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North Korea: Potential for Nuclear Weapon Development [redacted]

An Intelligence Assessment

~~Top Secret~~

[redacted]

September 1986

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North Korea: Potential for Nuclear Weapon Development [redacted]

An Intelligence Assessment

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September 1986

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North Korea: Potential for Nuclear Weapon Development [redacted]

Key Judgments

Information available as of 9 April 1986 was used in this report.

[redacted]

- In December 1985, at the urging of the USSR, North Korea acceded to the nuclear Non-Proliferation Treaty (NPT), renouncing acquisition of nuclear explosives and accepting safeguards on its nuclear activities.
- North Korea's penchant for military secrecy makes it unlikely that it would locate a primarily military reactor at a known research center or agree, as it has with NPT adherence, to open it to international inspection.
- The Soviet role in extracting the NPT pledge and subsequently selling North Korea a nuclear power reactor puts Moscow's prestige on the line in guaranteeing a peaceful program, with renewed economic and military aid the lever to enforce it. [redacted]

[redacted]

[redacted]

We have little information on North Korea's ability to conduct the nonnuclear research, particularly that involving high explosives, required for a nuclear weapons research program. [redacted] The North Koreans already have a suitable nuclear delivery system in the MIG-23 fighter [redacted]

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Exemptions: (b)(1), (b)(3)

[redacted]

In considering whether to embark on a venture as costly, hazardous, and politically sensitive as a nuclear weapons program, P'yongyang would face a complex calculation of benefits versus costs, as well as considerable uncertainty regarding the effect of such a program on its ultimate goal of reunifying the peninsula on its own terms. It might see nuclear weapons as a means of forcing political concessions from Seoul, as a hedge against possible South Korean development of a nuclear weapons capability, as leverage to gain a freer hand in paramilitary operations without provoking a military response, as deterring a US nuclear response to an attack on the South, or as a means of carrying out offensive operations in an all-out attack. [redacted]

P'yongyang would also see disadvantages, particularly if it recognized the difficulty of concealing such a program. Exposure could lead South Korea—with its superior nuclear technology—to develop nuclear weapons as a response. P'yongyang would also have to weigh the effect on the US commitment to Seoul under such an increased threat. Moreover, the North would have to calculate the less tangible, but still significant, impact on the diplomacy it has pursued for over two years aimed in large part at encouraging the eventual withdrawal of US forces. P'yongyang would also consider the likelihood that a weapons program would complicate its improved relations with Moscow. [redacted]

Contents

[redacted]

Figures

North Korea: Potential for Nuclear Weapon Development [redacted]

Introduction

Until 1984 the North Korean nuclear program was not viewed as a serious proliferation concern. Up to that time, available evidence had painted a picture of a rudimentary program incapable of very advanced research. [redacted] This paper presents that reassessment, which is based on subsequently developed information and a reinterpretation of information available in 1984. It addresses the extent of North Korean nuclear development, the reasons for it, and the potential for using it in the construction of nuclear weapons. [redacted]

A Nuclear Weapons Capability—How Soon?

The development of the capability to build nuclear weapons involves a variety of technological steps. These steps consist of a combination of some activities that are also necessary for the peaceful uses of nuclear energy and of some specific activities uniquely related to weapons. Figure 2 shows the way in which these various steps fit together. The pacing element (for all but the most technologically advanced states) is typically the production of fissile material (that is, plutonium or highly enriched uranium). The construction and operation of both a reactor and a spent-fuel reprocessing plant are necessary for plutonium acquisition. (A weapons cycle using enriched uranium can bypass these steps, but only with the generally visible construction of an enrichment plant.) Both of these items can be involved in strictly peaceful endeavors. Although these facilities have physical observables (and can be detected through a variety of collection means), this potential for dual purpose complicates our analysis of intended purpose. (S NF)

[redacted]

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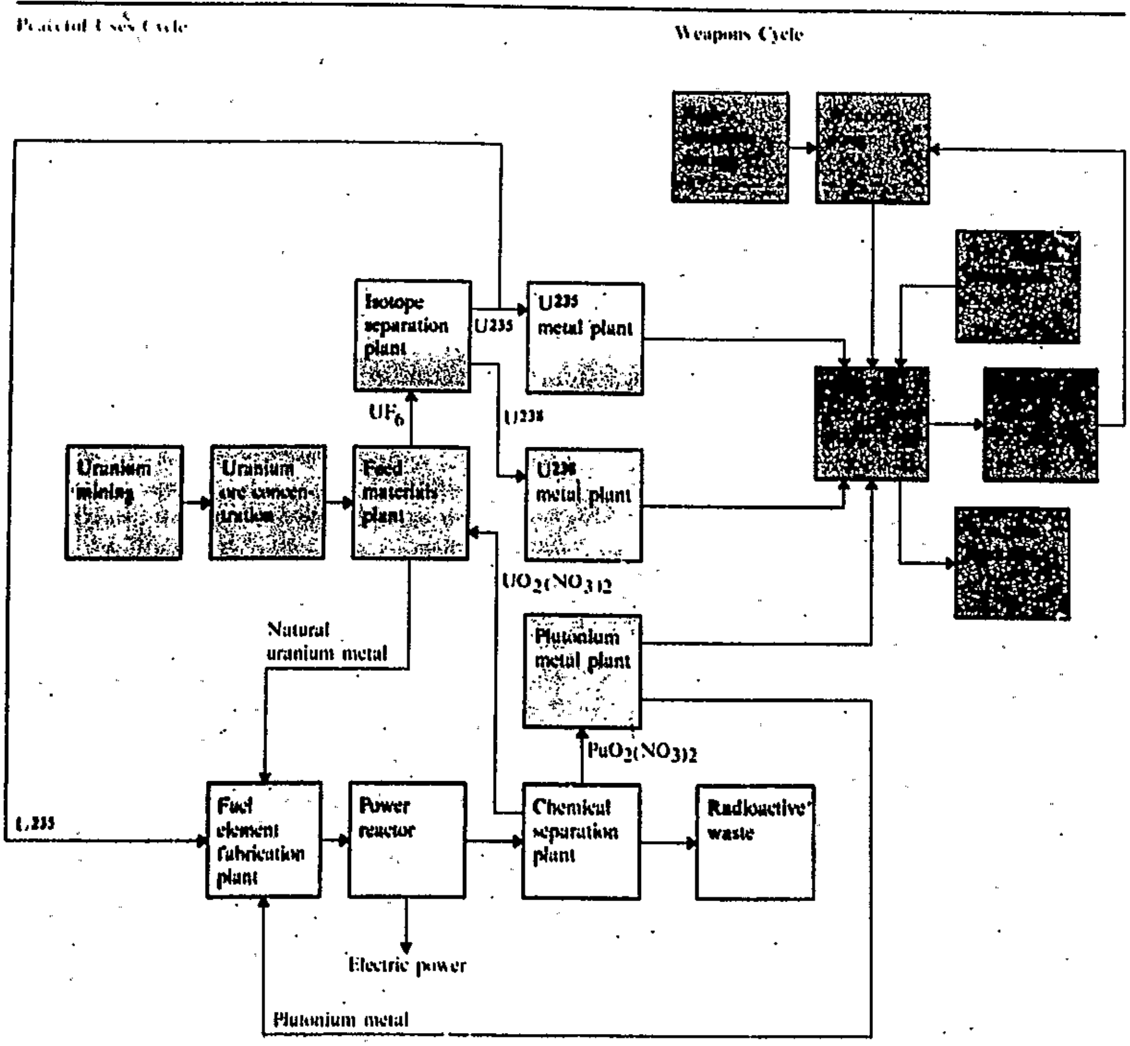
[1] This and other technical terms used in this paper are defined in the glossary (appendix D) [redacted]

Figure 2
Production of Fissionable Materials and Nuclear Weapons



[redacted]

The nuclear device design and development and high-explosive testing that are required would probably occur in parallel with production of the necessary fissile material and are unlikely to be pacing factors.

[redacted]

Once the raw materials and device design are available, it might take several months to assemble a nuclear device. Suitable delivery systems are already available, and crude versions of the necessary non-nuclear components could be adapted from them. Another year might be required to weaponize a device so that it could be mated to the delivery system and be assured of surviving the stockpile-to-target sequence. However, such requirements are very flexible; nuclear weapons were used against Japan three weeks after the concept of a nuclear explosive was proved. [redacted]

Background

[redacted] The largest research facility is the Yongbyon Nuclear Research Center (figure 3). Construction began in the early 1960s with Soviet assistance. The Soviets also supplied a 2-MW IRT research reactor [redacted] It is subject to IAEA safeguards under a 1977 agreement.

[redacted]

Pages: 4-7

Exemptions: (b)(1), (b)(3)

[redacted]

The scope of any North Korean reprocessing requirement would depend on the type of fuel cladding used, the type of spent-fuel storage, and how fast the North Koreans want the plutonium. Whether the North Koreans intend to reprocess the spent fuel to recover the plutonium, they would probably have to reprocess a magnesium-clad fuel (or arrange for another party to reprocess it) to avoid a radiological hazard. This would not be the case for an aluminum- or zirconium-clad fuel. [redacted]

[redacted]

[redacted]

Nonnuclear Aspects of Weapons Development

A capability to develop nuclear weapons clearly involves more than just the production of nuclear material. The ability to develop and test the nonnuclear components, particularly the high-explosive system, is required, both for device development and weaponization. A suitable delivery system must also be available [redacted]

High-Explosive and Component Development and Testing

[redacted]

Delivery Systems

North Korea has a variety of missiles and aircraft that could deliver a nuclear weapon to most major targets in South Kore [redacted]

P'yongyang's new MIG-23 fighter, with minor modifications, would probably be the preferred delivery aircraft. It has sufficient range to reach the more important targets in the northern part of South Korea. [redacted]

Other delivery systems available to North Korea would be less desirable. [redacted]

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Exemptions: (b)(1), (b)(3)

[redacted]

Motivation for Nuclear Development

NPT Accession

On 12 December 1985, North Korea deposited with the USSR its instrument of accession to the NPT. In acceding to the treaty, P'yongyang foreswore the manufacture or acquisition of nuclear weapons and agreed to IAEA safeguards on all its peaceful nuclear activities. [redacted]

Nevertheless, NPT adherence itself does not provide ironclad assurances against nuclear weapons development. [redacted] The NPT also contains a clause allowing a country to withdraw on 90 days' notice under special conditions. [redacted]

P'yongyang, moreover, must now negotiate the necessary safeguards agreements and actually open indigenous facilities to IAEA inspectors. These arrangements should lead to greater foreign access to North Korean nuclear facilities, more openness in the North Korean nuclear program, and improved estimates of North Korean capabilities. Safeguards should provide a timely indicator of any North Korean construction of a reprocessing plant or any attempt to divert plutonium or spent fuel to a weapons program. If North Korea intends to pursue a nuclear weapons program, it has made its job much more difficult by signing the NPT. [redacted]

[redacted] The military will almost certainly object to revelation of any projects in which it might be involved, even peripherally. We also expect P'yongyang to preclude access to its facilities by IAEA inspectors from most Western countries, a right it would have under standard IAEA inspection procedures. [redacted]

[redacted] by the end of the 1980s [redacted]

North Korea has a civilian nuclear power program that Yongbyon probably can support in any case. In March 1981, P'yongyang announced that, as part of the goal of expanded electricity production adopted by the 1980 Party Congress, it would have nuclear power

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Exemptions: (b)(1), (b)(3)

[redacted]

Whether the current nuclear developments in North Korea reflect a nuclear weapons program, they represent a considerable developing capability.

[redacted]

[redacted]

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Exemptions: (b)(1), (b)(3)

Appendix A

Background of North Korean Nuclear Program

[redacted]

The Beginning

North Korea's nuclear program dates at least from its participation in the founding in 1956 of the Joint Institute for Nuclear Research at Dubna, outside Moscow. Through 1981, according to a Soviet press statement, 120 North Koreans had studied there, and we judge that about another 30 have done so since. In September 1959, North Korea and the Soviet Union concluded a nuclear cooperation agreement, probably as a direct result of the US–South Korean agreement signed in July of that year. [redacted]

[redacted] the USSR subsequently supplied North Korea with a 2-megawatt (MW) IRT-type (that is, pool type, light-water moderated, and enriched-uranium fueled) research reactor and assistance in the construction of the Yongbyon Nuclear Research Center. [redacted]

[redacted]

The IRT reactor was originally supplied without IAEA safeguards. However, according to published IAEA documents, the reactor, the critical assembly, and all associated fuel are now subject to safeguards under an agreement negotiated in 1977 [redacted]

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Exemptions: (b)(1),(b)(3)

[redacted] The USSR reversed itself, however, during the visit of North Korean Premier Kang Song-san to Moscow in December 1985. According to official press accounts, the two countries signed an agreement on supply of a nuclear power plant. North Korea's accession to the Non-Proliferation Treaty (NPT) was announced almost simultaneously, meaning the reactor—and all other North Korean nuclear activities—would be subject to safeguards [redacted]

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Exemptions: (b)(1), (b)(3)

Appendix D

Glossary

Term	**Definition**
Burnup	A measure of reactor fuel consumption. For example, the percentage of fuel atoms that have undergone fission, or the amount of energy produced per unit weight of fuel in the reactor.
Cladding	The outer jacket of nuclear fuel elements. It prevents corrosion of the fuel and the release of fission products into the coolant. Aluminum or its alloys, stainless steel, magnesium alloys, and zirconium alloys are common cladding materials.
Control rod drive mechanism	Mechanism used to actuate the movement of control rods in a nuclear reactor
Control rod	A rod, plate, or tube containing a material that readily absorbs neutrons (hafnium, boron, and so forth), used to control the power of a nuclear reactor. By absorbing neutrons, a control rod prevents the neutrons from causing further fission.
Safety control rod	A standby control rod used to shut down a nuclear reactor rapidly in emergencies.
Shim control rod	A reactor control rod used in making infrequent coarse adjustments in reactivity, as in startup or shutdown.
Coolant	A substance circulated through a nuclear reactor to remove or transfer heat. Common coolants are water, air, carbon dioxide, helium, and liquid sodium.
Core	The central portion of a nuclear reactor, containing the fuel elements and usually the moderator but not the reflector.
Critical assembly	An assembly of sufficient fissionable material and moderator to sustain a fission chain reaction at a very low power level.
Criticality	The state of a nuclear reactor when it is sustaining a chain reaction.
Cyclotron	A particle accelerator in which changed particles receive repeated synchronized accelerations by electrical fields as the particles spiral outward from their source. The particles are kept in the spiral by a powerful magnetic field.
Dual use	Having more than one application (that is, nuclear and nonnuclear).

Enriched uranium	Material in which the percentage of a given isotope present in a material has been artificially increased, so that it is higher than the percentage of that isotope naturally found in the material. Enriched uranium contains more of fissionable isotope uranium-235 than the naturally occurring percentage of 0.7.
Fast neutron	A neutron with energy greater than approximately 100,000 electron volts.
Thermal neutron	A neutron in thermal equilibrium with its surrounding medium. Thermal neutrons are those that have been slowed down by a moderator to an average speed of about 2,200 meters per second (at room temperature) from the much higher initial speeds they had when expelled by fission.
Fissile material	While sometimes used as a synonym for fissionable material, this term has also acquired a more restricted meaning, namely, any material fissionable by neutrons of all energies, including (and especially) thermal (slow) neutrons as well as fast neutrons; for example, uranium-235 and plutonium-239.
Fuel	Fissionable material used or usable to produce energy in a reactor. Also applied to a mixture such as natural uranium, in which only part of the atoms are readily fissionable, if the mixture can be made to sustain a chain reaction.
Fresh fuel	Fuel which has not been irradiated (that is, has not been placed into a reactor).
Spent fuel	Nuclear reactor fuel that has been irradiated (used) and permanently removed from the reactor.
Fuel cycle	The series of steps involved in supplying fuel for nuclear power reactors.
Front end (of nuclear fuel cycle)	The series of steps including uranium mining, concentration, conversion, enrichment, and fuel element fabrication.
Back end (of nuclear fuel cycle)	Steps of the nuclear fuel cycle including handling of discharged fuel elements from reactor, chemical reprocessing, recycling of recovered fissile and fertile material, and disposing of radioactive waste.
Heavy water	Water containing significantly more than the natural proportion (one in 6,500) of heavy hydrogen (deuterium) atoms to ordinary hydrogen atoms. Heavy water is used as a moderator in some reactors because it slows down neutrons effectively and also has a low cross section for absorption of neutrons.
Light water	Ordinary water.
Ion exchange	A chemical process involving the reversible interchange of various ions between a solution and a solid material, usually a plastic or a resin. It is used to separate and purify chemicals such as fission products, rare earths, and so forth, in solutions.

IAEA	The International Atomic Energy Agency, a Vienna-based UN-affiliated organization with over 110 members, founded in 1957. Its purpose is to foster peaceful applications of nuclear energy and carry out a program of on-site inspections, audits, and inventory controls known collectively as safeguards.
IAEA Safeguards	The basic purpose of IAEA safeguards is to deter the diversion of nuclear materials from peaceful uses to military or explosive purposes by timely detection. The agency monitors the flow of nuclear materials at nuclear installations by auditing plant records and conducting physical inventories. Seals and cameras are used to ensure that materials are not diverted while IAEA inspectors are not present.
Leaching, acid and carbonate	Process by which uranium ore is subjected to a process to separate the pure uranium from other waste materials. Both acids, such as sulfuric acid, and alkalines, such as sodium carbonate, can be used.
Moderator	A material, such as ordinary water, heavy water, or graphite, used in a reactor to slow down high-velocity neutrons, thus increasing the likelihood of further fission.
Natural uranium	Uranium as found in nature, containing 0.7 percent of U^{235}, 99.3 percent of U^{238}, and a trace of U^{234}. It is also called normal uranium.
Neutron flux	A measure of the intensity of neutron radiation. It is the number of neutrons passing through 1 square centimeter of a given target in one second.
Non-Proliferation Treaty (NPT)	The treaty opened for signature in 1968, entered into force in 1970, and now has over 130 parties. The treaty binds nuclear weapons-holding signatories not to transfer nuclear weapons to any other countries and requires them to pursue nuclear disarmament. It commits non-weapons-holding parties not to manufacture or otherwise acquire them and to subject all peaceful nuclear activities to IAEA safeguards. It commits all parties to foster nuclear technology transfer but to transfer material and equipment only under safeguards.
Nuclear-grade graphite	Graphite of high purity used as a moderator in reactors. Reactor-grade graphite is made artificially (since naturally occurring graphite is relatively impure) by graphitization of petroleum coke.
Postirradiation examination	The process of subjecting materials (frequently reactor fuel) to a variety of mechanical and chemical tests to determine the effects of irradiation.
Radiation detectors	Devices that detect and record the characteristics of ionizing radiation. For example, Geiger counter or dosimeter.
Radiation dosimetry	The measurement of the amount of radiation delivered to a specific place or the amount of radiation that was absorbed there. For example, dosimeter or ionization chamber.

Radioisotope	A radioactive isotope. An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation.
Radiopharmaceutical	A radioactive isotope used for medical purposes.
Radionuclide	A radioactive nuclide.
Reactor	A device in which a fission chain reaction can be initiated, maintained, and controlled.
Reactor-grade plutonium	Plutonium that has a high Pu^{240} content, currently in the range of 15 to 25 percent. It could be substituted for weapons Plutonium in some weapons applications, but with decreased yield.
Reflector	A layer of material immediately surrounding a reactor core that scatters back or reflects into the core many neutrons that would otherwise escape. The returned neutrons can then cause more fissions and improve the neutron economy of the reactor. Common reflector materials are graphite, beryllium, and natural uranium.
Reprocessing	The processing of reactor fuel to recover the produced and unused fissionable materials.
Aqueous phase	The chemical stream in a reprocessing plant containing nitric acid and dissolved uranium, plutonium, and fission products.
Organic phase	The chemical stream in a reprocessing plant that contains an organic solvent designed to extract plutonium and uranium from the aqueous phase when brought into contact.
Phase-mixing separation	The aqueous and organic phases are mixed to allow the organic solvent to combine with the uranium and plutonium. The phases must then be separated to allow the fission products remaining in the aqueous phase to go to waste and the fissile material to go to further recovery. Equipment used includes mixer-settlers, pulse column extractors, and centrifugal contactors.
Spent-fuel storage pond	Storage pools constructed as part of the power plant complex for discharged fuel elements.
Uranium conversion	The chemical and metallurgical operations involved in purifying and converting virgin or recycled uranium to forms suitable for use in the fabrication of reactor fuel elements or as feed to uranium enrichment facilities. The principal product forms are uranium hexafluoride, uranium metal, and uranium dioxide.

Uranium ore processing and concentration	The process of taking uranium ore, typically less than 0.2 percent uranium, grinding and sorting it and chemically concentrating it into U_3O_8, commonly called yellowcake, of between 75 percent and 90 percent purity.
Weapons-grade plutonium	The plutonium used in weapons applications, commonly considered to contain 6.5 percent or less Pu^{240}.
Yellowcake	Certain uranium concentrates produced by uranium mills; while technically those concentrates in which uranium is mainly in the form of ammonium diuranate or sodium diuranate, it has also come to include U_3O_8.

[redacted]

[redacted]