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UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON 25, D. C.

APR 13 1965

Mr. John T. Conway
Executive Director
Joint Committee on Atomic Energy
Congress of the United States

Doc. #7874

Dear Mr. Conway:

By letter of February 6, 1964, you were advised of a visit to the reactor site at Dimona, Israel, by a three-man team of experts. Attached is the report of a recent visit to that site by Ulysses M. Staebler, Atomic Energy Commission; Clyde L. McClelland, Arms Control and Disarmament Agency; and Floyd L. Culler, Jr., Assistant Laboratory Director, Oak Ridge National Laboratory.

The visit at the Dimona reactor site on Saturday, January 30, 1965, lasted approximately 10½ hours. As in the case of the visit in January 1964, all of the facilities at this site could not be visited in one day. Although the visit was conducted at a rather fast pace, resulting in less detail than desirable, it is the consensus of the group that the visit provided a satisfactory basis for determining the present status of activity at the Dimona site.

Principal conclusions resulting from this visit are:

1. There appears to be no near term possibility of a weapons development program at the Dimona site.

2. The site has excellent development and plutonium production capability that warrants continued visits at intervals not to exceed one year.

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3. Although there still appears to be a general intent to relax or remove the tight classification on activities at Dimona, the timing for such a change appears more uncertain and less likely to occur in the near future than expected from discussions during the visit a year ago.

Sincerely yours,

Howard C. Brown, Jr.
Assistant General Manager
for Administration

Enclosure:
Trip Report

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NO FOREIGN DISSEM

This document consists of 37 pages
No. 16 of 26 Copies, Series A

March 17, 1965

REPORT

ON

VISIT TO ISRAELI ATOMIC

ENERGY INSTALLATIONS

January 27-31, 1965

NOT RELEASABLE TO THE PUBLIC WITHOUT FURTHER REVIEW BY DEPARTMENT OF ENERGY, OFFICE OF CLASSIFICATION.
AUTHORITY: DOE-OPC
BY: [illegible] DATE: 9/14/89 RoB

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I. INTRODUCTION

1. Professor Igal TALMI, designated by the Prime Minister of Israel as his representative, and Mr. Moshe GILBOA, Escort Officer during the 1962 and 1964 visits, met the team at the airport at 1830, Wednesday, 27 January 1965. In the schedule presented by the Israelis, the visit to Dimona Site was scheduled for Saturday. The team asked that the visit to Dimona begin Friday afternoon but was advised on Thursday evening that this would be very difficult to arrange. Professor TALMI "urged" that the team accept the proposed schedule. The team spent approximately 10½ hours at the Dimona site on Saturday. Although a visit to Dimona on Friday and an extension of the Saturday visit into the late evening were discouraged, the Israelis were cooperative and cordial throughout the visit and made every effort to expedite and to facilitate the team's activities. why?

2. Impressions regarding the future program for the Dimona site naturally reflect the statements of personnel contacted during the visit who are primarily associated with this site. However, these impressions were supported by statements of Professor TALMI and Mr. GILBOA who presumably reflect broader national programs and policies.

II. SUMMARY OF FINDINGS

1. Major uncertainties exist regarding the future direction of atomic energy development in Israel. These were stated to be primarily the result of the US-Israeli desalting project. There appears to be an assumption that the desalting project will result in Israel getting a nuclear power and desalination plant at half price or less. This has resulted in decreased interest in support of development of natural uranium fueled reactors within Israel for the near term.

2. The national water company (MEKOROT) has assumed the dominant role in the desalting project and the Israeli Atomic Energy Commission appears to have little, if any, influence. This has lead to the resignation (not accepted) of the Chairman of the Atomic Energy Commission and to obvious concern on the part of the Director of the Dimona Center.

3. Construction of the uranium recovery plant associated with the phosphate works has not yet been started. Discussions regarding such a plant are still in progress but a firm decision to build the plant has not yet been made. The plant now being discussed would be located at Arad rather than Oron, with a capacity 12 to 30 tons of uranium per year.

4. The fuel fabrication plant at Dimona (uranium metal to canned subassemblies) was placed in standby condition on January 1, 1965, and operation is not expected to resume for at least one year, based on estimated fuel requirements for the reactor.

5. The metal recovery plant also is being shut down. The first stages of operation (the wet processes) were discontinued in November 1964. Processing of the present stock of materials will be completed by mid-March 1965 and the plant will be placed in standby condition at that time. The Director of the Dimona Center said that it was indefinite when, or if, the plant would be returned to operating condition.

6. The reactor started a three month demonstration or acceptance run, at design power of 26 MW, on December 7, 1964. Operation at 32.5 MW was acknowledged to be possible within the original hot spot temperature limitation.

7. Integrated power on the reactor at the time of the visit was approximately 1700 megawatt days (about 200 MD/ton, average). Two fuel elements were removed at about 65 MD/T in order to insert two elements made in Israel. The reactor is loaded with 167 fuel elements containing 8.35 tonnes of natural uranium alloyed with 0.5% Mo.

8. The team made an effort to account for all of the uranium at the Dimona site and was able to make an approximate material balance for about 25 tonnes both by examination of records and by partial physical count.

9. There still are about 40 "foreigners" at the site, including about 18 at the reactor. They will stay until several remaining construction and testing jobs are finished which may be 6 months or more. Principal jobs

mentioned were installation of auxiliary equipment in the fuel storage pond and repair of CO_2 blowers for the reactor's experimental facilities.

10. There was little evidence of immediate plans for experimental use of the reactor even though the design power test run should be completed within about one month. This is at least partially rationalized by the fact that blowers and other equipment for the test facilities will not be ready for several months.

11. There has been no approval of a research and development program or of a budget for the fiscal year starting April 1, 1965. A program was prepared by Professor BERGMAN but has not been approved. An R&D budget of 5 million Israeli pounds has been requested by Mr. PRATT--he has only been advised that he will get less. He is very pessimistic about future support and even talked of the possibility of having to shut down the reactor. Total cost of running the center would be approximately an additional 26 million Israeli pounds.

12. Questions regarding procurement of uranium from other countries were ruled to be "outside the scope of this visit". It was suggested that such questions be taken up through normal diplomatic channels. Mr. PRATT and Professor TALMI denied any knowledge of such arrangements. This information was passed on to the U.S. Ambassador who plans to await further instructions from Washington.

13. Plant security has been increased by installation of perimeter lights and an electric fence--reportedly the result of sabotage activities around the Jordan River project.

14. There is no evidence of further activity on plutonium extraction from irradiated fuel. However, some basic work is now in progress in the extensive plutonium research facilities using 56 grams of the 150 grams of plutonium available to them from the French. Also, it was stated that one of the rooms in the hot laboratories with two small lead shielded boxes was to be used for small-scale transuranium element extraction from reactor fuel samples.

rudely by whom US or Israel

III. CONCLUSIONS AND RECOMMENDATIONS

1. As for the visit last year, not all facilities could be visited in one day at the site. It was necessary to curtail, sometimes rather rudely, detailed discussions of research projects in order to complete the minimum requirements for the visit. The Israelis made it clear that they would not favor an extension of the visit into the late evening. Although the pace was fast and the visit not as detailed as desired, it is the concensus of the team that the visit provided a satisfactory basis for determining the present status of activity at the Dimona site.

Why?

2. Although there still appears to be a general intent to relax or remove the tight classification on activities at Dimona the timing for such a change appears more uncertain and less likely to occur in the near future than expected from discussions during the visit a year ago.

3. While there appears to be no near term possibility of a weapons development program at the Dimona site, the site has excellent development and production capability. Those facilities now, or soon to be, on a standby basis could be reactivated on short notice. The Dimona site does not now include facilities for the chemical separation of plutonium from irradiated uranium. A small chemical separations plant could be constructed, however, within perhaps two years as an internal modification within an existing building.

4. The Israelis now possess, at the Dimona site, uranium equivalent to three reactor core loadings; an amount adequate to produce on the order of 10 to 20 Kgs of plutonium after $1\frac{1}{2}$ to $2\frac{1}{2}$ years of irradiation, dependent upon the irradiation level desired for the plutonium. (This amount does not include uranium concentrates that may have been obtained from Argentina since November 1963.) Approximately half of this uranium exists as fabricated

reactor fuel slugs, including the finished slugs supplied by the French. The fabricated fuel slugs now on hand should be adequate for normal operation of the reactor as a research tool for approximately two years.

5. Should the Dimona site remain a secret facility, the team recommends continued visits by United States personnel at intervals not to exceed one year. A visit, in about one year's time, should attempt to determine (a) whether the reactor operating schedule is indicative of "weapons-grade" plutonium production, (b) whether the fuel element production plant has remained on a stand-by basis as now planned, (c) status of areas for uranium recovery from phosphate, and (d) whether there then exists any evidence of the construction of a chemical separations plant. The visit also should include a brief tour of the "shop" area which has not been examined on any visits to date.

6. A more satisfacotry resolution of the problems created by the secrecy of the Dimona site would be to persuade the Israelis to expedite declassification of these activities. It should be possible to maintain plant security against sabotage without requiring classification of plant activities. The recommendation regarding activities in this direction following last year's visit still seems appropriate. A specific proposal for research and development support in a given area conditioned upon declassification of the facility appears to be the most promising way to bring pressure in this direction.

IV. CHRONOLOGICAL OUTLINE OF THE VISIT

1. Professor Igal TALMI, designated by the Prime Minister of Israel as his representative, and Mr. Moshe GILBOA, Escort Officer during the 1962 and 1964 visits, met the team at the airport at 1830, 27 January 1965. The schedule for the visit, as proposed by the Israelis, called for visits to the Weizmann Institute and the reactor at Nahal Sorek on Thursday, 28 January, and a visit to the Negev Institute for Arid Zone Research at Beersheba on Friday morning. The formal visit would begin Friday afternoon with a trip to the phosphate mines at Oron. The visit to the Dimona site was scheduled for

Saturday. The team suggested that the trip to Oron be deferred until Sunday to permit the visit to Dimona to begin Friday afternoon. Professor TALMI indicated that he thought the same restrictions applied to Oron as to Dimona but promised to investigate this possibility. Mr. GILBOA indicated that he thought there would be difficulty getting approval to go to Dimona on Friday afternoon because there would still be too many people working there. (On Thursday evening, Professor TALMI reported that he had been advised that a visit to Dimona on Friday would require informing many more people about the purpose of the visit and urged that the team accept the proposed schedule.)

2. After the initial discussions in the airport, the team was driven to the Sharon Hotel, a resort hotel on the outskirts of Tel Aviv, on the shore of the Mediterranean Sea. This hotel is near the Accadia Hotel where the team stayed during the 1964 visit. Dr. WEBBER, the Science Attaché, met with the team briefly in the hotel. After dinner at the hotel with Mr. GILBOA, the team went to the home of Professor TALMI at the Weizmann Institute, for social and professional discussions with a group of Israeli scientists. Present were: Professor Igal TALMI and his wife; Dr. Mikhail FELDMAN, a biologist from the Weizmann Institute, Professor Benjamin GOLDRING, in charge of the Van de Graaff accelerator section at the Weizmann Institute; Dr. David SAMUELS, of the Isotope Department at the Weizmann Institute; Dr. Gideon YEKUTIELLI, who was interested in data analysis problems in high energy physics at the Weizmann Institute; Dr. Israel PELAH, in charge of the research reactor at Nahal Sorek; Mr. FRIAR (phonetic), a graduate student of Professor DeSHALIT at the Weizmann Institute; and Mr. Moshe GILBOA, the Escort Officer.

3. The morning of Thursday, 28 January 1965, was spent at the Weizmann Institute with Professor TALMI as host. This visit was conducted in a manner somewhat more perfunctory than the 1964 visit. The guests at lunch were: TALMI, GOLDRING, SAMUELS, YEKUTIELLI, and FRIAR.

4. The team proceeded to the reactor at Nahal Sorek in the afternoon. Professor PELAH acted as host. This site now has under construction a hot laboratory for isotope research which will cost about four million Israeli pounds. It contains two hot cells under construction, which are probably capable of handling 10,000-12,000 curies of activity, in addition to less elaborate facilities for lower amounts of radioactivity.

5. The Israelis acted as hosts at a concert on the evening of 28 January 1965.

6. The team proceeded to Beersheba on the morning of 29 January 1965. Reservations had been made at the Desert Inn Hotel.

7. The team visited the Negev Institute for Arid Zone Research, Beersheba, during the morning of 29 January 1965, and the phosphate mines at Oron in the afternoon. Mr. PRATT and his wife acted as hosts at a dinner party in the evening. The team, Professor TALMI, and Mr. GILBOA were the only guests. At the hotel, Professor TALMI received a call warning him that Mr. KISSINGER, who had been an adviser to President Kennedy, was staying at this same hotel accompanied by two newspaper reporters. TALMI seemed relieved when informed that none of the team members was personally acquainted with Mr. KISSINGER, and he reported this fact by telephone.

8. The team left the Desert Inn Hotel about 06:15 on the morning of 30 January 1965, and arrived at the site shortly after 07:30. On arrival at the site, Mr. D. RANEN, in charge of "public relations" met the team and informed them that no photography would be permitted. Cameras worn openly by two team members were removed and stored in the car trunk. The original Israeli schedule for the visit had provided for arrival at 09:00; this schedule had been amended during the discussions of the previous evening. A typed schedule was presented to the team for discussion. This paper in English, was marked "SECRET", dated 28 January 1965, and headed "Nuclear Research Center - Negev." The schedule omitted a visit to the uranium metal production plant (since it was partially shut down), to the

fuel element production plant (completely on a stand-by basis), and allowed one and one-half hours for lunch. These two facilities were added to the schedule and the lunch period was reduced to one-half hour. Many of the technical personnel at the site were prepared for lengthy discussions of their projects. When Professor TALMI made it clear, during one such program discussion, that an extension of the visit into the evening would not be desirable, it became necessary to terminate, sometimes rather rudely, discussions of the technical projects in the laboratories. The results of this visit are outlined elsewhere in the report. The visit terminated about 18:00; the team departed by helicopter to Beersheba for a brief meeting with Mr. PRATT and his wife at their home, then by helicopter to Tel Aviv. A final meeting with Mr. PRATT was requested for Sunday morning, 31 January 1965 in Tel Aviv, to recapitulate the results of the visit and to clear up any uncertainties, The team also requested Mr. GILBOA to ask Dr. WEBBER to come to the Sharon Hotel Saturday night. Mr. GILBOA undoubtedly understood this request to be the result of Israeli refusal to discuss foreign procurement of uranium concentrates with the team which was announced during the luncheon at Dimona.

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9. Dr. WEBBER visited the team in the hotel late Saturday night. In a discussion in his car, the results of the visit were briefly reviewed and he was requested to ask the Ambassador whether the team could help further in resolving the questions related to foreign procurement of uranium.

10. The team met again with Dr. WEBBER on Sunday morning at approximately 10:30 and were informed that the Ambassador would await instructions from Washington before discussing foreign procurement of uranium with the Israelis. He was reported to be prepared to seek additional time at the Dimona Center if the team considered it essential to visit additional buildings but otherwise was inclined to leave things as they were.

11. Mr. PRATT, Professor TALMI and Mr. GILBOA came to the hotel about 11:30 on Sunday morning and reviewed the visit until approximately 13:00.

12. The team made final arrangements for departure from Israel at 18:30 on 31 January 1965, and visited Jerusalem briefly in the afternoon before departure.

V. PROGRAM AND POLICY CONSIDERATIONS

1. After the team completed the visit to the phosphate mines at Oron, and found that construction of the uranium recovery facilities had not yet begun, this deviation from the plans outlined during the 1964 visit was frankly discussed with Professor TALMI and Mr. GILBOA. They reported that serious uncertainties existed in the Israeli nuclear program which had tended to diminish the interest in natural uranium and in natural uranium reactors. These uncertainties were explained as the result of the joint Israeli-United States desalination studies which had caused some circles in the government, allegedly including the Prime Minister, to assume that the Israelis would be able to obtain a nuclear power and desalting plant with U.S. financial assistance for half price or less. Since such a reactor, under present technology, would use slightly enriched uranium, and would dominate any nuclear activities in the near future, this assumption had resulted in decreased interest in natural uranium and natural uranium reactor technology--the basis on which the Dimona site had been designed. The team was advised to discuss this question with Mr. PRATT during the dinner party at his home planned for the same evening. Mr. PRATT was described as "bitter" and "outspoken" about this problem.

2. This description proved accurate. During the dinner party and in subsequent discussions, Mr. PRATT described his difficulties as due to the Israeli-U.S. desalting project and, at least in part, to the national water company (MEKOROT) which is assuming a dominant role in that project. Apparently this company is large, aggressive, and seeking new projects now that the national water project is essentially complete. Mr. PRATT, who had been a representative of Israel at previous IAEA panels on desalting in Vienna and who still is much interested in the subject appears to have been excluded from

participation in current activities. Mr. PRATT had never received an invitation to visit the United States; he was aware, however, that such an invitation had been forwarded to the Government of Israel as a result of discussions during the visit a year ago. One of his physicists at Dimona, Dr. R. THIEBERGER, had been a member of the original Israeli team. He was no longer associated with this project. No personnel from Dimona were now involved in the desalting studies. The assumption that Israel would get a large, enriched uranium reactor at half-price had produced considerable uncertainty about the program of the Dimona site. The natural uranium metal plant would be shut down when processing of the present stocks of concentrate was complete (mid-March), and the fuel element production plant had already been placed on a stand-by basis. Mr. PRATT had requested ("demanded") five million Israeli pounds for the research and development program at Dimona for the fiscal year beginning 1 April 1965; he had been advised that he would get less. He was going to "knock on some doors" and demand an adequate sum for support of research. He acknowledged that there was little evidence of planning for research with the reactor. This was explained, in part, by defective cooling facilities for the experimental channels, which would be corrected before the end of the current fiscal year, and by the absence of some of the equipment for the cooling pond, which might not arrive for 4-5 months. He agreed, however, that some research with the reactor could begin when the current full-power acceptance tests were complete (March 1965), but pointed out that he would need more people and instrumentation for an effective research program. This was a budget problem. He mentioned the morale problem of getting people to work in the desert at Dimona; explaining that it was not so bad for the men, provided that their morale was maintained by an interesting program of research, but more difficult for the wives of the scientists. He implied that he could not now foresee a research program capable of maintaining the morale of the scientists. He mentioned the possibility that even the reactor would have to be shut down because of insufficient funds.

3. In a luncheon discussion, Dr. THIEBERGER confirmed many of these impressions. He had been very much involved in the desalting project and had assigned problems to some of his staff. By the end of the year, however, these studies had been dropped. He implied that he had been a strong advocate of a heavy water reactor for the desalting plant. A Progress Report for the Physics Department, 1963-1964, discussed briefly the experimental program during the start-up and calibration of the reactor--it does not indicate that an experimental program for reactor research has yet been developed.

4. The Chairman of the Israeli Atomic Energy Commission, Professor BERGMAN, has submitted his resignation supposedly because of the policy and funding problems now being experienced. His resignation has not been accepted. The research program for Dimona, which was outlined by a committee chaired by Professor BERGMAN, has not yet been accepted. Mr. PRATT stated that the Research Council of Israel has become very active. Mr. PRATT believes that the government officials who would normally correct the present uncertainties are now more concerned with the election. Mr. PRATT believes that the 1965 election will lead to the re-election of the present Prime Minister. He hopes that there will be some policy decision with respect to the future of Dimona soon after the election.

VI. MINING AND MILLING ACTIVITY

1. Since 1951, the Israelis have mined the extensive phosphate deposits near Oron. These phosphates are exported or shipped to the Haifa plant of Fertilizers and Chemicals, Ltd. for chemical processing to fertilizers. The phosphates contain approximately 0.01% uranium. A pilot plant for the separation of uranium is located at Haifa. This plant has produced about 3 tons of uranium, as UF_4, which is included in the materials balance elsewhere in this report. During the 1964 visit, the team was informed that a substantial expansion of the phosphate mines was planned and that the Israelis also planned to install chemical plants

for the separation of uranium from these phosphates to produce some 50-60 tons of uranium per year. This plant was scheduled for completion in 1-1/2 to 2 years.

2. On Friday afternoon, 29 January 1965, the team visited the phosphate works at Oron. They were met by Mr. BARNOY, civil engineer in charge of operations, and Mr. LEVY, civil engineer responsible for the construction of a new rotating kiln train for upgrading phosphate. The phosphate deposit was located about 4-5 kilometers from the plant. The deposits cover an area about 3-4 Km by 25 kilometers and contain a proved 50-70 million tons of phosphate rock. The phosphates are located in an area with an over-burden which ranges from zero to 10 meters in thickness. At the present time, this over-burden is stripped using tractor-powered scoops. There was no chemical plant in evidence at the site for phosphoric acid (and super- or triple phosphate production) production, nor any circuit for uranium recovery. Mr. Levy stated that neither phosphoric acid nor uranium recovery plants were part of the planned installation at Oron. Only mechanical and thermal benefication will be done at Oron to raise the phosphate content from 25 to 30-32% (as P_2O_3).

3. Mr. Levy (later confirmed by Mr. Pratt and Mr. Lavi) stated further that a new source for phosphates at a grade of about 32% had been found at Arad which is 30 miles northeast of Oron. Here super-phosphate, calcium phosphate, and other concentrated fertilizers will be produced, and phosphoric acid will be made as an intermediate. The construction of the fertilizer plant has started, to be completed in about one year, but no facilities have been authorized for uranium recovery. The Arad plant will have a capacity for production of about 165,000 tonnes per year of superphosphate as P_2O_5. From this, a maximum of about 30 to 60 tonnes/year of uranium could be recovered, depending upon yield and portion of the production of rock phosphate upgraded to more concentrated fertilizers through the production of phosphoric acid.

Production of Uranium for Israeli Domestic Phosphates

The reserves of phosphate are approximately as follows (Note: no uranium now being recovered):

Site	Primary Products and PO_4 Concentrate as P_2O_5	10^6 Tonnes/Year Production as P_2O_5		Reserves 10^6 Tonnes P_2O_5		U Reserve 10^3 Tonnes*	
		Now	Future	Proven	Estimate	Proven	Estimate
Oron	Primary rock (25%)	0.3-0.6	0.3 plus	70	210-700	7	21-70
	Roast-wash (32%)		0.7				
Arad	Primary rock (32%)	0	some	same as Oron		7	21-70
	Superphosphate (40%)	0	0.165	(guess)			

*The uranium appears in leach-zone phosphate rock at a concentration of approximately 0.01%.

4. The benefication processes used and now being installed at Oron preclude any possibility of recovery of uranium at this site. The existing mechanical benefication consists of a grinding step which reduces the raw rock to 100 mesh or less. The phosphate rock remains at about 100 mesh, but the impurity $CaCO_3$ rock is reduced to much finer size. Thus, a partial separation of the impurity can be obtained by air elutrication, which increases phosphates to about 27-28%. The new roast process, employing a large natural gas-fired (countercurrent) kiln about 10' in diameter by 120' long and subsequent lime slaking-slurry separation, will be completed by June, 1965. In this, the impurity $CaCO_3$ is converted by heat to CaO (lime); the lime is converted by steam to $Ca(OH)_2$ (slaked lime). The resulting dry mix is slurried in water with the result that the impurity $Ca(OH)_2$ is separated as a fine suspension from the heavier and larger particle size phosphate fraction. Thus, there is no present possibility of uranium recovery at Oron since neither process includes the necessary acid leach step. However, the beneficiated product from Oron could be shipped to Arad for leaching at some future time if there is an all out program for domestic uranium production.

5. The newly discovered, relatively high-grade phosphate deposit at <u>Arad</u> is soon to become a major producer of phosphates. In addition to probable shipments of rock phosphate, a plant will be installed to produce superphosphate at a design capacity of 165,000 tonnes (as P_2O_5) per year. Construction has been started under the supervision of Mr. Levy (not part of Israeli AEC), who is also supervising the Oron calcines. At the present time, no commitment has been made to install a uranium recovery circuit in this plant. However, the Israeli AEC has asked for estimates of cost for installing a uranium circuit on the superphosphate production cycle in this plant, with probable initial capacity of about 12 tonne/U/year, later possibly 20 tonnes/year with a maximum of 30 tonnes/year. Mr. Lavi of Dr. Pratt's group at Dimona is charged with the responsibility for providing technical data for these cost studies. Dr. Pratt and Mr. Lavi both think that the cost of uranium from this source will be at least $20 to $25 per kilogram, a factor of about <u>2</u> above the world market price of uranium. Pratt expressed the belief that the circuit will not be installed. No engineering design studies have been made for a uranium circuit by the Israeli AEC, but they have asked for estimates from the groups bidding on the phosphate mill for uranium recovery circuit costs. The process technology to be used for these estimates is that developed by the Israeli AEC.

6. Processes which have been developed and tested for uranium recovery from the phosphoric acid-sulfuric mixture which results from sulfuric acid leaching of phosphate rock are as follows:

(a) Solvent extraction with an organic pyrophosphate diluted with kerosene (reported in 1958 Geneva and similar to U.S. work on Florida leach zone phosphates), which is "stripped" by washing with HF solution, providing a precipitated hydrous UF_4 slurry from which it is difficult to prepare reactor-grade uranium. The organic used also carries trace quantities to the phosphate raffinate, which is used to produce mono-calcium phosphate supplement to cattle feed. This organic residue provides taste and odor that cattle do not like; the feed prepared from this stream will not be eaten by its intended offended recipients. This process was pilot-planted at Haifa producing about three tonnes uranium, 1.6 tonnes of which is still stored as UF_4 slurry at Dimona. The process will not be used because of difficulty of filtration of product, high solvent losses, reduction of H_3PO_4 by iron, and generally high iron concentrations in the raffinates which interferes in the production of sodium and calcium phosphate food supplements.

(b) Electrodeposition (cathodic) of uranium onto pure copper cathode from sulfuric acid--phosphoric acid solution. Process is difficult, it has been tested and reported somewhere in the literature. May be evaluated for Arad study. (Reference: Geneva Conference (1958): Paper 1609; Alter, Foa, Marcus, Throcher, Gruenstein, Lavi, Prulov, Tulipman, Waldman, The Electrodeposition of Uranium from Monocalcium Phosphate Solution.)

(c) A new leach system, selective for uranium on which patents have not yet been obtained, but which a Dr. Belstein will soon report in the open literature. After the selective leaching (apparently through combination of acid strength, selection, temperature control) uranium is recovered by ion exchange on IR-400 resin (weak base); then eluted and precipitated as ammonium diuranate. Will be evaluated in Arad study; no pilot plant work yet; apparently, only lab study to date. (Reference: Geneva Conference (1958): Paper 1607; Alter, Foa, Hadari, Peri, Throcher, Selective Leaching of Uranium from Phosphate Rock by Dilute Mineral Acids.)

(d) One other on monitoring future note of the Israeli potential for recovery of uranium: The purchase of sulfur or pyritic in much larger quantities then current requirements plus that required for the design capacity of the Arad superphosphate plant (165,000 tonnes/year as P_2O_5) might indicate a substantial increase in uranium recovery plans.

VII. URANIUM METAL PRODUCTION

1. The first stages of the uranium metal production plant at Dimona were shut down in November 1964. These stages were the "wet" processes. Pumps were wrapped in plastic and the floor was clean and dry at the time of the visit. The balance of the plant will be shut down when the remainder of the uranium stock on hand is processed to uranium metal, about mid-March 1965. The production capability of the plant, as operated during the last year, was indicated by the figures shown on the master plant status board--a capacity of 25 ingots of uranium metal per month, each ingot weighing 80 kilograms. This yearly capacity, 24 meteric tons (tonnes) per year, agrees well with the capacity given during the 1964 visit--20 tonnes per year, for the production schedule outlined in the report of the last visit.

2. During the 1964 visit, it was stated that the Israelis hoped to produce the first ingot in July 1964. By January 1965, however, they had produced only 50 ingots at 80 kilograms per ingot (these figures from the master status board do not include several ingots still stored in the metal production plant). The production of about four tons of uranium metal, as ingots, was turned over to the fuel element fabrication plant.

3. The metal production plant has processed, or has in process, most of the uranium concentrates received at the Dimona Site. These total 20 tons of uranium concentrate as uranium diuranate (identical with the same quantity of this material mentioned in the report of the 1964 visit) from which 10 tons of uranium have been derived, and a total of three tons of uranium as uranium tetrafluoride from the uranium pilot plant at Haifa. Of the UF_4 from Haifa received at Dimona, a quantity equivalent to 1.6 tons of contained uranium remains unprocessed. Mr. PRATT could not estimate when the uranium metal production plant would be restarted. He had been informed that he would not be supplied with any more uranium concentrates. (At this point in the discussion,

the team mentioned Israeli orders for foreign concentrates; this discussion is reported in Section XII.)

4. Mr. LAVI stated that the uranium metal plant could produce 20-30 tons per year when operated on a batch process. He did not deny the estimate made by one team member that that plant could handle up to 100 tons of uranium per year when operated on a continuous basis. Mr. LAVI denied any knowledge of the source of the uranium diuranate which was in process; he stated that the material came from the Israeli Atomic Energy Commission. The normal operating staff of the uranium metals plant was given as 40-45 men; although Mr. LAVI mentioned that the plant was now operated by five men.

5. At the conclusion of the visit to the metal production plant, Mr. PRATT asked Mr. LAVI (in English) to consider the production of some uranium oxide for an experimental program.

VIII. FUEL ELEMENT FABRICATION

1. The fuel element fabrication plant, (technology building), has been on a "stand-by" basis since the first of the year. The plant received about four tons of uranium in the form of 80 kilogram ingots from the metal plant and has made 161 ten kilogram canned slugs for the reactor from this material. The balance of the initial four tons of ingots is stored in the building. The first Israeli canned fuel slug was produced on 15 November 1964; it is located in Mr. PRATT's office in a velvet lined box. Of the initial slug production, 50% were reject. The reject rate at the end of production had dropped to 30%. Of this production, 85 acceptable slugs were stored in the fuel element production plant together with 65 defective slugs. Ten additional good slugs, as two complete fuel elements, were placed in the reactor in early December before the beginning of the full power acceptance run on 7 December 1964.

2. The quantity of slugs to be produced by the plant before shut-down was determined by the physicists at Dimona. Mr. PRATT asked them to determine the number of fuel elements which would permit operation of the reactor throughout the next budget year; until April 1966. The physicists had calculated that an additional half core loading, to permit reloading the center zone of the reactor, would be required. The reactor is loaded with 167 fuel elements containing 835 fuel slugs. The French had supplied 1200 fuel slugs. The first core loading left, therefore, 365 slugs of French manufacture some of which were defective. Israeli production of 95 acceptable slugs provided enough for two fuel elements for testing (10 slugs), and 85 other slugs to make a half core load when combined with the unused French fuel slugs.

3. The technological building once had a staff of approximately 40 people. Only 10 remained assigned to this department. Mr. PRATT stated his desire to retain the capability to manufacture fuel elements; the technicians will not be dismissed but will be used elsewhere at the site. This building was designed as a production facility; it is not particularly suitable for research. Mr. PRATT could not predict when the facility would be re-activated. He had planned its production to permit shut-down for a full budget year but at times also talked of completing fabrication of available uranium metal into fuel cartridges at an earlier date. Actual plans undoubtedly will depend upon budget action.

4. The Israelis have not yet manufactured slugs of thorium metal although this was a part of the research program discussed during the 1964 visit.

IX. REACTOR OPERATIONS

1. The reactor at Dimona went critical on 26 December 1963, according to information supplied during the 1964 visit.

2. The initial start-up experiments ran until approximately April 1964. These experiments included the approach to criticality and poisoning tests, reactivity measurements and flux measurements. In the poisoning tests, an iron wire was attached to each fuel element. This load resulted in only about 0.03% excess reactivity and was intended to simulate the behavior of the reactor with a core poisoned by fission products. The same test was repeated with only half of the fuel elements "poisoned" by an iron wire. Criticality was achieved by raising the level of the heavy water moderator. Other initial experiments included measurements of the worth of the control rods, flux mapping, and temperature effects on reactivity. The reactor power was raised to five megawatts during runs in June, July and August; and to 10 megawatts beginning in September. The integrated power of reactor operation at these power levels is given below:

At 5 megawatts .... 315 megawatt-days

At 10 megawatts .... 180 megawatt-days

An acceptance test at the full power, 26 megawatts, began on 7 December 1964. This test is scheduled for 3 months of operation at design power. As of 30 June, the reactor had operated approximately 44 days at full power for a total of 1144 megawatt-days. The total integrated power to 30 January 1965, as estimated by the Israelis, is, therefore, approximately 1639 megawatt-days for a core loading of 8.35 metric tons of natural uranium, or an average fuel irradiation level of about 195 megawatt-days per ton.

3. Two fuel elements of French manufacture (10 slugs) were removed in early December to permit the insertion of two fuel elements of Israeli manufacture. The elements removed had an irradiation level estimated to be 50-75 megawatt-days per ton, average, and are now stored in the cooling pond.

4. Eighteen of the 40 "foreigners" still at the Dimona site are associated with the reactor. These "foreigners" will remain until acceptance testing is complete and until the defects in experimental equipment have been corrected and the cooling pond facilities have been installed. A bearing burned out in the carbon dioxide blowers for the cooling system on the experimental channels. The experimental channels have been removed from the reactor, since some cooling is required even when no experiment is installed in the channel. This defect will be corrected in a "couple of months". The facilities for cutting fuel elements in the cooling pond have not yet been received, however, a fuel element may be cut in the facilities of the hot laboratory. The reactor should be complete by the beginning of March although the cooling pond facilities may not be completed for 4-5 months. Foreigners will be present at the Dimona site for six months, perhaps somewhat longer, including those involved with other facilities at the site.

5. The hot spot temperature at full power is now approximately 450°C at 26 MW power level. The Israelis are confident that the reactor may be operated "easily" to 32 to 32-1/2 megawatts within the design hot spot limitation of 550°C, using only two of the three coolant circuits. At this power level, the flux should be 6×10^{13} n/cm^2/sec. They also noted that the power level could be increased even more by adding enriched uranium to improve the flux distribution.

6. Reactor operation has encountered a number of problems. In addition to the burned-out bearings in the CO_2 pumps for the experimental channels, they have had trouble with swelling of the plugs at the top of each fuel element. These plugs contained "hydrogen enriched"material like plywood. This swelling made the removal of the fuel elements difficult. Fortunately, this difficulty was discovered before the problem became serious, and it was corrected by turning down the diameter of these plugs. Vibrations in compensation rods during pump operation was corrected by changing the plungers to the same design used in the safety rods. The shafts for the fans on the cooling

towers developed cracks from vibration. This required a shut-down of these fans. The reactor was operated without the cooling tower fans at power levels up to 10 megawatts. The fans were repaired in Israel at an aircraft factory and re-installed before the full-power test run began. Operation at 10 megawatts without the cooling tower fans would be possible only in the winter. Operation at design power was started within about two weeks of installation of the repaired fans. The full-power test run was interrupted for a "couple of days" due to trouble with the diesel generators for the reactors. The radioactivity alarms on the stack once "scrammed" the reactor, due to operator error while the instruments were being calibrated. High temperature was observed in the recombiner for deuterium and oxygen during the rise to design power. The difficulty was corrected by raising the level of the heavy water by a few (about 5) centimeters; therefore may have been the result of insufficient internal recombination. The effect is reproducible with change in heavy water level, however, the reasons are not fully understood.

7. The reactor may not be unloaded or loaded during operation. It requires one to one and a half hours to remove a rod in the unloading cycle.

8. The uranium fuel for the reactor contains 0.5% molybdenum and, according to the suppliers, can stand 1000-3000 MWD/T irradiation. Mr. PRATT believes that this will represent 1200 MWD/T in practice, but will assume an irradiation level of 1500 MWD/T to be possible. The Israelis plan to approach this level cautiously, but stated that they do intend to operate the reactor to the maximum irradiation level possible. With two-zone reloading, and the extra half-core now on hand, Mr. PRATT mentioned two years as a possible figure for operation before new fuel elements become necessary.

9. No research with the reactor will be possible until the reactor is complete and the full-power tests are finished. Mr. PRATT

agreed that some experiments could be started in March, if the research programs were approved, but he noted that he needs more people and instruments to begin an effective research program--thus, it becomes a budgetary problem and he does not yet know the budget allocation for research that will be approved.

10. The irradiated fuel storage pond is full of water and the two fuel elements which had been removed were observed in the pond. There are 30 racks each capable of holding 32 elements for a total storage capacity of 960 elements. In addition to the storage space there are cells for other operations, such as cutting, but equipment has not yet been installed.

11. Heavy water "losses" from the reactor were described as being only a few hundred liters. It was stated further that most of this is still around in containers.

X. OTHER ACTIVITIES AT THE "NUCLEAR RESEARCH CENTER - NEGEV" (The Dimona Site)

1. Water Treatment Plant. Mr. KOPELMAN is in charge of this plant. Raw water is stored in a tall cylindrical tank of 500 cubic meters capacity, to provide a head, and in one of the three one million gallon (3750 m^3) tanks near the water plant. The plant produces four types of water:

a. De-carbonated water - 120 m^3/hr. which is stored in the remaining two one million gallon tanks. These tanks provide a reserve capacity adequate for 4-5 days operation of the site.

b. Soft water for the steam plant - 15 m^3/hr.

c. Demineralized water for cooling the reactor - 6-7 m^3/hr.

d. De-silicized water - 1/2 m^3/hr. The last three types of processed water are stored in smaller tanks and are supplied on demand.

2. Technical Services Building. Mr. KEINI is in charge of all services for the site, including the water plant. The team walked through

this building quickly. It supplies steam, compressed air and electricity to the site.

3. Laundry. The team checked this building quickly. It contains facilities for cleaning and repairing the clothing worn in radiation areas, and can process all such clothing worn by site personnel. It is now operating at 1/5 to 1/3 capacity. The Israelis have established rigorous health and safety controls. Even a trace of natural uranium requires processing a garment as radioactive. The waste water from this facility, to date, has contained so little radioactivity that the waste treatment plant must add natural uranium to assist development of their process technology.

4. Waste Disposal Plant. Mr. HAREL is the director of this facility. The plant was shown by Mr. SHNEIDOR, a chemical engineer. It handles all radioactive wastes produced in Israel, including those from the Weizmann Institute. Disposal of radioactive wastes to the ground has not been authorized. It can handle a maximum activity of 20 microcuries per cubic centimeter. The evaporator is shielded with 17 centimeters of concrete and could process some "tens" of curies. The plant is designed to handle the 500 cubic meters from one of the cells of the fuel element cooling pond, if one of the fuel elements should rupture. The waste tanks do not have cooling coils. The plant was also designed to receive a minor quantity of fission products from the planned (but not constructed) plutonium separation pilot plant. These wastes would be diluted before processing. Mr. SHNEIDOR hopes to get a decontamination factor of 10^{-5} from the single stage evaporator. Last month the plant received 400 m^3 of solution from the laundry and the decontamination plant; this waste had an activity in the micro-microcurie per liter range. One hundred kilograms of uranium is stored in the waste disposal building. This material is used as an additive to test their processes when handling low-activity materials.

5. Ventilation, Filtration, Decontamination Building. Mr. ROZEN is chief of the ventilation section of this building. Mr. ORION is chief of the decontamination section. The latter section has processed about 100 radioactive pieces to date. The building also contains the cell in which the plutonium separation plant was to have been installed. This latter facility has not been constructed. Mr. PRATT doubts that it will ever be constructed. The team did not visit the cell, which was said to be in use for storage of the filters for the ventilation system. There was no evidence to indicate that the radiochemical processing pilot plant does exist at the present time or is planned. This building also contains meteorological equipment which is a unit in the national system of meteorological stations.

6. a. Medical Center and Command Post. Dr. RONEN, a medical doctor, showed the medical facilities, which are equipped with facilities for treating a few casualties from a radiation accident. Mr. RIKLIS, a biologist, conducts studies of the local environment. Mr. GAL, in charge of health physics, is responsible for the site-wide health physics program. He led the visit to the Command Post, located in the basement and displayed an elaborate control panel on which lights indicate the nature of alarms received from any of the site buildings. The person on duty at the Command Post must query the personnel at the building concerned to determine the seriousness of the incident and the corrective action being taken. The alarm panel also shows a representation of the close-in fence surrounding the site with lights which indicate the sector of the electric fence contacted by any intruder. The master site map displayed on the wall included a resumé of the current meteorological data for the area, obtained from the station at the Dimona site and from the national net of meteorological stations.

b. Master records of all radioactive substances at the Dimona site are maintained at the Command Post. The team spot checked these records to confirm some of the material balance data obtained orally elsewhere. Each sheet of these records contained data on a single type of material located at a specific point, for example, a separate sheet of the record was maintained for each glove box containing plutonium. The records used Arabic numerals, but the tabular headings were labelled in Hebrew.

7. Cold Laboratories. Mr. RAVIV is in charge of this laboratory. Apparently, he does not speak English since Mr. LEVINE acted as the host during this visit. Mr. LEVINE described the main research interests of the group, which appeared to be the same as those reported for the 1964 visit. Some interesting results were presented from work on stainless steel decladding of uranium with nitric acid using SS as the cathode instead of the anode. The team did not visit the analytical wing of this building. Mr. BAROR discussed the metallurgical program briefly. This program includes work in four areas:

a. Physical metallurgy
b. Development of alloys for reactors
c. Physical studies of materials under irradiation
d. Studies of pyrometallurgical extraction techniques using liquid metals.

He has had one paper published in the Transactions of the American Institute of Metals and a second paper accepted for publication by this journal. Work on coherent precipitation preparation of uranium fuel with resultant increase of 30 to 40% in strength at room temperature was of particular interest.

8. a. Hot Laboratory. Mr. SEROUSSI is in charge of this facility, which includes hot cells, a radiochemical laboratory, a hot analytical laboratory, and a plutonium laboratory. Mr. POLES is in charge of the three hot cells. All three cells are now complete. One of the cells

is equipped for cutting fuel elements and similar operations. The second cell is empty at present. The third cell is equipped for metallurgical studies on radioactive materials. Mr. POLES displayed a photomicrograph of a metallurgical specimen prepared from 550 MWD/T irradiated uranium from France that had cooled for four years. He was apologetic about the quality of the photograph, which was not sharply focussed, but other photos of cold specimens were of satisfactory quality. One room is used to mock up hot cell equipment before final installation. Another room was stated to be intended for small lead brick hot cells for transuranium work or for work on small pieces of material removed in the larger hot cells.

b. The radiochemical laboratory was under the direction of Mr. GVION. Mr. FARAG'I was engaged in research in radiation chemistry, some of which has been published in the Journal of Physical Chemistry. Other facilities included a counting room, equipment for work with alpha-active solutions (by Simeon A. ADAR, who was granted U. S. Patent #3,136,600 on 15 August 1962), two rooms equipped for work with radioactive isotopes, equipment for gas chromatography, a glove box room for unshielded work with suitable isotopes (not alpha active) and a room for "tagging" organic substances with radioactive isotopes.

c. In the plutonium wing, the team met Mr. HADARY who showed three of the four rooms equipped for work with dangerous alpha-active substances such as plutonium. Two of these three rooms were in active use with plutonium, the third was being prepared for use. The fourth room, which was not visited, was equipped for reduction of plutonium compounds to plutonium metal. The plutonium laboratory was working with 56 grams of the 150 grams of plutonium received from the French. The plutonium was stated to have been made available on the basis that there would be joint French-Israeli planning of the research program using it. The plutonium supplied by the French has a density from 16.8-18.1 gm/cm^3, less than the normal density of plutonium, and contains about 6000 ppm of Fe, presumably as Fe_6Pu. All plutonium samples received were in the form of wire 4 mm. in diameter and one centimeter long. A paper on a special camera for X-ray diffraction has been accepted by the Journal of Instruments (Dr. EREZ) and will be published in about two months.

d. These plutonium facilities are very complete and are suitable for an extensive research or small production program. Each room has 9 to 11 glove boxes. The equipment in the glove boxes is relatively small scale, typical of that required for research with small samples. It would be possible, however, to equip the boxes with equipment suitable for the fabrication of the plutonium components required for a nuclear weapon.

e. The ventilation wing and analytical wing of this building were not visited by the team.

9. Physical Secruity and Personnel Control. The Israelis are concerned about the possibility of sabotage. The site is now surrounded by a triple fence equipped with lights -- the center fence electrified with a lethal voltage. The Israelis also plan to install proximity wiring in this fence, and have made arrangements with the military service to provide protection for the site. On the last day of the visit (31 January 1965), the team was informed that dynamite for sabotage had been discovered only 25 kilometers from the Dimona site. The Israelis have established strict controls over the radiation hazards at the site. All personnel are required to wear a film badge, which is obtained by exchange of an identification card, and to wear appropriate external clothing and special shoes for the radiation area in which they work.

XI. GENERAL COMMENTS ON THE DIMONA SITE

1. All facilities should be complete by the end of the budget year (31 March) with the possible exception of the facilities at the reactor

cooling pond which may not be complete for 4 to 5 months. The site employs about 1,300 people. The total cost of operating the facility is about 26 million Israeli pounds per year, not including the research budget. There are still about 40 "foreigners" at the site, eighteen of whom are associated with the reactor. Some "foreigners" may remain for six months or more. There are no immediate plans to declassify the facility, although the Prime Minister has stated that the site will be opened. There are two reasons for the restrictions on the site: (1) the protection of their foreign suppliers against the Arab boycott, which must continue until foreign personnel leave the site, and (2) the danger of sabotage. The Israelis recalled that there had been considerable delay in permitting foreigners to enter the small research reactor at Nahal Sorek and predicted that the Dimona site would remain closed for some time after all site construction was complete. When informed by the team that this position seemed less optimistic than the impression conveyed during the 1964 visit, Professor TALMI indicated that there was no specific reason for the different impression and explained that perhaps he was just less optimistic than Professor KATCHALSKI had been or possibly less capable of conveying an optimistic impression.

New construction at the Dimona site includes an open building constructed to the northwest of and adjacent to the Technological Department (fuel element fabrication). This building is little more than a shelter and is used to store certain supplies and the waste uranium from the fuel element fabrication process. There is also new construction in progress connected with north end of the waste disposal building, reportedly for administrative facilities. The construction is in a very early stage; the footings were not complete, but the preparations did not seem to indicate that heavy shielding walls were to be constructed.

Several construction shacks were located in this area. Somewhat further away from the north end of the waste disposal building is located an area, with a shack, where solid radioactive wastes may be stored. This area is apparently not in active use.

XII. URANIUM ACCOUNTING FOR THE DIMONA SITE

The quantity of natural uranium at the Dimona site was checked by inspection of the master accountability log, by separate conversations with different individuals, and by visual evidence where that was possible. We made a reasonable accounting of the uranium that has been delivered to the fuel complex and the reactor. Uranium has been received in three forms from three sources: clad-metal fuel sub-assembly from France; 20 tonnes of impure uranium concentrate (yielding about 10 tonnes U) as magnesium diuranate; and three tonnes U as UF_4 slurry from the Haifa phosphate pilot plant. The following table summarizes our knowledge of the natural uranium balance:

INPUT

Source and Form	Fuel Sub-assemblies	Metric tonnes Uranium
France, as sub-assemblies	1200	12
10 tonnes U from 20 tonnes foreign concentrate		10
UF_4 slurry from Haifa pilot plant		3
		25

DISPOSITION AS OF JANUARY 31, 1965

	Number	U Tonnes
Reactor (from France)	825	8.25
Storage pond (from France)	10	.10
Stored for second core (from France)	355	3.55
Produced from concentrate		
Acceptable fuel sub-assemblies	85	.85
Test fuel elements in reactor (Israeli)	10	.1
Stored rejects	65	.65
Metal ingots at 82 kg each	5	.41
UF_4 ready for reduction		1.5
UO_3 and UO_2		1.5
Purified nitrate		2.5
Scrap, skulls, and slag		1.5
Impure UF_4 slurry (from Haifa pilot plant)		1.6
Waste and waste plant		.2
Storage as metal ready for fabrication		1.6
		24.31 tonnes

XIII. Estimated Capabilities

Neither the total Israeli capability to produce natural uranium nor to manufacture Pu at Dimona is now being used. At present, facilities do not exist to produce more than about 3 tonns/yr of natural U; no capability exists to produce and recover Pu. However, the potential to enter into these companion efforts is there and could be implemented by installing additional equipment. An estimate of this potential follows.

Site and Facility	Raw Material	Total Yearly U (or Pu) Capability, tonnes/yr. Probable	Maximum
Oron	phosphate plants, with phosphate beneficiation only, now 300,000 to 600,000 tonnes/yr, will go to 1,000,000 tonnes/yr with new units, which have capacity of 165,000 tonnes P_2O_5 equivalent/yr @ 0.01% U. Reserves: Proved 70,000,000 tonnes, estimated 3 to 10 times this.	0	50-100
Arad	phosphate plants will have capability to produce phosphoric acid and various forms concentrated fertilizers, 165,000 tonnes as P_2O_5 equivalent. Will have chemical circuit, probably no U circuit, but the latter is being studied. 500,000 tonnes/yr ore @ .01% U Reserves: At least equal to Oron	12-20	30-60
Haifa	U recovery pilot plant	3	3
	Subtotal	25*	80-160**

Feed Materials			
Dimona	4 concentrate purification (wet) (3 shifts)	0	30-100 depending on feed concentration.
Dimona	uranium nitrate to uranium hexafluoride (3 shifts)	0	90-100
Dimona	uranium hexafluoride to metal (3 shifts)	0	90-100
Dimona	metal fabrication and canning (3 shifts)	0	70-90
	Note: Facilities thru metal fabrication have operated only on 1 shift /. day in batch sequence.		
Reactor Irradiation			
Dimona @ 26 MW, 85% on stream			8-9 kg Pu/yr. @ 1 core/yr.
Reprocessing	Only empty space available	0	None installed; space available for cells; no plans.
Pu Handling		research quantities 10 gm batch limits	Few hundred grams per week, with changes required.
	4 rooms, equipment and spaces for 24-3' glove boxes available, plus hall. Could be converted quickly, say in 6-9 months.		

* No approval has been given for any installation of a U recovery plant. Mr. LEVINE, engineer in charge of the installation of the mono calcium, triple and super phosphate complex at Arad (started in December 1964), has no knowledge of any plans for U recovery. Mr. LAVI, engineer in charge of feed materials at Dimona and formerly occupied with U recovery from phosphates stated that the Israeli Atomic Energy Commission has asked the fertilizer company to prepare cost estimates for recovery of U from that part of the production at Arad which will go through the phosphoric acid stage. The Commission, in Mr. PRATT'S opinion is unlikely to approve plant if costs exceed twice the world market price. Thus, since their and our estimates of the cost of recovery from phosphates is $20 to $25/kg, it is unlikely that uranium will be recovered.

** This is a maximum possible recovery based on processing all phosphate to recover uranium, something very unlikely, since considerable tonnage of untreated rock is shipped to other countries from Oron. The total output of Oron is likely to be sold without treatment.

XIV. PROCUREMENT OF URANIUM FROM FOREIGN SOURCES

1. Concentrates. When Mr. PRATT stated that the uranium metal plant would be shut down and that no more concentrates were available for processing, a member of the team advised the group (TALMI, PRATT, SIVRONI, RANEN) that we had noted a trade journal item which reported that some eighty tons of uranium concentrates had been ordered by Israel from a foreign source. Mr. PRATT replied that he was not responsible for the procurement of heavy water and uranium; these were supplied by the Israeli Atomic Energy Commission. Professor TALMI also denied any knowledge of this order for uranium concentrates. The team indicated that this was a matter of interest to the United States and requested that Professor TALMI locate an individual with whom we might discuss this question. Professor TALMI promised to do so. He reported at lunch that he had contacted Mr. Moshe BITAN, Chief of the U. S. Desk at the Foreign Ministry, who informed him that neither TALMI nor PRATT could discuss this matter; it was outside the scope of the Dimona visit. Mr. BITAN suggested that this question be raised through normal diplomatic channels. The team indicated some concern; one member informed Mr. Moshe GILBOA, the Escort Officer, that it would now be necessary to meet with the American Ambassador or with the Science Attache prior to our departure from Israel. Mr. GILBOA arranged a meeting with Dr. WEBBER, the Science Attache, Saturday night after the team returned to Tel Aviv, following the visit to Dimona. In a meeting in Dr. WEBBER's car, the team asked that he discuss this problem with the Ambassador and advise whether the Ambassador desired the team to remain in Israel to assist any approach to the Israelis about the uranium concentrates procured from foreign sources. On Sunday morning, Dr. WEBBER reported that the Ambassador did not plan to approach the Government of Israel on this problem at this time but would await instructions from Washington. It should be noted that no member of the team identified the

country believed to be the source of these concentrates (Argentina) nor were the price and exact quantity of the concentrates mentioned to the Israelis.

2. Procurement of the Second Reactor Core from the French. Mr. PRATT stated that the Israelis have not discussed with the French the possibility of procuring another core for the reactor. He appeared to be satisfied that the facilities at the Dimona site were adequate and would be used for the fabrication of finished fuel elements. This capability had been demonstrated prior to the shut-down of the fuel element production plant.

3. Chemical Processing of the First Reactor Core. Mr. PRATT confirmed that this first core will be returned to the French for chemical processing. However, he gave the impression that no detailed consideration has yet been given this problem. The Israelis have not yet determined the optimum cooling time, nor have they considered the costs of transporting the radioactive fuel. The reactor core load represents a very small batch for a large processing plant; they did not yet know where their fuel would be processed. The possibilities mentioned in the discussion were Marcoule and Mol. In response to a direct question about the disposal of the plutonium recovered from the Israeli fuel, Mr. PRATT replied that this was a question of policy. He did not doubt that the French would supply additional quantities of plutonium, if the Israeli program needed them, but under the same conditions as the 150 gram quantity of plutonium already supplied by the French. The conditions were not mentioned; it may be, however, that the Joint French-Israeli research program on plutonium, mentioned elsewhere during the visit, would determine the need for additional quantities of plutonium at Dimona. When one team member mentioned that a four-year cooling period would reduce transportation costs, Mr. PRATT acknowledged that the Dimona site has facilities adequate for such long cooling times, however, he was worried about the consequences of an air attack and did not want much irradiated fuel in storage at one time.

XV. THE CRATER: HAMAKHTESH HAQATAN

On the first two days of the visit the team displayed a casual interest in the geological configurations of the Negev Desert. Accordingly, the Israelis selected a route to the phosphate mines at Oron which passed through the large crater, Hamakhetsh Hagadol. This trip provided an excellent basis for low-key questions about the smaller crater, Hamakhtesh Haqatan. The rim cliffs of this latter crater are visible from the Dimona site. The site map displayed in the Command Post indicated that the exclusion area fence for the Dimona site runs along the west edge of the crater and excludes the crater. At no time did any of the Israelis reveal any sensitivity about the crater, nor did they give any indication that it was connected in any way with the activity at Dimona.

Mr. WEBBER said that drilling was known to have occurred in the Haqatan area but no activity was evident at the present time. It was not known whether these past activities were associated with construction plans or general geological surveys.

XVI. ISRAELI PERSONNEL MET BY THE TEAM

The following personnel were met by the team during the visit. The list is not complete, and there exists some uncertainty about the spelling of the names indicated as "phonetic".

BARNOY, Associated with the phosphate works at Oron

BA'OR, in charge of the metallurgical section at Dimona

DARIEL, associated with X-ray diffraction studies in the plutonium program at Dimona

DORON, associated with the reactor at Dimona

ESHEL, in charge of the fuel element production plant at Dimona

FARAG'I, associated with the radiochemistry laboratory at Dimona

MIKHAIL (ph) FELDMAN, a biologist at the Weizmann Institute

FRIAR (ph), a graduate student at the Weizmann Institute

GAL, in charge of health physics at Dimona

Moshe GILBOA, Escort Officer

Benjamin GOLDRING, in charge of the Van de Graaff group at the Weizmann Institute

GVION, in charge of the radiochemical wing of the hot laboratory at Dimona

HADARY, in charge of the plutonium wing in the hot laboratory at Dimona

HAREL, in charge of the waste disposal building at Dimona

KEINI, in charge of the services department at Dimona

KOPELMAN, in charge of the water treatment plant at Dimona

J. LAVI, in charge of the uranium metal production plant at Dimona

LEVY (ph), project officer for the calcination plant at Oron

LEVINE, a chemist in the cold laboratory

NAOT, in charge of the reactor at Dimona

ORION, in charge of the decontamination section at Dimona

Israel PELAH, in charge of the reactor at Nahal Sorek

POLES, in charge of the hot cells in the hot laboratory at Dimona

Mannes PRATT, Director of the Dimona site

R. RANEN, in charge of public relations at Dimona

RAVIV, in charge of the cold laboratory at Dimona

RIKLIS, a biologist at Dimona

RONEN, a medical doctor at Dimona, in charge of the medical facilities

ROSEN, in charge of the ventilation section at Dimona

ROZEN, associated with the plutonium laboratory at Dimona

David SAMULES, associated with the Isotope Department Weizmann Institute

SEROUSSI, in charge of the hot laboratory at Dimona

SHNEIDOR, a chemical engineer in the waste disposal facility at Dimona

SIVRONI, in charge of the over-all coordination at Dimona

Igal TALMI, Professor of Theoretical Nuclear Physics at the Weizmann Institute and designated by the Prime Minister of Israel as his representative during the 1965 visit

Reuven THIEBERGER, nuclear physicist at Dimona

Gideon YEKUTIELLI, nuclear physicist and mathematician at the Weizmann Institute

XVII. OTHER ISRAELI PERSONNEL ASSOCIATED WITH DIMONA

a. Associated with the Physics Department:

I. AVIRAM
Y. BONEH
E. CHEIFETZ
P. DEMARMELS
E. FINKMAN
A. GERSTEN
S. GOSHEN
T. GOZANI
Z. KAM
M. PASTERNAK
A. PAZY
H. SHAKED
J. WOLBERG

b. Mr. Simeon A. ADAR works in the radiochemistry laboratory and Dr. EREZ worked in the plutonium laboratory.