

Rocket Warfare in Operation Protective Edge

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Rocket warfare was Hamas' principal weapon in Operation Protective Edge. Throughout the 50 days of fighting, Hamas and the other organizations maintained their rocket launching capability. For Israel, the operation began as the Iron Dome war. Iron Dome was already recognized as a successful system in Operation Pillar of Defense, but Israel's aerial defense system entered Operation Protective Edge with more experience, more readiness, and more Iron Dome batteries. This article will analyze the rocket warfare and the defenses against it during Operation Protective Edge, and will assess the achievements of the respective parties.

The Hamas Capability

Hamas and the other organizations in the Gaza Strip have used rocket warfare since 2001, when Israel still controlled the Gaza Strip. Rockets launched against Israel at that time consisted mostly of locally developed Qassams and similar rockets using improvised fuel. Following Israel's disengagement from the Gaza Strip in the summer of 2005, the various organizations succeeded in procuring imported standard rockets, and also upgraded their ability to manufacture, or at least to assemble, rockets by themselves. When Operation Protective Edge began, the organizations' order of battle included standard 107-mm rockets (manufactured in China and Iran); 122-mm Grad rockets for short ranges, and upgraded Grad rockets for ranges up to 40 km; Iranian-made Fajr-5 rockets with a 75-km range; and recent additions of Syrian-made 302-mm rockets with a range of up to 160 km. Hamas also used its own self-produced rockets, which it said included the Sejil-55, M-75, and J-80 models. Production of the R-160 rocket was announced during Operation Protective Edge.¹ The Israel Military Intelligence Directorate estimated the

number of “short range” (up to 40 km) rockets possessed by Hamas as “in the thousands,” the number of 75-km range rockets as “in the hundreds,” and the number of longer range rockets (302-mm) as “in the dozens.”

Rockets Operations: An Outline

The rocket fire, which had stopped almost completely following Operation Pillar of Defense, increased in June 2014 (during Operation Brother’s Keeper). When the IDF announced the start of Operation Protective Edge, the number of launchings increased exponentially, reaching 150 daily, and Hamas began using its long range rockets. Rockets were fired at Tel Aviv and other cities in the Dan region, and at Jerusalem, Hadera, and the Carmel coast. Hamas managed to maintain a firing rate of about 100 rockets a day until July 23, 2014. The rate then declined, remaining at 50-60 rockets a day. After the second ceasefire was broken on August 19, the launching rate increased again, reaching a peak of 170 rockets on August 20 and 165 rockets on August 26, 2014, the last day of the operation – despite the IDF’s efforts to disrupt this activity.

In all, Hamas and the other organizations launched a total of about 4,500 rockets during Operation Protective Edge (from July 8 until August 26).² Approximately 3,600 of them fell in “open spaces,” and about another 200 were defined as unsuccessful launchings (meaning that they exploded upon launching or fell in the Gaza Strip). Iron Dome intercepted 735 rockets, and only 225 rockets fell in built-up areas and caused damage.³

For Hamas, the long range fire was a major symbolic victory, even though the actual damage caused was negligible. Yet despite the strategic importance of the long range fire, the vast majority of the rockets fired against Israel were short range rockets (up to 20 km), and the areas close to the Gaza Strip therefore absorbed most of the barrages. Furthermore, large portions of these areas are at too close for protection by Iron Dome capability, and this greatly increased their share of the damage. These areas also suffered most of the damage from mortar fire.

It appears that following the massive rocket barrages and the damage caused by IDF attacks, Hamas and the other organizations were left with a stockpile of rockets – perhaps a few thousand – likely to suffice for a similar period of fighting. Hamas’ capability was severely affected, however, and there is little likelihood of its being able to restore it to what it was. The Gaza Strip is more tightly blockaded than ever, Egypt has strengthened

its control of Sinai and demolished most of the smuggling tunnels, and Hamas' international connections with supporting parties like Iran, Syria, and Hezbollah have become weaker.

Damage from Rocket Fire

The direct damage to the Israeli civilian population from the rocket fire was limited. There were two fatalities, and several dozen cases of damage to buildings and property were reported (and only a few in areas not adjacent to the Gaza Strip). However, the number of wounded indicates a larger degree of damage. Magen David Adom reported that it treated 836 injured people during the operation, though only 36 were wounded by rocket fragments and another 33 by glass fragments. The rest were injured indirectly: traffic accidents that occurred during alerts (18), injuries suffered while running to a sheltered area (159), and most of all, victims of anxiety (581).⁴ This figure highlights more than anything else the fact that the heaviest damage caused by the rocket warfare lay in the disruption of ordinary daily life – the need to halt activity and run to the sheltered area during each alert. It is also reflected in economic damage: other than the direct damage suffered by businesses (about \$20 million) and damage caused by the absence of workers from their place of employment (about another \$20 million), the indirect damage was much greater – estimated at \$1.2 billion.⁵

A particularly noteworthy incident was the rocket fired at Yehud on July 22, 2014. This attack, which struck a residential building approximately one kilometer away from Ben Gurion Airport, caused the civil aviation authorities in Europe and the US to issue a warning, following which many airlines canceled their flights to Israel. Although most flights were renewed a day later, the event implied great potential damage amounting to a blockade of Israel, a threat that any future enemy will strive to achieve.

Iron Dome Activity

The IDF entered Operation Protective Edge with six Iron Dome batteries. During the operation, the absorption of batteries in earlier stages of deployment was expedited, and nine Iron Dome batteries were deployed by July 16, 2014.⁶

For Israelis, the proof of Iron Dome's success was in the results. Seven civilians were killed during the entire operation, and only two were killed by rocket fire.⁷ Very few hits were recorded in areas beyond the vicinity of the Gaza Strip. For the sake of comparison, during the Second Lebanon

War, the 4,000 rockets fired caused 44 fatalities. The small number of hits contributed to the public's general mood of complete trust in Iron Dome's capabilities and a feeling of great personal safety, which was also reflected in the media and probably also affected policymakers. This feeling was not shared by residents in areas close to Gaza, who bore the brunt of the attacks.

How effective was Iron Dome as a system? Early in the operation, it was reported that Iron Dome had achieved a 90 percent success rate.⁸ According to figures published at the end of the operation, Iron Dome intercepted 735 rockets, and failed to intercept only 70 rockets.⁹ This figure matches the number reported at the beginning of the operation, and indicates the system's technical capability.

In assessing the capability of Israel's aerial defense system to protect its territory, however, other factors should also be taken into account: first of all, the system's inability to protect certain areas, in particular, as shown during the operation, its inability to provide protection against short range rockets; second, the existing extent of coverage (the current number of operational batteries, from which its defense capability is derived; and the need to decide what to protect and what not to protect; this factor is a function of how the defense establishment invests these resources). To these should be added everything that distinguishes between a system's purely technological capability and the actual capability of an operational system: the temporary unavailability of batteries, whether because of logistical difficulties or as the result of technical malfunctions, and, of course, human error.¹⁰

The available figures are still superficial. In order to evaluate the system's effectiveness correctly, it is necessary to know precisely how many rockets were fired and at which targets, which of the targets hit were actually protected at the time the rocket was fired, when each battery was usable and when it was not, how many rockets were engaged, how many interceptors were used against each engaged rocket and how many interceptors failed, how many of the rockets were aimed at protected areas, where each rocket hit, and how much damage it caused (including in open spaces).¹¹

The available figures do, however, make it possible to give a rough estimate of the system's capability. Of the 960¹² rockets fired at built-up areas, 225 scored hits and caused damage. This yields a much lower success rate than the purely technical capability, but it is still an impressive and praiseworthy figure. This is the important figure for assessing the system's capability, since it includes all the above-mentioned limitations. At the same time, only an

in-depth analysis, which should be conducted by an independent agency within the defense establishment, can provide solid information about the system's effectiveness for the purpose of making the right decisions about further procurement and about the necessary improvements.

Future Threat and Iron Dome's Capability

The future rocket threat has four aspects that will present difficulties for Iron Dome, or any other defense system, in future conflicts:

- a. Long range rocket fire (up to 200 km)
- b. The enemy's procurement of accurate guided missiles (mainly applicable to Hezbollah)
- c. A large inventory of rockets (mainly applicable to Hezbollah), and the growing ability to fire heavy barrages
- d. Short range fire – both short range rockets and mortar fire.

Hamas has managed to procure rockets with ranges of up to 160 km, but not heavy rockets (500-600-mm caliber) and not guided missiles, such as the Iranian Fateh-110 and similar missiles. Syria and Hezbollah already have such missiles, which endanger mainly strategic sites that only a precise weapon can hit. The defense systems will have to focus on protection of such targets, since these missiles are not a "statistical weapon," and defense against them cannot rely on "ignoring rockets headed for open spaces."

Heavy barrages: One of the great advantages of a rocket weapon system is its ability to fire large scale barrages in an extremely short time span. During Operation Protective Edge, there were a number of attempts at such barrages, but it does not appear that Hamas is capable of firing very heavy barrages.¹³ In a future conflict, Israel is liable to face much heavier rocket barrages, which Iron Dome will have difficulty intercepting. In such a situation, there may be a strategic need to focus Israel's defense capability, and the question of what to defend and what not to defend will arise in full force – in other words, whether to bypass the civilian population in order to protect important military or civilian facilities.

Short range fire: Warfare in Operation Protective Edge highlighted the active defense system's inability to deal with short range fire. This disadvantage has been known for a long time and was exploited this time by Hamas, which concentrated most of its attacks against communities near the Gaza Strip.

This vulnerability has strengthened the demand to develop a defense system capable of intercepting short range rockets and mortar shells. The demands

by the supporters of the THEL chemical laser system (Nautilus/Skyguard) to procure such systems, whose development in Israel was halted in 2006, were raised again in this context. The demand to procure the Centurion system (also known as Phalanx) was also raised. The defense establishment previously considered these systems, and it was decided not to purchase them. It has also been reported that a new laser system, called Iron Beam, based on a solid state laser, is being developed in Israel.¹⁴ This technology is still in the early stages globally, and the chances that Israel will have an operational solid state laser system in the near future are slim (the same is true of a fiber optic laser – another technology currently in development).

The Argument about Missile Defense Systems

Iron Dome aroused controversy from its inception. Objections included technological arguments (“which system is preferable”), economic and operations research arguments (“any defensive system can be defeated,” “unnecessary investment,” “the cost of defense is greater than the cost of the potential damage”), and strategic arguments (“defensive systems run counter to the principle of deterrence”).

The debate continued during Operation Protective Edge from two opposite perspectives. On the one hand, it was argued that the protection provided by the Iron Dome system gave the decision making echelon maneuvering room that enabled decision makers to avoid haste and premature escalation of the operation. On the other hand, it was asserted that without the protection of the Iron Dome system, there would have been damage to the home front that would have forced the political echelon to launch an offensive to defeat Hamas at the very beginning.

However, these issues ignore the political aspect. Decision making in weapons procurement is a political act no less than a military one. The extent of rocket damage is important not only in the way it is measured, but also in how the public perceives it and in its political effect. The Israeli public has suffered prolonged rocket fire since 1968. The public’s ability to withstand it depended to a large extent on how it assessed the state’s efforts to protect it. Assertions of the uselessness and pointlessness of spending money on defense will be even more trenchant in the argument about defense against short range rockets and missiles, but they do not take into account the fact that deciding on such an investment will by nature be a political act designed

to prove to residents of southern Israel that the country has not abandoned them, no less than it will be a purely military decision.

In the future, the political consideration will also affect the degree to which protection will concentrate on military and strategic facilities. This is a measure that in the above-mentioned circumstances is militarily logical, but likely to prove problematic. Politically, it is actually already being raised in discussion of whether instructions to the system's operators indicates priorities as to what is to be better protected (e.g., to assign more interceptors per incoming rocket while defending certain assets) and what is to be less protected.

Conclusion

To a large extent, Operation Protective Edge was a war of rockets versus defense systems against rockets. Hamas can bask in its success in launching thousands of rockets without losing its capability over 50 days of fighting. On the other hand, Israel can take pride in its system, which gave a feeling of security to most of its residents, thereby enabling its decision makers to exercise patience and judgment.

Israel's defense system against missiles and rockets includes a large number of layers. Of these, only the warning system (Color Red), civil protection, and Iron Dome systems were put to the test. Israel has other defense layers, however, which were not tested at all – some existing and some slated for the future – and it is possible that these will constitute the principal defense in future conflicts. Meantime, as in any military conflict, Operation Protective Edge revealed both capabilities and limitations and defects. The defensive system is imperfect, and it clearly will not withstand all types of future threats.

Notes

- 1 The model numbers apparently represent the declared rocket range. There are few other details about these models, and in some cases, it is reasonable to assume that they are imported, not locally produced.
- 2 Even though all the sources that reported the extent of the firing were probably using the same official sources, they are not consistent with each other. Various sources have cited the numbers 4,519, 4,532, 4,594, and 4,564. Launchings: the number of rockets that fell in "open spaces" was listed by various sources as 3,362, 3,641, about 3,852, and 3,417. In addition, some of the sources stressed that their information includes both rockets and mortar shells, while at least one source stressed that its figure does not include mortar shells.

- 3 One report stated that Iron Dome had also intercepted 10 mortar shells – a weapon that is usually not within the range of Iron Dome’s capabilities. See Gili Cohen, “Iron Dome Intercepted About 10 Mortar Shells during the Fighting in Gaza,” *Haaretz*, August 13, 2014, <http://www.haaretz.co.il/news/politics/1.2405294>.
- 4 Yishai Karov, “Rocket Casualties and Births – Magen David Adom Summarizes Operation Protective Edge,” *Arutz Sheva*, July 27, 2014, <http://www.inn.co.il/News/News.aspx/282829>.
- 5 “Operation Protective Edge in Numbers,” *Ynet News*, August 27, 2014, <http://www.ynetnews.com/articles/0,7340,L-4564678,00.html>.
- 6 A sixth battery was deployed in September 2013. See Alon Ben David, “Israel Deploys New Iron Dome Batteries,” *Aviation Week and Space Technology*, September 9, 2013, <http://aviationweek.com/awin/israel-deploys-new-iron-dome-batteries>.
- 7 Two people were killed by a rocket hit during Operation Protective Edge: Ouda al-Waj was killed near Dimona on July 19, while Sergeant Netanal Maman was wounded on leave and died of his wounds on August 29. In contrast, five civilians and 11 soldiers were killed by mortar fire. See “All the Faces and Names,” *Haaretz*, August 27, 2014, <http://www.haaretz.co.il/news/politics/1.2393220>.
- 8 Dan Williams, “Israel Says Iron Dome Scores 90% Rocket Interception Rate,” Reuters, July 10, 2014, <http://www.reuters.com/article/2014/07/10/us-palestinians-israel-irondome-idUSKBN0FF0XA20140710>.
- 9 Alon Ben David, “Iron Dome Blunts 90% of Enemy Rockets,” *Aviation Week and Space Technology*, September 1, 2014, <http://aviationweek.com/defense/iron-dome-blunts-90-enemy-rockets>.
- 10 The most prominent example is the rocket that struck Yehud, resulting in the halt in aerial traffic. The failure to intercept the rocket was the result of an operator’s decision – a decision that in retrospect appears mistaken.
- 11 The definition of “built-up spaces” is in effect arbitrary. The two fatalities hit by rockets were actually in “open spaces.”
- 12 $735 + 225 = 960$.
- 13 In regular armies, a standard BM-21 rocket battery has six launchers capable of launching 240 rockets within 40 seconds. It is doubtful whether the Iron Dome system is capable of dealing effectively with such a heavy barrage against a single target.
- 14 Gareth Jennings, “Singapore Airshow: Rafael Launches Iron Beam,” *HIS Jane’s Defense Weekly*, February 10, 2014, <http://janes.com/article/33647/singapore-airshow-rafael-launches-iron-beam>.