Introduction

On 6 Oct 2024, reports emerged that the Indian Air Force (IAF) deployed a Rafale fighter jet to shoot down a Chinese spy balloon-type target at a very high altitude (55,000 feet) using an inventory missile over the Eastern Air Command. The balloon was relatively smaller in size with some payloads attached compared to the spy balloon, which was downed by the United States Air Force (USAF) F-22 Raptor jet early last year in 2023 in a similar manner over the coast of South Carolina.[1] Later on, sources confirmed that the targeted balloon was not from China but a smaller replica made for the IAF shooting practice during a training exercise.[2]

Such spy balloons have been spotted earlier near the Andaman and Nicobar Islands in past few years and are believed to be operated by China. While Indian government refrained from making any comment, others believed that India didn't have the capability to tackle such surveillance balloon infiltration over the Indian territory.[3] This latest report of Rafale jet shooting such a target has confirmed that the IAF considers such spy balloon infiltrations as a major threat to India's national security. Subsequently, it has to be analysed whether such tactics which are adopted from the USAF are compatible with the Indian air-power realities and force capabilities.

Understanding American Spy Balloon Threat

The United States (US) detected a high-altitude Chinese surveillance balloon over its airspace in early 2023. It was transiting through the continental North America and was regularly being tracked by the Pentagon. The Chinese also acknowledged the presence of such a balloon over the US airspace and termed it as a 'Civilian Airship' for meteorological research purposes and explained that due to limited self-steering capacity and force from the westerly winds, it got deviated from its path and entered the US airspace. But the US officials doubted this because the Pentagon assessed that the balloon had manoeuvring abilities due to a jet stream and the surveillance equipment was powered by a solar panel array. The Biden administration was also finding it difficult to shoot down this balloon due to the threat of debris falling over the civilian areas.[4]

Later, after due assessment from the Pentagon, this balloon was shot down over the Atlantic Ocean by a F-22 fighter jet. The debris were spread for an area over 7 miles.[5] Such large debris area could be due to the large size of the balloon which was 60 meters in diameter and attached with 900 kg payload.[6] Experts believe that inspite of the presence of satellites for intelligence gathering operations, surveillance balloons offer many advantages, such as low weight, economical, easier to launch, and with a very low signature which can't be easily detected. The main advantage with balloons is that they don't follow a set predictable path like a satellite and can loiter over an area of interest for a longer time period which allows constant and clear monitoring. The US was concerned that this balloon could likely be collecting sensitive information from the US intercontinental ballistic missiles silo sites and strategic bomber bases as it passed over them.[7]

Target Engagement Comparison

If we compare the American and Indian scenarios, there are tactical differences. The Chinese balloon was hovering at an altitude between 60,000 and 65,000 feet. The USAF F-22 jet was at an altitude of 58,000 feet (18 kms) and used an AIM-9 Sidewinder missile to puncture the balloon. The operational service ceiling of a F-22 Raptor jet is above 50,000 feet (15 kms).[8] This F-22 was supported by F-15 Eagles and mid-air tankers.[9] The Sidewinder is a heat-seeking supersonic air-to-air missile designed to home onto target aircraft's engine exhaust using infrared guidance. Its infrared seeker allows for a fire and forget targeting.[10] At such high altitudes, the F-22 had to be supported by additional fighters and fuel refuellers in the event of that balloon elevating its altitude or changing its path effectively deceiving the Sidewinder. This means that the F-22 had to use its additional Sidewinders and in the event of complete exhaustion of the F-22 payloads, the F-15 could have been pressed into action. This, in turn, implies that there are chances of a single jet failing in its mission to shoot such a high-altitude target.

The Indian practice spy balloon was shot at an altitude of over 55,000 feet (17 kms), which means that the balloon could have flown at more than 55,000 feet.[11] The operational service ceiling of a Rafale fighter jet is around 50,000 feet (15 kms), which is lower than the USAF F-22 Raptor having 18 kms (exact operational ceiling of F-22 is still classified).[12] The American target engagement happened at a maximum altitude of 65,000 feet (20 kms), whereas the Indian target engagement happened at approximately 55,000 feet. As per speculations, the most probable missile used was the MICA air-to-air missile having a range of 60 kms.[13] Its maximum launch altitude is 11 kms.[14] The lowest altitude point from where the Rafale could have shot the MICA missile should be somewhere close to 11 kms (36,000 feet) and the missile could have travelled for around 6-6.5 kms to intercept the target.

Limitations in the Indian Scenario

Although the Rafale successfully engaged the target, it has to be kept in mind that it was a practice target which was deployed by the IAF and not the Chinese. The IAF still doesn't have any accurate assessment of what the actual target could be in case of the Chinese deploying balloons of much higher size and flying at a much higher altitude. The US Assistant Secretary of Defense Melissa Dalton, during a senate hearing, said that such surveillance balloons could be as big as the size of Statue of Liberty, about 200 feet tall with a jetliner size payload.[15] Reports also suggest that such surveillance balloons can typically fly at an altitude of 80,000-120,000 feet (24-36 kms), which is more than the level at which commercial airlines fly.[16] In that case, the IAF will find it difficult to deploy its fighters to such high altitudes because the service ceiling

limit of Rafale (15 kms) alone won't allow it to reach that altitude and the only option would be to fire missiles from the maximum range.

Even if the missile is fired from maximum range, we must bear in mind that any air-to-air missile performance decreases with increase in altitude due to its target engagement envelope limitations. If the target is going up in altitude, the missile also simultaneously loses its energy and there is stress on the missile body due to the huge force of gravity, which also happens with fighter jets. The more the altitude of potential targets, the more it will be difficult to engage such targets. It is still unknown which version of MICA was fired, whether infrared (IR), which is heat-seeking, or RF (radio-frequency-based). It can be assumed here that the IAF target balloon could have been destroyed using the kinetic impact of the missile rather than the IR or RF features. In that scenario, the actual purpose of MICA is not utilised properly since the MICA was developed to engage with fighter jets and not balloons in the first place. In future, if the IAF is faced with a salvo/barrage of such spy balloons, the IAF will find it costly to fire missiles at more targets as it is not an economical strategy.

Alternate Economical Mechanisms

The threat of surveillance balloons should be tackled using mechanisms offering similar economical solutions, rather than costly fighter jet missiles. As we noted earlier that spy balloons are economical and easier to launch, we must develop corresponding counter-balloons which can fly at similar high altitudes and launch effective counter-measures. These countermeasures could target the balloons and, in few instances, the payloads if they carry high-intelligence collection equipments. The use of counter-balloons with guns attached to fire bullets/high grade ammunitions to puncture the spy balloon is an economical option. These counter-balloons could have jet streams for manoeuvring and can be controlled through ground control stations. If the counter-balloons can act like loitering munition balloons with explosives, that also can collide with the surveillance balloons to explode and bring it down. Finally, the use of high energy directed energy weapons from ground or counter-balloons will be an excellent answer to burn these surveillance balloons, as the material of the balloons are not made of metals, thereby, allowing the lasers to damage it more quickly.

Conclusion

The national security threat is evolving, and the threat of spy balloons are real and should not be ignored by the Indian government. The US strategy to deal with the spy balloons is not economical in the long run and not feasible/effective in the Indian context due to economical constraints. The IAF should, therefore, try to engage such threats with alternate economical mechanisms to secure the Indian airspace. The use of fighter jets to regularly counter spy balloons will only diminish/deteriorate the air-frame strength of those jets, thereby increasing the stress on the already depleting fighter squadrons which should be concentrated against rival fighter jets rather than spy balloons.

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