

VIII. Israeli nuclear forces

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As of January 2022, Israel was estimated to have a stockpile of around 90 nuclear warheads (see table 10.9), the same number as in January 2021. This estimate is on the lower end of a possible range that other analysts have estimated could reach as high as 300 nuclear weapons; however, SIPRI assesses that these larger estimates are probably too high.¹ Israel continues to maintain its long-standing policy of nuclear ambiguity: it neither officially confirms nor denies that it possesses nuclear weapons.² This lack of transparency means there is significant uncertainty about the size of Israel's nuclear arsenal and the yields and characteristics attributed to its weapons.³ The estimate here is largely based on calculations of Israel's inventory of weapon-grade plutonium and the number of operational nuclear-capable delivery systems. The locations of the storage sites for the warheads, which are thought to be stored partially unassembled, are unknown.

The role of nuclear weapons in Israeli military doctrine

Since the late 1960s, the Israeli government has repeated that Israel 'won't be the first to introduce nuclear weapons into the Middle East'.⁴ However, to accommodate the apparent fact that Israel possesses a significant nuclear arsenal, Israeli policymakers have previously interpreted 'introducing nuclear weapons' as testing, publicly declaring or actually using nuclear capability, which, according to available open-access sources, Israel has not yet done.⁵ Another caveat may be that the warheads are not fully assembled under normal circumstances (i.e. the nuclear cores would be stored and managed separately from their delivery systems). It is unclear what

¹ Luscombe, B., '10 questions: Jimmy Carter', *Time*, 30 Jan. 2012; and Clifton, E., 'Powell acknowledges Israeli nukes', *Lobe Log*, 14 Sep. 2016.

² For further detail on Israel's 'strategic ambiguity' policy see Cohen, A., 'Israel', eds H. Born, B. Gill and H. Hänggi, *Governing the Bomb: Civilian Control and Democratic Accountability of Nuclear Weapons* (SIPRI and Oxford University Press: Oxford, 2010), pp. 152–68.

³ Kristensen, H. M. and Korda, M., 'Estimating world nuclear forces: An overview and assessment of sources', SIPRI Topical Backgrounder, 14 June 2021.

⁴ This formulation was first expressed during Israel's negotiations with the United States over the purchase of 50 F-4 Phantom aircraft in the late 1960s. During these negotiations, it was made explicitly clear that both sides had very different opinions about what 'introducing nuclear weapons' meant; however, these competing interpretations allowed the two sides to look the other way, thus satisfying both their security interests and alliance relationships while 'agreeing to disagree' over their interpretations of what 'introducing nuclear weapons' actually meant. The most recent public iteration of this policy by an Israeli head of state was made by Benjamin Netanyahu in 2011. Prime Minister's Office, 'PM Netanyahu's interview with Piers Morgan of CNN', 17 Mar. 2011.

⁵ Cohen, A. and Burr, W., 'Israel crosses the threshold', Electronic Briefing Book no. 189, National Security Archive, 28 Apr. 2006; and Cohen, A. and Burr, W., 'The US discovery of Israel's secret nuclear project', Electronic Briefing Book no. 510, National Security Archive, 15 Apr. 2015.

circumstances would prompt Israel to 'introduce' nuclear weapons into the region under its own narrow definition. It is believed that one such scenario would involve a crisis that poses an existential threat to the State of Israel, such as a full-scale conventional attack.

In 2021 Israeli Prime Minister Naftali Bennett and United States President Joe Biden met to reaffirm that the USA would not pressure Israel to disarm or join the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (Non-Proliferation Treaty, NPT), and that any arms control agreement would not negatively impact Israel's nuclear arsenal.⁶ This has reportedly been a ritual performed with every US president since the administration of President Bill Clinton.

Military fissile material production

Declassified US government documents indicate that Israel may have assembled its first nuclear weapons in the late 1960s, using plutonium produced by the Israel Research Reactor 2 (IRR-2) at the Negev Nuclear Research Center near Dimona, in southern Israel.⁷ This heavy water reactor, which was commissioned in 1963, is not under International Atomic Energy Agency (IAEA) safeguards. There is little publicly available information about its operating history and power capacity (see section X).⁸

The International Panel on Fissile Materials (IPFM) estimates that, as of the beginning of 2020, Israel may have a stockpile of 850–1120 kilograms of plutonium.⁹ Another analyst estimates a lower amount, approximately 530 kg, depending on assumptions about the reactor efficiency.¹⁰ Assuming that its warhead arsenal is likely to consist of single-stage, boosted fission weapons, Israel could potentially use the larger number estimated by the IPFM to build anywhere between 170 and 278 nuclear weapons. However, as with other nuclear-armed states, Israel is unlikely to have converted all of its plutonium into warheads and has probably assigned nuclear weapons to only a limited number of launchers. Moreover, the available tritium required to boost the warheads would represent an additional constraint on the

⁶ Ravid, B., 'Biden and Israeli PM renewed agreement on covert nuclear program', *Axios*, 1 Sep. 2021; and Entous, A., 'How Trump and three other US presidents protected Israel's worst-kept secret: Its nuclear arsenal', *New Yorker*, 18 June 2018.

⁷ For a history of Israel's nuclear weapon programme see Cohen, A., *The Worst-kept Secret: Israel's Bargain with the Bomb* (Columbia University Press: New York, 2010); Burr, W. and Cohen, A., 'Duplicity and self-deception: Israel, the United States, and the Dimona inspections, 1964–65', Briefing Book no. 733, National Security Archive, 10 Nov. 2020; and Cohen, A. and Burr, W., 'How Israel built a nuclear program right under the Americans' nose', *Haaretz*, 17 Jan. 2021.

⁸ Glaser, A. and Miller, M., 'Estimating plutonium production at Israel's Dimona reactor', 52nd annual meeting of the Institute of Nuclear Materials Management (INMM), 17–21 July 2011.

⁹ International Panel on Fissile Materials, 'Countries: Israel', 31 Aug. 2021.

¹⁰ Jones, G. S., 'Estimating Israel's stocks of plutonium, tritium and heu', *Proliferation Matters*, 18 Sep. 2018, p. 6.

Table 10.9. Israeli nuclear forces, January 2022

All figures are approximate and some are based on assessments by the authors.

Type/designation	No. of launchers	Year first deployed	Range (km) ^a	No. of warheads
<i>Aircraft</i>	125/50 ^b			30
F-16I	100/25	1980	1 600	30
F-15	25/25	1998	4 450	.. ^c
<i>Land-based missiles</i>	50			50 ^d
Jericho II	25	1990	>1 500	25
Jericho III	25	[2011]	[>4 000]	25 ^e
<i>Sea-based missiles</i>	5/20 ^f			10
'Popeye' variant SLCM	20	[2002]	[<1 500]	10
Total stockpile	120			90^g

.. = not available or not applicable; [] = uncertain SIPRI estimate; SLCM = sea-launched cruise missile.

^a Aircraft range is for illustrative purposes only; actual range will vary according to flight profile, weapon payload and in-flight refuelling.

^b The first figure is the total number of aircraft in the inventory; the second is the number of aircraft that might be adapted for a nuclear strike mission.

^c The United States Air Force's F-15E Strike Eagle has been given a nuclear role. It is not known whether the Israeli Air Force has added nuclear capability to this aircraft, but when Israel sent half a dozen F-15s from Tel Nof Air Base to the United Kingdom in Sep. 2019, a US official privately commented that Israel had sent its nuclear squadron.

^d Commercial satellite images show what appear to be 23 caves or bunkers for mobile Jericho launchers at Sdot Micha Air Base. High-resolution satellite imagery that became available in 2021 indicates that each cave appears to have two entrances, which suggests that each cave could hold up to 2 launchers. If all 23 caves are full, this would amount to 46 launchers.

^e The Jericho III is gradually replacing the older Jericho II, if this has not happened already. A longer-range version of the Jericho ballistic missile with a new solid rocket motor may be under development.

^f The first figure is the total number of Dolphin-class submarines in the Israeli fleet; the second is the estimated maximum number of missiles that they can carry. In addition to six standard 533 millimetre torpedo tubes, Israel's submarines are reportedly equipped with four additional, specially designed 650 mm tubes that could potentially be used to launch nuclear-armed SLCMs.

^g Given the unique lack of publicly available information about Israel's nuclear arsenal, this estimate comes with a considerable degree of uncertainty.

Sources: Cohen, A., *The Worst-kept Secret: Israel's Bargain with the Bomb* (Columbia University Press: New York, 2010); Cohen, A. and Burr, W., 'Israel crosses the threshold', *Bulletin of the Atomic Scientists*, vol. 62, no. 3 (May/June 2006); Cohen, A., *Israel and the Bomb* (Columbia University Press: New York, 1998); US National Security Archive, various document collections related to Israel's nuclear weapon programme and declassified US government documents relating to Israel's nuclear weapon capability; Albright, D., Berkhout, F. and Walker, W., SIPRI, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies* (Oxford University Press: Oxford, 1997); International Institute for Strategic Studies, *The Military Balance*, various years; *IHS Jane's Strategic Weapon Systems*, various issues; Fetter, S., 'Israeli ballistic missile capabilities', *Physics and Society*, vol. 19, no. 3 (July 1990); *Bulletin of the Atomic Scientists*, 'Nuclear notebook', various issues; and authors' estimates.

number of weapons Israel could build. As a result, SIPRI estimates that Israel has approximately 90 warheads, rather than several hundred.

Having produced enough plutonium for Israel to produce some weapons, IRR-2 may now be operated primarily to produce the tritium needed to boost those weapons.¹¹ Shutdown of the ageing reactor was scheduled for 2003 but has been postponed until at least 2023. The Israel Atomic Energy Commission is reportedly examining ways to extend its service life until the 2040s.¹² Satellite imagery indicates that significant construction started at the Negev Nuclear Research Center in late 2018 or early 2019 and continued throughout 2021, with a large dig several storeys deep located near the reactor.¹³ It is unclear whether the construction is related to life-extension operations at Dimona.

Aircraft and air-delivered weapons

Approximately 30 of Israel's nuclear weapons are estimated to be gravity bombs for delivery by F-16I aircraft. It is possible that some F-15 aircraft could also play a nuclear role.¹⁴ When Israel sent half a dozen F-15s from Tel Nof Air Base to the United Kingdom for an exercise in September 2019, a US official privately commented that Israel had sent its nuclear squadron.¹⁵

Nuclear gravity bombs without nuclear cores would probably be stored at protected facilities near one or two air force bases. It is possible that Tel Nof Air Base in central Israel and Hatzirim Air Base in the Negev desert might have nuclear missions. Israel is also acquiring 50 F-35s from the USA, which are particularly suitable for deep strike operations, although it is unclear whether Israel would use them for that role.¹⁶

Land-based missiles

Up to 50 warheads are thought to be assigned for delivery by land-based Jericho ballistic missiles, although the Israeli government has never publicly confirmed that it possesses the missiles.¹⁷ The missiles are believed to be located, along with their mobile transporter-erector-launchers (TELS), in

¹¹ Kelley, R. and Dewey, K., 'Assessing replacement options for Israel's ageing Dimona reactor', *Jane's Intelligence Review*, 20 Nov. 2018; and International Panel on Fissile Materials (note 9).

¹² Bob, Y. J., 'Experts agree Dimona nuke reactor can exceed original life expectancy', *Jerusalem Post*, 12 July 2019.

¹³ Gambrell, J., 'Secretive Israeli nuclear facility undergoes major project', AP News, 25 Feb. 2021.

¹⁴ Israeli Air Force, 'The F-15I as the IAF's Strategic Aircraft', 19 Jan. 2016; and Israeli Air Force, '19 years of "Ra'am"', 19 Jan. 2017.

¹⁵ US military official, Interview with the author (Kristensen, H. M.), Oct. 2019.

¹⁶ Lockheed Martin, 'Israel's 5th generation fighter', [n.d.].

¹⁷ For further detail see Kristensen, H. M. and Korda, M., 'Israeli nuclear forces', *SIPRI Yearbook 2021*.

caves or bunkers at Sdot Micha Air Base near Zekharia, about 25 kilometres west of Jerusalem. High-resolution satellite imagery that became available in 2021 showed that an upgrade of the bunkers is ongoing, and indicated that each suspected Jericho missile bunker might be capable of storing two launchers. Given that there are 23 caves or bunkers visible in satellite imagery, this lends support to the estimate of approximately 50 mobile missile launchers. Each cluster of bunkers also appears to be coupled with a covered high-bay drive-through facility, potentially for missile handling and warhead loading. A nearby complex with its own internal perimeter has four tunnels to underground facilities that could be used for warhead storage.

Israel is upgrading its arsenal of missiles from the solid-fuelled, two-stage Jericho II medium-range ballistic missile to the Jericho III intermediate-range ballistic missile. The newer and more capable Jericho III is a three-stage missile with a longer range, exceeding 4000 km. It first became operational in 2011 and might now have replaced the Jericho II.¹⁸ In recent years—including 2015, 2017, 2019, 2020 and possibly 2021—Israel has conducted several test launches of what it calls ‘rocket propulsion systems’, although it is possible that some of these tests could be related to the development of Israeli space-launch vehicles, which use solid rocket motors.¹⁹ In April 2021 video footage captured a blast at Sdot Micha Air Base that external analysts suggested was likely to be another rocket engine test; however—unlike its previous rocket propulsion tests—the Israeli Ministry of Defence did not confirm it as such.²⁰

Sea-based missiles

Israel operates five German-built Dolphin-class (Dolphin-I and Dolphin-II) diesel-electric submarines, and plans to take delivery of at least four more submarines.²¹ It is possible that the newer enlarged Dolphin-II submarines could be equipped with a vertical launch system that could carry new types of missile.²² In early 2022 Israel signed a deal with Germany to procure three submarines, which will be known as the Dakar class, to replace the three

¹⁸ O'Halloran, J. C. (ed.), ‘Jericho missiles’, *IHS Jane's Weapons: Strategic, 2015–16* (IHS Jane's: Coudsdon, 2015), p. 53.

¹⁹ Agence France-Presse, ‘Israel tests rocket propulsion system’, *Defense News*, 5 May 2015; Israeli Ministry of Defense (@Israel_MOD), ‘A few moments ago, Israel conducted a test launch of a rocket propulsion system around central Israel’, Twitter, 29 May 2017; Kubovich, Y., ‘Israel carries out test launch for rocket propulsion system’, *Haaretz*, 6 Dec. 2017; and Israeli Ministry of Defense (@Israel_MOD), ‘The Israel Ministry of Defense has completed a test of a rocket propulsion system from a military base in central Israel. The test launch was scheduled in advance and carried out as planned’, Twitter, 31 Jan. 2020.

²⁰ Lewis, J., ‘Israeli rocket motor test’, *Arms Control Wonk*, 23 Apr. 2021.

²¹ SIPRI Arms Transfers Database, Mar. 2022.

²² Sutton, H. I., ‘Israel's submarine secret: New dolphin-IIs could have VLS’, *Naval News*, 19 Jan. 2022.

oldest Dolphin-class boats.²³ In addition to six standard 533 millimetre torpedo tubes, Israel's submarines are equipped with four additional, specially designed 650 mm tubes.²⁴ Both the German and Israeli governments have stated that these tubes are 'for the transfer of special forces and the pressure-free stowage of their equipment'; however, the unusual diameter has led many to speculate that Israel has modified some or all of the submarines to carry indigenously produced nuclear-armed sea-launched cruise missiles (SLCMs), giving it a sea-based nuclear strike capability.²⁵ Additionally, a 2012 media report—which remains one of the most significant exposés on the topic—quoted several former German defence ministry officials stating that they had always assumed that Israel would use the submarines for nuclear weapons.²⁶ If this is true, the naval arsenal might include about 10 cruise missile warheads for the submarines. Israel's submarines have their home port at Haifa on the Mediterranean coast. In recent years—including in 2021—they have occasionally sailed through the Suez Canal, as a possible deterrence signal to Iran.²⁷

²³ 'Israel signs \$3.4 bln submarines deal with Germany's Thyssenkrupp', Reuters, 20 Jan. 2022.

²⁴ Sutton, H. I., 'History of Israeli subs', *Covert Shores*, 20 May 2017; and Bergman, R. et al., 'Israel's deployment of nuclear missiles on subs from Germany', *Der Spiegel*, 4 June 2012.

²⁵ Bergman et al. (note 24).

²⁶ Bergman et al. (note 24). See also Frantz, D., 'Israel's arsenal is point of contention', *Los Angeles Times*, 12 Oct. 2003; and Sutton (note 24).

²⁷ See e.g. 'Iranian state media claims Israeli submarine passed through Suez into Red Sea', *Times of Israel*, 10 Aug. 2021.