October 8, 1964

Report, Canadian Defence Research Board, 'Possible Israeli Military Nuclear Program'

Citation:

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Summary:

After analyzing photographs taken of the Israeli nuclear facility at Dimona, J. Koop, a career intelligence analyst at Canada's Defence Research Board, concluded in March 1964 that Dimona had all of the "prerequisites for commencing a modest nuclear weapons development project." When the Dimona reactor went critical, it could produce enough plutonium for at least one implosion device by the end of 1965 and increase its operating level to produce one to two per year by 1966. Arthur Kellas, a British diplomat in Israel, wrote in his forwarding letter that they were highly impressed by the analysis.

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ISRAEL

ER1241 | 32 /G

FROM A.R.H. Kellas
Tel Aviv – Goodison

No. 1242 | 164G.

Dated Oct 8th

Received Oct 16th

(Outward Action)
D/H) R.C. Treweeks, D.I.S.
A. Goodison 27/11
D/H A.R.H. Kellas, Tel Aviv
A. Goodison 22/12

SUBJECT:

Canadian Service Attaché has shown Embassy paper prepared by Canadian Directorate of Scientific Intelligence which gives answers some outstanding points on Israel nuclear activity

Encloses Copy of:

References and Relevant Papers:
-/26 G.

MINUTES

Can you obtain a copy of this paper for us to see?
[signature] 19/10

Mr B.O. White RUSD.

Grateful for a sight of this if you have received or can obtain a copy.
[signature] 23/10

~~DIS(E)~~ Mr Read ~~PUSD~~
Pse see ~~letter~~ photocopy of paper attached.
[illegible] [signature] 11/11 [illegible]

B.U. to Mr. Goodison O.R. [signature] 18/11

[signature] [signature] 27/11

A) R. C. Treweeks, M.O.D – A.C. Goodison
230/130 D/DSTI/8/10(NU) Dec 8

Draft [signature] 21/12 [signature] 21/12

(Printing Instructions)

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Mr. McLaren? Enter Green
AW2
14/10.

50 14/10

1242/ /64G

BRITISH EMBASSY,
TEL AVIV.

October 8, 1964.

Dear Alan,

ER1241/26G

Please refer to my letter No. 1242G/64 of July 6 about nuclear development in Israel.

2. The Canadian Service Attaché has just shown us an extremely interesting and well-written secret paper issued by the Directorate of Scientific Intelligence of the Canadian Defence Research Board entitled "Possible Israeli Military Nuclear Program". The author is Mr. J. Koop and the paper is numbered 1/64 and dated in March of this year.

3. The Ambassador has asked me to say that, in our view, this admirable paper states the Israel position accurately and moreover answers a number of pertinent questions which we have for a long time wanted to see answered (e.g. how the Israelis would go about testing - or even not testing). We would not ourselves have a word to add to the report, which seems to us a model of what these things should be.

Yours ever,

A. R. H. Kellas

(A. R. H. Kellas)

A. C. Goodison, Esq.,
Foreign Office,
London, S.W.1.

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DEFENCE RESEARCH BOARD

DEPARTMENT OF NATIONAL DEFENCE
CANADA

DIRECTORATE OF SCIENTIFIC INTELLIGENCE

POSSIBLE ISRAELI MILITARY NUCLEAR PROGRAM (U)

by

J. KOOP

DSI REPORT NO. 1/64

Submitted February 1964
Published March 1964
OTTAWA

64-846

SECRET

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POSSIBLE ISRAELI MILITARY NUCLEAR PROGRAM (U)

SUMMARY

Israel has almost completed construction, with French help, of a major nuclear facility involving a medium-sized reactor, a possible plutonium separation plant, and various supporting facilities. The installation, located near Dimona in the Negev Desert, provides all the prerequisites for commencing a modest nuclear weapons development program. It has been built and continues to be maintained under conditions of extreme security. On the basis of an analysis of all relevant technical and political factors, it is concluded that Israel is now in a position to proceed rapidly with a nuclear weapons program at any time, and that she may have already taken a decision to do so. It is estimated that by appropriate direction and support of its nuclear program, Israel could conduct an initial nuclear test by 1966, and could develop a limited nuclear weapons capability, consisting of some 6 to 10 low-yield plutonium bombs designed for aircraft delivery, by the end of 1968.

DISCUSSION

POLITICAL BACKGROUND

In a speech to leading Israeli industrialists and businessmen, on 8 February 1963, the Israeli Deputy Minister of Defence, Mr. S. Peres, referred to a "nuclear arms race" in the Middle East which Israel must win; he lauded the decision by France to rely on its own efforts in building a national nuclear striking force; and he derided Britain for choosing to merge its nuclear deterrent into a multinational nuclear force. He clearly implied that Israel must, in the final analysis, rely on its own capabilities, and he warned that major expenditures would be required to maintain the technical supremacy Israel needed to ensure its national security. On 13 April 1963, Major-General Moishe Dayan, the Israeli Minister of Agriculture, stated that Egypt almost certainly intends to produce atomic warheads for her surface-to-surface rockets, and that Israel too must "diligently develop these weapons so that we don't lag." On 13 May 1963, Mr. Ben-Gurion, the Israeli Prime Minister, speaking in the Knesset, twice emphasized the increasing deterrent strength of the Israeli defence forces as one of two ways in which war in the Middle East might be averted, the other way being to "secure the moral and political support of all those world forces that are as concerned as we are for the preservation of peace in the Middle East." He emphasized, however, that without adequate independent military strength, neither guarantees of territorial integrity nor alliances were sufficient for the protection of Israel.

Mr. Eshkol, who succeeded Ben-Gurion as Prime Minister and also as Minister of Defence in July 1963, has continued to stress that Israel has no alternative but to rely on its own military strength to deter and, if necessary, defeat attack from any quarter. Unlike his predecessor, however, who invariably cited national security as Israel's prime consideration, Eshkol has in his public statements placed

economic stability and growth on the same level of concern as the preservation and strengthening of national security. In a year-end review of Israeli military strength, the Armed Forces Chief of Staff, Major General Tsur, stated that his major concern was not over present Arab military capabilities, but over the trend of new weapon (i.e., missile) development in Arab nations, particularly in the UAR. Israel, he stated, can deal with the enemy now, but must develop new weapons and learn how to use them in order to retain this deterrent power in the future. Both Peres and Dayan have on numerous occasions during the past year expressed a similar concern over the trend in Arab weapon development and the necessity for aggressive and urgent Israeli counter-action.

ORGANIZATION

Reports by western attachés and visitors to Israel in recent years have led us to conclude that there are two distinct atomic energy organizations in Israel: a relatively small group concerned with basic nuclear research and training and with planning for the eventual development of nuclear power, and a much larger group concerned with developing the prerequisites of a nuclear weapons program. Scientists connected with the first group profess to have little or no knowledge of the activities of the second group. Although the two programs almost certainly share top level direction, i.e., involving the Deputy Minister of Defence (S. Peres) and the Chairman of the Israeli Atomic Energy Commission (Dr. Bergmann), in addition to the Prime Minister, there appears to be a complete separation of responsibilities and organization at all lower levels, and the two programs appear to operate in virtual isolation from each other.

Official statements by the Israeli government continue to deny the existence of a military nuclear program in Israel and maintain that the work at the Dimona nuclear installation is entirely concerned with peaceful, i.e., civilian, objectives. Nevertheless, there have been numerous unofficial indications to the contrary, in addition to the technical considerations outlined later in this report. An article in the Jerusalem Post, in June 1963, referred to the intended production of plutonium at Dimona for "military purposes". Tourist guides escorting groups of foreigners across the Negev Desert show no hesitation in pointing out the Dimona installation as the site of "secret" atomic energy work. During a press interview in November 1963, the former Israeli Prime Minister, Mr. Ben-Gurion, is reported to have said that Israel is engaged in nuclear experimentation with military implications. Although he later issued a qualified denial of this statement, the fact still remains that the large (by Israeli standards) nuclear installation at Dimona was and is being built under conditions of extreme security, and there is every indication that a high degree of security will continue to be maintained as the facility becomes operational.

PEACEFUL ATOMIC ENERGY PROGRAM

The peaceful or civilian nuclear program in Israel includes primarily:

(a) Basic research in nuclear physics and allied subjects carried out at the Weizmann Institute at Rehovoth (see sketch map Fig. 1).

(b) A relatively small (1 to 5 Mw) research reactor supplied to the Weizmann Institute under the terms of a bilateral US-Israeli agreement and located at Nahal Sorek, not far from Rehovoth.

(c) Construction of a nuclear engineering center at the Haifa Institute of Technology, to include a small 250-kw reactor and a subcritical facility for instructional and training purposes.

(d) Academic courses and fundamental training in the nuclear sciences offered by various other educational and technical institutes.

The reactor at Nahal Sorek is used for training and research (and possibly some isotope production), and has no potential for the production of weapons-grade plutonium. The Israeli government has also formed several ad hoc study groups to study and advise on the feasibility of developing large-scale nuclear power in Israel. One such committee, under Dr. S. Yiftah, recommended an early start on a long-term program of nuclear power development and suggested several sites in Israel that might serve as locations for nuclear power stations. It is significant that the area around Dimona was characterized as a completely unfavorable location for a nuclear power reactor, and that the installation and expansion of conventional power facilities was recommended for the town of Dimona. A later report by a US advisor, Mr. P. Sporn, engaged by the Israeli government, stressed that the development of nuclear power in Israel was not yet economically feasible, and recommended that Israel wait for a decade or so before committing itself on the construction of any particular type of nuclear power plant. In commenting on this advisory report, the Israeli Minister of Development, Mr. Almogui, indicated that regardless of economics, Israel was determined to start construction of a 125-Mw nuclear power station soon, and would probably have such a station in operation by 1967/8. There have been recent indications that a decision on this matter will be taken early in 1964.

"MILITARY" ATOMIC ENERGY PROGRAM

Dimona Nuclear Installation

The major known effort of the "military" group has been the construction of a large nuclear installation in the Negev Desert near the town of Dimona (see Fig. 1) whose central facility is a 24 to 40 Mw reactor, believed to be fuelled with natural uranium and probably using heavy water as both moderator and primary coolant. This reactor appears to be a modification of the French EL-3 reactor at Saclay, and is known to have been constructed with French assistance supplied under the terms of a classified Franco-Israeli agreement on nuclear co-operation. This agreement, which was signed in 1956, included provisions for France to assist Israel in building a nuclear research center and a nuclear reactor, such assistance to include material and equipment as well as technical personnel, and to train Israeli scientists and technicians at establishments of the French Atomic Energy Commission. It is believed that the agreement also made provision for the transfer to Israel of complete design specifications for a larger plutonium production reactor, probably of the size of the French G-3 reactor at Marcoule.

Work on the reactor and supporting facilities is believed to have started under the most stringent security conditions shortly after the signing of the agreement. It was not until the latter part of 1960 that western intelligence sources reported the construction of what appeared to be a nuclear complex in the Negev Desert. Coupled with the reported acquisition by Israel of a substantial quantity (some 20 tons) of heavy water from Norway, further intelligence observations soon confirmed that Israel was constructing in secrecy a sizable nuclear reactor and ancillary facilities at an isolated desert site near Dimona. Soon after this knowledge was made public, announcements by both Israel and France confirmed the existence and nature of the reactor, and emphasized that it was intended to be an experimental research facility, the initial step in the development of a nuclear power program for Israel, and that ultimately the Dimona installation would be open to students and scientists from other countries. Nevertheless, there has been no relaxation to date of security and access control to the site.

Under apparently considerable pressure from the US State Department, the Israeli government has permitted two US inspections of the Dimona site, the second one occurring in December 1962.* In each case, entry was specifically limited to two or three persons, and arrangements for the visits appear to have been carefully engineered by the Israelis to show the visitors only those aspects of the installation

* It has been reported (December 1963) that arrangements have been made by the US State Department with the Israeli government for a third inspection.

consistent with the aforementioned peaceful explanation. It has been reported that on at least one occasion considerable time was spent viewing an alleged model of the site, that both tours were quite rushed and brief, and that not all parts of the establishment were visited. There is at least a suspicion that misleading information may have been supplied on one occasion concerning a part of the site that was viewed only from a distance. This area apparently includes one or more major excavations, which were stated to be intended for long-term storage of irradiated reactor fuel elements. However, their location and apparent size (as estimated from the mounded earth noticed at a distance by the visitors) make it equally likely that they could represent excavations for a second larger reactor.

Dimona Site Analysis

Recent photographs (November 1963) of the Dimona site confirm that the installation is nearing completion, or at least an initial stage of completion. Most of the scaffolding evident in photographs of about a year ago has been removed and only one or two of the larger cranes (out of some half dozen present before) are still in evidence. The dome-shaped reactor housing, estimated to be about 120 ft. in diam. and nearly 100 ft. high, appears to be complete. From the progress of construction since photography was first attempted in early 1961 and from recent public statements, it is estimated that the reactor may be coming into operation at any time now and certainly by mid-1964. A tall stack, estimated to be well over 200 ft. in height and about 10 to 15 ft. in diam., which was not evident in early 1961 photography, has been constructed during the period mid-1961 to late 1962 and now appears to be complete. This stack could serve to disperse slightly radioactive gaseous effluent from either the reactor or from a possible chemical separation plant, or both. The latter alternative appears more likely as there is a much smaller (60 to 70 ft. high and 2 to 3 ft. in diam.) pipe or stack close to the reactor that could serve to disperse gaseous effluent. It has been suggested that a large and apparently windowless building near the larger stack could contain chemical separation facilities because of its proximity to the stack and to the reactor. These facilities would be used for processing irradiated fuel elements and separating out plutonium. Three circular tanks, probably for water storage, are clearly evident in the latest photography, whereas only two were noted in 1961. One tank appears to be higher, or located on higher ground, than the other two. It is estimated that these tanks, which are located approximately in the center of the installation, are about 80 ft. in diam. and 30 to 40 ft. high. The probable water tower, which was noted more or less completed in early 1961, appears unchanged in more recent photography and is estimated to be about 30 to 40 ft. in diam. and about 130 ft. high. Recent photography has confirmed that at least two coolant towers are now under construction much closer to the reactor; circular scaffolding of about the appropriate size was observed in this area in December 1962. Several large buildings apparently nearing completion are believed to include facilities for uranium metal production, fuel element fabrication, and radiochemical and related process work.

The above analysis based entirely on ground photography acquired during the period 1961 to 1963 indicates* that the northern part of the Dimona installation consists primarily of "housekeeping" facilities such as administration, office-type, accommodation, and maintenance buildings. The three water storage tanks and the "old" water tower are located in the approximate center of the site. The reactor, the [illegible] effluent stack, two coolant towers, the laboratories and process plants, and the possible chemical separation plant are located towards the southern end of the site. If a second larger reactor is intended to be constructed at or near this site, it would almost certainly be located at or beyond the southern extremity of the site, to place it near the chemical separation plant and possibly permit it to share the use of some facilities built near the first reactor. Photography in June 1963 taken from the relatively inaccessible [illegible]

* See tentative site plan Fig. 2.

south side of the installation revealed some construction at the south-east corner of the site in the general area of the excavations mentioned previously. The nature of this construction has not been firmly ascertained, but it does not appear to be the start of a second reactor.

Plutonium Separation

Although it has not been positively confirmed that plutonium separation facilities are under construction or in existence at Dimona, either in the windowless building referred to above or in some other building, there is evidence that a pilot-plant facility for this purpose was planned for Dimona. The intent to do so was revealed during conversations between Canadian and Israeli officials in the course of the visit to Canada by the Israeli Prime Minister in 1961. Conflicting statements regarding the capacity of this plant to extract plutonium from reactor fuel elements were reported at that time, ranging from 25 to 300 g per year. The latter figure is regarded as the more reliable and would correspond to processing about 1 kg of reactor fuel elements per day irradiated to a level of about 1000 Mw-days per metric ton. Extraction of plutonium in small amounts for metallurgical investigation and other experimentation would be a necessary stage in the ultimate development of a plutonium implosion device, although a facility larger than the one mentioned above would be required to separate enough material for one or two initial devices. Pilot-plant plutonium separation could also represent a preliminary step in the development of plutonium-fuelled power reactors. However, it would be very surprising for Israel to undertake such an advanced development at such an early stage in its nuclear program, and to separate it so completely and carefully from its overt research program at Rehovoth and Nahal Sorek. It is highly unlikely, therefore, that the purpose of a plutonium separation facility at Dimona at this time could be anything but military in nature.

Uranium Requirements

It is estimated that the initial core loading of the Dimona reactor will be about 8 to 10 tonnes of natural uranium fuel. If operated at its rated thermal capacity of 24 Mw, a complete fuel change would be necessary at least once and probably twice a year to ensure that the bulk of the plutonium is not irradiated beyond about 1000 Mw-days per tonne, and hence remains weapon-grade material. Thus, Israel would require a source of supply of 16 to 20 tonnes of uranium per year to operate the Dimona reactor for military purposes. Extraction of uranium from Dead Sea phosphates has been studied for some time in Israel, and a pilot plant with a potential output of about 1.5 tons of uranium concentrate per year has been reported at Rehovoth. In addition, there have been reports that the Haifa Fertilizer and Chemical Company has been extracting uranium on an industrial scale from local phosphate deposits for several years. However, a series of chemical analyses of fertilizer products from this firm has revealed no evidence of uranium extraction from any of the phosphates used in fertilizer production. In any event, the cost of uranium extraction from this source is known to be much higher (by a factor of at least 3 or 4) than the present world price of uranium concentrate, and recent statements appear to indicate that it will be used only if efforts to obtain uranium elsewhere fail. Nevertheless, Negev phosphate deposits remain a potential, high-cost source of uranium for Israel, to the extent of possibly 10 to 15 tonnes per year.

The initial fuel charge for the Dimona reactor is probably being provided by France under the terms of the classified agreement. It is not known, however, what safeguards, if any, are stipulated in the agreement, nor whether further uranium shipments from France to Israel are contemplated. Israel is believed to have made an attempt in 1961 to procure 500 tons of uranium concentrate from South Africa in lots of 50 tons per year over a ten-year period. However, the negotiations were apparently terminated when agreement on safeguard provisions could not be reached. The interest in 50 tons per year obviously indicates an intent by Israel to operate an additional larger reactor than the one at Dimona. Such plans

would be consistent with the reported provision by France of design specifications of a G-3-type reactor, although there is no evidence to date of the construction of a larger reactor in Israel.

Israel is known to have obtained 10 tonnes of uranium concentrate from Argentina in 1962 without safeguards and a similar amount from South Africa under nominal IAEA* safeguards in early 1963. These amounts would probably be used to provide standby fuel rods of Israeli manufacture to eventually replace those of (presumed) French manufacture. Israeli interest in acquiring safeguard-free uranium is continuing. Spain, which provided 25 tonnes of uranium to India, is a possible source, and approaches are believed to have been made to Brazil. Sweden, which has recently started construction of a relatively large uranium ore concentration plant at Ramstad, is another potential supplier. However, if efforts to obtain safeguard-free uranium fail or do not produce sufficient quantities, Israel is almost certain to commence exploitation of domestic deposits at higher cost.

Military Implications

At its rated thermal operating level of 24 Mw., the Dimona reactor is capable of producing 7 to 8 kg of weapons-grade plutonium per year. If the reactor goes critical, as expected, early in 1964 and achieves its rated thermal capacity by mid-1964, enough fissile material for some weapons research and development work and for at least one implosion device could be available by the end of 1965. An initial nuclear test therefore could occur at any time in 1966. The reactor contains certain design features that may permit its thermal operating level to be uprated eventually to about 40 Mw. If this occurs after one or two years of operation, the reactor could be producing 12 to 15 kg of plutonium per year by 1966 – enough to fabricate 1 to 2 low-yield implosion devices per year. These might provide Israel with the minimum deterrent capability desired. However, it is considered much more likely that by 1966 (or sooner), Israel will have initiated construction of a significantly larger production reactor, possibly 100 to 200 Mw thermal output, capable of providing enough plutonium for 5 to 10 low-yield nuclear bombs per year. Such a reactor would take some 3 to 4 years to build, and as there is no evidence that it is already under construction, plutonium in larger quantities than produced by the Dimona reactor (possibly uprated) is unlikely to be available before 1968. It is believed, however, that construction of such a reactor will be undertaken, regardless of whether further direct assistance is received from France.

There is no indication of any Israeli interest in uranium isotope separation and the production of uranium-235. Hence, unless a technological breakthrough is achieved, permitting the use of plutonium without uranium-235 as the fissile trigger in thermonuclear devices, the Israeli nuclear weapons stockpile will probably consist of a very limited number of bombs of low to intermediate yield (probably not exceeding 100 KT) for aircraft delivery during the remainder of this decade. The advanced technology necessary for the development of properly weaponized nuclear warheads for missile applications would normally mean that at least two years of development and testing would be required to proceed from aircraft bombs to missile warheads. However, if some design and development information were made available or is already known to Israel, presumably from or through individuals sympathetic to its aims, who have or have had access to nuclear programs in the US, UK, France or elsewhere, missile warheads could probably be developed by the end of 1968 without extensive testing.

If Israel has in fact embarked on a military nuclear program, the eventual need to test one or more devices may create difficulties, in view of the small land area available and the likelihood of Arab retaliatory action. It might be possible to conceal one or two Israeli weapons tests in the future (1965 on) French test program in the Pacific, although French government spokesmen continue to maintain that no

* International Atomic Energy Agency.

assistance or advice useful in a weapons-oriented program has been, or will be, given to Israel. One or two underground tests of low yield might be carried out with relatively little risk of detection, if sufficiently large caverns can be found or excavated on Israeli soil. On the other hand, if maximum publicity and credibility are important to Israel for psychological and political purposes once a device has been developed, then there should be no real problems in a limited number of low-yield tests in the Negev Desert, conducted at sufficient depth to contain the resulting fission products, but with no deliberate attempt at concealment. Such tests are permitted by the limited test ban agreement, to which Israel is a party.

There is at least a strong likelihood that Israel will receive significant aid in its weapons development program, including possibly nuclear weapons design information, from sympathetic individuals or organizations in the US, the UK, France, or elsewhere. In addition, it is known that several scientists now resident in Israel have worked in, or have been associated with, nuclear energy programs in western countries and may have had access to some weapons-oriented information. Thus, if sufficient up-to-date weapons design information can be procured by Israel in one way or another, tests may not be considered essential, and a stockpile of untested devices could be built up covertly. Trials of the high-explosive implosion mechanisms, which could be concealed with relative ease, might suffice to give Israeli scientists and the military sufficient confidence that their devices would detonate as planned.

The covert build-up by Israel of a nuclear weapons stock-pile, either through concealed testing or without testing, appears to be consistent with the general tenor of Israeli statements and actions regarding Dimona over the past few years. The Israeli government has periodically announced its peaceful intentions for the Dimona installation, without however being at all specific about the nature of the work to be performed here. It continues to maintain a high degree of security, not only on the installation itself but on all operations associated with it, and has made little if any real effort to convince the world of its peaceful motivations here. It appears therefore that Israel may want the various nations and, in particular the Egyptians, to believe that work at Dimona has a military objective. However, she is undoubtedly well aware that any public admission of this fact or the conduct of a nuclear test would "force" the Egyptian government to take preventive military action. Hence, Israeli actions and public statements will continue to be motivated by the need to provide the Egyptian government with a face-saving rationale for not going to war, while at the same time leaving Egyptian intelligence (and the military) under no illusions as to the direction and progress of Israeli weapons development.

CONCLUSIONS

Although we cannot demonstrate conclusively that Israel has or has not taken a decision to proceed to the production of nuclear weapons, our assessment of the available technical evidence leads us to believe that Israel has embarked on the first phase of development of a facility for the production of plutonium for military purposes. Unless unforeseen difficulties develop, either political or technical, Israel could explode a nuclear device as early as 1966 and develop a limited nuclear weapons capability based on aircraft delivery before the end of this decade.