The oral histories placed on this Website are from a few of the many people who worked together to meet the challenges of the Shuttle-Mir Program. The words that you will read are the transcripts from the audio-recorded, personal interviews conducted with each of these individuals.

In order to preserve the integrity of their audio record, these histories are presented with limited revisions and reflect the candid conversational style of the oral history format. Brackets or an ellipsis mark will indicate if the text has been annotated or edited to provide the reader a better understanding of the content.

Enjoy "hearing" these factual accountings from these people who were among those who were involved in the day-to-day activities of this historic partnership between the United States and Russia.

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GARY KITMACHER

June 29, 1998

Interviewers: Rebecca Wright, Carol Butler, Paul Rollins

Wright: It's June 29, 1998, and we're speaking with Gary Kitmacher as part of the Shuttle-Mir Oral History Project. I'm Rebecca Wright, with Paul Rollins and Carol Butler.

Good morning, and thank you for making time to visit with us.

Kitmacher: Thank you for picking me to participate in this.

Wright: We have learned that you have a long history with this project, and we'd like to begin that this morning by your telling us what are your roles and responsibilities with the Phase One Project.

Kitmacher: I've been involved in it for quite a while, and went through a kind of evolution of roles. Probably my most notable role was as the project manager for the Priroda. The Priroda was the last big module of the Mir Space Station that was launched to the Mir and carried a good deal of the U.S. science and systems hardware that supported our activities on the Mir.

But actually, before that I had some other roles. I was involved, even before the NASA-Mir Program got started, with the Spacehab Project. In fact, I was one of the advocates and one of the people urging Spacehab on to develop the larger double-module configuration and urged them to make a play to get involved in the Mir Project as that was getting started. So I had some involvement there.

After my role in the Priroda activity, once the Priroda was launched, I became sort of a project management specialist or support person for the Mir Operations and Integration Working Group, which was one of the working groups, the joint working groups, set up in the program office, in this particular case to put hardware on board the Mir and to make sure that we knew how to operate it, the crew was trained to properly operate it. I set up much of the configuration management and program management associated with that, so I've gone through several periods.

My involvement, I guess, in the Mir Project started back in about 1991-92 with Spacehab. I was one of three NASA participants in the Spacehab Project. We had a very small office. The Spacehab was a commercial module that was developed to support U.S. science on board the Space Shuttle. My particular role initially was as the utilization planning manager, and, as such, I was looking for different kinds of missions and activities for the Spacehab to support, [such as] science experiments and other kinds of activities.

I had previously been involved with the Space Station Program, was involved in some of the design of the Space Station, the International Space Station, at that time Space Station Freedom. One of the things that I was urging the Spacehab people to do was to develop a larger cargo-carrying configuration of their module and to support the Space Station as a logistics transport carrier.

When the NASA-Mir Program came along and we needed to look for a way to support the Mir activities, it was sort of a natural fit, except that at that time the Spacehab double module did not yet exist. I worked with the Spacehab people in terms of identifying what it would take to create a larger module. I advocated the development of that module with NASA Headquarters and with the Space Station Program, which became eventually the NASA-Mir Program, and so we developed that module into a larger cargo carrier and ultimately was involved in the selection of the Spacehab over some other competing systems like the Space Lab because of cost and because of the logistics of being able to support a very quick turnaround.

As my activities with the Spacehab people were winding down, I was actually the mission manager on STS-60 for NASA, and STS-60 was the first of the NASA-Mir flights, although that was not a docking mission; it was just a rendezvous and a fly-around.

[Correction by Kitmacher: STS-60 was the first US/Russian flight with Sergei Krikalev as a crewmember; STS-63, which I also had some involvement with, was the first Mir rendezvous mission].

But as that activity was winding down, in my office, which was the science payloads management office, the opportunity came up to lead the Priroda effort. There was already an ongoing effort to put science hardware on board the Spektr module. The Spektr, which was one of the modules of the Mir station, carried much of the life sciences hardware. The Priroda was a little bit different, in that the Priroda module was going to support a great deal of Earth observation activity and, from the science aspect, from the NASA science aspect, was going to support microgravity experiments, which is really more of my forte than the life sciences. I had not had too much to do previously with the life sciences activity.

I was actually not the first person that they had gone after to do that. There was someone else in the office, but she had a family and obligations and felt that lots of trips to Russia was probably not going to be something she was going to be able to support. So I jumped at the opportunity to go after the Priroda. I'm one of these space nuts who sort of grew up with the program and had been following very actively the Russian program as well as the U.S. program for much of my life, I guess. So I thought it was a great opportunity to see how the other program worked and how it had evolved. And it was not as though they had a lot of people available to do it.

So when I jumped at the opportunity, they gladly said, "Sure. Go ahead and take it on." That was in, I think, March of '94. As I say, I'd been peripherally involved earlier in 1993 with some of the other kinds of activities, and I was involved through my Spacehab experience with flying many of the payloads that we ultimately were going to put on Mir in terms of developing the integration plans, integration documentation.

When we actually went ahead and started about early '94, the first goal was what was it we were going to fly. We had a group of people called the Tactical Planning Group, and they were busy looking at what kinds of payloads, what kinds of science could you do on Mir and could actually be supported and that we could also support by having the hardware ready in time. So they had put together some lists of payloads, but there really was nothing finite as far as exactly what it was that we would fly.

I went out and I negotiated with many different centers. Priroda was a little bit different from the Spektr experience, in that the payloads that we were flying were coming from all over. We had Canadian payloads. We had U.S. microgravity payloads that were really being built by the European Space Agency or their contractors. We had payloads coming from many of the different NASA centers, from Lewis Research Center, Ames Research Center, [also Jet Propulsion laboratory] as well as some from here at JSC [Johnson Space Center]. So I was involved in going out and identifying what were the payloads that could be readied in time, that were far enough along already, and that would provide a viable program. So I sort of picked up where the tactical planning group had left off.

We identified a candidate list of payloads. Most of them ultimately made it on to the mission, although there were a couple that fell off because they either did not have the contractual support available or they could not make the kinds of schedules that we were outlining. And so most of the payloads were there and were ready to be integrated. So that was the first identification of what it was that we were going to fly.

Then we came back to work with the Russians and identify what was it that was required in order to support these payloads. This led me to get to work on some of the systems that we were going to need on board the Mir. Most of the payloads that we were flying were offshoots of things that had been flown previously on the Space Shuttle or on the Spacehab, and, as such, they were designed to fit into a standard locker, a mid-deck, Shuttle mid-deck locker. We had to design in the interfaces inside the Russian module to support these, the mechanical interfaces, the electrical interfaces, the data interfaces.

I had a very small group of people within the Lockheed-Martin Company, and some of them were just about fresh out of school, very talented, though, and we decided that because of the nature of the payloads we were going to fly, we needed to get these mid-deck types of lockers. We went out to the people who had built lockers previously, the Space Shuttle people or the Spacehab people, and we said, "We need a bunch of lockers, probably on the order of fifty or seventy-five lockers," and we needed them within six to nine months. They came back and they said, well, they'd only built enough lockers to support the Space Shuttle or to support the Spacehab. If they were going to go out and design and build or even just build the same things as what they already had, it would take two to three years to arrange the contracts and subcontracts and put in place the mechanisms necessary to build these things and supply them to us, and it was going to cost big bundles of dollars.

So I took some of these young folks from Lockheed-Martin, and they were trained engineers and designers, and they got the right kinds of machines, and they went to work physically designing the hardware. The lockers were designed to be common interface with the Space Shuttle lockers and with the Spacehab lockers, but they were unique because, since we knew we were supporting active payloads, they had to have some unique features, such as removable panels, removable fronts, so that you could provide different kinds of feed-throughs, you could provide air flow to them. And they went to work physically designing that.

The electrical system, there was a standard utility outlet capability in the Space Shuttle. We knew most of our payloads were coming either on a Space Shuttle or on a Spacehab which had similar kinds of interfaces. So we took the Shuttle designs, we modified them to a configuration somewhat unique to the Mir, we worked out the interface details with the Russians so that we knew how to integrate our system, but our system became the interface between the U.S. experiment hardware and systems hardware to the Russian hardware. Again we went out, we designed the systems, and we set to work building them.

We were on a very rapid template. We had to turn around so quickly that physically constructing the hardware was a major problem. We just could not turn them out quickly enough. The Spektr folks had gone into some trouble because the Russians were looking to launch Spektr, and when the hardware could not be turned around quickly enough, they came back to NASA and said, "You're delaying the program." I was under strict orders from my management at the time, both within the space and life sciences directorate and also the NASA-Mir Program, that no matter what I did, I could not delay the launch of the Priroda. So we had to go out and figure out ways to design and build, test the hardware quickly enough so that we were not going to serve any kind of delay on the Russians.

For instance, in the case of the lockers, we negotiated both locally here at the JSC, here at Johnson Space Center, to have some of the lockers built here, but they could not physically turn them out quickly enough, so we went to an outside contractor, and they were contracted to turn out some also. So my design people turned out the [CAD/CAM] tapes and for our design. We fed them to both of these groups. The hardware was coming off the assembly line, and I was physically examining this stuff. Within a matter of just about two or three months we were actually getting these things turned around and ready for testing and ultimately for shipment to Russia.

Wright: It must have been an exciting time for these new people.

Kitmacher: Oh, yeah. Some of them had never really worked on a real space effort before and especially to see them go themselves from the design; first we'd defined what the requirements were, but then the design and the manufacture and construction and then figure out the logistics in shipping to physically get them to Russia and then go over there and actually integrate the hardware into the Russian module. Keep in mind, most of the projects at NASA, you never see that kind of end-to-end activity, and usually it's over a much longer time period. Here we were going within about a year, year and a half, from just beginning to understand what it was we were going to fly through the design, development, construction, actual fabrication, tests, and then do the actual integration for flight. So it was very exciting, and we made use of capabilities here at the Johnson Space Center that probably had not been made use of for decades, but it was here, and when we needed it, it really came about.

And a lot of the talent, not only of the young designers but also of folks here to be able to turn around flight crew equipment that quickly was really amazing in terms of how it could be turned on so rapidly.

Wright: How much did you know about Priroda, or how did you find out more about Priroda so that you knew when you were building this it was going to work?

Kitmacher: Within the first couple of months of actually getting involved in the program, I went off on my first trip to Russia. I worked partly through the science organization, but probably more so through the actual vehicle design and development organization.

The Priroda module is one of four of modules on the Mir that are somewhat similar in the basic shape and form and systems. The other module, which is the base block or the core module, is somewhat different, in that it has much of the more integral environmental control and power distribution systems. But these other modules are primarily utilization modules. They're built to support experiments and other kinds of activities.

We worked with the designers and developers for the mechanical systems, for the electrical, for the data, for the thermal control, for the environmental control in terms of identifying what it was we could fly. Now, early on in the program, we were under severe constraints, primarily from a standpoint of mass. That was set up through the contract that we had with the Russians. Actually we were limited by the amount of mass we could carry on both the Spektr and the Priroda modules, and the Spektr folks had been indicating that they were going to fly a lot more hardware than actually they had ultimately flown. So we were reduced down in terms of how much we could actually put on board. If we had it to do over again, we probably would have flown more capability and carried more things up.

But we outlined the plans to carry roughly about thirty lockers' worth of equipment. We figured out where the best place was to situate the different kinds of hardware. We had about three major facilities, a Microgravity Glovebox, a Microgravity Isolation Mount, and the Biotechnology System. None of these systems was quite developed at the time we started on the effort. We did identify what the requirements were for physical placement for astronaut use, and many of the systems that we developed were actually defined around what those pieces of equipment were. In addition, we had a number of other experiments, on the order of about a dozen additional experiments that were going to make use of different systems, at least at the time of the launch of the Priroda, and then later on those systems would be changed out for other kinds of payloads.

So that's how we got involved. We started working with the Russians designers in terms of identifying how to tap into the power supply, what were the appropriate places to put the different kinds of structural attachments, where was the best place physically to set the equipment up so that the astronauts could make use of them. The Russian modules are pretty confining in interior volume, and on top of that, as we found out, as more equipment is brought in, it becomes even more confining. So it was somewhat strategically located in order to be able to have the astronauts support the activities. So we worked out those kinds of details.

The young engineers that I had working for me, and when I say young, most of them were in maybe their late twenties, on average-but they were working hand in hand with the Russians in terms of identifying what were those kinds of interfaces that needed to be defined, how best to build the equipment. It was somewhat interesting to watch this activity going on, this sort of group dynamics, because while most of our folks were in their late twenties, most of the Russians had been around since the beginning of the program. So the people they were dealing with truly were experts on the various systems they dealt in and had been doing this kind of work for thirty years or more, some of them since the early Vostoks and Voskhods, and so they were, on average, in their early to late fifties and some of them even into their seventies. Some of the individuals that were introduced and their roles in past programs was pretty amazing to me, that these folks were still around and still playing an active role and, at the same time, that in many cases the Russians did not have the young people that we had been developing. So it was a little bit of a cultural shock to get these two different groups together.

Wright: Did it work out well?

Kitmacher: Oh, yes. There was no - very little problem, very little issue. Interestingly, one of the things that we decided early on that was required were a set of standards and specifications and working processes for how to do this work. The Spektr folks were under such time pressure that they were not able to get a lot of that in place. So while part of the work that we were doing was physically designing and developing, testing and integrating the hardware, another major thrust of my activity was in terms of defining what are the working processes; what kind of documentation was required; what kind of safety inspection was required; what kind of interface testing; how do we actually document what we were flying; how do you build a manifest and provide the right kinds of details so that the people on the other side, whether they be in the engineering or in the operations arenas, would know what kind of hardware they're dealing with.

We worked out a system of documents, the USR-001 that actually defined the working process and the kinds of documentation that would be required; the USR-002 that defined the technical details to be supplied for every piece of hardware; the USR-004, which was the manifesting detail of what kind of hardware to be flown. So in many cases we were defining the process and the information required at the same time we were defining the hardware. Eventually, later on, it got caught up so that we provided, I think, a useful guide for the people who were coming later, for the hardware that was coming up on the later Shuttle missions, but early on, a lot of that was undefined and we were just trying to establish what the working processes were.

Wright: You didn't rewrite the book; you just ended up writing the book.

Kitmacher: Pretty much we wrote the book. The Russians actually had drafted some pieces. Based on the Spektr experience, we had some knowledge of what kinds of information they were looking for, but the problems early in the program was that you had several dozen different Russians looking at a couple dozen different U.S. experiments, and every time you got a group of these people together, exactly what the information content and documents were, were a little bit different. So we sort of systematized and standardized the approach so that we didn't do a lot of duplication of the documentation and of the information exchange, so that we provided the kind of information that was required, either for hardware integration and operation, for training of the crew members, for ground support. So it was a systemized approach, I guess.

Eventually we got that turned into a system of databases and a management control system so that we knew what to ask of the people who wanted to fly hardware, so that we could actually develop those tools up front and know whether, in fact, it was a good move to put certain kinds of hardware on board. But early on, we were kind of searching. We weren't sure actually what it was we needed to know before we even got the program started.

Wright: That's curious. On the candidate list of what becomes a criteria, how do you start sorting when it's the first time you've ever done this and it's the first time you've ever put these things together? What were you looking for to make those decisions?

Kitmacher: Well, we were looking for, number one, did the hardware even exist. Now, in many cases, what we ultimately flew were offshoots of things that had been flown previously on the Shuttle, on the Space Lab, on the Spacehab. Some of them had had serious developmental problems, so we needed to have some comfort that when we got to the point of being able to integrate and verify this hardware on board the vehicle, that it was going to be ready to be integrated and verified.

Some of the problems had to do with physical size. For instance, we looked at putting exercise equipment, ergometers and rotating chairs and things like that, and in some cases we physically could not manage that because of the constrained environment inside the vehicle. Some of it had to do with funding; was the funding and the contracts in place to support the development and the flight of this equipment? In some cases it rules out experiments. They were good experiments, they had a flight history, but we could not get the contracts in place quickly enough. Ultimately, it became something of a choice, because since we were limited in terms of the resources on board the Russian vehicle, we had to cut out some things. It turned out that there was nothing cut out early on that probably would have made it anyway, so it all worked out in the end. But the dozen or so payloads that we picked up front were able to be fit and could be developed in the time that it took and the organizations were able to support that activity on the schedule that we needed the activity to be supported.

Wright: Will you give us some examples of some of the ones that made it that seem to be significant to the project?

Kitmacher: Probably the most interesting experience was a biotechnology system, BTS, as it was called. It had flown a couple of different Shuttle flights in various forms, prototype forms, and it had had some serious developmental problems: contamination of the working fluids; the hardware not functioning properly. But it was a very high-priority payload. It was something that had been briefed to Congress several times.

It was well known within the program as being on the cutting edge of technology development, in this case to support the growth of different kinds of organisms, and it was tied to a lot of research, cancer research, how different kinds of organisms could grow and could develop in microgravity. In fact, even though there had been some developmental problems, there was also some major successes with it, in that they could show that certain kinds of organisms would grow to much larger sizes and the organism's structure, the molecular structure, for instance, was far better defined when it grew in microgravity than when you try to do the same kind of activity here on the ground. So it was a very high-priority payload.

We determined that the system that was in development for the Space Station could be adapted to put inside of the Mir vehicle. It would take about a half dozen lockers' worth of volume, but that could all be done. Some repackaging was necessary because we would have to fit it into the Space Shuttle for launch and return and then transfer it over to the Mir. There were some constraints because the people who were working on the development of the system did not really understand, in many cases, what it was going to take to provide the information and develop the operations and training information necessary to get it integrated onto the Mir. So along with the development of a lot of the supporting hardware, my group was sent in to help them out in terms of identifying how to document and define exactly what it was they were going to do. So we spent several weeks with the biotechnology system people identifying their configuration, their interfaces, the kinds of documentation they would have to develop in order to support flying on board the Mir. Ultimately it was successful.

I even had a chance to personally load some of the experiment. It flew in the forward end of the module, four lockers' worth of equipment all adjacent to one another, a couple of additional lockers of stored equipment, and provided a lot of activity on board the Mir. Sometimes we had developmental problems and problems with the fluids going through the system, and the astronauts involved had to do a lot of hands-on work in order to make it all function properly, but I think in the end it was a very beneficial activity. It not only showed us some new things scientifically, but it also proved out a lot of the systems ultimately to be flown on the Space Station.

That was the biggest effort here at JSC, the biggest single development activity as far as a payload goes. We had a payload called the Microgravity Glovebox. It was an offshoot of glove boxes that we had flown on the Spacehab and the SpaceLab in the mid-deck, either previously or subsequently, but it was a little bit unique in terms of its design for the Mir. It was more of a facility. It wasn't a payload in and of itself, but we could use it for supporting a whole variety of experiments. We had experiments in how fluids would shift and move in microgravity, experiments in how flames would burn and propagate in microgravity. We also used it as a system for supporting other kinds of activities, loading of different kinds of cells and vials and whatnot.

It was probably the largest and single most complex piece of equipment that we had to get ready, and its development schedule was pacing the schedule for the program, so we were working hand in hand with the people, in this case from Marshall Space Flight Center, so that as they were developing the system we were getting the information necessary in order to provide back to the Russians and also look at it ourselves from a safety standpoint and from an integration standpoint. And again, it was a system that was developed specifically so that we could prove out that system's development and configuration for systems to be flown now on the International Space Station.

The microgravity isolation mount, or MIM, was another one of these major systems. It was developed by the Canadian Space Agency, and it served as a platform to isolate experiments from the vibrations of the spacecraft, which are a regular occurrence. It provided sort of a floating platform that was magnetically isolated from the rest of the vehicle, and it was also a system that the development of it was pacing the development of our own integration efforts on Mir. So we were working hand in hand with the Canadians to make certain that we understood the interfaces to our systems, data management system, and we were also developing several of the payloads that ultimately flew and used this platform. So it was another interesting experience, because now we had a three-way Canadian-U.S.-Russian set of interfaces that we were working between.

From an engineering standpoint, it wasn't a real problem. I mean, the engineering was relatively straightforward, but we had to communicate between not only those three parties, but Lewis Research Center, Marshall Space Flight Center, all had payloads that were flying on this. We needed to verify that the software all worked together, that everyone understood how the other uses were going to be affected. On top of that, we had a system that could not be simulated here on the Earth, so we were developing something that, we hoped, once we got it into orbit, could actually be modified in terms of its operational factors and parameters so that it could, in fact, provide the kind of microgravity isolation that it was meant to. And in the end, it worked out, I think, quite well.

Wright: Can you tell us where were you when it went up into orbit and then about watching it become part of Mir?

Kitmacher: Over the course of my involvement in the activity, I made, I think, about fifteen or sixteen trips to Russia. Three of those trips I went from Moscow or the vicinity of Moscow also over to Baikonur Cosmodrome in Kazakhstan. My activity also involved lots of trips to the various other NASA centers and also to Canada on developing all of the payload hardware.

It went through in different phases. The early part of the program, the first several trips, were involved in just defining how was it that we were going to set up this program. We had different payloads on different development schedules, different systems on different development schedules, and we needed to work out a manageable plan for how all this was going to come together. We couldn't be dealing with a dozen different payloads and a half dozen different systems all on their own individual schedules. So we worked out with the Russians almost a series of relays of, "Okay. You come here. We're going to do this set of hardware in terms of reviewing it, developing the documentation, doing the inspections of the hardware, doing certain kinds of interface verification. Once we've finished with that group of hardware, we're going to take that hardware; we're going to go over to Russia; we're going to mount it into either the Priroda module, which was still on the ground, or in some of their simulators. We're going to verify how it all operates together. When we're done with that, we're all going to go back to the U.S., we're going to do the next set of hardware."

There was a set of relays, probably about five or six of those. Generally, the earlier systems, things like the lockers were first. The little bit more complex systems came along later, and the last of the complex systems, which included the BTS and the microgravity isolation mount and the glove box, those were the last things. In fact, some of the final integration and verification work was going on as we were loading it into the module at Baikonur Cosmodrome. So it was back and forth. Sometimes it was very interesting, we would ride with our Russian colleagues on the same airplanes going back and forth to the same set of activities.

Sometimes we were hindered in what we were doing, mainly by the logistics and shipping and customs processes. Here in the U.S., although we had a small shipping department and physically they'd prepare some of the hardware for moving back and forth, generally they went through a big NASA shipping organization that we had very little insight into initially, and we assumed that they'd take these various packages, locker-sized packages, wrap them up, ship them over, we'd go over to Russia, and someone would deliver these to us. It turned out, for instance, that our shipping group was taking ten or twenty of these lockers and putting them in a crate maybe ten feet long and six or eight feet high, and weighing probably several hundred, if not thousands of pounds.

We would go over to Russia, and I know I made the rounds to the various custom houses several times, and this stuff was stuck in Customs, partly because we hadn't filed the appropriate paperwork, partly because there was no equipment in Russia to physically be able to load these things. The Russians had to go out and lease buses-they were actually hearses that they used over there, and they would have to get a half dozen or ten people together in order to be able to lift these crates, load them in there. They'd deliver them over to a facility that we were using for a lot of our early testing, a facility called the NITS, which was actually a schoolhouse that was offsite from the main Energia facilities.

Then I had to bring my Americans along, and we all had to work together with the Russians in order to get this stuff off the hearse, drag it down the halls. I mean, there was nothing in the way of big power equipment or anything. We were all manually handling that. I had to go back to the shipping people and say, "You can't ship it that way. It needs to be in much smaller pieces."

We learned what was the appropriate documentation that needed to be filed, what was the appropriate process, when was it best to ship big things over separately, when was it best to carry it as hand luggage and take it through the airport Customs. I made many trips going into the Customs with my Russian counterparts in order to recover hardware. I learned what were the regulations and laws on tariffs and taxes and what it was that we had to pay. In some cases we had to get involvement even by people as high up as the Vice President to say, "Certain kinds of hardware are excluded so you don't have to pay any kinds of taxes," and we'd have to bring those letters along and show the Russian Customs officials.

It was a long involved affair, and it was interesting because we were working overtime in building the hardware and then in many cases the hardware was stuck in Customs for weeks or even months at a time before we could get it out and bring it over to do the work we needed to do with it. But it was interesting, because I got to see a lot of things that the typical American tourist, I'm sure, never envisioned.

Wright: You saw it from the inside out, or literally had hands on every part of it, didn't you?

Kitmacher: Oh, yes. And then when we actually went to Baikonur-,I made three trips there. I was there leading a group. The initial trip to Baikonur, we had about a dozen Americans [and 1 Canadian] altogether, most of them representing a given payload or a given set of payloads. My job was pretty much to choreograph the whole activity, together with my Russian counterparts, make sure we knew what we were doing, that we had a test plan in place, and that once we got there we actually were following that plan and that we were actually verifying everything that we needed to verify in terms of the physical interfaces, the functional interfaces.

The last big integration trip, I just brought a couple of people with me, and we did the final physical loading of the hardware, the final physical stowage for flight, some of the larger systems that we had previously been verified but which we did not want to leave in the module because they were still working on other things inside the module. Then the last trip, I physically got to go over and see the launch of the Proton booster and see the vehicle take off into orbit.

Wright: Was it like sending your child away to college?

Kitmacher: Yes. The Proton is a [totally] liquid-fueled vehicle, unlike the shuttle, and because of that it takes off very, very slowly, much more slowly than I had anticipated. I'd seen some other purely liquid fuel vehicles, like Saturns, take off, but it had been many years. So first thing when you see the launch take place, they really don't give you a countdown, and here you are, you've been on the road, in this case for days, traveling from the U.S. to Moscow, Moscow to Baikonur. You're not even sure exactly what time it really is. You're standing around with a bunch of people, high-ranking Russians, other Europeans, and other internationals who also have hardware on board, and everyone's standing around saying, "Well, it's about time," and all of a sudden they say, "And it's launching." So you're looking at it.

The particular day of the Priroda launch was a very, very windy day, low overcast clouds, and we were commenting to ourselves, "Boy, we would never launch a Shuttle in this kind of weather." You're quite a ways away from the vehicle, probably on the order of a few miles, because it's using propellants that are fairly dangerous so that if anything were to happen, they don't want you too close. The vehicle takes off, and there's antenna posts in the ground not too far from you, so you have something to judge the vertical rise of the vehicle. Well, first what you see is ignition and flame and then a tremendous amount of smoke, and we saw nothing happen. I thought, "Oh, my God, that's the end, and we've spent all this time and effort and money and it probably blew up on the ground."

Then all of a sudden you see something rising very slowly out of this huge cloud, this rocket. Now, there's a little low overcast cloud layer, as I mentioned, probably about a mile up or so, and it took a full minute for that vehicle to get from the launch pad up to the clouds where it disappeared, so it was averaging sixty miles an hour, not very fast. And because of the wind, and you could see it shifting between these antenna rods and you could literally see the vehicle moving off to the side as it was rising vertically. So it was quite a dramatic launch. So I was there for that.

Subsequent to the launch, I went back to the control center and participated in some of the activities associated with the docking and the crew first opening up the hatch. I had previously been involved with the crew, both Shannon Lucid, who was the first U.S. astronaut to get to work in the Priroda, and then later with Norm [Norman] Thagard [*Kitmacher's correction: Thagard was on Mir prior to Priroda's launch*.] [John Blaha] and I spent more time training and [he's] who really spent much more time making use of the Priroda and its systems. I was involved with some of their training. I got them into the module and reviewed some of the locations of equipment.

In fact, on that same trip as the launch and working in the control center, spent some time with [John] Blaha, making sure that he knew exactly how everything was laid out, where cables were routed, where we had specifically put holes to route different kinds of utility lines, what kinds of things were located in each individual locker. So he was fully aware of exactly what was on board.

Shannon, who had to go in first, was not really meant to use a lot of the equipment inside there, but still had to be somewhat familiar. There were some problems with the launch that Shannon had to face, which I was delivering information back home. For instance, the Priroda, as it was launched and as it's operating even today, carries none of its own power solar cells for power. So in order to power this from the time that it was launched for the few days until it got to the Mir and docked to the Mir, the Russians used batteries, and it turned out they were batteries that were developed for use on their nuclear submarines but had never been used in space before. And so there was a lot of concern back here about what were these things, what kind of development and test program, and there was especially a lot of concern because one or more of the batteries exploded and burned up after the time of launch and before it got there. So, for instance, when they opened up the hatch on board, the crew was very concerned that they smelled this acidic and toxic material and they smelled the fire. So I was providing some of that information.

One of the things that I had gotten, either on my own or from the Russians, was the photographs of the vehicle as it was closed out and prepared for flight, and that was something that was being widely used and evaluated both here and in Russia, as it turns out. So I was involved pretty much with all aspects and was right there on top of the hardware throughout its preparation phase, and until it got into orbit probably was the American with the most time in the spaceship. It was interesting from that standpoint also.

It was interesting to see how the Russians actually developed and built the spacecraft. Priroda had actually been built probably a decade earlier, had not been launched, either for financial or other kinds of technical reasons, and so when it was being prepared for the NASA-Mir program, they were doing some major retrofits. So we got to see a lot of that activity going on.

Wright: If you compared it to something on Earth, how big is it?

Kitmacher: It's probably the size of a bus. That's probably the closest thing that we would be familiar with. But it's very, very loaded with equipment. There's interior walls versus the exterior. There's things behind these interior walls. Part of what we were learning was exactly how the Russians loaded it all up with different kinds of equipment and tested all that equipment out.

It turned out, as we ultimately flew the different Mir missions, that we were running out of the inside space. We initially had this agreement with the Russians based on a contract that we had with them, that we were limited in terms of how much mass could be placed in the vehicle. But, really, the mass limit was not something that was a big concern, because once you get it into orbit, the mass is really of very little consequence.

I negotiated with the Russians as part of the Phase One-C extension contract that we could put a lot more equipment on board the Mir and that we were not limited by mass, but that we were going to be limited in terms of volume, and therefore we had had to develop a joint team to take a look at the overall vehicle and what kinds of equipment we were trying to put on board and make certain it was all going to fit.

Priroda went up very clean early on, but as we kept bringing up more and more stuff on board our Shuttles, which, by the way, provided a logistics capability that the Russians had never really had previously, the Priroda, as well as the other modules, were really filling up with things, because it turned out they could not get rid of-and also were not of a mind to get rid of things as quickly as we were bringing things up. So the space, the volume inside, was becoming very constraining. If we had to do it over again, we would have provided more lockers, more housing for payloads, much more electrical capability.

The way we designed it, it was very good in terms of it provided a good, direct interface. You could slide something out of the Shuttle or out of the Spacehab, bring it over, plug it right in. The astronauts thought that was great. It was how a spaceship needed to be designed. But we just didn't have enough. We were just trying to do an awful lot, make use of the crew's time, bring up a lot more payloads, and we just needed more storage space, more electrical power. We kept building more extension cables and Ys in the extension cables so that you could power additional hardware off the same outlets that we had limited inside the vehicle. So we just needed more.

Wright: On an average day, how much time does an astronaut or cosmonaut spend in Priroda?

Kitmacher: Well, it varied some. Early on, for the first year of so of activity, of course, we had two main modules, the Spektr and the Priroda, that were being used for U.S. science. The Spektr was primarily the life sciences module. The Priroda was primarily the microgravity module. And in addition to that, the Spektr, for Shannon Lucid and for John Blaha, was really their living quarters, so they were sleeping and doing other kinds of things in there also. The base block module was being used for food and exercise and so on, and then the Krystall and the Kvant and Kvant-2 modules were being used in a limited extent for other kinds of science.

But by and large, the predominant activity was going on in Spektr and Priroda. That was especially true as we were getting from Blaha into Mike Foale and the later missions. They were doing a lot more of the microgravity, so they were probably spending a good portion of their working day inside the Priroda, probably four to six hours a day.

When the Spektr collision occurred early in 1997, June of 1997, that eliminated one whole main U.S. module. We had to launch on some of the subsequent Shuttle missions equipment to replace some of the equipment that had been lost in Spektr, mainly to support the life sciences research, and so now we were really spending a lot of our time inside the Priroda versus the other locations because most of our equipment was now inside the Priroda. So probably on the order of eight to ten hours, maybe more, or their working time was being spent in the one module. So it was quite a bit of time that they were using it, and a lot of valuable research going on with the different facilities and other kinds of experiments that we had put in there.

Wright: There was quite a number of accomplishments you've mentioned, I mean, getting something off the ground that had never been off the ground and designing it all. So personally you must have seen a lot of growth for what you have been able to do just in these last few years.

Kitmacher: Yes. I was able, as I say, to work with the Spacehab folks, which was a new system, and develop that into a greater capability for logistics and cargo support going back and forth to a Space Station. We worked out new methods with the Shuttle for how to operate. Previously, of course, the Shuttle was the system, so everything was tied together in terms of, you know, you launch, and minute by minute you plan out what the astronauts are going to do, how the equipment is going to operate.

Here we were going somewhere and so we had to interface with a whole different set of people, different set of activities, different vehicle. So that was another major portion, was working out how to interface across cultures and across different kinds of systems, the module activity itself, in terms of the design and the development, making certain that everyone was in agreement of the kinds of technical engineering information that needed to be exchanged, what kinds of hardware inspections needed to be conducted before you felt that the hardware not only was safe to fly, but all the interfaces had been verified, working out what those processes were and documenting those.

Then, ultimately, I came back to the U.S. after the Priroda activity, and we needed to be a little bit more specific in terms of working out the organizational details between the people who were doing the hardware integration on Spacehab and Shuttle, the people who were responsible for integrating the hardware on board the Mir, the people who were responsible for training the astronauts, the people who were responsible for supporting and managing the on-orbit operations. So my later role came back to be a project management role in terms of working out those interfaces, working out what the databases were to support documenting the information, not only on the hardware, on the physical parameters and the interfaces, but on crew time and procedures and how to operate that equipment and also how to transmit the equipment, both to the NASA-Mir Program office and to the Shuttle Program. So that was how I was involved later on. So I saw a lot of development and personal growth all through that, and we developed a lot of the processes that I'm hoping will be made use of as we get into the next stage of activity, which is the International Space Station.

Initially we saw a great deal of reluctance on the part of the Phase Two Space Station people to make use of our ideas and our hardware, but as time has gone on and we've gotten closer to flight, they have adopted a lot of what we developed. We developed a logistics system, the actual system of bags and stowage and so on that was used throughout NASA-Mir. The Phase Two Program is now going and developing those bags a little bit further for their own uses. The actual hardware lockers, power utilities, a lot of that is now being adapted for use on board the Space Station. The actual payloads that we developed and used in Phase One are, in many cases, going to be flown now on board the International Space Station.

And a lot of the working processes, I think, are being used as a guide for how to set it up for the Space Station, also.

Wright: You told us about watching the launch. Are there other times that are very significant to you as good memories of this program?

Kitmacher: Well, as I mentioned at the outset, I had been watching the Russian program since I was about seven or eight years old, so I'd spent the better part of three decades trying to learn the history. One of the things that I really enjoyed and made sure that my people had the opportunity to see was the Russian program. We didn't have a lot of time for tours and things like that, but what time we did have we made sure that we visited a lot of the Russian facilities and installations. We met many of the cosmonauts and designers, and we saw a lot of the actual hardware, hardware from their successful programs like the Vostok and the Voskhod, Soyuz, Mir, hardware and how they developed some of the unsuccessful things also, their moon-landing effort that was never successful. The Buran Space Shuttle was something that, especially when we went to Baikonur, we had lots of time to examine close up. The Energia rocket. So that was one of the most enjoyable parts, actually working with the people who had been party to and developed a lot of this, and learning a lot more about how they operated was really a great experience.

Also, having the opportunity to work with, on the U.S. side, people from a lot of the different areas. Previously I had been primarily involved in payload integration, and here I was getting involved much more in systems development, safety verification, operations of the hardware on orbit, training of the astronauts. So those were things that I'd never previously had an opportunity to do and had a lot more opportunity on this program.

As I mentioned also earlier, on other programs you usually see a small segment over a lengthy period of time, and so you become specialized in that one area. On this program we got to see almost the end-to-end development, from picking or designing the hardware that we needed to fly in the first place all the way to operating it on orbit and in some cases returning it back to the Earth and seeing what the results were. So we got to see the end to end and over a very short period of time. The time pressure in doing these things, especially early in the program, was tremendous, but it was very positive because you could see the results of your work very quickly, something which in some other programs you never have the opportunity to see and do.

Wright: How did the language difference affect your business?

Kitmacher: In my case it didn't really have too much of a hindrance. Generally we always had interpreters and translators. The biggest problem was physically to take all these documents that we were working out the outlines and processes and physically turning them around into the Russian language. But generally speaking, it wasn't a real problem to deal with the Russians at a personal level. Partly because I had had a couple of years of Russian language training, albeit a long time ago in college and in high school, so I knew a little bit of the Russian. I could understand much more than I could speak, and a fair number of the Russians could speak English fairly well. Between that and having the interpreters and translators, it generally did not pose too much of a problem.

Wright: I guess a common language was the success of the Priroda.

Kitmacher: That's right. I mean, much of the work that we were doing was either scientific or technical in nature, and once you understood what the goals of the activity were, it was very easy to communicate. Once you understood and outlined the details that needed to be provided, it was very easy because people were driving towards the same set of information to be exchanged.

Wright: Several years ago you jumped at the chance to do this. Now that you've been through it, would you be jumping at the chance again?

Kitmacher: Yes. I really thoroughly enjoyed all of the activity, and given the opportunity, I'd certainly do it over again. I'd kind of like to get more involved in some of what we're developing now for the International Space Station, especially with the Russians or some of the international partners. My biggest concern is that so many of the people, not only myself, but so many of us who went through this, some of them are going on to work on the station, but in many cases they are not, and that's probably my biggest concern, is that we make sure that we take what we have learned through this program and transmit it to the International Station Program.

Wright: It was a real-time lesson in real-time activity. Everything was moving at the same time and everybody was learning.

Kitmacher: There were a lot of things that we learned that are very different, from a standpoint of operating on a long-duration mission something like a Space Station versus operating on a Shuttle. For instance, on the Shuttle, you know, you plan things out to the minute. On the station it's much more important that the crew, for instance, have a sort of generic knowledge of the facilities, the operation, and that you provide some guidance, that you not try to dictate down to the minute all of their activity.

It's very different in terms of the power system. On the Shuttle you have a finite amount of power that can be used over the duration of a one- to two-week mission. On the Mir Space Station, with the solar cells, the total amount of energy that you have to use is not too significant. It's much more important how much power you're using at any given point in time, but the power is a renewable energy source, so you can do the experiments over much longer periods of time and use a much larger amount of energy.

In terms of the internal volume, you know, managing the volume and the physical configuration of the Shuttle is relatively simple because you have to launch within a certain amount of volume. You're not adding a lot of hardware to it, so you package it for launch, you use it on orbit, you put it back pretty much in its place for the return. Trying to keep track of the hardware, whether it be the inventory management or the management of the stowage volumes, is very different on board the Space Station, because what goes up in one configuration doesn't need to stay there. Some of the things, like stowage cushions that you use for packing, is just wasted volume once you get up there, so you need to get rid of it. You need to keep close track so that either during normal operations the astronauts know where to go looking for things, because there are constantly changes of crew and handovers. Or, in the case of something off nominal like the Spektr collision, you need to know very quickly what kind of equipment you lost and how you're going to use other kinds of systems to fill in those kinds of gaps. So those were some of the things we learned that, quite honestly, at the outset we had never even thought about. So it was as much a cultural shock as it was a technical shock to learn some of those things.

Wright: While we've been visiting, we've had two models sitting here that, I understand, you put together. Is this a hobby, or is this something you did for the program?

Kitmacher: This is a hobby.

Kitmacher: This is one of the ways in which I got involved in the space program back when I was seven or eight years old, and I've continued that, although I don't build them too frequently anymore. But the Mir and the Shuttle were something that a lot of people in the program wanted these, and they were not generally accessible. So I went out and took bids on them and built a whole bunch for folks. So they're now disseminated all across the working force of the program.

Wright: And did you design it, or was there a package out there?

Kitmacher: There's a couple of different packages, but I had to get it all together, and a lot of it did not have the kinds of detail to show the real equipment. So I had to do a lot of detail work and adding things, and also for different kinds of open houses and visitations, people really didn't have much of an idea of what the insides of the modules looked like. We had technical drawings and so on, so the cutaway of the module really shows a little bit better what the inside of the vehicle is like and what kinds of things we were working with. But that was also something that was generally not available and was very useful as an educational tool.

Wright: It helps. And how many of the Shuttle-Mirs are--

Kitmacher: I think I built about a dozen and a half of the Shuttles with the Mirs, and everybody from the program manager on down to different folks in the operations and the astronauts, those are pretty widely distributed right now.

Wright: Speaking of the astronauts, I notice you have an astronaut pin, not the pin but the pin that the astronauts give, a Snoopy. Tell us how you got that.

Kitmacher: Shannon Lucid gave me the silver Snoopy pin. That's probably the most significant recognition that I received from the program. That's something that you hear about, and especially on the NASA side not too many people received them, but I thought that was pretty nice, and I guess that was for my work with the Priroda. As I say, the experience of actually doing the job was really the best thing to come out of it, but the recognition on the side, like the silver Snoopy and some of the awards, were also nice. I didn't turn anything down.

Wright: Thank you. I was going to ask Paul and Carol if they have any questions for you. Do you have anything you'd like to ask?

Rollins: I want to move the camera so I have a better backdrop and have you explain from one end of the module to the other.

Kitmacher: Okay. All right.

Rollins: There's twelve Shuttle-Mirs, but only one of the--

Kitmacher: This one here? Yes, just one of those. At one time I was going to do Spektr also, but I never quite got to finish that.

Wright: You must have had other things to do.

Kitmacher: Yes, I have a wife and four kids that, when I'm not enjoying myself in the space program.

These are a couple of models, I guess, that represent some of the work that I had involvement in the program. This is the Mir and the Space Shuttle. The Space Shuttle has a double hab module that was flown on, I think, about five of the missions, and then a single hab was flown on a couple of other missions.

The Priroda module, which was where I had my most involvement, is the module that's towards the upper end here. One of the most notable features is this large radar antenna, and it was used for some of the observations of the Earth. "Priroda" means "nature," and it was primarily an Earth-observation module, although as we used it, it was principally for microgravity experiments.

Some of the other modules here include the Spektr, which was the module used primarily for the U.S. life sciences research prior to being hit about a year ago by one of the Progress spacecraft, and that put it out of commission from the standpoint of internal use, although the solar cells are still being used to supply power.

The Soyuz and the Progress spaceships are used to carry crew and cargo back and forth. The base block, which is the long module down the centerline of this station, is where the astronauts' and cosmonauts' primary living and exercise quarters are, I guess, versus the science modules that are arranged in this cruciform arrangement.

This is the Priroda module. I had spent some time in the Spektr module prior to its launch, mainly taking a look at what my colleagues were doing in terms of integration and development, but most of my time was spent in the Priroda. Of course, I'd never been in any of the other modules of the Mir because they were all in orbit by the time I got involved in the program.

The blue represents everything that we launched inside of the Priroda or, in some cases, things that went up subsequently. The module has what we call the front end or the nose end. This was actually the part that was at the top of the rocket at launch, and then the hatch end, which was actually down at the bottom of the rocket at launch. As you go in through the hatch, you have a large open area. This is mainly to accommodate the hatch and some of the systems that are arranged inside of there, the power and the systems for blowing air through the module, for distributing air.

Then you have an area at the bottom, on the floor of the spacecraft, which is a large stowage compartment that we have actually designed in. They're the same size and shape as lockers, but we didn't provide lockers. The Russians built a storage cabinet, and that's what is here and back here.

Overhead we launched something called the "enhanced dynamic load system," EDLS. It was a system that made use of different kinds of handholds and footholds and touchpads so that you could see how much force was actually being applied and distributed through different parts of the structure. It was in the overhead. Although initially during the launch the Russians had put a different system up in this vicinity called the Toru, and it was the actual steering system. Since Priroda was launched up without any people on board, they had an automated guidance and control system, and it was the steering system that drove the Priroda to the rest of the Mir station and ultimately docked it there.

Beyond that is a series of standard interface racks, SIA racks. These are very similar to the racks that are used predominantly in the Space Station. On Priroda we launched an experiment called the "GASMAP," which was a metabolic analyzer that was used in conjunction with some of the exercise equipment. The astronaut would breathe into it, and this system could detect what kinds of gases he was exhaling and what kinds of things were being dissolved in his system. That GASMAP experiment was moved from the Priroda into the Spektr after Priroda was launched, and ultimately the GASMAP was lost in the Spektr module.

Then the next area is the Microgravity Glovebox. This is a facility used for viewing contained experiments where you have to be protected from things going on, whether it be dangerous fluids or flames, that we were burning things to see how flames propagated. It had interfaces to the data system, and it had its own data system for recording photography and different kinds of information. It was a prototype for things flown on Shuttle and also to be flown on the Space Station.

The MIM is in this vicinity, opposite of where the gas map was. This is a Microgravity Isolation Mount. We had to build a special compartment that would totally house and surround the MIM, but which would allow the astronauts to do different kinds of work and also allow different kinds of experiments to be placed on this floating surface. This is an electromagnetically floating surface.

We had power panels in the front end of the module, and that allowed us to bring in equipment from the Shuttle and very quickly power it up. We had a lot of stowage that ultimately got arranged along the floor and the sides of the module, and that's what is in the center section.

The other big section that we had for the integration of experiments was the nose end, opposite from the hatch. We had an arrangement on the floor of a series of four lockers, and this is where the biotechnology system was placed. It had an integral set of gas supply modules, electronics control modules, and experiment modules. The experiment modules were changed out several times over the course of the NASA-Mir Program so that we flew different kinds of experiments and used this one facility. On the ceiling we had a series of about nine different lockers, and it was used for stowing a lot of the equipment that was being used for all these different facilities. On the aft wall, we had a mounting location. Originally it was designed to mount some refrigerator devices, although ultimately we wound up using it to mount different kinds of glove boxes and facilities for other kinds of biological and plant-growth experiments.

So that's mostly what was inside the Priroda, either at launch, and as time went on, as I mentioned, we were launching up lots more hardware inside the Shuttle, and it was becoming very full, especially after the collision with the Spektr, when one of the Progress vehicles went off and hit several places here, including on the Spektr module. The Priroda became the main U.S. working space on board the Mir. So that's where the astronauts were spending a lot of their time.

Rollins: That's a relatively new piece of gear. I guess it's not feasible to use that on the station?

Kitmacher: Well, it's interesting that you bring that up. The Priroda, of course, has only been up there for a couple of years now. A lot of us thought that, you know, because it was so new, it would probably be really useful to put it on board the station as a Russian science module and yet have a lot of U.S. territory inside, because it's our systems, and the systems are directly interchangeable and common with the Shuttle and with the logistics carriers for the Shuttle. So that's one of the bigger disappointments, is that Priroda had a relatively short life before they're going to dispose of it.

Rollins: Because I'd heard that there were discussions of trying to use some of the stuff from the Mir on the station, but--

Kitmacher: As a matter of fact, we brought back a lot of the equipment that had been on board the Mir back on the Shuttle, and now we're talking about putting some of that equipment on the Russian modules or other modules of the International Space Station. The microgravity glove box, for instance, was something we brought down on STS-89. It's perfectly suitable to fly again and a lot of capability for doing different kinds of experiments and a lot of research work. So we're talking about putting it on either the FGB or the service module or maybe one of the later modules. BTS, and GASMAP are going to required in order to do some of the life science, exercise and medical experiments on board.

So there's a lot of the equipment that we physically did carry. Some of it's available. Some of it we'd have to go to back-up equipment. The MIM, for instance, we decided to leave on board the Mir because the Russians are continuing to use it, and there's no longer any capability to return it to the Earth. But there's a back-up MIM, so we'd be able to put it on board the Russian vehicle.

A lot of the actual systems that we developed for use on the Priroda, the lockers, the SIA racks, the power supplies, those things are all things that are potentially useful. In fact, we have a study going on right now to put some of those even on the first launches of either the FGB or the service module, try to put an early science capability on the International Space Station. This came up a few weeks ago, and some agreements that were reached between the highest levels of the government agencies, they said, "We'd like to provide some useful work for our astronauts and cosmonauts to do early on." They said, "What kinds of equipment do we have available to put on board early, and it has to be available now?"

We built not only a full set of flight hardware, but we built a full set of training hardware. Most of the training hardware was pretty much flight-like or flight standard. And we had a fair amount of back-up hardware. So it's all available and just waiting for someone to make use of it. And then some of the equipment the Space Station people are now taking, modifying it a little bit - lockers and the stowage bags, the logistics system -- and are intending to use offshoots of it. So we did a fairly good job, and now they're developing it for their own purposes.

Rollins: Thank you very much.

Kitmacher: Thank you.

[End of interview]