DOI: 10.2968/066002007

Bulletin of the Atomic Scientists

Revisiting the NUMEC affair

It is the story that won't go away—the possibility that in the 1960s Israel stole bomb-grade uranium from a U.S. nuclear fuel-processing plant. Now two former NRC officials explain what they think happened.

BY VICTOR GILINSKY & ROGER J. MATTSON

IN A 1977 *60 MINUTES* INTERVIEW, MIKE WALLACE ASKED then Israeli Prime Minister Menachem Begin whether he could, or would, shed any light on rumors that in the early 1960s Israel had stolen bomb-grade uranium from the United States. Begin ridiculed the question, but he didn't answer it directly: "From time to time, I read in the press the most fantastic stories—how everywhere Israel snatches away uranium from America and from Europe. It belongs to the James Bond stories—"

"Not so?" Wallace interjected.

"I don't pay any attention to them," Begin answered.

Wallace let it go, and after a year or two of interest, so did the rest of the media, which is a shame, because when the known facts are put together, it is difficult to escape the conclusion that Israel probably did steal highly enriched uranium (HEU) from the United States.

The story landed in the press about a year before the Wallace/Begin interview. It started, improbably, with James Conran, an engineer at the Nuclear Regulatory Commission (NRC) who was angry about being denied access to an intelligence report on Israel's nuclear activities—a report he thought he needed to properly assess safeguards at U.S. commercial nuclear facilities against theft of bomb-capable materials. To address Conran's insistent complaints and to scotch rumors, NRC Chairman William Anders in February 1976 invited CIA Deputy Director Carl Duckett to brief about a dozen senior NRC officials. Instead of dismissing the rumors, Duckett stunned his audience by telling them that the CIA believed Israel had illegally obtained HEU from a fuel-processing plant run by the Nuclear Materials and Equipment Corporation (NUMEC) in Apollo, Pennsylvania, and that Israel used this HEU for its first bombs.[1] (Both coauthors worked at the NRC at the time and were involved

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in one or another aspect of the NUMEC affair—one as a commissioner who attended the CIA briefing and the other as the head of a task force charged with developing the NRC's response to Conran.)

Anders immediately passed along Duckett's information to James Connor, a smart, confident assistant to President Gerald Ford who knew his way around nuclear issues because he briefly had been director of planning and analysis at the Atomic Energy Commission (AEC), the precursor to the NRC.[2] As Connor recounted it, he told Ford, "Mr. President, I have good news and bad news. The good news is that Israel definitely has the Bomb and can take care of itself. The bad news is that the stuff came from Pennsylvania."[3] At Connor's urging, the Justice Department began looking into the matter.

Drawing on an earlier FBI case summary, Attorney General Edward Levi informed Ford that the FBI had never conducted "an investigation into the alleged discrepancy in nuclear materials at NUMEC because it was advised by the AEC that any loss likely was attributable to inadequate accounting procedures and that there was no evidence or suspicion of a violation of law."[4] Levi listed several criminal statutes that might have been violated: Some dealt with unauthorized release of restricted data; two pointed to his suspicions that enriched uranium was unlawfully removed from Apollo; and three others referred to the possibility that federal officials concealed the events after the fact. He concluded: "I believe it necessary to conduct an investigation," which he instructed the FBI to undertake.[5]

The original investigation. NUMEC started processing HEU at Apollo in the late 1950s, mostly for the AEC. However, by the early 1960s, worrisome signs appeared that the plant's security and accounting were deficient—even by that era's lenient standards. Here is how then AEC Chairman Glenn Seaborg described the situation in his 1993 book, *The Atomic Energy Commission under Nixon*: "The AEC's materials accountability system as of 1960, the year when the discrepancies were first noted at NUMEC . . . provided no means of ascertaining how much material a company might ship abroad other than by referring to the company's own records; there was no provision for AEC physical checks of shipments. The system did not require that [special nuclear material such as plutonium or enriched uranium] be physically protected within, or when in transit to and from, private plants. Nor was every private employee who handled [special nuclear material] required to have a security clearance or even to be a U.S. citizen. . . . In addition, AEC staff did not seem to emphasize vigorous enforcement even of existing requirements."[6]

AEC officials did complain about NUMEC's performance and began to lose patience with its lack of response. In 1965, after the company could not account for a substantial amount of HEU and

dragged its feet about resolving the discrepancy, the AEC conducted its own careful inventory.[7] The commission concluded that there was about a 200-kilogram difference between the HEU supplied to the plant and the amount returned in product to customers. After accounting for processing losses, the fate of about 100 kilograms of HEU remained unexplained. Neither NUMEC nor the AEC could figure out where the missing HEU might have gone.

NUMEC's president Zalman Shapiro traveled frequently to Israel; NUMEC was a procurement and sales agent for the Israeli ministry of defense; and the company was involved in a partnership, called ISORAD, with Israel's nuclear organization to develop food irradiators, which involved sending large packages of radioactive sources to Israel.

Unexplained losses occurred at other commercial plants, but Apollo's losses were proportionately larger.[8] Equally troublesome were the extensive contacts NUMEC's president, Zalman Shapiro, an eminent chemist and inventor, had with the Israeli government. Shapiro traveled frequently to Israel; NUMEC was a procurement and sales agent for the Israeli ministry of defense; and the company was involved in a partnership, called ISORAD, with Israel's nuclear organization to develop food irradiators, which involved sending large packages of radioactive sources to Israel.[9]

All of this left the AEC in an embarrassing fix. The commission had been aware that it was technically possible for *foreign recipients* to use HEU or plutonium fuel imported from the United States for nuclear weapons, but, incredible as it seems today, the agency had not given any thought to the possibility that individuals or groups could steal nuclear material *within* the United States.[10] Worse yet, public suspicion that bomb material had been stolen from a U.S. facility would undermine support for the AEC's grandiose nuclear projects. The commission's immediate concern, however, was how to deal with the inevitable questions from the powerful Joint Committee on Atomic Energy (JCAE)—the AEC's congressional overseer, and real boss.[11]

At a key February 1966 meeting in preparation for congressional testimony, AEC Assistant General Manager Howard Brown said the basic AEC position "should be" that it had "no evidence or suspicion that diversion had occurred." Seaborg emphasized the desirability of stressing to the JCAE the "theory" presented by Brown that no diversion had taken place. This theory, in Brown's opinion, made it unnecessary to formally involve the FBI—which had jurisdiction over all alleged or suspected criminal violations of the Atomic Energy Act.[12]

Commissioner James Ramey asked about interviewing NUMEC personnel. Brown did not think much would come of it but agreed

to do so. A month later, the AEC sent a team to Apollo to question NUMEC employees. To the dismay of team leaders, AEC attorney Marcus Rowden instructed them not to take any written statements and to cease questioning and return to Washington at the first indication of illegal activity. The investigators asked about 36 NUMEC employees only whether they knew about any diversion.[13] None did. Some guards volunteered that a diversion would have been possible, but that information did not seem to gain traction.

While the AEC "investigated" the HEU loss, the FBI restricted itself to briefly examining whether the ISORAD arrangement required Shapiro to register as a foreign agent. The Justice Department concluded that it did not.[14] The AEC then talked the FBI out of investigating the possibility of diversion on grounds that the AEC had found no suspected criminal violations, just sloppy accounting.[15] In short, the AEC took the position that diversion was so unlikely that there was no need to consider it at all. In retrospect, it looks as though the agency's single-minded interest in nuclear power expansion smothered any security concerns.

Suspicions continue to mount. The case, however, was revived a couple of years later after clandestine U.S. environmental sampling around Israel's nuclear weapons facility at Dimona detected minute traces of HEU that reportedly bore the signature of an enrichment plant in Portsmouth, Ohio.[16] It is unclear from public documents how firm the evidence was, but an unambiguous identification would have been possible if the samples were of ultra-HEU that was produced only at Portsmouth. Such uranium was used in U.S. naval reactor fuel and processed by NUMEC at Apollo.[17] Plus, the possibility that Israel had enriched uranium domestically was discounted, bringing additional attention to NUMEC.[18]

In April 1968, Director of Central Intelligence Richard Helms wrote to Attorney General Ramsey Clark in a memo that remains highly classified that HEU processed at Apollo might have ended up at Dimona and requested that the FBI resume its investigation of NUMEC.[19] (The CIA could not legally conduct such an investigation within the United States.) At about the same time, Helms informed President Lyndon B. Johnson of the CIA's suspicions. Johnson reportedly told Helms, "Don't tell anyone else, even [Secretary of State] Dean Rusk and [Defense Secretary] Robert McNamara."[20]

Two months later, Clark ordered the FBI to place Zalman Shapiro under electronic and physical surveillance, which revealed unusual meetings between Shapiro and known Israeli intelligence operatives that have never been explained.[21] For instance, Israeli scientific attachés, who the FBI believed were senior Israeli intelligence officers, frequently visited NUMEC.[22] Shapiro later admitted that he met with the head of Israeli military intelligence in Israel.[23]

He also revealed to investigative reporter Seymour Hersh that he knew Binyamin Blumberg, the head of LAKAM, Israel's scientific intelligence operation.[24]

In early 1969, the incoming Nixon administration, including the president himself, took a keen interest in the NUMEC case, but principally as one involving possible espionage rather than diversion.[25] Seaborg might have convinced the administration that it was futile to pursue the diversion charge.[26] The ensuing discussions, many of which are still secret, centered on what to do about Shapiro's Q clearance in light of what the FBI discovered. FBI records and Seaborg's memoirs show that at one time or another the issue occupied Attorney General John Mitchell, Defense Secretary Melvin Laird, Deputy Defense Secretary David Packard, White House Counsel John Ehrlichman, science adviser Ed David, National Security Advisor Henry Kissinger, Secretary of State William Rogers, FBI Director J. Edgar Hoover, and, of course, Seaborg himself.

Hoover and Mitchell still strongly urged the AEC to lift Shapiro's Q clearance, but Seaborg and the other commissioners refused, claiming to be concerned about the reaction of the scientific community.

In June 1969, Shapiro had a rushed meeting at Pittsburgh International Airport with another Israeli scientific attaché, Jeruham Kafkafi, which Shapiro again had difficulty explaining. Interviewed by AEC security two months later, Shapiro, surprised that the AEC knew about the meeting, first claimed it was about an overdue invoice. When the AEC interviewers didn't buy his story, he called back to say Kafkafi asked about an individual at Oak Ridge National Laboratory, whose name he could not remember.[27] (A possible explanation: Because the meeting came right before what was to be the last U.S. inspection of Dimona, Kafkafi might have sought information about U.S. team members who were assigned to the inspection.) Despite such dissembling, Shapiro did not lose Seaborg's backing or that of the AEC commissioners. In its report on the Shapiro interview to JCAE Chairman Chet Holifield, the AEC admitted that Shapiro was "less than completely candid" in discussing his relationship with Israeli officials, but that the commission "does not contemplate further action in this matter at this time."[28]

Hoover and Mitchell still strongly urged the AEC to lift Shapiro's Q clearance and to do so without a hearing—something the AEC could have done under its rules. But Seaborg and the other commissioners refused, claiming to be concerned about the reaction of the scientific community.[29] As such, the FBI discontinued its active investigation in September 1969.[30]

The actual HEU losses at Apollo. The heated high-level dis-

cussions in Washington about Shapiro's security clearance deflected attention from diversion at Apollo, where it turned out later there was more to worry about than the 100 kilograms of HEU that were discovered to be missing in 1965. In 2001, the Energy Department reconstructed NUMEC's "unaccounted for" losses of HEU throughout its operating history.[31] Energy's analysis showed that the unexplained losses for the period between 1966 and 1968 were even larger than the ones discovered earlier, a matter that received little or no attention from the AEC, FBI, or any other agency. Apparently, everyone assumed that after the 1965 imbroglio and a 1967 change in plant ownership—it was bought by ARCO—security and material accounting at Apollo would have improved sufficiently so that any subsequent theft could be ruled out. However, Shapiro stayed on as president and kept his senior management team intact until he left the company in October 1970. Only when the Babcock and Wilcox Company (B&W) bought the plant in 1971 did accounting and protection practices come up to industry standards.

Energy's 2001 report stated that Apollo's cumulative HEU loss from the start of operations in 1957 through 1968 was 269 kilograms of uranium 235, including the approximately 100 kilograms that were found to be missing in 1965. It also reported that only 76 kilograms were unaccounted for in the period from January 1969 until 1978, including the eight years that B&W ran the operation, during which the plant's HEU "throughput" increased substantially.[32] Records from the time indicate that losses of HEU in the 10 years of operation through 1968 exceeded 2 percent of HEU throughput while losses in the 10 years after 1968 were less than 0.2 percent of throughput.[33]

The large unexplained losses in the period from 1966 to 1968 cast an ominous light on a September 1968 visit to NUMEC by four Israeli intelligence operatives. In its request to AEC security to approve the visitors, NUMEC identified the four as Rafael Eitan ("chemist, Ministry of Defense, Israel"); Avraham Bendor ("Department of Electronics, Israel"); Ephraim Biegun ("Department of Electronics, Israel"); and Avraham Hermoni ("scientific counselor, Israeli Embassy, Washington").[34] They were supposedly there to discuss the purchase of small plutonium 238 power sources, but they were an astonishingly inappropriate group for that purpose. Eitan was not a chemist; he was a high-level, highly experienced Mossad agent who was reputed "not to have missed an operation" and established an early reputation for "killing without hesitation."[35] He headed the team that captured Adolf Eichmann in Argentina in 1960, and he might have previously visited Apollo in the early 1960s.[36] Later, he became an adviser to Prime Minister Begin and headed LAKAM.[37]

Bendor's real name—the one he adopted in Israel—was Avraham Shalom. He was a long-time agent of Shin Bet, Israel's internal intelligence arm. He also served as Eitan's right-hand man in Eichmann's capture. He became the head of Shin Bet in 1981, but he was forced to retire in 1986 after he ordered, and then covered up, the deaths of two Palestinian prisoners.[38] Biegun was the head of the Mossad's Technical Department; his specialty was electronics and communication.[39] Unlike the others, Hermoni was what NUMEC reported him to be—the scientific counselor at Israel's embassy in Washington. But he also had been technical director of Israel's nuclear bomb project at RAFAEL, Israel's armament development authority, and he played an important role in the Dimona project.[40] And as scientific counselor, he presumably was part of LAKAM's operations.[41]

The Israelis would have been very interested at the time in getting HEU. And they obviously knew the opportunities for diversion NUMEC presented. Nor did they shy away from complex clandestine activities, especially in support of the country's nuclear weapons program.

There is no indication in released FBI and AEC documents that anyone asked why these four intelligence operatives were at the Apollo plant in 1968 or questioned NUMEC's false statement of their affiliations. It does not make sense that they were seeking technical information, because at least three of them were not expert in the technologies applied at Apollo. It had to be something else, something important enough to risk drawing attention to themselves and Shapiro. The Israelis would have been very interested at the time in getting HEU. And they obviously knew the opportunities for diversion NUMEC presented. Nor did they shy away from complex clandestine activities, especially in support of the country's nuclear weapons program. It is hard to believe that the Israeli intelligence establishment would have let such a tempting opportunity slip away.

Why did Israel have such a strong interest in obtaining HEU at the time? First, in the early 1960s, the Israelis could not have been sure that their plutonium complex would work as designed and on their desired schedule. Second, weapon designers always want the flexibility of having both plutonium and HEU. Finally, as some have suggested, the HEU could have been used as a driver fuel at Dimona to increase production of plutonium and tritium.[42]

Had the FBI known about the Plumbat affair at the time, in which Israeli secret services illegally slipped 200 tons of yellowcake, or uranium oxide, out of Europe a mere two months after Eitan, Bendor, Biegun, and Hermoni met with Shapiro in 1968, the bureau might have taken more seriously Israel's by-any-means-necessary approach to securing nuclear weapons. But the FBI did

not know about the Plumbat operation because the Europeans kept it quiet for more than a decade out of embarrassment.[43] Any lingering doubts that Israel would conduct an illegal diversion of HEU at NUMEC because it risked alienating Washington were erased further by the mid-1980s Jonathan Pollard spying operation, during which Israel obtained thousands of highly classified U.S. intelligence documents.

In a book about the Pollard operation, Wolf Blitzer, the former Washington correspondent for the *Jerusalem Post* and current CNN anchor, wrote: "One inescapable conclusion of the Pollard affair is that Israel's famous chutzpah can be a source of weakness as well as strength. It has enabled Israel to survive in a very dangerous part of the world. Yet it also has engendered a widely held attitude among Israeli officials that Israel can get away with the most outrageous things. There is a notion among many Israelis that their American counterparts are not too bright, that they can be 'handled' thanks partially to the pro-Israel lobby's clout in Congress."[44]

The story that just will not die. In response to Attorney General Edward Levi's April 1976 instructions, the FBI resumed its NUMEC-related interviews but to little avail. As James Connor later told reporter John Fialka, the investigative trail had become cold: "You could look at all the documents and ask yourself whether something had happened here. The answer was probably yes. Then the question was whether you could do anything about it, and the answer was no."[45]

During the transition to the Carter administration, Ford's assistants alerted Carter's team to the existence of the most important CIA and FBI documents concerning the NUMEC case.[46] The FBI continued interviewing people, apparently driven by congressional interest. The later FBI reports, some still heavily redacted, describe interviews with ex-NUMEC employees and add suggestive details concerning the possibility of illicit shipments from Apollo to Israel. According to an earlier interview report, NUMEC delivered a 600-pound package, listed as containing neutron sources, to El Al Airlines in December 1963.[47] It turns out the AEC's 1965 inventory showed that more HEU went missing from the Apollo plant in 1963 than any other year. Former NUMEC employees also told FBI agents about strange truck shipments in the 1960s. The trucks went directly to Israeli ships docked in the New York area. One recalled an unusual truck loading what looked to be HEU containers from the plant one night in 1965 or 1966. He said that an armed guard ordered him to leave the area. Others claimed to have been threatened by NUMEC managers to keep quiet about what they saw at the loading docks.[48] Whether or not these accounts are reliable is hard to say.[49] In any event, the FBI does not appear to have followed

up on them.

The House Interior Committee, NRC's principal oversight committee after the JCAE's demise in 1977, also looked into the possible Israeli connection. In fact, Committee Chairman Morris Udall personally conducted an interview with Zalman Shapiro. Udall had been a prosecutor, and he was as fair-minded a congressman as could be found. When a BBC interviewer asked him in 1979 if he thought the Israelis had taken HEU from Apollo, he replied, "If someone had me write in an envelope whether a diversion occurred or did not occur and that I would be put to death if I answered wrong, I suspect I would have to put in the envelope that I believe there was a diversion."[50]

The top NRC official responsible for overseeing nuclear fuel plants told Congress that a 1980 NRC study on NUMEC proved "a knowledgeable insider could quite easily have obtained the material in [the Apollo] plant . . . [and it] would have been very, very difficult to detect."

In 1980, at Udall's urging, NRC security experts looked carefully into the possibility of an alleged diversion from NUMEC. They concluded: "It is possible that significant quantities of [HEU] could have been removed from the NUMEC Apollo facility during the mid-1960s, by a knowledgeable insider or an outside group with assistance of an insider, without detection. It is, of course, possible that no such removal occurred. Our review did not develop any information to indicate that a theft did or did not occur, only that the system would not have been able to detect a theft."[51]

The top NRC official responsible for overseeing nuclear fuel plants told Congress that the NRC study on NUMEC proved "a knowledgeable insider could quite easily have obtained the material in that plant . . . [and it] would have been very, very difficult to detect."[52]

A frequently encountered canard espoused most notably by Hersh in his book *The Samson Option* is that the missing HEU was recovered when the Apollo plant was taken apart.[53] Beginning in 1978, B&W did carefully dismantle Apollo, recovering HEU containing 95 kilograms of uranium 235 from equipment and structures, and estimating that another 31 kilograms was left unrecovered in the concrete floor and walls, for a sum of 126 kilograms. But the cumulative "material unaccounted for"—the unexplained missing amount—for the entire 1957–78 period of HEU operations at Apollo was 463 kilograms.[54] That leaves 337 kilograms as the cumulative amount of HEU still unaccounted for—more than three times the amount unaccounted for in the 1965 inventory. In other words, the fact that about 100 kilograms of uranium 235 in the form of HEU was found during post-1978 decommissioning does not eliminate the possibility that the 100 kilograms of HEU that the AEC could not ac-

count for in Apollo's 1965 inventory, or the larger amount that went missing during the 1966–68 period, was diverted.

Ironically, the 89-year-old Shapiro has now revived this very point, claiming that the missing material was recovered and that this exonerates him. In August 2009, at the urging of Shapiro's lawyer, Pennsylvania Democratic Sen. Arlen Specter wrote to the NRC asking the agency to reexamine the case with a view toward "confirming that Shapiro was not involved in any activities related to the diversion of uranium."[55] In its response to Specter the NRC chose instead to address the larger question of diversion—saying it had no "specific evidence" of a diversion but it couldn't rule it out "unequivocally." It was a cautious, bureaucratic response; nevertheless, it was a remarkable statement by a federal agency because it leaves open the possibility that Israel stole bomb-grade uranium from the United States unbeknownst to all the government agencies tasked with preventing such a thing from happening.

Why now? We recount the NUMEC affair now not to pursue Shapiro and others who may have been involved in it. In a sense Shapiro was a red herring in the case. By personalizing the NUMEC investigations around him, the government lost sight of the real issue—the missing HEU.

We do think, however, that the circumstantial evidence supports the conclusion that the HEU ended up in Israel. It seems to us self-evident that if the federal government knows something about how NUMEC and/or Shapiro helped Israel get the Bomb, the public has a right to know the details. A good starting point would be to declassify key CIA and FBI documents pertaining to the NUMEC case.

Perhaps the most worrisome aspect of the NUMEC affair is that the government itself did not seem to want to find out what happened because it feared the answer. In his last book, *Adventures in the Atomic Age*, Seaborg defended this head-in-the-sand approach by questioning "what sense" it made to pursue the case.[56] For our part, getting at the truth makes sense enough. ■

A physicist, Victor Gilinsky is an independent consultant who most recently advised the State of Nevada on matters related to the proposed nuclear waste repository at Yucca Mountain. From 1975 to 1984, he served on the Nuclear Regulatory Commission (NRC), having been nominated by President Gerald Ford and renominated by President Jimmy Carter. Roger J. Mattson is a mechanical engineer who consults on safety matters with NRC licensees and Energy Department contractors. From 1967 to 1974, he was on the Atomic Energy Commission technical staff. In 1976, he led a NRC task force that addressed the Apollo/NUMEC affair. He left government service in 1984.

NOTES

1. "Inquiry into the Testimony of the Executive Director for Operations," Nuclear Regulatory Commission (NRC) Offices of General Counsel and Inspector and Auditor, February 1978, NRC document room; strictly speaking, by regulation, the dividing line between low-enriched uranium and highly enriched uranium (HEU) is 20-percent enrichment in the uranium 235 isotope. Throughout this article, however, we use HEU to designate uranium of roughly 90-percent enrichment (i.e., material that can be a reactor fuel or a nuclear explosive).

2. Meanwhile, another NRC commissioner, Marcus Rowden, confided to Gen. Edward Giller, the head of the U.S. nuclear weapons complex, that some younger members of the NRC wanted to "to spill the beans." "August 8, 1977 NUMEC-Related Congressional Hearing," Energy Department memorandum, deputy inspector general to undersecretary, April 27, 1979, p. 4; "Summary of May 4, 1978 Interview of General Edward B. Giller, former deputy assistant administrator for National Security, Energy Research and Development Administration," documents attached to each other and located at University of Arizona, Special Collections Library, Morris Udall papers, MS 325, Box 365, Folder 1. (Documents cited in this article are housed in repositories including the Glenn T. Seaborg and Benjamin Loeb papers at the Library of Congress's Manuscript Division, the University of Arizona's Morris Udall papers cited above, and the James Connor and John Marsh papers at the Gerald R. Ford Presidential Library. In addition, FBI documents were obtained under Freedom of Information Act (FOIA) File No. 117-2564 and Freedom of Information, Privacy Act File No. 1091168-000. NRC and Energy Department documents are available from their respective public document rooms.)

3. Washington knew by that point that Israel had nuclear weapons, but there still was considerable uncertainty about the extent of Israel's program.

4. FBI document, FBI director to the attorney general, "[subject redacted]," April 22, 1976; Justice Department memorandum, Attorney General Edward Levi to President Gerald Ford, April 22, 1976, Loeb papers.

5. An FBI interview with the interviewee's name redacted, but who obviously was James Connor, reports, "The president is particularly concerned with any indication of a prior cover-up. [Redacted] expressed the feeling that he was appalled at the superficiality of the AEC investigation into the matter." FBI Airtel, special agent in charge, Washington Field Office to FBI director, [subject redacted], June 15, 1976, Loeb papers.

6. Glenn T. Seaborg with Benjamin S. Loeb, *The Atomic Energy Commission under Nixon: Adjusting to Troubled Times* (New York: St. Martin's Press, 1993), p. 196.

7. Howard C. Brown Jr., Memorandum for the Files, July 22, 1965, Udall papers; S. T. C. McDowell, assistant director for control, AEC Division of Nuclear Materials Management, "Report of Survey: Control Over Enriched Uranium, Nuclear Materials & Equipment Corp., Apollo, Pennsylvania, Division of Nuclear Materials Management, Nuclear Materials Management Survey Number DNMM-53,"April 6, 1966, Loeb papers.

8. Seaborg wrote that the AEC staff "tended to believe that the losses at NUMEC had indeed been excessive." See *The Atomic Energy Commission under Nixon*, p. 198. In addition, in a letter to John Conway, the executive director of the Joint Committee on Atomic Energy (JCAE), on February 14, 1966 (Udall papers), R. L. Hollingsworth, the AEC's general manager, wrote, "NUMEC's cumulative losses from time of plant start-up in 1957 have been higher than those determined by other companies having comparable operations."

9. H. J. Badini, AEC Division of Security, "Nuclear Materials and Equipment

Corporation, Apollo, Pennsylvania," memorandum for files, August 1, 1963; AEC memorandum, G. A. Palazzolo, chief, Research Branch, AEC Headquarters Division of Security to Harry R. Walsh, director of Security and Property Management Division, 1965. All from Loeb papers.

10. Although, as Seaborg wrote, "such dangers did not have the prominent place in the national consciousness that they were later to acquire." See *The Atomic Energy Commission under Nixon*, p. 196

11. The JCAE existed from 1946 to 1977 and had exclusive jurisdiction over all civilian and nuclear matters.

12. Atomic Energy Act of 1954, section 221. b., provides that "the FBI of the Department of Justice shall investigate all alleged or suspected criminal violations [of the act]."

13. AEC memorandum, Ellyson Outten [Office of Investigations, Division of Inspection] to Anson Bartlett, Division of Inspection, February 28, 1966, Loeb papers.

14. Justice Department letter, J. Walter Yeagley, assistant attorney general, Internal Security Division, to FBI director, March 23, 1966, Loeb papers.

15. AEC letter, Glenn Seaborg, AEC chairman, to Chet Holifield, joint committee chair, February 14, 1966, Udall papers.

16. John J. Fialka, "CIA Found Israel Could Make Bomb: Soil, Air Samples Disclosed Atomic Capability," *Washington Star*, December 8, 1977; John J. Fialka, "The American Connection: How Israel Got the Bomb," *Washington Monthly*, January 1979; Seymour Hersh, *The Samson Option: Israel's Nuclear Arsenal and American Foreign Policy* (New York: Random House, 1991), p. 255; *The Atomic Energy Commission under Nixon*, p. 197; Energy Department memorandum, deputy inspector general to undersecretary, "August 8, 1977 NUMEC-Related Congressional Hearing," April 27, 1979, Udall papers.

17. National Nuclear Security Administration, *Highly Enriched Uranium: Striking a Balance, a Historical Report on the United States Highly Enriched Uranium Production, Acquisition, and Utilization Activities from 1945 through September 30, 1996*, Revision 1, January 2001.

18. *The Atomic Energy Commission under Nixon*, p. 197.

19. The April 2, 1968, cover note on the letter from Helms to Clark resides in the Ford Presidential Library. In the note, Helms wrote, "Since the subject matter of this letter is so sensitive for obvious reasons, I would appreciate if you would return it to me when you have taken whatever action you feel appropriate." The CIA has repeatedly refused to declassify the Helms letter, which might say more about the CIA's discovery in Israel of traces of HEU with a Portsmouth signature. In January 1978, Carl Duckett wrote to Morris Udall to confirm that the CIA's suspicions in 1968 led to the letter from Helms to Clark. See John J. Fialka, "CIA Heads' Suspicions on A-Matter Reported," *Washington Star*, January 18, 1979.

20. Interview of Carl Duckett, "Inquiry into the Testimony of the Executive Director for Operations," NRC Offices of General Counsel and Inspector and Auditor, February 1978, Vol. III, p. 178, NRC document room.

21. FBI memorandum, FBI director to special agent in charge (SAC), Pittsburgh, June 6, 1968; FBI memorandum, FBI director to SAC, Pittsburgh, September 17, 1968; "Justification for Continuation of Technical or Microphone Surveillance," FBI director to SAC, Pittsburgh, April 24, 1969; FBI letter, FBI director to the attorney general, "Dr. Zalman Mordecai Shapiro, Atomic Energy Act," April 22, 1976. The letter notes that in September 1968, Col. Avraham Eylonie, a senior Israeli official of the military intelligence service, was in the United States and had several meetings with Shapiro in Apollo and Washington.

22. On November 3, 1968, Avraham Hermoni, the then-Israeli scientific counselor, held a meeting at Shapiro's house with 11 U.S. scientists about which Shapiro was vague when questioned. See "Dr. Zalman Mordecai Shapiro, Atomic Energy Act,"

Loeb papers.

23. U.S. Congress. "Informal Meeting between Interior Committee Representatives and Dr. Zalman M. Shapiro," transcript of proceedings, December 21, 1978, p. 88, Udall papers.

24. The scientific intelligence operation got the name LAKAM in 1970. Blumberg headed it from 1962 to 1977. See *The Samson Option*, p. 250.

25. "Office Diary of Glenn T. Seaborg, Chairman, US AEC, 1961–72," Loeb papers.

26. *The Atomic Energy Commission under Nixon*, p. 199.

27. AEC letter, Assistant General Manager Howard C. Brown Jr. to Director of Central Intelligence Richard Helms about transmitting William T. Riley's summary of August 14, 1969 interview of Shapiro, August 28, 1969. CIA response to FOIA request by Natural Resources Defense Council, reference F87-1446, December 15, 1989.

28. AEC letter, general manager to Rep. Chet Holifield, August 27, 1969, Udall papers.

29. Seaborg took responsibility for this reasoning. See *The Atomic Energy Commission under Nixon*, pp. 199–201.

30. FBI letter, FBI Director John Edgar Hoover to William T. Riley [director of AEC Security Division], "[subject redacted]," September 3, 1969, Loeb papers.

31. *Highly Enriched Uranium*, p. 107.

32. For unexplained reasons the Energy Department made 1968 a dividing point. Because NUMEC processed HEU batches of somewhat different enrichments, inventories were reported in terms of the contained uranium 235. The total loss of 345 kilograms of uranium 235 in HEU over the life of the plant is in close agreement with NRC's 1982 estimate of 337 kilograms of uranium 235 in HEU that was lost. See NRC letter, Robert F. Burnett, director, Division of Safeguards, to [redacted], FBI, May 19, 1982, Loeb papers. Burnett called it "inventory difference," which is the current usage, but we will stick with the earlier more descriptive terminology.

33. Surviving throughput records include the April 6, 1966 "Report of Survey"; a Government Accountability Office report, *Review of Accountability Control over Special Nuclear Materials, NUMEC*, June 1967; a FBI report, "Interview of Charles A. Keller, Assistant Manager for Manufacturing and Support, Oak Ridge Operations Office, DOE, Atomic Energy Act, Obstruction of Justice," November 9, 1979, Loeb papers; a technical report, "The Shippingport Pressurized Water Reactor and Light Water Breeder Reactor," J. C. Clayton, Bettis Atomic Power Laboratory, presented at the 25th Central Regional Meeting American Chemical Society, October 4–6, 1993, available at http://www.osti.gov/energycitations/product.biblio.jsp?osti_id=10191380; and licensing documents that reside in Energy Department and NRC document rooms.

34. AEC letter, Harry R. Walsh, director of New York Operations Office, Division of Security, to Bruce D. Rice, manager of NUMEC Security Division, September 20, 1968; FBI memorandum, SAC, Pittsburgh, to FBI director, September 20, 1968; NUMEC letter to Harry R. Walsh, AEC director of Security and Property Management Division from Bruce D. Rice, NUMEC manager of security, September 12, 1968; FBI memorandum, SAC, Pittsburgh, to FBI director, October 17, 1968. All from Loeb papers.

35. Neal Bascomb, *Hunting Eichmann: How a Band of Survivors and a Young Spy Agency Chased Down the World's Most Notorious Nazi* (New York: Houghton Mifflin Harcourt, 2009).

36. Gordon Thomas, *Gideon's Spies: The Secret History of the Mossad* (New York: Thomas Dunne Books, 2007).

37. Wolf Blitzer, *Territory of Lies: The Exclusive Story of Jonathan Jay Pollard: The American Who Spied on His Country for Israel and How He was Betrayed* (New York: Harper & Rowe, 1989), pp. 10–13.

38. Ian Black and Benny Morris, *Israel's Secret Wars: A History of Israel's Intelligence Services* (New York: Grove Press, 1991), pp. 357–360, 400–409.

39. "The Technical Genius of the Israeli Secret Service," trans., obituary of Ephraim Biegun, *Ha'aretz*. Available at http://braddye.com/newsletters/2007/ephraim_biegun.html (accessed February 23, 2010).

40. Avner Cohen, *Israel and the Bomb* (New York: Columbia University Press, 1998), pp. 24, 229.

41. Ephraim Kahana, *Historical Dictionary of Israeli Intelligence* (Lanham, Md.: Scarecrow Press, 2006), p. 54, states: "Through NUMEC, LAKAM was able to obtain uranium for the Israeli nuclear weapons program." On p. 215, under NUMEC listing, "Ephraim Lahav and Avraham Hermoni, officially the Israeli scientific attaches at the embassy in Washington, D.C. But in fact LAKAM representatives in the United States, were frequent visitors at the NUMEC plant."

42. See Dan Raviv and Yossi Melman, *Every Spy a Prince: The Complete History of Israel's Intelligence Community* (Boston: Houghton Mifflin, 1990), p. 366.

43. Elaine Davenport, Paul Eddy, and Peter Gilman, *The Plumbat Affair* (London: A. Deutsch, 1978).

44. *Territory of Lies*, p. 280. See also, Charles R. Babcock, "U.S. an Intelligence Target of the Israelis, Officials Say," *Washington Post*, June 5, 1986.

45. John J. Fialka, "The American Connection: How Israel Got the Bomb," *Washington Monthly*, January 1, 1979.

46. During the transition, Ford's assistant John Marsh wrote a two-page memo about the "NUMEC matter" to Jack Watson, President Jimmy Carter's transition head. Marsh recalled their earlier discussion of NUMEC and attached copies of certain classified documents that he had shown to Watson. The four documents Marsh listed are in the Ford Presidential Library where they remain classified by order of the CIA. See memo, John O. Marsh Jr. for the Honorable Jack H. Watson, February 8, 1977, Ford Presidential Library.

47. FBI memorandum, SAC, Pittsburgh, to FBI director, "Dr. Zalman Mordecai Shapiro, IS [Internal Security]-Israel, Atomic Energy Act," June 13, 1968, Loeb papers.

48. FBI report of interview, SAC, Pittsburgh, to FBI director and Criminal Investigative Division, Terrorism Section, "DIVERT," March 25, 1980; FBI teletype from Pittsburgh to FBI Director, "DIVERT," March 25, 1980. All from Loeb papers.

49. One ex-employee, Marlin J. Ebert, described cobalt 60 shipping procedures at Apollo and recounted an unusual shipment in a large container made one night in late 1969 or 1970 when he was not present to witness the packing. He said this was a deviation from usual shipping procedures and there was excess space in the lead casks after the cobalt 60 was packed, leaving room to place other materials into the casks. See FBI teletype, San Francisco Office to FBI director and Washington Field Office, May 9, 1980, Loeb papers.

50. "Panorama on Israel," BBC, transcript of program discussing Israel's acquisition of the Bomb, June 26, 1979, Udall papers.

51. A draft of the NRC report, *A Safeguards Case Study of the Nuclear Materials and Equipment Corporation Uranium Processing Plant, Apollo, Pennsylvania*, was circulated in 1979 for comments by other federal agencies. Energy Department reviewers, who had contemporaneous experience with NUMEC, did not take issue with these conclusions. See W. Altman, J. Hockert, and E. Quinn, *A Safeguards Case Study of the Nuclear Materials and Equipment Corporation Uranium Processing Plant, Apollo, Pennsylvania*, NRC report, January 1980, NRC document room.

52. William Dircks, quoted in John J. Fialka, "A-Bomb Materials Difficult to Protect," *Washington Star*, June 12, 1979.

53. According to *The Samson Option*, pp. 257, 331, the 100 kilograms of HEU was never really missing from NUMEC's plant in the mid-1960s—instead it had stuck

to equipment or seeped into the concrete floor and structures, where it was later found during the dismantling of the plant after operations ceased. Seaborg later repeated Hersh's conclusion that the "missing uranium" was found during cleanup of the plant. Glenn T. Seaborg and Eric Seaborg, *Adventures in the Atomic Age: From Watts to Washington* (New York: Farrar, Straus, and Giroux, 2001), p. 222.

54. NRC letter, Robert F. Burnett, director Division of Safeguards, to [redacted], FBI, May 19, 1982, Loeb papers. The precise accounting was done in terms of uranium 235 content because the HEU batches processed at the plant did not have exactly the same enrichment.

55. NRC letter, R. W. Borchardt, NRC executive director, to U.S. Sen. Arlen Specter, November 2, 2009, NRC document room.

56. *Adventures in the Atomic Age*, p. 221.

Victor Gilinsky & Roger J. Mattson, "Revisiting the NUMEC affair," *Bulletin of the Atomic Scientists*, March/April 2010, vol. 66, no. 2, pp. 61–75.

DOI: 10.2968/066002007

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