Review on 18th Revision of "Notice on Export and Import of Strategic Items"

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1. Introduction

International society has taken measures to prevent illicit trade of items usable to nuclear weapon, so-called nuclear strategic items. Inter alia, Nuclear Suppliers Group (NSG) has established a guideline and continued to revise it in accordance with ever-changing international situation and developing technology. The Part 1 of guideline, 'Guidelines of Nuclear Transfers' covers the Trigger List items which triggers safeguards as a condition of supply. Currently NSG has published the 12th revised guideline (INFCIRC/254/Rev.12/Part1) [1] in November 2013.

Korean government fully reflected the guideline to its national legislation to implement in accordance with internationally agreed standard. The export control of nuclear strategic items in Korea is responsibility of Nuclear Safety and Security Commission (NSSC), which entrusted the technical review of the work to Korea Institute of Nonproliferation and Control (KINAC). The specific guidelines for the technical review are stipulated in Notice on Export and Import of Strategic Items [2] with other strategic items usable to other Weapons of Mass Destruction. The Ministry of Trade, Industry and Energy approved the 18th revision of Notice on Export and Import of Strategic Items on 31 January 2014 as Notice no. 2014-15, which strictly follows the NSG guideline.

The 18th revision of the notice reflects the final proposals agreed from the last Dedicated Meeting of Technical Experts (DMTE) of NSG's Consultative Group (CG) in April 2013. The 3-year-DMTE offered the 'fundamental, holistic approach to the technical review' [3] within the international framework of NSG, rather than sporadic endeavors by individual states in the past. The 18th version itself has meaning in that the final products of the international technical review were reflected in the Korean national legislation of nuclear export control. It addressed various changes in control text in technical, contextual, and editorial aspects.

The revision is analyzed herein concentrating only on technical and semantic changes in control text. The analysis excluded editorial changes which are limited to formatting and do not change their content. This endeavor could contribute to an understanding of the current status and future of nuclear strategic item control and its impact on Korean industries. Thus, the position, stance, and response of the ROK could be established in the ever-changing export control environment hereafter.

2. Analysis on the Revision

In this section all the revised texts – except those with editorial change – are described. Each text is assorted by its implied meaning regarding influence on the scope of control list. The revised text might add or delete some items on the list. The results could be classified into three categories: narrowing, broadening, and maintaining the scope of controlled items. Then, in each category, the revisions were grouped according to the method they used.

2.1 Narrowing the Scope

The narrow scope means fewer items are controlled, resulting mitigation in export control.

2.1.1. Deletion of items. Crossing out controlled items reduces the scope of Trigger List. Liquid uranium metal handling systems (0B001.i.4) and neutron measuring instruments (0A001.j) were excluded in this revision. The deletion of measuring instruments would prevent general-use items being caught by export controls, including pre-amplifier, amplifier, analog to digital converter and much more.

Table I: Deletion of items

Control no. (Item)	Previous text	Revised text
0A001.j (Neutron detectors)	•"Neutron detection and measuring instruments"	•"Neutron detectors"
0B001.i.4 (Liquid uranium metal handling systems)	•"molten uranium or uranium alloys, consisting of crucibles and cooling equipment for the crucibles."	•(deleted)

2.1.2. Change in features. The more specific the features of items might be the more limited are the items in control. The material protecting ion sources for UF_6 mass spectrometers/Ion sources (0B002.g) is particularizing 'alloys with a nickel content of 60% or more,' which does not include ion sources protected by alloys with nickel composition less than 60%.

Table II: Change in features

Control no. (Item)	Previous text	Revised text

0B002.g (UF_6 mass spectro-meters /Ion sources)	•"lined with nichrome or monel or nickel plated;"	•"protected by nickel, nickel-copper alloys with a nickel content of 60% or more by weight, or nickel-chrome alloys;"

2.1.3. Addition of exception. Including an exception adds an uncontrolled item in the same manner of deleting an item from the Trigger List. Fusion reactors were excluded from Nuclear Reactors (0A001).

Table III: Addition of exception

Control no. (Item)	Previous text	Revised text
0A001 (Nuclear Reactors)	-	•Exception: fusion reactor

2.1.4. Specification. Elaborating the words in List might contribute to narrowing the scope. As 'product' and 'tails' in the molecular laser isotope separation (MLIS) (0B001.g), the uranium compounds are more focused rather than just 'dissociated or reacted compounds' and 'unaffected material.' Also, we could know from this revision that the uranium vaporization systems (0B001.g.1) are vaporizing the 'uranium metal.' Therefore, it might be possible not to control 'product' and 'tails' collected in MLIS process other than uranium compounds and uranium vaporization systems that are not using uranium metal.

Table IV: Specification

Control no. (Item)	Previous text	Revised text
0B001.g (AVLIS)	•"dissociated or reacted compounds as 'product' and unaffected material as 'tails'"	•"enriched and depleted uranium compounds as 'product' and 'tails'"
0B001.g.1 (Uranium vaporization systems)	•"uranium vaporization"	•"uranium metal vaporization"

2.2 Broadening the Scope

The broad scope means more items are controlled, resulting enhancement in export control.

2.2.1. Addition of items. The new entries were created such as external thermal shields (0A001.k), ammonia synthesis converters or synthesis units (0B004.b.9), and neutron measurement systems for process control (0B006.f). Some components of entries were added in accordance with the context of entry so as to make sure the components are controlled as well.

Table V: Addition of items

Control no. (Item)	Previous text	Revised text
0A001.b (Nuclear reactor vessels)	-	•Calandria
0A001.g (Primary coolant pumps or circulators)	-	•Circulators for gas-cooled reactors •Electromagnetic and mechanical pumps for liquid-metal-cooled reactors
0A001.h (Nuclear reactor internals)	-	•calandria tubes
0A001.i (Heat exchangers)	- -	•"Steam generators (…) for the primary, or intermediate, coolant circuit" •"In a gas-cooled reactor, a heat exchanger may be utilized to transfer heat to secondary gas loop that drives a gas turbine."
0A001.k (External thermal shields)	•(no old text)	•External thermal shields
0B001.b.7 (Static compo-nents)	-	•Active magnetic bearings
0B001.b.13 (Special shut-off)	-	•"Shut-off valves (…) to act on the feed, product or tails UF_6 gaseous stream of an individual gas centrifuge"
0B001.d (Aero-dynamic enrichment plants)	•"(…) made of (…)"	•"(…) made of or protected by (…)"
0B001.g (AVLIS)	-	•selective excitation
0B002.b (Desub-limers, cold traps or pumps)	•"Desublimers (or cold traps)"	•"Desublimers, cold traps or pumps"
0B002.e (Header piping systems)	•"It is wholly made of UF6 - resistant materials"	•"It is wholly made of or protected by UF6 - resistant materials"
0B004.b.9 (Ammonia synthesis converters or synthesis units)	•(no old text)	•Ammonia synthesis converters or synthesis units for heavy water production utilizing the ammonia-hydrogen exchange process.

0B006.f (Neutron measure-ment systems for process control)	•(no old text)	•Neutron measurement systems EDP for integration and use with automated process control systems in a plant for the reprocessing of irradiated fuel elements.

2.2.2. Change in features. Some features were deleted in 0B001.b.12, 0B001.c.2, 0B001.c.3, 0B001.c.6, 0B001.d.2, 0B001.d.3, and 0B001.g.1. This led uncontrolled items in the old text to be controlled, e.g., scoops with the diameter under the previous standard will be controlled from henceforth. Furthermore, the ranges of specification of some items were modified in order to bring the items up to date in light of technology changes. Consequently, the entries become capable of containing more items of certain specification which were excluded in the old text.

Table VI: Change in features

Control no. (Item)	Previous text	Revised text
0A001.f (Nuclear fuel cladding)	•"in quantities exceeding 500kg (…) in any period of 12 months" •"the relation of hafnium to zirconium is less than 1:500 parts by weight"	•"in quantities exceeding 10kg" •"the relation of hafnium to zirconium is typically less than 1:500 parts by weight"
0B001.b (Gas centrifuges)	•"between 75mm and 400mm diameter"	•"between 75mm and 650mm diameter"
0B001.b.3 (Rotor tubes)	•"a diameter of between 75mm and 400mm"	•"a diameter of between 75mm and 650mm"
0B001.b.4 (Rings or Bellows)	•"a diameter of between 75mm and 400mm"	•"a diameter of between 75mm and 650mm"
0B001.b.5 (Baffles)	•"between 75mm and 400mm diameter"	•"between 75mm and 650mm diameter"
0B001.b.6 (Top caps/Bottom caps)	•"between 75mm and 400mm diameter"	•"between 75mm and 650mm diameter"
0B001.b.9 (Molecular pumps)	•"75mm to 400mm internal diameter"	•"75mm to 650mm internal diameter"
0B001.b.10 (Motor stators)	•"in the frequency range of 600-2000Hz and a power range of 50-1000VA"	•"at a frequency of 600Hz or greater and a power of 40VA or greater"
0B001.b.12 (Scoops)	•spec. of tubes(internal diameter)	•(deleted)
0B001.b.14 (Frequency changers)	•"A multiphase output of 600 to 2000Hz" •"High stability (with frequency control better than 0.1%)" •"Low harmonic distortion, efficiency"	•"A multiphase frequency output of 600Hz or greater" •High stability (with frequency control better than 0.2%) •(deleted)
0B001.c.2 (Diffuser housings)	•spec. of housings(diameter, length, dimensions)	•(deleted)
0B001.c.3 (Compressors and gas blowers)	•"axial, centrifugal, or positive displacement compressor"	•(deleted)
0B001.c.3 (Compressors and gas blowers)	•"pressure ratio between 2:1 and 6:1"	•"pressure ratio of 10:1 or less"
0B001.c.6 (Special shut-off and control valves)	•spec. of control bellows valves(diameter)	•(deleted)
0B001.d.2 (Vortex tubes)	•spec. of vortex tubes(diameter, length to diameter ratio)	•(deleted)
0B001.d.3 (Compressors and gas blowers)	•spec. of compressors or gas blowers(displacement, suction volume capacity)	•(deleted)
0B001.d.7 (Special shut-off and control valves)	•"valves (…) with a diameter of 400 to 1500mm"	•"valves (…) with a diameter of 400 mm or greater"
0B001.g.1 (Uranium vaporization systems)	•spec. of vaporization systems("high-power strip of scanning electron beam guns with a deliver power on the target of more than 2.5kW/cm")	•(deleted) ("These systems may contain(…)")
0B002.a (Feed autoclaves, ovens, or systems used for passing UF6 to the enrichment process)	•"centrifuge cascades at up to 100kPa (15 psi) and at a rate of 1 kg/h or more;"	•"ovens, or systems used for passing UF_6 to the enrichment process;"
0B004.b.1 (Water-Hydrogen Sulphide Exchange Towers)	•"Exchange towers fabricated from fine carbon steel(such as ASTM A516) with diameters of 6m (20ft) to 9m	•"Exchange towers with diameters of 1.5 m or greater"

	(30ft)"	
0C004 (Nuclear grade graphite)	•"in quantities exceeding 30 metric tons for any one recipient country in any period of 12 months."	•"in quantities exceeding 1 kilogram."
0A001.b (Nuclear reactor vessels)	-	•"regardless of pressure rating"
0B001.b.11 (Centrifuge housing/recipients)	•"The housings are made of or protected by materials resistant to corrosion by UF_6"	•(deleted)
0B001.b.12 (Scoops)	•"The tubes are made of or protected by materials resistant to corrosion by UF_6"	•(deleted)

2.2.3. Deletion of exception. Deleting an exception brings the exact same effect of adding an item. The revision removed the zero energy reactor exemption from complete nuclear reactor (0A001.a). The letter from Chair of the NSG to Director General of IAEA [1] said it 'will inter alia ensure that reactors using the thorium fuel cycle are also controlled.'

Table VII: Deletion of exception

Control no. (Item)	Previous text	Revised text
0A001.a (Complete nuclear reactor)	•Exception: zero energy reactor (maximum rate of production of plutonium not exceeding 100 grams per year)	•(deleted)

2.2.4. Generalization. Some elements of entries were generalized, which makes the controlled item more abundant. 'Stable isotopes' in 0B001, and 0E001.2 was replaced with "other elements" (all elements other than hydrogen, uranium and plutonium) and uranium pentafluoride product collectors (0B001.h.2) with ''product' or 'tails' collectors.' Here, this category concerns more with change in word's semantic field such as using a hypernym while numerical features were modified or specification of the items were deleted in 2.2.2. Change in features.

Table VIII: Generalization

Control no. (Item)	Previous text	Revised text
0A001.i (Heat exchangers)	•"In the case of liquid metal fast breeder reactor (…) the heat exchangers for transferring heat from the primary side to the intermediate coolant circuit are understood to be within the scope of control"	•"In the case of a fast reactor (…) stream generator is in the intermediate circuit"
0A001.i (Heat exchangers)	•Exception: heat exchangers for the emergency cooling system or the decay heat cooling system	•Exception: heat exchangers for the supporting systems of the reactor, e.g., the emergency cooling system or the decay heat cooling system
0B001 (Plants for the separation of isotopes)	•stable isotopes	•"other elements"(All elements other than hydrogen, uranium and plutonium)
0B001.d.8 (UF6/carrier gas separation systems)	•"UF_6 cold traps capable of temperatures of -20℃ or less"	•"UF_6 cold traps capable of freezing out UF_6"
0B001.h.2 ('Product' or 'tails' collectors (molecular based methods))	•Uranium pentafluoride product collectors(MLIS) -	•'Product' or 'tails' collectors (molecular based methods) •"components or devices for collecting uranium product material or uranium tails material following illumination with laser light."
0B001.i.3 (Uranium plasma generation systems)	•"which may contain high-power strip or scanning electron beam guns with a delivered power on the target of more than 2.5 kw/cm."	•"for use in plasma separation plants."
0E001.2 (General Notes on the Controls of Technology)	•stable isotopes •"equipment and technology"	• "other elements" (All elements other than hydrogen, uranium and plutonium) •"plants, equipment and technology involving isotope separation of "other elements"."

2.2.5 'Softening'. The 'softening' means something mandatory is made to be optional in this context. Motor stators (0B001.b.10) and liquid or vapour uranium metal handling systems and components (0B001.g.2)

'may contain' not just 'contain' the essential component of the stators and systems. The previous language might have given the impression only devices and systems with the specified component are controlled. However, stipulating 'may', 'sometimes', 'for example' additionally in the passage embraces possibilities that items with other components could be controlled.

Table IX: 'Softening'

Control no. (Item)	Previous text	Revised text
0A001.e (Nuclear reactor pressure tubes)	•"Tubes (…) at an operating pressure in excess of 50 atmospheres"	•"Pressure tubes are (…) sometimes in excess of 5 Mpa"
0A001.h (Nuclear reactor internals)	•" (…) including (…)"	•"This includes, for example, (…)"
0B001.b.10 (Motor stators)	•"The stators consist of (…)"	•"The stators may consist of (…) "
0B001.g.2 (Liquid or vapour uranium metal handling systems and components)	•" (…) consisting of crucibles and cooling equipment for the crucibles."	•" (…) may consist of cruibles and cooling equipment for the crucibles"

2.3 Maintaining the Scope (no change in scope)

In some entries, some examples of devices or materials were supplemented, however, which does not allude to setting boundaries and limiting control items by using 'may', 'sometimes', and 'include.' These words leave room for controlling items which are not specified in the text. Nevertheless, since examples of the entries in this category were not mentioned in the earlier text unlike those in 'Softening' category, the instantiation does not affect any change in scope at all, just showing the possible examples.

Table X: Instantiation

Control no. (Item)	Previous text	Revised text
0D (SOFT-WARE CONT-ROLS)	-	•"The transfer of "software" directly associated with any item in the List will be subject to as great a degree of scrutiny and controls as will the item itself, to the extent permitted by national legislation." •software, microprogram, program
0B001.g (AVLIS)	-	•" (…) sometimes mixed with another gas or gases"
0A001 (Nuclear Reactors)	-	•Types of reactors characterized by moderator, spectrum of neutrons, coolant, and function
0B001.b.13 (Special shut-off)	-	•Types of valves specified
0B001.d (Aero-dynamic enrichment plants)	-	•copper alloys, aluminium oxide, aluminium alloys
0B001.g (AVLIS)	-	•copper alloys, aluminium oxide, aluminium alloys
0B001.g.2 (Liquid or vapour uranium metal handling systems and compo-nents)	•"molten uranium or uranium alloys"	•"molten uranium, molten uranium alloys, or uranium metal vapour"
0B001.h.6 (UF_6/carrier gas separation systems)	-	•"The carrier gas may be nitrogen, argon, or other gas."
0B002 (specially designed or prepared auxiliary systems, equipment and components for isotope separation)	-	•"EXPLANATORY NOTE Some of the items listed below either come into direct contact with the UF6 process gas or directly control the centrifuges and the passage of the gas from centrifuge to centrifuge and cascade to cascade."
0B005 (Plants for the fabrication of nuclear reactor fuel elements, and equipment especially designed or prepared therefor)	- -	•"Items (…) include equipment which (…) is used for assembling reactor fuel elements." •"Such equipment or systems of equipment may include, for example: (…) systems especially designed or prepared to manufacture nuclear fuel cladding."

3. The Future of Nuclear Strategic Item Control

Several items were added and the scope of item broadened in various ways. In the light of this analysis, the future of international regime on control of nuclear strategic item could be suggested as below.

First, NSG will ensure advanced nuclear technology and items possibly applicable to nuclear weapons are controlled. In this revision, for example, text of frequency changers (0B001.b.14) was modified to have greater range of multiphase frequency output and high

stability, reflecting up-to-date technology changes. Also, material made of water-hydrogen sulphide exchange towers (0B004.b.1) were deleted 'to take account of the possible use of different materials.'

Second, the control items and language thereof will be more specific, explicit, and accurate in order to reduce the conflict in national implementation in compliance with the international regime. The items previously controlled implicitly were added in the control text such as software (0D) control. While special software was tacitly controlled as a technology subject to the Trigger List, the revision makes the control of software explicit. Since the wording 'Heat exchangers (steam generators)' (0A001.i) might have given impression that only steam generators are controlled as heat changers, therefore steam generators and other heat exchangers were clarified in order to state that other heat generators are controlled as well.

Third, even though the momentum of strengthening the control will be consistent, however, there will be still rational and reasonable movement in regulation. For instance, according to the same letter mentioned above, the previous wording in neutron detection and measuring instruments (0A001.j) 'led to generally used items being caught by export controls. The new wording ensures that only detectors are covered.' [1]

Since the DMTE concluded in 2013 with proposals which led to the 12th revision of Trigger List, and a new Technical Experts Group (TEG) will continue the technical review of the control list henceforth.

4. Impact of the Revision on Korean Industries

Industries are sensitive to controlled items which might cause delay in their international trade and affect their interest. For this reason, it is important for industries to be aware of strategic items in order to not only increase profit of enterprises but also promote national interests.

In this revision, most of the items added or changed in its features did not affect Korean nuclear industries for several reasons [3];

1) The item is not necessary for the design of nuclear power plants in Korea (external thermal shields (0A001.k)); 2) the item is for usage in heavy water reactor and not necessary to replace them during life of reactor. Especially, Korean government does not have plan to build another heavy water reactor (calandria of nuclear reactor vessels (0A001.b)); 3) the item is designed for reactors under development such as gas-cooled reactors and fast reactors (circulator of primary coolant pumps or circulators (0A001.g), heat exchangers (0A001.i)); 4) Korean government has already controlled the items before its addition or clarification (research reactor of nuclear reactors (0A001), software (0D)); 5) the item is related to isotope separation or reprocessing industries which is not allowed in Korea (frequency changers (0B001.b.14), special shut-off and control valves (0B001.d.7), neutron measurement systems for process control (0B006.f), etc).

Nonetheless, there will be a few repercussions for the industries exporting nuclear fuel cladding (0A001.f) and nuclear grade graphite (0C004). The previous text only controlled the zirconium metal tubes or zirconium alloy tubes when the amount of them is exceeding 500kg in any period of 12 months. However, it was regarded as ineffective control when assuming a state imports bulks of 400kg zirconium tubes from a multitude of other states. Hence the NSG set the quantity limit of 10kg, and it will affect KEPCO Nuclear Fuel, the one and only company capable of producing the item in Korea. In the same way, nuclear grade graphite – having a limit of more than 30 metric tons during 12 month period in the old text – raised control bar to quantities exceeding1kg in the new text.

5. Conclusions

The results of analysis showed the modified text including more technology and items, and being more elaborated and flexible at the same time. The text will do no harm to Korean nuclear enterprises except few companies.

The analysis herein might be of help in active participation in the international export control regime. The analysis method might provide a tool to review the proposals by other states during the NSG TEG meetings. It could suggest what the ROK should to do and how to do.

Korea should continuously make proposals seeking for strengthening export control system and furthering its national interest within the enhanced framework of export control. There will be more specified text and advanced items in the list after each TEG meeting. We have to admit that it will greatly contribute to the implementation of export control and eventually nonproliferation of nuclear weapons. However, raising the control standard blindly is not a wise solution. The world should make a reasonable decision with discretion on what will be controlled and what will be not since it is closely related to the profit of domestic companies and further, economy of the state.

Thus, as a representative of international review meeting, the Korean government should understand the position of national nuclear industry when making or reviewing proposals. In response to this, the industries should fully engage in the process of reviewing the control list items. They must recognize the importance of export control as well as the effect of control on their business. Accordingly, the communication between government and industries is stressed. There were several meetings in Korea with government, related organizations, experts attended to deal with NSG DMTE proposals at the state level [3]. Still, constructing a channel to communicate and having meeting regularly to offer suggestions or inform the recent technology is highly recommended.

REFERENCES

[1] INFCIRC/254/Rev.12/Part1, 2013.
[2] Ministry of Trade, Industry and Energy, Notice on Export and Import of Strategic Items, 2014.
[3] KINAC, Study of International Cooperation on Fundamental Review of NSG Control List, 2013.