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# The Libyan Nuclear Program: A Technical Perspective

**An Intelligence Assessment**



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*February 1985*

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# The Libyan Nuclear Program: A Technical Perspective [redacted]

An Intelligence Assessment

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# The Libyan Nuclear Program: A Technical Perspective [redacted]

## Key Judgments

*Information available as of 1 November 1984 was used in this report.*

Although Libya signed the Nuclear Nonproliferation Treaty, we believe Libya wants to develop a nuclear weapon. The Libyan program is so rudimentary that it is not yet clear whether plutonium or uranium will be chosen as the basis for a weapon. It is clear, however, that the program has major problems, including poor leadership and lack of coherent planning, as well as political and financial obstacles to acquiring nuclear facilities. The emergence of a Libyan nuclear scientific cadre indicates that the program, but perhaps not its weapon goal, would survive the end of the Qadhafi regime. [redacted]

We believe the serious program deficiencies make it highly unlikely the Libyans will achieve a nuclear weapon capability within at least the next 10 years. Significant parts of the nuclear fuel cycle probably will be developed, such as the capability of producing nuclear fuel pellets and converting uranium yellowcake to uranium hexafluoride—the feed material used in a uranium enrichment plant. Such capabilities could bring Libya closer to developing the plutonium and/or enriched uranium fuel cycle, but Libya will most likely not be able to master the more critical technologies such as uranium enrichment and reprocessing within the next 10 years. [redacted]

The nuclear research center at Tajura is operational, but few Libyans occupy responsible positions. Over 200 Soviet specialists are at Tajura, and as long as the Soviets remain there it will be difficult for the Libyans to ~~conduct sensitive nuclear research.~~ [redacted]

The Libyans are also negotiating with the Soviets over acquisition of two Soviet-built 440-megawatt nuclear power reactors, but after six years of negotiations, a final agreement has not been reached, due to technical, financial, and political problems. [redacted]

A shortage of competent scientists and engineers also has delayed the nuclear program substantially. We believe that Libya will continue to try to upgrade its personnel. The rate of progress will depend on Libya's ability to convince foreign nuclear suppliers to provide training. [redacted]

[redacted]



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Technical cadre are being trained at the Soviet-supplied Tajura center and at Al Fatah University in Tripoli. The level and quality of training, as well as the numbers of engineers, scientists, and technicians, however, appear to be barely adequate even for the limited range of activities now in Libya's nuclear program. [redacted]

Their stagnating relations in the nuclear field with the USSR have caused the Libyans to seek nuclear assistance from other countries. These include Belgium—the most important—West Germany, India, Finland, and Brazil. Some assistance has been obtained from Belgium and Finland. [redacted]

Libyan and Belgian officials have negotiated a nuclear cooperation agreement, but the Belgian Government has not ratified it. Such an agreement would represent a major achievement for the Libyans. Even if only nonsensitive technology were involved, it would provide Libya with an umbrella bilateral agreement through which it could negotiate contracts for equipment, consulting services, and personnel training. [redacted]

Earlier negotiations with a Belgian firm for a uranium tetrafluoride plant have been on hold. If the protocol is concluded, however, negotiations for the plant may begin again. The plant would be a step toward a capability to produce uranium in a form suitable for use as fuel in a nuclear reactor, but additional capability would be required to provide weapons-grade material. [redacted]

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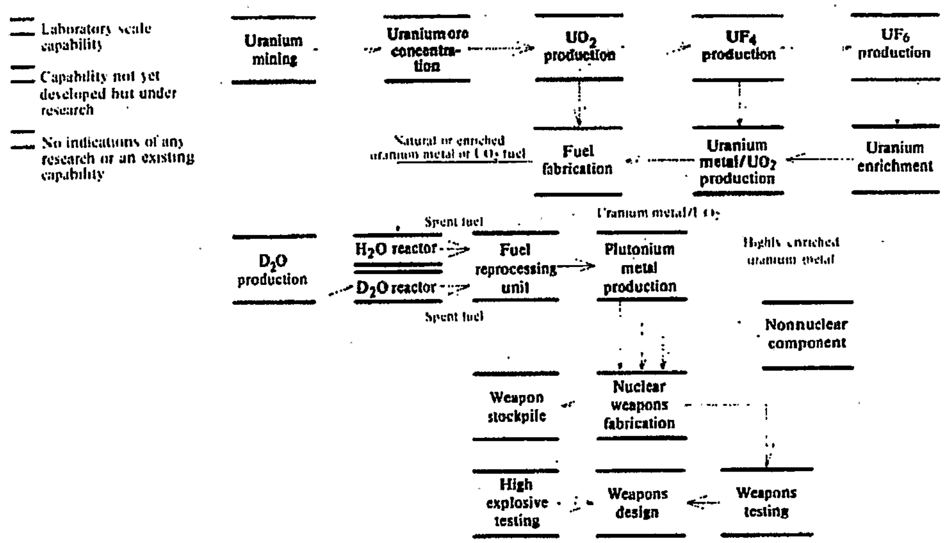
**Figure 1**
**Libyan Pathways for Developing Nuclear Fuel Cycle**

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# The Libyan Nuclear Program: A Technical Perspective [redacted]

**Introduction**
We believe the ultimate goal of the Libyan nuclear program is to develop nuclear weapons, although Libya has been a party to the Nuclear Nonproliferation Treaty (NPT) since 1975. Libyan leader Mu'ammar Qadhafi long has harbored a strong interest in a nuclear weapon capability and has made an effort to obtain a weapon directly. Qadhafi approached the Chinese in 1973 and again in 1976 in attempts to purchase nuclear weapons. On both occasions he was rebuffed [redacted]

The Libyans face many obstacles to achieving their goal, including the absence of coherent planning and a shortage of competent personnel. Other obstacles are political unrest and the intense suspicions of Western suppliers toward Libya and its nuclear goals. [redacted]

**Possible Technology Routes to a Nuclear Weapon**
The Libyans have a choice of two technology routes to produce fissile material for a nuclear weapon—one is to produce enriched uranium; the other is to produce plutonium. [redacted]

The enriched uranium route to a nuclear weapon would include the following steps (figure 1):

- Producing uranium dioxide ($UO_2$) and then uranium tetrafluoride ($UF_4$) from uranium yellowcake ($U_3O_8$).
- Using the $UF_4$ to make uranium hexafluoride ($UF_6$), the feed material for an enrichment facility.
- Enriching the $UF_6$ in the isotope U-235 to make weapons-grade (greater than 90-percent U-235) uranium for use in a weapon.
- Converting $UF_6$ highly enriched in U-235 to uranium metal for use in weapons. [redacted]

The other possible technology route to a nuclear weapon—using plutonium—involves these steps:

- Producing $UO_2$ from $U_3O_8$.
- Either fabricating fuel directly from the $UO_2$ for use in a heavy water reactor, or producing $UF_4$ from the $UO_2$ and then using the $UF_4$ to make uranium metal to fuel a heavy water reactor.
- Reprocessing the highly radioactive spent fuel from the reactor to recover plutonium for use in a nuclear weapon. [redacted]

Libya's nuclear program is currently at such a rudimentary stage that the Libyans are trying to develop or acquire any technology that would be relevant for either approach to producing fissile material. Most of the steps involved in both routes require skills and equipment beyond what Libya now has, and Libya probably will continue to meet resistance in efforts to obtain relevant technology from the West and the USSR. [redacted]

The most difficult aspect of the uranium route is the technology for enriching uranium in the isotope U-235. The Libyans have been pursuing basic research in the gas centrifuge and laser isotope enrichment techniques, but have made little progress. Because of the complexity of the technology and the lack of foreign suppliers, they are unlikely to make significant advances in this area in the next 10 years. Moreover, these technologies would be subject to safeguards through Libya's adherence to the NPT. [redacted]

On the plutonium side, the most difficult technologies are those related to the construction of a reactor to produce plutonium, and the construction of reprocessing facilities to separate plutonium from the irradiated nuclear fuel. Libya's only reactor is a small safeguarded research reactor (supplied by the Soviets) that cannot produce significant quantities of plutonium. Libya for several years has been discussing purchasing from the Soviets two 440-MWe light-water-moderated power reactors. Such reactors would have the potential to produce significant quantities of plutonium, and the Libyans apparently once hoped

[redacted]

that the acquisition of these reactors would provide them with a source of fissile material for nuclear explosives.[redacted]

However, the Libyans now appear to realize that the safeguards on the reactors, as well as the strict safeguards and control of sensitive nuclear material, would make it practically impossible to divert spent fuel or plutonium clandestinely. Libya has expressed interest in acquiring a heavy-water-moderated reactor (which could be used to produce plutonium from natural uranium), but no supplier nation is likely to provide one. Libya has little capability to design or build an unsafeguarded reactor indigenously. Libya also lacks the capability to reprocess spent nuclear fuel to extract plutonium. There are no facilities in Libya to handle more than gram quantities of highly radioactive material and no significant expertise in radiochemistry and related disciplines. Overall, Libya is unlikely to have any capability to produce significant quantities of plutonium in the next 10 years. [redacted]

Libya does have the capability to produce $UO_2$ and $UF_4$ on a laboratory scale and is trying to develop the capability to produce uranium metal. Libya has sought (unsuccessfully to date) to acquire production-scale facilities for $UF_4$ and $UF_6$ from foreign suppliers. These technologies, although relatively minor and less difficult than those described above, could be used for fissile material production for a nuclear weapon.[redacted]

In addition to the sensitive technology of fissile material production, the Libyans will have the substantial tasks of developing a workable design for a nuclear device and producing the necessary high-explosive and other nonnuclear components if they are to develop nuclear weapons. (Meanwhile, they would need to keep such development clandestine.) There is no evidence that they have taken any steps in these areas.[redacted]

**Safeguards**

Libya has had to sign the Nonproliferation Treaty and accept safeguards to obtain outside assistance for its fledgling nuclear program. The Soviet Union delayed signing a contract to provide Libya with its first nuclear research facilities until Libya became a party to the NPT in 1975. Although the Libyan Secretariat of Atomic Energy (SAE) could decide to conduct unsafeguarded, sensitive (controlled) research activities independently or with foreign assistance, the Soviet Union probably would discourage such activities if it became aware of them, or it might cease its assistance altogether. (See appendix A for a discussion of the organization and functions of the SAE.)[redacted]

Libya has little incentive to evade current safeguards on its program because of the risk that evasion would be discovered and result in a cutoff of outside assistance. For the foreseeable future, Libya probably will continue to be willing to accept whatever safeguards or other constraints are required in order to increase its chances of acquiring foreign technology and training. In fact, many scientists of Libya's SAE look upon IAEA involvement in Libya as a positive influence, although they do not have a significant policy input. An example is the international seminar on "The Use of Research Reactors in Fundamental and Applied Sciences" held at the Tajura research center (figure 2) in September 1984 and supported by the IAEA.[redacted]

**The Tajura Nuclear Research Center**

The Soviet-supplied Tajura nuclear research center is currently the major element in Libya's nuclear program[redacted] The Libyans hope that the recently completed, turnkey research center, staffed by Soviets and by Libyan personnel from Al Fatah University, will allow them to develop the technical cadre required to support a wide range of nuclear activities. While this center gives Libya the facilities it needs to begin its nuclear program, the Soviets are filling most positions and excluding other foreigners. (A detailed description of the facilities and research departments at Tajura is in appendix B.)[redacted]

Despite the difficulties encountered in working with the Soviets at Tajura—such as disputes over the vaguely worded Tajura contract, inadequate fresh water supplies to cool the research reactor, and construction problems—the SAE apparently is pleased with what it is getting for the 1975 contract price. It will have an equipped research facility for

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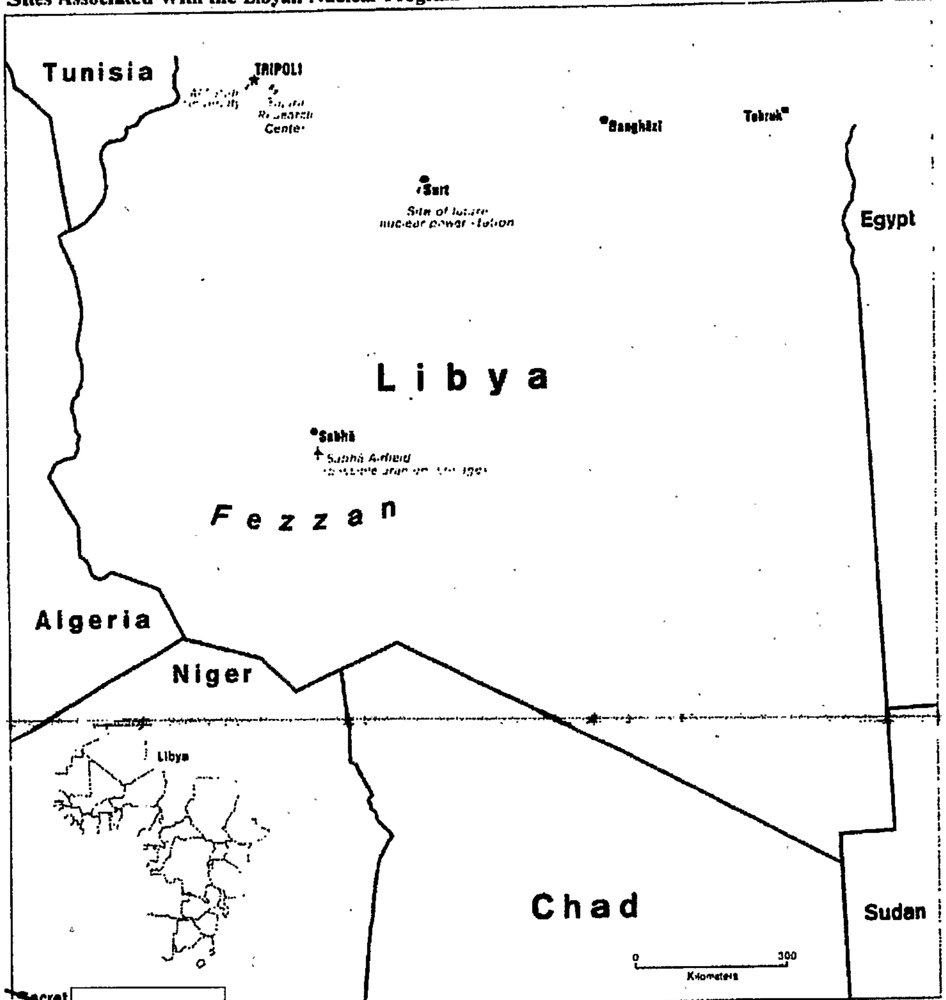
Figure 2
**Sites Associated With the Libyan Nuclear Program**

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what it would have cost to build the Tajura buildings alone in 1975. The Soviets have provided a small thermal research reactor (IRT), a zero-power critical assembly (a low-power version of the IRT), a neutron generator (accelerator), a radiochemistry laboratory, a Tokamak device (used for fusion research), radioactive waste storage facilities, computers, and other laboratories, workshops, and support facilities [redacted]

***Basic Reactor Research.*** The IRT Research Reactor Section of the Reactor Department at Tajura is responsible for research using the IRT reactor and the critical assembly. The Neutron Generator Section of the Reactor Department has undertaken research using a small charged-particle accelerator. [redacted] the Department of Nuclear Physics and Material Science is the main user of the IRT, and much of its work will involve physics experiments, using neutron beams from the reactor when it becomes operational [redacted]

The "critical assembly" is a low-power version of the IRT that has been used for more than a year as a training facility for Nuclear Department personnel and for students from the Nuclear Engineering Department of Al Fatah University. The facility is used for basic reactor experiments, such as flux and reactivity measurements and fuel rod evaluations. [redacted] As is the case for all of the activity at Tajura, none of this research is directly related to nuclear weapon development but would give the Libyans fundamental nuclear knowledge needed by personnel working in a nuclear program. [redacted]

***Radiochemical Research.*** The radiochemical laboratory within the Radiochemistry Department is designed for extracting radioactive isotopes from targets irradiated in the reactor, for producing radiopharmaceuticals, for conducting research, and for training personnel in radiochemistry and related disciplines. Libya currently has no radiochemists, however, and research in this area is limited [redacted]

There is no real capability to reprocess spent nuclear reactor fuel. [redacted] um, and they have not yet been used. Libya probably will use the hot cells to gain experience in working with radioactive material. Such skills are necessary for beginning any serious work on reprocessing, which is essential for the plutonium route to a nuclear weapon. Tajura has no solvent extraction equipment—one of the technologies needed to recover plutonium from spent fuel [redacted]

Overall, the Radiochemistry Department has a low priority, and there is no pressure or direction from the SAE to develop a reprocessing capability. This lack of an SAE push for such an important technology illustrates the incoherence in the Libyan program and weakens the prospects for developing a reprocessing capability within the next 10 years. [redacted]

***Fusion Research.*** Research in physical processes, in high-temperature plasma, and nuclear fusion experiments are conducted within the Plasma Physics Department, using a Tokamak device. [redacted] the SAE has little interest in plasma physics, and this program receives lowest priority for the assignment of personnel. [redacted]

***Nuclear and Material Science Research.*** The Nuclear Physics and Material Science group is one of the least active departments at Tajura and suffers from a lack of resources and personnel. [redacted]

**Soviet-Supplied HEU Fuel**

Because the Soviets have always been concerned about Qadhafi's nuclear intentions, they initially planned to provide only low-enriched uranium fuel (LEU) for use in the IRT research reactor. [redacted] the Soviet Union in December 1980 delivered approximately 11 kilograms (kg) of uranium with an enrichment level of 80 percent. The

[redacted]

Soviets probably decided to supply this highly enriched uranium instead of the LEU after the Libyans accepted IAEA safeguards on their IRT reactor. Information [redacted] indicates that the fuel is enriched to 93 percent and that the 11 kg delivered by the Soviets is sufficient for one reactor core load. Either enrichment level is sufficient for use in weapons, but the quantity is not enough for even a single explosive device. The Libyans also would probably be deterred from trying to divert any of the fuel for use in an explosive device because such a diversion would violate safeguards and would result in a cutoff of Soviet assistance. [redacted]

[redacted] the Soviets have not required that Libya return accumulated spent fuel from the IRT to the USSR. [redacted] there are no provisions for long-term storage of spent fuel in Libya and only a limited short-term storage capacity. The amount of plutonium produced through normal reactor operations—only a few grams per year—would not constitute a proliferation risk, even if the Libyans had the capacity to separate the plutonium from the spent fuel. However, with the spent fuel available, the Libyans could practice reprocessing on a small scale if they acquire the equipment to do so. This training would be important in developing a cadre of skilled technicians. [redacted]

**Efforts To Acquire Key Technologies and Material**

***Nigerian-Supplied Uranium.*** Since 1979, Niger reportedly has agreed to sell Libya over 1,700 tons of uranium yellowcake, the starting material for developing the enriched uranium and plutonium routes to a nuclear weapon. [redacted] at least 1,100 tons was reported to the IAEA. This amount of uranium—which, if enriched and manufactured into fuel rods, would be enough to operate two 440-MWe power reactors for up to 10 years—is far in excess of any foreseeable Libyan need. [redacted]

***Uranium Conversion.*** Libya has approached several nuclear supplier countries for uranium conversion technology, which involves the processing of uranium yellowcake to make $UO_2$, $UF_4$, $UF_6$, and uranium metal (see table). Although a necessary preliminary step, uranium conversion is a relatively straightforward part of the weapon/fuel cycle (see figure 1); uranium enrichment technology, production reactors, and reprocessing technology are much more sensitive and difficult to obtain. [redacted]

[redacted] in 1981 representatives of the Belgian firm, Belgonucleaire, and Libyan nuclear officials held discussions regarding a 100-ton-per-year uranium hexafluoride ($UF_6$) plant. The talks eventually slowed because Libya was not confident that Belgonucleaire was sincere about the supply of this technology. [redacted] the Libyans—in attempting to establish a competitive relationship as a lever for acquiring $UF_6$ technology from Belgium—made requests to the Soviets concerning technology for transforming yellowcake to uranium tetrafluoride or uranium hexafluoride. The Soviets agreed to consider a contract for such a facility only after a final contract is signed for the sale of two power reactors to Libya. [redacted]

Belgonucleaire tried to convince Libya to accept, instead of a $UF_6$ plant, a uranium tetrafluoride ($UF_4$) facility that had been authorized for sale to Libya by the Belgian Government in October 1982, despite US efforts to prevent the sale. Production of $UF_4$ would leave the Libyans only one step further away from technology directly relevant to fissile material production than would production of $UF_6$. [redacted]

[redacted] the Belgian Government believed that the sale of a $UF_4$ plant to Libya would not involve any proliferation risk. Belgium told the United States it would not approve the sale of technology beyond $UF_4$ as long as Libyan leader Qadhafi is in power. [redacted]

Realizing the $UF_4$ technology was of little value in its quest for developing the fuel cycle, Libya informed Belgonucleaire in April 1983 that a continuing commercial relationship depended on Belgium's decision to supply Libya with the $UF_6$ facility. But the Belgian Government, in response to strong US pressure, indicated to Libya that it would refuse to grant permission for selling $UF_6$ technology to Libya as long as no other supplier agreed to a sale. [redacted]

***Uranium Enrichment.*** Some rudimentary work has been conducted on a prototype gas centrifuge under a German scientist but, after several years of promises and delays, this effort has not produced any results. A uranium enrichment capability is a crucial step in the enriched uranium route to a nuclear weapon. [redacted]

## Principal Libyan Approaches for Nuclear Technology and Other Support

| Date | Country | Technology |
|---|---|---|
| **Usable in enriched uranium route** | | |
| 1978-79 | Pakistan | Uranium conversion ($UF_6$) |
| November-December 1981 | Belgium | Uranium conversion ($UF_6$) |
| 1981 | Finland | General support |
| 1978 | India | Exploration and mining |
| | | Production of yellowcake and uranium hexafluoride |
| November 1982 | Finland | Training |
| March-April 1983 | Belgium | Uranium conversion ($UF_6$) |
| **Usable in plutonium route** | | |
| 1981 | Switzerland | Heavy water production |
| 1981 | Yugoslavia | Heavy water production |
| 1981 | Canada | Heavy water reactor |
| 1981 | West Germany | Heavy water production |
| December 1981 | West Germany | Heavy water production |
| 1982 | Argentina | Heavy water reactor |
| 1982 | Romania | Heavy water production |
| 1982 | Canada | Heavy water reactor |

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**Principal Libyan Approaches for Nuclear Technology and Other Support (continued)**

| Date | Country | Technology |
|---|---|---|
| Late 1982 | Argentina | Heavy water reactor |
| **Usable in both routes** | | |
| 1975 | Argentina | Uranium exploration and processing |
| 1978-79 | Pakistan | Training |
| August 1978 and 1982 | China | General support |
| 1981 | Yugoslavia | Training |
| March 1981 and January 1982 | Italy | Reprocessing |
| November-December 1981 | Belgium | Uranium conversion ($UF_6$) |
| December 1981 | Romania | General support |
| ~~February 1982~~ | ~~France~~ | ~~Fuel fabrication~~ |
| March-June 1982 | Romania | General support |
| 1982 | Finland | Training |
| 1982 | West Germany | Uranium storage |
| February 1982 | West Germany | Uranium extraction and reprocessing |
| March-April 1982 | West Germany and United Kingdom | Uranium conversion |

**Principal Libyan Approaches for Nuclear Technology and Other Support (continued)**

| Date | Country | Technology |
|---|---|---|
| April and June 1982 | United Kingdom | Uranium extraction and reprocessing |
| | United Kingdom | Uranium extraction and reprocessing |
| May 1982 | West Germany | Uranium extraction and reprocessing |
| August-October 1982 | West Germany | Fuel fabrication |
| September-October 1982 | India | Fuel fabrication |
| September 1982 | West Germany | Fuel fabrication |
| June 1983 | Iran | General support |
| September-October 1983 | West Germany | Uranium conversion |

[redacted]

This table is Top Secret [redacted]

A laser facility for isotope separation has been proposed for the Physics Department of Tajura. While the lasers could be used to enrich uranium, we do not believe that Libya has the technical manpower to master the technique. In 1983 Libya approached vendors directly, including some in Canada and West Germany, to procure laser equipment. We believe no contracts have yet been signed [redacted]

Both Libyan enrichment projects are at a very rudimentary stage, and there is little likelihood that Libya will be able to develop a uranium enrichment capability in the next 10 years. [redacted]

***Fuel Fabrication.*** In late 1982 Libya approached India for equipment to produce $UO_2$ nuclear fuel pellets. Although the equipment probably was not delivered, and no further discussions were held, the Libyan approach indicates continuing interest for nuclear assistance from India. [redacted]

Uranium dioxide fuel pellets can be made either from natural uranium for use in a heavy water reactor or from enriched uranium for use in a light water reactor. The immediate Libyan need for the technology is unclear, because there is no prospect that the Libyans will be able to build either type of reactor (or enrich the uranium for use in the light water reactor) any time soon. The Soviets will supply the fuel for the 440-MW reactors they have proposed building for the Libyans. [redacted]

[redacted]

## Problems

Libya's nuclear program has major problems, including poor leadership and lack of coherent planning, as well as political and financial obstacles to acquiring nuclear facilities. These problems are apparent in Libyan dealings with the Soviet Union for nuclear power reactors [redacted]

***Lack of Trained Personnel.*** Manpower problems pose a major handicap. Libya is limited in scientific manpower, even when compared to other Third World countries interested in developing a nuclear program, such as Iraq or Egypt. The number of bachelor-level graduates in Libya has increased, but deficiencies are apparent in the quality and numbers of personnel at the postgraduate level, as well as at the technician and skilled labor levels [redacted]

Libya's main center for education in nuclear science is Al Fatah University in Tripoli [redacted] which was established in 1978. Most of the faculty members are drawn from Third World countries. Educational standards are low because of the poor quality of the students and the politicization of the university [redacted]

Most Libyan students resist training as technicians, preferring the prestige of the university. A proposal has been made to establish a special school for technicians, called the Technical Training School for Energy at Qarabulli near Tajura. [redacted]

The training deficiencies within Libya mean that Libyan personnel must seek their education abroad. Because of foreign concern about Qadhafi's long-range nuclear intentions, the Libyans, so far, have encountered difficulties in obtaining foreign education in nuclear science at the highly specialized levels required for either route to a nuclear weapon. For example, the Canadians allow Libyan students to enroll only at the elementary levels of nuclear science. Although Libyan nationals have studied in the United States, as of 11 March 1983 US law prohibited them from studying nuclear-related subjects. This new law also terminated the nonimmigrant status of Libyans or Libya-sponsored persons who were engaged in such training at that time. [redacted]

In 1980 Libyan scientists visited the Indian Department of Atomic Energy establishments in New Delhi, Bombay, and Calcutta. The Libyans hoped to obtain assistance in training programs. [redacted]

Libyan nuclear personnel have been trained in Belgium. The Belgian reactor fuel company, Belgonucleaire, has already trained 20 Libyan nuclear engineering students from Al Fatah University in the operation of research and power reactors and the metallurgy of uranium, as well as a variety of uranium processes, ranging from mining to the fabrication of fuel for power reactors. [redacted]

[redacted] the SAE plans to allow engineers and scientists from the Third World to do research at Tajura. Through association with these well-trained foreigners, Libyan scientists and technicians could receive advanced knowledge and experience. [redacted] the Soviets intend to prevent an influx of other foreign scientists. [redacted] The Soviets almost certainly are concerned that such foreigners would engage in sensitive research, forcing a confrontation between the Soviets and the Libyans. The Soviets also prefer to keep Soviet scientists, engineers, and technicians from having foreign contacts. [redacted]

***Soviet Reactor Deal.*** Libya also has had major problems with the Soviets in acquiring nuclear power reactors. The project for construction by the Soviets of two 440-MWe power reactors in Libya has encountered major delays because of inadequate planning and poor implementation of program goals. The Libyans are continuing to negotiate with the Soviets for these light water reactors. [redacted]

We believe that Tripoli and Moscow still have hard bargaining ahead, but Qadhafi's determination to build a reactor (and his lack of an alternate supplier) ~~will probably result in an eventual agreement. Even if~~ construction were to begin immediately, the reactors probably would not be operational by 1990. [redacted]

The Libyans once viewed the reactors as a source of plutonium for nuclear weapons, but they no longer consider this a practical goal. (They now regard the reactors as a source of electricity and an industrial showcase.) Although the amount of plutonium produced per year in one 440-MWe power reactor would be sufficient for 30 nuclear weapons, Libya would find it practically impossible to divert plutonium clandestinely. An overt diversion of spent fuel would be possible if Libya were to withdraw from the

Nonproliferation Treaty and terminate safeguards on the reactor, but the diverted fuel would still have to be reprocessed to extract the plutonium. Because of a continued need for foreign fuel and expertise, Libya could not overtly withdraw from safeguards unless it intended to sacrifice further operation of the reactor. And withdrawal from the NPT would almost certainly be interpreted as an open indication of a nuclear weapons intent. Thus, Libya cannot anticipate going straight to reprocessing, the final step for obtaining plutonium for a nuclear weapon. [redacted]

The SAE activities related to purchase of the two Soviet pressurized water reactors were not subject to any competent scientific review until 1981. This probably reflects conflicting views within the SAE on the need for such reactors. [redacted]

The basic seismic parameters used in the design of the reactors have proved to be incorrect. The projected site at Surt is unsuitable for the power reactors, because it is susceptible to earthquakes. [redacted] The Belgian firm, Belgonucleaire, has recommended that Libya ask the Soviets to redesign the power reactors in accordance with its seismic calculations. Libya, however, requested that IAEA experts review the work performed by the Soviets in analyzing the site. So far, IAEA representatives have made two trips to Libya to resolve the problem. [redacted]

The Soviet Union has been forced to make increased expenditures to keep the Libyan project for the two 440-MWe power reactors going ahead. Between 1981 and 1983 approximately 200 Soviets were assigned to making the necessary design changes to add desalinization plants to the reactors, as well as making on-site environmental studies of seismic conditions and wind directions. Results of these studies forced design changes in the water intake system for cooling the reactors, as well as changes to meet the seismicity of the site. Such changes caused delays in contract negotiations. [redacted] We believe that the Soviets would be angry, given these expenditures, if the deal falls through, but we do not envision any further pressure (or reprisals) against Libya as a result. [redacted]

[redacted]

***Financial Problems.*** The Soviets are continuing to seek payment, as originally agreed, in foreign exchange, with US $450 million to be paid when the contract is signed. By mid-1983, however, Libya no longer had the foreign exchange reserves and earning potential from oil exports to enter into any long-term contract. [redacted]

Believing that the Soviets could not be budged, the Libyans attempted to use a series of technical arguments to delay signing of the final document. Several attempts were made by the Soviets to bring negotiations to an end during 1981 to 1983. [redacted]

At the same time the Soviets made credit terms difficult, they demanded hard currency payments for the power reactors. Moscow's pressure probably resulted from the prospect of making large foreign exchange earnings and from a desire to recoup expenditures incurred over four years for the site surveys, design changes, and site preparation work. Because the Soviets might already have fabricated some of the reactor components in anticipation of the signing of the contract, they may be willing to accept a barter arrangement (for example, oil for nuclear technology). [redacted]

**Prospects for Libyan-Belgian Cooperation**
Negotiations between Libya and Belgium on a nuclear support protocol began in April 1984. [redacted]

The terms of the protocol suggest that Belgium could provide the expertise Libya needs to develop its nuclear program, possibly allowing Libya eventually to develop an indigenous capability to construct nuclear reactors, which are essential to developing the plutonium route to a nuclear weapon. Such assistance also could enable the Libyans to manage and to operate Tajura without depending on Soviet scientific and technical personnel. However, there would be large startup costs for indigenous reactor development, because of the lack of any relevant industrial base in Libya. [redacted]

[redacted]

Libya hopes that successful implementation of the proposed Belgian cooperation agreement would provide an alternative to Soviet assistance, as well as expand research capabilities that would bring it a little closer to developing a nuclear weapon. The training specified by the Belgian protocol could eventually give Libya the capability to set up a nuclear facility outside of Soviet control. [redacted]

Libya will try hard to get Belgium to agree to provide nuclear cooperation in sensitive areas such as $UF_6$ technology and will threaten to suspend commercial and other dealings unless it gets what it wants. [redacted]

We believe there are few cost constraints on the Libyans with respect to Belgian cooperation. In fact, it can be argued that Belgium's consulting on the reactor project was largely responsible for the lower Soviet bid on the power reactors. For this reason, we believe the Libyans wish to continue such assistance to ensure they are not overcharged as they have been in the past. The USSR probably resented Belgian interference at first but is probably resigned to accepting any future Belgian role in Libya. [redacted]

We believe the Belgians would like to conclude the protocol. Libyan officials, however, leaked information about it, and public discussion has caused the Belgian Government to delay final approval. Brussels' delay was probably an effort, in part, to avoid criticism from other Western nuclear supplier nations during a special conference held in Luxembourg in mid-July to discuss nuclear export issues. [redacted]

In the near term, there is still a possibility that the Belgian Government will be dissuaded from the agreement by prospective negative international reactions. The United States, Britain, and several other Western nuclear supplier states will advise against providing any major nuclear technology or training to Libya because of Qadhafi's long-term nuclear ambitions and the political instability in Libya. [redacted] Belgian officials may agree to limit cooperation between Belgonucleaire and Libya to noncontroversial areas. [redacted]

In the long term, however, the poor Belgian economic situation, a general decline in Belgian nuclear exports, and competition from other European suppliers increase the possibility that the Belgian Government may approve the sale of technology that would support the enriched uranium route to a nuclear weapon. Because Libya is a signatory to the Nonproliferation Treaty, the supply of sensitive fuel-cycle technology (that is, uranium hexafluoride) would be covered by IAEA safeguards. [redacted]

## Appendix A

### The Libyan Secretariat of Atomic Energy

The Libyan Secretariat of Atomic Energy (SAE) was established in 1981, replacing the Atomic Energy Establishment (AEE) (figure 7). It provides information to the National Committee on Nuclear Energy, which reports, in turn, to the cabinet or to Qadhafi. The National Committee is authorized to make decisions on proposals submitted by the SAE secretary, who serves as chairman of the committee. Three components at the Secretariat headquarters in Tripoli--the National Academy of Science, SAE Security, and a Special Committee Reviewing the Technical Aspects of the Purchase of Nuclear Power Reactors from the Soviet Union—report directly to the Secretary [redacted]

Libya's National Academy of Science, called until the end of 1981 the Arab Development Institute, is headed by Mousa Omar. It promotes science in Libya by determining specific needs and recommending programs and policies to the cabinet. The academy has access to the cabinet only through the Secretary of SAE. [redacted]

SAE security comprises political intelligence officers and the Army personnel who are assigned to monitor the SAE and the Tajura Nuclear Research Center. [redacted]

The Committee for the Technical Review of the Nuclear Power Plant Contract is a temporary component, established by the SAE to study the technical appendixes of the Soviet PWR contract. Abd Al-Fatah Eskanji, former Director General of the AEE, was appointed its chairman in 1981 [redacted]

Directly below the Secretary is the Committee for Financial and Administrative Affairs. Bashir Madah is head of this committee, which is responsible for finances, administration, public relations, documentation, and legal affairs. The Committee for Scientific Affairs, headed by Dr. Fathi Nuh, is composed of seven subordinate divisions, as follows.

**Power**
This division is headed by Dr. Fathi Bara and staffed with 15 scientists and engineers. It is totally occupied in power reactor negotiations with the Soviet Union [redacted]

**Exploration and Mining**
Dr. Khalid Al-Hangary is head of this division, which is responsible for mining and milling uranium ore to yellowcake ($U_3O_8$). The $U_3O_8$ produced is then turned over to the Fuel Division. The Exploration Section, with a staff of 10 to 15 scientists, is responsible for conducting uranium surveys. [redacted] The Mining Section essentially is inactive, but four of its members are receiving training in Brazil. [redacted]

**Fuel**
This division, which is headed by Dr. Mahmud El-Borai, is responsible for the conversion of $U_3O_8$ through all of the production steps up to and including the production of nuclear reactor fuel rods. It is staffed by 10 to 15 engineers who were educated abroad. It is believed to be the best organized and most productive division of the SAE. [redacted]

**Technical Training and Cooperation**
This department, which is headed by Najib Al-Shabani, is responsible for supervising all foreign and domestic training programs, as well as for monitoring bilateral cooperation agreements and foreign contracts [redacted]

**Health Physics and Radiation Safety**
The sole responsibility of this division is establishing regulations to meet safety and environmental requirements for the SAE. Although it has held a low priority within the SAE for many years, the division was reactivated in 1983 as a result of the completion of the Tajura Nuclear Research Center [redacted]

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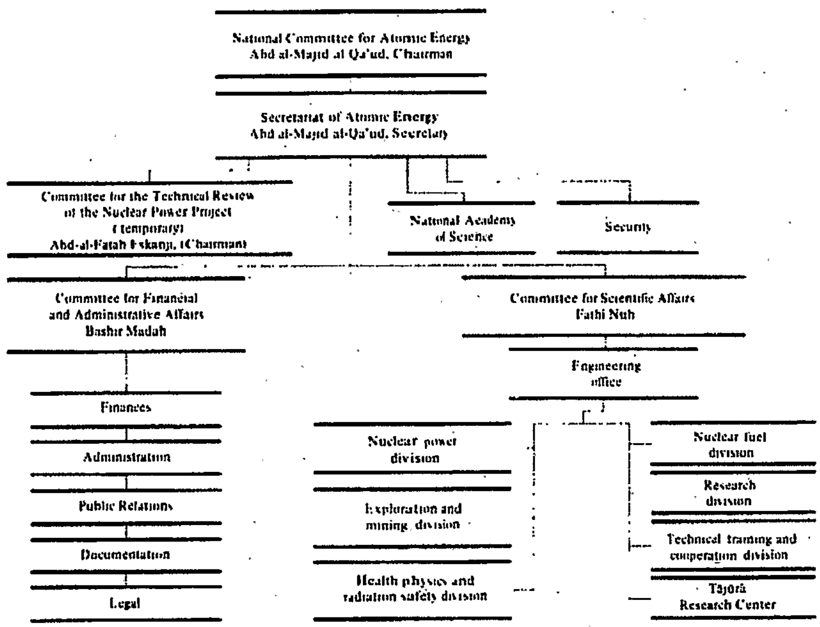
**Figure 7**
**The Libyan Secretariat of Atomic Energy**

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**Research**
This division handles matters beyond the other divisions' responsibilities. It is not effective because it lacks a supervisor, but it is intended to coordinate and integrate activities of the divisions, initiate projects, and recommend the division to which a project should be assigned. [redacted]

**Tajura Nuclear Research Center**
The center is responsible for the administration of safeguards and scheduling of IAEA inspections. It has eight departments. Its head is Dr. Faruk Al-Humaydi. [redacted]

## Appendix B

## The Nuclear Research Center at Tajura

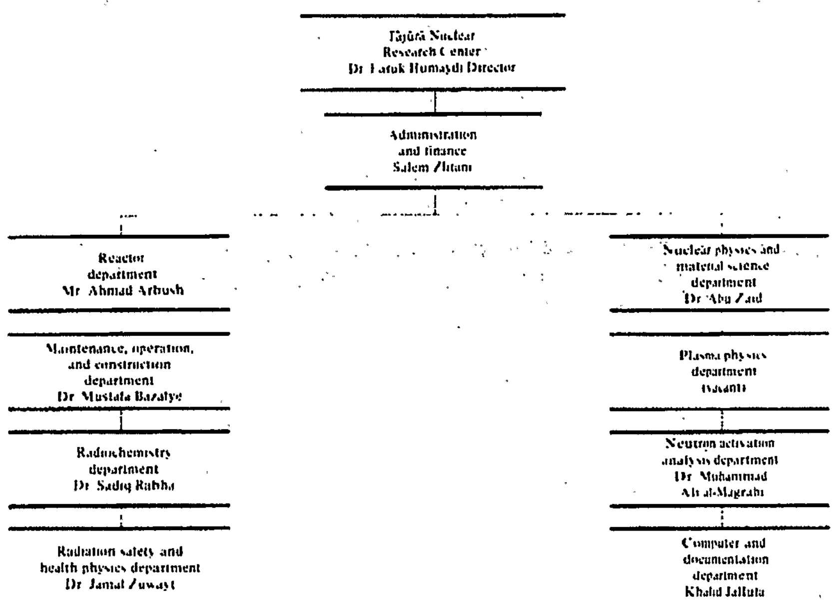
**Description of the Facility**
The center, which is adjacent to the Tajura Barracks, consists of a research area, housing area, radioactive waste storage area, secured warehouses, and associated desalination plant [redacted] Construction was started in late 1977. [redacted] The building interiors, however, probably were not finished until late 1981. [redacted]

[redacted]

[redacted]

**Nuclear Research Departments at Tajura**
The Tajura Nuclear Research Center has eight research departments (figure 8). They are as follows. [redacted]

**Figure 8**
**Department of the Tājūrā Nuclear Research Center**

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***Reactor.*** Ahmad Hobrush is head of this department, which is divided into the IRT Research Reactor, Critical Assembly, and Neutron Generator Sections. The Reactor Section is the largest—with a staff of about 30, including one or two foreigners. [redacted]

***Neutron Activation Analysis.*** This department is headed by Dr. Muhammad Ali al-Maghrabi and has a total staff of five or six. [redacted]

***Nuclear Physics and Material Science.*** Dr. Abu Zaid is head of this department, which has a technical staff of 15 to 20. The head of the Material Science Section is Ibrahim Shaybani. SAE is debating whether this department's work should be mainly training or research. [redacted]

***Radiochemistry.*** This somewhat inactive department has a total staff of only four or five technicians. Dr. Sadiq Rabha, whose speciality is food preservation using radiation, replaced Dr. Ahmad Al-Hisnawvi (no background in radiochemistry) as department head in early- to mid-1983. [redacted]

***Maintenance, Operations, and Construction.*** Dr. Mustafa Bazelya is head of this department, which has a staff of 100 to 150. The department is responsible for water treatment and desalination processes. It supervises machine and electrical shops, as well as waste and storage facilities. [redacted]

***Health Physics and Safety.*** Dr. Jamal Zuwayt is head of this department, which has a competent staff of seven or eight. Its responsibilities overlap those of the Health Physics and Radiation Safety Division of the SAE. It is developing and implementing radiation protection standards for the Tajura Center, the university, and Libyan hospitals. [redacted]

***Computer and Documentation.*** This department uses a computer system provided by Siemens in West Germany under subcontract to the Soviets. The main computer (equivalent to a CDC 6400) is connected to terminals in the Tajura Center. However, no Siemens representatives are at Tajura, and the department is understaffed. The minicomputer systems are used for various analysis and control functions, such as radiation detection and analysis. [redacted]

***Plasma Physics.*** The work of this department centers around the Tokamak device, which is used for research in physical processes in high-temperature plasma and for nuclear fusion experiments. Acquired from the Soviets, the Tokamak was recommended by Izzat Abd-Al-Aziz, an Egyptian plasma physicist brought into the Libyan nuclear program to advise the SAE. The directorship of this department has been vacant since Sadiq Rabha's transfer to the Radiochemistry Department. [redacted]