that we have.

PRS: These rocket systems will operate from bases--maybe air bases--where there is intrinsic air defence protection. If they get out of these 'hides', they will be vulnerable in open terrain. We must not get perturbed by this news. They are using missiles to fill the void in their air force capabilities. Clearly, what they are doing is posturing, 'deterrence by punishment'. We need to respond to this with 'deterrence by denial'.

How do we do this?

PRS: They can target Leh from Hotan (in Xinjiang) using the 400 km range version of the rocket. But if they use the 160 km variant, they have to come onto their G-219 highway passing through Aksai Chin. This means that the whole system will get exposed. They will deploy in a hide, stage forward to shoot and scoot. But in doing so, during entry or exit, they can be detected. And they can be vulnerable after firing. A rocket fired at this altitude will be visible from miles away. They have many vehicles like an ammunition loader etc. which means they have to deploy astride a road, they can't go far away. So what we need to do first is keep them under surveillance, then hunt them down with our special forces or trans-border patrols. We need to have dedicated surveillance capability. This means our sensor-to-shooter links have to be of a very high order, including communications and procedures which we don't have now. Deterrence by denial should be our motto, ideally using the extended range Pinaka MRLs.

What should be our response?

PRS: The Smerch, which is a 300 mm rocket, has a range of 90 km. The indigenous 214 mm Pinaka also has a range of 90 km. It also has an extended range version. Guided Pinaka rockets can go up to 100 km. Using ram jet-propelled rockets, in a couple of years, we can go to 200-250 km. But we need to increase numbers and we need to use it all along the LAC. If you have a range of 100 km, then you can control the entire area of the G-219 (China National Highway 219) because they have to come astride the highway. If you deny them the G-219, then they are confined to firing from Xinjiang. As the saying goes, more small shells do greater damage than few large shells. Pinaka is great equipment that we have; unfortunately, we aren't exploiting it enough.

When you say not exploiting it fully, how many regiments of Pinaka do we have? How many are on order?

PRS: Right now, we have four Pinaka regiments, six are under order. The problem here is that at one point in time before the Chinese threat appeared, we had authorised 22 regiments...we wanted 22 regiments (a regiment has 18 launchers and each launcher can fire 12 rockets). Now, when the threat has gone up, we have reduced it to 10 regiments. This needs a rethink. Especially in light of these new deployments. Compared to the (Russian) Smerch, the Pinaka is dead cheap. Plus you have the capability to expand the range.

The fact that they have deployed rockets and not missiles, does it imply they are looking at a threshold? These are two nuclear-weapon states we are talking about.

PRS: They are reaching the threshold between non-nuclear and nuclear. When such a weapon is fired, you don't know if it is nuclear or not. Anything over 155 mm, you can put a nuclear warhead. You've gone beyond the zone between tactical and nuclear. We are going into a zone of ambiguity. Which is why our strategy of 'deterrence by denial' has to be very strong. Through this, the escalation dynamics come in. I'm not saying they will do it, but that's how they will posture.

We have fought a war in Kargilin the last two decades haven't we done anything to improve our firing capabilities in the high altitudes?

PRS: As far as guns with ranges at high altitudes, we have no problems. But we don't have firing ranges for longer-range systems. Unless you have ranges for longer-range systems and fire them and test them, you will not know. If we don't test our rockets at high altitude, we are in trouble.

<https://www.indiatoday.in/india-today-insight/story/match-chinese-mrls-with-pinaka-1t-gen-p-ravi-shankar-1794041-2021-04-22>

COVID 19: DRDO's Contribution



Fri, 23 April 2021

अवध शिल्प ग्राम में तेजी से बन रहा अस्पताल, ऑक्सीजन से लेकर ICU के इंतजाम में जुटा DRDO

डीआरडीओ अवध शिल्प ग्राम में 300 बेड का कोविड केअर अस्पताल बना रहा है। ऐसे में डीआरडीओ ने अवध शिल्प ग्राम के प्रेक्षागृह में ऑक्सीजन वाले एल 2 श्रेणी के वार्डों के ब्लॉक को बनाना शुरू कर दिया है। इसके आसपास बने पक्के कमरों को आईसीयू में तब्दील किया जाएगा।

By Anurag Gupta

लखनऊ: शहर में जब एक एक बेड के लिए कोरोना संक्रमित रोगी भटक रहे हैं। वही दूसरी ओर डीआरडीओ भी तेजी से अवध शिल्प ग्राम में कोविड केअर अस्पताल बनाने में जुट है। डीआरडीओ की देश के कई शहरों से आई टीम बेड बनाने, उसमें ऑक्सीजन और ऑक्सीजन की सुविधा देने में जुट गया है।

डीआरडीओ अवध शिल्प ग्राम में 300 बेड का कोविड केअर अस्पताल बना रहा है। ऐसे में डीआरडीओ ने अवध शिल्प ग्राम के प्रेक्षागृह में ऑक्सीजन वाले एल 2 श्रेणी के वार्डों के ब्लॉक को बनाना शुरू कर दिया है, जबकि इसके आसपास बने पक्के कमरों को आईसीयू में तब्दील किया जाएगा। डीआरडीओ के अधिकारियों के मुताबिक वैसे तो दिल्ली वाला अस्पताल सात दिन में तैयार हो गया था, लेकिन लखनऊ में कई ब्लॉक का निर्माण और फिर बाहर से ऑक्सीजन व वेंटिलेटर के लिये कई एजेंसियों से संपर्क किया गया है।



पहले चरण में होलडिंग एरिया सहित सभी ब्लॉकों के निर्माण का काम तीन से चार दिन में पूरा कर लिया जाएगा। इसके बाद बेड में आईसीयू और ऑक्सीजन उपकरणों को असेंबल किया जाएगा। यह काम होते ही एडवांस लाइफ सपोर्ट सिस्टम का ड्राई रन होगा। इस बीच लखनऊ के इस अस्पताल के नोडल अधिकारियों को भी नामित कर लिया जाएगा। कोरोना संक्रमित रोगियों की भर्ती से लेकर उनके उपचार और डिस्चार्ज को लेकर भी गाइड लाइन बन रही है। दो से तीन दिन में इसे भी तय कर लिया जाएगा।

<https://www.jagran.com/uttar-pradesh/lucknow-city-drdo-mobilized-from-oxygen-to-icu-arrangements-in-the-hospital-being-built-in-avadh-shilp-gram-21582408.html>

Amit Shah to visit DRDO Covid facility today

“The visit of Union Home Minister Amit Shah has been planned for tomorrow,” principal secretary education Anju Sharma confirmed

Ahmedabad: Union Home Minister Amit Shah is scheduled to visit a 900-bed dedicated covid care hospital set up by the Defence Research and Development Organisation (DRDO) and Gujarat University (GU) Friday.

“The visit of Union Home Minister Amit Shah has been planned for tomorrow,” principal secretary education Anju Sharma confirmed.

She added, “He will not be inaugurating the hospital but will visit to review the preparations. The facility will start operations from Saturday after a thorough sanitisation and cleaning of the area.”

A dry run was held at the hospital, an initiative by the state government with oxygen-equipped beds at the Gujarat University Convention and Exhibition Centre in Memnagar. The estimated expenditure is Rs 60 crore for the facility to be operational for three months.

Sources in the BJP said that after visiting DRDO’s Covid hospital on Friday morning, Shah is expected to chair a meeting of senior party officials and government functionaries and take stock of the prevailing Covid situation in the state.

Shah is expected to spend 2-3 days in Gujarat, sources added.

<https://indianexpress.com/article/cities/ahmedabad/amit-shah-to-visit-drdo-covid-facility-today-7285375/>



The 900-bed Covid facility gets ready at GMDC ground in Ahmedabad. (Express Photo)

DRDO's facility for COVID patients in Ahmedabad expected to start on 24 April

Defence Minister Rajnath Singh virtually reviewed the preparedness of Ministry of Defence and Armed Forces on Tuesday to deal with the recent spike in COVID-19 cases across the country

By Mayank Singh

New Delhi: Amidst the rising number of COVID-19 cases, the Ministry of Defence has pushed Defence Research and Development Organisation and defence PSUs along with the Armed Forces to spruce up facilities in different parts of the country. One of the largest facilities, which will be coming up in Ahmedabad, will start functioning by Saturday.

Sharing the details a source said, "The Dhanvantri COVID Hospital coming up at Gujarat University Convention and Exhibition Centre - Ahmedabad will have 900 beds out of which 150 will be ICU beds with ventilators. Remaining 750 beds also will be provided with oxygen supply." He said that while construction work started on 14 April, operations are expected to begin on 24 April said the source and "hospital is being jointly raised by DRDO and Govt of Gujrat in collaboration".



Defence Minister Rajnath Singh (Photo| Twitter)

Defence Minister Rajnath Singh virtually reviewed the preparedness of Ministry of Defence and Armed Forces on Tuesday to deal with the recent spike in COVID-19 cases across the country.

The Defence minister was informed by DRDO chairman Dr G Satheesh Reddy that a COVID-19 facility, developed by DRDO, has again been made functional in New Delhi and efforts are being made to soon increase the number of beds from 250 to 500.

He said that ESIC Hospital, which was converted to COVID hospital in Patna, has started functioning with 500 beds. He added that work on a 900 bed hospital in Ahmedabad was on war footing in addition to a 450-bed hospital in Lucknow and 750-bed hospital in Varanasi.

Rajnath had called upon the Armed Forces to be in close contact with the state governments and be ready to provide any required assistance. He also delegated the emergency powers of procurement so that critical needs are procured.

The defence minister suggested to utilise the services of vaccinated retired Armed Forces personnel to assist the civil administration/state governments to deal with the current situation.

<https://www.newindianexpress.com/nation/2021/apr/22/drdo-facility-for-covid-patients-in-ahmedabad-expected-to-start-on-24-april-2293502.html>

In Covid fight, Army, Air Force deploy doctors, send oxygen tanks

Coronavirus: The assistance from the armed forces comes at a time when several hospitals in the country have issued notices to say they have only a few hours of medical oxygen need for COVID-19 patients

Reported by Vishnu Som, Edited by Shylaja Varma

New Delhi: The army and the air force have pitched in to help India fight the battle against coronavirus as several parts of the country have been reporting dire shortage of essential medicines and oxygen supply.

The army and air force are deploying doctors and other medical staff in Delhi and other cities. While the army has sent its doctors to the Covid hospital set up by the DRDO (Defence Research and Development Organisation) in Delhi, the air force has airlifted doctors and nursing staff from Kochi, Mumbai, Visakhapatnam and Bengaluru to the Delhi hospital.

The IAF, which said it is ready to undertake any task for Covid relief, has also flown in oxygen containers of the DRDO from Bengaluru to Covid centres in Delhi. The air force is also flying in regulators, trolleys and essential medicines.

While 10 army doctors have been sent to the Gujarat University Convention Centre in Ahmedabad, four have been sent to the ESI Hospital in Patna.

An army team will be deployed at a Covid isolation facility in Madhya Pradesh's Sagar to help it its operation.

A special train service called the "Oxygen Express", which carries medical oxygen, used 32 flatbed bogeys which belong to the army in its journey to Visakhapatnam.

The assistance from the armed forces comes at a time when several hospitals in the country have issued notices to say they have only a few hours of medical oxygen need for COVID-19 patients.

India today marked a grim milestone in the pandemic, reporting 3,14,835 new daily cases, the highest one-day tally globally. 2,104 people died in the last 24 hours, the highest daily jump in the country.

With many hospitals unable to meet the rising demands for oxygen cylinders and medicines, desperate families and even Covid patients have been taking to social media to seek help for beds, oxygen or medication since the last few weeks.

<https://www.ndtv.com/india-news/coronavirus-in-covid-fight-army-air-force-deploy-doctors-send-oxygen-tanks-2419373>



The IAF has also flown in oxygen containers of the DRDO from Bengaluru to Covid centres in Delhi.

Military, defence wings go in overdrive for Covid relief

As many as 15,924,697 confirmed infections and 184,693 deaths (as of Wednesday) have been reported across the country since the pandemic began, according to HT's dashboard

By Rahul Singh

As India reels under an unprecedented public health emergency, its hospitals stretched thin by a staggering number of Covid cases and deaths due to scarcity of beds, oxygen and medicines, the military and other wings of the defence ministry have been ordered to respond on war footing to fight the outbreak that has so far claimed nearly 185,000 lives, people familiar with the developments said on Thursday.

From setting up Covid hospitals to ramping up oxygen production and airlifting of medical staff and oxygen containers to liaising with state governments to help them deal with the rising number of daily cases, the armed forces, the Defence Research and Development Organisation (DRDO) and defence public sector undertakings (DPSUs) are working overtime for Covid relief, said one of the people cited above.



The DRDO is among the organisations that are at the forefront of fighting the second deadly wave of Covid that has ripped through the country.(ANI Photo)

As many as 15,924,697 confirmed infections and 184,693 deaths (as of Wednesday) have been reported across the country since the pandemic began, according to HT's dashboard. The most worrying factor right now is how fast daily cases are multiplying, and how the trajectory is showing no clear signs of approaching a peak.

The DRDO is among the organisations that are at the forefront of fighting the second deadly wave of Covid that has ripped through the country. It has so far set up or is in the process of setting up state-of-the-art Covid hospitals in six cities to treat more than 3,100 critical patients, said a second official.

The DRDO has set up a 500-bed hospital in Delhi and converted an ESIC hospital into a 500-bed Covid facility in Patna. In addition, hospitals with 450 beds in Lucknow, 750 beds in Varanasi and 900 beds in Ahmedabad are expected to be functional soon. A sixth Covid hospital is being readied in Bihar's Muzaffarpur.

The DRDO has also stepped in to address the oxygen crisis precipitated by the second wave of the disease. It has transferred oxygen generation technology to the industry, which has now started providing oxygen plants to state governments and hospitals, the official said. The Uttar Pradesh government, for instance, has ordered five such plants from Coimbatore-based Trident Pneumatics.

The technology transferred to the industry is based on the onboard oxygen generation technology developed for the Tejas light combat aircraft. The oxygen generation plants can produce 1,000 litres of oxygen per minute. "More plants can be supplied by the industry to cater to the hospital requirements pan-India," the official said.

The DPSUs are also making arrangements to buy oxygen plants for the production and supply of oxygen cylinders at a swift pace.

Technology developed by the DRDO for a supplemental oxygen delivery system for soldiers posted in high-altitude areas has also been transferred to the industry, and it will soon be available in the market for use by Covid patients.

The Indian Air Force has deployed its aircraft for airlifting medical personnel, oxygen containers, oxygen cylinders, trolleys and essential medicines, an IAF official said.

“Doctors and nursing staff were airlifted from Kochi, Mumbai, Vizag and Bengaluru for setting up the DRDO Covid hospital at Delhi. Oxygen containers of the DRDO have also been airlifted from Bengaluru for Covid centres in Delhi,” he said.

The armed forces and other wings of the defence ministry can play an important role in the fight against Covid-19, said Lieutenant General BK Chopra (ret'd), a former director general of the Armed Forces Medical Services.

“They have the manpower, resources and discipline to provide relief in these hard times. The military especially has a culture of quick response, be it enemy action or natural catastrophes. It can do a lot to alleviate the sufferings of our countrymen during the pandemic too,” Chopra said.

On April 20, defence minister Rajnath Singh carried out an extensive review of the preparedness of the armed forces and other allied organisations to deal with the surge in Covid infections across the country.

At that meeting, Singh asked the DPSUs, the DRDO and others to work on war footing to provide oxygen cylinders and extra beds to civil administration and state governments. The armed forces and other stakeholders were also given the go-ahead to buy medicines and other critical items using their emergency powers.

The military is also exploring the possibility of utilising the services of vaccinated retired military personnel to help the civil administration and state governments deal with the grim situation.

<https://www.hindustantimes.com/india-news/military-defence-wings-go-in-overdrive-for-covid-relief-101619117332998-amp.html>



Fri, 23 April 2021

DRDO product an oxygen source for COVID patients

This automatic system delivers supplement oxygen based on the SpO2 levels

Hyderabad: Defence Research and Development Organisation (DRDO) has unveiled a new product that is useful not only for Army soldiers fighting in the extreme high altitude areas, but to all those grappling with COVID crisis.

The Defence Bio-Engineering and Electro Medical Laboratory (DEBEL), Bengaluru, has developed SpO2 (Blood Oxygen Saturation) supplemental oxygen delivery system for soldiers at extreme high altitudes. This automatic system delivers supplement oxygen based on the SpO2 levels and prevents the person from sinking in to a state of ‘hypoxia’, which is fatal in most cases.

Hypoxia is a state in which the amount of oxygen reaching the tissues is inadequate to fulfil all the energy requirements of the body. This is exactly the situation that a COVID patient may face leading to the current crisis, informed an official release.

The electronic hardware of the system is designed for functioning at extreme altitudes featuring low barometric pressures, low temperatures and humidity. The software safety checks incorporated into the system are critical in ensuring the functional reliability of the system in field conditions.

The system reads SpO2 levels of the subject from a wrist-worn pulse oximeter module through wireless interface and controls a proportional solenoid valve to regulate the oxygen supply. The oxygen is delivered from a lightweight portable cylinder through nasal prongs.

The system is available in various sizes from 1 litre and 1kg weight with 150 litres of oxygen supply to 10 litres and 10 kg weight with 1,500 litres of oxygen supply, which can sustain for 750

minutes with a continuous flow of two litres per minute. Since the system is indigenously developed for operation in field conditions, it is robust, cheap and already in bulk production.

The system can be used in the household for moderate COVID patients requiring oxygen flow therapy with flow controlled at 2/5/7/10 litres per minute. The automatic usage has huge advantage in the household, as the oximeter would give an alarm for lower SpO2 value. It will automatically increase/decrease the O2 flow based on SpO2 setting, which can be auto adjusted at 2,5,7,10 litres per minute flow rate.

The simple-to-use facility greatly reduces the work load and exposure time of doctors and paramedics to monitor the SpO2 levels of patients. A moderate COVID patient requires long time moderate O2 supply 10litre/150bar–10kg–1,500 litres, which can sustain up to 750 minutes, the release added.

<https://www.thehindu.com/news/cities/Hyderabad/drdo-product-an-oxygen-source-for-covid-patients/article34388421.ece>

Defence News

Defence Strategic: National/International



Press Information Bureau
Government of India

Ministry of Defence

Thu, 22 April 2021 3:33PM

Indian Navy dispatches its Deep Submergence Rescue Vessel to support Search and Rescue of missing Indonesian Submarine

Raksha Mantri Shri Rajnath Singh holds telephonic conversation with his Indonesian counterpart General Prabowo Subianto;

Extends full support to Indonesia's efforts to rescue missing Indonesian submarine

Indian Navy dispatched its Deep Submergence Rescue Vessel (DSRV) on Thursday to assist Tentara Nasional Indonesia-Angkatan Laut (TNI AL - Indonesian Navy) in search and rescue efforts for the Indonesian Submarine KRINanggala which was reported missing on Wednesday 21 Apr 21.

On 21 April, an alert was received by Indian Navy through International Submarine Escape and Rescue Liaison Office (ISMERLO), regarding the missing Indonesian submarine. The submarine was reportedly exercising in a location 25 miles North of Bali with a crew of 53 personnel.

Telephonic Conversation of Raksha Mantri with his Indonesian counterpart

Raksha Mantri Shri Rajnath Singh had a telephonic conversation with the Indonesian Defence Minister Gen Prabowo Subianto, today.

Raksha Mantri said, “I am extremely pained to hear about the missing Indonesian Submarine Nanggala with 53 crew on board. As a well wisher and a Defence Minister myself I can feel the pain and anguish. At this point I would like to extend the full support of the Indian Armed Forces to the Indonesian Rescue effort.”

“I have already directed the Indian Navy to move its Deep Submergence Rescue Vessel (DSRV) to Indonesia. I have also tasked the Indian Air Force to see the feasibility of induction of the DSRV intervention system by air”.

“India is committed to assist our strategic partners during times of necessity. Please accept my concern and best wishes to a successful rescue.”

General Subianto has acknowledged and appreciated India’s support to Indonesia.

Submarine rescue is required to be undertaken when a submarine is reported to be missing or sunk and specialised equipment is required for underwater search to locate the disabled submarine and rescue the personnel who are trapped inside the submarine.

India is amongst the few countries in the world capable of undertaking Search and Rescue of a disabled submarine through a DSRV. Indian Navy’s DSRV system can locate a submarine upto 1000 meter depth utilising its state of the art Side Scan Sonar (SSS) and Remotely Operated Vehicle (ROV). After the submarine is successfully located, another sub module of DSRV- the Submarine Rescue Vehicle (SRV) - mates with the submarine to rescue the trapped personnel. The SRV can also be used to provide emergency supplies to the submarine.

Under the framework of comprehensive strategic partnership between India and Indonesia, Indian Navy and Indonesian Navy share a strong partnership of operational cooperation. The two navies have been exercising regularly in the past and have developed synergy and interoperability which is considered important for the present mission.

<https://www.pib.gov.in/PressReleasePage.aspx?PRID=1713390>

Rafale weaponry prompts China, Pak to alter defence posture

According to top South Block officials, with the IAF's first Rafale squadron just one short of completion in Ambala, the Chinese have moved their so-called fifth generation fighter J-20 ahead in the Tibet and Xinjiang airbases

By Shishir Gupta

With the Indian Air Force's (IAF) Rafale fighter successfully test-firing the 60km range Hammer air-to-ground modular weapon in March, the air defence posture of both China and Pakistan has changed in the wake of the advent of the multi-role fighter in South Asia, according to people familiar with the matter.

The Hammer weapon secured a bunker-busting vertical hit on its target at the testing location. According to top South Block officials, with the IAF's first Rafale squadron just one short of completion in Ambala, the Chinese have moved their so-called fifth generation fighter J-20 ahead in the Tibet and Xinjiang airbases. The Pakistanis have also moved their Chinese import JF-17 fighter in key forward bases to tackle the clear and present threat of the Rafale fighter. Although the Chinese say the J-20 is the third operational fifth-generation fighter after the US F-22 and F-35, genuine fifth-generation fighters developed by the Americans do not have a canard that further reduces the cross-section of the plane, the officials said. The Chinese J-20 has the same canard as the Rafale, which the IAF calls a 4.5-generation fighter.

The Chinese and Pakistani air posture has also undergone a change with IAF's induction of the Rafale as the latter carries the Meteor air-to-air missile, whose range is way beyond any missile the other two forces have in their arsenal. The Hammer and Scalp air-launched cruise missile with a range of over 500km ensures that the adversary will have no early warning as the two weapons can be launched from within Indian territory and beyond visual range.

While India could only send three out of five readied fighters from the Merignac Bordeaux airbase in France on Wednesday due to unforeseen reasons, seven more fighters have been lined up for delivery to IAF next month. Although the seven fighters may come in batches of three and four, six of them will be flown to the Hashimara airbase in West Bengal via Ambala. The re-pavement and extension of the main runway at Hashimara, which sits astride the Siliguri corridor, is expected to be completed by this month-end. The Hashimara upgrade also includes blast pens and surface-to-air missile batteries to protect the vital base.

<https://www.hindustantimes.com/india-news/rafale-weaponry-prompts-china-pak-to-alter-defence-posture-101619117691126.html>



IAF chief Rakesh Bhadauria with the RB 007 fighter jet. All Rafale jets carry the RB call sign in honour of Bhadauria, who played a key role in negotiating the fighter jet deal.

With four more Rafale aircraft landing at Ambala Air Force Station, India has a full-strength squadron of the combat aircraft

By Ravi Sharma

Thirteen years after the process to acquire a medium multi-role combat aircraft (MMRCA) that would fill the gap between the indigenous, under-development Tejas light combat aircraft and the in-service Su-30MKI air superiority fighter was kicked off, the Indian Air Force (IAF) finally got a full-strength squadron of Rafale fighters. (A squadron generally comprises 18 aircraft.) Four more French-built Rafale aircraft joined the No. 17 Golden Arrows squadron in Ambala Air Force Station (AFS), Punjab, on April 21 after flying almost 8,000 km from Merignac Air Base in France, with air-to-air re-fuelling support.

The four Rafales are part of the order India had contracted with Dassault Aviation in September 2016 for 36 warplanes (two squadrons) for ₹59,000 crore under a government-to-government contract. With the arrival of the new aircraft, the number of Rafales in the IAF's inventory on Indian soil has increased to 18. France has already handed over 25 of the contracted fighters, but seven of them are being used in France to train IAF pilots and crew.



Significantly, the four fighters were flagged off by Chief of Air Staff Air Chief Marshal R.K.S. Bhadauria, who is on a five-day visit to France. The visit is expected to boost cooperation between the IAF and the French Air and Space Force (FASF). On April 20, Air Chief Marshal Bhadauria held talks with General Philippe Lavigne, Chief of Staff of the FASF, on ways to further expand cooperation between the two countries. Bhadauria also visited a Rafale aircraft training centre during his visit.

“This ferry, which is the fifth from here, marks the end of the [training of the] third batch of our pilots and all our maintenance crew. The Rafale training centre has provided world-class training and it is because of the level and quality of training that we were able to operationalise the aircraft quickly,” he said after flagging off the four Rafale aircraft. Saying that some of the Rafales had been delivered a “little bit” ahead of time, Air Chief Marshal Bhadauria said the fighters have contributed to the overall combat potential of the IAF.

The four Rafales were the fifth batch of the Dassault-built fighters to arrive in India. While the first batch of five Rafale jets (three single-seater and two twin-seater fighter aircraft) landed at AFS Ambala on July 29 after a stopover at the Al Dhafra air base near the Strait of Hormuz, the second, third and fourth batches reached the Jamnagar AFS in Gujarat in early November, January and early April respectively before they flew to their home base in Ambala. The formal induction ceremony of the Rafales took place on September 10, 2020.

Based at Ambala AFS, one of the IAF's most strategically located bases—the Indo-Pak border is around 220 km from the airbase—the Golden Arrows will certainly boost India's airpower, fighting capabilities and offensive arsenal. The IAF's second squadron of Rafale fighters will be stationed at Hashimara AFS in West Bengal.

With a combat range of 780-1,650-km without mid-air refueling, the 4.5-generation Rafales can be armed, depending on the nature of their mission, with long stand-off weapons like the over 300-

km range “Scalp” air-to-ground cruise missile, the “Meteo” air-to-air missile and the “Hammer” air-to-ground precision-guided munition.

Sources told Frontline that five more Rafales would be landing in India in a matter of weeks and will be ferried to Hashimara AFS. All the 36 contracted aircraft are scheduled to be delivered on time, by the end of 2022.

The Rafales were deployed for patrolling along the Line of Actual Control (LAC) with China in eastern Ladakh and other fronts during the height of the confrontation with China. The Rafales’ “Hammer” air-to-ground precision-guided munitions, which have a strike range of 20 to 70 km, are designed to destroy bunkers, hardened shelters and other targets in terrains such as the mountainous ones prevalent in Ladakh.

For the IAF, the Rafales are a welcome, and timely, force multiplier. But, with the Air Force’s combat squadron strength down to under 30, a far cry from the 42 that it seeks to maintain, the IAF is hoping that the Narendra Modi government will move fast and take to its logical conclusion the IAF’s long-deferred requirement for 114 MMRCA aircraft if it is to effectively deal with two hostile fronts. The MMRCA 2.0 deal is worth an estimated \$18-20 billion.

<https://frontline.thehindu.com/dispatches/with-four-more-rafale-aircraft-landing-in-ambala-air-force-station-india-has-a-full-strength-squadron-of-the-combat-aircraft/article34383789.ece>



Fri, 23 April 2021

Indian Air Force’s Hawk-i Trainer Jet is now equipped with deadly ASRAAM missile

The Indian Air Force’s Hawk-i trainer jet has been developed into a missile-carrying aircraft. An image doing the rounds on social media shows the trainer aircraft with a wingtip mounted AIM-132 ASRAAM missile.

Imagine an aircraft that can be used as an advanced trainer for Air Force recruits, which also can carry bombs and ammunition to counter hostile targets both in the air and land and is cheaper than conventional fighter jets.

Well, the Indian Air Force’s Hawk trainer could offer you a package deal after the latest modification.

An image tweeted by the IAF’s veteran pilot Grp. Capt. Harsh Vardhan Thakur (VSM) shows a Hawk-i aircraft with wingtip mounted AIM-132 Advanced Short Range Air to Air Missile (ASRAAM). The caption says, “Missile integrators. Hawk-i with ASRAAM.”

Although the image was taken during the Aero India show, he stated that the work is in progress for the integration of the missile with the aircraft. Thakur is also the experimental test pilot for India’s state-owned aerospace giant Hindustan Aeronautics Limited.

The Indian Air Force has been eyeing these trainer aircraft for combat support roles, arming them with air-to-ground munitions.

The Hawk is a British single-engine, jet-powered advanced trainer aircraft first flown at Dunsfold, Surrey, in 1974 as the Hawker Siddeley Hawk, and subsequently produced by its successor companies, British Aerospace, and BAE Systems.

It has been used in a training capacity and as a low-cost combat aircraft.

For the Indians, it could be an efficient and low-cost platform to carry out combat missions and train pilots simultaneously. It has been armed and already displayed its compatibility with rocket pods, and even used by the Defence Research and Development Organisation (DRDO) to carry out

weapon tests including the latest Smart Anti-Airfield Weapon (SAAW)- which can engage targets with high precision from distances as far away as a hundred kilometers.

While these air-to-ground munitions are being tested and integrated with the Hawk fleet, the addition of ASRAAM missiles would give it an aerial combat capability.

According to analysts, it would be a great addition to shoot down enemy UAVs, for which a fighter jet wouldn't need to be scrambled considering the cost-effectiveness and lower range.

The ASRAAM close-combat missile will eventually give the Hawk a self-defense ability against hostile aircraft, according to Thakur.

<https://eurasianimes.com/indian-air-forces-hawk-i-trainer-jet-is-now-equipped-with-deadly-asraam-missile/>

NAVAL TECHNOLOGY

Fri, 23 April 2021

Indian Navy's first MH-60R helicopter conducts maiden flight

The Indian Navy's first MH-60R production helicopter has conducted its maiden flight in Owego, New York

The Indian Navy's first MH-60R production helicopter has conducted its maiden flight in Owego, New York.

The milestone was announced by the US Naval Air Systems Command (NAVAIR) via Twitter.

NAVAIR tweeted: "The first India production aircraft takes flight in Owego, NY. India will receive a total of 24 aircraft. #BZ to the #NAVAIR PMA-299 team on securing three FMS cases in calendar year 2020."

It was carried out at Lockheed Martin's Rotary and Mission Systems (RMS) plant.

Lockheed Martin company Sikorsky Aircraft is under contract to produce the MH-60R Seahawk multi-mission naval helicopter.

In February last year, India and the US signed a deal for the procurement of MH-60R Seahawk helicopters for the Indian Navy.

Under the \$2.12bn deal, 24 MH-60R Seahawk helicopters will be purchased to replace the Sea King helicopters.

Out of the 24 choppers, delivery of the first six is expected to take place this year.

The MH-60 is expected to fill the Indian Navy's requirement gaps. The navy currently owns a few ageing Sea King and Kamov choppers.

The MH-60R integrates advanced mission systems and sensors developed by Lockheed Martin Mission Systems and Training (MST).

The helicopters are designed to conduct a range of operations, such as anti-submarine warfare, anti-surface warfare, vertical replenishment, surveillance, search and rescue, personnel transport, and logistics support.

In August last year, Sikorsky Australia won a through-life sustainment support contract for the Royal Australian Navy's (RAN) MH-60R (Romeo) helicopters.

<https://www.naval-technology.com/news/indian-navys-first-mh-60r-helicopter-conducts-maiden-flight/>



An MH-60R Seahawk conducts sonar operations. Credit: US Navy.

Why India opted for a ‘stand-alone’ agreement with China in Ladakh

It is my assessment that the Chinese issued a direct/indirect threat to go on the offensive in DBO and Gogra-Hot Springs sector

By Lt Gen H S Panag (Retd), Edited by Anurag Chaubey

There has been a phased but continuous source-based coverage and commentary about the lack of progress on the disengagement process — with special reference to Gogra-Hot Springs and Depsang Plains — since the 11th Corps Commander-level talks held on 9 April. In the past, deliberate ‘government leaks’ on the situation in Eastern Ladakh were given as handouts to all media houses and the story was broken almost simultaneously.

This time, such reports have appeared in different media outlets intermittently with slight variations to ensure their credibility. The intent seems to be to justify and shape public opinion to accept an ‘unfavourable peace’ that is being imposed on us by the Chinese.

The themes of the ‘unofficial briefings’

The Indian Express reported that Depsang was a legacy issue dating back to April-May 2013 intrusion, after which our patrols have been prevented from going beyond Bottle Neck/Y Junction up to Patrolling Points 10, 11, 12 and 13. The source emphasised that nothing new has happened in Depsang Plains during this entire crisis since April 2020, and that it was added to the list of friction areas so that it gets resolved. Thus, as of April 2020, the status quo has not changed in Depsang Plains. Even during the height of the standoff last year, the Chinese, the source quoted in the *Express* report said, were “not organised” for combat in Depsang Plains and Gogra-Hot Springs. The theme being propagated for public consumption is that there is nothing to resolve in Depsang Plains and that status quo never really changed.

The second theme being plied by the so-called “reliable sources” is that the Chinese are refusing to withdraw from Gogra-Hot Springs area, but they have a very limited presence — of approximately a platoon to a company on our side of the LAC — in areas of Patrolling Points 15 and 17A and that it is not really a flash point. This theme of information dissemination via the media plays down the serious implications of the Chinese intrusion in Gogra-Hot Springs and the threatening presence of a large number of Peoples’ Liberation Army (PLA) troops in this area.

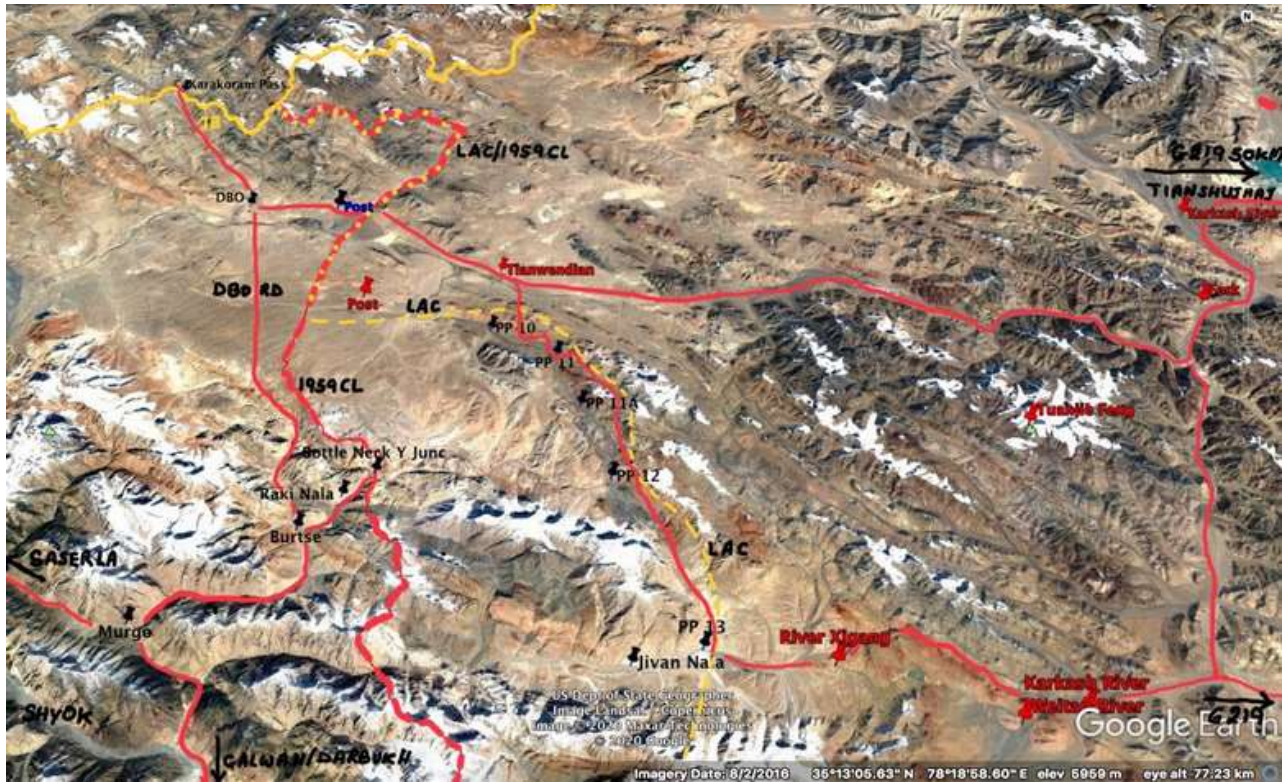
The third theme of the “unofficial briefings” is that North and South Pangong Tso were the only areas where troops and tanks were in very close proximity to each other that could have escalated to war. The intent here seems to be to justify the now apparent “stand-alone agreement” for simultaneous withdrawal and the loss of “leverage” of our relatively advantageous deployment on the Kailash Range.

The fourth theme that has been brandied about is that China now wants deescalation of additional troops deployed before further disengagement takes place. The aim is to convey to the public that our massive deployment checkmated China and now there is no harm in agreeing for the same to diffuse the situation. More so, when there is nothing to resolve in Depsang Plains and differences in Gogra-Hot Springs with respect to disengagement are of a minor nature that will soon get resolved.

Reality check

In the past one year, there has been no formal briefing about the situation in Eastern Ladakh. The quantum of Chinese forces, the extent of the intrusions and the details of the operations carried out have not been put in public domain. The media has not been given access to the operational area and has been spoon-fed through these “unofficial briefings”. Denial and obfuscation has been the predominant feature of the government’s political/unofficial statements. The media, afraid of

annoying the government, failed to critically analyse the open domain information and provide a realistic assessment of the situation.



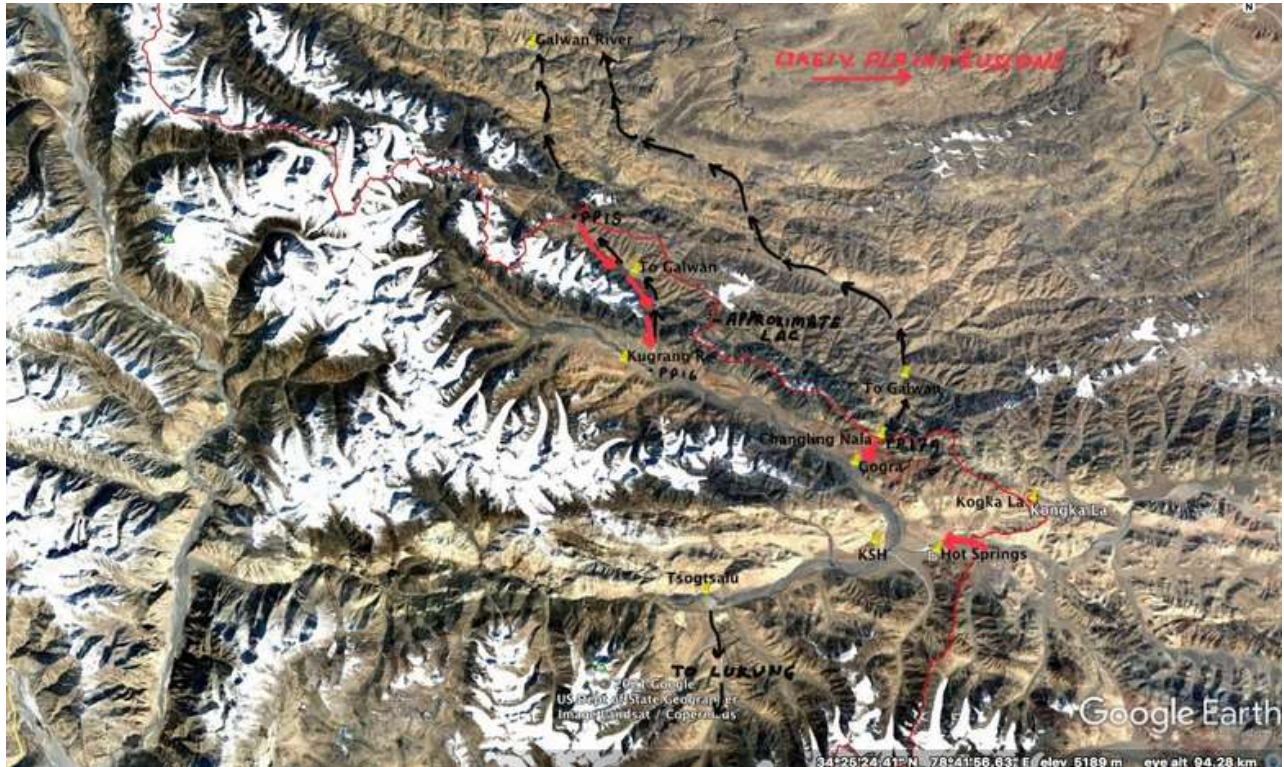
DBO Sector – Annotated Google Earth Image

Let there be no doubt that China strategically surprised and preempted us with two/three mechanised divisions to secure areas up to the 1959 Claim Line in Dopsang Plains and North of Pangong Tso, and in Gogra-Hot Springs even beyond the 1959 Claim Line. The Chinese were poised to capture the Daulat Beg Oldi Sector and entire area north and north-east of Pangong Tso, apart from threatening the Indus Valley up to the Ladakh Range. In early May 2020, our limited forces in Ladakh were no match for the PLA and all the above objectives were achievable. However, China had only a limited immediate aim of securing the 1959 Claim Line and preventing development of border infrastructure in critical areas, apart from the obvious assertion of its hegemony. Hence, it put the onus of further escalation on us.

After the initial surprise, we responded by confronting the Chinese with massive counter-deployment. Terrain configuration makes DBO and Gogra-Hot Springs sector defensively untenable in a limited war and, hence, rightly our focus was in North and South of Pangong Tso and the Indus Valley. Given the differential in military capability, we opted to stalemate the Chinese rather than resort to evicting them by an offensive action. This did not change the situation in the DBO Sector and Gogra-Hot Springs, which remained our critical vulnerabilities.

Our brilliant offensive manoeuvre to secure the Kailash Range on the night of 29-30 August created a military and political embarrassment for China. This led to diplomatic engagement and more meaningful military talks that culminated in disengagement from the North and South bank of Pangong Tso between 10 and 18 February. The 10th Corps Commander-level talks took place as per agreement exactly 48 hours later.

Let me reiterate that Dopsang Plains and Gogra-Hot Springs continue to be our critical vulnerabilities and the Chinese have no intent to withdraw from there. The withdrawal from the North and South bank of Pangong Tso was a “stand-alone agreement” with no commitments from China to disengage from other sectors. Note the alleged contemptuous quote attributed to the Chinese in the recent talks — India “should be happy with what has been achieved”.



Gogra-Hot Springs Sector-Annotated Google Earth Image

In a nutshell, the endeavour of the unofficial spokesperson(s) of the government is to obfuscate the reality and shape public opinion, possibly for an ‘unfavourable disengagement’ in Depsang Plains and Gogra-Hot Springs.

Two questions deserve to be answered. Why did India agree to a stand-alone agreement and vacate the Kailash Range? What are the terms of unfavourable peace likely to be imposed on us?

Standalone agreement

India’s securing of the Kailash Range was a great embarrassment for China. Domestically and internationally it lost face. The LAC passes over the crest of the Kailash Range, and thereafter there is a gradual plateau to the east, one to two km wide. India did not cross the LAC to secure this plateau and the eastern slopes. The PLA deployed its soldiers in matching strength opposite us on the plateau and also posed a threat to us from the Black Top, which also we had not secured. Moldo is not a garrison but a small post of PLA Border Guards. The main PLA base is well away. Thus, militarily, we were not posing a serious threat. In fact, our more serious threat was in the Indus Valley where we had concentrated our reserves.

It was the embarrassment and loss of face that led China to give up its absolutist position and come to the negotiating table. India insisted on an all-encompassing package to include North and South of Pangong Tso, Depsang, Gogra-Hot Springs and Demchok. It is my assessment that the Chinese issued a direct/indirect threat to go on the offensive in DBO and Gogra-Hot Springs sector. Given our critical vulnerability in these areas, we agreed to a “stand-alone agreement”.

‘Unfavourable peace’

The DBO sector is defensively untenable in war. China is unlikely to make any compromise in Depsang Plains and we seem to have accepted it as a *fait accompli*. Hence, the narrative that it is a legacy issue where status quo April 2020 has not changed and that it was a dormant sector during the entire crisis.

We also seem to have accepted the intrusion south of Demchok in Charding-Ninglung Nala. Indeed, this is a legacy of the past. This intrusion does not create any vulnerability, and the 1959 Claim Line still remains 30 km to west and is under our firm control.

In Hot Springs-Gogra, the 1959 Claim Line and the LAC coincide. India has been aggressively developing roads along the Kugrang river and Chunglung Nala from where approaches lead north

to upper reaches of the Galwan river. To ward off this threat, the Chinese have intruded from Changlung Nala and via upper reaches of the Kugrang river to deny us access to nearly 30-35 km-long and 4 km-wide Kugrang river valley beyond Gogra. We have no scope for any counter-action to gain leverage due to the 100-km-long tenuous road linking this area to Lukung. In the event of any escalation, the entire Chang Chenmo valley becomes defensively untenable as the road leading to it can be cutoff at Tsogtsalu / Marsimik La/ Phobrang. At best, what we can hope for is a buffer zone in the entire Kugrang river valley, which will entirely be in territory on our side of the LAC and which was under our control before May 2020.

We have stalemated the Chinese and denied them absolute victory. But Depsang Plains and Gogra-Hot Springs continue to remain our vulnerabilities and we have no counter-military leverage. It may be prudent to diffuse the crisis by negotiating buffer zones in these critical areas even if these entirely are on our side of the LAC. Rather than rely upon a false narrative, it is better to explain the situation to the public. It may appear to be “unfavourable peace” but given our vulnerabilities, it is the best we can hope for.

Lt Gen H S Panag PVSM, AVSM (R) served in the Indian Army for 40 years. He was GOC in C Northern Command and Central Command. Post retirement, he was Member of Armed Forces Tribunal. Views are personal.

<https://theprint.in/opinion/why-india-opted-for-a-stand-alone-agreement-with-china-in-ladakh/643757/>



Fri, 23 April 2021

Indonesia launches SAR mission for its missing submarine; Know about Indian Navy’s capability to handle subs accidents

The submarine reported to be missing is the KRI Nanggala-402 vessel, a German-built vessel in service of 1981 vintage

By Huma Siddiqui

An Indonesian Cakra (Type 209/1300) class diesel-electric submarine (SSK) has been reported to be missing near Bali. Indonesian Navy (also known as Tentar Nasional Indonesia-Angkatan Laut or TNI-AL) operated KRI Cakra (401) and the KRI Nanggala (402) since the early 1980’s decade. The submarine reported to be missing is the KRI Nanggala-402 vessel. The Nanggala is a German-built vessel in service of 1981 vintage.

What was the submarine doing?

According to reports, KRI Nanggala (402) had lost contact in the sea 95 km north of Bali on April 21, 2021 and had 53 crew members. It was conducting torpedo firing drills when the contact was lost in an area which was up to 700 meters deep in the sea.



Indian Navy has procured a Deep Submergence Rescue Vessel (DSRV) to undertake submarine crew rescue (Image: Indian Navy)

SAR (Search & Rescue) Operations initiated by Indonesian Navy (TNI-AL)

Indonesia reached out to India, Singapore and Australia for help and they have sent their submarine rescue boats. Six warships of TNI-AL are already at the location to assist other warships to help in the rescue mission.

More about TNI-AL

Indonesia as a nation is not new to submarine operations and it had operated a fleet of ex-Soviet era submarines in the 1960s and 70s. As per the Navy's areas of operations, there are three main Indonesian fleets with the Western fleet based at Jakarta, the Central Fleet at Makassar and the Eastern Fleet based at Sorong. As per the information available in the public domain, as part of its modernisation efforts it ordered Nagapasa (DSME 209/1400)-class diesel-electric submarine (SSK) in 2011. This March 2021, Indonesia took the delivery of the third and final class of the boat and this submarine was the first-ever SSK assembled indigenously under the Transfer of Technology (ToT) with South Korean shipbuilder Daewoo Shipbuilding and Marine Engineering (DSME).

SAR (Search & Rescue) Operations – How is it carried out? Know more about it

“It is very important that the search operations are as efficient as possible. A combined search operation using multiple ships and aircrafts speeds up this SAR process by covering the maximum search-area in a minimum time. Some of the visual signs which the search and rescue (SAR) team looks out for while searching for a distressed submarine are the oil spills or some floating debris nearby the last known location of the submarine,” explains Milind Kulshreshtha, a C4I expert, and Strategic Analyst.

According to him, “The SAR activity is a methodical process where the search patterns in water and from air are well defined to maximize the probability of location of the submarine. However, time is always critical when limited oxygen capacity exists onboard a distressed submarine, and some specialised searches which maximises the probability of detection in the shortest time too are useful. The naval vessels involved in the search operations use sophisticated sonars to scan the sea bottom to identify the submarine in the underwater profiles obtained on the displays. There is also a look out for any acoustic noise emanating from the machines of the submarine, if running, or emergency signal direction finding using passive means.”

Is Indian Navy equipped to handle such accidents?

Yes.

As has been reported by Financial Express Online earlier, Indian Navy has procured a Deep Submergence Rescue Vessel (DSRV) to undertake submarine crew rescue.

So how do these DSRVs operate?

“Every submarine undergoes periodical sea checks and has a highly specialised crew onboard for its operations. The SOPs are well laid out and followed to the hilt, without any exception. Despite the best of the efforts, rarely accidents occur due to various reasons like material failure or human errors etc. Incidents like Russian Kursk submarine sinking and fire accident onboard INS Sidhuratna had highlighted the need for a submarine rescue vessel. India's first DSRV was procured from the UK and successfully operationalised by Indian Navy after successfully completing Sea Trials in June 2019,” the C4I expert says.

“According to the specifications of the DSRV, it can recover submarine crew from depths up to 650m. The DSRV is equipped with sonar and an ROV (Remotely Operated Vehicle) to clear the underwater obstructions and for the rescue operations. The DSRV can be transported to the area of operations by air or sea routes.”

How does it work underwater?

“The critical activity in the DSRV operations is the underwater ‘mating’ of the DSRV with the hatch of a submerged submarine and create an air-lock for crew transfer from the submarine to the DSRV for their recovery. As a special arrangement, the hatches of the submarines had required reinforced strengthening so as to be able to handle the load of the DSRV without buckling under the load,” Milind Kulshreshtha adds.

In conclusion he says, “The possession of DSRV vessels makes Indian Navy exclusive in the region, and it is planned to make India as the Centre of Regional Excellence for Submarine Rescue missions. The Hindustan Shipyard Limited (HSL) has launched work on Diving Support Vessels (DSV) project for construction of two 118m 7650 tons DSVs. The vessels shall be based at Vizag and Mumbai. These ships have 12 man saturation diving capability, towed sonars and the DSRV. The DSVs and DSRVs provide the much required submarine rescue capability, unique to the IOR.”

The Indian Navy has confirmed to Financial Express Online that “The Navy’s Deep Submergence Rescue Vessel (DSRV) departed from Visakhapatnam to support Indonesian Navy in Search & Rescue efforts for KRI Nanggala.”

<https://www.financialexpress.com/defence/indonesia-launches-sar-mission-for-its-missing-submarine-know-about-indian-navys-capability-to-handle-subs-accidents/2238024/>

Science & Technology News



Fri, 23 April 2021

New AI tool calculates materials' stress and strain based on photos

Isaac Newton may have met his match.

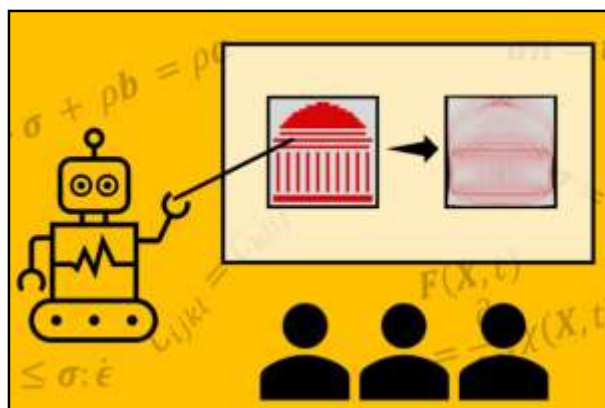
For centuries, engineers have relied on physical laws—developed by Newton and others—to understand the stresses and strains on the materials they work with. But solving those equations can be a computational slog, especially for complex materials.

MIT researchers have developed a technique to quickly determine certain properties of a material, like stress and strain, based on an image of the material showing its internal structure. The approach could one day eliminate the need for arduous physics-based calculations, instead relying on computer vision and machine learning to generate estimates in real time.

The researchers say the advance could enable faster design prototyping and material inspections. "It's a brand new approach," says Zhenze Yang, adding that the algorithm "completes the whole process without any domain knowledge of physics."

The research appears today in the journal *Science Advances*. Yang is the paper's lead author and a Ph.D. student in the Department of Materials Science and Engineering. Co-authors include former MIT postdoc Chi-Hua Yu and Markus Buehler, the McAfee Professor of Engineering and the director of the Laboratory for Atomistic and Molecular Mechanics.

Engineers spend lots of time solving equations. They help reveal a material's internal forces, like stress and strain, which can cause that material to deform or break. Such calculations might suggest how a proposed bridge would hold up amid heavy traffic loads or high winds. Unlike Sir Isaac, engineers today don't need pen and paper for the task. "Many generations of mathematicians and



MIT researchers have developed a machine-learning technique that uses an image of the material's internal structure to estimate the stresses and strains acting on the material. Credit: Massachusetts Institute of Technology

engineers have written down these equations and then figured out how to solve them on computers," says Buehler. "But it's still a tough problem. It's very expensive—it can take days, weeks, or even months to run some simulations. So, we thought: Let's teach an AI to do this problem for you."

The researchers turned to a machine learning technique called a Generative Adversarial Neural Network. They trained the network with thousands of paired images—one depicting a material's internal microstructure subject to mechanical forces, and the other depicting that same material's color-coded stress and strain values. With these examples, the network uses principles of game theory to iteratively figure out the relationships between the geometry of a material and its resulting stresses.

"So, from a picture, the computer is able to predict all those forces: the deformations, the stresses, and so forth," Buehler says. "That's really the breakthrough—in the conventional way, you would need to code the equations and ask the computer to solve partial differential equations. We just go picture to picture."

That image-based approach is especially advantageous for complex, composite materials. Forces on a material may operate differently at the atomic scale than at the macroscopic scale. "If you look at an airplane, you might have glue, a metal, and a polymer in between. So, you have all these different faces and different scales that determine the solution," say Buehler. "If you go the hard way—the Newton way—you have to walk a huge detour to get to the answer."

But the researcher's network is adept at dealing with multiple scales. It processes information through a series of "convolutions," which analyze the images at progressively larger scales. "That's why these neural networks are a great fit for describing material properties," says Buehler.

The fully trained network performed well in tests, successfully rendering stress and strain values given a series of close-up images of the microstructure of various soft composite materials. The network was even able to capture "singularities," like cracks developing in a material. In these instances, forces and fields change rapidly across tiny distances. "As a material scientist, you would want to know if the model can recreate those singularities," says Buehler. "And the answer is yes."

The advance could "significantly reduce the iterations needed to design products," according to Suvranu De, a mechanical engineer at Rensselaer Polytechnic Institute who was not involved in the research. "The end-to-end approach proposed in this paper will have a significant impact on a variety of engineering applications—from composites used in the automotive and aircraft industries to natural and engineered biomaterials. It will also have significant applications in the realm of pure scientific inquiry, as force plays a critical role in a surprisingly wide range of applications from micro/nanoelectronics to the migration and differentiation of cells."

In addition to saving engineers time and money, the new technique could give nonexperts access to state-of-the-art materials calculations. Architects or product designers, for example, could test the viability of their ideas before passing the project along to an engineering team. "They can just draw their proposal and find out," says Buehler. "That's a big deal."

Once trained, the network runs almost instantaneously on consumer-grade computer processors. That could enable mechanics and inspectors to diagnose potential problems with machinery simply by taking a picture.

In the new paper, the researchers worked primarily with composite materials that included both soft and brittle components in a variety of random geometrical arrangements. In future work, the team plans to use a wider range of material types. "I really think this method is going to have a huge impact," says Buehler. "Empowering engineers with AI is really what we're trying to do here."

More information: Zhenze Yang et al. Deep learning model to predict complex stress and strain fields in hierarchical composites, *Science Advances* (2021). DOI: [10.1126/sciadv.abd7416](https://doi.org/10.1126/sciadv.abd7416)

Journal information: [Science Advances](https://phys.org/news/2021-04-ai-tool-materials-stress-strain.html)
<https://phys.org/news/2021-04-ai-tool-materials-stress-strain.html>

Transient grating spectroscopy with ultrafast X-rays

Researchers at the Paul Scherrer Institute PSI have succeeded for the first time in looking inside materials using the method of transient grating spectroscopy with ultrafast X-rays at SwissFEL. The experiment at PSI is a milestone in observing processes in the world of atoms. The researchers are publishing their research results today in the journal *Nature Photonics*.

The structures on microchips are becoming ever tinier; hard disks write entire encyclopedias on magnetic disks the size of a fingernail. Many technologies are currently breaking through the boundaries of classical physics. But in the nanoworld, other laws apply—those of quantum physics. And there are still many unanswered questions: How does heat actually travel through a semiconductor material at the nanoscale? What exactly happens when individual bits are magnetized in a computer hard disk, and how fast can we write? There are still no answers to these and many more questions mainly because current experimental techniques cannot look deeply and precisely enough into the materials and because some processes take place far too quickly for conventional experimental methods. But if we want to push ahead with technical miniaturization, we need to understand such phenomena at the atomic level



Cristian Svetina at the experiment station of the X-ray free-electron laser SwissFEL. Credit: Paul Scherrer Institute/Mahir Dzambegovic

The mix of methods makes the difference

Fresh impetus is now being brought to the matter thanks to a new method devised by PSI researcher Cristian Svetina, together with Jeremy Rouxel and Majed Chergui at EPFL in Lausanne, Keith Nelson at MIT in the USA, Claudio Masciovecchio at Fermi FEL in Italy, and other international partners. "The method is actually not new, though, and it has been used for decades in the optical regime with exceptional results," says Svetina, who is currently setting up the new Furka experiment station on the SwissFEL beamline Athos at PSI. What is special, he says, is the combination and extension of known methods from nonlinear laser physics, but using X-ray light from the new X-ray free-electron laser SwissFEL. This combination is both new and surprising. Several attempts have been made in the past by many groups around the world but without success. It has even been questioned whether such novel experiments could be successfully conducted at all at the high energies of X-rays. The team at PSI has proven: Yes, it can be done.

At its core, this is a method called transient grating spectroscopy. Spectroscopy is a proven set of methods used by physicists to obtain information about a material, such as the chemical elements and compounds it consists of, its magnetic properties, and how atoms move within it. In the particular variant called transient grating spectroscopy, the sample is bombarded with two laser beams that create an interference pattern. A third laser beam is diffracted at this pattern, creating a fourth beam that contains the information about the sample's properties.

Looking beneath the surface

The term laser is always used to describe light in the visible or infrared range of the wavelength spectrum. Therefore lasers can look inside a sample only with resolution limited to hundreds of nanometres. To go beyond this, X-rays are needed. Researchers at PSI have now succeeded for the first time in making transient grating spectroscopy accessible to an X-ray laser, using very hard X-rays with an energy of 7.1 kiloelectronvolts, which corresponds to a wavelength of 0.17 nanometres, or about the diameter of medium-sized atoms. The advantage: For the first time, it is possible to look inside materials with a resolution down to individual atoms as well as with

ultrashort exposure times of fractions of femtoseconds (one millionth of a billionth of a second), which even allows videos of atomic processes to be recorded. In addition, the method is element-selective, meaning that one can selectively measure specific chemical elements in a mixture of substances. The method complements well established techniques such as inelastic neutron and X-ray scattering, adding better resolution in terms of both time and energy.

In practice, the experimental setup looks like this: SwissFEL sends a beam with a diameter of 0.2 millimeters, consisting of ultrashort X-ray pulses, onto a transmission phase grating made of diamond, which looks like a fine comb under the microscope. Diamond is used because it is not destroyed even by high-energy X-rays. It was made especially for this experiment by Christian David of the Laboratory for Micro and Nanotechnology at PSI. The spacing between the teeth of the comb is two micrometers, but this can go down to nanometres if needed. They break the X-ray beam into fine partial beams that overlap behind the grating, thus creating the transient grating diffraction pattern. Behind the grating, one-to-one images of the grating can be observed, repeated at regular intervals—so-called Talbot planes. If you place a sample in one of these planes, some atoms within it become excited, just as if it was sitting at the location of the grating. Only the atoms that "see" the X-rays in this periodic modulation are excited, while the neighbors that don't experience the irradiation remain in the ground state. This is the chief attraction of the method, since it enables researchers to selectively excite characteristic domains of interest.

Camera with flash

Excitation of the atoms alone, however, does not provide any information. For this, a kind of camera with a flash is needed to briefly expose the sample. In transient grating spectroscopy, this is done by a laser that targets the sample at an angle and shoots images with a minimal time delay to the X-ray beam from SwissFEL. The information comes out of the back of the sample and hits a detector that records the image. Initial experiments have shown one advantage of the method: It does not produce any unwanted background signal. "If the atoms are excited, you see a signal; if they are not excited, you see nothing," Svetina explains. This is extremely valuable when measuring samples that emit only weak signals and that cannot be seen with other techniques where a background obscures the signal.

The fact that Cristian Svetina and his team have managed to do what other researchers have not is due to the creativity and patience of the protagonists. "We proceeded step by step and did not want to try everything at once," says the physicist. Five years ago the researchers started experimenting at FERMI FEL with optical light and extended it to extreme ultraviolet light before moving on to X-rays at PSI. Here, instead of examining "real" samples right away, they used gold foils to test whether the energy was sufficient to excite atoms. They succeeded in burning the lattice pattern from a Talbot plane into the foil. Svetina: "That's when we knew: If we can even print structures, we can excite atoms with lower intensity." With this the way was clear for the now successful experiment. Using a sample of bismuth germanate, the researchers were able to show that the method fulfilled all their hopes in terms of spatial and temporal resolution, measurement speed, and element selectivity.

Next goal: everything with X-rays

However, the researchers have not yet taken the final step. So far, only the beam that excites the sample is an X-ray beam. The flash of the camera still comes from a laser, so it is visible light. The pinnacle would be reached if that too were an X-ray beam. Svetina: "We want to take this final step in the course of the year." And they have additional support: SLAC's LCLS and the PULSE Institute, both at Stanford in California, the RIKEN SPring-8 center in Japan, and DESY's FLASH in Germany have joined the collaboration team.

The researchers are publishing their results today in the journal *Nature Photonics*.

More information: Jeremy R. Rouxel et al. Hard X-ray Transient Grating Spectroscopy on Bismuth Germanate. *Nature Photonics*, 22.04.2021. [DOI: 10.1038/s41566-021-00797-9](https://doi.org/10.1038/s41566-021-00797-9)

Journal information: [Nature Photonics](https://www.nature.com/journal/nature-photonics)

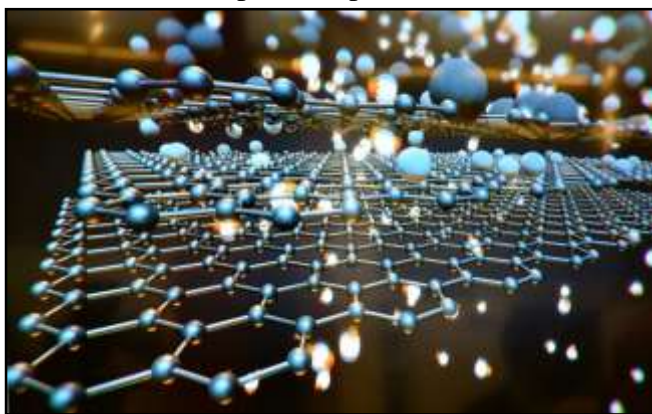
<https://phys.org/news/2021-04-transient-spectroscopy-ultrafast-x-rays.html>

New material could better protect soldiers, athletes and motorists

Soldiers, athletes, and motorists could lead safer lives thanks to a new process that could lead to more efficient and re-useable protection from shock and impact, explosion, and vibration, according to a new study.

Pressurized insertion of aqueous solutions into water-repellent nanoporous materials, such as zeolites and metal-organic frameworks, could help to create high-performance energy absorbing systems.

An international research team experimented with hydrothermally stable zeolitic imidazolate frameworks (ZIFs) with a 'hydrophobic' cage-like molecular structure—finding that such systems are remarkably effective energy absorbers at realistic, high-rate loading conditions, and this phenomenon is associated with the water clustering and mobility in nanocages.



Credit: CC0 Public Domain

Researchers from the Universities of Birmingham and Oxford, together with Ghent University, Belgium, published their findings today in *Nature Materials*.

Dr. Yueting Sun, Lecturer in Engineering at the University of Birmingham, commented: "Rubber is widely used for shock absorption nowadays, but the process we have discovered creates a material that can absorb more mechanical energy per gram with very good reusability due to its unique nanoscale mechanism.

"The material has great significance for vehicle crash safety for both occupants and pedestrians, military armored vehicles and infrastructures as well as human body protection.

"Soldiers and police could benefit from better body armor and bomb suits, athletes might wear more effective helmets, knee pads and shoe insoles as the material is liquid-like and flexible to wear." The reusability of the material, stemming from the spontaneous liquid extrusion, also enables the material to be suitable for damping purposes, meaning that it could be used to create vehicles with lower noise and vibration, as well as better ride comfort.

The material could also be incorporated into machinery to reduce harmful vibrations and noise—reducing maintenance costs. It could also be used to reduce the vulnerability to earthquakes of bridges and buildings.

Current state-of-the-art energy absorption materials rely on processes such as extensive plastic deformation, cell buckling, and viscoelastic dissipation—making it difficult to create materials that can provide efficient protection from multiple impacts.

More information: High-rate nanofluidic energy absorption in porous zeolitic frameworks, *Nature Materials* (2021). DOI: [10.1038/s41563-021-00977-6](https://doi.org/10.1038/s41563-021-00977-6)

Journal information: *Nature Materials*

<https://phys.org/news/2021-04-material-soldiers-athletes-motorists.html>

COVID-19 vaccination: Here's what is safe to do after the second dose

Medical experts have advised that one should continue to take precautions even after the jab

The government recently announced that everyone above the age of 18 would be eligible for vaccination from May 1, the registration process for which will begin on April 28.

Amid reports of some people contracting the virus even after getting vaccinated, medical experts have advised that one should continue to follow [COVID-19](#) protocol even after the jab.

The Health Ministry has also issued some guidelines on COVID-19 vaccination. Similar guidelines have been laid down by World Health Organisation (WHO) and Centers for Disease Control and Prevention (CDC). Take a look:

Can a person with COVID-19 (confirmed or suspected) be vaccinated?

The Health Ministry says on its website that such people may increase the risk of spreading the virus to others at the vaccination site. "For this reason, infected individuals should defer vaccination for 14 days after symptoms resolution."

If I had COVID-19 and was treated, do I need to get vaccinated?

It is advisable to complete the COVID-19 vaccine schedule irrespective of past history of infection with COVID-19. "This will help in developing a strong immune response against the disease. Development of immunity or duration of protection after COVID-19 exposure is not established therefore it is recommended to receive vaccine even after COVID-19 infection. Wait for 4-8 weeks after recovery from COVID symptoms before getting the vaccine."

When am I "fully vaccinated"?

According to CDC, one can be considered "fully vaccinated" two weeks after the second dose of the vaccine.

Do I need to wear a mask and take COVID-19 appropriate precautions after getting vaccinated?

The Health Ministry says, "It is absolutely necessary that everyone who has received the COVID-19 vaccine should continue to follow the COVID-19 appropriate behaviour i.e., mask, *do gaj ki doori* (social distancing) and hand sanitization to protect themselves and those around from spreading the infection."

"For the first fourteen days after getting a vaccination, you do not have significant levels of protection, then it increases gradually. For a single-dose vaccine, immunity will generally occur two weeks after vaccination. For two-dose vaccines, both doses are needed to achieve are required to provide the highest level of best immunity possible," mentions WHO.

Can I meet other people after I am fully vaccinated?

CDC mentions that a person who is fully vaccinated can:



One is considered fully vaccinated only after the second dose. (Express photo by Shuaib Masoodi)

- Visit inside a home or private setting without a mask with other fully vaccinated people of any age
- Visit inside a home or private setting without a mask with one household of unvaccinated people who are not at risk for severe illness
However, fully vaccinated people should not:
 - Visit indoors, without a mask, with people at increased risk for severe illness from COVID-19
 - Attend medium or large gatherings

One who is fully vaccinated should still watch out for symptoms of COVID-19, “especially if you’ve been around someone who is sick. If you have symptoms of COVID-19, you should get tested and stay home and away from others.”

Do I need to take precautions at my workplace?

The CDC recommends that one should continue to take safety precautions at their workplace and follow the guidelines laid out by the organisation.

Can I hug my kids/grandkids?

One who is vaccinated can hug their unvaccinated children or grandchildren who are all living in the same household and are not at high risk for severe disease, Namandje Bumpus, an expert in pharmacology and molecular science, mentions in an article on hopkinsmedicine.org.

How long will I remain protected against the virus after vaccination?

The longevity of the immune response is “yet to be determined,” mentions the Health Ministry. “Hence, continuing the use of masks, handwashing, physical distancing and other COVID-19 appropriate behaviours are strongly recommended.”

Does the vaccination protect me against new strains?

According to the Health Ministry, all vaccines are expected to provide “some amount of protection” against the mutated virus also. “The body responds to vaccination by making more than one type of antibodies to virus parts including spike protein...Based on the available data the mutations as reported are unlikely to make the vaccine ineffective.”

As research on the same continues, WHO advises that people should do everything possible to stop the spread of the virus in order to prevent mutations. “This means staying at least 1 metre away from others, covering a cough or sneeze in your elbow, frequently cleaning your hands, wearing a mask and avoiding poorly ventilated rooms or opening a window.”

<https://indianexpress.com/article/lifestyle/health/covid-19-vaccination-heres-what-is-safe-to-do-donts-precautions-7284653/>

