OLEG S. TSYGANKOV

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Interviewers: Mark Davison, Rebecca Wright, Paul Rollins
[Interview conducted with interpreter from TTI]

Davison: Good afternoon. This interview is between Dr. Oleg Tsygankov and myself, Mark Davison. Dr. Tsygankov is working in the Mir EVA [Extravehicular Activity] Office and working with maintenance on the Mir as well.

Tsygankov: Hello. I'm glad to greet everybody who is with us right now and watching us.

Davison: Dr. Tsygankov, you have a Ph.D. in engineering. Can you tell us what universities you attended in Russia?

Tsygankov: I graduated from the Technological Institute in the city of Kiev. That's in Ukraine. Then I got my Ph.D. from the Moscow Aviation Institute, and my doctorate degree I got at the Kharkov Aviation Institute.

Davison: What part of Russia did you live when you were growing up, and how was life in Russia then compared to now?

Tsygankov: I was born and grew up in the Soviet Union and Ukraine, in the city of Kiev, and that's the city where I grew up, and that's where I attended schools, and that's where I worked. I was the designer of the first welding unit tested in orbit, in the Scientific Institute of Paton. After that, they invited me to work for RSC [Rocket Space Corporation] Energia in Moscow.

Davison: How long have you worked at RSC Energia and what is your job title?

Tsygankov: I've worked for Energia since 1969. I'm the manager of the department which is responsible for the IVA [Intravehicular Activity] and EVA technical support.

Davison: Does your organization write the maintenance procedures that they perform, and do they perform the training of the maintenance tasks for the crew?

Tsygankov: This is the direct responsibility of my department, of my office, to develop the checklist, the on-board communication maintenance activity on the EVA and IVA. We conduct all the training, both at Energia, the crew training, as well as different other organizations that we visit with the crew members, of course, at our facility as well as at the cosmonaut training facility. And by the way, the training on the tools for the EVA for the crew of Mr. Shepherd, they've already completed in our department.

Davison: Tell us a little bit about the IVA and EVA tools on the Mir, the quantity, their stored location, the IVA workbench.

Tsygankov: There is a lot of history involved in here. The first set of tools we put on Soyuz-18 back in 1969. Back then, the weight of that set was 0.7 kilograms. After that, then stations, Salyut, came around then Mir, and we had more and more tools, and within this twelve years of Space Station Mir activity, we've delivered about 200 kilograms of tools and other devices, little by little, with the Progress cargo spacecraft.

Okay. Now that, I’m going to talk about stowage; the Space Station has been up there for twelve years. Nobody has expected that. Of course, when we launched, and, of course, having provided that much space for so many tools, for so many pieces of equipment and hardware to accommodate in different places. The girls that were born back in those days when this station was being designed, for them it's about time to get married now.

So the tools allocated in different places, in different spots, because the spaces that have been designed to put the tools to, they've already filled to capacity. So for us it should be a good lesson for our future joint work at the ISS [International Space Station] and we should provide more space for that, more room for that.

Davison: The IVA workbench, can he describe the one on Mir and the one he plans for Space Station?

Tsygankov: Well, yes, we do have the workbench on Mir, and it was too modest. It's a workbench with special devices to restrain all those tools for work. As far as ISS is concerned, a new station in the Russian segment with design of special module, we call it a docking storage module, but it has been determined when it's going to be born. There are different difficulties, objective difficulties, but it's been designed, and that's where we are planning to put the workbench, and I hope we will achieve it.

Davison: Could you please discuss the Mir airlock, the functionality, the pumps, and the air source, the valves, and the hatch.

Tsygankov: Well, since airlock is not my direct competence, but I'll try to explain it in general. There are two airlocks on Space Station Mir. One is in the core module, but that particular airlock, at the same time, is the adapter to dock other modules, because there are five docking mechanisms. There are four modules docked to that airlock permanently, and one docking mechanism, one port, is used for docking the Progress, the cargo space. So for us it's like a back-up airlock, but lately we haven't been using it.

The second airlock is part of the Kvant II module. On one side there is a hatch where you can open and perform the space walk, and on the other side it attaches to the other module, the part of the Kvant II, which also could be used as a back-up airlock. Well, actually, the airlock on the Kvant II module represents kind of an apartment, three-room apartment, and they connect to each other one by one.   If we walk into the first room, if I may say so, and if there is any problem in that room, then we will move to the next room and close the door. If there is a problem in this room, depressurization or something, we walk into the third room and close the door behind us. That's how we provide the reliability and the safety for the airlock activity.

All those airlocks are connected. They have valves for the pressure equalization, and if you open that valve, you can allow the air to get into that particular airlock using the air from the previous one. Besides that, those airlocks use the independent or stand-alone bottles for pressurization. This system for reliability provision has helped us a great deal within the last twelve years in different situations.

Davison: You might have already answered part of this question. Describe the airlock hatch operation, in particular the malfunction on the—I think they had a hinge at one time and then the latches, when they had the tool that broke.

Tsygankov: You see, nominally it's a very simple operation to open and close the hatch. You see, there are ten latches along the hatch perimeter, and they're all combined into one mechanism. All you have to do to open it is just to rotate that wheel. It's like a car wheel. But there are also ten back-up latches. Each of those latches can be opened and/or closed independently with a special key, and this particular system, the back-up system, is designed to use in case there was a failure nominally.

This system proved itself when we had a problem with the main nominal system for opening and closing the hatch. One of the latches failed in the main system, and we used the back-up system. Of course, the crew used more time and physical efforts as well. Nevertheless, they closed the hatch, with some depressurization, which was not dangerous at that time for the station. We delivered with Progress the back-up latch as a spare part. We were planning to install it instead of the failed one.

Davison: We asked Mr. [Aleksandr P.] Aleksandrov this question, but if he'd like to answer it as well, can you please talk to us about the Orlan suit, the size limitation of the suit, the pressure, and the flexibility?

Tsygankov: Yes. If you ask me, I'll answer. Orlan is a very good tool for the EVA. You can perform any task that might arise during the International Space Station mission, provided if this will be modified accordingly or to meet the needs in space, to perform all those tasks.

The last two or three years of our mutual work with NASA, we've studied, we've learned a great deal about different capabilities of Orlan and EMU[Extravehicular Mobility Unit]. Something is better in one spacesuit, something is better in another spacesuit, but from a standpoint of functionality, I would say they're both equivalent. Orlan would allow a person as high as 185 centimeters—it's about six feet, two inches—to walk into it.

You know what Mr. [Valery V.] Ryumin looks like. You've seen him. He is here for training. He is a big guy, and he worked with Orlan. The pressure in Orlan is 0.4 atmospheres. It's more than EMU, but it would allow it to decrease the process of desaturation. It takes about twenty minutes with Orlan. So if there was a real dire need, then you can real quickly get outside to do the space walk in Orlan suit.

Also, Orlan is like a monostructure. Of course, there are some disadvantages in this concept, but there are advantages as well. A person can get into Orlan without anybody's assistance relatively quickly. You open the door from the back like a refrigerator, you walk into the space suit and close it. Then you're ready to do a space walk. Those are the special features of the Orlan.

Davison: How much involvement do you or your group have in the EVA training in the hydrolaboratory in Russia?

Tsygankov: A hundred percent we're involved. You see, the initial data about the tasks, the purposes, for different training for different missions, Energia determines that, and we generate this document, what to train, how, where, what. We generate that document and send it to the Cosmonaut Training Center, depending on the flight plan, on the flight program. Also this is our responsibility to provide the mock-ups, tools, different devices for the Cosmonaut Training Center.

We develop, also, procedures. Based on those procedures, they conduct training. In other words, I would say that the technical support, the technical controls, so to say, is the functions of Energia, and it's absolutely mandatory that the Energia representative participate in the test.

The Cosmonaut Training Center, of course, they provide the hydrolab and scuba divers and different devices for the medical support, etc.

Davison: Who's responsible for designing, manufacturing, and testing the EVA tools, and could you please describe the process?

Tsygankov: I see you've put together the questionnaire in a very precise way, and you are a very literate person, because this is our responsibility as well. Again, this is our responsibility, and the process is the following. We get the flight plan with the tasks that the cosmonauts should perform, although those tasks also are generated with our participation. We evaluate whether it's feasible or whether it's doable to perform this or that task. So, based on that task and the purposes of that task, we look first whether we have ready tools to perform that task. If we don't have a tool ready to operate, then we write our requirements for our designers for certain tools, and those requirements should contain all the other requirements which would concur with the spacesuit and with different specifics of that particular mission. We send the set of requirements to our designers, and they start developing those tools. Our specialists, they participate in that process as well.

Then during the manufacturing, they monitor the manufacturing process so that the manufacturer adheres to the requirements. Of course, we try to solve all the safety issues at the early stages of design, different shock ranges, things like that. After the tools are ready, one set of tools goes to our department for tests. Of course, we have spacesuit. We have a special stand, a zero-G stand, and that's where we test those tools. Upon completion of that task, we test them in the hydrolab, but at that particular time, based on the purposes of different tasks. We write the instruction, how to use those, and we manifest those tools in the program. And when the time comes and they lose that tool and they can't find this or that tool, of course, they blame it on us.

Davison: It's always easier to blame the other guy. What are the EVA tethering and translation techniques used by the cosmonauts and astronauts in the Orlan suit on Mir?

Tsygankov: I always say that since we have one space to share, so the technology is the same on both sides of the ocean. Of course, on that spacesuit we have a tether with a lock. One tether length is one meter, and the other one can extend up to two meters and then retract. Also, we use foot-restraint units for certain workplaces. We translate along the surface of the Space Station using the handrails. We walk using our hands, not our legs.

There are some differences in methodology and procedures using this kind of equipment. We try to use foot restraints not that often. In the course of a long-duration flight, we learned that the person can adjust to weightlessness, even if he works in the space suit center. Only when we need some certain very specific, very precise operations with two hands, using two hands, or when we have to use great effort, physical effort to do something, only then we use those foot restraints in a certain spot, which is called "anchor." The name speaks for itself, you know, "anchor."

Also there is a difference, on the American spacesuit you have a winch which could extend that tether up to fifteen meters so that the crew may use this kind of restraint, to “lock” themselves in one place and walk to the other one. What we usually do is one tether removed, we translate it, then it takes another one, and then on and on, one more time. You see the differences that that winch system that American astronauts use, we use it on Shuttle, which is straight lines.

The station consists of a cylindrical surfaces, and it looks like a hedgehog, the different batteries and the antennas, so if you hook that tether somewhere in the far corner of that station and then try to translate, it might tangle or catch on something. Nevertheless, I do like that option with the winch, and recently we've used that option, we've used that variant with the winch. We tested that NASA winch on Mir recently. In a recent flight, Scott Parazynski used the Russian procedures, the Russian restraint protocol. He used two tethers since his winch was broken.

But together with the American method, together with Richard Fullerton's team, we have developed what we call a hybrid anchor, which would work both with Russian space suit and American spacesuit boots, and this anchor will be installed in all the places on the International Space Station, both in the Russian segment and the American segment.

Davison: I agree with him, that we have both learned very much from each other in these exchanges.

Tsygankov: That's true.

Davison: How much support does your group provide to the Russian MCC [Mission Control Center], the TsUP, during the Mir EVA maintenance?

Tsygankov: For each of the EVAs, in my office we have specialists, we have experts who were and are responsible for that particular operation, for that particular task, from the time of the development of that EVA through testing, through training and implementation of that EVA in space. That person is at all times at the MCC Moscow. He is one of those few guys who is allowed to directly communicate with the crew. Always my concern—I'm always worried so this guy won't get hurt or won't get sick, and get there in time, because otherwise I'm the guy who's sitting there and having direct communication with the crew members.

Maybe you'll be surprised, but we try not to interfere with the crew operation, especially during the communication session. Sometimes there are too many people on the ground that would like to talk and would like to ask different questions, so we talk to them only when they ask us, only if he doesn't understand something or some situations, some surprises. Of course we help them, but we try to limit ourselves, not to interfere.

There's a third crew member on board who is assigned to perform certain functions, so they can get help and assistance from us at any time, and if they're outside the range of visibility, they work by himself, but if there are any major surprises, any situations, they have the instructions not to do anything by themselves, wait till the next orbit, till the next radio session. That's how we organize all that. And, of course, prior to the EVA we discuss everything in great details with the crew members, and we conduct even on-board training with them.

Davison: I'd like to ask him a couple of questions that aren't on the list.

Tsygankov: Okay.

Davison: Can you tell us and the audience about your welding unit that you designed, that you mentioned earlier?

Tsygankov: Yes. It was called "volcano." It's a multipurpose welding unit. It's been designed and developed in the city of Kiev and the Welding Institute of Paton. Back then I was a designer at that particular organization and on the agreement between Mr. Paton, who was director of that institute, and Mr. Korolev, who was the general designer, we decided to perform that first experiment on the welding in space.

I was one of a few designers of that unit, and then back then I was young, I've become a test guide for that particular unit. I was a test specialist. We tested it on the plane during the parabolic flight and we confirmed its capability. It's a very, very complicated physical and technical issue, very complicated. How does it behave in zero-G? How does it behave in vacuum? How does the liquid metal behave under those conditions? It's a very complicated issue. Nevertheless, we've conducted that experiment, and after that, on Salyuts and Mir station, we've conducted a few more experiments, on the welding, on how we put the cover on the hot metals.

And you know, probably are aware of that, that recently they've conducted an experiment between the United States and Ukraine, and it didn't take place, unfortunately, because the hatch on the Shuttle didn't open, and they moved that particular experiment for the next flight, but at that moment they excluded that welding unit from the Manifest. But that's not the end. They're planning for STS-91 to deliver that unit to the Mir station and to conduct that experiment and in the American interest with American materials. While here, my experts in Moscow, they started the testing this unit, but still it's yet to be decided whether be they would manifest that unit into STS-91.

Davison: Another question I have for you is, the ring pen you have on your hand there, was that your design for orbit?

Tsygankov: Yes. That's a restraint. I'm not the only author of this. There is one guy from Hong Kong here. So we together came up with this idea so whenever you need to write, you can move it here and write. You can try it, write, and fix it this way. Okay?

Very high technology. High tech. It's one guy, that Chinese man from Hong Kong, helped me to install the ring on certain different tools.

Davison: The final question before we get kicked out of our room. Of your almost thirty years in the space program, what would be your greatest accomplishment or your most memorable moment?

Tsygankov: Well, it's not just an achievement; it's a bunch of achievements put together. Well, on a few occasions, yes, we managed to save Space Station Mir using our EVAs, using our tools. So I think that's an achievement as well. So, in the end I'd like to say the spacecrafts like Space Lab, Salyut, Mir, Shuttle maintenance and the EVA helped to repair, to save the program in general, but in principle, yes, you could do without it. The program would have been a little bit smaller program, fewer things to accomplish, but nothing drastic.

But ISS, by its essence, by its concept, cannot be built, cannot be created, without the EVA. We will build it up in space. It's a lot like they now build ships. They put it on the water and then they start to build up. Same thing with the station. So there should be an entirely different approach to EVA and the maintenance and other issues. Otherwise, there won't be an International Space Station without it, the way it has been designed initially.

Davison: I agree.

Rollins: What's your favorite beer?

Tsygankov: Milk.

Davison: Thank you. [Laughter]

Tsygankov: A friend of mine told me one story. Russia is a huge, big country as far as the territory is concerned. It's huge. It's bigger than the United States, but it's not bigger than Texas. [Laughter]

Rollins: A very smart man. [Laughter]

[End of interview]