

**MEETING WITH OFFICIALS FROM
YONGBYON NUCLEAR SCIENTIFIC RESEARCH CENTER
1300-1530 AUGUST 25, 2005**

Place: Potonggang Hotel, Pyongyang, DPRK

Present: Ri Hong Sop, Director, Yongbyon

Kim Hak Son, Official and Interpreter, Yongbyon

Kim Chol Nam, Senior Official, Department of External Affairs,
General Department of Atomic Energy

Gyong Hwa Suk Official, General Department of Atomic Energy (Recorder; female)

Kim Myong Gil, Bureau of American Affairs, Foreign Ministry

After initial pleasantries where Lewis referred back to January 2004 visit to the Yongbyon Center, he turned the “chair” over to Hecker. Hecker then made brief introductory remarks and Ri responded.

Ri: “It is very good to meet you again. We hope this meeting answers your questions and helps resolve the nuclear issue.” He then introduced his colleagues and said, “So, please now ask your questions.” Hecker responded by referring to the January 2004 trip and said, “It would be good to look at the current situation and to compare it to the situation in early 2004. What has changed? What has happened at Yongbyon since then?”

Ri: “There is a reason why we could not allow you to come to the Center even though you had requested to do so. We are running the reprocessing facility right now. When we run that facility, we do not allow foreigners visitors to come. There is a high radioactive background at the facility. This includes such isotopes as iodine 131 and krypton 85. So we cannot allow anyone to come during this reprocessing. Only the operators can enter the facility while this [reprocessing] is going on. This is a safety and health issue, so your August visit to Yongbyon was not possible.

“Moreover, in January 2004 – the last time you were here – your visit to the facility was an exceptional case.”¹

The 5MWe reactor.

Ri: “You visited the 5MWe experimental reactor when you were there. It had been running since January 2003. We were running it at 25MWe. We ran it continuously until mid-March 2005, when we shut it down. We discharged the fuel from the reactor in April, and it took us one month to remove all the 8,000 fuel rods. We then serviced [“maintained”] the reactor in late April and May, and in late May we recharged the reactor with new fuel. This took us until mid-June, when we restarted the reactor.

“The reactor is now rated at 25MWth” At this point Hecker asked: “Is it correct that in the 1990s you ran the reactor at 20MWth?” Kim answered: “The reactor began operating in 1986. In that

¹ On August 26, Vice Minister Kim Gye Gwan told Hecker, “You are the only scientist we know. We have a special relationship with you and no other scientists.”

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early start-up period, we kept the reactor output very low. We needed lots of tests. Learning how to replace damaged fuel rods while the reactor was operating was one of the problems. It took us a long time to find the damaged fuel rods in the core.

“From 1986 to 1994, therefore, the output of the reactor was low. But when we restarted the reactor in January 2003, we had no such problems, and could run at full power. We had learned a lot, and we could run the reactor at its rated power output of 25MWth. From there on it was possible to run the reactor at its rated power.” Hecker asked about the dummy fuel rods. Ri said: “We learned how to put dummy steel rods in the core. These allowed us to maintain a flat neutron flux. That is the current situation.”

Hecker said: “When we visited the reactor in January 2004, you told us that you could run the reactor virtually indefinitely. Hence, we were surprised that you shut down the reactor in March 2005 after only about two years of operation.”

Spent fuel rods and reprocessing.

Ri answered: “You ask why we unloaded the reactor in April. There were two reasons for the decision to unload the reactor then: (1) The rods that were inserted into the reactor in January 2003 had been fabricated before 1994. As you know, the fuel fabrication facility had its operation frozen and the facility sealed in October 1994 under the terms of the Agreed Framework. So the fuel rods were 10 years old, and we needed to remove and examine them. (2) We needed to extract the Pu.” Hecker: “Why not wait longer? You would have gotten more plutonium.” Ri: “We really needed to examine the spent fuel rods.”

Hecker: “What did the rods that you extracted look like?” Ri: “Their appearance was really quite good. It exceeded our expectation. As you know, the fuel rod cladding is made of Magnox. After we removed the rods, the cladding was in good shape. We could have run the reactor much longer, as it turned out.”

Hecker: “What was your plan for storing the spent fuel rods?” Ri: “Our plan was not to store it for long in the pool. So now [August 25, 2005] almost all of the spent fuel rods are out of the cooling pond. The cooling process is over, and the activity [radioactivity] of the rods has become low enough for safe removal. The time we left them in the spent fuel pond was long enough. The activity of the fuel rods has dropped enough. Almost all of the spent fuel rods are out of the pool now.”

Hecker: “What was the effect of the storage in the pond on the Magnox?” Ri: “We noticed a change in the color of the cladding. But that change was really quite small. You Americans know all about our cladding because you handled the spent fuel rods for over 8 years after the Agreed Framework went into effect.”

Ri continued: “Now the process has shifted to the Radiochemical Laboratory – the reprocessing center. After the period of cooling was over, we immediately started reprocessing in late June. The original throughput capacity of the facility was 375Kg of uranium per day. We told you this earlier. However, in the last period we modified the facility so we could increase the throughput

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by 1.3 times [roughly 487 kg of uranium/day]. We changed the box-type mixer/settlers to vertical partition columns. With the increase in capacity, the processing of the 8,000 rods is in a late stage now.”

Hecker: “In the reprocessing plant, the IAEA indicated that you had two reprocessing lines. So is the reprocessing at the rate of 375 kg per operating line or for both lines? That is, has the second line been finished?”

Ri answered: “When we say two lines, we do not refer to two separate reprocessing lines. One of the lines is a spare; that is, we only use one line for reprocessing. We also use that other line as a waste management line, so when we talk about the ‘two lines,’ these are lines with different functions.”

Hecker: “So the spare line can be regarded as a main line that you can switch to if you run into trouble?” Ri: “Yes.”

Hecker: “Is my understanding correct, that you expect to complete the reprocessing quite soon? When you do the reprocessing, do you go all the way to Pu metal? We thought you might stop at PuO₂, which is easier to store for long periods. So what do you do with the final Pu product?” Ri answered: “We are doing the same now as we did before. We are reprocessing the entire product into metal.” Hecker asked what the fuel burn-up was.

Ri continued: “From January 2003 to March 2005, the reactor was operating continuously [that is, for over 25 months]. You can calculate the burn-up easily yourself. The reactor is now running again after we maintained and recharged it.” Hecker: “Is it running well?” Ri: “Yes.” Hecker: “In January 2004, you said you had only one more load of rods ready to go. Is that this charge [you used in recharging the reactor]?” Ri: “Yes.” Hecker: “Do you feel good about putting this fuel in for several years?” Ri: “Yes, we can run the reactor as long as we need.”

The fuel fabrication facility.

Hecker: “What are you doing about fuel fabrication?” Ri: “We have some rods. We are maintaining the fuel fabrication facility and preparing to make new rods. The main problem with the facility is corrosion because it was frozen [and not taken care of] during the period of the Agreed Framework [October 1994-January 2003]. There is a problem with the fluoridation process. Some parts of it even collapsed because of corrosion.”

Hecker: “Did you make rods for the 50MWe reactor?” Ri: “We only made the rod cores, not the magnox cladding. The dimension of these rods differs slightly from the 5MWe reactor rods.” Hecker: “What was the last time you ran the fluorination facility in the plant?” Ri: “The last time was just before the Agreed Framework came into force. The facility was under IAEA safeguards.”

Hecker: “You have not made any UF₄?” Ri: “Yes, and we have not made any UF₄ since the Agreed Framework.”

Hecker: “How long will it take you to get the fuel fabrication facility up and running again?”

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Ri: “We are maintaining [refurbishing] one fabrication line. We will be able to start making fuel for the 5MWe reactor next year. We will not make fuel for the 50MWe or the 200MWe reactor then, but the uranium alloy is the same.

The 50MWe and 200MWe reactors.

Hecker: “The question of what to do about the 50MWe and 200MWe reactors was being considered in January 2004. What is their status now?” Ri: “As for the 50MWe reactor, we have completed the design, and we are preparing the construction worker teams for this reactor. On the 200MWe reactor, we are still studying what to do now. The investment in rebuilding that [200MWe] reactor will be bigger than the investment in a new one, but we have a methodology for recovering the construction of the 200MWe reactor. We have begun to prepare teams for this reactor. We are preparing the design for the reactor.

“On the 50MWe reactor, some parts can be recovered and some of the old fabricated parts can be installed. We will build – or rebuild – this reactor on the current site.” Hecker: “On the 50MWe, was there anything inside the building?” Ri: “Only the containment vessel. The containment vessel was there, but no core. We were preparing to install the core, and we had built parts of the core elsewhere. We were preparing to move those parts into the containment vessel. So, in 1994, some parts of the core were made but not installed.”

Hecker: “Can you use the current containment structure?” Ri: “We have made the decision to use the current containment vessel.”

Hecker: “Who does the safety controls on the design and installation?” Ri: “We have a regulatory body in the DPRK that does it. This is a department under our government. It is not part of the Ministry of Energy. We need to get a license from the body.” Lewis asked: “What is the body called?” Ri: “It is called the State Nuclear Regulatory Commission. It is the one that issues the license.”

Hecker then asked: “Does the Commission control the start of the reactor’s operation?” Ri: “Yes.” Hecker: “Do they inspect during the reactor’s operations?” Ri answered: “No. After we get the license, the Commission inspectors do not come again. We do our own operations inspections. We do the safety inspections. Hecker asked if the inspectors report to the director. The inspectors report to the director, to me. However, they do not report to me unless there is a problem. If there is a serious problem, they have the authority to shut down the reactor.”

Hecker: “How long will it take to finish the 50MWe reactors?” Ri: “We do not yet have a date for its completion. The only problem is the outmoded design of the graphite-moderated natural uranium reactor. We are confident the construction will start soon, but we cannot give you the details now.”

Ri continued: “We have been very busy.” Hecker: “Will fuel fabrication for this reactor be a big difficulty?” Ri: “There should be no problem. The fuel is the same and the cladding is almost the same for the 50 as for the 5MWe reactor. The cladding for the 200MWe reactor is more complicated.”

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Lewis asked: “Where will the electricity go from this reactor – to the local community like the 5MWe reactor at Yongbyon or the national grid?” Ri answered: “To the national grid.”

Hecker asked: “What else is going on at Yongbyon?” Ri said: “There are the reactors, the fuel fabrication, the reprocessing facility, the isotope use, and the development of detectors.” Hecker then asked: “Do you do isotope production?” Ri: “Yes, we are making our own isotopes. There is a large demand for isotopes from hospitals.”

The IRT reactor.

Ri continued: “There is a research building behind the IRT. This came from the former Soviet Union. Since then we have not had enough fuel rods for the reactor. We have been running the IRT to make isotopes, but we only run it from time to time. We are running short of fuel rods for this reactor.’

Hecker asked: “What isotopes do you make?” Ri answered: “We make iodine 131 for thyroid treatment. We produce isotopes on order.” Hecker: “How do you extract the iodine? Do you use the hot cell that is connected to the IRT?” Ri: “Yes. It is connected by an air pipe. The IRT was under IAEA inspection as early as the 1970s and was not part of the Agreed Framework.” [Later Ri said that the reactor was only inspected by the IAEA once or twice. “They were not very interested in it.”]

“At the beginning of its operation, the output of the IRT was 2 MW. We then increased it to 8 MW. We did so by changing the enrichment of the fuel rods. These rods were purchased from the Soviet Union. The enrichment level [of the rods] went from 10% to 80% and from the rod-type fuel to multiple-tube rods.”

Hecker: “When did you last receive fuel for this reactor?” Ri: “From the 1980s. This was the last fuel we received from the Soviet Union. We never received fuel from Russia.” Hecker: “How do you run the reactor when you have no new fuel?” Ri: “This is why we are running the reactor intermittently. We want to purchase more fuel. Our plan is for Yongbyon to produce isotopes. There is an urgent request in our country for isotopes. Right now, if we were able to get fuel, we would prefer they have 80% enrichment. We have a lot of 36% rods. The USSR liked rods enriched to 36%.”

Hecker: “What happens to the spent fuel from the IRT reactor?” Ri: “We store it in the spent fuel pond. This was under the IAEA supervision and inspection. The pond is in the IRT building. However, the IAEA came to the facility only once. They were not very interested in it, because they did not regard the reactor as significant.”

Hecker: “Does any other facility make isotopes?” Ri: “Some short-lived isotopes are made elsewhere. This is outside of my area. It is not under the Yongbyon authority.” Hecker asked if these were made in a cyclotron and if there are two cyclotrons in Pyongyang. Ri: “There is only one cyclotron. It is in Pyongyang, and there is no other [facility that makes isotopes].”

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Hecker: “Is anyone thinking about a long-term plan? Would this [isotope production] be an area of growth if you could get the fuel?”

Ri: “This is an urgent need and would be a good business. We are looking for this kind of business.”

Hecker: “Do you do research on neutron scattering?” Then he added in jest, “This could be a good job for me.” We had an older reactor at Los Alamos, which was converted to isotope production. After some years, we had to shut it down. It was very expensive. How long will the IRT be safe?” Ri said: “We did use the reactor for a long time. The only problem is with the reactor lining. If we change the lining, it could last for another 20-30 years.” This ended the IRT discussion.

We then took a ten-minute break at 2:50, which turned out to be a 25-minute break. We resumed at 3:15.

Hecker began: “I have two more technical questions, on cladding and spent fuel. How long can the spent fuel rods be kept safely? For many years?”

Ri answered: “We discharged the fuel from the 5MWe reactor in 1994 and did not look at it until 2003. At that time the cladding was pretty much destroyed. So we can only store the spent fuel safely for five years. This depends on the burn-up of the fuel. When we say five or six years, this is based on a burn-up of 600-700MWth-days/ton of uranium.

Control of dangerous gases.

Hecker: “What do you do to trap the dangerous fission gases? Do you use filters?” Ri: “We can trap the iodine 131 gases, but we have no filters for krypton 85. We would need to condense the gas at very low temperatures. We need to make greater efforts to trap the krypton gas. This is still under investigation worldwide.”

Hecker: “What about gases inside the building and your concern for the workers’ safety?” Ri: “Inside the building, we have a powerful ventilation system. We are concerned about the gases outside the building. The gases influence those outside the building.” [An interesting aside – during our Jan. 2004 visit to the Reprocessing Facility 3rd-floor corridor, the Chief Engineer said that they cleaned the corridor down before our visit so it is safe. So apparently they do get contamination inside the building also because of inadequate filtering.]

Weapons.

Hecker: “On February 10, your government announced that you had manufactured nuclear weapons. What is the role of your center beyond the materials production?” Ri: “We have only the role in the production of Pu metal. Then the material goes to someone else. I don’t know what happens beyond that.”

Civilian nuclear energy and proliferation risks.

Hecker: “On the discussion about different types of reactors, what is the potential nuclear weapons threat from LWRs? Does the Ministry of Foreign Affairs ask for your [Ri’s] advice on the threat from the fuel cycle?”

Ri: “Let me explain my view on this issue. If the fuel is burned out to the rated power in the LWR, there is a theoretical potential to use it to manufacture nuclear weapons, but this is basically technically impossible. It may still be of concern to some countries. It is practically impossible. We cannot say we should not develop LWRs because of the nuclear weapons concern. There is no practical concern for using the extraction [of fissile material] from the fuel [from LWRs] for nuclear weapons.”

Hecker: “What about graphite-moderated reactors?” Ri: “If you use a graphite-moderated reactor, then it depends on conditions. If there is a total burn-up of the fuel to 3,000MWh-days/ton of uranium, then there is no chance of using it to make a nuclear weapon. This also depends on the manufacturing capability of the particular country.”

Hecker: “On LWRs, you have a problem with enrichment at the front end?” Ri: “At the present time the only way for us to get the fuel rods is to purchase the fresh fuel rods. The South Koreans buy their fuel rods [from abroad].” Hecker: “How would you handle spent fuel?” Ri: “This depends on the contract between the importer and the exporter.” Hecker: “Could you modify the current reprocessing center to handle the spent fuel?” Ri: “Yes, we could modify the center, but this would be very difficult.” He added, “It would be best to send the fuel back.”

Lewis then talked about the conversation that he and Ri had in the car at Yongbyon in January 2004. At that time, Ri told Lewis that Yongbyon had acquired (“purchased”) a small number of gas centrifuges from Urenco and had pursued a dual path toward the bomb – “like other countries seeking nuclear weapons” – until late 1992, when they were convinced that the reprocessing center could do mass processing. Ri seemed very agitated by Lewis’s statement and vehemently denied that any such conversation had ever occurred. He said: “that is really incorrect. You do not have the right explanation.” Then in a somewhat calmer mood he added, “Before we experimented with which way to go for nuclear power (either LWR or graphite-moderated), we investigated all the ways to achieve nuclear power. We decided to go only one way. We didn’t have any spare resources to pursue two paths.” Lewis: “So you never purchased gas centrifuges?” Ri: “That’s right, we never did.”

Hecker then asked: “Did you investigate different reactors? One path was to enrichment and the other not to enrichment. How did you investigate this? By investigate, did you mean analyze?” Ri: “In the 1990s, we did not have any reactors. At that time, we developed an investigation plan, and we investigated all the possible technologies. We decided that the only one we could develop on our own [because of the available uranium] was the graphite-moderated reactors.”

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Hecker: "If the country's diplomats decide to end the graphite-moderated programs, you will need technical people to advise the political sector about alternatives. Have you thought about this?"

Ri: "No, I have not thought about that. We believe, however, that we can solve any technical problems. If we have to do this by ourselves, the graphite-moderated reactor is the way to go. We would need help [on fuels and some of the technologies] if we adopted LWRs. Would your people," he said looking at Hecker, "be willing to be involved with us on LWRs? We could only do some things, and most of the people would have to do other jobs."

Lewis asked about Yongbyon's possible involvement in technical working groups if these were established to support the Six-Party Talks. Ri: "That's up to the Foreign Ministry; it's their decision, not mine."

Lewis repeated his previous offer to invite Director Ri and his people to meetings on nuclear safety and security, such as the ones organized at the University of Salzburg, where Lewis serves on the board of advisors. Ri and a colleague had been invited to the University's International Conference on Nuclear Energy and Security in July 2005, but had declined the invitation. Ri said that he has been very busy in July and added: "If future meetings are held and if time allows, I would interested in an invitation."

Pritchard asked: "Where did the personnel for the Kumho KEDO project come from?" Ri said: "They came from different organizations, but they did not come from my organization." Hecker: "Do you work with the DPRK Academy of Sciences?" Ri said: "No." Hecker: "Do you relate to the universities?" Ri: "No." There is only a relationship on some academic questions.

Lewis asked Ri if he was optimistic about resolving the nuclear issue. There was lots of chatter among the Foreign Ministry officials present before Ri answered. Ri then said that he couldn't tell. "Relations change too often."

Hecker asked Ri if he had any questions. Ri answered, "What will you do with this knowledge?" Both Lewis and Hecker tried to answer Ri and compared their low-profile this time with the very high-profile visit last time. Hecker ended by saying: "We will return to our country and relay what we saw here." Hecker stated that after the January 2004 visit, he was asked to give a report to the U.S. Congress. He added that he had sent a copy of this report to the DPRK Ministry of Foreign Affairs in 2004. Hecker presented Ri with a copy of the report and also gave him an article on the January 2004 trip that he had written for the U.S. National Academy of Engineering.