

STEP-BY-STEP NUCLEAR CONFIDENCE BUILDING ON THE KOREAN PENINSULA: WHERE DO WE START?

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ABSTRACT: *Nearly a decade has passed since the Joint Declaration on the Denuclearization of the Korean Peninsula was promulgated in December, 1991. Many books and reports were published on the subject of nuclear crisis of DPRK and subsequent remedy through international diplomacy over one of the most challenging nuclear proliferation concerns of the 20th century. The Agreed Framework of 1994 between DPRK and USA seems to bring a nuclear crisis in the Korean peninsula under control. Supplying two light water reactors (LWRs) and heavy fuel oil while all graphite reactor facilities in the DPRK remain frozen, which is unprecedented in non-proliferation history, is nevertheless proceeding with limited success. Year 2001 is bound to be a critical juncture in the nuclear confidence building as the new atmosphere for dialog among DPRK and USA is reshaping as well as the much delayed LWR construction is expected to gain momentum. This paper intends to review the crucial stages managed by two Koreas, USA, KEDO and IAEA during the past decade, possibility of improvements in the Agreed Framework, KEDO LWR construction milestones with respect to the non-proliferation goals, and the challenging IAEA verification roles. Specific steps which are being taken by two Koreas and concerned entities are reviewed and recommended towards creating proper atmosphere for nuclear confidence building in the Korean Peninsula.*

Joint Declaration on the Denuclearization (the starting point)

On December 31, 1991, North and South Korean prime ministers signed the Joint Declaration on the Denuclearization of the Korean Peninsula. It was announced as a surprise to most of the concerned parties for its contents and timing. It became effective as of February 19, 1992 without going through the parliamentary ratification process. The ultimate goal of the Joint Declaration was to “eliminate the danger of nuclear war and ultimately promote peaceful reunification”. With the in mind, two Koreas have agreed to a detailed list of actions:

1. The South and the North shall not test, manufacture, produce, receive, possess, store, deploy or use nuclear weapons;
2. The South and the North shall use nuclear energy solely for peaceful purposes;
3. The South and the North shall not possess nuclear reprocessing and uranium enrichment facilities;
4. The South and the North, in order to verify the denuclearization of the Korean Peninsula, shall conduct inspection of the object selected by the other side and agreed upon between the two sides, in accordance with procedures and methods to be determined by the South-North Joint Nuclear Control Commission.
5. The South and the North, in order to implement this joint declaration, shall establish and operate a South-North Joint Nuclear Control Commission within one month of the effectuation of this joint declaration.
6. This Joint Declaration shall enter into force as of the day the two sides exchange appropriate instruments following the completion of their respective procedures for bringing it into effect.

The Joint Declaration sets an ambitious nuclear non-proliferation agenda for both Koreas. It goes well beyond the NPT regime by prohibiting nuclear fuel reprocessing as well as uranium enrichment, and stationing of nuclear weapons in those two non-nuclear weapon states. In fact, immediately after the Declaration, US government announced unilaterally that it has pulled out all nuclear weapons from ROK soil. It also created an additional burden on peaceful nuclear fuel cycle activities since ROK was promoting aggressive nuclear power development program from early '80s to construct a series of Korean Standard Nuclear Plants (KSNP) through technical self-reliance campaign.

A decade later, ROK is among the top ten countries in the world in nuclear electricity generation delivering over 40% of the nation electricity with its 16 operating nuclear power plants and 6 more under construction today. Ironically, while the nation is legally prohibited to conduct any activities in nuclear fuel reprocessing and uranium enrichment by the self-proclaimed Joint Declaration, sheer economic needs for such activities are increasing due to a large number of LWRs under operation. It is also recognized that the main solution to the nuclear crisis through KEDO LWR construction stems from the very KSNP nuclear power plants which are repeatedly proven successful in ROK with commercial operation of Yonggwang and Ulchin nuclear power plants.

JNCC and Mutual Inspection

North and South Korean government authorities created JNCC with policy team and technical expert groups immediately after the Joint Declaration and met 13 times during 1992-93 time frame. Despite the optimistic beginning, however, the JNCC meeting did not produce any agreement and became standstill with the last N/S JNCC meeting held in April, 1993. Although no follow-up actions in mutual inspections did materialize from this first encounter by both Korean nuclear officials, the Joint Declaration is still regarded as the only effective nuclear agreement between two Koreas today as exemplified at the June Summit of Pyongyang in 2000.

In the hindsight, two Koreas had little experience in defining an adequate bilateral inspection regime, particularly given that their basic relationship was still under suspicion and mistrust. Although the common goal of JNCC through mutual inspection was to verify other side's nuclear capabilities to bring confidence building between two Koreas, detail means to reach confidence was far apart. While South wanted to verify the North's nuclear capabilities by primarily inspecting Yongbyun nuclear center, North wanted to verify the absence of nuclear weapons deployed at all US military bases in the South. South offered equal number of inspection at both nuclear research centers as well as military bases in both sides, but could not reach any agreement.

It was apparent that JNCC could not function as desired simply because neither sides were prepared to conduct any meaningful inspection activities at that time due to lack of preparation. Technical capabilities in nuclear verification need adequate manpower, equipment and training which requires sufficient experiences. However, this very first historic encounter between two Koreas' nuclear officials has left an important precedent to be pursued during the subsequent decades. As witnessed during the 90's, South Korean nuclear program flourished significantly with new KSNP power reactors coming on line, and Technology Center for Nuclear Control (TCNC) was created at KAERI in 1994. TCNC was given a mission to develop and implement nuclear inspection activities through nuclear material accountancy control, physical protection and export control in support of the Ministry of Science & Technology(MOST). Creating of TCNC was a direct outcome

of JNCC activities and also in response to increase cooperation with IAEA. Nuclear materials and facilities under IAEA safeguards have more than doubled in ROK in the past decade, becoming only second to Japan among Asian countries. In fact, ROK is entering into an enhanced cooperation with IAEA on its twelve operating LWRs where both sides share inspection activities and raw data using remote monitoring surveillance. This technology could help the DPRK when their LWRs become ready for operation.

The Agreed Framework (Room for Improvements)

Nuclear Crisis and the Agreed Framework (AF)

The year 1994 was to be remembered as a nuclear crisis that developed suddenly after the inconsistency issues discovered following the IAEA ad-hoc inspections. In April 1994, DPRK discharged all 8,000 fuel rods without notice from the only operating graphite 5 MWe reactor at Yongbyun. Following 6 months must be one of the most tense period in the Korean peninsula with the death of Kim Il-Sung and reaching the Agreed Framework between DPRK and USA on Oct. 21, 1994.

As was the Joint Declaration of 1991, the Agreed Framework contained many elements of surprise and truly being a one-of-a-kind unprecedented agreement in the non-proliferation history. Unlike Iraq where its rogue behaviors were punished by air strikes at Gulf War, DPRK was rewarded with two light water reactors (LWRs) for 2000 MWe of electricity production in return for their freezing all existing graphite reactors and fuel cycle facilities. This landmark agreement, which were reached in only six-months time frame between U.S. and DPRK in front with close consultations with ROK at Japan behind the scene, is bound to have some incompleteness, unresolved issues and thus room for improvements as described below.

Missile Crisis and the AF

Another type of unexpected crisis developed in 1998 when DPRK fired a Nodong missile over Japan island. Although it did not violate any international treaty obligations per se, it created compounded threat particularly when nuclear and missile capabilities are taken together, and resulted in LWR schedule delays. Perry report of 1999 essentially attempted to take a five-year-old Agreed Framework a fresh look, and considered a step-by-step comprehensive approach with missile and nuclear issues in hand. New administration in Washington now attempts to bring these issues under control with strengthened verification measures. For example, the Korea Task Force report from the Council on Foreign Relations (CFR) made a policy recommendation in June, 2001 to Bush administration that the Agreed Framework be expanded to address DPRK's power infrastructure when the missile issues can be properly controlled.

Unresolved Issues in the AF

- Electrical power shortage and severity of poor power infrastructure in DPRK is much worse than initially anticipated. With severe drought and delayed construction of KEDO LWRs, their electricity situation will get much worse before LWRs start generating power. In addition, transmission grid to bring the electricity from LWR site at Kumho to consumers needs total overhaul. Unless power transmission lines are upgraded by the time LWRs are ready for operation, the new power reactors cannot operate. This problem was recognized from the beginning by KEDO, and their official position remains to be merely "assist DPRK to make loan arrangements for the transmission grid", beyond which is clearly out of current KEDO scope. As recommended by the CFR to expand KEDO scope to include improving electricity

infrastructure with favorable missile conditions, then the transmission line problem can be considered in this context. Remaining question is then who pays, and how much?

- The AF stipulates that the spent fuel from 5 MWe reactor be stored and ultimately disposed of in a manner that does not involve reprocessing in the DPRK. So far US has taken initiative to can and seal all 8000 spent fuels in 220 stainless steel canisters and kept under water pool at Yongbyun's 5 MWe reactor fuel building as an interim storage. Crucial question remains as to when and by whom these spent fuels be permanently disposed of. Being a Magnox type natural uranium metal fuel, it cannot be kept under water indefinitely without being reprocessed. Only countries who are equipped to conduct Magnox reprocessing are UK and France, but again questions are who pays and when this final disposal should take place.
- The AF stipulates also that the complete dismantlement of the DPRK's graphite-moderated reactors and related fuel cycle facilities will be completed when the LWR project is completed. This is to dismantle all five facilities under freeze and make them irreversibly unusable. The subject facilities are 5 MWe, 25 MWe graphite reactors, fuel fabrication plant and radiochemical laboratory (which is a reprocessing plant) at Yongbyun, and 200 MWe graphite reactor at Taechon. Since only the 5 MWe reactor, radiochemical lab and fuel fabrication plant were under operation and thus radioactive (while others were under construction and thus not radioactive), those three facilities will take considerable amount of effort to decontaminate and dismantle at Yongbyun. Again, who can do it, who will do it, and who will pay is not clear. However, this is more of radwaste disposal and environmental issue, then there exists a possibility that North and South could form a joint research task when certain conditions are met.

Fossil Plant Replacement (?)

Due to LWR project being delayed over 5 years and the DPRK's electricity shortage becoming increasingly acute, some sectors of US NGOs have suggested that currently ongoing KEDO LWRs (1 or 2 units) be replaced by fossil power plants. Underlying assumption is that if this can be done, then 1) new electricity can be generated much sooner than from LWR operation, 2) it may end-up costing less than LWRs, and 3) proliferation potential from LWRs can be eliminated. Careful examination on the current KEDO LWR construction status (as further described in section 3) reveals that the LWR construction progress has reached the 13% mark as of July 2001 and to stop it now will create a huge financial loss to begin with. Fossil plant will take less time to build but to start from scratch now means final time saving may be only minimal. In addition, fossil plant needs heavy dependence on imported coal for fuel and who can afford the fuel cost? Finally, the proliferation concerns over LWRs is only of academic concerns and it cannot be achieved in reality. First core load fuel is to be supplied from ROK and any sign of abnormal spent fuel handling from the first core will stop the next fuel shipment to the North. Besides, their reprocessing capability is for Magnox metal fuel (even then, main facility still unfinished and remain frozen for the last seven years) which is considerably different from the LWR spent fuel reprocessing.

The KEDO LWR Construction (Promises Come True)

Construction Permit and Reactor Excavation

Despite many delays experienced on the LWR project since the creation of KEDO in 1995, the project appears to be moving ahead and on schedule since all supply contracts between KEPCO,

the Korean electric utility and prime contractor for KEDO, and its suppliers became effective on February, 2000. All participants to this contract are well known and proven partners through many repeat KSNP projects in the South. Only exception to the team was General Electric who was to supply a portion of turbine-generator systems. GE bowed out of the project on the ground that the project cannot provide nuclear liability insurance as they requested.

Since the design and engineering of KEDO LWR plant is virtually copy plant of its reference plant at Ulchin unit 3&4, safety review and licensing activities are moving ahead without major difficulties. Only concerns stem from site-specific factors of the Kumho site in North Korea. Korea Institute of Nuclear Safety (KINS), together with IAEA and group of international nuclear safety experts, is providing licensing support service to KEDO. Newly formed nuclear regulatory authority in Pyongyang is expected to grant the construction permit on KEDO LWRs soon, and this will activate the reactor building excavation work at Kumho site before the end of 2001. The long awaited construction milestone, issuance of the construction permit, will signal an onset of a major nuclear construction activity to commence.

Nuclear power plant construction activities may not be much visible at the construction site since most of design and manufacturing work are taking place elsewhere. In this case KOPEC for architect engineering and NSSS system design, Dujung for NSSS and turbine-generator supply, and KNFC for nuclear fuel fabrication, all proven KSNP supplier in the South, are at their initial project stages of delivering respective hardware components and software designs. Series of technical meeting are taking place between North and South Korean nuclear specialists, providing design and safety analysis information by the South and seemingly endless question generated from the Northern counterparts. North is eager to absorb the new LWR technologies as the South has experienced during 70's.

Safeguards and Export Controls

Since ROK became a member of Nuclear Suppliers Group (NSG) in 1996 and the KEDO LWR project being its first turn-key supply contract, supplying some strategic hardware and related technology to DPRK is bound to occur. NSG stipulates seven components known as the trigger list items in a nuclear power plant, and they are listed below with contracted suppliers:

- Reactor vessel, supplied by Dujung (ROK), MHI (Japan)
- Steam generator, supplied by Dujung (ROK)
- Reactor internal components, supplied by ABB-CE*(US) (which recently merged with Westinghouse and became part of BNFL), Dujung (ROK)
- Control rod drive mechanism supplied by ABB-CE (US)
- Neutron source, supplied by ABB-CE (US)
- Reactor coolant pump, supplied by ABB-CE(US)
- Nuclear fuel, supplied by KNFC (ROK)

Among the above items, reactor vessel and steam generator are the first trigger list items to be delivered to the Kumho site. Today Dujung plant in Changwon is fully occupied with manufacturing of these long-lead items which are scheduled for delivery in 2004~2005 timeframe. To facilitate the site construction for the reactor building, some drawings and documents on reactor vessel and steam generators are soon to be delivered to Kumho site which come under NSG guideline. N/S nuclear experts in export control matters are beginning to communicate with each other to resolve

how to assure peaceful use warrantee between N/S Korean governments. This is a positive sign towards nuclear confidence building, perhaps first such move since the Joint Declaration of 1991.

Training on PWR Technologies

In order to own and operate a modern PWR nuclear power plant, it is necessary to setup a national nuclear power infrastructure. This can start with safety review, training on plant operation and maintenance, and nuclear material control and physical protection area as South Korea has experienced during 1970~80 period. North Korea is of no exception as it is entering into PWR technology which is vastly different from the graphite reactor technology they developed indigenously.

It is encouraging to promote various training programs for North Korean specialists in wide range of PWR related technologies. Several training programs are under preparation in 2001. Australians have taken initiative to provide safeguards training under DPRK's request through IAEA, and KEPCO is preparing a general overview of PWR technologies based on South Korea's own experience.

Nuclear Glasnost

Underlying assumption is that when a nation is committed to a LWR technology to generate her own electricity, the country is bound to be more transparent in all LWR related activities towards international community. This is simply because the supply of enriched uranium has to be imported from abroad, as it must come under IAEA full scope safeguards. With the modern remote monitoring technologies implemented at LWRs, any tampering of its spent fuel will be picked-up by IAEA in Vienna almost near real time and requested clarification from the operator. It is clear they will risk further production of electricity when anomalies are not cleared properly.

LWR plants being built at Kumho site will contribute significantly in transforming North Korean society into more open to the outside world. Supply of fuel, spare parts, regulatory information and safeguards interaction with IAEA will require interface with international community as the country is gradually introduced to market economy. "Nuclear glasnost" is unavoidable when North Korea is seeking economic progress through nuclear electricity.

The IAEA Verification (Drawing the Line)

The Agreed Framework stipulated clear linkage between the past inconsistency issue which led to the nuclear crisis and KEDO LWR construction schedule: *"When a significant portion of the LWR project is completed, but before delivery of key nuclear components, the DPRK will come into full compliance with its safeguards agreement with the IAEA... to verifying the accuracy and completeness of the DPRK's initial report on all nuclear material in the DPRK."*

It is well understood by everyone concerned that by when, what needs to be done by the IAEA in order to proceed with the LWR construction without interruption. The first key nuclear component, which is one of the trigger list items, is the reactor vessel for unit 1 which is being fabricated at Changwon plant and will be ready for shipment to Kumho site around the end of 2004. It means little over 3-year time period is left for IAEA to complete its verification activities.

Incentive for Early Start

IAEA has developed a comprehensive verification plan to conduct all inspection and evaluation activities and now in a process of discussing with the DPRK counterparts. IAEA also indicated that it may take at least 3 years to complete its missions provided the local hosts fully cooperate. Although the Agreed Framework did not stipulate when to start the verification process, but specified when it should be completed, it is necessary to start verification within 2001 if the IAEA conclusion will not jeopardize LWR schedule milestone beyond the reactor vessel installation. Any incentives for early verification start is needed to catch up with time lost already over 5 years. Readiness to accept the LWR project being viable and thus generating nuclear electricity is indeed real by the DPRK will give enough incentive to come for an early start and provide full cooperation with the IAEA verification.

How Much Plutonium?

IAEA plans to conduct verification activities centered around Yongbyun nuclear center including a specially developed NDA measurement of the spent fuel rods inside the underwater canister (gross-gamma for Pu contents), process and swipe sampling analysis among other routine material accountancy measures. The most central question IAEA must address is how much plutonium was separated, and is it over 1 SQ? Even with the help of advanced technologies now available to the IAEA, such as remote monitoring, environmental sampling and information analysis, it may be a formidable task to verify its correctness and completeness in precise quantities against the initial report declaration in accordance with the Agency's material accountancy safeguards criteria.

Alternate approach would be a gross macroscopic assessment of the plutonium production amount. Tracing the operational history of the 5 MWe reactor and its fuel inventory change, and maximum amount of material throughput at the radiochemical laboratory during 1987 – 1994 timeframe, it may be possible to come up with the upper bound on the amount of plutonium separated. Whether it turns out to be under 1 SQ or well over 1 SQ will be the most crucial point to be addressed. In addition, uranium enrichment capability in the North will be evaluated as to the type of process, level of enrichment reached and amount of HEU produced if any. IAEA then will be in a position to make the independent conclusion on whether DPRK has satisfied its NPT obligation or not which will have a direct bearing on the LWR construction progress. It will determine whether the reactor vessel for unit 1 will be shipped to Kumho site from Changwon Dujung plant in the year 2004.

Beyond 2004 and the Additional Protocol

One complementary measure for future consideration is to bring the Additional Protocol (INFCIRC/540) into force in the DPRK beyond the year 2004. As of July 2001, 55 Member State have signed the Additional Protocol and 19 states have already entered into force. This is creating a fundamental restructuring of international safeguards, particularly the role and scope of IAEA safeguards activities. Seeking optimal combination of traditional safeguards centered on quantitative nuclear material accountancy and the Additional Protocol measures focusing on information analysis of a State-as-a-whole is known as "integrated safeguards (IS)". The IAEA is about to commence the IS implementation to States whose Additional Protocol is fully adopted. ROK has signed the Additional Protocol in 1999 and anticipate it coming into force by early next year following legislative ratification process.

It would be highly desirable to bring the DPRK into the Additional Protocol. Question is what incentive for them to join? One possibility is that IAEA (through its Board decision) make a conditional approval of the verification issue to allow the LWR construction to continue beyond the

reactor vessel installation in 2004 should the Agency reach less than a fully satisfactory verification conclusions. The condition could be the DPRK will make the Additional Protocol into force before the initial core fuel loading at the LWRs. This will force them to be more transparent while they gain sure assurance of electricity through KEDO LWR operation. Delivery of nuclear fuel and acceptance of the Additional Protocol could be considered when a difficult situation arises.

Towards North-South Nuclear Confidence Building

In order to reach a state of affairs in promoting truly meaningful nuclear confidence building in the Korean Peninsula, following prerequisite conditions need to be satisfied:

- 1 Government level dialog between US/DPRK (with full cognizance of ROK and Japan) must attain a positive conclusion with a comprehensive reciprocity package, addressing missile threat reduction and early nuclear verification issues while the North Korea's electricity and energy infrastructure issue among others.
- 2 KEDO LWR construction progress must reach a higher level of visibility to the North as indeed a viable project that their electricity future can be improved. This can be partially achieved when the reactor building excavation work gets started in later month of 2001 immediately following the construction the construction permit granted by the DPRK's State Nuclear Safety Regulatory Commission. Construction activities at the Kumho site will be accelerated after the excavation of main reactor building starts. This is the long awaited onset of civil/structure which will satisfy the clause "a significant portion of the LWR project is completed" by 2004 corresponding to the Article IV. 3) of the Agreed Framework.

Step-by-Step Approach to Confidence-Building Measures

Assuming the above conditions are reasonably satisfied in 2001, some specific positive steps in the nuclear confidence building can take place in the order of increasing difficulty. Overriding concern is to assure nuclear/missile non-proliferation in return of electricity security through KEDO LWR project completion. It is not difficult to assume that each side will make any CBM steps only when they see it to be of their own interests, or win-win situation as below:

- **Peaceful Use Warrantee.** During the first week of July, 2001, working group level meeting on export control was held at Hyangsan, North Korea under KEDO arrangement. It was the first time North and South nuclear experts met in a bilateral mode. North side wished to receive technical documents early on some of the trigger list items, e.g. reactor vessel, and South side explained there must be a DPRK/ROK government-to-government peaceful use warrantee according to the NSG guideline.
- **Training in PWR Technologies.** KEDO and DPRK completed the training protocol in early 2001 without explicitly specifying the location of where the training will take place. It is clear, however, that South Korea can offer best source of various training program for its proven KSNP reactor operation sites, as well as construction, manufacturing and training center sites. Series of training program are under preparation by the South Korean nuclear companies on a wide range of subjects from health physics to operator training. It is anticipated that first training course for North Korean nuclear experts will take place in the South in 2001.

- **Training in Safeguards Technologies.** Until now, the DPRK side must have felt they were victimized through over inspection by IAEA and resisted any transparency measures. There are signs of change since they feel the need to set up their State System of Accountancy Control (SSAC) in order to be able to manage the nuclear material flows at the LWR facility. They asked IAEA to give their inspector some training experience and sent two inspectors to a regional safeguards training course in Australia in 2000 (where ROK also participated) and another safeguards training course is planned for the North Korean specialists in Australia in 2001. It is desirable that both North/South inspectors receive the same training course together to acquire common base of safeguards technologies in equipment, procedures and evaluation criteria on LWRs and related facilities.
- **Exchange of Visits among North/South Nuclear Specialists.** Based on ABACC experience, Argentina/Brazil initiated mutual exchange of visits by nuclear experts to break the suspicion and start gaining confidence by visiting each other's similar nuclear facilities during the early 90's. Similar scheme can be envisioned between KAERI in Taejeon and Nuclear Center at Yongbyun. Research reactors, fuel fabrication and hot cell facility experts need to visit the other side to develop and evaluate the other's capability and gain confidence through mutual respect.
- **Increased Cooperation between DPRK and IAEA.** In 1994 DPRK announced they are pulling out of the IAEA membership and still remain a non-member. IAEA stands ready to help them set up a viable nuclear infrastructure but DPRK needs to rejoin the Agency if they intend to receive any technical assistance from IAEA.
- **Mutual Inspection Revisited.** Cross safeguards inspection of similar-type nuclear facilities between North/South authorities can be envisioned in some way to complement the IAEA inspection. This could be the highest level of CBM between two Koreas following successful training exercises and mutual visits. Both sides acquired lessons learned from 1992~3 mutual inspection attempts, and may agree to revisit this under more symmetric terms when proper conditions develop.

In summary, two Koreas have just begun to scratch the nuclear confidence building measures through the KEDO LWR project. Nuclear specialists meetings from both sides are already taking place and several training programs will follow in the year of 2001. Throughout the difficult negotiations lie ahead, providing electricity to the North in return for the nuclear/missile non-proliferation assurances will be the central issue. After all, *atoms for peace* that created nuclear power in the world is the best alternative to nuclear weapons in harvesting the nuclear energy to mankind. This fact of history could and will repeat itself in the Korean Peninsula.

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