REMINISCENSES OF RUSSIA

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> "It is easy to blow up our planet. All it takes is a button to be pressed …," Russian school children's song.
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> "After so many years of very bad relations between our countries, this work is extraordinary...I wish you further success," Yuli B. Khariton, September 1993.
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> "All of you can be sure your children and grandchildren will be proud and this is the beginning...," Yuri Trutnev, September 1993.

The words above by Yu. B. Khariton, founder of the Soviet nuclear weapons program and Chief Scientist of the All-Russian Scientific Research Center of Experimental Physics (VNIIEF) in Sarov, were spoken to a Los Alamos National Laboratory (LANL) team after the completion of the first joint fundamental scientific experiment conducted at VNIIEF with LANL. Trutnev, Deputy Chief Scientist of VNIIEF and a colleague of Nobel Peace Laureate Andre Sakharov, added his comments at a banquet celebrating the same experiment.

Khariton was absolutely right: the budding LANL/VNIIEF collaboration was extraordinary and it was unprecedented in the nuclear age. Trutnev was absolutely right, too: it was just the beginning, and his words imply the hopes of all of those who have participated in the collaboration: that our children and grandchildren will live in a world free of the international tensions and fear of nuclear war that put a cloud over his and my generation.

For the author and most, if not all, of the LANL members of the collaboration, the opportunity to participate in the collaboration was one of the highlights of their careers. Each participant in this collaboration has accumulated a lengthy string of memories. These memories will be shared over and over with our grandchildren and any one else who will listen.

This review of those memories supplements the Lindemuth/Reinovsky and Garanin chapters that appear in Doomed to Collaborate.[1,2] It is also in many ways a supplement to

[1] I. R. Lindemuth and R. E. Reinovsky," LANL/VNIIEF Collaboration in Pulsed-Power-Based High-Energy-Density Physics—An American Perspective," in *Doomed to Collaborate: How American and Russian scientists joined forces to avert some of the greatest post-Cold-War nuclear dangers*, edited by S. S. Hecker (Bathtub Row Press, Los Alamos NM, 2016), Vol. II, pp. 199-214

[2] S. F. Garanin, "LANL/VNIIEF Collaboration in Pulsed-Power-Based High-Energy-Density Physics—A Russian Perspective," *ibid*, Vol. II, pp. 215-234.

previously published articles.[3] Although this review stands alone, the author recommends that the reader first become familiar with these prior publications.

In the following, I share some of my favorite memories of my interactions with VNIIEF scientists and Sarov residents. Most of the memories are from time spent in Russia. I also have many memories of the times the LANL team hosted VNIIEF scientists in the US. Some of those experiences, as seen through the eyes of VNIIEF scientists, have been documented.[4] These memories are, for the most part, memories shared with my LANL and VNIIEF colleagues. They are memories that cover more than two-and-one-half decades.

Setting the stage for collaboration 1989-1992

July 1989

My first trip to Russia was for participation in Megagauss-V, the Fifth International Conference on Megagauss Magnetic Field Generation and Related Topics. As discussed in Reference 1, the series of Megagauss conferences provided a forum throughout the Cold War for US-Russian dialog on magnetic flux-compression technology and applications, and essentially all of the initial LANL/VNIIEF collaborative topics that would be delineated in a June 1992 meeting were topics that historically fell under the megagauss conference umbrella.

My adventures in trying to secure visas and prepaid vouchers required for the trip will not be described in detail here. Suffice it to say, after having spent hours on the phone in Moscow, having taken a trip to Sheremetevo airport unaccompanied and having spent hours in back rooms of the airport's freight terminal, I never did receive vouchers forwarded to me by a US travel agency—fortunately, the conference organizers were able to arrange for me continue my travel in spite of not having the vouchers normally needed.

On a post-conference tour in St. Petersburg, we overheard some teenagers speaking English. We were to learn that they were travelling with the Hugh O'Brien Youth Foundation. And, because O'Brien was travelling with them, I met face-to-face with a

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[3] I. Lindemuth, ""US-Russian Nuclear Cooperation and the CTBT," Nonproliferation Review 16:483 (November 2009); I. Lindemuth, "Removing a Roadblock to the US Russian Nuclear Reset," Nonproliferation Review 17:214 (July 2010).

[4] In addition to Reference 2, the following papers by VNIIEF authors describe both pulsed-power collaboration and personal stories of that collaboration: A. A. Petrukhin, "The VNIIEF and LANL Interaction in the Field of Thermonuclear Fusion Using MAGO Systems"; V. P. Korchagin, "Experimental Studies of Magnetized Thermonuclear Plasma. Our Experience in the International Collaboration"; B. E. Grinevich, "Liner Experiment"; and Mikhail Ivanovich Dolotenko, "High Interaction Energy, International Collaboration in the Field of Ultra-high Magnetic Field Investigations." (All articles will be available in this electronic archive, translated from: *International Scientific Cooperation of RFNC-VNIIEF: Perspectives, Views, Recollections.* Sarov: FGUP "RFNC-VNIIEF", 2010.)

boyhood hero of mine who had played Wyatt Earp in the television series of the same name.

Describing my observations in a trip report, I wrote,

> *Because this was my first visit to the Soviet Union, I experienced for the first time the Soviet society and culture. For clearly irrational reasons, I entered the Soviet Union expecting a very different world. Because of my mindset … I had a rather strange feeling as I adjusted to the fact that … the people of the Soviet Union are like people in the United States.*

Little did I know then that over the next two decades and more, I would learn even more just how much alike we are.

I also wrote "there were even suggestions of using Soviet DEMGs to drive US loads and that US scientists spend six months at a Soviet laboratory … the collaborative efforts should be actively pursued." Little did any of us realize what the future held in store.

September 1991

Because I had interacted with Russian scientists from the Kurchatov Insitute in Moscow, most notably L. Rudakov, at international conferences, I had been invited to present lectures at the 2nd International Youth School on Plasma Physics and Controlled Fusion, which was to be held in Sochi, September 13-19, 1991. The attempted coup just a few weeks earlier had put the trip in jeopardy and it was only a few days before departure that the school organizers had confirmed that the school would be held as scheduled.

I was then on a LANL sabbatical to the Nuclear Engineering Department of Texas A&M University in College Station TX. Unfortunately, in spite of my frequent phone calls, many unanswered and unreturned, to Washington during the weeks prior to the trip, the US Department of Energy had not granted permission to travel right up until it was time to depart for the airport in Houston TX, some two hours away. At essentially the last moment before I would have to cancel my flight, I made contact with a person who told me "your trip has been approved … the last signature was obtained yesterday but I didn't enter the approval into the computer until this morning because I had to go to a class."

It was an eerie feeling as our small twin-engine YAK40 jet to Sochi took off from Moscow, climbing into cloud cover so heavy that all we could see as the "CCCP" on the wing tip. Recognizing that there was still a possibility of some unrest in Russia, my wife, Hedy, and I didn't really know if anyone would know where to find us if turmoil erupted.

Figure 1. Looking out window as plane takes off from Moscow en route to Sochi (September 1991)

At the school it was obvious that most of the Russian participants were using the school as an opportunity to recover from the traumatic events in their country just a few weeks earlier. Several of the participants had taken to the streets in Moscow to protest.

When I had received the invitation to the School, I had attempted to make contact with V. K. Chernyshev, hoping to set up a visit to Sarov (or Arzamas-16 as we knew it then) as a follow-up to the discussions that had taken place in June at the IEEE Pulsed Power Conference in San Diego and in Los Alamos. Through sporadic communications before my US departure and during the School itself, a visit to VNIIEF appeared to be a distinct possibility even though, to my knowledge, the only previous western visitors to VNIIEF was the Joint Verification Experiment (JVE) team in 1989. Chernyshev had phoned me, and subsequently the School chairman, in Sochi inquiring about the return schedule to Moscow. As I wrote in my trip report,

> *I was to find out … later that the return (to Moscow) schedule, coupled with our scheduled departure from Moscow the following day, made the security people at VNIIEF 'very happy,' for in their minds the schedule made it impossible for me to visit (VNIIEF).*

Because I could not visit VNIIEF, Chernyshev, Vladislav Mokhov and several of his colleagues travelled to Moscow to meet me at my hotel near the Kurchatov Institute upon my return to Moscow. Although we had studied papers authored by Mokhov, this was apparently the first time that an American had met him.

To my surprise, the VNIIEF delegation delivered a formal written proposal for collaborative work with LANL. Details of this proposal and its impact are discussed in Ref. 1. In my trip report, I wrote

> *Changes are occurring rapidly in the Soviet Union. If the US cannot keep up with these changes and respond rapidly, then the Soviets are likely to enter into agreements which are not consistent with US interests, e.g.,*

collaboration with China on a technology which we believe has important military applications … That proposal … represents a potentially historic interaction between the two laboratories. Because of the people who made the proposal, because the proposal has the support of the Soviet government … that proposal should be given very careful consideration by the Laboratory and the US Government.

Figure 2. Chernyshev-Mokhov team presents proposal for formal collaboration with LANL. Left-to-right: A. Petrukhin, S. Garanin, N. Bidylo, V. Mokhov, E. Panekina, V. Chernyshev, Elisabeth (Hedy) Lindemuth, the author (Moscow, September 1991)

Little did we know then that the Soviet Union would dissolve abruptly in just a few months.

January 1992

The first trip to Sarov for Bob Reinovsky and myself in January 1992, was filled first with some apprehension because of the unsettled political situation in Russia. But the apprehension was overwhelmed by the excitement of learning more about VNIIEF's fusion and flux compression efforts and with the recognition that we were playing a role in bringing the two institutes, and by implication the two nations, together.

As indicated in Ref. 1, prior to travelling to Sarov, we had attended the Zababakhin Scientific Talks that were sponsored by VNIIEF's sister laboratory, the All-Russian Scientific Research Laboratory of Technical Physics (VNIITF). When our plane from the United States arrived at Moscow's Sheremetevo II airport on January 12, we were greeted by VNIITF's Boris Vodolaga, who would accompany us to Kistym, the location of the Zababakhin Talks. We were not on the ground very long before Vodolaga inquired about the relationship between LANL and LLNL. He said that he had been told that the relationship was "like this" as he pounded his clenched fists together. We smiled, then asked him about the relationship between VNIIEF and VNIITF. After a period of deep thought, Vodolaga repeated his clenched fists gesture.

Figure 3. VNIITF's Boris Vodolaga (center) explains the relationship between LLNL and LANL (and VNIIEF and VNIITF) to Alan Spero (LLNL; left) and me (Moscow, January 1992).

Figure 4. The author (left) and Bob Reinovsky (right) meet with VNIITF's A. Avrorin and V. Nechay on behalf of LANL Director Sig Hecker to invite them to meet with US laboratory directors in the US (Kyshtym, January 1992).

At VNIIEF, I presented a formal seminar entitled "The Parameter Space of Magnetized Target Fusion" and Bob presented one entitled "Research Activities of the Shock Wave Physics Group at Los Alamos" to a large and curious audience in an auditorium in Chernyshev's building behind VNIIEF's security fences. When I had completed his seminar, Anatoli Demin asked "what has changed since your 1983 paper," to which I had to answer that nothing much had changed; unfortunately, in spite of the exciting results of

the 1983 paper, the U.S. chose to invest very little in any fusion approach except the mainline, well established conventional inertial and magnetic fusion approaches.[5]

One afternoon, we were taken to Sarov's school #2, the "English-speaking" school, where we were introduced to Vladimir Chernyshev's grandsons and Lena Gerdova's (VNIIEF interpreter) daughters and where we had an opportunity to interact with a number of students. It is difficult to describe the emotions we felt as we met intelligent, healthy, and polite students and very dedicated (and strict) teachers in this country that we thought considered us to be enemies. We were told "even in these troubled times, the children are our privileged class." As we asked ourselves why would they introduce us to their children, the only answer we could come up with was that we were being given a message that we all shared similar family values and a similar hope that our children could grow up in a safe and peaceful world.

This school visit set the stage for many future visits to Sarov schools by the LANL team who considered the visits to be among the most enjoyable social activities of the trips. Reciprocal visits to Los Alamos schools would occur when VNIIEF personnel visited Los Alamos, and these visits led to "pen pal" exchanges, with several hundred students from each city participating. It became commonplace for LANL scientists traveling to VNIIEF to carry numerous letters from the students of Los Alamos schools, and vice versa. The letter exchanges lead to Los Alamos and Sarov becoming Sister Cities.

At a closing banquet, the two of us, who were essentially tea-totallers (i.e., non-drinkers), found ourselves outnumbered about 10:1 by a cheerful group of vodka-drinking Russians who introduced us to the wonderful Russian tradition of offering toasts and who taught us our first Russian word. Noticing that we hardly sipped our vodka during toasts, our hosts good-naturedly spoke the word "chuit-chuit," which evidently meant "a little bit."

As we rode the train back to Moscow, accompanied by Chernyshev, Bidylo, and Gerdova, we were introduced to the Russian tradition of writing sentiments on the back of photographs. These captured the hopes that the visit had brought to all of us, and also showed that the shadow of Andre Sakharov was looming over us. Chernyshev wrote, "Let us try together to solve the problem [fusion] to which Andre Sakharov gave so much forces and his soul." On a picture of us in front of Sakharov's house, Bidylo wrote "Let this house which stays on Sarova land and the person who lived and worked in this house remind us that we choose the correct way or our activity." I wrote, in part, "to predict where our mutual interests will lead us, of course, is impossible. Wherever it leads, we will share the satisfaction that we tried."

[5] See Ref. 1 for a discussion of the 1983 paper and the Unexpected Legacy of the collaboration.

Figure 5. The author (left) and Bob Reinovsky stand in front of the house once occupied by Nobel Peace Laureate Andre D. Sakharov, who died just a few months after the Megagauss-V conference. We have always wondered what Sakharov would think of the LANL/VNIIEF collaboration (Sarov, January 1992).

When I returned home to College Station, Texas, where I was then a visiting professor of nuclear engineering at Texas A&M University on a year's sabbatical leave from LANL, I discovered a small plaster figurine in my suitcase. Totally baffled at the figurine's origin, I called Bob, who explained that figurines had been given to us at a Sarov art school. I had no memory whatsoever of the art school and had totally blanked out the visit, evidently due to a combination of jet-lag and the very emotional impact of the visit to school #2 that had preceded the visit to the art school.

After seeing poor quality presentation equipment and materials at the Zababahkin Talks, one of our recommendations upon our return was for the U.S. to send a "boxcar full of paper" and other equipment and materials to Russian scientists. Within a few years, we were able to provide our collaborators with computers and printers that had more capability than they had available at the time.

Forming Collaboration 1992-1993

June 1992

Bob Reinovsky, Steve Younger (who had been appointed administrative point-of-contact for our interactions with VNIIEF after the September 1991 proposal was received), 74-year-old Max Fowler (the U.S. pioneer in magnetic flux compression) and I returned to Sarov in June 1992. We left Moscow by train on a beautiful summer evening. At approximately 11 PM, the train pulled into a station along the route. Our Russian hosts informed us that the train would be stopped for some period of time, so that we could go out on the platform and enjoy the mild temperature of the wonderful evening. We were traveling on a "sleeper" car, so that each of us had our own bed in a two-bed compartment shared with one other traveler. Because of the strenuous trip and the hour, all of us were preparing to go to bed, and Max had already put on his

pajamas. Nevertheless, we were able to talk Max into going out onto the train platform. To the surprise of all of us, including our Russian hosts, the train started moving while we were still on the platform. Getting our panicked selves and Max onto the slowly moving train was no small fete, but we did it. We have joked may times since then asking ourselves, if we had caught the train but Max didn't, how would we have explained to our masters at LANL and at DOE that the last time we saw Max was on a train platform in the middle of Russia and he was dressed in pajamas!!!

As Program Director for Above Ground Experiments (AGEX), Younger put out a monthly newsletter that was distributed to a hundred or more people within and outside LANL. However, as something that indicates the camaraderie of our team, a special version of the newsletter was prepared, one with a picture of the delegation on the train platform, with Max standing next to Lena Gerdova. The picture caption identified Max as "…Max Fowler (pajamas, with Russian woman)." Only four copies were made: one for each of the travelers. We didn't tell Max for about a week that this version was a fake. We suspect that he was somewhat concerned that such a picture, with such a suggestive caption, had been distributed outside the Lab, but he really wouldn't let on.

The U.S. delegation en route to the All Russian Institute of Experimental Physics. The Los Alamos team included Bob Reinovsky, Steve Younger, Max Fowler (pajamas, with Russian woman), and Irv Lindmuth (not shown).

Figure 6. Cover photo of special 4-copy issue of the July 1992 Los Alamos ICF AGEX II News.

During the visit, the LANL team witnessed an MC-1 high magnetic field experiment at Pavlovskii's firing point. Pavlovskii asked Fowler to push the button that set off the experiment, and Fowler was presented a bottle of vodka as payment for his services to VNIIEF.

March 1993

Five members of the LANL team visited VNIIEF in March (Carl Ekdahl, Dennis Erickson, Jim Goforth, Younger, and myself) to further define LANL's role in the first joint experiment, then scheduled for August. In January 1992, we had started carrying

with us unclassified Joint Operations Graphic maps of Sarov and the surrounding area, maps that had been prepared and published by the U.S. Defense Mapping Agency Aerospace Center. These maps helped us get our bearing, particularly on excursions outside the city. We are sure these made VNIIEF security personnel somewhat uncomfortable, particularly because we were immediately surrounded by Russians whenever we pulled the maps from our briefcases; evidently, many had never seen such a detailed map of their area.

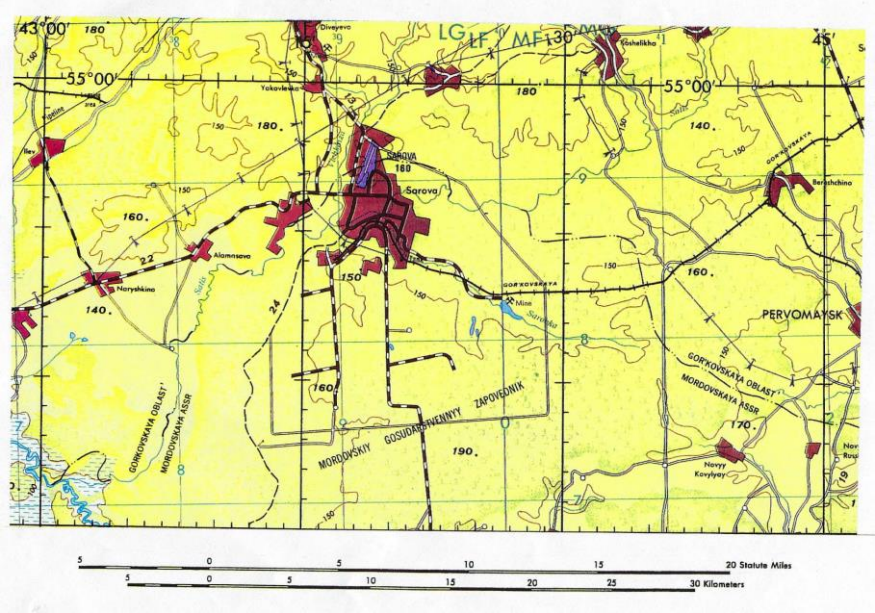

Figure 7. A Joint Operations Graphics map showing Sarov and vicinity.

For an encore, on the March trip we carried with us unclassified Landsat images of the entire Sarov townsite. Before presenting them as a banquet gift to VNIIEF deputy director Tumanov, we asked those in attendance to try to remember what they were doing on May 2, 1984, the date of the photos. Faces puzzled at why we would ask such a question quickly turned to smiles and laughter as the photos were revealed.

These photos evidently made a lasting impression. As a result of these photos, a large relief map, perhaps 8 feet square, of Sarov was declassified and displayed in the VNIIEF museum, where it was viewed frequently by LANL delegations (although we were not allowed to photograph it). In addition, the documentary "From Confrontation to Collaboration" that VNIIEF presented to LANL later in the year in commemoration of LANL's 50th anniversary noted that "the changes in the world have made it possible for Americans to not only see our city from a satellite but also to visit it," an apparent reference to these photos. To this date, I occasionally pull out the maps to reflect upon my many wonderful experiences in Russia.

June 1993

I travelled to Russia primarily to participate in the Third International Youth School on Plasma Physics and Controlled Fusion, but the trip also provided an opportunity for technical and administrative discussions with VNIIEF personnel who travelled to

Moscow. I also spent some time working on travel arrangements for VNIIEF scientists who were to to travel to LANL in the near future.

The Third Youth School was held on a ship that spent several nights in St. Petersburg, then cruised the Neva and Svir rivers and visited the ancient settlements on Kiji and Vallam. The School provided a unique opportunity to take my wife, Hedy, and youngest daughter, Lori, to Moscow and Russia. Hedy had previously accompanied me in September 1991 to the Second Youth School in Sochi.

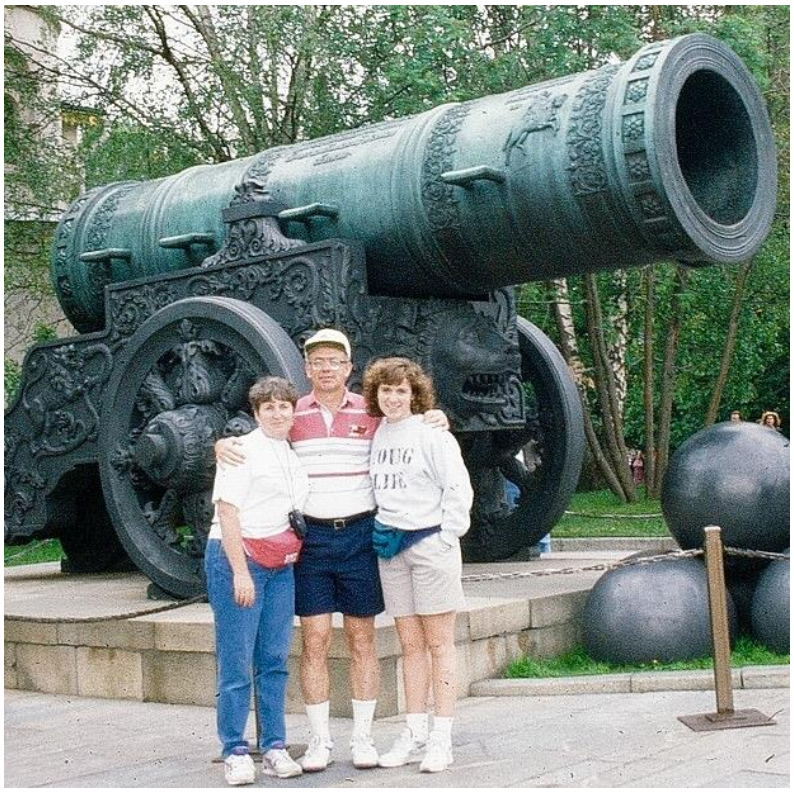

Figure 8. The author with his wife, Hedy (left), and youngest daughter, Lori, in front of the "Czar cannon" in the Kremlin (Moscow, June 1993).

Because of her earlier commitments, we had to send Lori home before the ship departed from St. Petersburg. The subsequent cruise was quite enjoyable. However, at about 3 AM one morning, the ship ran aground in the middle of Lake Ladoga. Rumor had it that the captain of the ship was drunk and had strayed outside the dredged channel. Approximately three hours of manipulating the ships thrusters and propellers were required to free the ship, which sustained no noticeable damage and proceeded on its course, once freed.

August 1993

After a number of schedule delays, a LANL team (Goforth, Reinovsky, Rodriguez, Younger, and myself) made a second trip in preparation for the first joint experiment. We had our first encounter with the wonderful hospitality of Vladislav Mokhov and his wife at Mokhov's home (originally built for Khariton), where we learned that "you are

not required to drink [alcohol], but your glass must always be full." When the attacks from the famous Russian mosquitos became too frequent, the visitors moved inside while Mokhov and I broke through thick mosquito-infested bushes to pass a table from outside through a rather high bedroom window, a surely comical sight.

Mokhov's homemade cherry wine made a lasting impression on us. One of our team members, who will remain unnamed, insists to this day that the stabilization he received from his teammates was not necessary and he really could have walked unassisted from Mokhov's home back to our hotel.

Figure 9. Picnics at the home of V. Mokhov, a house intially built for Yu. B. Khariton, were always a high point of the LANL team's visits to Sarov. Mokhov always said "you do not have to drink [alcohol] at my house, but your glass must be full" (Sarov, August 1993)

Figure 10. Mokhov presented us a with a souvenir bottle of vodka with a handwritten note, "from the house of Yu. B. Khariton." The bottle will always remain with my liquor collection, but I don't think I will ever drink it (Sarov, August 1993).

The Chernyshev team always seemed anxious to compensate the LANL team for the several schedule delays. On this trip, Chernyshev offered Goforth, our flux compression generator expert, an unprecedented look at the "guts" of the experimental apparatus as it sat on the assembly bench. When it became apparent that Goforth was too short for such a view, a muscular VNIIEF technician grabbed Goforth by the waste and lifted Goforth above his shoulders so that Goforth could look down inside the vertical cylinder.

I returned to Russia through Philadelphia. My Dad had suffered a major stroke and passed away while I was overseas. During my time in Philadelphia, driven by my curiosity to learn more about Sarov, my mother and I visited St. Andrews Russian Orthodox Cathedral. Surprised to find such a church in Philadelphia, I learned that it had been started by Russian naval officers who were in Philadelphia to watch Russia's most famous battleship, the Variag, being built at Phildelphia's ship yards (at a later visit to Sarov, I was to hear the children of school #2 sing a ballad about the Variag).

Figure 11. A photo of the Russian battleship Variag stands in the social room of St. Andrews cathedral in Philadelphia, PA.

When I asked the priest at St. Andrews about Sarov, he described it as 'the most beautiful of all monasteries in Russia, but we lost contact with it after the Revolution.' He further stated that St. Seraphim was 'perhaps the second most important saint of the Russian Orthodox church, having restored the monastic life to the church,' and he showed me several icons of St. Seraphim. He, of course, was curious as to why I was asking these questions, so I described what I knew about the town and showed him a Sarov newspaper that I had obtained on my most recent visit to Sarov. To say that he was amazed is an understatement. A year or two later, I returned to St. Andrews and presented to the congregation a slide show on what I knew was going on in Sarov.

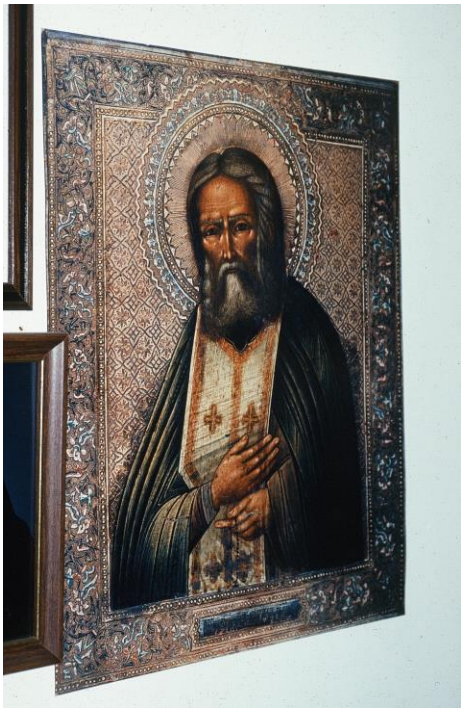

Figure 12. An icon of St. Seraphim of Sarov hangs in the office of the priest at St. Andrews cathdral in Philadelphia, PA (August 1993).

Frequent experimental campaigns and reciprocal visits 1993-1997

September 1993

The two-and-one-half week stay of the LANL team (Ekdahl, Goforth, J. King, Reinovsky, Rodriguez, Veeser, Younger, and myself) in Sarov for preparation, execution, and data analysis of the first experiment in September 1993 was the longest period a group of Americans had ever spent in Sarov. The period provided a number of opportunities to interact with VNIIEF leadership and Sarov residents as well as the VNIIEF experimental team.

It was an indescribable feeling for the team to be inside the security fences of a town that "didn't exist on any maps" only a few years earlier and to be working at an experimental test site that had been used to help develop nuclear weapons that had been aimed at the United States. The presence of the LANL team surely must have been amazing to the Russians as well, because in April of 1992 President Yeltsin had decreed that all security regulations of the old Soviet system were still in place until further notice; technically, the visits by LANL personnel to VNIIEF were illegal.

A CNN camera and news team arrived in Sarov on Tuesday, September 21, the day before the first experiment, fully prepared to cover the historic event. Unfortunately, Boris Yeltsin decided to lock out Parliament that evening. Furthermore, it appeared that CNN's only other Moscow camera team had been aboard an airplane carrying numerous journalists that had been reported as shot down that day over Georgia. Consequently, the CNN team in Sarov had to forego covering the actual experiment (although they did

cover some preparatory work) and instead turned around and returned to Moscow on Wednesday, to cover the political events in that city. It is ironic that while CNN was permitted to enter VNIIEF to cover the experiment, the US Department of Energy declined permission for them to film the December 1993, collaborative experiments in Los Alamos (CNN was subsequently permitted to film the MAGO-II experiments at Los Alamos in October 1994).

We learned quickly that September in Sarov is not as temperate as September in Los Alamos. When four members, including myself, arrived as an advance team, outside high temperatures were only 45 degrees Fahrenheit and, unfortunately, the Sarov central heating plant had not yet been started for the winter, so hotel room temperatures dropped to as low as 55 degrees. At this point early in Sarov's transition from a secret town, communications with the outside world were difficult. Nevertheless, with the help of our hosts, we were able to send messages back to Los Alamos asking the remaining team members to bring with them a long list of our warmer clothes that arrived none too early.

As had happened on previous trips, and would happen on all subsequent trips, our VNIIEF hosts went out of their way to make sure that our non-working hours in Sarov were far from boring (in fact, some future trips were so intense that at times we longed for some boredom). Weekend excursions took us to monasteries, markets, and museums outside the city.

During two visits to school #2, we were inundated by student questions about life in America. Showing that they understood the gravity of the global situation well, one group of students sang a song entitled "Let the peace last forever," with lyrics that began with "It is easy to blow up our planet. All it takes is a button to be pressed …" and concluded with "Are we here, in this world, being born into it only to destroy it, So that our children would never know how beautiful it is? ... But there is still some time left to save our world." One visit provided an opportunity to show slides of Los Alamos to a large number of students gathered in the school auditorium.

Figure 13. Autograph-seeking students from Sarov school #2 surround Bob Reinovsky (September 1993).

The second school visit was followed by a visit of the entire LANL team to the children's wing of the Sarov hospital. Whereas the visits to school #2 had been tremendously uplifting, the visit to the hospital was very sobering. Most of the 40 beds in the children's wing (for children less than four years of age) were empty because so little medicine was available that many sick children were being sent home untreated. The team was shown a premature baby (approximately 3 lbs. at birth) with none of the life support equipment that would be common in the US. The medicine cabinets contained less medicine than found in the homes, or perhaps even the suitcases, of the LANL team members.

Figure 14. The LANL team visits the Sarov medical center (September 1993)

Dr. Valentina Ponomoreva, a pediatrician, told us that medical supplies were available in Russia, but only at a price that was beyond the financial means of the hospital. We informed her that the Los Alamos community had been exploring means of providing medical assistance to Sarov, and the discussion made us realize that the most efficient and most expedient way to provide help was through direct cash contributions.

A VNIIEF leader expressed that the amount of contributions would not be as important as the expression of concern by the Los Alamos community, a conjecture supported by Ponomoreva's letter expressing thanks for a substantial personal contribution made by the LANL team:

> *Please receive our sincere gratitude for the interest regarding not only scientific work, but towards us, the citizens of Sarov and our children. Your meetings with children, the visit to our children's hospital, is the sign of your humanism and heartiness. Nowadays we are living the times of the crisis in the state power and national economy, that is the reason of children's suffering. The food quality decrease, the lack of the necessary medicine do not allow us to execute our duties in protecting them from suffering. That is why we shall gratefully accept the help to the children in case it comes from kind and pure hearts of the Los Alamos citizens.*

The "Sarov Children's Medical Fund" was started by Dr. John Eilert, Mrs. Carrie Zocco, and myself shortly after my return to Los Alamos. For many subsequent trips, the LANL

team would load as many medical supplies as possible into any spare space in their suitcases and deliver them to Sarov. Occasionally, cash from the medical fund was also carried.

Vladimir Rogatchev and Vladimir Pavloskii (Alexander's son) led the LANL team on a walking tour of much of the Sarov residential area. This tour lasted approximately two hours and was said to be the first time outsiders were permitted to take such a walk and the first time that cameras of foreigners were permitted. It was obvious as the team walked through the town site that brightly dressed, picture-taking groups of tourists were not a common sight.

Although the Rogatchev home was not in the official security plan, it was decided during our walk that we would "notice" that we were nearby, and stop in for a social call. "Coincidentally," dinner had been set for twenty people when we arrived. A second such coincidence happened on an early evening later in the visit when the bus we were on, ostensibly for another tour around town, stopped at Mokhov's home, although such a visit had not been on the formal agenda. As it turned out, Mokhov's wife had prepared a complete supper, which the LANL team felt obliged to eat even though we had previously eaten a full meal at the House of Scientists.

VNIIEF's pride in hosting LANL scientists has always been evidenced by our visits to cities outside of Sarov. We were taken to the city of Saransk where the mayor hosted us at a rather lavish dinner which included roasted suckling pig, three salads, caviar, tomatoes, sausage, cabbage rolls, Smirnoff vodka, Pepsi Cola, and Spumante champagne.

Figure 15. A waitress in Saransk brings a suckling pig to the table for the LANL team (September 1993).

April 1994

A 10-member LANL team (R. Chrien, Ekdahl, C. Findley, Goforth, R. Kirkpatrick, H. Oona, Reinovsky, Rodriguez, J. Shlachter, Younger, and myself) spent two-and-one-half weeks in Sarov in April, 1994, for another joint experiment, this time giving the U.S. its first look at VNIIEF's MAGO magnetized plasma formation system. This experiment

again combined LANL's diagnostics and computations with a truly unique VNIIEF capability.

Sarov's Saturday schools sessions gave us more opportunities to meet with students. We toured school #2's computer classroom and were told, proudly, that an e-mail link was expected to be installed by September so that students could communicate with students throughout the world, particularly in Los Alamos. We were shown the area in a school hallway where a "museum" commemorating the school's interactions with Los Alamos would be located. The LANL team countered a student song and dance concert with "The Los Alamos Family Singers," accompanied by Goforth and Oona on the harmonica, introducing ourselves with "you (the students) have shown us what can be done with much talent and much practice, so now we'll show you what can be done with absolutely no talent and no practice."

At school #2, Vladimir V. Chernyshev, grandson of V. K. Chernyshev, told us about a newly formed school association known as "Rainbow" which was formed to "reflect the many-sided activities between our towns and our countries." The rainbow was chosen as the organization's emblem because the rainbow is fresh, appears after the rain ("no contacts between our towns before"), and, even though the rainbow disappears, the memory of it remains. The association had more than 100 members and intended to invite students from Los Alamos, and other communities, to participate.

And we made our first visit to school #15, a visit that grew out of the "pen-pals" correspondence with the Los Alamos Middle School. Students from school #15 also treated us to some songs, including an English-rendition of "We shall overcome." We were shown a glass-enclosed wall display about the U.S. that included a variety of items signifying the LANL/VNIIEF collaboration and the interactions between the students. A teacher called the display a "window to the US" which had significance not unlike the "window to Europe" opened by Peter the Great. A visit to a Physical Education class resulted in an *impromptu* basketball game between the school's freshman basketball team and an unlikely team consisting of four heavily-shod, tie-clad LANL scientists and our VNIIEF security escort.

At both schools, Bob Reinovsky presented copies of a "Friendship Book" that had been prepared by Los Alamos students in conjunction with a LANL Bradbury Science Museum exhibit entitled "Russian/American Collaboration--the Transition to Peacetime Research," which had opened in December 1993, and which highlighted the LANL/VNIIEF collaboration. The original copy of the book had been presented to VNIIEF Director Belugin by the Museum staff during Belugin's visit to Los Alamos in January 1994. The book contained approximately 200 pieces of student artwork, all on the theme of peace and increasingly friendly relations between the two cities, and two nations. In his presentation, Reinovsky emphasized that the hopes of students in both countries are the same, and selected several pieces from the book to illustrate this point; one stated that "a man can be too proud to fight."

We had our first meeting with the Sarov English-Speaking Club, where the members welcomed the opportunity to practice their language skills with native speakers and

where we formed some lasting friendships. It became commonplace for us to specifically request that the English-Speaking Club be put on our social agenda.

Dr. Ponomoreva informed us that four premature babies had died in the six-month period since our last visit. She was very anxious to report her usage of moneys previously provided through the Arzamas-16 Children's Medical Fund. Extremely appreciative, she explained that "the Arzamas-16 doctors and nurses thought that Los Alamos was so far away, but now it seems very close."

Once again, it seemed like our VNIIEF hosts wanted to share us with the surrounding communities. Sirens screamed and lights flashed as our bus's police escort drove in the center, or to the left, of the highway, often forcing oncoming traffic to the shoulder of the road, as we entered the city of Arzamas, some 40 miles from Sarov; the police car even challenged a railroad train at a grade crossing (we had received a similar escort in June, 1992, when a bus took us from Sarov to a picnic at Dubki resort, perhaps 20 miles east of Sarov). Tours of the city and museums were followed by a luncheon hosted by the city's vice-mayor.

The return to Sarov included a stop at the Diveevo convent, where we were astonished at the progress that had been made since our first visit in August 1993 at restoration of the original cathedral and at construction of a new cathedral. To us Americans who have always lived in an environment of religious freedom, the restoration of cathedrals at Diveevo and elsewhere stands as an important symbol of the positive changes in Russia.

Because of a fortuitous delay in the April 1994 experimental schedule, we were able to assist a Sarov delegation of eight high school students and two high school teachers in their travels to Los Alamos to participate in a LANL-sponsored New Mexico High School Critical Issues Forum on Nuclear Dismantlement. Approval for the trip from high levels in the Ministry of Atomic Energy was required since Sarov students and teachers had never previously been permitted to leave the Soviet Union. Particularly because of the Russian perspective brought to the Forum by the Sarov teams, the Forum was an overwhelming success. This unprecedented visit to the US by residents of Sarov was another strong indication of the growing trust and respect that had been carefully established through the LANL/VNIIEF collaboration and was an important step in integrating Sarov into the global community.

Figure 16. Sarov students board an airplane en route to the US to participate in the New Mexico High School Critical Issues Forum on Nuclear Dismantlement (April 1994).

February 1995

In February 1995, the LANL team (B. Anderson, Ekdahl, J. Kammerdiener, Reinovsky, Rodriguez, Veeser, Younger, W. Zerwekh, and myself) travelled to Russia for the fourth experiment at VNIIEF in seventeen months, this time for a period of more than three weeks to conduct an experiment in which a VNIIEF DEMG was used to power a novel VNIIEF-designed x-ray production concept.

On three different occasions on travels throughout Moscow, Pat Rodriguez, who has a dark complexion, was stopped by Russian soldiers (not policemen) and his passport was inspected. Evidently the soldiers were part of increased security throughout Moscow because of the Chechnya situation, and Rodriguez was suspected of being a Chechnen terrorist. Fortunately, the passport appeared legitimate and Rodriguez was not detained.

Upon arrival and check-in at Moscow's Bykovo airport prior to the flight to Sarov, the team became rather concerned as they were taken to and boarded an airplane that was covered with more than six to eight inches of ice and snow. However, after the team sat in the cold, covered plane for 15-30 minutes, a truck with a jet engine mounted to it approached the plane, aimed the jet engine exhaust directly at the plane, and proceeded to de-ice the plane. The plane shook roughly as the jet engine exhaust passed over the wings and fuselage. A surprising, but effective, safety measure!!!

Los Alamos County had seen an unprecedented opportunity to participate in the growing peaceful relations between the two nations by providing assistance and friendship to Sarov as it underwent the transition from a "closed" city to an "open" one, the same transition that Los Alamos underwent some forty years previously. Our frequent visits to Sarov gave us an opportunity to act as “messengers” between the cities of Los Alamos and Sarov. A meeting with the Sarov city administration showed us just how enthusiastic Sarov was about the growing relationship. We were told that Sarov had joined the Russian Sister Cities organization, had become a member of the International Association of Sister Cities, and had formed a local sister cites organization. Furthermore, we were

told that exchange visits, including visits to Sarov, were now a real possibility and we were given a formal invitation for a Los Alamos delegation to travel to Sarov for the upcoming May 9 50th anniversary celebration of the end of "the Great Patriotic War."[6]

As a gift to the Los Alamos County Council, the Sarov city administration presented us with a brass bell that weighed about 25 lb. and stood about 10 inches high and contained engravings depicting Saint Seraphim (the most famous of the early residents of the ancient Sarov monastery, which is now surrounded by the city) and the Mother of Kazan (the patroness of the Russian army). After the meeting, Bob Reinovsky dutifully carried the cumbersome bell about 0.75 miles back to our hotel and we struggled to pack the bell in our luggage.

Figure 17. The bell given as a gift from the Sarov city administration to the Los Alamos County Council (February 1995).

And as previously indicated, the frequent visits provided us with continued opportunities to interact with the Sarov medical community. The Arzamas-16 Children's Medical Fund had recently leveraged $10,000 in donations from the Los Alamos chapter of the American Chemical Society into a shipment of medical supplies having a US wholesale value of approximately $500,000. A special Sarov medical team had been formed to distribute the supplies. Some supplies had been taken to the "delivery house" (maternity ward) and the "reanimation department" (intensive care ward). The medical shipment had been the subject of a special broadcast program and newspaper article. We were told

[6] As a result of this invitation, a delegation of seven Los Alamos citizens became the first US civic delegation to visit Sarov when they were in the city from May 3 until May 10, 1995. Included in the delegation were the chairman of the Los Alamos County Council, a middle school teacher, a librarian, a representative of the Los Alamos Chamber of Commerce, two housewives with extensive involvement in community activities, and an assistant editor from the Los Alamos Monitor newspaper. The Monitor representative was apparently the first US media representative permitted into the city by the Russian government. An Arzamas-16 Courier newspaper article describing this unprecedented visit ended with the statement "if all Americans are like these people, then you and I will not perish on this fragile planet."

"all hospital workers know the source" and "many people were happy to volunteer to help with translations of the documents." Evidently, the shipment took only a week to cross the ocean but nearly two months to process the documents. Ironically, Sudafed (a common US allergy medicine) included in the shipment had not yet been approved for use in Russia.

We truly felt welcomed by the community on this trip. Tours inside and outside the city, school visits, and several concerts were arranged by our hosts. Opportunities were provided for cross-country skiing and Brodie Anderson even made a few runs on Sarov's "downhole" (as opposed to downhill) skiing area in an abandoned quarry. Security restrictions had been relaxed enough that Bob Reinovsky and I were able to visit the home of a teacher from school #15, where we were treated to delicious Russian cuisine. The four school #15 students who had traveled to New Mexico with us in April, 1994 joined the group for reminiscences about the trip to Los Alamos. Exceptionally musically talented, the four students who had won the hearts of Los Alamos during their visit entertained the group with a series of Russian and English songs.

Figure 18. A poster commemorating the growing Sister Cities relationship and the April 1994 visit by Sarov students to Los Alamos hangs in Sarov school #2 (February 1995).

We continued to witness the remarkable resurgence of the Russian Orthodox Church. At Sanarksarsky Monastery we met with one of the 70 monks who resided at the monastery reopened only several years earlier and who told us how the monks from this monastery were taken to Sarov in 1923 and executed along with monks from the Sarovsky Monastery.

One of the most memorable scenes of the trip occurred on a visit to the shrine of St. Seraphim outside Sarov, but still within the security fences. In the quiet and beauty of the Russian winter, small prayer candles were found burning in the deep snow at the base of a small cross and through the forest we heard the beautiful sound of several women singing chants a cappela in front of another cross, perhaps the most spiritually moving event of all my time in Russia.

Figure 19. Candles glisten in the snow as Sarov women sing chants a cappella at a cross nearby (St. Seraphim shrine, February 1995).

September 1995

Another joint experiment to obtain data on the MAGO plasma formation scheme was conducted at VNIIEF. The 11 technical members of the LANL team (Anderson, Ekdahl, Goforth, G. Idzorek, H. Oona, T. Petersen, Reinovsky, P. Sheehey, Shlachter, Younger, and myself) were accompanied for the first time by a LANL interpreter (S. Shachowskoj) and spent essentially three weeks in Russia. This experiment involved the most LANL participation to date, with approximately 4,000 lbs. of LANL equipment being used to record many dozens of data channels.

For the first time, VNIIEF scientists were permitted to escort us for many of the technical activities without the need for a member of the security forces. Evidently, VNIIEF scientists who had visited LANL had reported to their security officials that LANL scientists, and not LANL security personnel, had acted as their escorts. However, they apparently did not report that LANL regulations set a limit of three foreign scientists per escort, so the VNIIEF scientists escorted larger groups. LANL's influence was also noticed in the "list of prohibited items" that we were all required to sign, a list remarkably like that used at LANL.

Once again, winter had arrived before the Sarov central heating plant had been put into operation after a summer interlude, and temperatures in our hotel rooms dropped to as low as 56 degrees Fahrenheit.

As an indication of the growing trust of the LANL participants, security restrictions on the team's movements about town for technical and social activities were far more permissive than on previous visits. In-home visits, English Club meetings, and even tennis had become almost commonplace. School visits had mixed emotions for us as students with whom we had become acquainted on our first visits had now graduated.

Several members of the team were taken through the catacombs under the city that dated back to 1697.

Figure 20. The LANL team meets with the Sarov English Club (September 1995).

A weekend excursion took us to the city of Nizhni Novgorod, some 120 miles north odf Sarov. Upon arrival in Nizhni Novgorod, I realized that I had left my passport in Sarov. Under the Soviet system, this would have been a major security breach. When the hotel would not issue a room to me, our VNIIEF host took me alone on the team's bus to several government offices throughout the city. Although I could not understand the Russian being spoken, it appeared that no office knew how to handle the situation and referred the host to yet another office. Finally, the contingent returned to the original hotel with no apparent resolution at hand. Nevertheless, I was then issued a room.

One of the more inspiring events of our trip to Nizhni Novgorod was a visit to the apartment where Andre Sakharov had spent his exile, once again reminding us how remarkable it was for the LANL and VNIIEF teams to be working together. As many times before, we wondered how Sakharov would have viewed our collaboration and, in a way, we felt cheated because he had not lived long enough to witness the remarkable relationship developing between his institution and Los Alamos. We were to learn some years later that the apartment, which had been turned into a museum, included a display about the joint experimental effort.

Figure 21. The author at the apartment where A. D. Sakharov was held in exile (Nizhni Novgorod, September 1995).

Two of the team members had roots in Russia, making the trip all the more meaningful for them. LANL interpreter Sergei Shachowskoj's father had fought in the White Army, and his stepfather had spent time in a Soviet jail. Sergei's family had come to the U.S. when Sergei was a young man. Sergei had returned to Russia more than sixty times prior to this trip, but this trip was special because a Shachhowskoj family estate was located along the road between Sarov and Diveevo.

Tom Petersen, making his first trip to Russia, had "Volga German" grandparents who had immigrated to the U.S. in 1910. Prior to departure from the U.S., I had contacted Sarov and VNIIEF officials to see if a trip to Saratov, Petersen's grandparents' home, could be arranged. From the beginning, Petersen had offered to pay all expenses as well as a fair daily wage, and there was some hint that some unsavory residents had vied for the opportunity to obtain American dollars. Nevertheless, the VNIIEF and Sarov administrations enthusiastically worked to make the trip possible, including the necessary arrangements with VNIIEF security. Victor Pavlenko, a retired school principle who had relatives in Saratov, and his daughter, Olga, an English teacher who also worked as a VNIIEF interpreter and who would several years later marry LANL scientist Ron Augustson, were selected to accompany Petersen. While the remainder of the team was spending a weekend in Nizhni Novgorod, Petersen and Anderson had what Petersen would describe as "the trip of a lifetime" to the land of his grandparents.

By this time, the LANL/VNIIEF collaboration was generally well known throughout Sarov. During this visit, four separate articles covering the joint experiment and interviewing LANL team members appeared in the Sarov courier newspaper.

August 1996

Again a large LANL contingent (Anderson, D. Clark, Ekdahl, R. Faehl, Goforth, Petersen, Reinovsky, L. Tabaka, and me) travelled to Sarov for nearly three weeks to conduct a joint experiment. The experiment provided our first opportunity to work with VNIIEF's pulsed power "flagship," the 1-m-diameter Disk Explosive Magnetic Generator (DEMG).

The experiment would be the largest electrical current, the highest electrical energy, and highest magnetically driven liner kinetic energy experiment ever involving U.S. scientists. Because approximately 770 lbs. of high explosive were detonated in the experiment, the bunker shook noticeably more than on previous experiments.

When we emerged from the bunker, several small fires were noticed in the grass and brush adjacent to the firing point, and a column of smoke was rising from the forest perhaps 200-300 m away from the explosion point. To our surprise, a loud heavy, powerful tracked vehicle carrying water and pumps came roaring out of the forest essentially unimpeded by the trees and undergrowth in its path as it trampled trees while it squelched the blazes initiated by the debris of the experiment.

Several team members carried with them numerous copies of a special issue of Los Alamos Science entitled "US/Russian Collaboration to Reduce the Nuclear Danger." The books were passed to VNIIEF administrators and scientists and to social acquaintances. The recipients seemed to take pride in their contributions to the collaboration.

Once again, our VNIIEF hosts planned an extensive social and cultural schedule for the team. These events reminded us that, in addition to conducting state-of-the-art research, we were filling a very important role as ambassadors for our nation and our laboratory. The warmth with which we were received in Sarov made us realize that we had not only won the trust and respect of the scientists but also the entire community.

Figure 22. At the VNIIEF museum, Tom Petersen examines the Friendship Book that had been sent in January 1994 to Sarov students by Los Alamos students (August 1996); Bob Reinovsky had presented copies of this book to schools #2 and #15 in April 1994.

Figure 23. A poster at the VNIIEF museum commemorates the joint LANL/VNIIEF experiments (August 1996).

The people of Sarov were making an impression on us, as well. The joy of meeting new friends at the English Club prompted Anderson in his spare time to write some beautiful poems that expressed many of the feelings that both the Russians and the Americans had. Impromptu concerts on the "garmmuk," an accordion-like instrument, by Sergei, our bus driver, brightened our days but also saddened them as Sergey told us about his father's memories of World War II.

The Sarov city administration asked us to carry a shipment of children's artwork to Los Alamos for an upcoming art exhibition, "Art from Sarov, our Sister City." Because we were given papers indicating that all work had been approved for export by all cognizant Russian authorities, and all packages had the appropriate stamps, the material passed through Russian customs with no problem. Lufthansa airlines in Moscow checked the delegation in as a group, so there was no extra luggage charge for the eight tightly wrapped packages.

However, in Frankfurt, when asked, I informed security personnel that I had not personally seen the packages packed and did not know with certainty what was contained in them. Therefore, I was escorted down to the tarmac under the huge Delta plane where all packages were opened in the presence of an inspector. To my surprise, the shipment contained not only children's art of limited value but also a number of clearly professional pieces of unknown, but apparently high, value, leaving me to ponder for the entire flight what would happen at U.S. customs. Fortunately, U.S. customs passed the shipment without imposing the substantial import duty that was probably warranted.

Prior to the start of the experimental campaign, a large LANL contingent including Ekdahl, Goforth, Reinovsky and myself had participated in the Seventh International Conference on Megagauss Magnetic Field Generation and Related Topics. As previously mentioned, the Megagauss conferences had set the stage for the LANL/VNIIEF collaboration. As an indication of the increasing openness in Russia, the first days of the conference were held entirely within the security fences of VNIIEF. Chernyshev, the Technical Program Committee chairman, said in his opening remarks that "we could only dream 3-4 years ago [at the last conference] that we would gather on Sarov soil." Chernyshev described the impact of Max Fowler's 1965 paper on megagauss magnetic fields as "like a bomb exploded" and emphasized that "it is not too strong to say that these conferences have contributed to world peace."

As part of the conference opening ceremonies, I was asked to accompany the family of Alexander Pavlovskii to place flowers on Pavlovskii's grave. The warm weather provided our first and only opportunity to swim in the Satis river; unfortunately, we weren't able to swim with V. N. Mokhov, whose home sat along the river and who always spoke about his enjoyment of being able to swim in the river.

Figure 24. The author (left) swims in the Satis river with Los Alamos colleague Dave Scudder (August 1996).

November 1996

Anderson, Petersen and I returned to Sarov only one-and-one-half month after our previous departure. Bartsch and Ladish completed the team that was in Sarov to bring into operation a set of LANL-owned diagnostic equipment being provided for VNIIEF use on a project sponsored by the International Science and technology Center (ISTC) and to test the equipment on the first of several ISTC-sponsored MAGO magnetized plasma experiments.

It was certainly beginning to seem like the presence of someone from Los Alamos created a certain excitement in Sarov. Nearly every day Sarov residents stopped by our hotel or stopped us on the streets to pass letters to us or to send greetings to their friends

in Los Alamos. Evidence of Los Alamos was seen throughout the city, including the hotel lobby (a copy of Los Alamos Science), the museum (the 200-page Friendship Book from Los Alamos students), and the city administration building (a life-size photo of a joint experiment). A number of Russian-language publications included pictures of Los Alamos scientists and residents. One quoted the Sarov mayor as saying

> *From my point of view, the key to this program is our young generation. For the sake of its future we are establishing these contacts, so that our young people learn to understand another nation. Last year, our children visited Los Alamos; this summer American children will come over. This is more important than economic or technical cooperation. This is our younger generation's future, the future of Russia.*

The now-common visit to the English club had a special surprise as a 13-year-old daughter of one of the members recited one of Brodie Anderson's poems in perfect English. A meeting with city officials reviewed the past and upcoming Sister Cities exchanges that now included physicians visits as well as students, teachers, and city administrators. Ladish remarked afterwards that in Sarov and Russia we were seeing a democracy being born, and that Los Alamos had an unprecedented opportunity to be part of this process.

Because LANL travelers to Sarov often found it necessary to carry large amounts of cash to Russia, I had begun to investigate the possibility of "wire transfers" of money between US banks and the bank in Sarov. Just prior to this trip, as an experiment, I transferred by wire $100 from my Los Alamos bank account to the Sarov bank (the Los Alamos bank charged a $35 fee for this service!!!). My US passport number was included in the transfer document for identification purposes.

Sure enough, my visit had been expected by the Sarov bank and a number of documents had been prepared for my signature. I was given a Sarov bank account number and passbook specifying, in dollars, the account balance and a statement that, at present, the bank was paying 3% annual interest. Evidently, the account was one of a growing number of "currency" accounts, as opposed to Ruble accounts where the balance is specified in Rubles. I withdrew $50 (a choice of Rubles or actual US bills was given). Because the money had been wire-deposited, rather than direct-deposited, a 2% fee ($1) was charged for the withdrawal, leaving a balance of $49 that may still remain today even though the account has been dormant for more than 20 years. A bank manager pointed out that in the near future (e.g., six months) wire-transfers would not be necessary because he expected to install a capability to accept Visa cards for cash withdrawals.

A broadening and yet declining collaboration 1997-1999

This three-year period saw the collaboration broadening with small efforts initiated in a number of new areas, and a number of LANL personnel visited VNIIEF for the first time. In addition, joint experiments at LANL on the Pegasus and Atlas capacitor banks were being planned and some trips to VNIIEF were aimed specifically at defining new

contracts and experiments at LANL. The collaboration became more involved in experiments and other projects conducted under the auspices of the ISTC.

Even as the collaboration was trying to grow, there were harbingers of bureaucratic impediments yet to come. VNIIEF reported increasing difficulty in getting permission for U.S. scientists to enter Sarov. The U.S. Department of Commerce changed its export license requirements for anything being shipped to VNIIEF, which had been put on the Commerce department "entities" list. There was even an attempt to require an export license as a prerequisite for technical discussions. These new regulations seriously complicated the process of getting U.S. government country clearance to travel to Russia and resulted in several near-cancellations of trips.

Shipments of LANL equipment to VNIIEF for experimental campaigns in October 1997 and August 1998 were held up in the licensing process, and I and others spent countless hours writing letters and memos to Commerce and Defense Department personnel, talking on the phone with them, and even travelling to Washington for briefings in an attempt to rescue the shipments. One official stated "you were caught in a backlash that has been building for two years."

In spite of the bureaucratic issues, for the LANL team, 1997-1999 was a good period to visit Sarov. VNIIEF security regulations were much less restrictive than in the past as VNIIEF security seemed to settle into a reasonable balance between security concerns and operational concerns, as well as an apparent recognition that social activities were an important part of the relationship. School visits, excursions outside the city, meetings with the English Club and meetings with the Sarov Duma to discuss the Los Alamos/Sarov Sister Cities program and medical exchanges had become the norm. The LANL visitors were hosted for dinners in the homes of scientists, teachers, friends and Duma members. Lydia Alexandrovna Ilkaeva frequently arranged tennis for the visitors, and VNIIEF Director Radii Ivanovich Ilkaev occasionally joined the competition.

As always, school visits were highlights of the trip. Although we were sure the students wouldn't agree, we were always glad that school was in session on Saturdays, while VNIIEF was closed, giving us an ideal time to visit. The visits always included talent displays (e.g., music, dancing, martial arts, etc.) and lots of questions from the students. We know of nowhere else where LANL scientists are surrounded by students wanting autographs.

During this period, the VNIIEF team also made a number of trips to Los Alamos.

October 1997

To our surprise as Bartsch, Ekdahl, Faehl, Reinovsky and I walked into the auditorium of school #15, there in front of our eyes on the stage interspersed with the younger students were two of the students whom we had accompanied to Los Alamos in April 1994 and whom had won the hearts of the Los Alamos community with their beautiful voices. We knew that they had long since graduated, but apparently they had been recruited for a special performance for the Los Alamos delegation. As this example illustrates, our

many visits to Sarov actually gave us a number of opportunities to watch the children of Sarov grow into young adults.

April 1998

Even though Anderson had not accompanied us on the October 1997 trip, once again one of his poems was recited by a young student at the English Club. When nine of us (Atchison, Roger Bartlett, Bartsch, John Benage, Faehl, Ladish, Reinovsky, Sheehey, and me) visited the English Club again in April, LANL team pictures and one of Anderson's poems were featured prominently on a poster that the Club had prepared describing its history. Since even Anderson himself had not retained copies of the poems, we asked for, and were given, copies of the three poems. The handwritten poems had been retyped by the Club under the byline "Brodie (Pushkin) Anderson."[7]

Figure 25. The Sarov English Club (and Bob Reinovsky, in sport coat and tie) displays a poster telling the Club's history; a poem by Brodie Anderson appears on the right side (as seen by the viewer) of the poster; the photo in the upper middle depicts a visit to the Club by a LANL delegation.

VNIIEF security was always happy when the LANL team left Sarov on weekends. A weekend excursion took us to Nizhni Novgorod and a park that had many reconstructed 17th, 18th, and 19th century buildings and churches. Normally, the park is closed for the winter until May 1, but special arrangements were made for the LANL team, who was escorted through still-deep snow by an 80-year-old guide who spoke reasonable English.

[7] For these poems, see https://lab2lab.stanford.edu/human-dimension/strictly-unofficial-record/poems-brodie-anderson-american-poems-sarov

I paid the admission for the entire team to the park. As was the case in the Soviet Union, the admission taker insisted on providing receipts for the fee paid. However, the receipts available were in units of "old" roubles, not in the "new" roubles (that had a value of 1000 times the old roubles), so I was given a huge stack of receipts.

Figure 26. "Old" rouble receipts for park admission (Nizhni Novgorod, April 1998).

George Crile, CBS 60 Minutes producer and later the author of the best-seller Charlie Wilson's War, flew from Moscow on the same flight as the LANL team and learned from Atchison that the LANL delegation was aboard. Upon deplaning in New York, Crile quickly began inquiring about the team's trip. When Crile learned that two of the bags I was carrying contained "pen-pal" letters, Crile hurriedly unpacked his video camera and began filming the bag contents. Video camera in hand, Crile accompanied the team to its next flight, conducting interviews along the way.

In response to a follow-up e-mail message I had sent him, Crile wrote in an e-mail message:

> *I'm so pleased just to know that all of this has happened and that it is still underway. For the moment I will just leave you and your colleagues with a preliminary reaction: Congratulations! You make me proud.*

August 1998

The LANL team (Anderson, Benage, William Broste, Goforth, Kirkpatrick, Oona, Reinovsky, Richard Siemon, Darin Westley, and me) returned to Sarov in August 1998 when the joint team was to conduct several experiments. Because experiments were to be conducted at three different experimental sites, and because a large number of data channels were to be used to record several very complex plasma diagnostic systems, this visit represented perhaps the most ambitious experimental campaign yet.

Westley was making his first trip to Sarov. Westley became fascinated with Sarov's tall pine trees that had branches only near the top and seemed to have no bark on the bottom.

When Westley noted the white trunks, Anderson explained that the lower bark had been removed by the "Russian bark bears" that climbed the trees for food. For a time, Westley was hoping to see these bears, until he finally realized that he had been deceived.

With my assistance, George Crile and his video team had obtained unprecedented Russian government permission to accompany the LANL team to Sarov. Crile, his cameraman, and his assistants spent the week filming the joint experimental activities and interviewing the participants for what Crile had hoped would become a documentary program on the uniqueness of the relationship. Because Crile was not permitted into the firing area, he handed me a camera and I filmed the experimental activities.

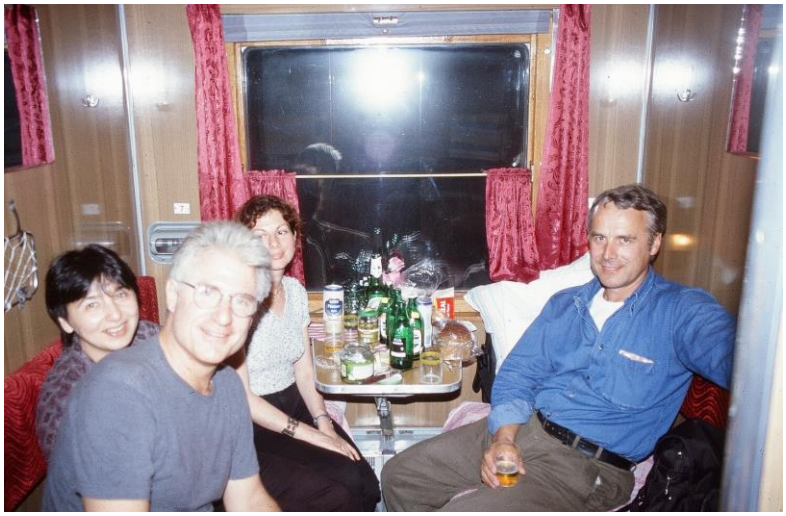

Figure 27. George Crile, CBS 60 Minutes producer and author of best-seller Charlie Wilson's War (second from left) and his team accompanies the LANL team on train to Sarov (August 1998).

Figure 28. George Crile (right, with back to photo) and his team interview LANL team members in Sarov. Team members are Hank Oona (third from left), Jim Goforth (to Crile's left), and John Benage, Daren Westley, and Ron Kirkpatrick (in order, to Crile's right) (August 1998).

Unfortunately, before all of the planned experimental work had been completed and before any progress toward defining expanded collaboration was made, LANL management ordered the LANL delegation to return to the United States immediately and banned travel to Russia by all LANL personnel. The reasons for the order to return to the United States were never made public, but the ban that had been put on lab employees' travel to Russia—after the team had already arrived in Sarov—was lifted just three days later, the day after the LANL team had left Sarov.

October 1999

A nine-member LANL team (Anderson, Atchison, Clark, Faehl, Goforth, G. Rodriguez, John Stokes, Lenny Tabaka, and me) spent a three-week period in Sarov in October and November 1999. The purpose of the visit was to conduct an experiment using a DEMG to provide U.S. scientists with the first available data on the behavior of magnetically imploded liners in the upper current performance level predicted for the U.S. Atlas capacitor bank then under construction.

During this visit, we were invited to go to the "banya" with members of the Sarov Duma who had visited Los Alamos in December 1998. During their Los Alamos visit, the Duma members had attended a Christmas concert by well-known western singer, Michael Martin Murphey, whom I had introduced to the Russians and who had dedicated "Tumbling Tumbleweeds" to the visitors during his concert. Therefore, for the entire evening, Murphey's music echoed throughout the banya facility.

"Pen pal" letter exchanges were the initial basis for the Sister Cities relationship, and by November 1999, hundreds of letters were being carried to and from Sarov by each traveling LANL or VNIIEF delegation. Since the bulk of the letters was becoming too large for what little spare suitcase space the travelers had, Jim Goforth donated an old blue suitcase to the cause, and this suitcase always travelled with delegations from both institutes.

Figure 29. Anatoli Buyko (left) and Sergei Garanin (right) bring bags of "pen pal" letters to the LANL delegation's hotel in Sarov. The author is in the center (October 1999).

A unidentified middle-aged Sarov woman followed the LANL delegation from room-to-room during a visit to one of Sarov's art schools and then followed the delegation to its bus. As Tabaka boarded the bus, the woman attempted to hand him one of her shoes that she had removed from her foot. Tabaka was totally confused, but our totally surprised interpreter learned that, for unknown reasons, the woman wanted him to autograph her shoe. He dutifully obliged, whereby she promptly handed him her second shoe. Tabaka thereafter became known as the "shoe-sign boy" (as opposed to shoe-shine boy) and was to find a half-dozen pairs of shoes, each with a pen in it, outside the entrance to his room when he awoke the following morning.

Figure 30. Shoes sit outside the room of "shoe-sign boy" Lenny Tabaka (Sarov, November 1999).

Trying to restore the collaboration 2000-2003

The 1997 enthusiasm for expanded collaboration had all but dissipated by 2000. A mid-level LANL manager who had described himself as "too much of a Cold Warrior to want to work with Russians" had almost abruptly cancelled all funding for collaborative activities. Fortunately, Undersecretary of Energy Moniz met with his Russian counterpart, Lev Ryabev, and subsequently asked LANL and other U.S. laboratories to increase interactions with the Russian labs. Therefore, trips to VNIIEF in 2000 and 2001 were devoted to restarting nearly cancelled projects and initiating new ones. The year 2000 would become the only year since 1993 that VNIIEF and LANL did not conduct at least one joint experimental campaign.

Bureaucratic impediments continued to grow. Getting U.S. and Russian government approval to travel to Sarov was becoming more difficult, leading to trip postponements or cancellations. Security restrictions on LANL delegations in Sarov reverted to those encountered in our early visits (apparently the law that foreigners were prohibited in

Sarov had remained on the books), and many of the social interactions with the Sarov community that had made previous trips so enjoyable were now prohibited.

The Russian government actually denied approval for representatives of many U.S. programs to enter Sarov. Fortunately, our pulsed-power-based high-energy-density physics collaboration was still able to get access, often only after heroic efforts by our VNIIEF hosts, and we interpreted this access as an indication that Russia continued to desire such collaboration. In June 2001, Rickey Faehl, who worked part-time on the Nuclear Cities Initiative (NCI), apparently became the first person associated with the NCI in eighteen months to enter Sarov and conduct NCI business; presumably, if Faehl had not also been involved in the HEDP collaboration, he would not have received access permission.

June 2000

In Sarov to review past projects and begin to implement the Moniz/Ryabev agreement, Clark, Faehl, Reinovsky and me were inundated with questions regarding the Wen Ho Lee affair, the May 2000 Cerro Grande Fire that had delayed our original departure, and the LANL missing hard drives that allegedly contained classified information. On the subject of the missing hard drives, which had been reported missing during our time in Sarov, we learned more than we knew. It was obvious from comments made that this incident had received extensive coverage in the Russian news media.

November 2000

Bob Reinovky and I returned to Sarov to continue the process started in June 2000. Whereas high-ranking VNIIEF leaders had always participated in the joint activities, their LANL counterparts had been for the most part conspicuously absent. Therefore, to demonstrate LANL's commitment to the Moniz/Ryabev process, we had enlisted two division managers and a program manager to join us. Unfortunately, at the last moment, all three had to cancel due to a combination of work obligations, personal commitments, and sudden illness, something we considered to be really bad luck. Although all three expressed intentions to travel to Sarov at the earliest possible date, LANL management changes precluded such visits, and LANL upper leaders remained conspicuously absent.

Bob and I were accorded quite an honor when we were given certificates indicating that we had been inducted into the International Informatization Academy after nomination by our VNIIEF colleagues. Although we have never really understood the function of the academy, we were thrilled because we knew our colleagues considered it an honor.

Figure 31. I. D. Sofronov (standing, right) presents the author with a certificate indicating membership in the International Informatization Academy. Bob Reinovsky (left) and V. N. Mokhov (sitting, right) look on (Sarov, November 2000).

June 2001

A nine-member team (Anderson, Atchison, Clark, Faehl, G. Rodriguez, Stokes, Tabaka, Westley, and myself) returned to Sarov in May and June to conduct the second experiment using VNIIEF DEMGs to emulate the Atlas capacitor bank. The experiment had been delayed from early April first because of heavy late-winter snowfall caused soggy and unsafe firing point ground and then because of U.S. travel regulations.

The late thaw and much remaining moisture in the forests surrounding Sarov and the firing point made conditions perfect for a terrible infestation of mosquitos and gnats. The experimental team was accosted by these insects whenever their activities required them to work outside, even though they applied mosquito repellent and wore long sleeved shirts, high collars, and hats. The buzzing noise of the insects within the protective plastic sheeting "house" placed over the experiment to protect it from rain was deafening.

Although cautionary steps were taken to prevent the insects from entering our hotel rooms, it was not uncommon to be awakened in the middle of the night by mosquito buzzing or a mosquito bite. Invited by Lydia Ilkaeva to play tennis, Faehl and I were immediate victims of a vicious attack from the gnats and mosquitos that hid among the foliage surrounding the tennis courts and we received numerous bites that festered for nearly a week after their return to the US.

The growing relationship between the medical professionals in Sarov and Los Alamos had reached a point where doctors in both cities were quite familiar with each other. On this trip, this growing medical relationship had a direct impact on our team. Stokes required treatment for a swollen foot that became evident on the trans-Atlantic flight to Moscow. A week later, fours hours away from Sarov by train, Atchison began to experience pain that had become so severe by the time we arrived in Sarov that we insisted that he immediately be transported to the Sarov hospital. In both cases, we and

the Sarov physicians consulted by phone and e-mail with Los Alamos physicians for diagnosis and recommended treatment. Much to our comfort, the Los Alamos doctors confirmed the diagnosis and approved the treatment. Stokes had an infection and Atchison had kidney stones, both the type of ailments that travelers dread when far from home. Fortunately, both received excellent care. Stokes rested in the hotel for five days and Atchison was hospitalized for three.

Stokes and Atchison were insistent that they make a fair and reasonable payment for their treatment, an insistence that continued for many days when no bill was forthcoming. It became apparent that the insistence on payment and receipt was causing a great deal of administrative headaches. The deputy head of the Sarov medical services strongly emphasized that in Russia, by law, emergency treatment is rendered free of charge; there simply was no way whatsoever that the Sarov hospital could submit a bill and receive payment. After considerable further discussion, the Sarov physicians reluctantly agreed that the hospital would accept a "personal donation" which would be used to benefit the medical center.

En route to Moscow, Faehl had been assigned an airplane seat next to Glen Schweitzer who had been the first director of the ISTC. Schweitzer expressed dissatisfaction and disenchantment with most U.S./Russian initiatives in the nuclear arena and stated that, in his opinion, only the "lab-to-lab" scientific cooperation and non-government-run Sister Cities interactions were giving cost-effective results, sentiments that certainly meant a lot to our delegation.

Because the experiment was not conducted until 11:36 P.M. and the team did not even return to their hotel until nearly 1 AM the next morning, the LANL team had assumed that the traditional celebratory banquet that had been scheduled for earlier in the evening had been cancelled. A quick inquiry confirmed the Americans' worst fear: the banquet was not cancelled. Suggestions to delay until the next morning or noon (the team was scheduled to depart from Sarov the next afternoon) and arguments to cancel—extremely tired people, a long trip ahead, etc.—all went for naught, so four Americans and about a dozen Russians attended a very subdued banquet that began at about 1:30 AM and ended at 3 AM.

July 2001

As noted early, George Crile, CBS 60 Minutes producer and author of Charlie Wilson's war, had accompanied the LANL team to Sarov in August 1998. In July 2001, a VNIIEF delegation and members of the LANL team were participating in a scientific conference in Las Vegas. When I phoned Crile to tell him that a VNIIEF delegation was in Las Vegas, he hurriedly ordered a local camera crew to the conference site. He then flew to Las Vegas and then traveled by automobile to Los Alamos with the LANL/VNIIEF team, with stops at Hoover Dam, Grand Canyon, Meteor Crater, and other sites along the route.

Figure 32. George Crile (center front) with LANL/VNIIEF team at Grand Canyon (July 2001).

In January 2003, Crile wrote to me confirming his continued determination to make a documentary about the LANL/VNIIEF collaboration,

> "I'm afraid I'm forever appealing to you for patience in thinking about me and whether or not I am for real in terms of ultimately intending to deliver something that could share with our audience the grand work that I have partially chronicled. It's been something of an indecent interval on my end in terms of not yet putting something together. Nevertheless I would like you to know that you and your Russian-American colleagues remain very much alive in my thoughts. And although I don't, at the moment have something tangible to tell you about my plans, I still believe that I will come through in the end. The stories I invest in, more often than not, tend not to be diminished by the passage of time. I think that's the case with your adventure. I see it as a towering tribute to something glorious and beyond the science, which is not to be diminished in its significance, there is simply the clear and powerful message about mankind's capacity to see things differently and to change and to find a way to be of benefit to each other."

Unfortunately, Crile was to die prematurely in 2005, and any thoughts he had about documenting the collaboration died with him.

January 2002

The visit to Sarov by Atchison, Faehl, Reinovsky, Stokes and myself for a data review and planning coincided with the tenth anniversary of Bob's and my first visit to Sarov in January 1992. Our hosts arranged a celebratory banquet attended by VNIIEF leaders and key collaboration participants. Numerous toasts and reminiscences of the first visit were offered. Director Ilkaev offered the first toast and said, prophetically, that a book should be written on the professional and personal experiences of the team. We certainly did

not know that Doomed to Cooperate (see References 1 and 2) would become a reality a decade-and-a-half later.

VNIIEF had prepared certificates signed by Ilkaev, Chernyshev, Mokhov, Reinovsky, and myself. The certificates had a place for LANL Director Browne to sign on our return to the US. According to the certificates, "this certificate confirms that" Lindemuth and Reinovsky had,

> *on January 20, 1992, laid the foundation for productive and mutually beneficial collaboration in the field of super powerful magnetic explosive energy sources and the use of pulse power in scientific research between the All-Russian Scientific Research Institute of Experimental Physics and the Los Alamos National Laboratory.*

Certificates for the others indicated that they had

> *made a significant contribution to the development of joint fundamental scientific research in the field of high energy density physics and in the establishment of productive collaboration between the All-Russian Research Institute of Experimental Physics and the Los Alamos National Laboratory.*

Figure 33. A cake commemorates the first decade of LANL/VNIIEF collaboration (Sarov, January 2002).

VNIIEF security regulations governing LANL computers ebbed and flowed throughout the first decade of collaboration. Sometimes, computer use was permitted only in the hotels, other times there were no restrictions, and, this time, computers were almost confiscated. VNIIEF security regulations required us to turn the computers over to security personnel, but I resisted, saying that LANL regulations prohibited us from giving up possession. A compromise was reached whereby we heavily taped our computers and turned them over to security personnel, who assured us the computers would remain locked in the hotel's safe.

Figure 34. LANL computers heavily taped before being turned over to VNIIEF security (January 2002).

Los Alamos friends and colleagues had questioned why our delegation would want to travel to Russia in the middle of January, particularly when the Sarov temperature had dropped to -30 degrees Fahrenheit earlier in the month. Approximately two feet of snow covered the ground on our arrival, and snow fell on many days of our visit, but temperatures were barely below freezing and some heavy rain melted much of the snow, so we escaped Russia without experiencing a true Russian winter.

January 2003

NNSA Administrator Gordon met with Ryabev in April, 2002, and had done what Reis, and Moniz had done before: signed a protocol espousing expanded collaboration of the type Russia's scientific leaders had said many times prior was needed. Ed Heighway, LANL's principle associate laboratory director for weapons physics, recognized that a concerted effort was required to meet the goals of the Gordon/Ryabev agreement and appointed me to be LANL's point-of-contact for the process. Through the next year or so, I formed a cadre of principle investigators who were well recognized by the Russian experts in their fields and hence considered worthy collaborators.

A January 2003 trip took LANL delegations to VNIITF (Atchison, James Kamm, Dean Preston, Reinovsky, William Rider, Marvin Zocher, and me) and VNIIEF (Atchison, Goforth, Kamm, Reinovsky, Todd Urbatsch, Zocher, and me) to establish Gordon/Ryabev projects.[8] All of the Russian leaders with whom we met were emphatic

[8] One result of this visit was that Kamm re-established the "5-lab" computational meetings. Five highly successful "5-lab" (LANL, LLNL, SNL, VNIIEF, VNIITF) computational workshops had been held (in 1992, 1994, 1995, 1996, and 1997) before being mysteriously (to the Russians) stopped when the DOE head of the Advanced Scientific Computing Initiative directed that none of the funds originating in his office could subsequently be used to support such workshops.

that the new relationships must be long-term, in contrast to the many small projects that had previously been defined more or less on a yearly basis.

Cold but bright days were experienced at VNIITF, but the weather in Sarov was pretty much the same as a year earlier (so similar that an identical paragraph appears in our two trip reports), so once again we escaped from Russia without encountering the cold for which Russia is noted.

October 2003

I made my last trip to Russia as an employee of LANL, this time to participate in the Sarov Supercomputing Seminar. This trip provided an opportunity for my wife, Hedy, to visit Sarov for the very first time and to get a feel for the city that had been so important in my career for the last decade or so. She was to experience the legendary Mokhov hospitality, visit the house of General Negin, and tour the Sarov museum.

Figure 35. Hedy Lindemuth (left) visits the home of Vladislav and Tatiana Mokhov (right); VNIIEF interpreter Rimma Zubaerova is in the center (Sarov, October 2003).

November 2003

I had retired from LANL in November, 2003. For two months prior, having sold our Los Alamos home and having moved our possessions to Tucson, Arizona, Hedy and I lived in borrowed or rented quarters as I tried to bring my time at LANL to closure. My discussions with LANL senior leaders regarding expanding LANL's role in the Moniz/Ryabev (now Gordon/Ryabev) process seemed to fall on deaf ears.[9]

Whenever the VNIIEF team visited LANL, an attempt was made to return the hospitality always extended in Sarov, and such attempts often included excursions outside the city. A November excursion to Albuquerque was unique for Vladislav Mokhov. Just one week prior to my retirement, I and Olga Augustson, as interpreter, accompanied Mokhov to the Albuquerque Heart Hospital for an examination by Dr. Barry Ramo, a noted

[9] See Ref. 3 for a discussion of LANL management opposition to collaboration.

television personality as well as noted physician. Mokhov's prognosis was not good, and the very next day hospital surgeons performed angioplasty and installed stents in Mokhov's arteries. Mokhov was back in Los Alamos within two days, participating in technical discussions and proudly showing off a bruised leg where his angioplasty catheter had been inserted. Perhaps because of the stents, Mokhov lived for another 8 years.

As my very last official duty at LANL, "working" until late in the evening of my very last day, I attended a banquet hosted by LANL's director Nanos and held in honor of Radii and Lydia Ilkaev, who were visiting LANL. A toast or two and several comments were made to me commemorating my role in the LANL/VNIIEF collaboration, a fitting end to the most exciting and rewarding part of my career at the U.S. national laboratories.

Figure 36. The author (left) attends LANL banquet in honor of Lydia and Radi Ilkaev (center, hosted by former LANL Director P. Nanos (right) (Los Alamos, November 2003).

Epilogue 2006-2016

March 2006

I returned to Sarov for the first time since retirement to participate in the Khariton Scientific Readings, this time as a part-time member of the Physics Department faculty at the University of Nevada (UNR). My UNR colleagues, Dick Siemon and Vlad Makhin, and I were in Sarov to meet with the Chernyshev-Mokhov team to discuss their thoughts on some of the ideas Dick, LANL's former program director for fusion energy, had for university-level research relevant to Magnetized Target Fusion (MTF). This meeting lead to a joint LANL/VNIIEF/UNR project to study the effect of megagauss magnetic fields on metallic surfaces.

Figure 37. Representatives of University of Nevada, Reno, Physics Department (Dick Siemon, left, and author, right) discuss physics with Moscow Circus representative (March 2006).

I was honored to help Paul White (LANL's representative to the Sister Cities program) present to the Sarov Vice-Mayor the last remaining funds in the "Arzamas-16 Children's Medical Fund," a fund I had helped start in late 1993 when the medical situation in Russia was desperate.

Figure 38. Paul White (right) and author (left) present last remaining funds of Arzamas-16 Children's Medical Fund to Sarov administrator (March 2006).

Through heroic efforts by our VNIIEF hosts, Bob Reinovsky and I were given permission to visit the grave of Vladimir Chernyshev, who had passed away the previous year. As we walked through the newly fallen, knee-deep snow in the Russian-winter quiet of the cemetery, it was easy to ask ourselves how our lives would have been different if Vlad

and his close colleague, Vladislav Mokhov, had not presented us with a proposal for joint collaborative work in September, 1991, back when there was still a Soviet Union.

Figure 39. Bob Reinovsky (right) and author (left) visit grave of Vladimir K. Chernyshev, accompanied by Chernyshev's son (center) (Sarov, March 2006).

November 2006

I was able to reacquaint with some VNIIEF colleagues when they attended the 2006 Megagauss conference in Santa Fe.

July 2008

Hedy and I have always welcomed the opportunity to host Sarov Sister Cities visitors to Los Alamos. The first group of Sarov students in April 1994 had spent several days at our "dacha" in northern New Mexico, near Chama. Even though we had moved from Los Alamos to Tucson in November 2003, we continued to spend summers at the dacha, so when a Sister Cities delegation arrived in Los Alamos in the summer of 2008, we jumped at the opportunity to have visitors.

We showed them some northern New Mexico culture by taking them to the Jicarilla Apache Indian Reservation's Little Beaver fair and rodeo. They "chased" the Cumbres & Tolted train, America's longest and highest narrow gauge railroad. And some of them even had a chance to ride our horses.

Figure 40. Bob Thomsen of Los Alamos Sister Cities program leads Sarov students on a horseback ride (July 2008).

April 2012

"Doomed to Cooperate" made it possible for Hedy and I to return to Russia and Sarov. In a sense, the "kick-off" for Doomed to Cooperate was a conference celebrating the 20th anniversary of the US/Russian lab directors' exchange visits in early 1992. It was an honor for us to be invited to participate along with a number of people who had played indispensible roles in all of the post-Cold-War lab-to-lab endeavors.

Although Hedy had travelled with me to Sarov in October 2003, she was the only wife on the trip and her movement throughout Sarov was quite limited. So this trip was her best chance ever to see many of the sites that had become so significant to me: Moscow, Nizhni Novgorod, and Sarov. In Sarov, Hedy and the other accompanying wives were treated like royalty as the Sarov community welcomed them with tours of the city, including the recently excavated catacombs under Sarov. Most importantly, Hedy had a chance to meet many wonderful Russian women and learn how they lead their lives.

Of special meaning to me was the opportunity to visit the grave of Vladislav Mokhov, who had died only four months earlier, in December 2011. It was a chance to ponder all that had happened in my life because Mokhov had published a paper in 1979.[10] A meeting Hedy and I had with Mokhov's widow brought tears to all three of us.

Sig Hecker's aides, Peter Davis and Niko Milonopoulos, had accompanied us through Moscow and Nizhni Novgorod. Unfortunately, our Sarov hosts had not obtained permission for them to enter Sarov, so they spent several days in Nizhni Novgorod while the rest of us went on to Sarov. Therefore, they had a chance to visit the apartment where Andre Sakharov had spent his exile, the apartment that I had visited nearly two decades

[10] References 1 and 3 discuss how Mokhov's 1979 paper stimulated the US's curiosity and ultimately lead to the LANL/VNIIEF pulsed-power-based collaboration.

earlier. This time a poster featuring Sakharov's scientific work displayed a picture of a joint LANL/VNIIEF experiment.

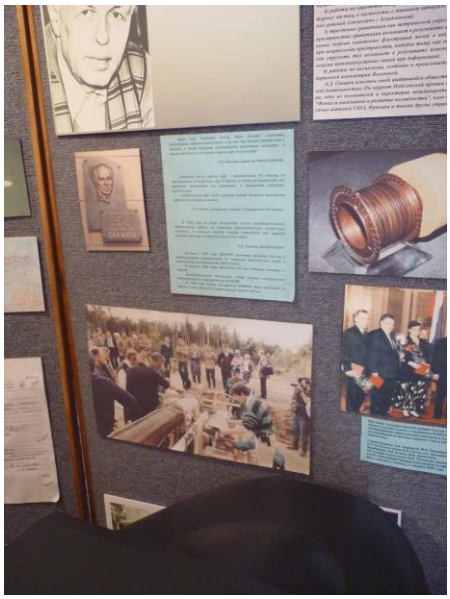

Figure 41. A photo of a September 1995 joint LANL/VNIIEF MAGO magnetized plasma formation experiment is displayed on a poster board at the Andre D. Sakharov museum in Nizhni Novgorod. The author is in the rear, far right of the photo (Peter Davis photo, 2012).

October 2012

The Megagauss-XIV conference in Maui, Hawaii, provided another opportunity to reacquaint with VNIIEF colleagues. I reported on calculations that used a combination of a US magnetohydrodynamic (MHD) code and a VNIIEF-developed equation-of-state and resistivity model to simulate experiments conducted at the University of Nevada, Reno that were part of a joint LANL/VNIIEF/UNR collaboration.

June 2013

Doomed to Collaborate made it possible for me to return to Moscow once more to participate in a conference and a workshop related to the upcoming book. As always, it was an honor to have an opportunity to present some of the accomplishments in the LANL/VNIIEF collaboration on pulsed-power-based high-energy-density physics.

The Conference on Nuclear Cooperation between the Russian Federation and the United States: Past Accomplishments and Future Prospects gave VNIITF's Boris Vodolaga to reminisce about our first meeting more than two decades earlier, where Boris had clenched is fists to describe the relationship between LANL/LLNL and VNIIEF/VNIITF. We were to agree that not much has changed since then.

Figure 42. Boris Vodolaga (left) and the author once again (see Figure 3) describe the relationship between LANL and LLNL and between VNIIEF and VNIITF (Moscow, June 2013).

November 2016

Even though I am retired, I still do a little physics research as a "hobby" (meaning nobody pays me!!). Where much of my earliest research required some of the most powerful computers then available, now I can do an incredible amount of scientific computation on my MacIntosh laptop. In late 2015 I extended the 1983 Lindemuth/Kirkpatrick paper that had set the stage for my early interactions with VNIIEF.[11] The extended paper attracted so much attention from the fusion energy community that I was invited to give seminars at a number of US labs and universities. And, in November, I gave a prestigious "invited tutorial" at the annual meeting of the American Physical Society Division of Plasma Physics, the most important fusion energy conference of the year where only 4 of the approximately 2000 papers presented were "tutorials." If the LANL/VNIIEF collaboration had not kept interest in Magnetized Target Fusion going for two decades and more, that paper, the seminars, and the tutorial just might not have happened.

Doomed to Collaborate lead to an invitation for me to give a seminar at Stanford University on my Russian interactions.

Concluding Remarks

As I complete these writings, there is perhaps a feeling of emptiness. These words simply do not convey the impact that our Russian interactions have had on me and my colleagues. How does anyone capture events that change one's life and give one's life a

[11] References 1 and 3 discuss how the 1983 paper set the stage for the LANL/VNIIEF pulsed-power-based collaboration.

new meaning? As I have tried to convey, the Russian interactions have been a fantastic adventure for me. For sure, they were the most rewarding aspect of my career.

Everyone who has been involved in the interactions described here had the hope and prayer that the work we were involved in would lead to a more peaceful world, and, in fact, for maybe two decades, the world was more peaceful. Unfortunately, now the relationship between the United States and Russia has deteriorated to a point not unlike the interlaboratory relationship depicted by Boris Vodolaga and me in Fig. 42. For me, my American colleagues, and my Russian colleagues, this is a disappointment whose magnitude cannot be overstated.

I had a unique opportunity in 1992 to play a formative role in a collaboration unprecedented in the nuclear age. Unfortunately, in spite of past accomplishments, I felt compelled to end my November 2016 seminar at Stanford University with the questions:

> *Will we have Cold War II? Will Russia return to nuclear weapons testing? Will scientists once again be called upon to solve issues that threaten the security of the US, Russia, and the world?*

As I have told my close colleague, Bob Reinovsky, it is important to document our experiences because someday in the future there may be two scientists who will find themselves in a position not unlike we were in over two-and-one-half decades ago and can hopefully learn from our experiences. That is the purpose of this article and the articles that it supplements.[12]

[12] See references 1, 2 and 3.