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# Trip Report on "International Conference on Nonproliferation Problems," Kazakhstan[1], September 1997.

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*Introduction*

From September 8 – 11, 1997, the Kazakhstani Ministry of Science-Academy of Sciences held an "International Conference on Nonproliferation Problems," co-sponsored by the Kazakhstan Atomic Energy Agency, the Ministry of Foreign Affairs, the National Nuclear Center, and the Security Council. The first day of the conference took place in Almaty, Kazakhstan and focused on the political aspects of nonproliferation. On Tuesday, September 9, all conference participants were flown on a chartered plane to the northeastern city of Semey (Semipalatinsk), where they were greeted by a military band and a fleet of buses to take them to the city of Kurchatov, about two hours west of Semey on the territory of the Semipalatinsk Test Site (*Polygon*). The conference continued from September 10-12 in Kurchatov, focusing on the technical aspects of nonproliferation. Conference participants were also taken on tours to the three nuclear research reactors and nuclear weapons test fields at the Polygon.

Of the foreign conference participants, the United States sent the largest delegation, with representatives from the Department of Energy, the National Laboratories, the Defense Special Weapons Agency, the Department of State, and other agencies.[2] In addition, there were representatives from Russia, Ukraine, Sweden, France, Germany, and Norway, as well as from the United Nations, and the IAEA. Although there was at least one representative from the Russian Ministry of Foreign Affairs (Mr. V. I. Rybachenkov), many of the Russians were scientists from the All-Russian Research Institute of Technical Physics at Chelyabinsk-70. Based on earlier discussions with scientists from the Institute of Physics Power Engineering in Obninsk, I would guess that many other scientists from the NIS were invited, but could not afford to attend. There were also a few representatives from the International Physicians for the Prevention of Nuclear War. Lastly, there were many scientists and officials from Kazakhstan, including representatives from the Ministry of Foreign Affairs, the Ministry of Defense, the Committee for National Security, the Security Council, Academy of Sciences, the Kazakhstan Atomic Energy Agency, the National Nuclear Center, the Ministry of Health, the Ministry of Power and Natural Resources, as well as representatives from environmental and activist groups such as "Nevada-Semipalatinsk."

As abstracts for all presentations were made available to conference participants, this report will not go into any detail on the presentations themselves. However, the report

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[1] According to a Kazakhstani foreign ministry official, the "h" has been official put back into "Kazakhstan."

[2] In addition, Harlan Strauss, Joe Tipton, Christina Rocca (a staffer for Senator Sam Brownback), and a representative from OSIA were in Almaty for the first day of the conference. They were in Almaty for discussions with Kazakhstani officials regarding follow-up activities under the DOD-FBI program and were scheduled to go to Bishkek on Wednesday, September 10.

will include general observations of the proceedings and make note of any particularly interesting remarks. Because of the large number of presentations, no time for discussion was allowed and conference participants were instructed to ask their questions directly of presenters during the coffee breaks.

*Almaty: Political Aspects of Nonproliferation*

Minister of Science and President of the Academy of Sciences Vladimir Shkolnik opened the conference. Greetings were read from both Kazakhstani President Nursultan Nazarbayev and UN Secretary General Kofi Annan. In addition to the expected diplomatic welcome and congratulations, Secretary Annan's greeting made particular reference to the Almaty Declaration, which called for the creation of a Central Asian Nuclear-Weapon-Free Zone (NWFZ). He also noted that the Almaty conference could be seen as "bridge" to the Tashkent Conference the following week, which would specifically address a Central Asian NWFZ. This early reference to the NWFZ set a tone for the rest of day, as no fewer than five subsequent presentations made reference to the zone. Many of the journalists at the press-conference at the end of the day also focused on the NWFZ idea, and a local newspaper later reported on "President Nazarbayev's latest idea" -- the creation of a NWFZ in Central Asia.

Kazakhstani Speakers on Monday, September 8 included: Minister of Science Shkolnik, Minister of Health Vasiliy Devyatko, First Deputy Foreign Minister Erlan Idrisov, Director-General of the Kazakhstan Atomic Energy Agency Timur Zhantikin, leader of the Nevada-Semipalatinsk movement Olzhas Suleymenov, and an impromptu presentation by a Senator from West Kazakhstan, Senator Gabbasov. International speakers included US Ambassador to Kazakhstan Elizabeth Jones, the Japanese Ambassador to Kazakhstan, Ukrainian Deputy Foreign Minister Konstantin Grishenko, Russian Foreign Ministry official V. Rybachenkov, Hannalore Hoppe from the United Nations, Islam Nurul from the IAEA, Bill Potter from the Monterey Institute, Arthur Muhl and Jacques Mongnet from the International Physicians for the Prevention of Nuclear War, and Dr. A. Weinberg from Baylor College of Medicine in the United States.

The Kazakhstani presentations were a fairly mixed bag, covering the history of nonproliferation in Kazakhstan, the current legal aspects of the nonproliferation regime in Kazakhstan, the Central Asian NWFZ initiative, and the health consequences of nuclear testing. Minister Shkolnik gave a strong lead presentation on Kazakhstan's nonproliferation policy. In reciting the history of Kazakhstan's involvement in the international nonproliferation regime, Shkolnik emphasized that although Kazakhstan inherited an advanced nuclear industry, a highly developed scientific potential, and nuclear weapons themselves, over the past few years Kazakhstan has repeatedly demonstrated its commitment to nonproliferation. Director-General Zhantikin's presentation examined the legal foundation for the controls exercised by various government bodies over nuclear activities in Kazakhstan, ensuring adherence to the nonproliferation regime in Kazakhstan. In particular, he noted the Law on Export Controls, passed in 1996, and the recent Law on Atomic Energy, passed in April 1997. He also noted that the Kazakhstan Atomic Energy Agency was developing a state system expressed Mongolia's interest, in principle, in such a corridor and said that Mongolia would be ready to support it should *Russia and China* decide to create such a corridor. Dr. Muhl took advantage of his time in Almaty to discuss his idea in side meetings at the Kazakhstani Foreign Ministry. He then went on to Bishkek to promote his idea there, before ending up in Tashkent at the NWFZ conference. It should be noted that the Uzbeks asked Dr. Muhl not to mention his corridor idea in Tashkent, as they were concerned that it would not be well received.

Mr. Rybachenkov from the Russian Foreign Ministry also made reference to the Central Asian NWFZ. He noted that Russia welcomed initiatives for new NWFZs, including both the Central Asian and the Central and Eastern European initiatives.[3]

One of the last presentations was made by Senator Gabbasov, a member of Parliament from Western Kazakhstan. He reminded the conference participants that Semipalatinsk was not the only region that suffered from Soviet nuclear testing. He reminded the group that there had been 10 nuclear explosions at the Kasputin-Yar nuclear missile test site, and 17 underground nuclear explosions at the Azgir test site. He made an appeal for these two west-Kazakhstani test sites not to be forgotten by the Kazakhstani and international community.

*Kurchatov: Technical Aspects of Nonproliferation*

Kurchatov, also known as Semipalatinsk-21, is a small, formerly closed city located in the northeast corner of the Semipalatinsk Test Site (Polygon) on the Irtysh River.[4] Scientists and military personnel conducting nuclear tests and working at the scientific reactors located on the test site lived in the city of Kurchatov. Previously, there were approximately 25,000 inhabitants of Kurchatov. During a tour of city, conference participants were told that the population has dropped to approximately 15,000. The city appeared to be little more than a ghost town, however, with many abandoned buildings, half finished construction projects, and crumbling laboratories filled with outdated equipment. The streets are mostly quiet and empty. Almost all inhabitants of the city, as well as the overwhelming majority of Kazakhstani conference participants, appeared to be ethnic Russians, and most of the cars have Russian license plates.

On Tuesday, September 9, the day of our arrival in Kurchatov, we were taken on a brief tour of the city. The tour included trips to one of the laboratories at the Institute of Radiation Safety and Ecology, a small museum dedicated to the history of the test site (complete with displays of various animal organs that had been exposed to massive radiation from nuclear explosions), and a new joint-venture "KK Interconnect."

KK Interconnect represents one of many defense conversion efforts taking place at the test site. It is a joint venture between the Institute of Atomic Energy and the U.S.

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[3] A Kazakhstani foreign ministry official had earlier noted that he believed Russia would be "very supportive" of a Central Asian NWFZ, as they continued to keep in mind the proposal for a Central and Eastern European NWFZ.

[4] The total area of the test site is 18,500 km, with a perimeter of roughly 600 km. The test site covers large portions of the Semipalatinsk, Pavlodar and Karaganda oblasts of Kazakhstan.

for physical protection, which would standardize coordination between Ministries and government agencies in the sphere of physical protection.

Minister Devyatko's presentation focused on the responsibilities of his ministry in addressing the medical and health consequences of nuclear testing at Semipalatinsk. The Ministry of Health recently opened an Institute of Radiological Medicine and Ecology in Semipalatinsk and a regional diagnostic center in Kurchatov City. In addition, the ministry is creating a national register of Kazakhstani citizens suffering from radiation-induced health problems.

Deputy Minister Idrisov's presentation focused on the idea of a Central Asian NWFZ. He explained Kazakhstan's interest in the zone by noting that Kazakhstan was looking for additional ways to contribute to the nonproliferation regime. He called the idea a "Central Asian initiative" put forth in the Almaty Declaration in February 1997. Prior interest in the idea on the part of Kazakhstan or other Central Asian states was not mentioned. Idrisov also claimed that many countries had approved the idea in principle, including the nuclear powers. Regarding the zone itself, Idrisov had three main points:

1) the zone should be open to eventual participation by additional countries;
2) the exact geographic borders of the zone will have to be defined before any final agreement is reached on the zone;
3) a protocol on environmental problems should be attached to a Central Asian NWFZ treaty, focusing the attention of the international community on the severe environmental consequences of nuclear testing. Such a protocol could include an invitation to the international community to cooperate with the Central Asian states on the conversion of the Semipalatinsk test site, and environmental clean up of the problems caused by nuclear testing, uranium mining, and storage of radioactive waste.

One additional presentation in particular is worth mentioning. Dr. Arthur Muhl gave a presentation on the possible creation of a Nuclear-Weapon-Free Corridor linking the Central Asian NWFZ with the already self-declared Nuclear-Weapon-Free State of Mongolia. Dr. Muhl's idea is to create an NWF-corridor along a 40-km, scarcely populated strip of land high in the mountains between Kazakhstan and Mongolia. The corridor consists of both Russian and Chinese territories. According to Dr. Muhl, the advantages of such a corridor are the following:

1) it is a logical way to link Mongolia to the Central Asian NWFZ;
2) it would be a novelty – it would be the first NWFZ on the territory of declared NWS;
3) it would be proof of the proclaimed friendship and mutual confidence between all countries involved;
4) it would be a strong confidence-building measure in Asia;
5) it would be a symbol of mutual understanding, peace and respect.

Dr. Muhl made available copies of a letter he received from Mr. Surenguin Badral, the Foreign Policy Advisor to the Prime Minister of Mongolia. In this letter, Mr. Badral company "Cross" (sic). The U.S. government, mostly likely under the auspices of either the IPP program or the Nunn-Lugar defense conversion program provided the initial funding for the project. The company produces printed circuit boards for universal remote controls and "World Connect" universal modem adapters. And they even have a few customers... Apparently, KK Interconnect recently received an order from the Sharper Image catalog for 10,000 universal remote controls. The equipment in the small factory is impressive to look at – consisting of very high-tech, state of the art computers and machinery. The company employs 33 people, all former employees of the Institute of Atomic Energy. Although it is a very modest operation, even such small conversion projects, if successful, will help to ensure that the former nuclear scientific elite remain gainfully employed and help to keep Kurchatov from fading away completely.

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Conference presentations continued on Wednesday, September 10, focusing on the technical aspects of nonproliferation. Most presentations focused on conversion and dismantlement projects, and current nuclear research activities in Kazakhstan.

Dr. Yuri Cherepnin, Director of the National Nuclear Center, gave the first presentation on "Conversion of the Semipalatinsk Test-Site" (viewgraphs available upon request). The presentation was both informative and very well presented, with viewgraphs in English and in Russian, high-quality photographs of nuclear explosions, and a map showing the locations of different facilities located on the test site. Between 1949 and 1989, 456 nuclear tests were conducted. Of those, 86 were atmospheric tests, 30 were above ground tests, and 340 were underground tests. In 1962, there were 40 nuclear explosions in 20 weeks, the highest number of tests ever conducted in one year.

Sem. Test Site

The Semipalatinsk Polygon was used exclusively as a site for conducting nuclear tests from 1949 to 1957. In 1958, however, construction began on the IGR reactor, which is described below. In 1964, construction began on the Baikal-1 reactor complex, also described below. Both reactor sites were functionally unrelated to the nuclear testing activities at the Polygon, but were built on its territory because a large, uninhabited area was needed for these particular reactors. However all activities at the Polygon were conducted exclusively for the Soviet military complex—there were no civilian activities.

After the Soviet Union broke up in 1991, the Russian military began to pull out of Kurchatov. Cherepnin explained that, because there were no viable civilian activities at the Polygon, there was a real danger that the entire scientific-production complex there would be destroyed. Thus, it was crucial to the fate of the complex that the Kazakhstani leadership decided to establish a National Nuclear Center (NNC) in Kurchatov on the basis of the existing nuclear infrastructure. This decision made it possible to retain a qualified cadre of personnel, maintain and continue to exploit the existing nuclear facilities, and begin work on the implementation of a full conversion plan. The initial plans for conversion activities envisioned a continuation of work on the nuclear rocket engine programs at Baikal-1. However, it very quickly became obvious that such work could have been continued only in close cooperation with Russia and/or the United States. As both countries had essentially discontinued active programs in this area, the scope of conversion activities at NNC has been continually refined over the past four years.

Current activities at the NNC include a feasibility study on the construction of thermal nuclear power plants; research in the area of nuclear reactor safety; research under the auspices of the International Thermonuclear Energy Reactor (ITER) project; destruction of the nuclear testing infrastructure; nonproliferation activities, including the improvement of MPC&A at the reactor complexes and the return of highly-enriched reactor fuel to Russia; development of technology, equipment and sites for storage of spent nuclear fuel; opening of a joint-stock company for production of printed circuit boards; and assessment of the effects of nuclear testing. International projects currently involve Russia, the United States, Japan, and the European Community.

The next presentation was given by Dr. D. Linger from the U.S. Defense Special Weapons Agency, who discussed some of the analogous conversion work being done at the Nevada Test Site in the United States. Dr. Linger is part of the U.S. team that is helping the Kazakhstanis to seal the nuclear testing tunnels at the Degelen mountain complex at the Polygon. (Dr. Linger chose to use his own, American interpreter, rather than use the simultaneous interpretation provided by the Kazakhstani Ministry of Science.)

The United States conducted roughly 100 atmospheric tests at the Nevada Test Site between 1951 and 1962. Peaceful Nuclear Explosions (PNEs) were also conducted, to see if nuclear explosives could be used to construct canals, etc. One PNE created the "Sedan Crater," which is 1200 feet in diameter and 600 feet deep. In 1962, the United States began testing nuclear weapons in tunnels to contain the radiation. The name of the complex of tunnels at the Nevada Test Site is Ranier Mesa, analogous to Kazakhstan's Degelen mountain complex. But unlike Degelen, where only 1-2 tests were conducted per tunnel, 15-20 tests were conducted per tunnel at Ranier Mesa. The United States has had an easier job of closing down its underground test site, because the Ranier Mesa site has only five tunnel complexes, whereas the Degelen site has roughly 200 tunnels. The last underground test in the United States was conducted in 1992.

In addition to closing the tunnels, the U.S. is also trying to define the future role of the Nevada Test Site. Current efforts are focused on site remediation, as well as trying to redirect the scientific potential of the complex as a National Research Center. There are three major missions at the Nevada Test Site now, which may help to define what the future long-term activities of the complex may be:

1) Accident Mitigation Assessment (with a focus on chemical weapons)
2) National Defense Initiatives (such as destroying ICBMs)
3) Nuclear Waste Management. There is currently a low-level waste disposal project to store medical and other low-level industrial waste at the test site. Another project, called the Yucca Mountain Project, is examining the suitability of using this site for storage of high-level waste as well.

The next three presentations focused on the destruction of the testing infrastructure at the Polygon, and particularly on the destruction of the "nuclear device" in Tunnel 108 on May 1995. The device was destroyed by specialists from Russia's VNIITF under a special agreement between Russia and Kazakhstan. With the assistance of Kazakhstani experts from the Ministry of Ecology and Bioresources, all possible measures were taken to ensure complete ecological safety of the operation. In addition, while preserving the classified nature of the technical specifications of the device, all possible measures were taken to ensure transparency and confidence-building.

The scientist who gave the presentation explained that the device was not a bomb and not a warhead -- it was a nuclear device with unique technical characteristics that was constructed and placed in Tunnel 108 in 1991. It was meant to be used after just a few month. But then the Soviet Union fell apart and new political realities made it impossible to explode the device. In 1992, President Nazarbayev closed the Polygon and within the next year Kazakhstan signed the NPT as a non-nuclear-weapon state. However, as time passed, experts determined that the unexploded device was causing a number of ecological problems, and if left in the tunnel indefinitely could eventually contaminate the water table. As it would be exceedingly dangerous to dismantle the device, it was decided that the best possible option would be to destroy it using a chemical substance. One presentation focused on the fact that the measures of transparency employed turned out to be particularly useful in improving relations with the press and with various environmental, non-governmental organizations.

One of the more interesting aspects of the final presentation on the destruction of the test site infrastructure was the description of the infrastructure itself. There are two sites at the Polygon where test infrastructure remains: the Degelen mountain complex is at test site "G," in the Southern portion of the Polygon, and the technical area "Balapan" is at the Southeast edge of the Polygon. The test infrastructure at Degelen consists of a series of underground tunnels in natural mountain formations. The tunnels were constructed of sealing concrete and stone. Equipment to monitor the parameters of the explosions was placed a safe distance from the mouths of the tunnels. The first test was conducted here on October 11, 1961, the results of which proved that conducting tests in tunnels significantly reduced the release of radioactive materials into the atmosphere. 223 tests later, the last nuclear test was conducted at Degelen on October 10, 1989. Underground tests were also conducted at the technical area, "Balapan," but in vertical holes in the ground as opposed to tunnels. The depth of most of the holes is 500-600 meters, and the bottom of the hole is up to 900 meters in diameter. Instrumentation to gauge the parameters of the explosions is lowered into the hole along with the device to be tested, and is connected to measuring equipment located above ground by cables. Collapsed craters were not generally created by tests at Balapan, as the holes were made in solid rock, such as granite. On January 15, 1965, a nuclear device was placed in a test hole at Balapan at a depth of 178 meters and exploded to test the procedures for creating man-made reservoirs. The resulting 130 kT nuclear blast created an artificial lake with a diameter of 408 meters -- Lake Balapan, also known to locals as the "Atomic Lake." The lake remains to this day, and radiation levels on the shore of the lake are still quite high.

The last nuclear test conducted at the Semipalatinsk Polygon was at the Balapan technical area in November 1989.

The next presentation of note related the eight ISTC projects that have been awarded to the institutes at the National Nuclear Center. They are as follows:

1) Project K-048, Institute of Atomic Energy. This project provides funding for the development of a plan to decommission the RA reactor at the Baikal-1 complex, so that the fuel in the reactor can be returned to Russia. (As was further explained during a tour of Baikal-1, a formal decision to decommission the RA reactor has not yet been taken by Kazakhstan.) This project involves 110 people.
2) Project K-057, Institute of Atomic Energy. This project provides funding for the creation of storage, control, and physical protection systems for nuclear materials and radioactive sources at the Baikal-1 complex, using international standards for the control and accounting of radioactive materials.
3) Projects K-053 and K-054, Institute of Radiation Safety and Ecology/Institute of Nuclear Physics. These projects are designed to evaluate the effects of nuclear testing on the flora and fauna of the region and to examine the levels of radiological and non-radiological contamination at the Polygon. In addition, scientists are working to determine the migration paths of radionuclides from the Polygon. 103 people work on project K-053 and 100 people on project K-054.
4) Project K-056, Institute of Geophysical Research. This project provides funding for the study of possible contamination of the groundwater with radionuclides as a result of underground nuclear testing. This project involves 130 people.
5) Project K-063, Institute of Geophysical Research. This project provides funding for the Institute of Geophysical Research to monitor seismic events as part of the International Monitoring System for verification of the Comprehensive Test Ban Treaty. This project involves 120 people.

Other ISTC projects include research on beryllium coating for superconductors, and ensuring the safety of local populations in areas close to the test site.

There is one final presentation that it is worth noting in some detail – a presentation on the "Nuclear Industrial and Power Complex of Kazakhstan." The presentation was given by Valeriy Shemansky, Vice-President of KATEP. Interestingly, Mr. Shemansky did not explain the recent creation of the organization "Kazatomprom," nor did he explain the role that KATEP will play now that it is no longer the parent company of most of the nuclear industrial facilities in Kazakhstan.[5] Instead he avoided mentioning both companies and spoke of the development of Kazakhstan's nuclear industry generally.

According to Shemansky, 120,000 people work in the 37 different organizations that comprise the nuclear industry in Kazakhstan. Over the past 5 ½ years the nuclear

[5] In a private conversation, Mr. Shemansky indicated that Kazatomprom was responsible for all aspects of the fuel-cycle through fuel fabrication (i.e., uranium mining and milling and fuel pellet production at Ulba), and KATEP was responsible for development of nuclear power and dealing with spent fuel. He was unable to explain why the change had been made, indicating only that it had been a political decision. He also complained that Kazatomprom had immediately been given levels of authority that KATEP had been denied for many years.

industry has accomplished much, including the conversion to exclusively peaceful activities. This conversion has ensured that much of Kazakhstan's scientific potential in the field has been preserved. Kazakhstan's nuclear industry is comprised of the following:

1) Uranium mining companies: State Holding Company, "Tselinniy Mining and Chemical Combine;" the Stepnoye Ore Directorate; the Central Ore Directorate; Ore Directorate No. 6; and KASKOR, located in the city of Aktau;
2) One nuclear reactor fuel pellet fabrication factory, the Ulba Metallurgy Factory;
3) Two factories which process rare and rare-earth metals, the Ulba Metallurgy Factory and the Irtysh Chemical Metallurgical Factory;
4) The Mangyshlak Energy Combine;
5) The Scientific Complex "National Nuclear Center" under the auspices of the Ministry of Sciences – Academy of Sciences.

Roughly 25 percent of the world's uranium is located in Kazakhstan. Proven reserves are approximately 691,000 tons, and unexplored reserves may bring the total up to approximately 1,617,000 tons. Uranium is mined in six oblasts in Kazakhstan, and milled at the Tselinniy Mining and Chemical Combine, the Prikaspiskiy Mining and Chemical Company,[6] and at the Kara Balta Combine in Kyrgyzstan and the Vostokredmet Combine in Khodzhent, Tajikistan.

Currently there is only one nuclear power plant in Kazakhstan, the BN-350 fast-breeder reactor in Aktau at the Magyshlak Atomic Energy Combine. The energy produced at this reactor represents only 0.7% of Kazakhstan's electrical energy production. The reactor, which uses 21% enriched HEU fuel, is due to be removed from service in the year 2003. As the demand for energy in Kazakhstan is projected to increase significantly in the next 20 years, the Ministry of Energy, together with the Ministry of Science, has developed a plan for the development of the nuclear power and the nuclear industry in Kazakhstan. As outlined by Shemansky, the proposed plan has three basic elements: increase production of natural uranium, produce nuclear fuel pellets for all types of nuclear reactors, and encourage the training of qualified specialists to work in the nuclear field. The profit made from increased uranium production can be used to finance the development of nuclear power in Kazakhstan. Preliminary plans are to build at least one major new nuclear power plant, as well as possibly a small atomic power reactor at Kurchatov.

In preparation for Kazakhstan's initiative to develop nuclear power, much of the work that is currently being done at the IGR, IVG.1M, and RA research reactors is on reactor safety. There was an interesting technical presentation given by a scientist from the Institute of Atomic Energy, who explained this work in great detail.

There were also a series of presentations by Russian participants on such subjects as the role of the Ministry of Atomic Energy in Russian export controls and the physical

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[6] I would guess that this is the same outfit as KASKOR.

protection upgrades that are being implemented at Russian nuclear facilities such as the Kurchatov Institute in Moscow.

On Thursday, September 11, the morning was devoted to tours of the various facilities and sites within the Polygon. I chose to go on the tour to Baikal-1 on Thursday morning and to the IGR reactor and the site of the atmospheric nuclear tests on Friday morning. Tours were also given of the Degelen mountain complex and of Lake Balapan, the "atomic lake" described above. At the afternoon session, where attendance was considerably diminished, there was a series of rather technical presentations on the potential for Kazakhstan to play an active role in the seismic monitoring required by the Comprehensive Test Ban Treaty. There was also a presentation on the possibility of sending high-level atomic waste to the sun for disposal.

On the morning of Friday, September 12, two sessions were held simultaneously, one called "Supporting the Nuclear Nonproliferation Regime and Control of Nuclear Materials," at which many of the U.S. DOE participants gave presentations on U.S. export control and MPC&A assistance to Kazakhstan, and one called "Radio-ecological Research on the Effects of Nuclear Testing." I did not attend either session, choosing instead to go on more tours. According to the DOE representatives, most of the Kazakhstani participants chose to attend the session on radio-ecological research and attendance was rather thin at the first session.

*Excursions to Kurchatov Research Reactors*[7]

Baikal-1 Reactor Complex:
Information given here is based primarily on the comments of Dr. Alexander Kolbayenko, Deputy Chief Engineer at Baikal-1, who led a tour of the complex on September 11, 1997. A fact sheet on the reactor, provided by the conference organizers, was used to supplement the information here. Additional comments are based on remarks by Dr. Vyacheslav Ganzha, Chief Engineer at Baikal-1, and personal observations.

The Baikal-1 Reactor Complex is located near the geographical center of the Semipalatinsk Polygon. It is the location of two research reactors, the IVG.1M[8] and the RA, and the "non-reactor stand" ANGARA. (The IGR reactor is at another location on the Polygon.) The reactors had no scientific connection to the nuclear weapons tests that were conducted at the Polygon. They were built on the territory of the test site because their technological specifications required a location distant from populated areas. The Baikal-1 Reactor Complex was previously a branch of the Russia-based NPO Luch Production Facility, and its principle activity was research on the Soviet nuclear rocket engine program. The program ended in the late 1980s. Baikal-1 no longer has any

[7] A version of the portion "Excursion to Kurchatov Research Reactors" of this trip report was sent to George Anzelon at LLNL by Bill Potter in a memo entitled, "Potter and Ewell Notes from Kurchatov/Semipalatinsk Conference and Excursion."
[8] The reference to the IVG.1M as "EWG.1M" is probably not necessary. It is simply an alternative transliteration from the Russian.

formal association with Luch, and falls under the auspices of the Institute of Atomic Energy at the Kazakhstani National Nuclear Center. Current projects include research on nuclear safety, and research under the International Thermonuclear Energy Reactor (ITER) program.

Funding for Baikal-1 comes primarily from the Kazakhstani government. However, the facility has some joint projects with other countries (such as Russian and Japan), as well as four projects funded by the International Science and Technology Center in Moscow (ISTC). There are currently about 250 people who work at the Baikal-1 facility (including support personnel), almost all of whom appear to be ethnic Russians. Although there is no longer a major exodus of scientists from the facility, many have already left and there are currently only enough personnel for 1 ½ shifts. (One scientist noted privately that about half the scientists remaining had Russian citizenship, and many had apartments in Russian cities.) Scientists and all other personnel at Baikal-1 live in the city of Kurchatov.

Both the IVG.1M and the RA reactors are located in Building 101, which is part of a cavernous underground structure. The IVG.1M is a pulsed reactor, which means that it is not continually in operation, but operates only for short periods at a time. Construction of the IVG.1 reactor was completed in 1972, and in 1975 it first reached criticality with a power rating of 40 MW.[9] The design of the reactor made it possible to reach a power rating of 720 MW, but in fact the maximum power it ever reached was 280 MW. From 1989-1990, after the nuclear rocket engine program had ended, the IVG.1 was modified and became known as the IVG.1M. The core of the reactor has 30 cells for fuel channels,[10] one of which is gas-cooled. The remaining channels are water-cooled. The reactor contains approximately five kg of 90% enriched U-235. Although at one point fresh fuel containing 14 kg of U-235 was stored at Baikal-1, at present there are only three fresh fuel channels in storage, each containing 200 grams of 90% U-235, for a total of 600 grams. With the exception of this 600 g, all fresh fuel has been returned to Russia. The spent, irradiated fuel is in the process of being returned. The most recent shipment was in July 1997, when 50 kg of irradiated fuel was returned to the Luch facility in Podolsk, Russia. For the purposes of IAEA safeguards, Russian and Kazakhstani material is stored separately. IAEA inspections are conducted at this site on a quarterly basis. The IVG.1M was last operated in May 1997 in conjunction with the ITER program. It is scheduled to be operated next in October 1997. The reactor is in operation only about 2 or 3 times per year.

The RA reactor was converted from a nuclear rocket engine prototype into a research reactor in 1987, after the nuclear rocket engine project had ended. It reached initial criticality with a power rating of 500 KW. The reactor has a project capacity of 200 MW, although thus far it has only reached 60 MW. Although the reactor is Kazakhstani, the approximately 7 kg of 90% enriched U-235 fuel in the reactor is Russian. The technological composition of the fuel is highly classified, and it will have to be returned

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[9] This clarifies the two conflicting dates currently given in Profiles.

[10] According to Dr. Kolbayenko, the core contains 30 channels. According to the fact sheet distributed, the core contains 31 channels.

months of 1997, 20 times. Most experiments now are connected with nuclear reactor safety, although some work is conducted under the ITER project.

As at the Baikal-1 complex, all new physical protection systems were scheduled to be formally commissioned on September 13, 1997. The only visible physical protection equipment in the reactor room were a number of strategically placed infrared sensors which record all movement within the room and relay the information to a central control room. Alarms were apparently installed as well, although they were not obviously visible. There have been no attempted thefts of material from this facility.

# КОМПЛЕКС ИССЛЕДОВАТЕЛЬСКИХ РЕАКТОРОВ «БАЙКАЛ-1»

9 AM, 11 Сентяб.

Комплекс исследовательских реакторов «Байкал-1» был создан для наземных испытаний ядерных ракетных двигателей, отработки их прототипов и отдельных узлов. Стендовый комплекс расположен в центральной части Семипалатинского полигона в 65 километрах к югу от города Курчатова. Место для строительства было выбрано с учетом специфики технологического процесса испытаний ЯРД с открытым выхлопом рабочих газов в атмосферу и требований радиационной безопасности.

В состав основных сооружений комплекса входят испытательный корпус, в котором размещены два действующих исследовательских реактора – ИВГ.1М и РА, центральный пункт управления, сбора и обработки информации, хранилища теплоносителей (воды, водорода, азота), здание энергоснабжения. На комплексе «Байкал-1» также находится хранилище отработанных источников ионизирующего излучения, позволяющее решить проблему сбора и временного хранения отработанных АИИИ в масштабах всего Казахстана. В настоящее время прорабатывается вопрос о возможности строительства на комплексе «Байкал-1» атомной станции электротеплоснабжения малой мощности.

Реактор ИВГ.1 введен в эксплуатацию в 1975 году. Это корпусной реактор , активная зона которого содержит 31 ячейку для установки технологических каналов с топливом. В зависимости от типа и назначения технологических каналов они могут охлаждаться водой или газом. В 1975…1988 годах на реакторе ИВГ.1 был выполнен основной объем испытательных работ по программе разработки ЯРД в СССР. В 1989…1990 годах реактор был модернизирован. После модернизации реактор используется для проведения исследования взаимодействия конструкционных материалов с водородом и его изотопами. Эти исследования выполняются в рамках проекта создания международного термоядерного реактора ИТЭР.

На комплексе «Байкал-1» проводились испытания трех стендовых прототипов реакторов ЯРД. Третий из них был переоборудован в исследовательский реактор РА, который введен в эксплуатацию в 1987 году. На реакторе РА проводились испытания длительной радиационной стойкости топлива космической ядерной энергодвигательной установки.

Теплотехнический стенд «Ангара» предназначен для исследования поведения элементов конструкции ядерных энергетических установок при моделировании различных аварийных ситуаций. В частности, на стенде созданы установки «Лава» и «Слава» для исследования процессов взаимодействия расплава материалов активной зоны ядерных реакторов с водой и бетоном.

# КОМПЛЕКС ИССЛЕДОВАТЕЛЬСКИХ РЕАКТОРОВ «БАЙКАЛ-1»

9 AM, 11 Сентябр.

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protection upgrades that are being implemented at Russian nuclear facilities such as the Kurchatov Institute in Moscow.

On Thursday, September 11, the morning was devoted to tours of the various facilities and sites within the Polygon. I chose to go on the tour to Baikal-1 on Thursday morning and to the IGR reactor and the site of the atmospheric nuclear tests on Friday morning. Tours were also given of the Degelen mountain complex and of Lake Balapan, the "atomic lake" described above. At the afternoon session, where attendance was considerably diminished, there was a series of rather technical presentations on the potential for Kazakhstan to play an active role in the seismic monitoring required by the Comprehensive Test Ban Treaty. There was also a presentation on the possibility of sending high-level atomic waste to the sun for disposal.

On the morning of Friday, September 12, two sessions were held simultaneously, one called "Supporting the Nuclear Nonproliferation Regime and Control of Nuclear Materials," at which many of the U.S. DOE participants gave presentations on U.S. export control and MPC&A assistance to Kazakhstan, and one called "Radio-ecological Research on the Effects of Nuclear Testing." I did not attend either session, choosing instead to go on more tours. According to the DOE representatives, most of the Kazakhstani participants chose to attend the session on radio-ecological research and attendance was rather thin at the first session.

*Excursions to Kurchatov Research Reactors*[7]

Baikal-1 Reactor Complex:
Information given here is based primarily on the comments of Dr. Alexander Kolbayenko, Deputy Chief Engineer at Baikal-1, who led a tour of the complex on September 11, 1997. A fact sheet on the reactor, provided by the conference organizers, was used to supplement the information here. Additional comments are based on remarks by Dr. Vyacheslav Ganzha, Chief Engineer at Baikal-1, and personal observations.

The Baikal-1 Reactor Complex is located near the geographical center of the Semipalatinsk Polygon. It is the location of two research reactors, the IVG.1M[8] and the RA, and the "non-reactor stand" ANGARA. (The IGR reactor is at another location on the Polygon.) The reactors had no scientific connection to the nuclear weapons tests that were conducted at the Polygon. They were built on the territory of the test site because their technological specifications required a location distant from populated areas. The Baikal-1 Reactor Complex was previously a branch of the Russia-based NPO Luch Production Facility, and its principle activity was research on the Soviet nuclear rocket engine program. The program ended in the late 1980s. Baikal-1 no longer has any

[7] A version of the portion "Excursion to Kurchatov Research Reactors" of this trip report was sent to George Anzelon at LLNL by Bill Potter in a memo entitled, "Potter and Ewell Notes from Kurchatov/Semipalatinsk Conference and Excursion."

[8] The reference to the IVG.1M as "EWG.1M" is probably not necessary. It is simply an alternative transliteration from the Russian.

formal association with Luch, and falls under the auspices of the Institute of Atomic Energy at the Kazakhstani National Nuclear Center. Current projects include research on nuclear safety, and research under the International Thermonuclear Energy Reactor (ITER) program.

Funding for Baikal-1 comes primarily from the Kazakhstani government. However, the facility has some joint projects with other countries (such as Russian and Japan), as well as four projects funded by the International Science and Technology Center in Moscow (ISTC). There are currently about 250 people who work at the Baikal-1 facility (including support personnel), almost all of whom appear to be ethnic Russians. Although there is no longer a major exodus of scientists from the facility, many have already left and there are currently only enough personnel for 1 ½ shifts. (One scientist noted privately that about half the scientists remaining had Russian citizenship, and many had apartments in Russian cities.) Scientists and all other personnel at Baikal-1 live in the city of Kurchatov.

Both the IVG.1M and the RA reactors are located in Building 101, which is part of a cavernous underground structure. The IVG.1M is a pulsed reactor, which means that it is not continually in operation, but operates only for short periods at a time. Construction of the IVG.1 reactor was completed in 1972, and in 1975 it first reached criticality with a power rating of 40 MW.[9] The design of the reactor made it possible to reach a power rating of 720 MW, but in fact the maximum power it ever reached was 280 MW. From 1989-1990, after the nuclear rocket engine program had ended, the IVG.1 was modified and became known as the IVG.1M. The core of the reactor has 30 cells for fuel channels,[10] one of which is gas-cooled. The remaining channels are water-cooled. The reactor contains approximately five kg of 90% enriched U-235. Although at one point fresh fuel containing 14 kg of U-235 was stored at Baikal-1, at present there are only three fresh fuel channels in storage, each containing 200 grams of 90% U-235, for a total of 600 grams. With the exception of this 600 g, all fresh fuel has been returned to Russia. The spent, irradiated fuel is in the process of being returned. The most recent shipment was in July 1997, when 50 kg of irradiated fuel was returned to the Luch facility in Podolsk, Russia. For the purposes of IAEA safeguards, Russian and Kazakhstani material is stored separately. IAEA inspections are conducted at this site on a quarterly basis. The IVG.1M was last operated in May 1997 in conjunction with the ITER program. It is scheduled to be operated next in October 1997. The reactor is in operation only about 2 or 3 times per year.

The RA reactor was converted from a nuclear rocket engine prototype into a research reactor in 1987, after the nuclear rocket engine project had ended. It reached initial criticality with a power rating of 500 KW. The reactor has a project capacity of 200 MW, although thus far it has only reached 60 MW. Although the reactor is Kazakhstani, the approximately 7 kg of 90% enriched U-235 fuel in the reactor is Russian. The technological composition of the fuel is highly classified, and it will have to be returned

[9] This clarifies the two conflicting dates currently given in Profiles.

[10] According to Dr. Kolbayenko, the core contains 30 channels. According to the fact sheet distributed, the core contains 31 channels.

to Russia. Although the Baikal facility received an ISTC grant to develop a plan for removing the fuel and decommissioning the RA reactor, a formal decision to decommission has not yet been taken by the Kazakhstani government. Dr. Kolbayenko expressed the hope that eventually Baikal-1 will be able to purchase new fuel, and the reactor can continue to operate. The RA is still being used, however, and is next scheduled to be put into operation at the end of September for three days and six hours.

A third research reactor was planned for this facility, and was to have been constructed in the same room as the RA reactor. It had a projected completion date of 1995, but the project was halted due to lack of funds.

The ANGARA non-reactor stand was built just last year in 1996, and is located above ground in a separate building from the rest of the Baikal complex. It consists of two components, "LAVA" and "SLAVA." The stand is used to conduct research on nuclear accidents at water-cooled reactors, by modeling the core of a reactor. A furnace liquefies up to 60 kg of a metal composed of zirconium oxide, uranium oxide and steel, and forces it into water. The experiments conducted at the ANGARA stand are done under contract to a Japanese firm, "Marumel" (name as given). Roughly 10-12 people work at ANGARA on a regular basis, and 20-25 people when preparing for an experiment. The stand is put into operation roughly every two weeks. High levels of radiation were measured in this building.

There is one operational hot cell at Baikal-1, and one that is not yet complete. There are also large storage facilities for radioactive ampoules. A project is under consideration that would store spent fuel from the BN-350 reactor in Aktau at the Baikal-1 complex. In addition, scientists at Baikal-1 have proposed a project to build a 7 MW, water-cooled reactor prototype of a nuclear power station, in conjunction with Kazakhstan's plan to develop its nuclear energy capabilities.

The Baikal-1 facility is in an extremely remote location, on flat treeless steppe, about a one-hour drive along a dusty, isolated road from the city of Kurchatov. Although the National Nuclear Center does not have funds to fence and patrol the entire perimeter of the Polygon, the three kilometer perimeter of the Baikal-1 facility is fenced and patrolled by a 20-person guard force from the Ministry of Internal Affairs. The facility also has a contract with Lockheed Martin to build a more substantial perimeter defense. In addition, under the U.S. DOE MPC&A program, alarms, magnetic locks, and monitoring equipment have been installed at all critical areas of the facility. Information from this equipment is automatically sent to computers located at the central alarm station. The newly installed equipment was scheduled to be formally commissioned at a ceremony on September 13, 1997.

<u>The IGR Complex:</u>
Information given here is based primarily upon comments by one of the chief scientists from the IGR (*Impuls-grafit reaktor*), who led a tour of the complex on September 12, 1997.